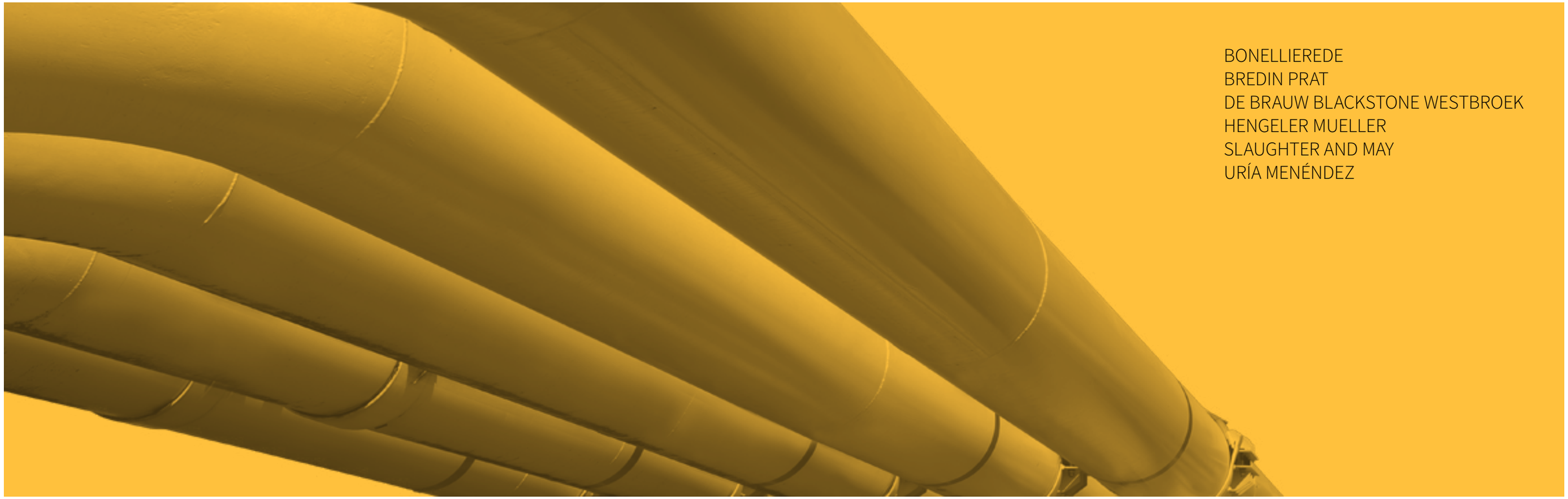

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FROM VISION TO REALITY:
A REGULATORY GUIDE TO CARBON CAPTURE, USAGE AND STORAGE IN EUROPE

SEPTEMBER 2024

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FOREWORD

Policymakers in Europe are increasingly focusing on the development of carbon capture, usage and storage (**CCUS**) value-chains, driven by decarbonisation and energy security considerations.

We are actively advising some of the first CCUS projects in our respective jurisdictions and have firsthand experience of the challenges and opportunities arising as CCUS moves from vision to reality. We are seeing projects and ventures proliferate in some markets, with developers and investors increasingly looking to commit substantial capital in the context of significant regulatory flux. Meanwhile, in other markets, policymakers are beginning to lay the groundwork for the development of the industry.

In this guide, we examine the status of the European CCUS sector, and explore the emerging regulatory landscape across the value-chain in 7 jurisdictions:

- France
- Germany
- Italy
- Netherlands
- Portugal
- Spain
- United Kingdom

This guide is intended to assist developers, investors, lenders, policymakers and other market participants to navigate:

- the evolving regulatory frameworks for CCUS across the value-chain; and
- the interface between CCUS and other policy considerations such as carbon markets and e- fuels.

By providing a comprehensive introduction of the current state of the regulatory landscape for CCUS in the jurisdictions reviewed, we hope the guide will become a valuable resource for stakeholders committed to driving forward the CCUS agenda in Europe, and will support the identification of the challenges to be faced and the opportunities to be seized in making CCUS a cornerstone of Europe's sustainable energy future.

If you would like to discuss this guide or would like further information on any aspect of it, please get in touch with your usual contact.

September 2024

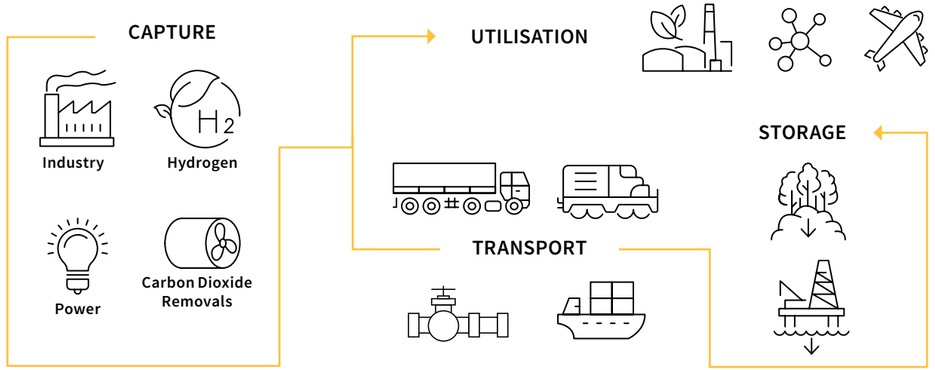
This guide is a collaboration between our Best Friends firms, consisting of BonelliErede in Italy, Bredin Prat in France, De Brauw Blackstone Westbroek in the Netherlands, Hengeler Mueller in Germany, Slaughter and May in the United Kingdom, and Uría Menéndez in Portugal and Spain. Each is a market leader in its respective jurisdiction, each has a formidable international reputation, and all are authorities in cross-jurisdictional best practice.

We regularly work together on energy and infrastructure matters and are actively engaged on CCUS mandates in all the jurisdictions mentioned in this guide.

KEY TAKEAWAYS

- The carbon capture, usage and storage (**CCUS**) value-chain is complex, regionally diverse and with significant variation in the commercial business cases across the jurisdictions reviewed. Given the lack of existing infrastructure, initially projects are highly co-dependent. Project developers, investors and their lenders will need to understand the full CCUS value-chain applicable to their project as part of building their investment case.
- In some jurisdictions, such as Italy, the Netherlands and the UK, significant capital is needed to fund projects which are moving forward at pace. In the UK, the two CCUS clusters, HyNet and the East Coast Cluster, are expected to take their final investment decisions (**FIDs**) in Q4 2024. The Porthos project, currently under construction in the Netherlands, underscores the importance for the first projects of aligning geological storage opportunity with a coherent subsidy and regulatory framework for CCUS, and an experienced and creditworthy value-chain.
- But with policy still in the early phases of development in a number of jurisdictions, such as Germany, Italy and France, projects are being brought forward in the context of a rapidly evolving regulatory framework. Figure 1 highlights key findings in relation to the development of the CCUS value-chain in the jurisdictions reviewed.

FIGURE 1: KEY TAKEAWAYS ALONG THE CCUS VALUE-CHAIN



CAPTURE

A number of drivers for installation of carbon capture technology apply, depending on the emitter's business sector and market factors. Sectors where carbon capture may have an application range from industry, power generation and transport to agriculture. As a result, business models also vary, and are often geography or sector specific. The availability of financial incentives is increasing. Support schemes are already open at the EU level and in France, Netherlands and UK. Incentives are also being planned in other jurisdictions such as Germany and Spain.

UTILISATION

A range of policy measures are being introduced to support CCU at the EU-level as well as in the UK. In particular, e-fuels using recycled carbon are gaining traction as they represent a sustainable energy vector for use sectors where electrification may not be feasible such as maritime and aviation transport. However, currently, e-fuels infrastructure and markets remain under-developed, although circumstances vary depending on each jurisdiction.

TRANSPORT AND STORAGE

Many (but not all) of the jurisdictions reviewed have recognised the strategic importance of CO_2 transportation and storage networks as an enabler for the CCUS sector as a whole.

Private investment is needed to deliver this. Given the time-scales for development and commissioning of storage capacity, action is required now in order to for CCUS contribute to decarbonisation ambitions in the next decade.

However, approaches to deliver network infrastructure differ depending on local circumstances such as domestic geological storage potential and national decarbonisation pathways. A range of approaches are also seen in market structure and support schemes. In all jurisdictions reviewed, CO_2 transport and storage will be highly regulated and is expected to require significant private investment. In this context direct or indirect incentives are required to deliver initial network infrastructure.

- CCUS is not currently feasible without financial and non-financial support. In particular, the design of financial incentives across the CCUS value-chain is important for the development of the sector. However, this depends on the robustness of the carbon price, local market(s) as well as on the emitters' business sectors and the transportation and storage solutions envisaged. In the UK, operating support for initial projects is proposed along the value-chain. By contrast, in the EU, operating support in the markets where this is available tends to be focused on supporting the additional costs faced by emitters, with funds cascading through the value-chain. Projects may also be enabled by the involvement of state-owned entities in CO_2 transport and storage.
- CCUS needs robust regulatory or commercial frameworks which combine to address key hurdles to investment including:

1 provision of a revenue stream to incentivise the installation of carbon capture equipment when the carbon price is insufficient to justify that investment;

2 mitigation of "project-on-project" risks involved as a result of co-dependent projects which enables management of uncertainty surrounding CO_2 volumes in a nascent market;

3 integration of a range of CO_2 transportation modes ensuring both efficient transport of CO_2 and that the needs of dispersed emitters are met;

4 cross-border co-operation, particularly for emitters in jurisdictions with insufficient available national CO_2 storage capacity; and

5 a robust regime for the management of long-term CO_2 storage liability.

- CCUS regulation is still under development in all the jurisdictions reviewed. Some markets, such as the Netherlands and the UK have a more mature regulatory framework, but even in these markets more work is still required. Other markets such as Germany and Italy are about to embark on significant regulatory programmes to develop their CCUS laws nationally.
- But for CCUS to contribute to climate goals, regulatory frameworks must also ensure climate and sustainability objectives are achieved by assuring the effectiveness of storage solutions and the sustainability of the processes used. CCUS regulation also intersects with the carbon markets, both the compliance markets and, in relation to negative emissions, the voluntary carbon markets. Carbon prices act as a driver for carbon capture on the one hand, but on the other, any CCUS regulatory regime must also interface with carbon markets regulation, which is also in flux. As a result, we are seeing increasingly complex regulatory frameworks emerge across the CCUS value-chain.
- Whilst the investment outlook for CCUS in the EU and the UK is positive, recent elections to the European Parliament, as well as in certain jurisdictions such as France, Netherlands and UK mean that the policies outlined in this guide may be subject to review by incoming administrations. Given the exposure of the CCUS sector to political risks, investors will be keen for clarity as soon as possible in order to progress projects.
- CCUS regulation also intersects with the carbon markets, both the compliance markets and, in relation to negative emissions, the voluntary carbon markets. Carbon prices act as a driver for carbon capture on the one hand, but on the other, any CCUS regulatory regime must also interface with carbon markets regulation, which is also in flux.
- The intricate and varied regulatory frameworks and nascent (although fast evolving) nature of many regulatory regimes means that it is vital to seek advice in the relevant jurisdiction(s), tailored to the specific circumstances of each individual project.

INTRODUCTION: REVIEWING A COMPLEX VALUE-CHAIN

To reach decarbonisation goals, greenhouse gas (**GHG**) emissions need to be reduced in hard-to-abate sectors such as heavy industry, agriculture and transport. Where electrification is not possible, the deployment of CCUS is increasingly being considered to decarbonise processes directly as well as indirectly via the use of low carbon hydrogen or the recycling carbon captured to make e-fuels.

In this guide, Carbon Capture and Storage (**CCS**) refers to the capture of CO_2 with a view to its permanent sequestration and Carbon Capture and Usage (**CCU**) refers to the capture of CO_2 with a view to usage for example in the production of building materials or e-fuels (rather than long-term storage). We refer to e-fuels as a sub-set of sustainable synthetic fuels, where low carbon hydrogen is combined with captured CO_2 to produce synthetic hydrocarbons.

In some markets, there is a recognition that negative emissions, also known as carbon dioxide removals (**CDRs**), will be needed to offset unavoidable emissions in these hard-to-abate sectors. Both nature-based and engineered CDRs will be required. Whilst nature-based solutions are vital, they are outside the scope of this guide. Technologies such as bioenergy with carbon capture and storage (**BECCS**) and direct air carbon capture and storage (**DACCS**) will be considered in the context of the wider CCUS value-chain.

CCS technology is not new but has not been deployed at scale in the jurisdictions covered by this guide previously and requires significant capital expenditure. Similarly, e- fuels have higher costs than the counterfactual fuel and a market price is yet to emerge. Combined with this, the CCUS value-chain is made up of co-dependent projects or businesses which need to manage project-on-project risks and the complexity of coordination between value-chains.

As a result, there is a role for governments and regulators to enable the development and deployment of CCUS technologies, amongst emitters, in the development of first-of-a-kind CO_2 transportation and storage infrastructure and by enabling CCU.

In this guide, we examine the status of the European CCUS sector, and explore the emerging regulatory landscape across the value-chain in 7 jurisdictions: France, Germany, Italy, the Netherlands, Portugal, Spain and the United Kingdom.

The scope of this guide is broad, covering the entire value chain, from policy frameworks and technological innovations to economic impacts and strategic opportunities.

The guide considers:

- The current policy landscape (Policy Overview)
- The emerging regulatory frameworks (Regulatory Overview)
- Transboundary CO_2 transport and storage (Transboundary Markets)
- Incentives for capture projects (CO_2 Capture)
- CO_2 usage and e-fuels (CCU)
- CO_2 transportation and storage (CCS Networks)
- CO_2 storage decommissioning and liability (Post-Closure)

By providing a comprehensive introduction of the current state of the regulatory landscape for CCUS in the jurisdictions reviewed, we hope the guide will become a valuable resource for industry stakeholders, policymakers and investors committed to driving forward the CCUS agenda in Europe.

What is CCUS?

CCUS involves the capture of CO_2, often from a large, point-source emitter, its compression and transportation (using a variety of methods) to be used or stored.

The principal methods of carbon capture are:

- Post-combustion: the CO_2 is separated from the exhaust gases, after burning the fossil fuel.
- Pre-combustion: the CO_2 is trapped before the fuel is burnt. This method also produces a mixture rich in hydrogen – this hydrogen can be separated and used as fuel.
- Oxy-fuel combustion: the fuel is burnt in oxygen rather than air, creating CO_2 and steam, from which the CO_2 can be captured.

A range of transportation methods exist, including pipeline but also rail, road and ship.

Captured CO_2 may be re-used in processes, products and materials such as in the manufacture of cement or the production of e-fuels.

Storage refers to geological storage in depleted oil and gas fields or other geological formations such as salt-caverns, where long-term storage is envisaged. Other, medium-term storage methods may also be used, such as chemical storage.

POLICY OVERVIEW: CCUS POLICY IS CRYSTALLISING

Political appetite for CCUS has waxed and waned over the last 10 years. However, as the need for deeper decarbonisation increases, CCUS has emerged as a necessity in certain markets to achieve climate goals.

The UK is an example of this shifting political appetite. Despite a strong history in offshore oil and gas and significant CO_2 storage potential, the UK's commitment to the sector suffered a set-back in 2015 when the then-government cancelled a £1 billion CCS competition on cost grounds. However, the adoption of the UK's net zero climate change target in 2019 led to a renaissance, supported by the UK's independent Climate Change Committee conclusion that CCUS is "a necessity, not an option" for the UK's net zero transition. This assessment, together with the skilled job opportunities presented by the sector, has resulted in growth in political support for CCUS in the UK.

In contrast to the UK and some individual member states, EU-level policy has been slower to focus on CCUS. Although the directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide (the **Carbon Storage Directive**) was adopted in 2009, implementation was left to the discretion of the individual EU member states. In practice, low levels of development were seen outside of the Nordic region. However, as seen below, recent policy developments seeking to establish an EU-level framework for co-operation between member states may encourage the development of CCUS in the EU.

However, despite developments at the EU level, political appetite for CCUS varies by jurisdiction. A range of factors play a role such as the nature of the economy (particularly the size of the industrial sector), the availability of national or regional geological storage capacity and the national emissions reductions pathway to achieve climate objectives.

In addition, recent elections to the European Parliament, as well as in certain jurisdictions such as France, the Netherlands and the UK mean that the policies outlined in this guide may be subject to review by incoming administrations. Given the exposure of the CCUS sector to political risk, investors will be keen for clarity as soon as possible from the new administrations in order to progress projects.

In this context, we consider the latest policy approaches in the EU and the jurisdictions reviewed. For further information in relation to the Carbon Storage Directive, please see the Existing Regulatory Framework section (here) of this guide.

EU policy overview

Despite the adoption of the Carbon Storage Directive in 2009, there was little focus on CCUS at the EU level until the European Commission's 2050 strategic long-term vision 'A Clean Planet for All' was published in 2021. This outlines seven key building blocks to achieve net zero GHG emissions by 2050, which is a target enshrined in Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (the **EU Climate Law**). Tackling CO_2 emissions with CCS is one of these building blocks, and as such forms a central part of the EU's climate policy. The role of CCUS in the EU was further reinforced by "The future of European competitiveness" report by Mario Draghi published on 9 September 2024 (the **Draghi Report**), which emphasises the role of CCUS in accelerating the EU's green transition, particularly in the industrial and power sectors.

The European Commission's Industrial Carbon Management Strategy Communication (COM/2024/62) (the **EU Industrial Carbon Management Strategy**) sets out the levels of CO_2 that must be captured for the EU to reach the 90% net emissions target by 2040 and climate neutrality target by 2050.

By 2030

At least 50Mt of CO_2 per year to be stored geologically plus related transport infrastructure.

By 2040

Modelling suggests approx. 280 Mt CO_2 needs to be captured.

By 2050

Modelling suggests approx. 450 Mt CO_2 needs to be captured.

The EU Industrial Carbon Management Strategy further outlines the actions that must be taken at both the member state and EU level to establish a single European CO_2 market for carbon management and an attractive environment for investment in industrial carbon management technologies. These actions are built around four main objectives:

1 deployment of CO_2 transport infrastructure;

2 boosting CCS;

3 supporting carbon removals; and

4 fostering CCU.

The Net Zero Industry Act, 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 and amending Regulation (EU) 2018/1724 (**NZIA**) is a key part of the EU framework for CCUS. The NZIA was approved in May 2024 and came into effect on 29 June 2024. This regulation aims to increase the EU's capacity in clean technologies, including CCUS, and to ensure a smooth transition towards clean energy. Part of the EU Green Deal Industrial Plan, it creates a clearer legal framework for net zero industries with the aim of reducing the EU's reliance on certain imports and to protect the EU's competitiveness.

FIGURE 2: SUMMARY OF NZIA ACTIONS

The NZIA, depending on its implementation, may have significant implications for the CCUS sector:

- it establishes an injection target of 50 million tonnes CO_2 per year (**Mt CO_2 pa**) within the EU by 2030;
- it introduces a storage obligation on EU oil and gas producers which is likely to require collective investment in CO_2 storage capacity; and
- it calls on member states to improve their transparency and reporting of geological data.

To reach the 2030 target for EU-wide injection capacity of 50 Mt CO_2 pa, the NZIA assigns CCS projects priority status as "net zero strategic projects", meaning they benefit from expedited permit application procedures. However, the substantive criteria established in the Carbon Storage Directive (outlined further below) for obtaining a permit for safe and permanent geological storage will continue to apply.

The EU Industrial Carbon Management Strategy estimates that significant investment would be required to achieve the NZIA objectives. It estimates that to achieve the storage target of 50 Mt CO_2 pa by 2030 requires approximately €3 billion of investment in carbon storage facilities, depending on the location and capacity of the geological storage sites. Furthermore, a report prepared for the European Commission estimates the investment needs for pipeline and shipping transport infrastructure associated with this target at between about €6.2 and €9.2 billion by 2030.

However, the impact of the NZIA on the development of CCUS related infrastructure will depend on how it is implemented, which in turn will depend both on actions of individual member states and on several delegated and implementing acts that have yet to be adopted by the European Commission.

In particular, the following implementing acts are required:

- by 1 March 2025 at the latest - guidelines to ensure uniform implementation of criteria for recognising "net zero strategic projects", which include the establishment of an EU market for CO_2 storage services; and
- by 30 March 2025 at the latest - two implementing acts specifying (i) the minimum environmental sustainability requirements applicable to public procurement procedures relating to or including particular "net-zero technologies" listed in the NZIA, such as CCS and SAF technologies, and (ii) the pre-qualification and award criteria to be applied by EU member states when designing auctions for the deployment of renewable energy (this may in particular be relevant to biomass or biogas projects, using CCS).

These implementing acts will be submitted to a committee made up of representatives of EU member states and will only be adopted by the European Commission if the committee issues a favourable opinion (whether on first submission, following amendment or on appeal). Certain delegated acts are also required to be adopted, particularly in relation to the storage obligation on EU oil and gas producers mentioned above. These are considered further in the Regulatory Overview section (here) of this guide. Significant scrutiny of both implementing and delegated acts is likely, particularly following recent elections, both to the European Parliament, and in some EU member states.

