2024 THOUGHT LEADERSHIP

CO_2 STORAGE PERMITTING PROCESS IN THE EUROPEAN UNION: A GUIDE

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COLLABORATION AMONG COUNTRIES AND KNOWLEDGE SHARING CAN HELP IMPROVE EFFICIENCY OF THE CO_2 STORAGE PERMIT APPLICATION PROCESS

1.0 PURPOSE

The purpose of this guide is to outline the process and main features of applying for a carbon dioxide (CO_2) storage permit in the European Union (EU). It aims to assist governments and industry in understanding the process better to facilitate a more streamlined approach to making CO_2 storage available.

Only a few countries in the EU have developed clear procedures for developing and obtaining CO_2 storage permits. Leveraging off these examples, this document serves as a starting point for developing CO_2 storage permit documents by identifying key components and likely necessary information. As every jurisdiction will need to evaluate and develop its own rules and procedures, this report is not intended as exhaustive.

2.0 KEY TAKEAWAYS

1. Legal and regulatory frameworks for carbon capture and storage (CCS) in Europe have been under development since the EU CCS Directive was released in 2009

CCS has been gaining momentum in the EU as an emissions reduction measure and a technology to deliver carbon removals, but many challenges remain in establishing a business case for CCS and in the timely development of CO_2 transport and storage. The recently adopted Net Zero Industry Act (NZIA) introduces an injection capacity target of 50 Mtpa of CO_2 within the EU by 2030, which will require the development of permanent geological CO_2 storage.

2. Developing a CO_2 storage site takes several years

Experience shows there are legitimate reasons why it takes so much time, including the need for storage exploration, data collection and analysis, preparation and approval of a storage permit application, aligning capture and transport activities with storage development, etc. However, it is possible to gain some efficiency. Regulatory clarity, streamlined procedures and growing experience with CO_2 storage will help to reduce the lead time.

3. The EU CCS Directive establishes a legal framework for environmentally safe geological storage of CO_2

Directive 2009/31/EC on the geological storage of CO_2, more commonly known as the EU CCS Directive, provides a comprehensive framework for storage development, including criteria to determine whether a geological formation is suitable for storage. It also sets requirements for considering the interests of local residents and potential impacts on surrounding habitats and species through environmental impact assessment. However, there are several other prevailing laws and regulations at the international, EU, regional and national levels that should be considered.

4. Issues related to the development of a CO_2 storage permit application process are gradually being clarified as experience grows

This includes challenges with defining financial security of storage, requirements for third party access, issues of liabilities and long-term stewardship. This guide provides an overview of the latest thinking and experience.

5. Collaboration and information exchange in the European Economic Area is crucial

This is enabling a deeper understanding of storage application processes. This report uses experiences with CO_2 storage application processes in Norway, the Netherlands and Denmark to illustrate how relevant laws and regulations are working in practice.

6. The CO_2 storage application process should be an interactive one between the project proponent and relevant authorities

The experience of countries that have established CO_2 storage application processes shows that a continuous dialogue between project proponents and the designated national regulatory authority as well as between a Member State and the European Commission (EC) helps improve the efficiency of developing and evaluating a CO_2 storage permit application.

3.0 INTRODUCTION

CCS legal and regulatory frameworks in Europe have been under development since the EU CCS Directive was published in 2009. As the carbon cap is tightening and CO_2 credit prices in the Emissions Trading System (ETS) are reaching relatively high levels (although still volatile), and as support from the EC and national schemes is increasing, CCS is gaining momentum in Europe as an emissions reduction measure and a technology to deliver carbon removal. However, many challenges related to establishing a business case for CCS and the timely development of CO_2 transport and storage remain. The Net Zero Industry Act (NZIA), adopted in 2024, introduces an injection capacity target of 50 Mtpa of CO_2 within the EU by 2030. This requirement will facilitate the development of permanent geological CO_2 storage that will enable CCS deployment in Europe.

The legal and regulatory framework developed for CCS in the EU also applies to countries in the European Economic Area (EEA), which was established through an international agreement that enables the extension of the EU's single market to Member States of the European Free Trade Association (EFTA). The EEA links the EU Member States and three of the four EFTA states (Iceland, Liechtenstein, and Norway) into an internal market governed by the same basic rules. Currently, only a few countries in the EEA have developed clear procedures for developing and obtaining CO_2 storage permits. Countries with no or limited experience with subsurface oil and gas exploration find it challenging to develop comprehensive and clear rules and policies for offshore and onshore CO_2 storage activities.

The intention of this guide is to provide information for developing CO_2 permit documents. It is non-exhaustive as every jurisdiction will need to evaluate its applicable laws and develop its own rules and procedures, but outlines the key components and serves as a starting point for developing CO_2 storage permit processes.

It is important to distinguish between onshore and offshore storage when considering CO_2 storage permits as health, safety and environmental provisions may differ. It is also important to distinguish between "green fields" like saline aquifers and "grey fields" like depleted oil and gas fields. "Grey fields" will have more detailed subsurface and geological data available due to previous exploration and production operations. This guide does not consider the regulatory requirements for CO_2 transport or capture. However, when developing a CO_2 storage resource, it is important to consider from the very beginning the potential CO_2 emission sources and transportation options to deliver captured CO_2 to the storage facility under consideration, and ensure it is economically and logistically accessible.

Before an application process for CO_2 storage can be initiated, many countries will require an exploration permit to establish whether storage is possible in terms of suitability and capacity. A 2023 report by the EC on the implementation of the EU CCS Directive *(4th implementation report)* found the majority of reporting countries required exploration permits to generate subsurface information, even for depleted oil and gas fields for which subsurface data was available.

This guide does not include information on requirements for an exploration permit, but an overview of other permits that may be required before a CO_2 storage permit application process can be initiated is provided in *Section 5*.

When thinking about a storage facility, it is useful to consider stages of the maturation process:

- Identify potential CCS opportunities
- Assess areas for potential CO_2 storage, considering capture and transportation options (optional: receive exploration permit)
- Select a storage concept
- Design and apply a detailed design and storage development plan to begin the application for CO_2 storage permit process
- Authorise – CO_2 storage permit is granted
- Build/execute development of a CO_2 storage site/ facility
- Operate – Commence CO_2 injection, operate site, monitor CO_2 storage for safety and accounting purposes
- Close – Cease CO_2 injection, seal injection wells, close site
- Monitor storage site during operation and post closure
- Long-term stewardship – Ensure post-operational durability of geologic storage, continue monitoring the site/transfer the rights to the State after a designated post-closure period.

The guide document focuses on the “Select” and “Design and Apply” stages. The storage site selection in the “Assess” stage is a critical step in developing a storage permit, and this guide assumes the assessment has been done and site selected prior to launching an application process for a storage permit.

4.0 APPLICABLE LEGISLATION

Several EU, international and national laws need to be considered when applying for a CO_2 storage permit in the EEA.

At the EU level, Directive 2009/31/EC (or EU CCS Directive) is the main law that governs environmentally safe geological storage of CO_2. Several other EU laws also apply, including the EU Environmental Impact Assessment Directive, the EU Environmental Liability Directive, the TEN-E Regulation, the Revised EU ETS Directive, and the NZIA.

At the international level, two conventions play an important role: the London Protocol and the OSPAR convention. There are several regional conventions that also need to be considered in relevant regions.

At the national level, many laws and regulations may be relevant, and vary by country. In some countries, a mining law that governs exploration of subsurface resources will be the most applicable. EU Member States had to transpose the EU CCS Directive into their national laws. Some, such as France, included the CCS Directive provisions in its Mining Law. Others have integrated the EU CCS Directive provisions in oil and gas laws. Some countries will also need to consider their marine laws if they plan to host offshore CO_2 storage. It is possible that several national laws and regulations will need to be amended to allow for safe CO_2 storage. In the example of Norway below, several national regulations had to be amended to enable implementation of the Longship CCS project. In addition, climate strategies and roadmaps may also include specific targets and parameters for CCS deployment.

EU laws

EU CCS Directive

Directive 2009/31/EC on the geological storage of CO_2, or the EU CCS Directive, establishes a legal framework for the environmentally safe geological storage of CO_2. It aims to ensure permanent containment of CO_2 in such a way as to prevent any risk of CO_2 leakage or damage to health or the environment. The EU adopted the Directive as part of a package of climate and energy measures aimed at cutting the greenhouse gas emissions (GHG) that contribute to climate change, increasing energy security, and moving towards a low-carbon economy.

EU Member States were required to transpose the EU CCS Directive into national law by 2011. States are free to choose whether to allow geological storage of CO_2 in their territories, exclusive economic zones and continental shelf. If a country opts to allow such an activity within its boundaries, it must comply with the Directive. As a result, it must assess the storage capacity available in specific regions or across the whole of its territory, including by allowing exploration.

No exploration can take place without a permit, and permits must be granted according to transparent and objective criteria. They must cover a limited area and last no longer than the time needed to carry out the exploration. If necessary, however, permits can be extended to enable the completion of exploration. The decision on whether a geological formation is suitable for use as a storage site must be based on thorough characterisation and assessment of the potential storage complex and surrounding area (defined as area of interest). Criteria specified in Annex I of the EU CCS Directive must be applied. These include the development of computer models and simulations of CO_2 injection, risk assessment, and identification of all potential hazards, especially those that can result in leakage of CO_2. Developers also have to consider local residents and the interests of surrounding habitats and species and draw up an analysis of potential environmental and health impacts.

