OXFORD PUBLIC INTERNATIONAL LAW

Oxford Encyclopedia of EU Law

Carbon Capture and Storage

Leonie Reins

Content type: Encyclopedia entries
Product: The Oxford Encylopedia of EU Law [OEEUL]
Article last updated: August 2021

Subject(s):
Environment

A. Introduction

1 The technology of Carbon Capture and Storage ('CCS'), also described as a family of technologies (Zillman, McHarg, Barrera-Hernandez and Bradbrook 13 Find it in your Library), aims, as its name suggests, at capturing carbon dioxide (CO2) from large point sources (power plants) and transporting it to a storage site to depose or store the CO2 in underground geological formations (Fouillac 121–41 Find it in your Library; Gibbins and Chalmers Find it in your Library). The technology consists of several components: i) the capture of CO2 from various point sources (cement factories, chemical factories, fossil fuels plants); ii) to the extent relevant, the transportation thereof to a storage site via pipelines; and ultimately iii) the long-term storage of the carbon underground.

2 Within the United Nations Framework Convention on Climate Change (UNFCCC), the potential for CCS as a mitigation technology was first recognized in a special report written by the Intergovernmental Panel on Climate Change ('IPCC') in 2005 (IPCC Special Report). CCS was subsequently included as part of the UNFCCC's Clean Development Mechanism. The technology regained public, political, and academic attention after the adoption of the Paris Agreement in 2015 and recognition of the related need to decarbonize the economy rapidly in order to meet its goals of limiting global average temperature growth since pre-industrial times to 2c and to 1.5c if possible (Maddahi Find it in your Library). The (legal) discussion on CCS however is also closely interlinked with the European Union's climate change goal to reduce CO2 emissions by 55% by 2030 and to be carbon neutral by 2050. CCS can play a significant role in doing so, by contributing to the achievement of deep decarbonization in hard-to-abate sectors, such as the cement and chemical sectors, and by delivering negative emissions, for example through air capture carbon storage ('DACCS') or through coupling geologic CO2 storage with bioenergy ('BECCS)'.

3 The European Union (EU or 'Union') was one of the first jurisdictions to adopt specific CCS regulation dealing with all aspects of the technology. Directive 2009/31/EC ('CCS Directive'), a *sui generis* rule on the geological storage of carbon dioxide, establishes a legal framework for the environmentally safe geological storage of carbon dioxide to contribute to the battle against climate change (Doppelhammer Find it in your Library). The European Commission itself purports that an integrated approach for the regulation of CCS exists (European Commission (Climate Action B) Find it in your Library; Reins Find it in your Library). The purpose of environmentally safe geological storage is permanent containment of CO2 to prevent and eliminate negative effects, as well as any risks to the environment and human health (Art. 1 Directive 2009/31/EC). However, in practice 'the realisation of large-scale CCS projects in Europe has been challenging, with many projects being slowed down or cancelled by financial restrictions, public acceptance and also lack of incentives' (European Commission (EU Science Hub) Find it in your Library).

4 Importantly, CCS is a cross-cutting energy and environmental issue which is likely to also affect European energy policy. In the European Union, 'Energy' and 'Environment' are shared competences between the Union and the Member States in accordance with the provisions of Articles 4(2)(i) and 4(2)(e) Treaty on the Functioning of the European Union (TFEU) and Article 191–93, as well as Article 194 TFEU. The interplay between the competences of the Member States and the Union in the area of energy has become more complicated with the entry into force of the Lisbon Treaty. Since then, Article 194(2) TFEU specifies that, without prejudice to Article 192(2)(c), the measures necessary to achieve the objectives of the EU energy policy 'shall not affect a Member State's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply'. The regulatory framework applicable to

CCS was adopted under the environmental competence prior to the Lisbon Treaty, and thus, also prior to the introduction of the Energy Title of the TFEU (Reins).

5 The discussion on competences at European level is complicated by the divergent regulatory and policy approaches towards CCS at the Member States level. According to Article 4(1) of the Directive, 'Member States shall retain the right to determine the areas from which storage sites may be selected pursuant to the requirements of this Directive. This includes the right of Member States not to allow for any storage in parts or in the whole of their territory'. In this regard, Finland, Luxembourg, and the Brussels Capital Region of Belgium do not allow CO2 storage on the ground that their geology is not suitable (International Association of Oil and Gas Producers ('IOGP'), 2019 Find it in your Library). Further, Austria, Croatia, Estonia, Ireland, Latvia, and Slovenia do not allow geological storage of CO2. Sweden, the United Kingdom (UK), and the Netherlands have restricted its offshore storage. The Czech Republic enacted time restrictions providing that CO2 storage would not be authorized before 1 January 2020. Poland only allows it for demonstration purposes (European Commission, 2017 Find it in your Library), and has determined one storage area. Germany has restricted the annual quantity of CO2 that can be stored both per storage side (1.3 Metric Tonnes (Mt) of CO2) and with a national total of 4 Mt CO2. Further, the federal states of Lower Saxony, Schleswig-Holstein, Mecklenburg-Western Pomerania, Saxony-Anhalt, and Bremen have already established or intend to establish limitations on or bans of underground storage of CO2, including for research purposes (European Commission, 2017). The reasons referred to are diverse, ranging from 'prioritising uses of the underground such as for geothermal energy, storage of energy or mining to giving special emphasis on the public interest such as environmental and tourism concerns' (European Commission, 2017).