Policy overview in each jurisdiction covering emitters, CO_2 transportation and storage

The jurisdictions reviewed have taken different approaches to the adoption of CCUS according to their circumstances. Some heavily industrialised countries have set storage ambitions for 2030 such as Italy, the UK and (albeit to a lesser extent) France. In others, such as the Netherlands, CCUS development is being delivered without targets, but with a supportive policy framework and the involvement of state-owned champions working together with industry.

In some markets such as Germany and Italy, policy is nascent but emerging. For example, in Germany steps have been taken recently to remove restrictions preventing the development of CCUS on an industrial scale and its proposed policy framework explicitly recognises the need to ramp-up CCUS technologies to combat climate change.

Whilst these countries are focused on developing their national storage capacity, some, like the Netherlands and the UK with CO_2 storage potential beyond their national requirements, envisage becoming importers of CO_2 for storage.

By contrast, in other markets, such as Spain and Portugal, CCUS is seen as less central to decarbonisation efforts. This is reflected in the fact that CCUS policy is less developed in these jurisdictions.

In those markets where deployment of CCUS is envisaged at scale, it will require a substantial capital investment in capture technologies, transport infrastructure and storage sites. The table below highlights key information regarding each jurisdiction reviewed, with further detail on the policy of each county available in the country specific overviews below.

TABLE 1: OVERVIEW OF KEY CCUS-RELATED INFORMATION IN THE JURISDICTIONS REVIEWED

	2030 CO_2 storage ambition (Mt CO_2)	Sectors envisaged for carbon capture	National geological storage potential (Mt CO_2)*	CO_2 importer/ exporter?
FRANCE	4 - 8	Agriculture; Heavy industry; Chemicals and refineries;	1,680 (onshore) No data for offshore	Exporter
GERMANY	None specified	Heavy industry; Chemicals and refineries; Power; Waste	22,880 (onshore) No data for offshore	Exporter
ITALY	20 - 40	Heavy industry; Chemicals and refineries; Power; Maritime transport	2,954 (offshore) but under investigation	Unknown
NETHERLANDS	None specified	Agriculture; Heavy industry; Chemicals and refineries; Waste	2,700 – 3,200 (offshore) No data for onshore	Importer
PORTUGAL	None specified	Heavy industry; Power; Heavy Industry	7,600 (offshore) 430 (onshore)	Unknown
SPAIN	None specified	Heavy industry; Chemicals and refineries; Waste	13,525 (onshore) No data for offshore	Unknown
UNITED KINGDOM	20 - 30	CDRs; Heavy industry; Chemicals and refineries; Power; Waste	78,000 (offshore) No data for onshore	Importer

*Note: Data on storage capacity is either lacking or requires further investigation in a number of jurisdictions. These figures are indicative only and may be subject to revision.

FRANCE

France's ambition is to capture 4 - 8 Mt CO_2 pa in the industrial centre by 2030 and between 12 - 20 Mt CO_2 pa by 2040. Deeply decarbonising French industry and achieving climate neutrality is expected to require the capture of 30 to 50 Mt CO_2 pa by 2050. This is a relatively modest amount compared with the magnitude of the CO_2 reduction required to meet national climate change targets (- 138 Mt CO_2 pa by 2030 and - 80 additional Mt CO_2 pa by 2050).

France plans to deploy CCS projects rapidly in three phases between 2028 and 2034:

- Phase 1 (2024-2030): deployment of local CCS infrastructure in the industrial clusters of Dunkirk, Fos-sur-Mer and the Rhône, Le Havre and Saint-Nazaire axis. These areas are particularly well-suited to initial deployment: they have a high concentration of large industrial emitting sites, operators of shared infrastructure (such as liquefaction terminals, pipelines, etc.) may already be present and maritime transport capability to CO_2 storage facilities located mainly in the North Sea and the Mediterranean.
- Phase 2 (2030-2040): it is expected that underground storage facilities, particularly onshore, will be developed in France after 2030, which will (i) open up certain industrial areas that are far from foreign storage facilities, such as the Paris Basin, the Mediterranean and the Pyrenean foothills, and (ii) reduce the cost of CCS in France.
- Phase 3 (post 2033): the capture of 30 to 50 Mt CO_2 pa by 2050 is uncertain and depends on a number of factors including delivery of a European-wide CO_2 network infrastructure, development of CDRs and deep decarbonisation of emitting industrial sites in line with "ecological transition contracts" ("contrats de transition écologiques").

Little storage capacity has been identified to date; 865 Mt CO_2 storage has been identified with the maximum potential estimated potential to be only 1680 Mt CO_2. As a result, France is preparing export captured CO_2 to major storage projects (such as Northern Lights, Aramis, Callisto).

Given the country's petrochemical and cement industry and limited storage capacity, France's focus is more on CO_2 capture and usage projects than on storage projects in the short and medium term. Deployment is focused on industrial clusters (mentioned above) with the intention to create synergies. For example, the carbon capture chain can also be used to create hydrogen or heat that can be reused onsite, and the CO_2 captured can be used as a feedstock for chemical or energy products or materials such as e-fuels. Funding is being made available, particularly for carbon capture projects in the form of grants and carbon contracts for difference (although these are still under development). CO_2 pipelines are expected to be developed to serve these major industrial clusters in the short-term, however studies have yet to determine whether a national CO_2 pipeline network is required.

Investment in capture systems and transport infrastructure is currently estimated at between €11 billion and €18 billion over the period 2028-2034. No estimates are available for investment storage given the limited capacity.

GERMANY

It is only recently that the German Federal Government embarked on a reform programme of its CCS/CCU policy. Its implementation of the Carbon Storage Directive in the 2012 Carbon Storage Act (KSpG) was limited to research and development projects, preventing the ramp-up of CCS on an industrial scale in Germany.

In February and May 2024, acknowledging that CCS and CCU will form indispensable parts of a robust strategy for reaching Germany's net zero target by 2045, the German Federal Government set out the "key principles" to be addressed by its Carbon Management Strategy (**CMS**). The final CMS has not been published yet, so the information below is based on these "key principles" and the German Federal Government's draft of an amendment act to the KSpG.

Germany has not yet set out any specific targets for CCS and CCU, and policy for CCU is still in its infancy. In general, Germany aims to use CCS and CCU to decarbonise hard-to-abate emission-intensive sectors, including, in particular, cement and lime production, basic chemicals, and waste management. These sectors will likely be the main recipients of government support for the ramp-up of CCS. Other sectors, such as electricity generation using gaseous (fossil) fuels, may also apply CCS technologies and use the developing transport network for the purpose of delivery of CO_2 streams to storage sites, but will not benefit from state support. Notably, CO_2 streams originating from coal-fired power plants will be excluded from both transport and storage.

Under the revised regulatory framework, CO_2 storage will only be allowed offshore in Germany's exclusive economic zone (**EEZ**) and on its continental shelf (excluding marine protected areas). However, the new framework also provides for an opt-in for the individual federal states (Bundesländer) to allow permanent onshore CO_2 storage. To enable CCUS on an industrial scale, Germany will develop its CO_2 pipeline capacity as the least expensive transportation option. For an interim period, it will rely on other modes of transportation (rail, ship and road transport).

ITALY

Italy's National Integrated Energy and Climate Plan (**NIECP**) for the period 2021-2030 provides that CCUS is indispensable to limit global warming and envisages the development of a regulatory environment conducive to the development of CCUS.

Policies particularly focus on deployment of carbon capture technology in heavy industry such as cement, steel, and natural gas power generation, where the adoption of CCUS is crucial for reducing CO_2 emissions.

Whilst Italy's offshore geological storage potential is under investigation, the Adriatic Sea is considered to be one of the most appropriate offshore storage sites due to its storage capacity and proximity to major emission sources. Pipeline transportation is considered the most efficient and safe method for transporting large volumes of CO_2 from capture sites to storage sites.

The Italian government, in collaboration with the EU, has allocated significant funds for the research and development of CCUS technologies. However, without substantial public and private financial support, these projects may not be economically feasible.

NETHERLANDS

CCS will play an important role in reaching the Netherlands net zero ambition by 2050 and is prioritised over CCU. A recent report by the Netherlands Environmental Assessment Agency (*Planbureau voor de Leefomgeving*) stressed that increasing the CCS capacity is indispensable to reach net zero. CCS will also be necessary for negative emissions to offset residual emissions.

The country's CO_2 storage capacity is offshore, where depleted gas fields hold a potential capacity of 1700 Mt CO_2. Whilst

the Netherlands has not set any target for CO_2 capture and storage, of the countries reviewed, it is the first to deploy a large-scale project; the Porthos project. Another, the Aramis project, is in the preparatory process.

The main sectors deploying CCS in the Netherlands will be energy-intensive industries, such as refineries, cement, chemical production and the steel industry. For those industries CCS will be the short-term solution to decrease their carbon emissions, as transformation of their industrial processes to carbon-neutrality is very difficult.

PORTUGAL

Clear targets for CCUS have not been defined yet by the Portuguese government. However, CCUS is implicit in a number of policies. For example, the Portuguese Carbon Neutrality Roadmap 2050 (**CNR 2050**) anticipates the production of synthetic fuels from green hydrogen and captured CO_2. The amendment proposal to the National Plan for Energy and Climate 2020-2030 (**PNEC 2030**) also envisages the progressive replacement of traditional fossil fuels by electricity, advanced biofuels, renewable synthetic fuels, green hydrogen and biomethane, achieving significant environmental and efficiency gains. Given that the PNEC 2030 and CNR 2050 are currently under revision by the Portuguese government, it is expected that the revised policies may emphasize a greater role for CCUS in meeting energy targets.

According to the Directorate-General for Energy and Geology (**DGEG**), a number of studies have been undertaken over the years, including (i) to estimate annual process emissions that need abatement through carbon capture in order to achieve carbon neutrality by 2050, with strategies including recycling, storing CO_2 in products and CCUS; (ii) to assess the annual biogenic and direct air CO_2 available for geological storage; and (iii) the geological CO_2 storage capacity which can be made available annually.

However, direct funding is currently lacking. The Recovery and Resilience Plan (**PRR**) foresees investments to promote the energy transition and economic decarbonisation, potentially covering carbon capture and utilisation projects but, at present time, the Portuguese government has not allocated any public funding support for investment in CCUS. The total private investment needed for CCUS initiatives in Portugal could amount to several billion euros over the coming years.

SPAIN

Spain has set a goal of achieving net zero carbon emissions by 2050. However policy is more focused on nature-based carbon capture: the Spanish Climate Change Law only mentions CCUS in the context of the need to increase the capacity of ecosystem carbon sinks. Engineered CCUS policy is scant and Spain's main energy policy instruments for decarbonisation of the industrial sector - the "National Energy and Climate Plan" covering the period 2021-2030 (the **Spanish PNIEC 2030**) and the Spanish "Long-Term Decarbonisation Strategy 2050" (*Estrategia de Descarbonización a Largo Plazo 2050*) (the **Long-Term Decarbonisation Strategy**) - barely mention CCUS. However, the Spanish PNIEC 2030 now (based on the updated draft published by the Spanish authorities in June 2023) clarifies that, as part of measure 1.10, CCUS will be considered for sectors where there are no alternatives to fossil fuels and for demonstration projects.

Notwithstanding this lack of specific policy, there have been several initiatives sponsored by Spanish authorities, agencies and universities. Examples include the $PTECO_2$ platform, established

to carry out R&D activities regarding CCUS, and the ALGECO$_2$ plan, which was aimed at identifying areas and structures favourable for geological storage of CO_2. Some industries are also taking a lead. For instance, the Spanish cement industry has developed a roadmap to achieve net zero which relies on CCUS (amongst other technologies).

UNITED KINGDOM

The UK's CCUS policy is based on advice from the UK's independent Climate Change Committee which identified that CCUS is 'a necessity, not an option' to meet the 2050 net zero target under the Climate Change Act 2008. However, the election in the UK on 4 July 2024 means that the new Labour government will need to publish its vision for the sector.

With 68% of the UK's emissions originating in 7 industrial clusters, the UK is focused on developing CO_2 networks and carbon capture projects in industrial areas, capturing emissions from point-source emitters such as power generation, energy recovery plants, hydrogen production, chemicals and materials (such as cement, glass and lime). Coupled with the fact that the UK has significant sub-sea geological CO_2 storage capacity (the UK Continental Shelf in the North Sea, accounting for approximately 85% of Europe's CO_2 storage potential) and a workforce experienced in offshore oil and gas exploration and production, the strategic development of CCUS in the UK is expected to continue, irrespective of the political party in charge.

The previous UK government's policy was to create 4 initial CCUS industrial clusters, permanently storing 20-30 Mt of CO_2 pa offshore in geological storage sites by 2030. Initially 4 CO_2 pipeline and storage networks were identified, but in the longer-term, non-pipeline transportation is also envisaged.

Up to £20 billion has been earmarked by the UK Treasury to support two initial networks and associated emitter carbon capture projects. This investment is expected to leverage £8-10 billion of private sector investment for the initial projects.

Interface with EU and UK Emissions trading, carbon dioxide removals and CBAM policies

A. Emissions trading is a driver for CCUS

Emissions trading schemes established in both the EU and the UK provide a strong incentive for sectors covered by the schemes to decarbonise, with CCUS seen as one of the available decarbonisation pathways.

The EU Emissions Trading Scheme (**EU ETS**), by putting a price on CO_2 emissions, has encouraged the capture of CO_2 for permanent storage in the EU and the European Economic Area (**EEA**) as there is no need to surrender EU allowances (**EUAs**) for emissions deemed to have been captured and used permanently[1], providing EU emitters with incentives to capture CO_2.

Recent reforms of the EU ETS will require industrial emissions to fall at an accelerated rate to meet the 2030 target and the extension of the EU ETS to emissions from fuel use in road transport, buildings and other sectors from 2027 is expected to create further demand for CCUS and low carbon fuels. These reforms also made a number of changes to support industrial carbon management, including extending the scope of CO_2 transport for storage purposes and introducing incentives to encourage the use of synthetic fuels in the aviation sector. The introduction of the EU Carbon Border Adjustment Mechanism (**CBAM**), which is being phased in together with the removal of free allowances in the EU ETS, will also provide an incentive for importers into the EU to decarbonise their production methods.

[1] This includes the CO_2 used for the production and use of renewable fuels of non-biological origin.

Indirectly, the EU ETS also provides funding for CCUS via the EU Innovation Fund which is already supporting CCS projects with a potential of around 10 Mt CO_2 pa. These revenues are expected to grow in the future with the expansion of the EU ETS.

Similarly, the UK Emissions Trading Scheme (**UK ETS**), which has its origins in the EU ETS pre-Brexit, provides an incentive for UK based emitters in covered sectors to reduce emissions and so avoid liability. Although we have seen significant volatility in UK allowance prices, with an estimated 12% reduction in the cost of UK allowances in the last 12 months to the beginning of September 2024, prices are expected to increase in the medium term due to tightening supply and increasing demand. Higher carbon prices, coupled with the phase out of free allowances and the introduction of the UK CBAM in 2027, is expected to provide a significant incentive for UK emitters to capture CO_2.

B. Demand for CO_2 removals is expected to generate further demand for CCUS

Both the EU and UK envisage a role for BECCS and DACCS.

The European Commission Communication on Sustainable Carbon Cycles published in December 2021 sets out an action plan to foster carbon removals across the EU. Its strategic, long-term vision related to CCS depends on BECCS and DACCS in particular. The Communication established the following objectives in relation to CCUS to reach climate neutrality by 2050:

1. by 2028, any tonne of CO_2 captured, transported, used and stored by industries should be reported and accounted by its fossil, biogenic or atmospheric origin;
2. at least 20% of the carbon used in the chemical and plastic products should be from sustainable non-fossil sources by 2030, in full consideration of the EU's biodiversity and circular economy objectives and of the upcoming policy framework for bio-based, biodegradable and compostable plastics; and
3. 5Mt CO_2 should be removed annually from the atmosphere and permanently stored through frontrunner projects by 2030.

To ensure carbon removals in the EU are high quality, the European Commission proposed a regulation for an EU Carbon Removal Certification Framework, with provisional agreement reached by the European Parliament and the European Council in February 2024 and approval by the European Parliament achieved in April 2024. It creates the first voluntary EU-wide framework for verifying permanent CDRs, carbon farming, and carbon storage products generated in the EU. It is seen as a complementary regime to emission reductions. It mandates third-party verification and the publication of certification-related information in an EU registry. It also establishes, amongst other things, EU quality conditions and outlines monitoring and reporting procedures to facilitate investment in innovative carbon removal technologies and sustainable carbon farming solutions. Finally, it also addresses the issue of greenwashing.

Importantly for CCUS, the regulation proposes the following definitions:

- 'carbon removal' means the anthropogenic removal of carbon from the atmosphere and its durable storage in geological, terrestrial or ocean reservoirs, or in long-lasting products; and
- 'permanent carbon removal' means any practice or process that, under normal circumstances and using appropriate management practices, captures and stores atmospheric or biogenic carbon for several centuries, including permanently chemically bound carbon in

products, and which is not combined with enhanced hydrocarbon recovery.

The UK also expects to require negative emissions to reach its net zero targets by 2050. As a result, it is currently consulting on how to incorporate UK based carbon dioxide removals (referred to as greenhouse gas removals) into the UK ETS, with a likely integration date of 2028 at the earliest. The consultation proposes that only 'highly durable' removals are included in the UK ETS, although it also acknowledges there is little definition of what constitutes sufficient permanence. CCUS is expected to play a significant role in achieving these removals. A key question posed by the consultation is what changes will be required to the UK ETS cap to allow for integration. Initially, the proposal is to maintain the gross cap, so that each removal issued will replace UK allowance, ensuring that overall supply and demand is unaffected. However, the government recognises that, in the longer term, the UK ETS may not provide sufficient incentives for individual emitters to decarbonise, particularly if the deployment of CO_2 removals exceeds the UK ETS's size (as is expected in the government's projections).

Case Study: The challenges of integrating CDR and ETS policies in Germany

The German ETS takes an upstream approach, which places the duty to cover any CO_2 emissions with EUAs at the point of first emission. To date, it does not allow the deduction of emission reductions achieved by operators of CCUS technologies in covered sectors.

While the EU is expanding its CDR policy, including through the proposed regulation on an EU Carbon Removal Certification Framework for CO_2 removals, the German framework is still riddled with significant economic and institutional hurdles. But given the absence of sufficient land area for ecosystem-based measures to achieve its emission reduction targets, Germany is expected to need to rely on engineered CDRs. Accordingly, the German Federal Government published "key principles" for its long-term negative emissions strategy to deal with unavoidable residual emissions in February 2024. The potential of technologies such as BECCS and DACCS, however, is significantly diminished due to the persisting limitations posed by the present regulatory framework for CO_2 storage.

The German long-term negative emissions strategy also acknowledges the need to provide secure, sustainable and cost-efficient economic incentives to accelerate the ramp-up of CDRs. Beyond subsidies, the German Federal Government will evaluate the economic impacts of integrating CDRs in the EU ETS as an option for incentivizing CDRs. Germany is also seeking to contribute to the EU ETS review procedure on negative emissions, to be presented by the European Commission in July 2026.

REGULATORY OVERVIEW: THE EMERGING REGULATORY FRAMEWORK FOR CCUS

Existing regulatory framework

All jurisdictions reviewed, both the EU member states and the UK, have regulatory regimes underpinned by the Carbon Storage Directive. Whilst approaches to implementation have varied across the jurisdictions reviewed, at a high-level, as a result of its implementation, all take a precautionary approach to increase and secure public support for CCS by reducing perceived environmental risks. In the EU, the implementation of the NZIA looks set to continue this precautionary approach.

There are, however, significant differences in maturity of the regulatory frameworks for CCUS between the jurisdictions reviewed. In many jurisdictions regulation is lagging behind political and commercial CO_2 storage ambitions. To speed up deployment of projects, it may be necessary to accelerate the development of regulation in order to promote decarbonisation and to achieve carbon capture and storage objectives.

Despite this, tangible progress can be seen in jurisdictions such as the Netherlands where the Porthos project is under construction and the Aramis project is undergoing review.

The UK's regulatory framework is amongst the most advanced of the jurisdictions reviewed and its risk-based approach to incentivising projects (considered further in the CCS Networks section (here) is generally regarded by as a positive differentiator for UK projects. However, the UK has come under criticism for delays both in bringing forward the regulatory changes needed and in taking decisions to enable the first CCUS projects to take their FID.

In this context, we provide an overview of the regulatory frameworks for CCUS below. For consideration of the regime applicable to CO_2 exports, please see the Transboundary Markets section (here) of this guide. For information about decommissioning, please see the Post-Closure section (here) of this guide.

A. The Carbon Storage Directive underpins both the EU and UK regimes

The 2009 Carbon Storage Directive represents the cornerstone of the EU's regulatory framework for CCS. The UK regulatory framework is also based on this legislation, as it was implemented by the UK pre-Brexit.