Once exploration activities are concluded and possible CO_2 storage areas identified, operators need to obtain a storage permit with the designated national regulatory authority. An exploration permit holder has the priority right to apply for a storage permit. As part of the process, operators need to substantiate their technical competence to operate a CO_2 storage site safely and provide detailed data on the site and complex to ensure that a geological formation will be selected

only if there is no significant risk of CO_2 leakage or other environmental or health impact. Finally, the applicant needs to outline the measures it will take to prevent significant irregularities or leakage, propose plans for monitoring, corrective measures, and post-closure arrangements, and provide proof of financial security prior to the injection of CO_2 to ensure that all obligations can be fulfilled.

A CO_2 storage permit can be granted by a country only if all the requirements of the EU CCS Directive and other relevant EU legislation are met. The permit itself must indicate, amongst other things: the precise location of the storage area, the maximum quantity of CO_2 to be injected, and an approved monitoring plan, plan of corrective measures, provisional post-closure plan. Member States are responsible for issuing permits, but must forward the applications they receive, as well as the draft permits they intend to issue, to the European Commission for review. Norway, Iceland and Liechtenstein should also seek review by the EFTA Surveillance Authority (ESA). Following the review process, the EU may issue a non-binding opinion that is communicated to the national authorities. The latter may choose not to follow the EC or the ESA's opinion, if they provide justification of their reasons. This procedure is designed to ensure consistent implementation of the EU CCS Directive and boost public confidence in safety.

National authorities must be informed about any changes to storage sites and, when necessary, update the permit. In the event of CO_2 leakage, significant irregularities or failure to meet other conditions, authorities can withdraw a permit and take over management of the site, recovering costs from the former operator. All storage permits are reviewed five years after they are issued, and then every 10 years.

Every three years, the EC publishes a status report on the implementation of the EU CCS Directive on the geological storage of CO_2 highlighting progress achieved in EU Member States. The ESA has done the same report focusing on *Norway, Iceland and Liechtenstein*. The latest EC report was published in October 2023 covers May 2019-April 2023 and was the fourth to be released. At the time of reporting, geological storage of CO_2 was allowed in all Member States, Iceland and Norway except for Germany, Estonia, Ireland, Cyprus, Latvia, Austria, Finland, Slovenia and Lithuania. Germany is currently revising its relevant legislation to allow geological storage of CO_2, while Estonia, Latvia and Lithuania are conducting stakeholder consultations regarding the potential role of CCS in their national climate and energy strategies.

Guidance documents

Four *legally non-binding guidance documents* were published in 2011 to provide an overall methodological approach for implementing the key provisions of the CCS Directive. In 2022 the EC contracted DNV Netherlands B.V. to gather inputs for a *technical update of the four guidance documents* to reflect global state-of-the-art CCS practises and remove ambiguities identified during the first CCS deployments in the EEA. The revised guidance documents, which were published in July 2024, were aimed at providing the best possible support for operators and authorities in the implementation of permitting procedures in line with the EU CCS Directive.

The four guidance documents respectively outline a CO_2 storage Life Cycle and Risk Management Framework; Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures; Criteria for Transfer of Responsibility to the Competent Authority; and Financial Security and Financial Contribution, for competent authorities, project operators and other relevant stakeholders. They were developed following consultations with Member States, EEA countries and key stakeholders, including industry, the research community and NGOs.

The updates reflected technical and market developments and additional information collected by governments and project developers over the years of experience, including:

- Additional guidance specific to depleted field storage
- Additional guidance related to considerations around induced seismicity
- Clarifications on obligations that are being transferred
- Clarification on interpretation of the terms 'permanence' and 'long-term stability'
- Guidance on the opportunities and limitations with insurance, and approaches to cover gaps in insurance coverage, etc.

Revised EU ETS Directive

EU ETS Directive (Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC) is a law establishing a system for GHG emissions allowance trading within the EU. The EU ETS provisions on CCS are subject to storage being carried out in accordance with the EU CCS Directive and as of June 2023 cover all modalities of CO_2 transport. If CO_2 is stored in the EEA in accordance with the EU CCS Directive, the captured and stored CO_2 will be considered as "not having been emitted" under the EU ETS, and industrial point-source emitters can subtract the captured emissions from their compliance obligations. Storing CO_2 emissions outside the EU and EEA is allowed, but such emissions cannot be used to reduce compliance obligations, providing little incentive to store CO_2 abroad.

The EU ETS Monitoring and Reporting Regulation (MRR) lays down rules for monitoring and reporting GHG emissions and activity data pursuant to the EU ETS Directive. Article 49 deals with CO_2 that is captured in an ETS installation and transferred out of the installation for transport and permanent storage in accordance with the EU CCS Directive or permanently chemically bound in a product. A revision of the EU ETS MRR was completed in September 2024 to align the regulation with the revised EU ETS Directive.

Revised TEN-E Regulation

The Trans-European Networks for Energy (TEN-E) is a regulation that focuses on linking the energy infrastructure of EU Member States and neighbouring countries. It defines the criteria for projects of common interest (PCIs) and projects of mutual interest (PMIs), and was updated in May 2022 to align with the EU's 2050 climate neutrality objectives. The priority thematic area for "cross-border CO_2 networks" includes CO_2 pipelines, CO_2 storage facilities linked to cross-border transport of CO_2 (excluded prior to the update), fixed facilities for liquefaction and buffer storage that is associated with further transportation, and other required equipment.

Other transport methods – ships, barges, trucks and trains – are now referenced, but do not appear to be considered eligible. The infrastructure for geological storage that is applicable to this regulation is the associated surface and injection facilities necessary to allow the cross-border transport and storage of CO_2, and CO_2 transport infrastructure is currently limited to pipelines. In addition to receiving access to funding through the Connecting Europe Facility – Energy (CEF-E), projects that have PCI or PMI status may also receive preferential treatment from relevant authorities in the context of permitting and environmental assessment.

PCIs can benefit from fast-tracked planning and permitting, liaising with a single authority for obtaining all necessary permits and approvals throughout the process, and lower administrative costs from streamlined environmental review processes:

- Article 7 of the TEN-E gives "priority status" to PCIs and PMIs, which ensures rapid administrative processing and bestows the projects the status of the highest national significance possible in the permit granting process.
- Article 8 requires Member States to designate one national authority responsible for facilitating and coordinating the permit granting process.
- The TEN-E Regulation imposes strict timelines for the permit-granting process of PCIs and PMIs – a maximum of 24 months for the pre-application and 18 months for the statutory permit-granting procedure – with a combined duration not exceeding 42 months. EU Member States have the flexibility under national law to shorten the deadline for the pre-application phase.

Net Zero Industry Act

As part of the first pillar of the Green Deal Industrial Plan, the EC proposed the NZIA in March 2023. The legislation was adopted in June 2024 to scale up technologies that will drive decarbonisation, including CCS. In particular, the Act includes an injection capacity target of 50 Mtpa of CO_2 within the EU by 2030. The NZIA requires the EU's oil and gas producers, with some exemptions, to proportionally contribute to establishing the required CO_2 storage sites in the EU. Their respective contribution will be the subject of a Delegated Act that the EC is to release in 2025. Such sites can be recognised as Net-Zero Strategic Projects if they are located on EU territory. The NZIA requirements will facilitate CO_2 storage development in the EU, and this will enable CCS deployment. Through this Act, the Commission also calls on EU Member States to enhance their transparency and reporting, particularly as it relates to geological data, to ensure the EU-wide injection target is met.

EU Environmental Impact Assessment Directive

Directive 2014/52/EU, known as the EU Environmental Impact Assessment (EIA) Directive, establishes a legal framework around the assessment of the effects on the environment of certain public and private projects. Annex III of the EIA Directives determines whether a project should be subject to an environmental impact assessment based on the following criteria:

- Characteristics of projects
- Location of projects
- Type and characteristics of the potential impact

CCS projects have to undergo EIA, and this may apply not only to CO_2 storage but also capture and transport projects under specific conditions covering the whole value chain. For CO_2 capture and pipeline projects, the EIA becomes mandatory under the following conditions: when CO_2 is captured from an installation already subject to an EIA and the total CO_2 capture capacity is 1.5 Mtpa or more; and when CO_2 pipelines exceed 800 mm in diameter and 40 km in length for geological storage purposes.

Natura 2000 areas

Natura 2000 is a coordinated network of protected areas in the EU that covers 18% of the EU's land area and more than 8% of its marine territory, aimed at ensuring the long-term survival of Europe's most valuable and threatened species and habitats listed under the *Birds Directive* and the *Habitats Directive*.

Natura 2000 is not a system from which all human activities would be excluded. While it includes strictly protected nature reserves, most of the land is privately owned. The approach to conservation and sustainable use of the Natura 2000 areas is much wider, largely centered on people working with nature rather than against it. However, Member States must ensure that the sites are managed in a sustainable manner, both ecologically and economically. When a new project is proposed in a Natura 2000 site, Member States' authorities and the project promoters must first determine whether it is likely to have a significant negative effect. There are numerous guides on how to conduct such an assessment, as well as on how to manage and protect Natura 2000 sites.

EU Hydrocarbons Licensing Directive

The EU hydrocarbons licensing directive defines the conditions to guarantee non-discriminatory access to the prospection, exploration and production of oil and gas in EEA countries. When granting an authorisation for these activities, Member States must ensure the procedure is transparent, based on objective and non-discriminatory criteria. This includes the technical and financial capabilities of the entities, record of performance, proposed exploration and/or production, as well as the price the entity is prepared to pay to obtain the authorisation.