6 The next section of this entry considers the state-of-the-art of the development of the technology. The following section examines the social and environmental regulatory risks associated with CCS. The entry then goes on to look in detail at the regulatory approaches adopted at the international level and in the European Union to regulate those risks whilst promoting the technology's use. The entry concludes by outlining future (regulatory) perspectives on the technology.

B. State of the Art and CCS Applications

7 According to the classification of the Global CCS Institute, in 2019, the combined capture capacity of all 51 CCS facilities globally is 96 million tonnes of CO2 yearly. There are 19 facilities in full operation, four under construction, and 28 in various stages of development, most of them located in the United States (Global CCS Institute 2019 Find it in your Library). In the European Union, it was originally estimated that by 2030 the CCS technology could foster 15% of the carbon emission reductions required and that seven million tonnes of CO2 could be stored by 2020, and up to 160 million tonnes by 2030 (Recital 5 Directive 2009/31/EC), however these estimations will in all likelihood not materialize. According to the International Association of Oil and Gas Producers, there are currently only four projects in Europe in operation: one of them in the EU (CO2 EOR Project Croatia); the others in the EEA, namely two in Norway: Sleipner CO2 Storage; Snøhvit CO2 Storage, and one in Iceland: Hellisheidi (IOGP, 2021 Find it in your Library).

8 For the future, four projects currently under development have been identified as

> promising [to] push CCS further: the Porthos Project in the Port of Rotterdam which targets a major industrial cluster; the Northern Lights project in Norway, which aims to be an open-access hub where companies can deliver captured CO2 for storage; the Acorn project in Scotland, which promulgates close public-private cooperation, and the Teesside region, where process industry and a gas power plant are jointly working on CCS infrastructure (Elkerbout and Bryhn, 2019A Find it in your Library).

Also, in the EU, two opinions on draft storage permits have been issued by the European Commission, one regarding certain blocks of the Dutch continental shelf and the other one for certain blocks on the UK Continental Shelf (European Commission (Climate Action A) Find it in your Library). In several jurisdictions CCS has been and still is subject to research and funding programs and initiatives. For example, the European Industrial Initiative ('EII') on CCS was established as part of the Strategic Energy Technology ('SET') Plan, together with the CESAR project on the advancement of the technology as part of the Commission's FP 7 program (CESAR Find it in your Library). Additionally, the European Energy Programme for Recovery ('EEPR') and the NER300—now replaced by the Innovation Fund—are programmes funded by European Union Emission Trading System ('ETS') allowances (European Commission, 2013, 4 Find it in your Library).

9 The (potential) applications of CCS are manifold, ranging from more traditional industrial sectors, such as the cement, iron, and steel sector, but also in the hydrogen, natural gas, and power sector. The negative emission technologies (BECCS and DACCS) are more innovative applications of the traditional CCS. Problems with the large-scale role out of CCS are generally associated with the fact that the technology is very expensive and not economically attractive. This is due not only to the long-term liability but also to the fact that the technology is not cost-competitive with other technologies such as wind or solar energy. In addition, the carbon price has not been at a high enough level during the operation of the EU's emission trading system to incentivize CCS investment by actors with duties to cover emissions for which they are responsible by obtaining allowances (Slagter and Wellenstein 5738 Find it in your Library; Akerboom and others 644796 Find it in your Library). Further, the lack of legal certainty surrounding its application, over-prescriptive requirements, and unclear regulatory frameworks can also stifle the technology (Reins). There is (academic) debate on the question whether the technology can be considered a 'new' technology or whether it is just a modification of various existing technologies, which have been applied in practice for many years (Havercroft, Macrory, and Stewart Find it in your Library). In line with this discussion, the perception of risks associated with the technology differs: 'Business and research NGOs have the most positive views of CCS, and environmental NGOs the most negative views' (Romanak, Fridahl, and Dixon 629 Find it in your Library).