However, dating back to 2009, the current EU regulatory framework has a limited scope of application and offers a limited degree of harmonisation. Notably, the capture and transport of CO_2 are only marginally addressed by the Carbon Storage Directive and whilst the directive takes a precautionary approach to the geological storage of CO_2, it also leaves considerable discretion in relation to implementation. In particular, EU member states retain the right not to allow for any CO_2 storage in parts or in the whole of their territory and have broad discretion in terms of the liability regime. Accordingly, Austria, Slovenia and Ireland, amongst others, have banned CCS exploration and storage projects completely. Italy, Slovakia, Poland and Germany have imposed temporal, geographical and/or quantitative limits on CO_2 storage. However, recently, national governments have started reconsidering their views on CCS and CCU technologies and are contemplating regulatory changes. Please see below for consideration of the regimes applicable in each of the jurisdictions reviewed in this guide.

According to the Carbon Storage Directive, operators must apply for permits for both the exploration of storage sites and for the injection of CO_2. To obtain these permits, operators must submit extensive evidence as part of the application process and the directive provides for both the minimum conditions for issue and the minimum requirements of storage permits.

In the operating phase, operators must continuously monitor the injection facilities, the storage complex, and the surrounding environment to detect significant irregularities, in particular in relation to migration and leakage of CO_2. The results of this monitoring, as well as the quantities and properties of injected CO_2 streams, must be reported to the competent authority. Member states must also ensure that access to the infrastructure is provided in a transparent and non-discriminatory manner.

In the event of leakage or significant irregularities, the operator is required to immediately notify the competent authority and take the necessary corrective measures. To ensure that all obligations under the permit, including the obligations related to leakages, are met, the operator must provide financial security. Beyond this, liability at the civil and criminal level is largely left to the discretion of the member states. For example, in Germany the precise scope of liability is determined in accordance with the Environmental Liability Act (UmweltHG) which limits the liability of operators for damages to health or property to a total of €85 million, respectively. In Spain, fines for infringement of the Spanish CCS Law are capped at €5 million (but this is without prejudice to any other civil, environmental or criminal liability). In the other jurisdictions reviewed, liability to third parties tends to fall to be settled in accordance with usual applicable legal principles unless a specific regime is introduced to govern this. In the UK, a CCS Network Code is currently under development which regulates the relationship between a CO_2 transport and storage network and its users. This envisages a reciprocal limitation of liability, with each party's liability limited to property damage and third-party liability at law (notably death or personal injury) and capped at £20 million in relation to each party or, in respect of the aggregate liability of the network operator, £100 million in aggregate (all other losses are purported to be excluded).

The storage site will be closed if either the conditions stated in the permit have been met or the operator or the competent authority (after withdrawal of a storage permit) requests the closure. The directive also provides a regime for decommissioning and the post-closure obligations of the operator, including continuous monitoring, reporting, and taking of corrective measures if required. The decommissioning regime and its implementation is considered further in the Post-Closure section (here) of this guide.

B. The EU regulatory framework is evolving rapidly

The Net Zero Industry Act aims to enable the development of EU supply chains and storage infrastructure

As mentioned above, the NZIA is a new piece of the regulatory puzzle for CCUS in the EU. As well as establishing the objective of reaching 50 Mt CO_2 pa of injection capacity in EU geological CO_2 storage sites by 2030, it also envisages the creation of net zero 'Acceleration Valleys', encouraging member states to create clusters for the manufacture of certain net zero technologies in the same areas, and to streamline administrative processes. Furthermore, CO_2 storage and associated transportation infrastructure within the EU will benefit from a priority permitting process and should obtain all necessary permits to operate a storage site within 18 months.

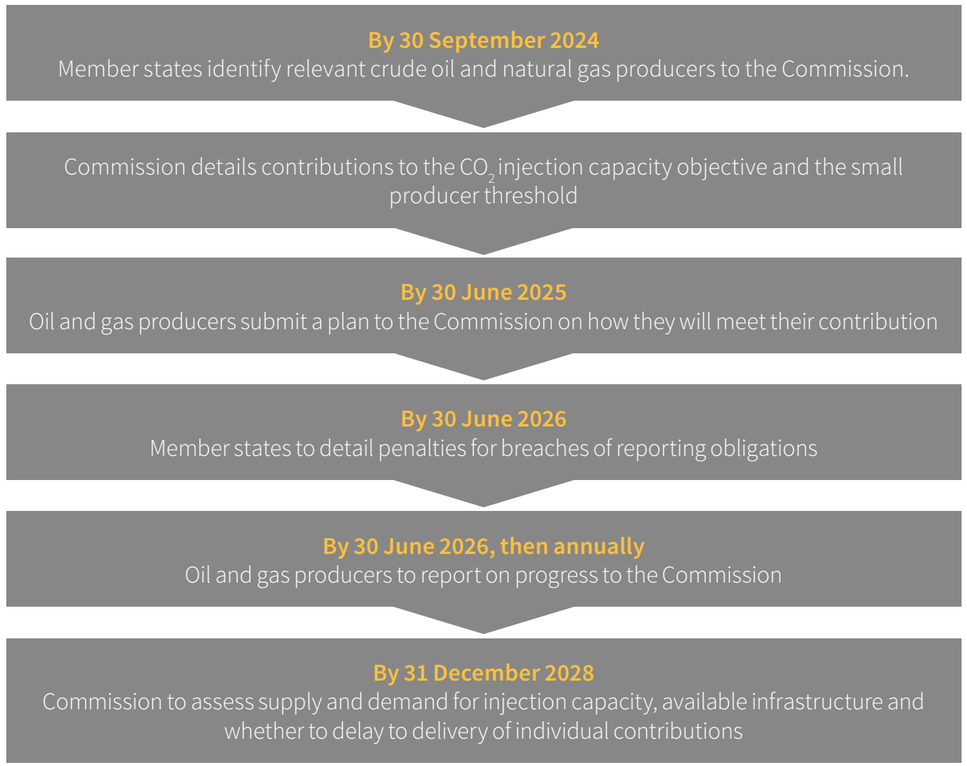
The NZIA also seeks to make CO_2 storage capacity available in the EU. It requires producers of crude oil and natural gas to contribute individually to the 2030 storage objective. The contributions will be proportional, based on the producer's pro-rata production of oil and gas calculated from 1 January 2020 to 31 December 2023 (those below a certain threshold to be defined under a delegated act will be

exempt). By 30 June 2025, obligated entities must present a plan to the European Commission of how they intend to meet their contributions (which can be via investment in or developing CO_2 storage projects or entering into agreements with third-party storage developers or investors). A member state may apply for a derogation in respect of their producers before the end of 2027 provided that the available storage capacity exceeds all the obligated entities' crude oil and gas production in the relevant period (implying a derogation is only possible if the storage obligation is already met). Details of how this obligation would work in practice are not yet available however and will be elaborated further by the European Commission in several delegated acts adopted under powers assigned to it under the NZIA. In particular, the NZIA envisages the following issues will be covered by delegated acts:

- the rules relating to the identification of entities required to make an individual contribution to the annual injection capacity target, including the threshold below which entities are exempt from their contribution;
- the arrangements by which agreements between these entities and investments in storage capacity held by third parties are taken into account in achieving their individual contribution; and
- the content of the reports detailing the progress that oil and gas producers have made in achieving their contribution.

These delegated acts may only enter into force if the European Parliament or the European Council do not object to the draft delegated act. Following the election of new MEPs, the appetite of the newly constituted European Parliament for these measures is, at the time of publication, as yet, untested.

FIGURE 3: TIMELINE FOR ESTABLISHMENT OF CO_2 INJECTION OBLIGATION



The TEN-E Regulation is enabling cross-border projects

Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure (the TEN-E Regulation), revised in 2022, provides a framework for supporting projects of common interest and projects of mutual interest. It provides that projects for the transport and/or storage of CO_2 for the purposes of permanent geological storage in application of the Carbon Storage Directive are the categories of energy infrastructure to be developed to implement energy infrastructure priorities. For example, in March 2023, Italy, France and Greece submitted a regional plan to support the development of CCS infrastructure in the Mediterranean Sea basin within the scope of the TEN-E Regulation. Please also see information on cross-border CCUS projects in the Transboundary Markets section (here) of this guide.

CCUS is recognised within the EU Taxonomy

Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to stimulate sustainable investment (the **EU Taxonomy Regulation**) may also be seen as an enabler of the development of CCUS. Broadly, an economic activity is considered to make a substantial contribution to climate change mitigation when it makes a substantial contribution to stabilising GHG concentrations in the atmosphere in accordance with Paris Agreement objectives. These innovations include the use of environmentally safe CCU and CCS technologies that achieve a net reduction in GHG emissions. In addition, the European taxonomy sets carbon intensity thresholds for cement, steel, chemicals, hydrogen and natural gas. CCUS projects that can demonstrate that compliance with the European Taxonomy are expected to attract a wider pool of investor capital as these investments will also attract funds earmarked for sustainable purposes.

EU-level funding for CCUS

In the following sections of this guide, we examine support schemes for CCUS which are being established in the jurisdictions reviewed. However, not every country is deploying bespoke support mechanisms for CCUS. At the EU level however, several financial measures are available to support CCUS. These include:

- **The EU Innovation Fund** – Using revenue generated by the EU ETS, the EU Innovation Fund is already supporting CCS projects with a potential of around 10 Mt CO_2 pa, which will become operational from 2027.
- **Projects of Common Interest (PCIs) and Projects of Mutual Interest (PMIs)** – PCIs must meet criteria established under the TEN-E regulation (see box). PMIs are projects promoted by the EU in cooperation with countries outside the EU that further the EU's climate objectives. The current list of 14 PCIs and PMIs increases the overall planned capacity to 103 MT CO_2 pa through four onshore storage sites and eight or more offshore storage sites.
- **The European Interconnection Mechanism (EIM)** - This supports the development of cross-border energy and transport infrastructure projects. To date, €680 million have been granted under the EIM to CO_2 PCIs. In December 2023 the EU allocated €480 million to four CO_2 transportation and storage projects (D'Artagnan, the CO2NEX project, Northern Lights and the EU CCS Interconnector).
- **Horizon Europe** – This is the EU's framework programme for research and innovation for 2021-2027, with a budget of €95.5 billion. Through this programme, the Commission supports research, development and innovation for industrial carbon management technologies such as the Strategic Energy Technology Plan Working Group on CCUS

and its associated European Technology and Innovation Platform "Zero Emissions Platform". The UK rejoined Horizon Europe in 2023 and so UK-based research into CCUS may now be eligible.

- **The European Investment Bank** – The EIB has included CCS in its €45 billion financing package to support the Green Deal Industrial Plan.

What are Projects of Common Interest?

PCIs are key infrastructure projects which link energy systems between EU member states that meet the criteria of the TEN-E Regulation. These projects benefit from accelerated permitting procedures and are eligible for funding under the Connecting Europe Facility. In relation to CCUS projects the TEN-E Regulation requirements are:

- a necessary cross-border CO_2 network between two member states and with neighbouring third countries, capturing from industrial installations for the purpose of permanent geological storage or CCU for synthetic fuel gases leading to the permanent neutralisation of CO_2;
- the potential overall benefits of the project outweigh its costs, including in the longer term. For CCUS it is important that the project avoids CO_2 emissions whilst maintaining security of supply, increases resilience and is an efficient use of resources by connecting multiple sources of CO_2 and minimises environmental risks and burdens; and
- the project meets any of the following criteria: (i) it is cross-border involving at least two member states; (ii) it is located on the territory of one member state and has a significant cross-border impact in that it transports CO_2 originating from at least two member states.

Overview of national legislative frameworks and changes underway

FRANCE

CO_2 transport and storage activities are subject to different legal regimes in France. CO_2 transport activities will be regulated by the Energy Regulation Commission (Commission de Régulation de l'Énergie) (**CRE**). Currently, the regulations in force do not prohibit an operator from carrying out CO_2 transport and storage activities at the same time. However, proposals to introduce a regulatory framework based on a negotiated third-party access regime are being developed. For more details, please refer to the CCS Networks section (here) of this guide.

In France, CCUS projects are currently faced with a fragmented legal framework that makes it impossible to list the numerous authorisations governing these projects in all their many facets. These projects are subject, depending on the case, to the rules applicable to the transport of chemical products by pipeline, to the maritime rules governing the transport of hazardous products and, of course, to mining (where applicable) and environmental authorisations (despite the recent reform of the French mining code having improved coordination with French environmental law). The appraisal phase of the procedures takes a considerable amount of time, there are still many legal uncertainties and CCUS projects are subject to the application of rules relating to gas, which are not always appropriate.

A national consultation on the French CCUS strategy was published in June 2023. The results of this consultation should be published in the coming months to establish a clearly defined strategy. In addition, the National Low Carbon Strategy is currently undergoing a review (**SNBC-3**), which should incorporate the EU's new GHG emissions reduction target, as set out in the European Climate Law (55% reduction by 2030 compared with 1990 levels).

The draft decree put out to consultation from 27 February 2024 to 19 March 2024 aims to transpose into the regulatory part of the Environmental Code the revisions to the EU ETS adopted in May 2023. The draft decree completes, at the regulatory level, the transposition begun at the legislative level by articles 14 to 17 of the bill containing various provisions for transposing EU law in the fields of the economy, health, labour, transport and agriculture (**DDADUE bill**) submitted to Parliament on 23 November 2023, with an initial version adopted by the Senate on 20 December 2023, and currently being examined by the National Assembly. France will also have to transpose the provisions of the NZIA, which should come into force in 2026.

In relation to environmental authorisations in the Green Industry Act, it is proposed to "mutualise" the stages of the procedures for examining exclusive research permits (geothermal energy, mining substances, CO_2 storage), which until now have all been carried out in series, without however affecting the authorisation for mining works, a procedure during which the environmental impact of the project is assessed. The expected saving per project would be in the region of 6 to 9 months, halving the current 16 to 18 months.
An exceptional three-year extension of existing PERs (for mining substances) is also envisaged, for exploration work that has been prevented or delayed. The French government also wants to make it easier to convert hydrocarbon wells for CO_2 storage. The aim is to store "as a last resort" only so-called "residual" CO_2, i.e., emissions that are unavoidable during certain industrial processes.

GERMANY

Whilst the current KSpG implements the EU Carbon Storage Directive in Germany, as

mentioned above, the regulatory regime in Germany is still emerging and undergoing reform.

The current KSpG applies to onshore geological storage as well as offshore storage in the German EEZ and on the German continental shelf. The federal states (*Bundesländer*) can limit or completely prohibit storage projects within their territory. Schleswig-Holstein, Lower Saxony and Mecklenburg-West Pomerania have banned access to their relatively large geological storage capacity.

However, more fundamentally, the current KSpG is unsuitable for any large-scale deployment of CCS beyond research, testing, and demonstration; the deadline for permit applications expired in 2016 and the maximum injection rate is currently limited to 4 Mt CO_2 pa, a scale intended to cover pilot and demonstration projects.

The permitting process for the construction and operation of storage facilities follows the general rules for planning approval (*Planfeststellungsverfahren*) under the Administrative Procedure Act (**VwVfG**). In large parts, the procedure is aligned with the planning procedure established in the Energy Industry Act (**EnWG**). Beyond the scope of the KSpG, the project must comply with the requirements set out in the Federal Emission Control Act (**BImSchG**) and accompanying executive legislation. Furthermore, projects sequestrating more than 1,5 Mt CO_2 pa have to undergo an Environmental Impact Assessment (**EIA**). On the other hand, CO_2 streams intended for sequestration, transportation and storage are exempted from obligations arising from the German waste law regime.

The German ETS, established through the Greenhouse Gas Emission Trading Act (**TEHG**), does not allow CCS operators to reflect their emission reductions in the national ETS. Under its upstream approach, the compliance obligation applies to entities at the point of first commercialisation of a fossil fuel. Nevertheless, operators of carbon capture, pipeline transport and storage facilities have to obtain credits to cover their process-based CO_2 emissions.

Achieving climate neutrality by operationalising CCS in Germany on an industrial scale requires not only changes to both the maximum injection capacity and the temporal restrictions for permit applications, but an overall change in policy for CCUS.

According to the CMS and a draft amendment bill to the KSpG proposed by the German Federal Government in May 2024, the scope of the KSpG is set to be expanded to cover industrial-scale storage as well as pipeline-based transport of CO_2. The previous temporal and quantitative restrictions will be removed. However, permanent storage of CO_2 will only be allowed offshore in Germany's EEZ and its continental shelf, with the exclusion of marine protected areas. In the German Federal Government's view, general concerns relating to the economic viability and technical feasibility as well as the broader environmental impact and social acceptance of permanent CO_2 storage can better be addressed offshore rather than onshore. Still, the amended KSpG provides for an opt-in for the individual federal states (Bundesländer) to also allow permanent CO_2 storage onshore.

The proposal prioritises renewable energy projects, in particular connection lines for offshore windfarms, and the ramp-up of the hydrogen economy over the deployment of CO_2 storage and transport facilities in case of usage conflicts arising at the planning stage. Furthermore, the proposal restricts CO_2 transport and storage of CO_2 streams originating from coal-fired power plants. The intention is that CCS/CCU will not serve as an incentive to generate electricity from coal, but rather foster the gradual and steady coal phase-out in Germany.

Therefore, fundamental obstacles persist even if the substantive requirements and the procedural framework seem rather well elaborated. The changes envisaged by the proposed German CMS should alleviate these concerns. However, it remains to be seen in practice how effectively they will pave the way for a large-scale deployment of geological storage of CO_2 in Germany's EEZ and its continental shelf.

ITALY

Legislative Decree 14 September 2011, No. 162 establishes a regulatory framework for the storage of CO_2, transposing the Carbon Storage Directive into Italian national law. The decree applies to the geological storage of CO_2 within Italian territory, including the EEZ and the continental shelf. It prohibits CO_2 storage in the water column and provides detailed definitions for key terms such as: "geological storage of CO_2", "storage site", "leakage and monitoring", amongst others.

Within the Ministry of Environment and Energy Security (**MASE**), as the competent authority, the CCS committee (**Committee**) is established to carry out various tasks, including the examination of applications for exploration licenses and applications for grant of authorisation for CCS. The Committee was introduced by Decree-Law No. 89 of 29 June 2024 and converted into law by Law No. 120 of 8 August 2024. In addition, for technical and operational support, a technical secretariat, composed of 11 experienced units in relevant sectors, is established (**Technical Secretariat**) to integrate the technical/legal competences of the Committee. A registry for the confinement and storage of CO_2 is established by the Committee, containing information on transport infrastructure, licenses, authorisations, and closed storage sites. The registry is publicly accessible, subject to confidentiality regulations.

The Ministry of the Economy and Finance (**MEF**) and the MASE, with the support of the Committee, identify areas suitable for CO_2 storage and areas where storage is not permitted This evaluation is subject to strategic environmental assessment. Exploration licenses are issued by the MEF and MASE, with the Committee's advice and in agreement with the interested Region. Applicants must demonstrate technical, organisational, and economic capabilities. The license term is 3 years initially and can be renewed up to three times, for a maximum of 2 years each time. The license can be revoked if requirements are not met, there is any non-compliance with its terms, or if work does not start within 1 year. In case of revocation or surrender, the holder must secure and restore the environment.

The construction, management, monitoring, and closure of a storage site require prior authorisation by the MEF and MASE, with the Committee's advice and in agreement with the interested region. Authorisation holders must provide financial guarantees to cover the costs of necessary measures in case of closure and post-closure of the storage site. These guarantees must be sufficient to cover monitoring, control, and corrective interventions needed to ensure site safety even after closure.

Measures are provided to ensure the availability of financial resources needed for storage activities. The MEF, in agreement with the MASE, can establish a financial mechanism to support storage operation costs, including corrective actions in case of significant leakages or irregularities.

A number of further changes are required to the Italian regulatory framework to support CCUS development:

1. Strengthening the regulatory framework: there is a need to strengthen existing regulations to include stricter purity criteria for captured CO_2 streams, enhancing safety and public trust in CCUS.
2. Integration with other energy policies: CCUS should be integrated with other

emission reduction policies, such as renewable energy and energy efficiency, to ensure a holistic approach to climate change mitigation.

3. Development of CO_2 transport infrastructure: the construction of CO_2 transport infrastructure, such as pipelines, requires detailed and standardised regulations to ensure safety and efficiency.

NETHERLANDS

Two main, complementary frameworks regulate CC(U)S: the Mining Act (*Mijnbouwwet*) and the Environmental Act (*Omgevingswet*). The Mining Act focuses on certain activities regardless of their environmental impact and the Environmental Act provides that certain activities with substantial environmental effects are subjected to an environmental permit and cannot be executed until an EIA is carried out. The capture, usage, transportation and storage of CO_2 are therefore all governed by the Environmental Act.