The authorisation must be granted for a period that does not exceed the time needed to perform the activity – prospection, exploration or production of oil and gas – for which the authorisation is delivered. As such, the EU Hydrocarbons Licensing Directive does not include provisions on the decommissioning of the production site, and its potential repurpose for the storage of CO_2. In the absence of guidance from the EU, it is up to Member States to decide how they would like to deal with decommissioning of depleted oil and gas fields and converting them into CO_2 storage site. Member States will also decide on the rights to reuse the infrastructure (Roggenkamp, 2020).

Environmental Liability Directive (ELD)

The *Environmental Liability Directive*, adopted in 2004, establishes an EU-wide liability regime for environmental damage to protected species and habitats, water and land, based on the 'polluter-pays' principle. It applies to activities carried out in the course of an economic activity, business or undertaking, irrespective of whether it is private or public, profitable or non-profitable, divided into two different categories:

- Those listed under Annex III of the Directive for which the operator will have to strictly comply with the liability rules;
- Other occupational activities for which the operator will only be liable for harm to protected species and habitats.

The EU CCS Directive formally amended the ELD to extend its provisions to the operation of storage sites. The operation of storage sites for the geological sequestration of CO_2 pursuant to the CCS Directive is part of Annex III of the Environmental Liability Directive.

As such, the operator of the storage site has a duty to take preventative steps where there is an imminent threat of damage, and to take steps to prevent further damage if damage has already occurred. The operator will be liable for environmental damage until the end of the post-closure period when the responsibility is transferred to the competent authority, as described in the EU CCS Directive.

International laws

London Protocol

The London Protocol was adopted on 1 November 1996 to update and supersede the International Maritime Organization (IMO) London Convention (1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter), an international agreement aimed at preventing marine pollution. Currently there are 54 Parties to the London Protocol. Until 2019 the protocol was seen as a major international legal hurdle for the development of regional CO_2 transport infrastructure as it effectively prohibited the transport of CO_2 across national boundaries for sub-seabed storage. CO_2 storage was not considered when the London Protocol was drafted, thus CO_2 was not initially included in Annex 1 (the list of wastes that were allowed to be dumped provided there was a permit), and was therefore prohibited from being stored offshore as it fell within the definition of dumping.

In 2009 an amendment to the Protocol was suggested allowing CO_2 streams to be exported for CCS offshore purposes. However, the amendment must be ratified by two-thirds of the contracting parties to come into force, which has not been achieved yet.

In October 2019 Norway and the Netherlands proposed an interim solution to the slow-moving ratification of the 2009 CCS Export Amendment. The resolution, which was formally accepted with the support of several Contracting Parties, allows countries to agree to export and receive CO_2 for offshore geological storage via bilateral (or multilateral) agreements. Building on this momentum, Norway and the Netherlands signed a bilateral memorandum of understanding in November 2021. The 2019 resolution marked a major step forward in the development of transboundary CCS projects.

The provisional application of the 2009 amendment now means that two or more countries can agree to export CO_2 for geological storage. However, to do so they must first submit a formal declaration of provisional application to the IMO Secretary-General and enter into an agreement or arrangement in accordance with the provisions of the London Protocol.

Most EU Member States and EEA countries are Contracting Parties to the London Protocol, except for Greece, Hungary, Malta, Poland and Portugal, which are party to the London Convention only, and Austria, the Czech Republic, Latvia, Liechtenstein, Lithuania, Romania and Slovakia, which are currently not a party to either treaty.

Seven EEA countries have accepted the 2009 amendment to the London Protocol: Belgium, Denmark, Estonia, Finland, Netherlands, Norway and Sweden. Switzerland and the UK are also Parties to the London Protocol and have accepted the 2009 amendment to the Protocol. As of 20 August 2024, five EEA governments (Belgium, Denmark, the Netherlands, Norway, and Sweden) have also used the 2019 Resolution to submit declarations of provisional application of the 2009 amendment to allow movement of CO_2 across national boundaries for the purpose of sub-seabed geological sequestration.

The EC has issued a paper opining that there is a substantive alignment between the requirements of the London Protocol and the legal framework in place in the EEA for the capture, cross-border transport and safe geological storage of CO_2 between EU Member States and EEA partner countries (EC, 2022). Therefore, Directive 2009/31 and Directive 2003/87, which bind all the Member States, can act as a relevant “arrangement” between the Parties in the meaning of Article 6(2) of the London Protocol.

Similarly, the EEA treaty and the incorporation of the above-mentioned two directives in the EEA legal regime provide the necessary arrangement between EEA partners. To transport CO_2 from one EEA Member to another within the EEA, EEA Members that are parties to the London Protocol are still required to first submit to the IMO a formal declaration of provisional application of the 2009 amendment to the London Protocol, even if there are no additional issues to cover. EEA Members that are party to the London Protocol could conclude additional bilateral arrangements with EU Member States and EEA partner countries only on issues that are not already covered by Directive 2009/31 and Directive 2003/87. Such additional bilateral arrangements should be strictly limited to the residual issues not covered by EU law and not refer to matters covered by EU rules.

To ensure transparency for the emerging market of cross-border transport and safe geological storage of

CO_2, the EC considers establishing a public repository listing per EU Member State, indicating:

- The names and contact details of the relevant competent authorities for CCS storage, ETS installations and UNFCCC inventories in the Member State
- The name and contact details for relevant undertakings of a Single Point of Contact for CO_2 export
- The references to national legislation transposing the relevant parts of Directive 2009/31/EC and Directive 2003/87/EC (for parties to the London Protocol)
- The date of deposition of the declaration of provisional application of the 2009 amendment of the London Protocol to the IMO secretariat (for parties to the London Protocol)
- The full text of any additional bilateral arrangement notified to the IMO.

Convention for the Protection of the Marine Environment of the North-East Atlantic, known as OSPAR Convention

The OSPAR Convention is the mechanism by which 15 governments and the EC cooperate to protect the marine environment of the North-East Atlantic. The 15 governments are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK.

The OSPAR Convention takes its start in 1972 with the Oslo Convention against dumping and was broadened to cover land-based sources of marine pollution and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea.

The OSPAR Convention includes a series of Annexes that deal with the following specific areas:

- Annex I: Prevention and elimination of pollution from land-based sources
- Annex II: Prevention and elimination of pollution by dumping or incineration
- Annex III: Prevention and elimination of pollution from offshore sources
- Annex IV: Assessment of the quality of the marine environment
- Annex V: On the protection and conservation of the ecosystems and biological diversity of the maritime area.

In 2007 the OSPAR Commission adopted amendments to Annexes II and III to the Convention to allow the storage of CO_2 in geological formations under the seabed. In association with this, OSPAR adopted *Decision (2007/2)* to ensure safe storage of carbon dioxide streams in geological formations together with *guidelines for risk assessment and management of storage of CO_2 streams in geological formations*. In addition, OSPAR adopted a *Decision (2007/1)* to prohibit the storage of CO_2 streams in the water column or on the seabed because of the potential negative effects.

Helsinki Convention

The Convention on the Protection of the Marine Environment of the Baltic Sea Area 1992 (Helsinki Convention) covers the Baltic Sea Area and aims at addressing the increasing environmental challenges from industrialisation and other human activities which severely impacted the marine environment. The original Convention was signed in 1974 by seven Contracting Parties. It was updated in 1992 "to take into account the geopolitical changes and emerging environmental challenges in the region" and was extended to 10 Contracting Parties – Denmark, Estonia, the EU, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden. The updated Convention entered into force in 2000. The Helsinki Convention Commission has made clear that "the Convention is amended whenever deemed necessary, such as to follow the developments in international environmental and maritime laws".

Article 11 prohibits dumping in the Baltic Sea Area except for dredged material, which in each case requires a prior special permit. The definition of dumping includes any disposal into the seabed. The Helsinki Convention differs from the other regional sea conventions and the London Protocol in that it is stricter with only one exception to the ban. Thus, as CO_2 is not listed as an exception in the Helsinki Convention, any storage would be prohibited

(Lena W. Østgaard2 & Ingvild Ombudstvedt3 (IOM Law), 2023).

A Contracting Party to the Helsinki Convention that is also Party to the London Protocol cannot exercise discretion to dump the wastes and other matter listed as permissible under Annex 1 of the London Protocol (e.g. CO_2) in the Baltic Sea Area because it is permitted under the London Protocol (Lena W. Østgaard2 & Ingvild Ombudstvedt3 (IOM Law), 2023).

In June 2023 some of the Contracting Parties met for an informal meeting to discuss amending Article 11 in the context of carbon storage, acknowledging that Article 11 in its current form prohibits this activity (Lena W. Østgaard2 & Ingvild Ombudstvedt3 (IOM Law), 2023). Discussions revolved around possible solutions to this ban (in the event that the States would wish to facilitate offshore storage in the region). To amend an article, all the Contracting Parties need to accept the amendment. Many stakeholders are considering options for overcoming this barrier.