C. Environmental and Social Concerns and (Regulatory) Risks

10 Generally, risks related to CCS can be distinguished between risks of a global nature, such as the release of CO2 in the atmosphere, and risks of a local nature. On a local level, using Germany as a case study, Kramer identifies public acceptance, environmental concerns, economic grounds, and overall policy considerations as the main reasons for the rejection of CCS technology (Krämer Find it in your Library). Indeed, several regulatory risks related both to the technological and financial challenges and to environmental and social concerns present themselves in regard to CCS (McHarg and Poustie 249 Find it in your Library); even though the risk perception depends on the viewpoint of stakeholders, governments, and scholars as well as the status of the project cycle (Faure 387 Find it in your Library). Arguably for CCS, *ex ante* determination of the risks is more complicated as there are only a few past experiences to draw from, especially as to the long-term consequences. Potential environmental risks relate to the impact on water aquifers, seismic risks, and deforestation at the local level (Faure 387). Social risks or concerns largely related to the public perception of CCS combine with low levels of awareness and misperceptions around CCS to hamper public acceptance of the technology (Romanak, Fridahl, and Dixon 629). One of the main concerns associated with the technology is carbon leakage into the atmosphere, as well as the scientific uncertainties and knowledge gaps regarding long-term security and liability of the geological storage sites (IPCC 2005a Find it in your Library; Grevers and Luten 6–14 Find it in your Library). Additional uncertainties in this regard are identified as '[a]ccess to and ownership of pore-space, especially in the US; Operational requirements, including monitoring, reporting, and verification (MRV); Liability issues, including long-term liability requirements and transfer of liability to the state' (Friedmann and others, 2020 Find it in your Library).

11 Although it cannot address all of these issues, concerns, and risks, law still plays an important factor in the development of the technology. Against this background, law and regulation more broadly can act as 'enabler' of the technology, but can also stifle its development. Existing legal uncertainties in the regulatory framework are perceived as a main barrier to the development of the technology. In the next section it will be described how the EU has addressed these (regulatory) uncertainties and risks, as well as what regulatory action has been taken at the international level.

D. Regulatory Approaches

12 The employment of CCS has led to regulatory action on international (Brus 19–59 Find it in your Library), regional, and national levels. At the international level, notably the Convention for the Protection of the Marine Environment of the North-East Atlantic ('OSPAR Convention') and the Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ('London Protocol') have been adapted to the technology. At the national or regional levels several jurisdictions have adopted regulatory frameworks regarding CCS. These either enhance existing regulatory frameworks with CCS-specific provisions or enact standalone CCS-specific legal frameworks (Friedmann and others 33). The development of legislation applicable only for one specific project has been an exception (eg see the Barrow Island Act, 2003 (Western Australia) which regulates Western Australia's Gorgon CO2 injection project; Friedmann and others 33). The European Union is an example of a jurisdiction with a stand-alone CCS-specific framework. The United States offers an example of a jurisdiction that has enhanced an existing regulatory framework. In contrast to the EU approach, CCS is not the focus of any Federal or State legislative action in the US (Gerrard and Gundlach Find it in your Library). As pointed out by Havercroft, Gerrard aptly summarizes that there is 'almost no purpose-built Federal legislation, a growing raft of federal regulations and Executive Orders, and a diverse list of state laws and local ordinances. [In the United States], [without a coherent and stable climate change policy, including the imposition of] a robust carbon price, CCS as a technology for climate change mitigation is unlikely to become commercially viable' (Havercroft, Macrory, and Stewart).

1. International law

13 At the international level, two instruments, the London Protocol and the OSPAR Convention, have addressed CCS activities offshore. There is currently no international regulatory framework for onshore activities. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ('London Convention') and the London Protocol are the global agreements regulating dumping of wastes at sea, aiming at the prevention of marine pollution. The European Union is not a contracting party to these instruments, but some of its Member States have ratified them. The London Protocol prohibits all dumping, except for possibly acceptable wastes on the so-called 'reverse list'.

In 2006, the Protocol amended its Annex I to regulate, amongst others, carbon capture and sequestration in sub-sea geological formations and to end legal uncertainty regarding a potential prohibition. More precisely, it added to the list of substances that can be dumped 'CO2 streams from CO2 capture processes for sequestration', under the caveat that: 'Carbon dioxide streams may only be considered for dumping, if: 1 disposal is into a sub-seabed geological formation; 2 they consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture and sequestration processes used; and 3 no wastes or other matter are added for the purpose of disposing of those wastes or other matter' (International Maritime Organization (IMO) 2006). The storage of CO2 is hence not prohibited if the disposal takes place in the sub-seabed geological formation and it consists overwhelmingly of carbon dioxide, meaning that it is not used as a means of dumping other wastes (Dixon, McCoy, and Havercroft 431 Find it in your Library).