The storage of CO_2, as well as exploration of underground deposits suitable for CO_2 storage, requires a license from the Ministry of Climate Policy and Green Growth under the Mining Act. When deciding whether to grant a license, the Minister will consider, *inter alia*, the technical and financial capacity of the applicant, the safety of the inhabitants of the surrounding area, and national security. The license can set out conditions which the CO_2 storage site must comply with regarding the manner, depth, and area in which CO_2 is stored, as well as other commitments necessary to protect the interests of the inhabitants and infrastructure of the surrounding area, national security, the management of natural resources, and the possibilities of storing other materials. The Mining Act distinguishes between the temporary and permanent storage of CO_2. The latter must fulfil additional obligations not applicable to the temporary storage thereof.

Temporary CO_2 storage license holders are required to take all measures which can be reasonably requested of them to prevent CO_2 storage from negatively affecting humans and the environment, ground movements, safety, or the general interest in planned management of natural resources. In addition, license holders must submit a storage plan to the Minister for approval, including plans for the amount of CO_2 expected to be stored, the duration, the manner of storage, the annual costs of storage, any anticipated ground moment, and risks for the inhabitants, infrastructure, and buildings in the surrounding area.

Permanent CO_2 storage facilities must fulfil several additional requirements, in addition to the requirements for temporary storage mentioned above. The Minister must also send all license applications to the European Commission for its non-binding advice. Once granted, the license will specify, *inter alia*, the time-period and location of CO_2 injection, the maximum amount of CO_2 to be stored, measures to be taken for monitoring and managing risks, corrective measures to be taken in case of leakage, and the amount of financial security which the potential storage operator must provide to ensure it complies with its obligations under the license. Any changes to the storage complex made after the license has been granted must be notified to the Minister. The Minister may revoke the license as a result of recurring leakages or other irregularities, where the license holder does not comply with the license requirements, in particular those relating to financial security, or where this is necessary on the basis of scientific findings or progress.

Once a license has been granted for permanent CO_2 storage, the license holder must monitor and record the amounts and types of CO_2 delivered to and stored

by it, as well as any leaks, and report this to the Minister annually. The license holder is also required to establish reasonable, transparent and non-discriminatory criteria for granting access to its storage locations.

The license will set out closure requirements. Once these have been met, the license holder will set out a closure plan, which the Minister must approve. The license holder must then seal off the CO_2 storage deposit and remove any injection sites or other equipment left at the surface.

The operation of pipelines transporting dangerous substances is designated as an environmentally harmful activity, which is subject to the licensing system of the Environmental Act. The transportation of CO_2 is explicitly mentioned as a dangerous substance, when the particular pipelines meet certain size and pressure specifications. Furthermore, the transport of CO_2 is also regulated by the Mining Act, requiring operators of CO_2 transport networks to offer access to their network under reasonable, transparent and non-discriminatory conditions.

The Authority for Consumers and Market Authority (**ACM**), the State Supervision for the Mines (**SODM**) as well as the Minister, are the competent supervisory authorities for CCS. SODM supervises the safety of the transport and storage of CO_2, insofar as this transport by pipeline that is part of the operation of mining works and SODM monitors the non-discriminatory third-party access requirements under the Carbon Storage Directive.

PORTUGAL

The existing regulatory frameworks focus mainly on the geological storage of CO_2 in Portuguese soil and is primarily regulated by DL 60/2012, which enacted the Carbon Storage Directive. Under this regime, geological storage of CO_2 will be implemented throughout the whole of the Portuguese territory, including at sea, the EEZ and the continental shelf. Interested parties may submit a request to the DGEG for the award of (i) an exploration licence for the right to explore a specified geological formation for the purpose of assessing its suitability for CO_2 storage, or (ii) a storage concession for CO_2 injection and storage in a designated suitable site on an exclusive basis. The award of these rights may also be granted through the launch of a tender procedure.

The exploration licence can be granted for a maximum 5 years that can be extended for an additional three-year period in case the initial period is insufficient for the assessment of a CO_2 storage site's suitability. If upon the conclusion of the research the geological formation is deemed suitable for CO_2 storage, the holder of the licence may request the award of a storage concession on a priority basis. A storage concession is awarded through the execution of a concession agreement with the Portuguese state, which determines the concession's duration, operation, information and decommissioning obligations, seabed rent and compensation for the state, amongst other things. Although DL 60/2012 provides that the activity of transportation of captured CO_2 shall be regulated under specific legislation (at the time of writing this legislation has not been enacted).

According to the information available, no permits under DL 60/2012 have been requested or granted for geological formation research or storage in Portugal. However, power and cement production are the only sectors in which companies have tested CO_2 capture technologies and their potential use through the implementation of pilot capture projects.

Other types of permits may also be required for CCUS activity. For example, the CO_2 storage activity is also subject to the obtaining of an establishment licence for the storage facility granted by DGEG at the

time of the award of the storage concession. An environmental impact declaration following an EIA is also required for CO_2 pipelines and capture facilities which use geological storage as well as for the storage sites themselves. Depending on the use of the captured CO_2, the activity may also be subject to the obtaining of an industrial licence.

SPAIN

In general terms, the CCUS regulatory framework in Spain is still under development with further regulation required. The Carbon Storage Directive has been generally transposed into Spanish law through the Spanish CCS Law, which provides the regulatory framework applicable to geological CO_2 storage in Spain (although CO_2 geological storage for R&D purposes is currently subject to Spanish mining regulations if the expected CO_2 storage capacity is below 100,000 tonnes). This covers storage in underground geological structures located in territorial waters, the EEZ and the continental shelf.

The Spanish CCS Law requires operators to obtain (i) an exploration permit (*permiso de investigación*) to carry out CO_2 storage exploration, and (ii) a storage permit (*concesión de almacenamiento*) to implement and operate a CO_2 storage site within the authorised geological area. In general terms, the competent authority involved in this permitting procedure will be the Spanish Ministry for the Ecological Transition and Demographic Challenge (*Ministerio para la Transición Ecológica y el Reto Demográfico*) (**MITERD**) (acting through the General Directorate of Energy and Mining Policy (**DGPEM**)). Regional authorities (*comunidades autónomas*) will be competent to issue research permits if the storage site is located within their territory only. Operators with exploration permits over a certain area will have priority to obtain the storage permit before CO_2 full-scale injection. Both permits will grant their holders exclusive rights to explore or exploit (as applicable) the relevant CO_2 storage site. The exploration permit will be granted for a maximum period of 4 years (subject to two 2-year extensions in certain cases) and the storage permit will have a maximum duration of 30 years (which may be extended for two subsequent 10-year periods).

When an operator is granted a storage permit over a certain geological formation, the overlying land required for the installation of the CO_2 injection facilities (and other ancillary facilities) will be declared of public interest (at the operator's request) and the operator may then resort to compulsory purchase proceedings if necessary (e.g., if the operator fails to conclude agreements with the relevant landowners). The same regime would apply to exploration permits in general terms, but land rights will be limited in time and will only cover overlying land that is necessary to carry out the exploration works.

CO_2 transport is briefly addressed in the Spanish CCS Law following the principles set out under the Carbon Storage Directive. This requires third-party access to CO_2 transport and storage sites in a transparent and non-discriminatory manner and a dispute settlement mechanism settled by Spanish authorities if a conflict between CO_2 storage or transport operators and potential users occurs. It is worth highlighting that, subject to implementing regulations that may be approved by Spanish authorities, operators of CO_2 storage sites will be free to set the price applicable for the use of their CO_2 storage facilities, provided that such price scheme follows the principles of transparency and non-discrimination. By contrast, the revenue model applicable to CO_2 transport networks will be based on the methodology and principles to be approved by the MITERD.

Separately CO_2 facilities may be subject to other permits or consents, such as those deriving from urban-planning, health and

safety and environmental regulations. Regarding environmental regulations, CO_2 capture facilities may require an integrated environmental authorisation (autorización ambiental integrada) when used to inject CO_2 into geological storage sites, which in most cases may be time-consuming; likewise, CO_2 facilities (including storage, injection and transport) will be generally subject to an EIA, which may be processed under an ordinary or simplified procedure depending on certain factors (e.g. length of the CO_2 transport pipeline, CO_2 capture volume expected, type of CO_2 facilities).

Lastly, the Spanish Allowances Law considers CCUS activities as subject to the regulatory framework applicable to CO_2 emission obligations and allowances. If any CO_2 leakages from any CO_2 storage or transport facilities occurs, the relevant operator will be liable to surrender EUAs equal to the tonnes of CO_2 leaked. The same principle would apply conversely, as operators will not have to surrender allowances for CO_2 that is captured and safely stored in accordance with the Spanish CCS Law.

UNITED KINGDOM

The UK implemented the Carbon Storage Directive via the Energy Act 2008 and secondary legislation. The Oil and Gas Authority (now acting under the name of the North Sea Transition Authority (**NSTA**)) is the licensing authority for CO_2 storage sites in UK offshore waters. Whilst devolved authorities have powers in relation to some offshore areas, we refer to the NSTA below for convenience. Developers must obtain a licence to assess a potential storage site, and a further storage permit for injection of CO_2 into the site. Before the storage permit is issued, the NSTA must be satisfied that there is 'no significant risk' of leakage or of harm to the environment or human health.

The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 (the **Licensing Regulations 2010**) regulate the issue of CO_2 storage licences, establish powers to allow the NSTA to require the operator to undertake corrective measures if necessary and include requirements relating to closure and post-closure. It also includes provisions relating to change of corporate control of a licence holder. Equivalent regulations apply in Scotland. The Storage of Carbon Dioxide (Access to Infrastructure) Regulations 2011 establish a regime for third-party access to CO_2 transportation and storage infrastructure. Finally, the Storage of Carbon Dioxide (Termination of Licences) Regulations 2011, transfer liability to the UK government (or Scottish Ministers in certain, narrow, circumstances) following termination of the licence.

Project developers must also obtain a grant of the appropriate transportation and storage rights in relation to the seabed from The Crown Estate or the Crown Estate Scotland. The planning and environmental permitting regimes also apply, including the requirement for an EIA and the regimes for use and discharge of chemicals and for dealing with offshore pollution. CO_2 transport and storage operators are also covered by the UK ETS.

The Energy Act 2023 is the enabling legislation underpinning the economic regulatory regime which will provide financial support to the first CO_2 networks. The legislative framework establishes a regulatory asset base model for CO_2 networks, which is designed to attract private finance and remove market barriers to investment, providing long-term revenue certainty needed to establish and scale up CCS across the UK. It establishes Ofgem as the economic regulator for CO_2 transport and storage (GB-wide coverage) and introduces a criminal offence to undertake the following activities without an economic licence: 1) to operate a site for the disposal of CO_2 by way of geological storage and 2) to transport CO_2 by pipeline (or another means of transportation to be

specified in regulation). The Energy Act 2023 also enables the entry into revenue support contracts with the Low Carbon Contracts Company to top up the revenues of CO_2 transport and storage networks in the event of no or low network utilisation. The UK government will also provide a government support package for initial CO_2 transportation and storage networks, covering high impact, low probability risks such as CO_2 leakage and unavailability of insurances.

Revenue support contracts also underpin the economic business models for the emitter projects. These private law contracts are based on the UK's Contracts for Difference for renewables and may be entered into to support emitters deploying industrial carbon capture, gas power generation plus CCS and low carbon hydrogen production. Powers to enable these are found under the Energy Act 2013 and the Energy Act 2023. Revenue support regulations have been enacted in relation to industrial carbon capture, hydrogen production, power generation plus CCS and CO_2 transport and storage. These regulations are important for the grant of support under the business models and relate to matters such as the process by which the Secretary of State may direct contracts to be offered, eligibility requirements and information which will be made public in respect of such contracts.

Further aspects of the regulatory frameworks are expected to be developed over the coming months including:

- finalising the regulated asset base model and contract terms for revenue support for CO_2 transport and storage, industrial carbon capture, power generation plus CCS and CCS-enabled hydrogen production and the funding of these regimes. After years of development, the terms are almost finalised with initial CO_2 network and emitter projects expected to take FID in the coming months;
- finalising the CCS Network Code which is critical to the operation of CO_2 transport and storage networks as it is the commercial interface between network users and operators. It will provide the framework for connections, user charging, and network use, plus other arrangements including on governance, disputes, data management and liabilities;
- reforms to the UK ETS for the integration of CDR's to enable the development of a power BECCS business model and support for other CDR projects; and
- consultations on changes to the CO_2 network unbundling regime, to the third-party access regime and to enable the emergence of a new market development framework from 2030.

TRANSBOUNDARY MARKETS: AN INTERNATIONAL MARKET FOR TRANSBOUNDARY CO_2 TRANSPORT AND STORAGE IS NEEDED

The availability or lack of storage capacity in the jurisdictions surveyed creates an opportunity for the emergence of a pan-European market for CO_2 trading. Of the countries reviewed, the Netherlands and UK are preparing to become net importers of CO_2, whereas France and Germany are already anticipating becoming net exporters.

Political support for the emergence of such a market is growing in both the EU and in the UK. For example, the importance of cross-border trade was highlighted in both the UK government's CCUS Vision publication of 20 December 2023 and in the EU Industrial Carbon Management Strategy.

However, the need for international cooperation and integration with existing international treaties as well as domestic regulation means that implementation is not necessarily straight forward. Several international legal instruments are relevant to the transboundary shipment of CO_2.

Of particular importance is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 1972 (the **London Convention**) and the 1996 Protocol to the London Convention (the **London Protocol**) (see box).

We consider the existing regulatory framework and examine key changes required to expand this market later in this guide.

The London Convention and the London Protocol

International exports of CO_2 for sub-sea storage fall within the regime established under international law by the London Convention and the London Protocol. The London Protocol prohibits the dumping of waste at sea unless such dumping falls into one of the exceptions in Annex I. Following an amendment in 2006 (which entered into force in 2007), captured CO_2 streams are one of the exceptions under Annex I, thus permitting offshore CO_2 storage.

However, article 6 of the London Protocol, originally conceived to prevent "offshoring" of dumping, also prevents the export of CO_2 for storage at sea. In 2009 an amendment was adopted adding a provision allowing countries to export and receive CO_2 for storage provided that:

1. there is an agreement or arrangement between the countries concerned, allocating permitting responsibilities between the parties (for exports to non-contracting countries, such an arrangement must include provisions consistent with the London Protocol); and
2. the International Maritime Organisation is notified.

However, the 2009 amendment's entry into force requires ratification by two-thirds of the London Protocol's contracting parties, which has not yet happened. In the interim, the parties adopted a resolution in October 2019 allowing provisional application of the CO_2 export amendment to article 6. This is the basis upon which parties to the London Convention may participate in international CO_2 trading. Exports to non-London Protocol countries are restricted, however.

The existing legal framework for CO_2 transport internationally

A. Exporting CO_2 within the European Economic Area

The framework enabling the export of CO_2 within the European Economic Area (**EEA**) requires consideration of both the London Convention and the EU ETS.

An emitter in a sector covered by the ETS Directive is not required to surrender EU allowances in respect of emissions captured and transported for permanent storage in accordance with the Carbon Storage Directive. Similarly, the EU Monitoring Regulation provides that (i) operators measure and report both emissions from activities covered under the ETS Directive and fugitive emissions; and (ii) operators may subtract from the installation's emissions any amount of CO_2 that is transferred for long-term geological storage to a capture installation, transport network, or storage site for storage in accordance with the Carbon Storage Directive. The benefit of avoiding EU ETS liability is therefore retained, provided CO_2 is exported to an EEA member state which has implemented the Carbon Storage Directive.

There is, however, a need to clarify in the EU ETS the methodology for subtraction of CO_2 from the installation's emissions where the transfer from a covered installation is via ship and other non-pipeline transportation of CO_2, as methodological nuances exist under the EU Monitoring Regulation that are still to be bottomed out. As shipping is covered by the EU ETS from 2024, responsibilities for shipping emissions, as well fugitive emissions during transportation, need to be allocated and appropriate calculation and monitoring methodologies to be put in place.

The EU Industrial Carbon Management Strategy recognises the importance of international cooperation. For EU member states of the EEA, the EU Commission considers that the EU legal framework is the relevant 'arrangement' between the Parties within the meaning of the London Protocol so any operator of CO_2 transport networks and/or CO_2 storage sites can draw the full benefit of the EU's legal framework to import or export captured CO_2 within the EEA.

To comply with the requirements of the London Convention, the London Protocol and the 2009 amendment to article 6, EEA member states have begun establishing the bilateral arrangements. The first bilateral agreement for the export of CO_2 for storage abroad was signed between Belgium and Denmark on 26 September 2022. Other countries have also declared plans to formalise bilateral arrangements. The agreements relevant to the countries reviewed in this guide are set out in the table below.

As mentioned in the Regulatory overview section (here) of this guide, in some cases restrictions to CO_2 exports exist at the country level. For example, in Germany, the Maritime Dumping Act (**HSEG**) prohibits the offshore injection of a CO_2 stream loaded in Germany in non-German EEZs and continental shelfs. Germany has not yet ratified the amendment of the London Protocol but proposes to do so as part of the reforms envisaged by the proposed CMS, thereby enabling access to storage capacities in neighbouring states such as the Netherlands and Norway. Indeed, Germany has signed three joint declarations of intent, with Belgium, Denmark and Norway, as a preliminary step towards CO_2 exports.

Italy similarly has not ratified the amendment of the London Protocol. However, according to the Italian PNIEC 2030, Italy intends to file a formal declaration of provisional application and initiate discussions with France and Greece with a view to concluding bilateral agreements on transboundary CO_2 transport to develop permanent geological storage projects.

B. Barriers remain to exporting CO_2 from the European Economic Area

As mentioned above, exports to non-London Protocol contracting countries are restricted by the London Convention and the London Protocol. However, it is permitted under the London Convention and London Protocol for contracting parties to enter into arrangements for the transboundary transportation and

storage of CO_2 between themselves, provided the requirements of the 2009 amendment are met. As a result, EEA countries may, in principle, enter into arrangements with third countries such as the UK.

However, emitters based in the EEA seeking to export CO_2 outside of the EEA face a constraint due to the requirement of the EU ETS for emissions captured and transported for permanent storage to be stored in accordance with the Carbon Storage Directive (see above). Absent further legal clarity, EU/EEA CO_2 producers intending to export CO_2 for storage outside of the EEA are not eligible to deduct captured and stored CO_2 from their EU ETS liabilities. The EU Industrial Carbon Management Strategy notes that "for the time being, the only way of extending such benefits to non-EEA countries would be to operate storage sites under an ETS that is linked with the EEA ETS and under a framework that provides legal safeguards equivalent to the EU's Carbon Storage Directive".

C. The UK is beginning to consider CO_2 import and export opportunities

Given the UK's CO_2 sub-sea geological storage capacity, it is widely expected that the UK will become a net importer of CO_2. However, UK government policy has been slow to emerge in respect of CO_2 imports, with the development of a national CCUS value-chain given precedence. In December 2023, the UK government's CCUS Vision document recognised that CO_2 import networks would need to be enabled by 2030, in order to create a self-sustaining CCUS market by 2035. In addition, the UK government will also explore the potential role of CO_2 exports in providing increased resilience in the UK CCUS sector.

EU member states are, given their proximity, the most likely markets to export CO_2 to the UK. In addition to political considerations, there however are several regulatory barriers to overcome in order to establish transboundary transportation and storage of CO_2 with EEA countries.

As a contracting party to the London Convention and the London Protocol, it is open to the UK to agree both to export and import CO_2 to and from other contracting parties. The UK however has yet to enter into any such agreements or arrangements. And, whilst the UK implemented the Carbon Storage Directive when it was a member of the EU, following Brexit, the UK is now a third country. EEA based emitters seeking to export CO_2 for storage in the UK are therefore constrained by the application of the EU ETS rules mentioned above.

D. The way forward

Industry groups such as the Zero Emissions Platform, the Carbon Capture and Storage Association and the Clear Air Taskforce have observed that the establishment of a pan-European market for CO_2 transport and storage requires political cooperation to address the regulatory barriers mentioned above. To facilitate CO_2 transport and storage between an EU member state and the UK, individual EU member states may enter into bilateral arrangements with the UK to address the London Protocol requirements. Notably, the UK has signed declarations with both Germany and France, acknowledging their shared interest in cooperating on CCUS deployment and in the examination of potential opportunities regarding cross-border CO_2 transport. However, these declarations fall short of the arrangements required under the London Protocol. The regulatory barriers mentioned above under the EU ETS also mean that EU-level cooperation and legislative change are needed. There is scope for this cooperation to take place under the framework of the UK-EU Trade and Cooperation Agreement which includes provisions for cooperation on trade and climate change. However, the political climate to do so will be crucial to the development of transboundary CO_2 markets.

TABLE 2: AGREEMENTS FOR EXPORT OF CO_2 RELEVANT TO THE COUNTRIES REVIEWED

	Other contracting states	Agreement under the London Protocol?	IMO notified*
FRANCE	Norway	Yes	No
FRANCE	Denmark	Yes	No
GERMANY	Belgium	No (Joint Declaration)	No
GERMANY	Norway	No (Joint Declaration)	No
GERMANY	Denmark	No (Joint Declaration)	No
NETHERLANDS	Norway, Denmark, Sweden and Belgium	Yes	No
UNITED KINGDOM	Norway	No (MoU)	No

*It is understood that only one agreement concluded between Belgium and Denmark (Project Greensand, September 2022) has been notified to the IMO.