Barcelona Convention

This Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean 1995 (Barcelona Convention) aims to "prevent, abate, combat and to the fullest possible extent eliminate pollution of the Mediterranean Sea Area and to protect and enhance the marine environment in that Area so as to contribute towards its sustainable development". The Barcelona Convention was initially adopted in 1976 and entered into force in 1978. In 1995, the Convention was amended and renamed. The amended Convention entered into force in 2004 and has 22 Contracting Parties. The 1976 Dumping Protocol to the Convention in Annex I lists the wastes and other matter that are prohibited to dump. Annex II lists the wastes or other matter that may be considered for dumping pursuant to a special permit. CO_2 is not included on either list and may therefore be stored pursuant to a general permit (Article 6).

The 1995 Dumping Protocol to the Barcelona Convention is more like the London Protocol in that only the wastes and other matter explicitly listed in the Protocol may be considered for dumping, having first acquired a permit – that is, the reverse list approach. The amended protocol from 1995 has not yet entered into force, however. In practice, this means that the previous protocol from 1976 still applies. Under this interpretation, CO_2 could be stored pursuant to a general permit provided by Article 6 (Lena W. Østgaard2 & Ingvild Ombudstvedt3 (IOM Law), 2023). However, should the 1995 Protocol enter into force unamended, CO_2 storage would be prohibited.

Bucharest Convention

The Convention on the Protection of the Black Sea Against Pollution 1992 (Bucharest Convention) applies to the Black Sea and aims to "prevent, reduce and control the pollution in the Black Sea in order to protect and preserve the marine environment and to provide legal framework for co-operation and concerted actions to fulfil this obligation." It was signed in 1992, entered into force in 1994 and has six Contracting Parties.

The Bucharest Convention has three protocols, including one dedicated to dumping. Under the Protocol, dumping in the Black Sea of wastes or other matter containing substances listed in Annex 1 of the Protocol is prohibited. Dumping in the Black Sea of wastes or other matter containing noxious substances listed in Annex II requires, in each case, a prior special permit. All other wastes or other matter may be dumped with a prior general permit. CO_2 is not listed in Annex I or II and may therefore be stored pursuant to a general permit in line with Annex III. (Lena W. Østgaard2 & Ingvild Ombudstvedt3 (IOM Law), 2023).

The Protocol sets out the factors to be considered when issuing permits for dumping at sea. The factors are similar to those contained in the London Convention and include requirements to assess and account for characteristics and composition of the matter, as well as the characteristics of the dumping site and disposal method.

National laws

Several national laws may need to be revised, amended or developed to accommodate for CCS. This may include mining, marine, environmental and land-use laws.

National climate laws and strategies may be instrumental in promoting or prohibiting CCS projects in general, and CO_2 storage in particular. Incorporation of CCS in National Energy and Climate Plans (NECPs) has helped to better support the role of CCS in achieving decarbonisation targets in Member States and at the EU level.

EXAMPLE: RELEVANT NATIONAL LAWS AND REGULATIONS IN NORWAY

The EU CCS Directive was implemented in Norwegian law in 2014 via specific new Storage Regulations, an added chapter to existing Pollution Regulations and Petroleum Regulations. Other relevant Norwegian laws and regulations needed to be considered for the implementation of the Longship CCS project included the Pollution Control Act, regulations on handling hazardous substances, CO_2 safety regulations and the Planning and Building Act.

An added chapter in the Pollution Regulations is intended to ensure that all storage of CO_2 is done in an environmentally safe way. All companies that inject and store CO_2 need a permit from the Norwegian Environmental Agency. Under the Planning and Building Act, the operator needs to obtain a zoning plan and building consent for the pipeline from quay out to one nautical mile offshore. For the Longship CCS project this involves applications to two municipalities and agreement with many stakeholders (e.g. crossing pipelines and infrastructures).

As Longship includes a full CCS value chain, additional permits were needed for the construction of capture facilities. Hafslund Celsio and Heidelberg Materials Cement Norge needed consent from the Directorate for Civil Protection, the Labour Inspection Authority and the County Governor/Norwegian Environmental Agency, and a building permit from the municipality. The two applied to Norwegian Environmental Agency for a permit under the Pollution Control Act and needed to apply for/or update the ETS/emissions permit.

For the Northern Lights storage site, the Environmental Impact Assessment was required under several regulations: the Storage Regulations, the Planning and Building Act, and the Pollution Control Act. The Norwegian Directorate for Civil Protection regulates facilities' handling of hazardous substances, including pressurised CO_2, and has provided necessary consents to the industrial partners in the Longship CCS project. The Petroleum Safety Authority, which has the regulatory responsibility for safety, the working environment, emergency preparedness and security in the petroleum sector, has developed new regulations on safety and working environment for transport and injection of CO_2 on the continental shelf (the CO_2 Safety Regulations).

Source: Gassnova, 2022

5.0 TYPES OF STORAGE-RELATED PERMITS

Exploration permit

Before a CO_2 storage permit process can begin, several preparatory activities are necessary. This may include the need for exploration, which will be governed by an exploration permit. Some storage sites may also require a pilot phase before an industrial-scale storage process can begin. Pilot storage may be included in the exploration permit, or may require an additional permit for the pilot phase.

The EU CCS Directive defines that "exploration" means the assessment of potential storage sites for the purposes of geologically storing CO_2 by means of activities intruding into the subsurface such as drilling to obtain geological information about strata in the potential storage complex and, as appropriate, carrying out injection tests to characterise the storage site. "Exploration permit means a written and reasoned decision authorising exploration and specifying the conditions under which it may take place, issued by the competent authority". For example, in Denmark licences can initially be granted for exploration for up to six years, during which the exploring company has exclusive rights to the area. Norway also awards *exploration licences.*

Storage permit

According to the EU CCS Directive, 'storage permit' means "a written and reasoned decision or decisions authorising the geological storage of CO_2 in a storage site by the operator and specifying the conditions under which it may take place, issued by the competent authority.".

If CO_2 storage is envisaged in "grey fields" – depleted oil and gas fields – there may be issues associated with transitioning from oil and gas production permits to CO_2 storage permits. Some legal and regulatory issues may arise, including for example, first right to licences, where a question may arise as to whether the holder of a production licence has the first right to apply for a CO_2 storage permit in that location. Limited guidance exists regarding transfer from oil and gas operations to CO_2 storage operations in hydrocarbon fields. For example, in the Netherlands the storage permit for the Porthos project was granted to Energie Beheer Nederland (EBN) – the Dutch public energy company and one of the project developers and Taqa, a gas operator of the (depleted) gas field that will be transformed into a CO_2 storage field. Taqa will then transfer its rights to the CO_2 storage permit to EBN/Porthos.

Assets to be reused, if applicable

If a proposed CO_2 storage facility is in depleted oil and gas fields, there might be a potential for reuse of some infrastructure previously used for oil and gas production, including wells, pipelines, and platforms. This potential must be evaluated in the process of applying for a CO_2 storage permit.

Trunk pipelines and depleted oil and gas reservoirs have the greatest reuse potential. Reuse of trunk pipelines could result in time and cost savings for CO_2 transport infrastructure. Although there are similarities between CO_2 and conventional hydrocarbon pipelines, there are differences in the design, construction, and operation, primarily due to the specific characteristics of CO_2 (GCCSI 2024). In addition to rigorous hazardous liquid pipeline standards that govern the transportation of crude oil, petroleum products, and highly volatile liquids such as propane, butane, and ammonia, specific standards for CO_2 transportation need to be applied. Many trunk pipelines remain in operation and their decommissioning timeline may not match the timescale needed to deploy CCS technologies.

Depleted oil and gas reservoirs could allow for more cost-effective modelling of CO_2 injection and storage, given that the subsurface geology has already been well characterised. Decommissioned and abandoned wells may not be suitable to be reused for CO_2 injection or monitoring if the construction specifications are not suitable or if there is a lack of data and technical records on the condition of the well. Usually, regulations require previous oil and gas asset owners to be liable for the costs associated with decommissioning infrastructure. However, clarity is needed if assets are intended to be transferred for reuse.

Hydrocarbon licences transitioning into storage permits

There might be an incompatibility between an operator's preference for rapid removal of an oil and gas platform, due to high maintenance costs, and the desire to adapt multiple platforms and wells for CO_2 storage service in an orderly manner. Notably, guidance on the transfer of liabilities, as well as on the role of the different actors (competent authorities, owners, and future developers) during the transfer process is currently not available. The EU Hydrocarbons Licensing Directive leaves it to Member States to develop suitable rules related to access to information and site characterisation; provisions related to risk allocation between the oil and gas and storage operators; and the decommissioning of oil and gas exploration and transfer of the site into a CO_2 storage facility. New rules may be needed if countries want to encourage the reuse of oil and gas infrastructure to support CCS projects.

In the absence of clear rules, early engagement between competent authorities and project promoters may help in obtaining necessary guidance related to such issues as the required level of detail in the interim documents/plans and the criteria for the demonstration of permanent storage of CO_2. Ongoing interactions and discussions between the project operators and competent authorities have been identified as critical to the success of CCS projects.

6.0 CO_2 STORAGE PERMIT APPLICATION PROCESS

It is possible to envisage a generic CO_2 storage application process in the EEA countries given that in all of them, the process is governed by EU level regulations transposed to national legislations. Some differences will be determined by national laws and regulations as well as specific conditions of storage sites, but the core of the process and the structure of storage permit itself will be similar.

Information to be collected

Each CO_2 storage application process will involve extensive data collection. The competent authority in each country will define the required data and level of detail. However, all CO_2 storage permit applications will need to include data defined by Annex I of the EU CCS Directive.

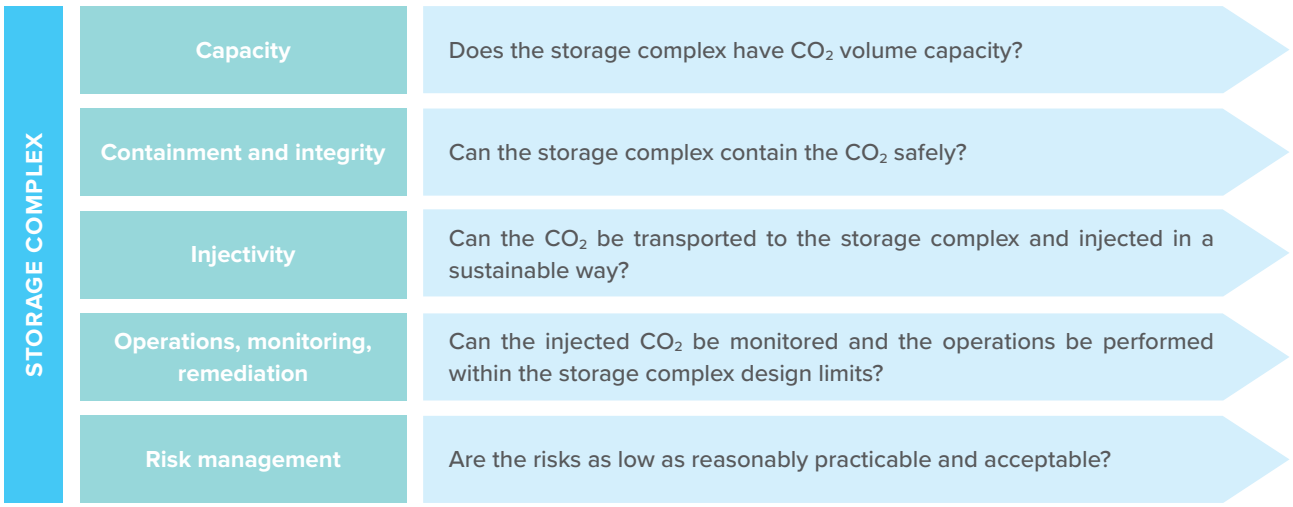
Before launching an application process, a lot of technical information needs to be collected, relating to:

- Capacity – How much CO_2 can be stored
- Geology and containment – Will CO_2 stay underground permanently
- Well construction materials to ensure integrity of wells
- Injectivity – What is the rate of injectivity
- Monitoring technologies and approaches – What technologies can be used at the site to facilitate the ongoing monitoring of injected CO_2 and other operational parameters, and what approaches are available for verifying and reporting this information to authorities
- Risk assessment – Hazard characterisation, exposure assessment, effects assessment

This information will need to be included in the technical documents as part of the CO_2 storage application process; this is discussed in more detail later in this report.

Below is a diagram with questions that an applicant needs to answer in the process of applying for a CO_2 storage permit.

Figure 1 - Guiding questions used in the Porthos CO_2 storage application process. Source: EBN, 2022



Stakeholders

Each CO_2 storage permit application process will involve numerous stakeholders. The first step in this process would be to identify and engage with all relevant players.

Key stakeholders in the CO_2 storage application process include:

- Applicant, (including oil/gas field operator if applicable)
- Project customers (emitters)
- Government bodies
- The European Commission
- Advisors (both to the applicant and to the government)
- Experts, consultants
- Public concerned by the project

EXAMPLE: STAKEHOLDERS IN PORTHOS PROJECT CO_2 STORAGE APPLICATION PROCESS

1. Project developer-side Applicant: Dutch state-owned parties EBN, Gasunie, Taqa, Port of Rotterdam Authority.

State-owned company EBN is co-owner (40%) with the government (60%) of Dutch oil and gas resources and is a non-operating partner of the Porthos project. EBN is also responsible for storage safety and will transfer liability to the state after the project completion.

2. Project customers: Air Liquide, Air Products, ExxonMobil, Shell
3. Dutch government: Ministry of Economic Affairs, Council of State (on environmental permits)
4. Advisors: TNO – advisor to the Ministry; SoDM is the Regulator
5. European Commission
6. Experts/consultants

The role of consultants is to support project proponents and the government with:

- Environmental studies, with company experts or coordinating third party experts
- Preparing the documents for the EIA and permit application
- Supporting the project team with collecting technical information, feedback on environmental impact and suggestions mitigating measures
- Discussion with authorities
- Supporting authorities on the legal framework and examples from previous projects
- Supporting with information on spatial planning to be done by authorities
- Supporting stakeholder engagement

7. Public concerned by the project/community

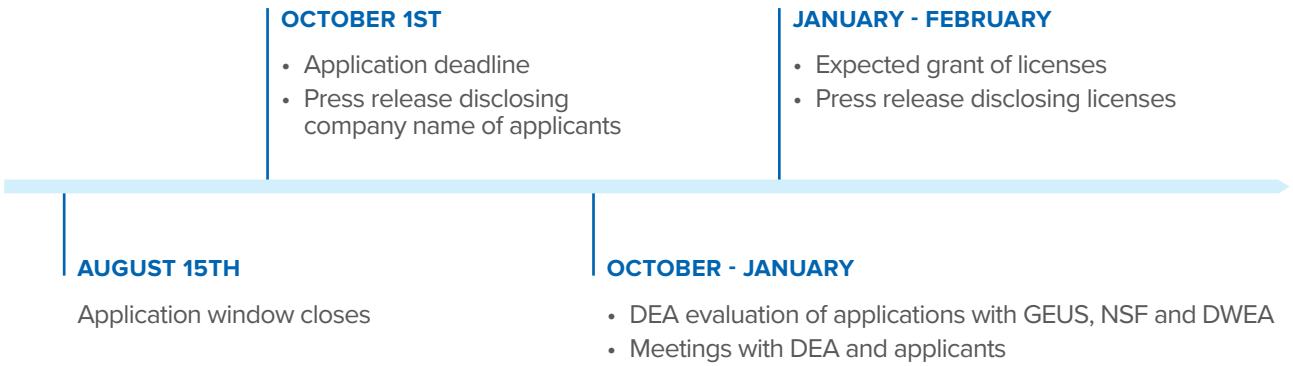
Source: EBN, 2022

Interactive process

As the experience with CO_2 storage permit applications is still developing and there are differences between geologic storage sites, the application process should be an iterative one that will likely benefit from an ongoing dialogue between the applicant and the government. In addition, a dialogue between a competent authority and the European Commission will also be helpful. These dialogues will help in answering questions that may come up in the process of developing an application for a permit, including technical questions, and preempt any challenges. An interactive process may also speed up a process of developing an application and issuing a permit as deficiencies or disagreements could be addressed as they arise. A dialogue between the government and the EC could facilitate a timely transfer of useful (non-sensitive) information received by the EC from other CO_2 storage applications in other EU Member States to a government that may be going through such a process for the first time.

Some countries may select a tender process for receiving applications for CO_2 storage permits within a specified timeframe. For example, Denmark issued a tender to receive CO_2 exploration permit applications for offshore and onshore storage exploration.

Figure 2 - Denmark's offshore exploration permit application process. Source: Danish Energy Agency, 2022



Application timeline

Application processes take a significant time. Examples from storage facilities that have obtained permits to operate suggest that, on average, an application process takes up to 18 months and more; it took 18 months for the Porthos project to receive its storage permit, and almost 2 years for Northern Lights. One of the objectives of the revised TEN-E Regulation (although only for PCIs and PMIs) and NZIA is to streamline permit procedures for CO_2 storage projects.

Developing an application takes several months as a lot of information needs to be collected and documented. Once the application is ready and submitted to national authorities, it is also shared with the European Commission.

The EU CCS Directive requires EEA countries to make CO_2 storage permit applications available to the EC within one month of receiving them. Member States must provide the EC with draft storage permits and any other related materials that the competent authority has taken into consideration to decide on the award of a permit.

The EC may provide a non-binding opinion on the draft storage permit within four months of its receipt. The competent authority should inform the EC of its final decision, and where it departs from the Commission's opinion, it should state its reasons. Comments from the EC and national authorities need to be addressed by the applicant. Only after that, the final permit is issued by the relevant national authorities.

EXAMPLE: TIMELINE OF PORTHOS CO_2 STORAGE APPLICATION PROCESS

It took 18 months for the Porthos project to obtain the initial permit, almost twice as long as initially anticipated. The project was then delayed by a court case investigating claims by a civil society group of the risk of nitrogen emissions from the project. After several months of considerations, the case was closed and the project allowed to proceed.

STAGE	PLANNED TIME	ACTUAL TIME
Application - Concept Permit	3 months	10 months
Appeals + Advice EC	2 months	8 months
Appeals + Advice EC Final Permit	4 months	
Minimum Lead Time: Excluding hiccups, holidays, etc	9 months	18 months

Source: EBN, 2022

CO_2 Storage Permit Decision

The EU CCS Directive states: "Member States shall ensure that no storage site is operated without a storage permit, that there shall be only one operator for each storage site, and that no conflicting uses are permitted on the site."

Once the permit decision is made by the national authority, the permit is published as a public document. This document includes:

- The CO_2 Storage Permit
- The application as part of the permit
- The European Commission advice as part of the permit.