Examples of cross-border projects

A number of cross-border CO_2 transport and storage projects are under development as between EEA countries. These include:

- **GRTgaz-Equinor** - the two industrial players have launched a pipeline project linking Dunkirk (France) directly to CO_2 storage facilities in the North Sea off the coast of Norway. This project will enable the export of 3 to 5 MtCO_2 from 2029.
- **Pycasso** – this project will transport and store CO_2 in onshore storage in southwestern France from industrial emitters in France and Spain. This project is a European PCI.
- **Northern Lights** – this is a CO_2 transboundary project between several European capture initiatives in Belgium, Germany, Ireland, France and Sweden, involving transport by ship to storage offshore on the Norwegian continental shell. This project is a European PCI.

CO_2 CAPTURE: APPROACHES TO INCENTIVISING CAPTURE PROJECTS

Emitters are a key element of the CCUS value-chain. Whilst the imperative to decarbonise is now understood across all sectors of economic activity, carbon capture is one of a range of decarbonisation pathways emitters might pursue. However, in some hard-to-abate sectors, particularly heavy industry where electrification is not feasible, CCUS is increasingly being considered. We examine the drivers and incentives to install carbon capture technology for emitters in the jurisdictions reviewed.

Drivers for installation of carbon capture

Emitters in each of the jurisdictions reviewed may be incentivised to invest in CCS/CCU for several strategic, economic, and regulatory reasons, including:

- **Carbon costs and markets**: Economic drivers include avoidance of ETS compliance costs, the rising demand for low carbon products and the opportunity to participate in a developing voluntary carbon market. Please see the Policy Overview section (here) for further details on how carbon markets are incentivising carbon capture.
- **Grants and financial incentives**: National and regional incentives may make capital investment in carbon capture more economically viable. All jurisdictions reviewed other than Italy and Portugal have or will have support available for the capital cost of carbon capture projects. The form of support ranges from grants (as seen in the UK) and possible tax incentives for companies investing in emission reduction technologies (as seen in the Netherlands) to revenue support (as seen in France, the Netherlands and the UK). Please see below for further detail on financial incentives.
- **Reputational reasons**: Emitters may have corporate social responsibility commitments to reduce emissions and/or need to respond to stakeholder pressure. For emitters in sectors that are hard-to-abate, CCS and CCU equipment installation can be necessary to achieve corporate level net zero targets or to deliver on green claims.
- **Sustainability reporting**: With increasing focus on transparency and reporting and supply chain emissions, organisations are increasingly implementing international standards (e.g., ISO 14001) or GHG reporting frameworks to measure and report on their emissions.
- **Technological innovation and competitiveness**: Early adoption of carbon capture technologies can offer innovation as well as sustainability benefits.

Carbon capture technology may be relevant to the decarbonisation pathways of a range of emitters. The sectors considering carbon capture in the jurisdictions reviewed are shown in Figure 4.

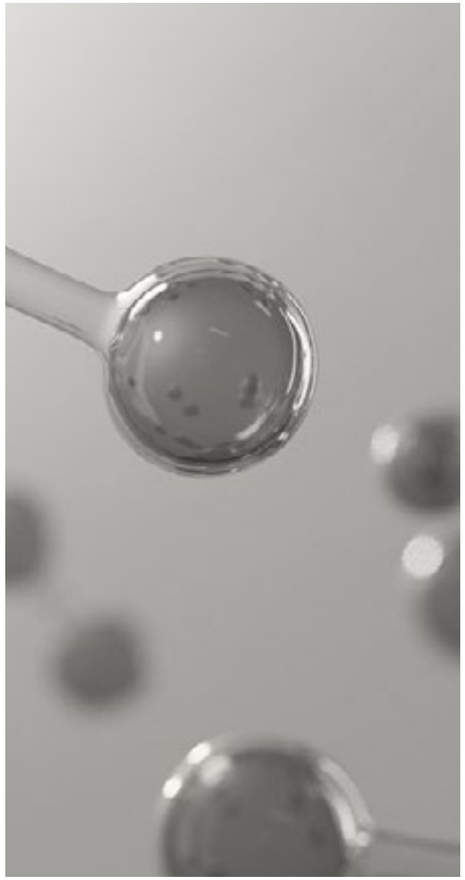


FIGURE 4: SECTORS WHERE CARBON CAPTURE MAY BE APPLIED IN EACH JURISDICTION

	FRANCE	GERMANY	ITALY	NETHERLANDS	PORTUGAL	SPAIN	UNITED KINGDOM
Pulp & Paper	✓		✓				✓
Cement	✓	✓	✓	✓	✓	✓	✓
Iron & Steel	✓		✓	✓	✓	✓	
Chemicals & Refineries	✓	✓	✓	✓	✓	✓	✓
Agriculture	✓			✓			
Power		✓	✓				✓
Bioenergy power		✓	✓				✓
Maritime transport			✓				
Waste		✓		✓	✓	✓	✓
CDR							✓

What incentives are in place or being introduced for carbon capture?

In this context, a number of the jurisdictions reviewed are considering intervention to support the deployment of carbon capture technology. A range of incentives are being considered. The table below summarises the support in place or being introduced for carbon capture in the jurisdictions reviewed and at the EU level. This summarises incentives which may be implemented directly at the relevant facility by either the facility owner or a carbon capture service provider. In some sectors, incentives to use carbon capture are indirect, for example in aviation or maritime transport where incentives encourage the adoption of low carbon fuels. These initiatives are considered further in the CCU section (here).

Carbon contracts for difference (CCfDs)

CCfDs are based on a similar contractual approach to contracts for difference for renewable energy, but in this case concern the price of carbon. The EU ETS caps the emissions of emitters in covered sectors each year. At the end of the year, each emitter must surrender a number of EU emission allowances (**EUAs**) equal to its allowance. Emitters which have installed carbon capture technology avoid the cost of purchasing EUAs and, if they have received any free allocation, can sell their surplus EUAs in the market. However, due to the low level and volatility of the EUA price, cost savings and any proceeds from the sale of EUAs are not enough to finance their capex investment in carbon capture equipment. CCfDs help to bridge this funding gap. A state offering support under a CCfD sets a cost per tonne of CO_2 required to produce a particular high emission product (for example, steel, cement, and aluminium). This fixed price is the CCfD strike price and will vary from one industrial sector to another. Under the CCfD with the emitter, the state undertakes to pay the difference between this strike price and the variable EUA market price when the EUA price falls below the strike price. In the EU, the Draghi Report highlighted the potential for CCfDs to be awarded at auction at the EU and/or the member state level, providing emitters with both carbon price certainty and a subsidy, and thereby facilitating access to finance. In the UK, CCfDs are also proposed to underpin support for BECCS and CDR projects, bridging the gap between the price that projects can sell their carbon credits in the voluntary carbon markets (or in the UK ETS if a decision is taken to integrate carbon credits into it) and the cost of construction and operation of these projects.

Capture as a service

In some jurisdictions, carbon capture technology providers are developing carbon capture as a service. Under this model, responsibility for building, owning and operating the carbon capture plant does not lie with the emitter, but with a third party who also funds capital costs. This third party contracts with the emitter for the provision of carbon capture services. This option may be particularly attractive for smaller emitters if the up-front cost of installing capture technology is prohibitive.

TABLE 3: FINANCIAL INCENTIVES IN PLACE OR BEING INTRODUCED FOR CARBON CAPTURE

	Support available?	What type of support?	Existing support schemes (open to applications)	Proposed support schemes (not yet open to applications)	Types of project eligible for support
EU	Yes	Grants Loans	EU Innovation Fund; Horizon Europe; Just Transition Fund; RRF, Connecting Europe Facility	N/A	Various
FRANCE	Yes	Grants Revenue support	France 2030; ADEME	CCfD	Industrial decarbonisation projects at high emission sites and relevant capture and sequestration projects.
GERMANY	Yes, expected to commence in September 2024	Grants	New Federal Funding for Industry and Climate Protection (**BIK**) programme will replace existing Decarbonization in Industry (**DDI**) programme	Climate Protection Agreements (*Klimaschutzverträge*)	Hard-to-abate emissions-intensive sectors; small and medium-sized enterprises (**SMEs**) with transformation projects from €0.5 million and larger enterprises from €1 million
ITALY	Not yet	N/A	N/A	N/A	N/A
NETHERLANDS	Yes	Grants Tax deductions Opex support	SDE++; MIA Subsidy; Vamil-Subsidy; DEI+: Energy and Climate Innovations; TSE Industry Studies; Environmental Taxes Act	National Investment Scheme Climate Projects Industry (**NIKI**)	Industrial decarbonisation projects (not power generation, except for bioenergy), new and pilot carbon capture devices/novel technologies; feasibility studies
PORTUGAL	No	N/A	N/A	N/A	N/A
SPAIN	Yes	Grants Loans	None	PERTE-DI	CO_2 capture facilities (subject to exceptions set out below in chapter)
UNITED KINGDOM	Yes	Grants Revenue support	Industrial Energy Transformation Fund; Net Zero Hydrogen Fund; Dispatchable Power Agreement; Industrial Carbon Capture Agreement; Low Carbon Hydrogen Agreement (details below)	GIGA; BECCS business model; GGR business model (details below)	New build and retrofit blue hydrogen production, new build and retrofit natural gas-fired generation plus CCUS, industrial facilities, greenhouse gas removal projects, power BECCS projects

As can be seen from the table, not all jurisdictions have in place current or planned financial incentives for carbon capture. In the jurisdictions that do, grants are generally available. However, some jurisdictions such as France, the Netherlands and the UK have or are developing operating support for carbon capture projects. The UK in particular is designing a range of emitter business models to incentivise carbon capture across a range of sectors.

Details of the schemes available in the jurisdictions that have or have announced incentives are set out below.

EU

As mentioned previously, the primary incentive for emitters to invest in carbon capture plants relates to the EU ETS. Companies are not required to surrender allowances for CO_2 emissions which have been captured and permanently stored or captured and utilised in such a way that they will no longer enter the atmosphere. Thus, companies can reduce their EU ETS liability by installing carbon capture.

In addition, a number of schemes are available at the EU level to support the deployment of carbon capture. These include:

- **EU Innovation Fund** provides financial support for demonstration projects involving highly innovative technologies, processes or products offering significant potential for reducing GHG emissions, including carbon capture. Through an annual call for projects, the fund can provide support for up to 60% of additional capital expenditure (**capex**) and operational expenditure (**opex**) for large-scale projects (investment costs of more than €7.5m), and up to 60% of capex for small-scale projects (investment costs of less than €7.5m). Since the 2023 reform, it has allowed the use of competitive tendering mechanisms with support for up to 100% of costs, such as CCfDs.
- **Horizon Europe's** Horizon Europe Cluster 5 (Climate, Energy and Mobility) supports developing new and/or improving existing CO_2 capture technologies. A dedicated project, CCUS ZEN, supports the integration of CCS and CCU in hubs and clusters, including knowledge-sharing activities. Under Horizon Europe Cluster 4 (Digital, Industry and Space), several calls address carbon capture and utilisation as this relates to industrial symbiosis and Hubs for Circularity.
- **Just Transition Fund** provides primarily grants to support the economic diversification of the territories most affected by the climate transition as well as on the reskilling and active inclusion of affected workers and jobseekers.
- **The Recovery and Resilience Facility** is available to EU member states to support investments in carbon capture.
- **The European Investment Bank** has included CCS in its €45 billion financing package to support the EU Green Deal Industrial Plan.
- **The Connecting Europe Facility** provides financial support for investment in European infrastructure PCIs, in particular to reduce emissions in the transport, energy and digital sectors. It has a budget of €33.7 billion for the period 2021-2027.

FRANCE

- As part of the "France 2030" investment plan, in February 2022, former French Prime Minister Jean Castex announced that €5 billion would be allocated to provide direct aid for the deployment of solutions to decarbonise industrial sites. The funding is for innovative technologies such as hydrogen or carbon capture, to decarbonise the highest emitting sectors, via competitive and innovative support mechanisms, in compliance with European law and in particular state aid law.

In addition, as part of the "France 2030" investment plan, the French Environment and Energy Management Agency (**ADEME**) is launching calls for projects aimed at decarbonising French industry through subsidies. ADEME closed a national call for projects in 2023 entitled "Maturation and Support for Low-Carbon Industrial Zones", which will benefit several CCUS projects. In June 2024, ADEME launched a public consultation and a call for expressions of interest on a draft call for tenders for "major industrial decarbonisation projects 2024". A project to decarbonise an industrial activity includes the addition of CCUS technologies and eligible projects will be those in sectors covered by the EU ETS. An investment project in new industrial installations is also in principle eligible if the activity to which the investment project relates is listed in Annex I of the EU ETS Directive. Eligible applicants may apply for grants of €20 million or more over the lifetime of the contract to offset the additional capex and opex costs of a decarbonisation project compared with a more carbon-intensive project. At this stage, the government expects the tender to open in Q4 2024, subject to state aid approval, with the auction period expected to close in January 2025.

In December 2023, the French government also signed a new "Chemicals and Materials" industry contract covering the period 2023-2027. One of the main aims of this contract is to support the competitive decarbonisation of the sector. To this end, the French government had undertaken to issue new calls for tenders to enable the decarbonisation of the highest-emission sites in France to continue in the first half of 2024, but this initiative is currently suspended following the European elections in May 2024. These regular schemes will finance the additional cost of major deep decarbonisation projects as compared with traditional technologies, up of €1 billion per year. These schemes are expected to be made permanent as part of the ecological planning process. These calls for tender will include envelopes dedicated to carbon capture projects based on CCfDs. The scheme is due to be pre-notified to the European Commission and an initial call for tenders is due to be launched in the second half of 2024 (although details of the mechanism are still awaited).

In addition, the Priority Research and Equipment Programme "supporting innovation to develop new industrial processes which are largely carbon-free" aims to encourage and support upstream research activities in the field of decarbonising industry. The IBaC PME and DEMIBaC calls for projects under the France 2030 programme also provide support for innovative technological building blocks and demonstrators to decarbonise industry, including CCUS.

GERMANY

The German Federal Ministry for Economic Affairs and Climate Protection (**BMWK**) on 24 August 2024 published a new funding guideline "Federal Funding for Industry and Climate Protection" (**BIK**). In future, this new funding will primarily support industrial SMEs in their decarbonisation. According to current plans, around €3.3 billion will be available for the duration of the funding programme. The first call for funding is expected to start in September 2024. Companies will then have three months to submit their projects.

The funding programme is planned to run until 2030 and there are to be annual funding competitions. Funding will come from the Climate and Transformation Fund. As the successor to the Decarbonization in Industry programme, the BIK complements the BMWK's funding offer and enables innovative small and medium-sized

transformation projects, in particular, to be implemented across all sectors and technologies. The BIK complements the climate protection agreements (*Klimaschutzverträge*) and is aimed specifically at SMEs. BIK and climate protection agreements are coordinated with each other and cannot be cumulated. The funding opportunities start from a project size of €500,000 for SMEs and €1 million for large companies. From a project volume of €15 million, co-financing of 30% will be provided by the federal states.

NETHERLANDS

CCUS is eligible under the Stimulation of Sustainable Energy Production and Climate Transition Incentive Scheme (*Regeling Stimulering Duurzame Energie++*) (**SDE++**) scheme and under the National Investment Scheme Climate Projects Industry (**NIKI**) (a combination of investment subsidy (capex) and operating subsidy (opex)), with a budget of over €200 million for support aimed at the industrial sector.

Another incentive is the national CO_2 tax. Since 1 January 2021, industrial companies with high CO_2 emissions (which fall under the EU ETS) have been subject to a national CO_2 tax (*Wet Industriële CO2-heffing*). The levy is part of a broad package of measures that encourages industrial companies to invest in sustainability. The plan was to increase the levy as of 2028, but the new government has announced it will not do so.

The Netherlands further incentivises the use of CC(U)S technology through the Environmental Taxes Act (*Wet belastingen op milieugrondslag*). Under the Environmental Taxes Act, waste incinerators, nitrous oxide plants, and electricity producers who use GHG-emitting fuels to generate electricity must pay a tax on each CO2-tonne-equivalent which they emit. This charge increases annually by €12.69 per CO_2 tonne-equivalent. Companies are entitled to deduct any emissions of CO_2 which they have captured and placed in permanent storage from their total taxable emissions, thereby reducing their tax burden by installing CCUS equipment.

SPAIN

The Spanish PNIEC 2030 now clarifies that CCUS will be considered for sectors where there are no alternatives to fossil fuels and for demonstration projects. Likewise, the Spanish PNIEC 2030 states that the Spanish "Strategic Project for the Economic Recovery and Transformation in relation to Industrial Decarbonisation" (*Proyecto Estratégico para la Recuperación y Transformación Económica de descarbonización industrial*) (**PERTE-DI**) allocated c. €3 billion for the decarbonisation of the manufacturing industry, which includes CCUS technologies.

However, as noted by the European Commission in its recommendation dated 18 December 2023, the Spanish PNIEC 2030 does not provide clear signals to operators as regards (i) the annual volumes of CO_2 expected to be captured by 2030, (ii) the planned CO_2 transport structure and (iii) the global CO_2 storage and injection volumes that will be available by 2030. As a result of this lack of definition, operators may consider that CCUS technologies are not being viewed by Spain as a strategic tool in its pathway to achieve net zero carbon emissions by 2050.

The first call under PERTE-DI amounted to c. €999 million and was launched in December 2023. Sponsors of CCUS facilities could only apply for a grant under this programme if, among other conditions, the projected CCUS facility did not use fossil fuels as its main input and did not prolong or provide an incentive to prolong the use of fossil fuels. As a result, no financial support will be granted to, for example, CCUS facilities to be implemented in blue hydrogen production projects. Likewise, investments

in CO_2 transport and storage facilities were only eligible if they were part of a CO_2 capture project compliant with the requirements and conditions applicable under this scheme.

This first call is currently closed and the Spanish government approved the allocation of financial public support to 14 projects for an aggregate amount equal to €97.5 million. However, none of those awarded projects envisages the implementation of CCUS facilities as a primary investment. A second call under this public support programme is expected by the second half of 2024.

UNITED KINGDOM

CCUS was a critical element of the UK government's Net Zero Growth Plan as part of the Powering Up Britain plan published in April 2023 under the previous government. More recently, in December 2023, policy support was confirmed in the previous government's CCUS Vision which sets out how the UK will transition from early projects backed by government support to becoming a competitive market by 2035.

From an emitter perspective, as mentioned in the Policy Overview section (here), avoidance of UK ETS liability is a significant, but not sufficient, incentive for emitters to install carbon capture equipment. As a result, other support is being made available.

A call for evidence in relation to supply chain support under the Green Industries Growth Accelerator (**GIGA**) scheme was launched in February 2024. GIGA is a £960 million fund announced in Autumn 2023 to support the expansion of strong and sustainable clean energy supply chains across the UK, including CCUS, GGRs and hydrogen. It remains to be seen whether this fund will be launched by the new government.

Grant funding is available, for example, via the £315m Industrial Energy Transformation Fund to support the capital expenditure for on-site industrial carbon capture projects around the UK. The CCUS Innovation 2.0 grant provided £20 million in grant funding for projects developing novel CCUS technology and processes that reduce the cost of deployment. Finally, the Net Zero Hydrogen Fund includes grant support for CCS-enabled hydrogen production.

A central aspect of the UK's policy is to develop operating support for carbon capture projects under a number of business models. Various revenue support business models are available or in development:

- **Gas-fired power with CCUS** will be supported by the Dispatchable Power Agreement – a bilateral contract using an Availability Payment and Variable Payment to incentivise dispatch ahead of unabated gas fired plant.
- **Industrial Carbon Capture** will be supported with a bespoke ICC business model. A bilateral contract using a capex payment, contract for difference to cover opex (initially asymmetric, and tops up from notional CO_2 price) and price assurance for forfeited free allowances. Modifications are made for application to energy from waste plants.
- **Low carbon hydrogen production** will be supported under the Low Carbon Hydrogen Agreement, a bilateral contract using a CfD mechanism topping up from a reference price (to be the achieved hydrogen offtake sales price, subject to a floor set by reference to the month-ahead natural gas price for initial contracts) to a negotiated strike price. Available to new build hydrogen production plants only; retrofit projects are supported under the ICC business model.
- **Greenhouse gas removals** will be supported under a bilateral contract using a CCfD (likely to top up from the achieved carbon credit sales price). Reform of the UK ETS is also underway and a consultation underway to enable integration of CDRs

in the UK ETS. A separate consultation is also expected on requirements for high integrity carbon markets.

- **Power Bioenergy with CCUS** will be supported under a bilateral contract using a dual CfD mechanism (CCfD + CfDe) which value both the negative emissions and the renewable electricity generated.