The Commission's Opinions on draft storage permits are public, while the final permitting decision remains with the national competent authority according to the subsidiarity principle. For example, the EC's opinion on the draft permit to permanently store CO_2 in block section P18-2 of the Dutch continental shelf and on the amendment to the permit to permanently store CO_2 in block section P18-4 (both constitute the Porthos project) can be found on the EC website.

7.0 CO_2 STORAGE APPLICATION OUTLINE & CONTENT

Under Article 7 of the EU CCS Directive, applications to the competent authority for storage permits must include at a minimum:

- Name and address of the potential operator
- Proof of the technical competence of the potential operator
- The characterisation of the storage site and storage complex and an assessment of the expected security of the storage
- The total quantity of CO_2 to be injected and stored, as well as the prospective sources and transport methods, the composition of CO_2 streams, the injection rates and pressures, and the location of injection facilities
- Description of measures to prevent significant irregularities
- Proposed monitoring plan
- Proposed corrective measures plan
- Proposed provisional post-closure plan
- Any Environmental Impact Assessment required under national legislation
- Proof that the financial security or other equivalent provision will be valid and effective before commencement of the injection.

The updated guidance documents related to the CCS Directive published by the EC in July 2024 contain useful details and explanations:

- Guidance Document 1: CO_2 Storage Life Cycle Risk Management Framework
- Guidance Document 2: Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures
- Guidance Document 3: Criteria for Transfer of Responsibility to the Competent Authority
- Guidance Document 4: Financial Security and Financial Contribution.

The following sections provide a brief overview of information that needs to be collected and incorporated in a storage application in accordance with requirements of the CCS Directive.

Technical description of a storage site (field specific)

This section of a permit application would correspond to the following requirements in the CCS Directive:

- Proof of the technical competence of the potential operator
- The characterisation of the storage site and storage complex and an assessment of the expected security of the storage
- The total quantity of CO_2 to be injected and stored, as well as the prospective sources and transport methods, the composition of CO_2 streams, the injection rates and pressures, and the location of injection facilities.

EXAMPLE: LENGTH OF THE PORTHOS CO_2 STORAGE APPLICATION

The application for the Porthos CO_2 storage permit consisted of two parts that totaled more than 1,200 pages:

- The application: Sections covering requirements 1 to 10 of Article 7 of the CCS Directive - 378 pages
- The appendices: Supporting reports

Source: EBN, 2022

Detailed characterisation of a storage site[1], storage complex and its surrounding area is an essential step to undertake ahead of the permitting of a site for storage development and injection operations. This phase involves extensive detailed studies by the operator to define the geological framework of the storage site and complex and its surrounding area, and to model it in three dimensions through initial versions of static and dynamic models. These models should consider any cross-border implications of the proposed scheme. Additional drilling and injection testing activities may also be conducted as part of this phase to reduce risk and uncertainty. Complex characterisation is also critical for assessing its "monitorability" as a starting point for developing a monitoring plan.

A review of other activities planned in the area is crucial to ensure safe storage operations. Containment of the storage site is key and requirements for the storage feasibility assessment need to be communicated by the competent authorities at an early stage of the licence application process. This involves, among others, a careful definition of the caprock, especially where several sealing layers are included in the storage complex. Annex I of the EU CCS Directive and Guidance Document 2 provide a high-level overview of the main steps to be followed by the operator for the characterisation and assessment of the storage complex and surrounding area, but do not indicate the level of detail of the underlying studies. This provides the flexibility to perform site-specific analyses.

In addition to the limits of the storage complex, capacity is also one of the key properties that define the viability of a storage site. Competent authorities' guidance in this area would be needed at an early stage of the feasibility assessment, and consultation and discussion between the project developer and the government should start before project development reaches an advanced level, and be held regularly.

Apart from activities related to the CO_2 storage project that will occur within the storage complex, activities above or below the storage complex also need to be addressed, (e.g., installation of wind farms). These activities may hinder monitoring plans and could therefore potentially hold up CCS project development. New projects should consult with other ongoing projects and consider their impact. In case of interference, existing projects should have the right to object. The Dutch "Noordzee akkoord" is a good example of a structure to manage different uses of the Dutch North Sea sector. The Dutch North Sea Agreement between the government and key stakeholders creates a framework for joint work on facilitating three main sustainable transitions in the North Sea: energy, nature and food (fisheries) and the connections between them. In addition, it contributes to the implementation of the national climate agreement and the international Paris Agreement.

Risk assessment/ management

The EU CCS Directive was developed on the basis that the regulatory framework for geological storage should be based on an "integrated risk assessment for CO_2 leakage, including site selection requirements designed to minimise the risk of leakage, monitoring and reporting regimes to verify storage, and adequate remediation of any damage that may occur". These requirements can be met by applying the principles of risk management to CO_2 storage projects. In this context, risk management is defined as the identification, assessment, and prioritisation of the risks to secure storage, together with the application of resources to prevent, monitor, and correct leakages or significant irregularities throughout the project life cycle.

[1] The CCS Directive defines 'geological storage of CO_2' as injection accompanied by storage of CO_2 streams in underground geological formations; 'storage site' as a defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities; and 'storage complex' as the storage site and surrounding geological domain that could have an effect on overall storage integrity and security, or secondary containment formations.

Risk management is therefore considered essential to ensuring the safety of CO_2 storage. This will require periodic and ongoing assessment of the risks relating to containment and leakage, as well as uncertainties in the geological framework, models and performance assessments. It is intended that risk management techniques will be used to identify, mitigate, and manage identified risks and uncertainties to ensure the safety of any CO_2 storage site.

Monitoring plan

Operators are required to monitor the injection facilities, storage complex and, where appropriate, the surrounding environment, according to a monitoring plan and for specified purposes including:

- Comparison of actual and modelled behaviour of CO_2 and formation water
- Detection of significant irregularities, migration or leakage
- Detection of significant adverse effects on the environment

Operators must then submit a report to the relevant authorities at least once a year with details of the monitoring results, as well as the quantities and properties of CO_2 streams delivered and injected. Once the first monitoring and injection data is available during the storage site's commissioning phase, they may lead to changes to the monitoring plan as improved insight in the storage system derived from early injection and monitoring data becomes available (ZEP, March 2022).

Operators are also responsible for monitoring and reporting measures after a storage site has been closed, but monitoring may be reduced to a level that allows for detection of leakage or significant irregularities. There are special criteria in place for establishing and updating the monitoring plan and for post-closure monitoring activities.

The operator is responsible for monitoring during site operation and after closure until transfer of responsibility to a designated authority takes place. The EU CCS Directive specifies that such transfer can take place not earlier than 20 years after the closure of a storage site unless the competent authority is convinced that all available evidence indicates that the stored CO_2 will be completely and permanently contained before the end of that period, see *financial security and financial contribution*. Once transfer of responsibilities takes place, the government takes on responsibility for the site monitoring.

Corrective measures plan

According to the EU CCS Directive, "corrective measures mean any measures taken to correct significant irregularities or to close leakages in order to prevent or stop the release of CO_2 from the storage complex".

The general principles for the overall approach for corrective measures are similar and closely linked to the risk assessment and monitoring of the storage complex. Corrective measures should be:

- Risk based, linked to identified risks from site and complex
- Specific to the storage site and complex
- Suitable for use to address leakage or significant irregularities
- Closely linked to monitoring plans and monitoring, which should provide triggers for use of corrective measures by identification of leakage or irregularities
- Used when there is any leakage or significant irregularities.

The initial plans will be based on the risks identified for the storage complex, with predicted pathways and scenarios of potential leakage based on site characterisation and modelling. The types of risk and pathways would likely be similar to generic types of pathways that may include either geological pathways (faults, fractures or caprock absence), man-made pathways (well bores or old mine workings) or the other types of risk (groundwater contamination, displaced oil and gas, subsidence). However, a specific location or type of irregularity may not be known until identified during the detection process.

Financial security and financial contribution

There are two types of financial requirements that are included in the EU CCS Directive (Article 19):

- Financial security: A requirement for Member States' governments to ensure that, when applying for a storage permit, a potential storage operator demonstrates proof of arrangements that could be used to cover necessary costs to prevent and remediate CO_2 leakage. The operator is responsible for all obligations relating to the surrender of emissions trading allowances in case of leakages, as well as preventive and remedial actions. The financial guarantee must be valid and effective when the injection starts.
- Financial contribution: A separate financial contribution to the competent authority, just before transfer of responsibility, must be sufficient to cover the anticipated cost of monitoring for at least 30 years after transfer, but also to potentially cover other post-transfer costs to ensure complete and permanent containment of the injected CO_2.

Financial security and financial contribution requirements should be based on risk assessments of the actual site. Site operators would require financial security to perform various types of obligations related to the security of the site. These can be divided into two types:

- Obligations that are certain to occur (monitoring and reporting)
- Obligations that are not certain to occur (corrective measures and surrender of allowances)

There are several options for demonstrating financial security, including insurance, parent company guarantee, bank guarantees, escrows, pooled funds, and so on. Several governments that are in the process of evaluating and issuing storage permits are considering a parent company guarantee approach as the most suitable for this stage of CCS deployment. In Norway, for example, under a parent company guarantee approach, a parent company that is usually a large operator from the oil and gas industry and well known to the government would provide unlimited and undefined financial guarantee for a storage site. This approach of undefined and unlimited financial security is used in the country's oil and gas sector and can also be applied for CO_2 storage. However, one of the key considerations is that the cost of financial security should not be prohibitive to CCS.