Non-financial incentives or actions to incentivise carbon capture

In many jurisdictions current or planned non-financial incentives are also encouraging the installation of carbon capture technology at emitter sites. Please also refer to the Policy Overview section (here) for consideration of the incentives provided by ETSs.

A. Sustainability reporting

Corporate sustainability reporting is increasingly a consideration following the adoption of the EU Corporate Sustainability Reporting Directive (**CSRD**) 2022/2464.

Under the reporting guidelines adopted by the EU Commission, companies must disclose their annual scope 1, 2 and 3 GHG emissions. Companies falling within the scope of the CSRD are also required to publish the amount of GHGs which they have removed and stored, for example via carbon capture. Currently, the CSRD reporting obligation only applies to large publicly-traded undertakings with more than 500 employees, but its scope will gradually expand. By financial year 2026, the scope will include all publicly traded to small and medium-sized undertakings, as well as certain smaller financial undertakings. Greater transparency of GHG emissions is likely to result in increased scrutiny which may incentivise the adoption of emission reductions as corporates consider their decarbonisation pathways.

B. Planning and permitting

In some markets, reforms to planning and permitting procedures are expected to facilitate the installation of carbon capture technology. For example, in Germany CCS and CCU will be incentivised by creating a single and integrated planning and permit procedure. This is expected to remove legal uncertainties arising from the current regulatory framework which provides for diverging procedures for pipelines intended for CCS and for CCU, respectively.

C. CCS readiness obligations

All of the jurisdictions reviewed have implemented Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (recast). This requires that operators of combustion plants with a nominal power equal or greater than 300 MW, whose initial construction or operating licences were granted after the entry into force of the Carbon Storage Directive, must demonstrate it is technically and economically feasible for carbon capture technology to be retrofitted. If these conditions are satisfied, as part of the plant's licensing or permitting procedure, adequate space must be set aside for carbon capture equipment at the installation site. As a result, a number of power plants across the EU and in the UK, have space available for installation of carbon capture technology. Indeed, some jurisdictions, such as France, has gone beyond the requirements of the directive (for example by applying the requirements to smaller scale plants as well).

In relation to the UK, following Brexit, the UK government is considering strengthening this requirement. In March 2023, the UK government consulted on decarbonisation readiness requirements to require all new build and substantially refurbishing combustion power plants to be built in such a way that they can decarbonise through either 100% hydrogen-firing or by retrofitting CCUS within the plant's lifetime.

CCU: PROMOTING CO_2 USAGE AND E- FUELS

In some cases, the CO_2 captured can be used rather than stored geologically – this is known as carbon capture and utilisation (**CCU**). There are a range of uses for the captured CO2: it can be used in a product which stores chemically (for example in construction materials) or it can be reused and then emitted (for example, the CO_2 might be used in the production of synthetic fuels).

A range of policy measures are being introduced to support CCU in the jurisdictions reviewed. In particular, e- fuels are gaining traction as they represent a sustainable energy vector for use in sectors where electrification may not be feasible such as maritime and aviation transport. Recycled CO_2 might also be used for the production of chemicals, polymers or minerals. By replacing raw materials of fossil origin, CCU can contribute to reducing GHG emissions, promoting energy security and contributing to a circular economy.

In this section we consider some of the initiatives underway in three areas of particular interest in the jurisdictions reviewed: e-fuels, agriculture and chemical storage.

E-fuels

Captured CO_2 may be used in the production of e-fuels. E-fuels are referred to in this guide as a sub-set of sustainable synthetic fuels, where low carbon hydrogen is combined with captured CO_2 to produce synthetic hydrocarbons.

In relation to production in the EU, the Renewable Energy Directive (recast) and the GHG Savings Threshold Delegated Act envisage the use of CO_2 for the development of low carbon fuels to replace fossil fuels by putting safeguards in place to ensure that a minimum 70% reduction in GHG emissions are achieved as compared with a fossil fuel comparator.

As projects proliferate, industry will be keen to understand the applicable regulatory framework and the intersections with different policies. For example, article 9 of the Hydrogen and Gas Directive requires the European Commission to define the necessary elements for the certification of low-carbon fuels to support a clear regulatory framework. There are questions regarding how this interacts with the GHG Savings Threshold Delegated Act which specifies a methodology for calculating GHG savings from RFNBOs and all types of recycled carbon fuels.

Sector specific considerations will also apply, particularly where the production is required to meet a regulatory requirement. In relation to aviation, the EU Regulation 2023/2405 of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport (**ReFuelEU Aviation Regulation**) requires that, from 2030, a minimum share of both sustainable aviation fuels (**SAF**) and synthetic fuels are required, with proportions gradually increasing until 2050. The policy, aimed at stimulating the demand-side, have left the airline industry concerned about the availability of supply.

The EU ETS Directive also supports this initiative by providing for up to 20 million EUAs from 2024 to 2030 to be allocated free of charge to aircraft operators to cover the cost difference between fossil jet fuel and renewable fuels of non-biological origin (**RFNBOs**) and other SAFs. The use of these CCU-derived fuels will also be recognised under the EU ETS to avoid double counting of intrinsic carbon emissions between upstream (carbon sequestration) and downstream (re-emission of carbon when the fuels are used).

In the UK, a SAF mandate and a revenue certainty mechanism for SAF are proposed to stimulate national SAF production and provide funding for the additional cost of SAFs. The UK SAF mandate, due to be introduced from 2025 under the Renewable Transport Fuel Obligations (Sustainable Aviation Fuel) Order 2024 (currently making its way through Parliament), will require at least 10.5% of jet fuel to be made from sustainable feedstocks by 2030, rising to 23.7% by 2040. E-fuels

(referred to as 'power-to-liquid' fuel under UK government proposals), produced by synthesising climate neutral CO_2 with electrolytic hydrogen using renewables or nuclear derived power are expected to be stimulated under the proposals. Whilst production of e-fuels currently takes place on a small scale, the UK government has introduced new targets for power-to-liquid fuel as part of the wider UK SAF mandate: a power-to-liquid obligation will be introduced in 2029 at 0.2% of total jet fuel demand, rising to 4.5% by 2040. E-fuels will therefore become an increasingly important use for captured CO_2, especially as the UK government has stated that input CO_2 for power-to-liquid fuel must not have been deliberately produced for the sole purpose of creating aviation fuel. Meanwhile, the revenue certainty mechanism proposed (likely to be introduced in Q4 2026) is expected to help to make this achievable by providing assurance and stable revenues for companies involved in the design and production of SAF, incentivising investment in the sector.

In relation to maritime transport, the Regulation 2023/1805 on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC (the Maritime FuelEU Regulation) provides an incentive to support the uptake of RFNBOs in shipping. In particular, it requires reductions in the GHG emissions of fuels used in covered ships visiting EU ports, measured as against a baseline, by a proportion starting at 2% from 2025 to 80% by 2050.

Please see the box for examples of projects currently underway.

Carbon Clean CEMEX is a CCU project that aims to enhance the production of renewable synthetic hydrocarbons by using CO_2 captured at a cement plant in Rüdersdorf, Germany. From 2026 onwards, the project aims to initially capture 100 tCO_2 per day for usage in the production of sustainable hydrocarbons, with a view to expand capture capacities to 300 tCO_2 per day.

Velocys plc is an English company specialising in developing technology that enables the production of sustainable fuels for aviation. Alongside developing SAF from various types of waste, Velocys has recently commenced a project (in partnership with several companies including British Airways) which aims to make power to liquid SAF. In December 2022, Velocys plc was awarded a £2.5 million grant from the UK Department of Transport's Advanced Fuels Fund to assist its power to liquid project.

Synkero is a project in collaboration with KLM, Port of Amsterdam, City of Amsterdam, and Schiphol Group with the aim of developing a commercial scale facility in the port of Amsterdam to produce SAF from green hydrogen and CO_2 in order to achieve the ReFuelEU Aviation Regulation blending mandate.

Verso Energy has teamed up with Trapil, the historic operator of the hydrocarbon pipeline transport networks in France since 1950, to develop e-fuels projects designed to decarbonise air and maritime transport. In addition, Verso Energy, in partnership with RTE (French TSO), plans to contribute to the decarbonisation of maritime transport by capturing some of the CO_2 from the Tereos plants in Mesnil-Saint-Nicaise and/or in Origny-Saint-Benoîte (OrCHyDé project). The captured CO_2 will be used to produce between 110,000 and 180,000 tonnes of e-methanol a year by synthesising the CO_2 and hydrogen.

Agriculture

The greenhouse horticulture sector is likely become an important user of CO_2, particularly in jurisdictions with significant agricultural activity such as the Netherlands. Please see the box for an example of a project currently underway.

The AVR Duiven project captures CO_2 and supplies the captured CO_2 to the greenhouses. In 2023, AVR captured 43.5 kilotonnes through their installation in Duiven, Netherlands. In 2023, a permit was received to build a second capture installation in Rozenburg which will have a capture capacity of 482 kilotonnes per year. Half of this amount will be delivered to the horticulture sector. The other half will be stored via the Aramis project.

Chemical Storage

Currently, the industrial sector in Europe mainly uses captured CO_2 in the manufacture of synthetic products, chemicals, and fuels. However, in future, chemical storage of CO_2 might permit the captured CO_2 to remain embedded, sequestered in the product formed. An example of this is low carbon building materials for the construction sector, where CO_2 maybe injected into recycled concrete to improve the carbon footprint of buildings. Please see the box for examples of initiatives currently underway.

The Vicat Group has equipped its Montalieu-Vercieu plant (Isère) with the CO2ntainer system, which aims to capture and permanently store the CO_2 from flue gases, and to manufacture high value-added products for the construction industry. The system also uses the principle of accelerated carbonation to carbonate cement dust using the captured CO_2, and to produce marketable lightweight aggregates.

The CLEANKER project, coordinated by LEAP, integrates 13 research organisations from seven countries: five representatives from academia, three research centres, one SME, one technology provider, two end users and one environmental organization. The project aims to demonstrate the Calcium Looping (CaL) concept to technology readiness level 7, in a configuration that is highly integrated with the cement production process, making use of entrained flow reactors. The CLEANKER core activity is the design, construction and operation of a CaL demonstration system that will capture the CO_2 from a portion of the flue gas of the cement plant in Vernasca (Italy) operated by Buzzi Unicem, using as CO_2 sorbent the same raw meal used for clinker production.

The AGGREGACO$_2$ project, developed by Petronor, Repsol and O.C.O. Technology in Biscay (Spain) and co-funded by the EU Innovation Fund, aims to produce carbon-negative limestone using CO_2 captured by steam methane reformation from the refinery process at a nearby plant. The captured CO_2 is then combined using accelerated carbonation technology with ashes from waste treatment facilities that would otherwise be disposed of, to create sustainable products for the construction sector. This project will have a capacity to valorise 22,000 tonnes of residues per year and will avoid CO_2 emissions equal to an estimated 2,200 CO_2 tonnes per year.

CCS NETWORKS: CO_2 TRANSPORTATION AND STORAGE NETWORKS ARE DEVELOPING

As we have seen, many (but not all) of the jurisdictions reviewed have recognised the strategic importance of CO_2 transportation and storage networks. However, approaches differ depending on a number of factors, including the maturity of their regulatory frameworks and the use cases targeted for carbon capture. There are also differences in their domestic geological storage potential, approaches to market structure and supporting the delivery of CO_2 network infrastructure. We examine these factors below.

CO_2 storage ambitions are dependent on national capacity

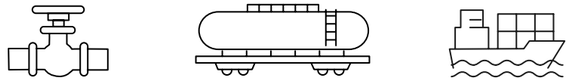
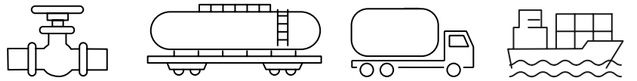
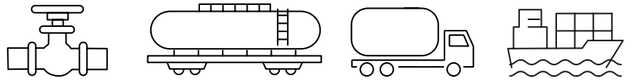
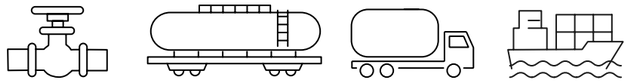
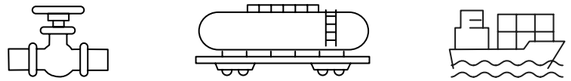
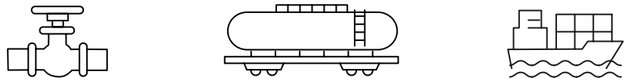
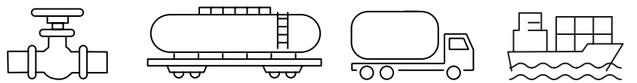
The development of national CO_2 storage infrastructure in each country is highly dependent on the storage capacity available. Whilst in some jurisdictions, such as the UK, data in relation to geological storage capacity has been collated, investigations are still underway in a number of countries. Please also see Table 1, in the Policy Overview section (here) for information on the national geological storage potential in the jurisdictions reviewed.

Of the jurisdictions reviewed, most are focused on offshore geological storage or a hybrid approach. Notably, the UK and the Netherlands are focused exclusively on offshore storage. This can be explained in part by the fact that the UK and the Netherlands have the opportunity to reuse depleted oil and gas fields for CCS, as well as making use of their other sub-sea geology for CO_2 storage. Other jurisdictions are taking a hybrid approach. For example, Germany's focus offshore is a result of a general prohibition on onshore geological CO_2 storage, however individual federal states (*Bundesländer*) will have the option to "opt-in" to allow permanent CO_2 storage onshore.

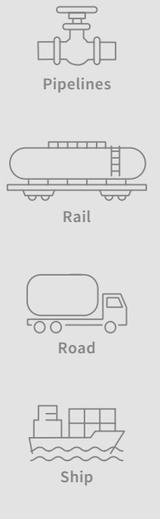
A range of CO_2 transportation modes are envisaged

In relation to CO_2 transportation, most jurisdictions reviewed anticipate using a range of CO_2 transportation modes both in the short-term and longer-term, including via rail, ship, road and pipeline. Notably, the UK is focused on the development of a CO_2 pipeline network in the short-term but envisages non-pipeline transportation and hybrid solutions in the longer-term. Non-pipeline transportation is particularly important to enable emitters in dispersed sites, outside of industrial clusters, to decarbonise. Please see Figure 5 below for an overview of the CO_2 transportation modes envisaged in the jurisdictions reviewed.

FIGURE 5: CO_2 TRANSPORTATION MODES ENVISAGED (SHORT AND LONG-TERM)

	CO_2 Transportation Modes Envisaged in Short-term	CO_2 Transportation Modes Envisaged in Long-term
FRANCE		
GERMANY		
ITALY		
NETHERLANDS		
PORTUGAL	Unknown	Unknown
SPAIN	Unknown	Unknown
UNITED KINGDOM		

KEY



Market parameters are evolving

As seen in the Regulatory Overview section (here), whilst the Carbon Storage Directive provides a framework for the development of storage sites, countries retain discretion in terms of their approach to the commercial structure and models they might use for the deployment of transportation and storage infrastructure.

Some countries such as France, Italy, the Netherlands and the UK are initially developing onshore and offshore CO_2 pipelines and storage as integrated projects. However, it is expected in the longer-term that the transport and CO_2 storage activities may be undertaken by separate entities. Initiatives like DeltaRhineCorridor and CO2Next are examples where the transport of CO_2 and temporary storage in hub terminals is already partly split from permanent storage.

Another key question will be in relation to unbundling and whether ownership or control of the transportation networks and/or of the storage assets will be required to be separate from that of users to ensure competition and non-discriminatory access to infrastructure. This is often required in the context of infrastructure where natural monopolies exist (such as in electricity or natural gas networks). Whilst regional monopolies in CO_2 transport and storage infrastructure are likely to exist, particularly in the initial phases of market development before more providers enter the market, introduction of unbundling rules could be challenging in a nascent market where integrated value-chains enable risk sharing.

We found a mixed approach to unbundling in the jurisdictions reviewed. Italy anticipates requiring unbundling, while the Netherlands proposes partial unbundling. Germany and France do not propose to require unbundling. However, they require that both connection and access to the respective infrastructure will be available to third parties on a non-discriminatory basis, to be granted on technical and economic terms that are adequate, transparent and not less favourable than those applied in comparable cases for services within the company of the operator or to affiliated or associated companies. For more information on the “negotiated third-party access” regime envisaged in France, please see the box below. Other jurisdictions also require non-discriminatory third-party access but have yet to publish a position on more formal unbundling rules.

France's emerging market parameters

In a report on the regulatory framework for hydrogen and CO_2 infrastructure of 6 June 2024, the CRE proposed that the regulation of CO_2 infrastructure should be organised as follows:

- Pipeline collection activities may be in competition with non-regulated activities (such as road, river or rail transport). To allow manufacturers to organise themselves within the hubs, CRE considers that it is preferable to provide for negotiated access, with transparency and non-discrimination obligations monitored by CRE.
- Pipeline transportation, liquefaction terminals and CO_2 storage will likely constitute natural monopolies. CRE therefore recommends that the law should now provide for the possibility of regulating these activities (for example, by providing for regulated third-party access with tariffs and access rules set by the regulator).
- CRE also considers that accounting separation from the other activities in the value chain is required for the activities of transporting CO_2 by pipeline, CO_2 storage and liquefaction. This is necessary to allow, initially, a degree of control of the profitability of these infrastructure assets, and, if necessary, to establish regulated tariffs reflecting their costs.

This approach has been provisionally approved by the French government. CRE will submit a detailed report to the government before the end of 2024, which could form the basis of a legislative framework for the deployment of CO_2 infrastructure in France.

CO_2 networks involve significant co-operation and regulatory oversight

Although CO_2 networks are still in the early stages of development, cooperation is required at multiple levels (regional, national and local) in order to efficiently plan and execute these significant infrastructure projects.

At the EU level, there is a need to co-ordinate the transboundary transportation and storage of CO_2. This has been recognised in the NZIA which establishes a framework for the identification of storage capacity in EU member states and coordination of infrastructure at the EU level. In particular, the NZIA envisages that where CO_2 is captured in one member state and transported to and stored in other member states, the member states are required to coordinate the measures taken by them. The European Commission may facilitate this coordination through the establishment of CCS regional groupings when there is a joint request from the member states involved.

In the UK, the government is overseeing the development of the first CO_2 networks via the CCUS Cluster Sequencing Programme. This involves the UK government selecting industrial clusters which will deploy CO_2 transportation infrastructure and connections to offshore geological storage sites, and matching emitters with these projects. In the longer-term there may be a role for the newly established National Energy System Operator (which will have responsibility for strategic planning of electricity, natural gas and hydrogen networks), but this will be subject to further consultation.

In all jurisdictions a number of regulators and public bodies are involved in the oversight of CO_2 transportation and storage infrastructure. Given the novelty of the sector, a material issue for infrastructure providers to manage will be how these entities co-operate and collaborate in a timely fashion. The table below highlights the regulators and public bodies involved in the jurisdictions reviewed.

TABLE 4: OVERVIEW OF RELEVANT REGULATORS INVOLVED IN CO_2 TRANSPORT AND STORAGE ACTIVITIES IN THE COUNTRIES REVIEWED

France	The CRE regulates CO_2 transport activities. The evaluation of geological storage capacity is led by the *Bureau de recherches géologiques et minières* (**BRGM**). The Minister for Mines (*Ministre chargé des Mines*) is responsible for granting an exclusive exploration licence and, during the exploitation phase, a mining concession for the geological storage of CO_2. The exploitation phase also requires an application for an environmental permit to operate a CO_2 geological storage site issued by the departmental prefect (Préfet de département) under legislation governing installations classified for environmental protection (Installations classées pour la protection de l'environnement or "**ICPE**").
Germany	The BMWK coordinates the regulatory framework for CCUS by providing evaluations and proposing future strategies. Scientific and technical support, in particular relating to geological storage, is provided by the Federal Institute for Geosciences and Natural Resources (**BGR**). BGR also coordinates the federal register of CO_2 pipelines. The Federal Environment Agency (**UBA**) advises on the broader environmental impacts by providing support on environmental protection and advising on individual permit procedures. Permit procedures are carried out by competent authorities at state level. The Federal Network Agency (**BNetzA**) acts as the competent supervisory body for various regulatory issues, including for coordinating third party access to CO_2 transport and storage infrastructure.

Italy	Both the MASE and the MEF are the main bodies responsible for planning and regulating CCUS. Some Italian regions are also active in network planning. The CCS Committee established at the MASE, is the competent authority to carry out various tasks (including the examination of applications for exploration licenses and applications for the granting of authorisation for CCS). A Technical Secretariat has been established with the objective to integrate the technical and legal competences of the CSS Committee. The Regulatory Authority for Energy, Networks, and Environment (**ARERA**) may play a role in regulating tariffs and overseeing energy infrastructure, including CO_2 transport. The Institute for Environmental Protection and Research (**ISPRA**) and the National Mining Office for Hydrocarbons and Geo-resources (**UNMIG**) provides scientific and technical support, assessing the environmental impact of CCS projects and monitoring storage operations.
Netherlands	Energie Beheer Nederland (**EBN**) is responsible for the mapping of sites where CO_2 is to be stored, opportunities to reuse assets and assessing potential partners. The Ministry of Climate Policy and Green Growth coordinates all necessary decisions (permits and exemptions) needed for the projects. The ACM, SODM as well as the Minister, are the competent supervisory authorities for CCS.
Portugal	The DGEG and the Minister responsible for geological resources are the competent authorities for CCUS. The Portuguese Environment Agency (**APA**) is the authority responsible for the environmental licensing and assessing the impact of CCS projects.

Spain	The MITERD oversees monitoring (and adopting the measures necessary to ensure) that third-party access to CO_2 transport and storage facilities is non-discriminatory and transparent. MITERD is also competent for setting the remuneration scheme applicable to CO_2 transport facilities and for settling disputes between operators of CO_2 transport and storage facilities and potential users. The MITERD (acting through the DGPEM) will be the authority responsible of issuing the main permits required for CO_2 storage facilities. Other state, regional and local (such as town halls) authorities may be involved in the permitting of CO_2 transport and storage facilities (including their environmental permitting) depending on their type, location, size and other parameters.
United Kingdom	The Department for Energy Security and Net Zero (**DESNZ**) sets CCUS policy in the UK, oversees the allocation of support for initial projects under the CCUS Cluster Sequencing Programme (see further below) and provides a government support package for initial CO_2 transportation and storage projects. The Low Carbon Contracts Company, a company wholly owned by the UK government, is the counterparty to the revenue support agreements entered into with initial CO_2 transportation and storage projects (and emitters). The NSTA is the licensing and permitting authority for offshore carbon storage in UK offshore waters (devolved administrations may also play a role in other areas). The NSTA also identifies, assesses and understands UK continental shelf regional carbon storage opportunities in support of CCS build out and spatial planning. The Environment Agencies (the UK Environment Agency and the Scottish Environmental Protection Agency and the Northern Ireland Environment Agency) are responsible for environmental protection and UK ETS administration in England and Wales, and Scotland respectively. The Offshore Petroleum Regulator for Environment and Decommissioning in the UK (**OPRED**) is the environmental regulator and oversees decommissioning with input from the NSTA. The Crown Estate/Crown Estate Scotland (as applicable) is the lessor of the seabed and confers exploration and storage land rights in the UK EEZ. Ofgem is the economic regulator for initial CO_2 transport and storage infrastructure in the UK under the regulated asset base model regime. The Health and Safety Executive enforces pipeline regulations and manages the Control of Major Accident Hazards regime in the UK.

Business models and incentives are being introduced for CO_2 transportation and storage in some countries

Although the technology is not new, carbon capture and transportation for permanent storage has not been undertaken in the countries reviewed before. These are high capex, complex, co-dependant infrastructure projects.

Given that the current prices of allowances in ETS markets are not high enough to ensure the economic viability of projects across the value-chain, a number of jurisdictions are considering what funding mechanisms to put in place to support the development of this new infrastructure, and whether any public subsidy or support is required, or other intervention is needed to de-risk or incentivise development.

Business models must however be established within the parameters of the overarching regulatory framework which, as we have seen, requires that access to infrastructure is permitted on a non-discriminatory and transparent basis.

The table below indicates the jurisdictions where revenue models and/or support is available or under development for CO_2 transportation and/or storage infrastructure in the jurisdictions reviewed. Please also see the Regulatory Overview section (here) for details of support available at the EU level.

TABLE 5: REVENUE MODELS AND SUPPORT FOR CO_2 TRANSPORTATION AND/OR STORAGE INFRASTRUCTURE

	Support for transport infrastructure?	Support for storage infrastructure?
 FRANCE	No	Yes – direct support
 GERMANY	Unknown, to be determined in final CMS	Unknown, to be determined in final CMS
 ITALY	No	No
 NETHERLANDS	Yes – indirect support	Yes – indirect support
 PORTUGAL	No	No
 SPAIN	No (but supported under PERTE-DI if part of a CO_2 capture project)	No (but supported under PERTE-DI if part of a CO_2 capture project)
 UNITED KINGDOM	Yes – direct support	Yes – direct support

NETHERLANDS

Both CCS and CCU are eligible for support under the SDE++ -support scheme. The SDE++ is an operating subsidy. In the case of CCS, that means that emitters (not the transportation and storage project itself) can receive subsidies as long as they capture and store CO_2. The subsidy reimburses the so-called unprofitable part of the CCS project, or the difference between: (1) the expected cost of CO_2 capture, transport and storage, including a reasonable return on investment, and (2) the proceeds from the sale of EUAs or avoided costs of purchasing of EUAs. The SDE++ subsidy guarantees emitters a reasonable return on their investment, as the subsidy covers the gap between costs and revenues. This in turn underpins their ability to pay for the services of the CO_2 transport and storage project.

This regime has been combined with involvement of state-owned entities in the delivery of CO_2 transport and storage infrastructure. However, the market is not expected to become completely publicly regulated like the gas and electricity market but, nevertheless, access to CO_2 storage is required to be on a non-discriminatory and transparent basis. For example, the tariff structure for the upcoming Aramis project is based on the cost of:

1. CO_2 gas compression or conversion prior to transport;
2. CO_2 transport via the main transport pipeline;
3. injection; and
4. a margin for marketing costs.

Since there is only ex post supervision on tariffs by the ACM / the State Supervision of Mines, several CO_2 storage applicants are concerned about the transparency of tariff calculations. As a result, industry is considering the need for *ex ante* tariff oversight ahead of the emergence of a competitive market with short-term contracts. For further details of how this model has been implemented in practice, please see the Porthos case study below.

UNITED KINGDOM

In the UK, initial CO_2 pipelines and storage networks will be funded using a regulated asset base funding model whereby an economic licence will be granted entitling the project company to be paid an allowed revenue set initially by negotiation, and subsequently by following a regulatory price control by the economic regulator, Ofgem. A single company is required to own the onshore and offshore pipelines and storage complex, known as the T&SCO. T&SCO collects the allowed revenues via user charges which will be initially paid from public funds (taxation or consumer levies) and passed through under the different emitter revenue support contracts (see the CO_2 Capture section here). There will also be contingent recourse to the taxpayer / consumer to cover shortfalls in the allowed revenue provided under the T&SCO's revenue support agreement with the Low Carbon Contracts Company, a company wholly owned by the UK government. A government support package is also proposed to mitigate high impact, low probability risks such as the unavailability of insurances or the risk of the assets becoming stranded due to low demand or forecast revenue shortfalls. The first projects in the UK, known as the Track-1 projects, are negotiating terms of the economic licence and the associated support package with DESNZ. For further information in relation to these projects and the UK allocation model, please see the case study below.

Early capex for CO_2 networks was also eligible for support under the UK government's £1 billion CCUS Investment Fund. In addition, a call for evidence in

relation to supply chain support under the GIGA scheme was launched in February 2024 by the previous government. GIGA is a £960 million fund announced in autumn 2023 to support the expansion of strong and sustainable clean energy supply chains across the UK, including, CCUS, engineered greenhouse gas removals and hydrogen. It remains to be seen how this funding might be impacted by the UK's recent change of government.

FRANCE

In France, the support for CO_2 networks is likely to be indirect, via public support in the form of CCfDs to support industrial decarbonisation projects, in particular for carbon capture projects. At the time of writing, France has not clearly defined how these CCfDs will operate.

Are any incentives or initiatives underway to repurpose existing infrastructure?

Whilst the storage of CO_2 requires a new licence and permit, companies that already have an exploration and/or production licence for oil or gas fields are likely to have some advantages such as knowledge of the geology (although for CO_2 additional studies will have to be conducted) and they already have invested in infrastructure which they can repurpose for CO_2 transportation and storage.

In some markets, the ability to reuse existing infrastructure is an incentive for deployment of CCS. In the UK, the avoidance of a future, contingent liability under the oil and gas decommissioning regime constitutes an incentive to reuse assets for CO_2 transportation and storage. The Change of Use Relief regime in the Energy Act 2008 was amended by the Energy Act 2023 to enable existing oil and gas assets to be transferred into and repurposed for use in 'eligible CCS installations' provided that a decommissioning fund is established, and the required amount has been paid into such fund to cover decommissioning liabilities. This effectively breaks the chain of liability under the Petroleum Act 1998 which in effect places liability for decommissioning costs on both existing and previous oil and gas installation owners, operators or parties to a joint operating agreement.

Other markets are considering how existing infrastructure can be repurposed also. For example, in Germany, the proposed CMS envisages incentives for repurposing existing gas pipelines through facilitated planning and permitting procedures. In Italy, the repurposing of existing infrastructure, such as decommissioned natural gas pipelines, for CO_2 transport is also under consideration.

CO_2 transportation and storage: key terms

Of the jurisdictions reviewed, only the Netherlands and the UK have published the terms / heads of terms applicable to the transportation and storage of CO_2 in their jurisdiction. The applicable terms are compared below.

TABLE 6: KEY TERMS APPLICABLE TO CO_2 TRANSPORTATION AND STORAGE IN THE NETHERLANDS AND THE UK

Key terms	Netherlands	UK
Instrument	Standard CO_2 Transport and Storage Terms, published by each operator. Terms below relate to the Porthos project unless otherwise stated.	CCS Network Code and standard form CO_2 Network Connection Agreement.
Duration of the right to use the CO_2 network	Depends on the transportation and storage provider. For example, Aramis will conclude transportation and storage contracts for 15 years.	From 1 year or up to 15 years. Initial users expected to secure capacity for 15 years.
Tariff / Payment structure	Fixed transport capacity fee, a storage space fee, a Transferable Transport Capacity Fee, a variable electricity fee, a variable CO_2 fee, a transport capacity exceedance fee and a ramp rate penalty.	Onshore and offshore user charges in respect of (i) capacity, (ii) metered CO_2 volumes and (iii) network charges covering any residual payment required to meet the allowed revenues, subject to a cap set by reference to the UK ETS price.
Passing title and risk to CO2	The risk and liability transfers to CO_2 transportation and storage provider at the connection point. Indemnity for claims arising.	Title, risk and liability to CO_2 transfers to transportation and storage provider at the user's connection point.
Liability for failure to take CO_2 during the operating period?	Outage Notice will be sent (not in case of force majeure or planned repairs) including an Outage Factor which has the effect of reducing the fees payable. Termination right for continuous or persistent outages. No compensation payable to the emitter in respect of EU ETS liability.	No direct liability to the emitter or reduction in user charges for failure to take CO_2. However, mitigation for project-on-project risk is provided to emitters under the relevant emitter business models (see below). The transportation and storage company is also subject to an availability incentive and disincentive regime. Rights for a user to terminate for a capacity constraint is expected to be included (but yet to be developed).

How is 'project-on-project' risk being dealt with in your jurisdiction?

The management of "project on project" risk is an important consideration in the development of CO_2 transportation and storage infrastructure. For first-of-a-kind projects where experience of project delivery is limited, the management of risks associated with third parties is often important, particularly where this impacts on the operations of the CO_2 network and its ability to earn revenues. From an emitter's perspective, a constraint, outage or closure of the CO_2 network infrastructure could result in the loss of a low carbon premium for a project's output, additional ETS liability or, at worst, might make the project a stranded asset.

Project-on-project risk

This describes the risk arising from mutually dependent projects:

- From a CO_2 transport or storage infrastructure operator's perspective, this is the risk that the emitter's capture project will be delayed or that there will be low or no demand for CO_2 transport and storage services.
- From an emitter's perspective, this is the risk that the CO_2 transport or storage infrastructure needed to offtake the emitter's CO_2 will not be ready on time, will not operate as planned and/or cease operations.

The occurrence of project-on-project risk in the context of a CCUS value-chain may result in additional costs, lost revenues, or increased liabilities, and may even result in a project becoming a stranded asset.

No proposals have been made to manage this risk to date in the regulatory landscape emerging in Germany, Italy, Spain or Portugal. However, in some of the jurisdictions reviewed, regulatory intervention is proposed or has been implemented in order to mitigate project-on-project risk. We set out below approaches seen to date.

FRANCE

The management of project-on-project risks is being debated in France with a number of risk sharing option under consideration:

- Send-or-pay contracts could ensure that the industrial emitter is commercially incentivised to deliver CO_2 and ensure the success of the CO_2 transportation and storage project.
- In the event of delays in the deployment of transport infrastructure, industrial emitters could be compensated for the carbon not stored, all or part of which could be covered by penalties applied to transport operators, with any shortfall being met by the State.
- In the event of a delay in the deployment of an emitter's capture project, a partial public guarantee of forecast volumes for the benefit of transport operators could

be envisaged (if the delay was due solely to the act or omission of the industrial emitter and not as a result of the process for selecting the industrial emitters supported by the State).

- Any residual risks could be partly covered by the State to insure the players in the CCUS value-chain against third-party risks in compliance with European law on state aid.

NETHERLANDS

In the Netherlands, the risk allocation as between the CO_2 transportation service provider and the emitter is regulated by the standard terms and conditions of the service provider. The terms for the Porthos projects envisage that the emitter is entitled to terminate the agreement following an outage which lasted for 6 months continuously, or 1 year in aggregate without payment of any termination fee.

Whilst this right will provide the emitter with flexibility in future to secure an agreement with alternative CO_2 transportation service provider, until a competitive market emerges, the emitter instead relies on the track record in delivery of the service provider itself.

UNITED KINGDOM

The emitter business models and the CO_2 transport and storage regulatory investment model expressly seek to mitigate project-on-project risks. In general, if the emitter is unable to capture CO_2 due to an issue with the CO_2 transportation and storage network, the position is that the emitter receives the payments it would have received had it captured the CO_2. By way of example, the approach applicable to gas power generation plus CCS projects as at the time of publication has been summarised at a high level in the table below.

Key terms	Dispatchable Power Agreement for power plus CCS	T&SCO
Delay in commissioning by the other party	Option to: Delay commissioning without compensation ; or Operate unabated and receive availability payments (but bear UK ETS costs), subject to compliance with other environmental permits.	Recovery of unavoidable opex, and after 12 months, allowed cost of capital and depreciation.
Outages / constraints affecting the other party	Entitlement to claim relief upon full or partial outage of the CO_2 network. Availability payment made on the basis of assumed availability of capture (but generator bears ETS costs).	Payment of the allowed revenue in the event of a shortfall by the Low Carbon Contracts Company, subject to availability incentives / penalties.
Abandonment by the other party	Termination payment covering capex and certain other costs, reduced to reflect residual economic value of the unabated facility.	Compensation capped at a level representing the regulated asset value to date plus certain costs.

Delivering CO_2 transportation and storage projects in practice

To date, of the jurisdictions reviewed, only the Netherlands and Italy have had a CO_2 transportation and storage project achieve its FID. In that regard, the Porthos Project in the Netherlands sets an important precedent. For details, please see the case study box on the following page. In Italy, the first phase of the Ravenna CCS project, under development by Eni and Snam, commenced CO_2 injection in September 2024.

Progress is, however, also underway in other jurisdictions. In the UK, DESNZ have been leading a CCUS Cluster Sequencing Programme to meet the UK's CCUS ambitions. For details of the approach to allocation and the projects under development, please see the case study box.

Case study: the UK CCUS Cluster Sequencing Programme

The UK government has taken a centralised approach to the development and the allocation of support to CCUS because most of the UK's industrial emissions are generated in its industrial clusters. As a result, DESNZ is leading a centralised exercise to evaluate CCUS projects and negotiate support simultaneously with both CO_2 transport and storage infrastructure providers, and emitters. The first two industrial clusters which have been selected to negotiate terms are the East Coast Cluster (being led by bp) and the HyNet cluster (being led by ENI). These were selected in a process called the Track-1 Custer Sequencing process. This Track-1 process was split into two phases. Firstly, phase 1 involved the selection the two priority industrial clusters – whilst potential emitters were identified as part of this process, discussions focused largely on the delivery of transport and storage network infrastructure. Phase 2 followed to select shortlisted emitter projects. The rationale for splitting Track-1 into two phases was to drive flexibility, competition and value for money in emitter selection. Projects in both phases were assessed using five evaluation criteria, namely, deliverability, emissions reduction potential, economic benefits, cost considerations, learning and innovation. Whilst the centralised process has efficiency benefits, it has been time-consuming with heavy information requirements; indeed, the final investment decisions for Track 1 projects are expected in Q4 2024 despite the process being launched in 2021. In July 2023, the UK government announced the transport and storage systems of the Acorn project in Scotland and Viking CCS project in England, were selected for Track-2 development. DESNZ, in its December 2023 CCUS Vision publication, noted they are already considering the evolution of the delivery model to accelerate deployment.

Case study: Porthos project

Porthos is a CCS project initiated by Gasunie, the Port of Rotterdam, and EBN. It aims to store approximately 37 Mt CO_2 over the next 15 years, with an annual storage capacity of 2.5 Mt. The project's infrastructure includes a 30-kilometer gathering pipeline in the port of Rotterdam area, a compressor station, and an offshore pipeline to the P18-A platform in the North Sea. The captured CO_2 is stored in former natural gas reservoirs through the P18-A platform.

The project is currently under construction and is expected to be commissioned in 2026. The CO_2 captured by Porthos will be transported through a sub-sea pipeline as well as via ships. The CO2Next project, which includes a loading terminal for ships, is responsible for the CO_2 transport infrastructure. From 2062 onwards, the responsibility for CO_2 storage will be transferred from Porthos to the Dutch State. The state will be responsible for monitoring the CO_2 storage and ensuring its safe storage.

Porthos' customers, which capture CO_2 for storage by Porthos, can receive a total operating subsidy (SDE++) of up to €2.1 billion to cover the unprofitable portion of the CCS project, which includes the cost of CO_2 capture, transport, and storage, minus the proceeds from the sale of CO_2 allowances or the avoided costs of purchasing CO_2 allowances. In this model, the EU ETS serves as an incentive for CCS. Companies that permanently store their CO_2 underground are exempt from surrendering CO_2 allowances, as outlined in the Policy Overview section (here). The rising price of CO_2 in the EU ETS makes investing in CO_2 reductions, such as CCS, more attractive for companies covered by the system.

Porthos was initially seen as a unique project where the Dutch state's involvement as a market maker was crucial to facilitate its development. However, in the long-term, the government expects the private sector to lead the development of other large-scale CCS projects. An example is the current even larger Aramis project that is being developed.

POST-CLOSURE: DECOMMISSIONING AND LONG-TERM LIABILITY REMAIN IMPORTANT ISSUES

A key area for due diligence for investors and lenders to CCUS projects is the cost of decommissioning and potential liability in respect of CO_2 storage sites. In particular, the financial liability associated with the current post-closure regime, including the financial security in the relevant jurisdiction, must be properly understood.

A common framework exists for managing CO_2 leakage and post-closure liability

Once again, the Carbon Storage Directive provides a common framework for the management of leakages and post-closure liability in the jurisdictions reviewed.

The operator must establish a strategy for continuously monitoring the injection facilities, the stored CO_2 stream and its effects on the geological storage site as well as the surrounding environment. In the event of a leakage or "significant irregularity", a storage operator has to inform the competent authority without undue delay. The operator must also take appropriate measures to stop the leakage or significant irregularity and to prevent further incidents.

The Carbon Storage Directive provides that the storage site will be closed if either the conditions stated in the permit have been met or the operator or the competent authority (after withdrawal of a storage permit) requests the closure. The directive also provides a regime for decommissioning and the post-closure obligations of the operator. The framework provides for both the responsibility for post-closure obligations as well as the transfer of any liability for monitoring, reporting and corrective measures under the Carbon Storage Directive or the surrender of EUAs under the EU ETS to the competent authority under certain conditions after the lapse of a minimum period of 20 years (or such longer period to be determined by the implementing country). To cover any costs borne by the competent authority after the successful transfer of liability, the operator must make a financial contribution.

Overview of the regimes in each jurisdiction

The table below highlights that, whilst a common framework exists for decommissioning and post-closure obligations, there are nevertheless differences in how each of the jurisdictions reviewed have implemented the requirements in their own jurisdiction. In particular, the time period between closure and transfer of the storage site to the relevant competent authority varies by jurisdiction. Other differences also exist. For example, of the regimes reviewed the UK is the only jurisdiction which proposes to implement a regulatory requirement to build up decommissioning funds via user the charges paid by users of the CO_2 network. However, in practice, the cost of funding post-closure obligations is likely to be factored into the charges levied by CO_2 storage providers in other jurisdictions also to meet their potential liabilities. We consider the regimes applicable in each of the jurisdictions reviewed below.