While it may be reasonably easy to calculate the possible costs of technical measures that will need to be taken to address possible risks associated with a CO_2 storage, including CO_2 leakage, it is challenging to estimate costs of addressing possible environmental damage from a future leak, including the future cost of CO_2 allowances that would need to be purchased to compensate for the escaped CO_2.

The cost of monitoring and reporting is an important component of financial security and contribution. This cost is relatively low compared to other costs embedded in financial security, but may represent a major component of the financial contribution mechanisms. Article 18(1)(b) of the EU CCS Directive requires at least 20 years of monitoring by the storage operator after closure prior to transferring responsibility to the competent authority, unless the competent authority is convinced that all available evidence indicates that the stored CO_2 will be completely and permanently contained before the end of that period. A 20-year post-closure monitoring period should be used as a starting point for calculating the amount of financial security, since the actual length of the post-closure period cannot be predicted in advance (European Commission, 2024b). The operator will be asked to pay for monitoring costs after the state assumes responsibility for the site after the post closure period, an amount that must at least cover anticipated monitoring costs for the national authority for 30 years (European Commission and DNV (no date)).

Financial security must be periodically adjusted, although the CCS Directive does not specify when adjustments should be made to the amounts of financial security. Germany plans to make such adjustments annually (via personal communication with German federal government representatives).

In addition to a parent company guarantee or other form of guarantee, governments will require the project to be insured. The commercial insurance market should be able to provide insurance products to the CCS industry on a similar basis as to the oil and gas industry for:

- Assets installed by the CO_2 storage operators
- Drilling and well operations
- Business interruption
- Third-party liabilities (European Commission, 2024b).

THE COST OF MONITORING AND REPORTING OF A CO_2 STORAGE SITE IS AN IMPORTANT COMPONENT OF FINANCIAL SECURITY AND FINANCIAL CONTRIBUTION REQUIREMENTS

Insurance companies are in the process of developing suitable products to support the CCS market. There is a steady increase in providers willing to support both pre-commercial and commercial projects globally (O'Halloran, G. 2023). While there have been positive developments in the insurance market to cover CCS, there are remaining gaps in covering specific risks around corrosion and CO_2 leakage. For environmental liability of CCS projects, it is necessary to design new clauses that directly apply to the unique risks of repressurising underground caverns or trading carbon credits. In other cases, traditional insurance market products are already fit for purpose, especially those used by the oil and gas industry (O'Halloran, G. 2023). Traditional Construction All Risk (CAR), Marine Cargo+Hull, and Industrial All Risk (IAR) and Operators Extra Expense (OEE) policies will be able to cover most of the common risks associated with a CCS project.

The global insurance groups Howden and SCOR (SCOR, 2024), announced a new insurance facility specifically for carbon storage (and related transport issues) in January 2024 (IEAGHG, 2024). For example, Howden announced an insurance facility designed to address leakage risks of CCS sites. Built from the framework of an existing insurance product – Environmental Liability insurance – the leakage policy is tailored to address the financial risks associated with a discharge, release, escape or migration of CO_2 and other contaminants from a CCS underground storage or surface infrastructure and transportation network (O'Halloran, G. 2023).

Long-term liability

Pursuant to the EU CCS Directive, the state may assume liability after the expiry of a 20-year minimum period from the date of closure of a storage site, unless the competent authority is convinced that all available evidence indicates the stored CO_2 will be completely and permanently contained before the end of that period. In any case, the operator needs to provide evidence indicating that the stored CO_2 will be completely and permanently contained. The CCS Directive requires the operator to prepare a report that demonstrates the following:

- The conformity of the actual behaviour of the injected CO_2 with the modelled behaviour
- The absence of any detectable leakage
- The evolution of the storage site towards a situation of long-term stability.

Each holder of a storage permit must pay an amount towards the estimated long-term monitoring and verification costs for the storage site, as discussed earlier in the *financial security and financial contribution section.*

The EU CCS Directive define "closure" of a storage site as the definitive cessation of CO_2 injection into that storage site and "post-closure" as the period after the closure of a storage site, including the period after the transfer of responsibility to the competent authority.

THE EU CCS DIRECTIVE REQUIRES MEMBER STATES TO ENSURE THAT POTENTIAL USERS CAN OBTAIN "FAIR AND OPEN" ACCESS TO CO_2 STORAGE SITES IN A NON-DISCRIMINATORY MANNER

Access to storage

The EU CCS Directive requires Member States to ensure that potential users can obtain "fair and open" access to CO_2 storage sites in a non-discriminatory manner. Much like its stipulations for access to shared CO_2 transport networks, the Directive has in place provisions for access to storage that are determined by reasonable availability of capacity and technical requirements. According to Article 21 of the EU CCS Directive, the access should be provided on transparent and non-discriminatory basis considering storage capacity, proportion of CO_2 emissions reduction obligations, the need to refuse access where there is an incompatibility of technical specifications that cannot be reasonably overcome, and the needs of the owner or operator of the storage site.

EXAMPLE: THIRD PARTY ACCESS PROVISIONS IN NORWEGIAN REGULATIONS

In Norway, national regulations derived from the EU CCS Directive provide a comprehensive regulatory framework for CO_2 transport and storage. This framework includes several provisions that seek to clarify coordinated storage development and third-party access of the site:

- **Coordination of CO_2 storage:** The framework notes that if a subsea storage reservoir extends across multiple licence holders, or into another country's jurisdiction, the affected parties must submit for approval an agreement on how they will co-ordinate transport, injection and storage activities.
- **Third-party access:** The relevant authority can allow third parties to access and use CO_2 storage sites if it determines that such shared use is "not an unreasonable impediment" to the licensee's own storage needs. The licensee that owns the storage facility may refuse third-party access if it determines there is a lack of capacity to take on the additional CO_2. However, the relevant authority is allowed to intervene and instruct the licensee to increase the site's capacity if it is economically justifiable or if the third party will pay for the necessary capacity increases, so long as the capacity addition does not adversely affect the rest of the storage site.
- **Specifications for access:** For third parties to take advantage of capacity in a shared storage facility, the CO_2 flow must have specifications that are "reasonably certain" to be compatible with the technical requirements of the storage facility and location.
- **Operator risk and profit:** The framework empowers the relevant authority to ensure that storage of CO_2 is implemented with consideration of resource management and that the owner of the facility is afforded a reasonable profit, taking into account investment and risk.

Source: Gassnova, 2022

8.0 COMMUNITY/ STAKEHOLDER ENGAGEMENT PROCESS

Community engagement is a critical component of a CO_2 storage application process, and securing support from local stakeholders is instrumental for a successful implementation of a CCS project.

The EU CCS Directive recommends that community efforts on CCS projects be conducted as early in a project as possible. It also affirms that environmental information relating to CO_2 storage should be made publicly accessible. The Environmental Impact Assessment as part of CO_2 storage permit process requires community engagement activities such as publication in local newspapers, written submissions, public inquiries, etc.

In 2021, the EC established the Industrial Carbon Management (ICM) Forum (previously known as the CCUS Forum). The work of the ICM Forum has been supported by several working groups, one of which is dedicated to the topic of public perception.

In February 2024, the EC released the *EU Industrial Carbon Management Strategy* outlining its intention to work alongside Member States and/or industry to "specify operating conditions for CO_2 transport and storage projects that can reward local communities for hosting them and increase knowledge, awareness and public debate on industrial carbon management" (European Commission, 2024a).

Engaging into a two-way dialogue with all stakeholder groups regarding a proposed CO_2 storage project is an important process to secure understanding and support for the project. Effective community engagement activities should be run as part of the project development. Such activities can be conducted by establishing regular, transparent and open forms of dialogue used to share information about the goals and outcomes of the projects, as well as the processes in place to manage accountability and mitigate risks (US DOE, no date).

Project engagement should consider the project specifics and the broader context in which the project is located. It could be achieved via different activities, consisting of disseminating information at the local level, involving communities in the decision-making process or compensating them with financial contributions (Duetschke, 2023). Participatory formats such as town halls, citizens assemblies may be important formats of public engagement with communities. Communication activities could leverage classic media (such as brochures, local media), face to face interactions (local activities and events) or digital media for a broader reach (Witte, 2021).

Community engagement needs to be well planned, and experience shows that dialogue is required before the project is launched (to show the community that their views and those from other relevant stakeholders are considered), and during the project implementation (to respond to any questions and concerns). Socio-demographic factors (i.e. gender, age, profession, level of education, etc.) which can influence the creation of public perception should also be taken into consideration during stakeholder engagement (Heidebroek, Deijkers and Hernández, 2024).

It is also important to define the lead for community engagements – e.g. a governmental agency, a project developer, a research/expert organisation, a trade union, an NGO, etc. Building trust between the community and project developer will be crucial. The project developer may also lean on community members who are better spokespeople to engage with the community on its behalf. The project developer should identify and prepare all necessary information that would be required during community engagement conversations and campaigns.

Community engagement is only a part of a broader stakeholder engagement. With CCS being increasingly featured in national, sub-regional and global climate policies as a crucial climate mitigation solution to overcome the global challenge of climate change, informing and engaging all relevant stakeholders is needed to make sure that a wide range of opinions from key players are considered in the relevant decision-making processes (Duetschke, 2023). An Environmental Impact Assessment, discussed below, requires public consultation. A broader understanding and support for the technology is instrumental in developing favorable views at a community level.

International and national advocacy work that provides objective information about CCS and creates opportunities for stakeholder engagement on the topic is very important for promoting an objective and balanced take on CCS. This could be achieved through a wide range of actions, including:

- Communicating the role of the technology in the broader context of the climate change crisis and decarbonisation strategies, as well as unpacking the risks and other benefits associated with CCS, leveraging scientifically proven facts;
- Identifying credible, independent and trusted channels of communication (such as experts, scientists and industry specialists) to talk about CCS technology;
- Showcasing success stories of CCS projects as concrete examples and sharing their lessons learned during the process.

Building on the experience of past projects, it would be advisable to kick-start the engagement process by developing a map of stakeholders aimed at identifying all relevant groups and representatives to be involved (CCUS Projects Network, 2020). Alongside the project developers and public concerned by the project, other relevant stakeholder groups may include:

- Local and national authorities
- Policy makers and regulators
- NGOs and experts
- Academia
- Media
- Industries and trade unions
- Other offshore users of the sea; fishing, mining, shipping, offshore wind projects.

9.0 ENVIRONMENTAL IMPACT ASSESSMENT

Directive 2014/52/EU establishes a legal framework for Environmental Impact Assessment (EIA) in the EU. Annex III of the Directives determines whether a project should be subject to an EIA based on the following criteria:

- Characteristics of projects
- Location of projects
- Type and characteristics of the potential impact

The CO_2 storage operator must conduct an EIA in the process of obtaining a storage permit. In the Netherlands an integrated assessment of the whole value chain is required as part of a storage application, considering capture, transport and storage.

A CO_2 storage developer should consider the timing for conducting the EIA so that it is completed within the same timeframe as all other documents that are being collected for obtaining a storage permit. The project developer may consider drafting a Roadmap to keep all necessary data and process steps together. As a first step, the project developer may need to identify all necessary regulations (this will also depend on the presence of Nature 2000 or archeological sites in the vicinity of a proposed project). A discussion with the competent authority is necessary in the early stages to jointly agree on the scope of the study, which in turn will be defined by the characteristics of the project, its location, types of potential impacts.

Characteristics of projects

- The size and design of the whole project
- Identification and description of any linked or related projects
- The use of natural resources, in particular land, soil, water and biodiversity
- The production of waste
- Pollution and nuisances

EXAMPLE: PORTHOS PROJECT EIA INSIGHTS

To develop an integrated EIA, the CO_2 storage developer for the Porthos project needed to collaborate with defined or potential CO_2 capture facilities and transport providers. In case of an open access infrastructure, it should include assessment of possible future activities. If future transport and capture providers are not known, it is required to develop an EIA for various types of capture and various types of transport.

Source: EBN, 2022

EXAMPLE: GOVERNING ENVIRONMENTAL SAFETY OF CCS PROJECTS IN DENMARK

Denmark is obligated to comply with various requirements for safety and environmental protection in relation to CCS under the auspices of the EU and several international agreements. For offshore activities, these obligations follow from the London Convention and Protocol, as well as the OSPAR Convention and the Helsinki Convention (HELCOM), all of which aim to protect the marine environment.

Several safety and environmental aspects are regulated by the CCS Directive. CCS is also covered by current Danish environmental and risk assessment legislation, including the Danish Environmental Assessment Act, Danish Subsoil Act and the Executive Order on impact assessments in connection with offshore projects.

Source: Danish Energy Agency website

- The risk of major accidents and/or disasters which are relevant to the project concerned, including those caused by climate change, in accordance with scientific knowledge
- The risks to human health (for example due to water contamination or air pollution)

Location of projects (environmental sensitivity of geographical areas)

- Existing and approved land use
- Relative abundance, availability, quality and regenerative capacity of natural resources (including soil, land, water and biodiversity) in the area and its underground
- Sensitivity and ability of the natural environment to handle a proposed industrial activity, paying particular attention to the following areas:
    - Wetlands, riparian areas, river mouths
    - Coastal zones and the marine environment
    - Mountain and forest areas
    - Nature reserves and parks
    - Areas classified or protected under national legislation; Natura 2000 areas designated by Member States pursuant to Directive 92/43/EEC and Directive 2009/147/EC
    - Areas in which there has already been a failure to meet the environmental quality standards, laid down in EU legislation and relevant to the project, or in which it is considered there is such a failure
    - Densely populated areas
    - Sites of historical, cultural or archaeological significance

Type and characteristics of the potential impact

The likely significant effects of projects on the environment must be considered in relation to:

- Magnitude and spatial extent of the impact (geographical area and size of the population likely to be affected)
- Nature of the impact
- Transboundary nature of the impact
- Intensity and complexity of the impact
- Probability of the impact
- Expected onset, duration, frequency and reversibility of the impact
- Cumulative impact with other existing and/or approved projects
- Possibility of effectively reducing the impact

Typical environmental issues related to CO_2 storage to be considered in an EIA include:

- General Energy – CO_2 balance, along the chain
- Onshore External safety
    - Noise
    - Air quality – nitrogen
    - Impact on biodiversity
    - Soil, water, archaeology
- Offshore
    - Nitrogen emissions
    - Marine ecology
    - Noise (under water noise), disturbance
    - Archaeology

- Subsurface – outside the biosphere
    - Environmental law applies to a layer from the surface to 500 meters below the surface, known as biosphere. Activities in subsurface below 500 meters are regulated by the Mining law.
    - Setup of specific methodology to describe impact of CO_2 storage in the subsurface
    - Change in the subsurface rock formations (mechanical, chemical, temperature)
    - Exclusion of other usages of these depleted gas fields or aquifers
    - Risks for the biosphere through breach of containment (possible leakage of CO_2 into the biosphere though: Wells, Cap rock, Spill point, Faults) or earthquakes (EBN 2022).

The EIA should include stakeholder participation and rely on a committee of experts who carry out analysis and develop final reports.

EXAMPLE: INFORMATION PROVIDED BY PORTHOS FOR THE EIA

Information that had to be provided by the CO_2 storage developer as part of Porthos' application in the Netherlands, including that related to capture and transport, contained:

- Description of current situation
- Description of the aspects of the environmental impact of the project
- Consider future development (if multiple sources, including future ones will be using this storage site)
- Post decommissioning impacts on the environment of potential leakage of CO_2 to the near surface and seabed or the surface.

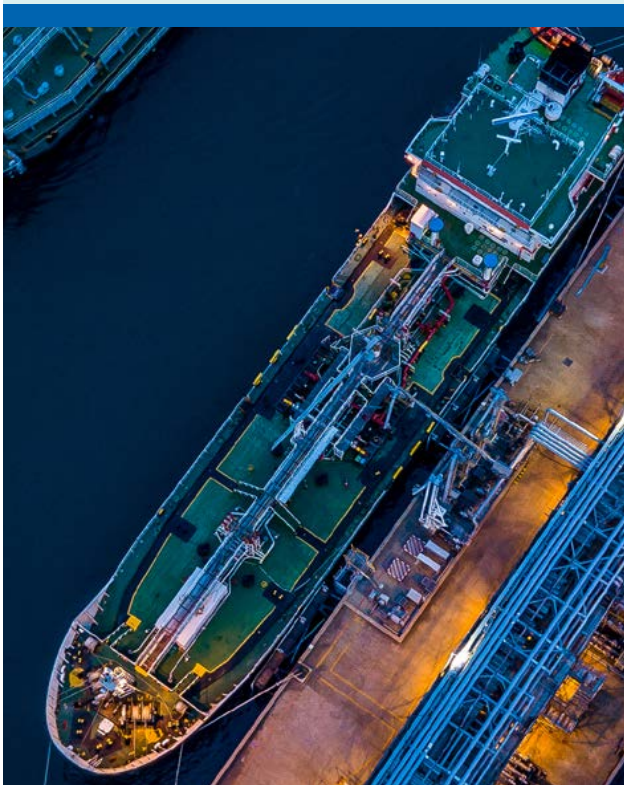
Source: EBN, 2022

EXAMPLE: EIA REQUIREMENTS IN NORWAY

Norway's approach puts an emphasis on the protection of the geological area of subsea reservoirs and requires operators to consider any transboundary environmental effects. As part of the EIA, the relevant authority requires storage operators to assess and specify the following environmental consequences of the development and operation of a storage site:

- Describe discharges to sea and emissions to air
- Describe any material assets and cultural artefacts that may be affected as a result of the development
- Assess the consequences of the chosen technical solutions
- Clarify how environmental criteria and consequences have been used as a basis for the chosen technical solutions
- Describe possible and planned measures to prevent, reduce and if possible, compensate for considerable negative environmental impact

Source: International Energy Agency, 2022



10.0 CONCLUSIONS

CO_2 storage development requires substantial effort and time from both the project proponent and the competent authority. Having a template of what is required and examples from similar processes could help start this process with a strong advantage by having a solid basis of information and understanding and save time for initial scoping.

Collaboration among countries and knowledge sharing can help improve efficiency of the storage permit application process.

Legal and regulatory frameworks that govern CO_2 storage in the EU provide a strong basis for safe and permanent geological storage of CO_2. However, Member States may need to develop additional regulations and/or amend their current national laws and regulations to provide further clarity. New insights are still being developed as the experience grows. Some adjustments to national requirements may need to be made to reflect new information and understanding.

Stakeholder engagement is one of the critical components of the CO_2 storage application process. The public affected by the project needs to be informed, listened to and provided with all necessary information to develop confidence in the project and understand its benefits.

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