TABLE 7: OVERVIEW OF KEY ELEMENTS OF THE POST-CLOSURE REGIMES IN COUNTRIES REVIEWED

	Post closure plan	Financial security	Transfer to state post-closure	Years post-closure before transfer
 FRANCE	✓	✓	✓	30
 GERMANY	✓	✓	✓	40
 ITALY	✓	✓	✓	20
 NETHERLANDS	✓	✓	✓	20
 PORTUGAL	✓	✓	✓	20
 SPAIN	✓	✓	✓	20
 UNITED KINGDOM	✓	✓	✓	20

FRANCE

In France, authorisations for CO_2 geological storage sites are granted for a limited period and set out the volume of products stored or extracted, as well as the conditions for restoring the site. Under the ICPE legislation, when a CO_2 geological storage site is permanently closed, the operator must notify the Prefect of the shutdown date at least six months in advance. This notification sets out the measures taken or planned to ensure that the site is made safe as soon as operations cease. In addition, the operator must restore the site of the facility to such a condition that ultimately allows future use of the site.

In addition, the commissioning of CO_2 geological storage sites is subject to the provision of financial guarantees unless exempt (for example an exemption exists for sites that are operated directly by the French state or that benefit from a financial guarantee from the French state).

The amount of the financial guarantees is established on the basis of the information provided by the operator and taking into account the cost of the following operations for a CO_2 storage site: (i) the implementation of the measures provided for in the post-closure plan, including in particular the permanent shut down of the site and its monitoring for a period of at least 30 years after it is permanently shut down , (ii) intervention in the event both of a risk or actual leakage of CO_2, of accidents, or pollution before or after the site is permanently shut down and (iii) the surrender, in the event of leaks, of EUAs.

A licence is required for the geological storage of CO_2. The mining concession is granted for a period of 25 years, subject to renewal with approval from the Minister of Mines. At the end of the concession, where applicable, under the conditions set out in the administrative decision that established the concession, the storage site is handed back to the French state, after completion of the work prescribed in the Mining Code. Any fixed property may be handed over free of charge or sold to the French State where the site remains exploitable and, in the event of the disappearance or default of the operator, all the rights and obligations of the concession holder are transferred to the state.

GERMANY

Under the KSpG, the operator is liable to provide financial security to cover liability for its statutory duties. This includes any decommissioning and post-closure obligations, potential damages claims, and obligations arising from the TEHG and the UmweltHG in the period until the transfer of responsibility for the storage site. This financial security can be provided primarily by concluding a liability insurance.

Regarding the decommissioning of a CO_2 storage facility, the operator must obtain a separate permit from the competent state-level authority. To obtain this permit, the operator has to provide a strategy for decommissioning and post-closure which meets the statutory requirements and ensure the long-term environmental security of the storage site by taking precautionary measures against leakages and environmental risks. After decommissioning, the operator has to comply with the post-closure obligations according to the strategy provided.

The transfer of responsibility implies the transfer of duties and responsibilities of the operator relating to monitoring and reporting, post-closure, and liability to a public body, which is the relevant federal state. The earliest possible time of transfer of responsibility is 40 years after successful decommissioning of the CO_2 storage facility. However, this can occur earlier if the operator demonstrates the long-term security of the storage site and pays a financial contribution to cover monitoring costs arising after the transfer of responsibility. In particular, a transfer

of responsibility requires that the long-term security and stability of the storage site is supported by the state of scientific and technical knowledge and that the operator has provided another financial contribution to cover monitoring costs for a period of 30 years after conclusion of the transfer of responsibility.

ITALY

The closure of a CO_2 storage site requires authorisation from the MEF, acting in concert with the MASE and the relevant region. A storage site is closed if the conditions specified in the closure authorisation are met, upon the operator's request, or if the storage authorisation is revoked.

Post-closure, the operator remains responsible for monitoring, reporting, and corrective actions until responsibility is transferred, including sealing the site and dismantling injection facilities. The operator must comply with post-closure obligations based on a plan prepared in accordance with best practice and approved by the relevant authorities. If the site is closed due to revocation of authorisation, the Ministry of Economic Development is responsible for monitoring and corrective measures.

After closure, responsibility for monitoring and corrective measures transfers to the MEF if conditions such as permanent confinement of CO_2 and fulfilment of financial obligations are met.

The operator must present a detailed final report demonstrating compliance and stability of the storage site. If conditions are not met, the Ministry may request additional information. Once conditions are confirmed, a decree authorising the transfer of responsibility is issued. The MEF assumes monitoring and corrective actions post-transfer, funded by the financial guarantee and operator resources if necessary.

Financial guarantees must cover all obligations, including closure and post-closure phases. Criteria for determining the financial guarantee amount are set by a decree from the MEF and the MASE, in consultation with the MEF and the State-Regions Conference (*Conferenza Stato Regioni*).

The guarantee must be unconditional and payable upon simple written request from the MEF. The operator must periodically update the financial guarantee to reflect changes in risk and cost estimates. Guarantees must remain valid beyond the authorisation's duration until responsibilities are transferred and financial obligations are met.

The financial contribution amount and payment methods are determined by a decree. Contributions cover monitoring costs for 30 years, ensuring permanent CO_2 confinement, and covering potential damage to the environment and health. Specific provisions for post-transfer expenses and their calculation are established by decree.

The costs of decommissioning and post-closure activities are borne by operators based on actual service costs. The tariffs charged to operators are determined by decree and updated at least every 2 years. Revenues from tariffs are reserved exclusively for decommissioning and post-closure related activities. Payments must be made in advance, before the relevant development activities are carried out. The implementation of the decree should not incur any new or additional public financial burden.

NETHERLANDS

According to the Dutch Mining Act the operator of the CCS project is responsible for possible leakage. In case of leakage or potential leakage permits can be revoked. After closing of the storage facilities, the operator remains responsible for a period of 20 years for monitoring and leakage risks or such shorter or longer as is justified in the opinion of the Minister (to be determined

in the permit), and the storage holder has provided the financial means to the State to cover the anticipated costs, covering at least the estimated monitoring costs during a period of 30 years, starting from the time of withdrawal.

In general, the risk of CO_2 leakage is covered through insurance, supplemented by a guarantee. CO_2 leakage can be insured as an insured property (all risk insurance with a customised cover). Please see the box for further details. Following the expiry of the insurances, the long-term risk including the leakage risk and the monitoring costs of CO_2 storage, lies with the Dutch state. The Dutch government intends EBN to become responsible for organising activities related to the long-term management of closed CO_2 sites. Although experts consider the leakage risk as very small, a leakage event could occur over a long time-frame of decades or even centuries.

PORTUGAL

Decommissioning obligations and long-term liability applicable to CO_2 storage sites are regulated by DL 60/2012. On termination of the concession agreement, the work carried out, equipment, instruments, facilities and buildings owned by the concessionaire, as well as any other assets directly and permanently assigned to the concession, shall revert to the Portuguese state, unless provided otherwise in the contract. In general, during the period after the closure of a storage site and until the transfer of liability for the storage site to the DGEG, the operator remains liable for several obligations based on a post-decommissioning plan approved by the DGEG during the procedure for the concession award, including the decommissioning of the injection facilities, sealing of the storage reservoir, monitoring obligations, implementation of corrective measures and the preventive and repairing measures imposed by the Environmental Liability Regime set forth by Decree-Law no. 147/2008, of 29 July (**Portuguese Environmental Liability Regime**), amongst others. After the elapsing of a period determined by the DGEG, which should be at least 20 years from the site's decommissioning, and assuming that certain obligations have been complied with, the liability for the compliance of the obligations mentioned in this paragraph can be transferred from the operator to the DGEG.

In terms of financial security, under DL 60/2012, the operator of a storage site must provide financial security as a guarantee of compliance with the obligations foreseen in this legal regime, including decommissioning and post-decommissioning obligations as well as obligations arising from Portuguese Decree-Law no. 12/2020 (**CELE**), which establishes the legal regime applicable to the GHG emission allowance trading legal regime.

Insuring CO_2 leakage events

As part of the annual determination of insured values for insured property, the amount of CO_2 in the reservoir and the value (EUA price) can be communicated to insurers annually and thus insured properly. To offer more certainty, the Dutch state can be a co-policyholder of the All Risks insurance, so that the state can claim at all times under the policy. The maximum insured limit for CO_2 leakage can be set by reference to the maximum volume of CO_2 leakage coupled with a maximum EUA price. The insurance is long-dated – the insurance for CO_2 storage expires for the Porthos project expires in 2062.

This financial guarantee shall usually remain valid until the transfer of liability to the DGEG. However, prior to the transfer of liability, the operator must provide a reserve fund to the DGEG, as a financial contribution to cover monitoring and post-transfer costs that covers a period of at least 30 years, in an amount to be determined by the relevant government member.

The above financial security is separate to the financial guarantee to be provided by the operator under the Portuguese Environmental Liability Regime to cover the environmental liability inherent to the CO_2 storage activity.

In the event of a CO_2 leakage or significant anomalies, DL 60/2012 foresees that the site operator must notify DGEG as well as other competent authorities immediately and take the necessary corrective measures based on a plan pre-approved by the DGEG during the procedure for the concession award. Other obligations are also applicable, for example, in the event of a leak, the operator must return the emission licences issued under CELE legal regime and under the Portuguese Environmental Liability Regime, and in case of environmental damage, storage site operators are responsible for adopting the preventive and remediation measures foreseen in this regime.

SPAIN

The framework in Spain is mainly set out in the Spanish CCS Law. Firstly, prior to applying for a storage permit (*concesión de almacenamiento*), the operator must deliver to public authorities a bond securing its obligations under the Spanish CCS Law (including its closure and post-closure obligations). The amount secured by the bond will be calculated by the public authorities based on estimated closure and post-closure costs, CO_2 storage capacity and estimated EUA costs resulting from leakages. Further bond obligations may also apply (e.g., where applicable under environmental regulations).

In general terms, the competent authority involved in the procedures and matters relating to the closure and post-closure of a storage site will be the MITERD (acting through the DGPEM). Upon the closure of the storage site, the operator must fulfil all actions set out under the post-closure plan prepared and approved in accordance with the requirements laid down in the Spanish CCS Law. Such post-closure plan must address *inter alia*: (i) monitoring, reporting and corrective measures, (ii) the surrender of EUAs in case of leakage pursuant to the Spanish Allowances Law, (iii) other environmental measures in accordance with Law 26/2007 of 23 October on environmental liability (the **Spanish Environmental Liability Law**), and (iv) the sealing of the storage site and removal of injection facilities. If the storage site is closed due to the withdrawal of the storage permit, the competent authority will assume such post-closure obligations and the operator will bear all costs incurred by the competent authority (or by a third party designated by the competent authority) in connection with such post-closure obligations.

The operator will comply with such post-closure obligations until responsibility is legally transferred to the Spanish state. Such transfer of responsibility will only happen if certain conditions are met (e.g., there is sufficient evidence that no leakage will occur) and when at least 20 years have elapsed since the closure of the storage site. As a condition to complete such transfer, the operator must pay to the competent authority an amount equal to the post-closure monitoring costs estimated for a period of 30 years thereafter. The bond mentioned above, initially posted by the operator upon application for a storage permit, will expire upon such transfer of responsibility.

The competent authority may impose fines and other sanctions on the operator if the operator does not comply with, amongst other things, its closure and post-closure obligations under the Spanish CCS Law. The amount of those fines will be calculated based on the severity of the relevant infringement and other variables (e.g., danger to persons and the environment, damage caused, recurrence, etc.). For "very serious" infringements fines may range from €2 million to €5 million and may also entail other sanctions such as the withdrawal of the storage permit. The above is notwithstanding other sanctions that may be imposed to the operator under the Spanish Environmental Liability Law.

UNITED KINGDOM

The UK implemented the Carbon Storage Directive via the Energy Act 2008 and the Licensing Regulations 2010. Section 30 of the Energy Act 2008 applies section 29 of the Petroleum Act 1998 to carbon storage installations. This provides the Secretary of State may require a licence holder (or a broad category of connected parties) to prepare an abandonment programme, which governs decommissioning processes and liabilities in respect of a CO_2 storage site. An abandonment programme may be required from (and so may attribute liability to) associated bodies corporate of the party responsible for preparing the abandonment programme.

OPRED assesses the level of risk associated with operators and other s.29 notice holders and may require them to provide security for the completion of an abandonment programme. As a condition of the storage permit, the operator must maintain financial security sufficient to cover their obligations under their storage permits and other statutory obligations from prior to first injection until termination of the licence under the 2010 Licensing Regulations. A further power was also introduced under section 92 of the Energy Act 2023 which enables the making of regulations in future requiring provision of security relating to abandonment or decommissioning of sites, pipelines and installations and may also amend the 2010 Licensing Regulations. These powers are expected be used to make any changes required implement the funded decommissioning regime described below.

Under the Storage of Carbon Dioxide (Termination of Licences) Regulations 2011, CO_2 storage operators may transfer certain obligations and liabilities, including liability for CO_2 leakage and environmental damage, to the Secretary of State or the relevant Scottish Minister (where they are the permitting authority of a storage site in Scotland) once the site is closed and the storage licence terminated. This transfer is permitted after a period of no less than 20 years post closure with (i) decommissioning and (ii) provision of finance to cover post-transfer costs being conditions precedent to such transfer.

The UK has decided to establish a funded decommissioning regime to ensure that the costs of decommissioning and post-closure monitoring falls on the network users rather than the general taxpayer. We expect further regulations under the Energy Act 2023 to be introduced to implement the funded decommissioning regime, alongside requirements within the economic licence issued by Ofgem. Decommissioning funds will then be built-up via the accumulation of CO_2 network user charges. Under the proposed CO_2 Transport and Storage Business Model (see the CCS Networks section here), the build-up of funds for decommissioning and post-closure monitoring is one of the building blocks making up the allowed revenues which a CO_2 network owner may recover from their users. The CO_2 network owner will be required to manage these funds over the life of the project.

GLOSSARY

ACM	Dutch Authority for Consumers and Markets
ADEME	French Environment and Energy Management Agency
APA	Portuguese Environment Agency
ARERA	Italian Regulatory Authority for Energy, Networks, and Environment
BECCS	Bioenergy with Carbon Capture and Storage
BGR	German Institute for Geosciences and Natural Resources (*Bundesanstalt für Geowissenschaften und Rohstoffe*)
BIK	German Federal Funding for Industry and Climate Protection (*Bundesförderung für Industrie und Klimaschutz*)
BImSchG	German Federal Immission Control Act (*Bundes-Immissionsschutzgesetz*) of 17 May 2013, last amended 26 July 2023

BMWK	German Federal Ministry for Economic Affairs and Climate Protection (*Bundesministerium für Wirtschaft und Klimaschutz*)
BNetzA	German Federal Network Agency (*Bundesnetzagentur*)
BRGM	French Bureau de recherches géologiques et minières
CaL	Calcium Looping
capex	Capital expenditure
Carbon Storage Directive	Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006
CBAM	Carbon Border Adjustment Mechanism

CCfD	Carbon Contract for Difference
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Usage
CCUS	Carbon Capture, Usage and Storage
CDRs	Carbon Dioxide Removals
CELE	Portuguese Decree-Law no. 12/2020, which establishes the legal regime applicable to greenhouse gas emission allowance trading
CMS	German Carbon Management Strategy of the German Federal Government of 26 February 2024
CNR 2050	Portuguese Carbon Neutrality Roadmap 2050
CO_2	carbon dioxide
CRE	French Energy Regulatory Commission (*Commission de Régulation de l'Énergie*)
CSRD	EU Corporate Sustainability Reporting Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting
DACCS	Direct Air Carbon Capture and Storage
DDADUE bill	French Bill containing various provisions for adapting to EU law in the fields of the economy, health, labour, transport and agriculture
DESNZ	UK Government Department for Energy Security and Net Zero (formerly the Department for Business, Energy & Industrial Strategy (BEIS))
DGEG	Portuguese Directorate-General for Energy and Geology
DGPEM	Spanish General Directorate of Energy and Mining Policy (*Dirección General de Política Energética y Minas*)
Draghi Report	"The future of European competitiveness" report by Mario Draghi published on 9 September 2024
EBN	Energie Beheer Nederland

EC	European Commission
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIM	European Interconnection Mechanism
EnWG	German Energy Industry Act (*Energiewirtschaftsgesetz*) of 7 July 2005, last amended 15 July 2024
ETS	Emission trading system
EU	European Union
EUAs	European Emissions Allowances
EU Climate Law	Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999
EU ETS	The trading system for greenhouse gas emission allowances established by the EU ETS Directive
EU ETS Directive	Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC
EU Industrial Carbon Management Strategy	European Commission's Carbon Management Strategy Communication (COM/2024/62)
EU Monitoring Regulation	Regulation 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012
EU Taxonomy Regulation	Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to stimulate sustainable investment and amending Regulation (EU) 2019/2088

FID	Final Investment Decision
GHG	Greenhouse Gas
GHG Savings Threshold Delegated Act	Commission Delegated Regulation (EU) of 10.2.2023 supplementing the Renewable Energy Directive by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from liquid and gaseous transport RFNBOs and from recycled carbon fuels
GIGA	UK Green Industries Growth Accelerator Scheme
HSEG	German Maritime Dumping Act (*Hohe-See-Einbringungsgesetz*) of 25 August 1998, last amended 19 June 2020
Hydrogen and Gas Directive	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, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast)
Innovation Fund	The fund established under article 10(a)8 of the EU ETS Directive

ISPRA	Italian Institute for Environmental Protection and Research
Italian PNIEC 2030	Italian National Integrated Energy and Climate Plan 2021 -2030
KSpG	German Carbon Storage Act (*Kohlendioxid-Speicherungsgesetz*) of 17 August 2012, last amended 10 August 2021
Licensing Regulations 2010	UK Storage of Carbon Dioxide (Licensing etc.) Regulations 2010
London Convention	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 1972
London Protocol	1996 Protocol to the London Convention
Long-Term Decarbonisation Strategy	Spanish "Long-Term Decarbonisation Strategy 2050" (*Estrategia de Descarbonización a Largo Plazo 2050*) approved in November 2020
Maritime FuelEU Regulation	Regulation (EU) 2023/1805 on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC

MASE	Italian Ministry of Environment and Energy Security
MEF	Italian Ministry of the Economy and Finance
MITERD	Spanish Ministry for the Ecological Transition and Demographic Challenge (*Ministerio para la Transición Ecológica y el Reto Demográfico*)
Mt	Million tonnes
Mt CO_2 pa	Million tonnes of CO_2 per year
MtCO2e	Metric tonnes of CO_2 equivalent
NIECP	Italy's National Integrated Energy and Climate Plan
NIKI	Dutch National Investment Scheme Climate Projects Industry
NSTA	North Sea Transition Authority, being the business name for the Oil and Gas Authority, the relevant permitting authority in the UK for the purposes of the Storage of Carbon Dioxide (Licensing etc.) Regulations 2010/2221
NZIA	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 and amending Regulation (EU) 2018/1724
opex	Operating expenditure
OPRED	UK Offshore Petroleum Regulator for Environment and Decommissioning
PCIs	Projects of Common Interest
PERTE-DI	Spanish "Strategic Project for the Economic Recovery and Transformation in relation to Industrial Decarbonisation" (*Proyecto Estratégico para la Recuperación y Transformación Económica de descarbonización industrial*) approved on 27 December 2022
PMIs	Projects of Mutual Interest
PNEC 2030	Portuguese National Plan for Energy and Climate 2020-2030

Portuguese Environmental Liability Regime	Portuguese Environmental Liability Regime set forth by Decree-Law no. 147/2008
PRR	Portuguese Recovery and Resilience Plan
ReFuelEU Aviation Regulation	Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on ensuring a level playing field for sustainable air transport
Renewable Energy Directive	Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, revised by Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023
RFNBO	Renewable fuel of non-biological origin such as renewable hydrogen and hydrogen-based synthetic fuels
SAF	Sustainable Aviation Fuels
SDE++	Dutch Stimulation of Sustainable Energy Production and Climate Transition Incentive Scheme
SMEs	small and medium-sized enterprises
SODM	State Supervision for the Mines in the Netherlands
Spanish Allowances Law	Spanish Law 1/2005, of 9 March, on the regulatory framework applicable to the trade of greenhouse emission allowances
Spanish CCS Law	Spanish Law 40/2010, of 29 December, on geological storage of carbon dioxide
Spanish Climate Change Law	Spanish Law 7/2021, of May 20, on climate change and energy transition
Spanish Environmental Liability Law	Spanish Law 26/2007, of 23 October, on environmental liability
Spanish PNIEC 2030	Spanish “National Energy and Climate Plan” covering the period 2021-2030 (based on the updated draft published by Spanish authorities in June 2023)

TEHG	German GHG Emissions Trading Act (*Treibhausgas-Emissionshandelsgesetz*) of 21 July 2011, last amended 10 August 2021
TEN-E Regulation	Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013
UBA	German Federal Environment Agency (*Umweltbundesamt*)
UK ETS	UK Emissions Trading Scheme established by the Climate Change Act 2008, the Finance Act 2020 and the Greenhouse Gas Emissions Trading Scheme Order 2020 (SI 2020/1265)
UmweltHG	German Environmental Liability Act (*Umwelthaftungsgesetz*) of 10 December 1990, last amended 17 July 2017
VwVfG	German Administrative Procedure Act (*Verwaltungsverfahrensgesetz*) of 23 January 2003, last amended 4 December 2023

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