14 Further, the Parties to the London Protocol amended Article 6 regarding the export of wastes or other matter to other countries for dumping or incineration at sea in 2009 to address the transboundary issues that arose after the 2006 amendment. The amendment included an exception to the general prohibition of the export of wastes or other matter to other countries for dumping or incineration at sea under the condition that the protection standards of the Protocol are fully met and 'an agreement or arrangement has been entered into by the countries concerned'. Such an agreement or arrangement shall include the 'confirmation and allocation of permitting responsibilities between the exporting and receiving countries consistent with the provisions of this Protocol and other applicable international law' (IMO 2009). This is also required in the case of export to non-contracting Parties (IMO 2009). The amendment has not yet officially entered into force, and will only do so 60 days after two-thirds of the Contracting Parties have deposited an instrument of acceptance with the Organization (see also Art. 21 London Convention). Currently, the amendment has only been ratified by six parties (Norway, the UK, the Netherlands, Iran, Finland, and Estonia). From an EU perspective, Denmark, Germany, Sweden, France, Belgium, Ireland, Spain, Italy, Luxembourg, Slovenia, Bulgaria, Croatia, and Cyprus have not ratified the amendment as yet.

15 The OSPAR Convention governs relations between North Sea/North-East Atlantic States concerning environmental protection of these marine areas. OSPAR Parties are predominantly EU Member States. Similarly to the Parties of the London Protocol, Contracting Parties of the OSPAR Convention adopted two Decisions to clarify the legal status of the storage of carbon dioxide in geological formations under the seabed in 2007 (OSPAR Commission, 2007a). The OSPAR Convention has explicitly prohibited the storage of carbon dioxide streams in the water column or on the seabed, but adopted guidelines to ensure safe storage of carbon dioxide streams in geological formations, meaning such formations in the sub-soil of the OSPAR maritime area including sub-seabed geological formations (OSPAR Commission, 2007b; for a more detailed analysis of the OSPAR Convention and CCS see Dixon, McCoy, and Havercroft).

2. The CCS Directive

16 In 2009 the CCS Directive was adopted. From the outset, law and policymakers in the EU had dual objectives: managing the environmental risks of the technology whilst addressing commercial barriers to its development. Their aim was to meet investors' needs for both legal certainty and a stable legal framework for their investments and economic incentives to invest in CCS (Roggenkamp and Woerdman 349 Find it in your Library; Woerdman and Couwenberg Find it in your Library; CEPS Find it in your Library). With the inclusion of CCS into the EU Emissions Trading System ('ETS'), the Commission believed that it had established such an incentive (Woerdman and Couwenberg), alongside

Commission funding programs and Member States' own initiatives. The Commission stated that '[t]he EU is committed to supporting CCS both financially and with regulatory steps' (European Commission, 2013, 3). Indeed, the focus was not so much 'if' CCS should be supported but rather 'how' and under which enabling framework and conditions (Woerdman and Couwenberg 99).

17 As mentioned above, the European legislator aimed at creating an integrated framework for the regulation of CCS. The CCS Directive amends the Environmental Impact Assessment Directive (Directive 2011/92/EU); the Water Framework Directive (Directive 2000/60/EC); the Directive on the limitation of emissions of certain pollutants into the air from large combustion plants (Directive 2001/80/EC, 'Large Combustion Plants Directive'); the Environmental Liability Directive (Directive 2004/35/CE); the Waste Framework Directive (Directive 2008/98/EC); the Integrated Pollution Prevention and Control Directive (Directive 2008/1/EC), since replaced by the Industrial Emissions Directive (Directive 2010/75/EU); and the Waste Shipment Regulation (Regulation (EC) No 1013/2006). Thus, the CCS Directive creates a specific regulatory regime for CCS activities by establishing an overall and general framework of the activity, and in addition makes use of the existing legal tools, such as the Environmental Impact Assessment and the Environmental Liability regimes.

(a) 'Capture' and 'transportation'

18 The aspects of 'capture' and 'transportation' are mostly dealt with in other, previously existing legislative instruments (Recital 15 Directive 2009/31/EC). For capture, the Industrial Emissions Directive regulates 'the risks of CO2 capture to the environment and human health' for covered industry installations (Roggenkamp Find it in your Library). The Environmental Impact Assessment Directive is to be applied regarding 'the capture and transport of CO^2 streams for the purposes of geological storage' for covered installations (Directive 2011/92/EU). For transportation, the CCS Directive itself requires Member States to grant access to transport networks and storage sites for potential users (Art. 21) and, in case of transboundary transport of CO2—as well as for transboundary storage sites or complexes—to cooperate and jointly meet the requirements of the CCS Directive (Art. 24). One regulatory shortcoming in this regard is that the definition of 'transport network' (Art. 3(22)) only includes transportation through pipelines and not via ships or trucks (Roggenkamp).

19 The CCS Directive directly addresses the issue of third-party access to transport networks such as pipelines (Art. 21) but not transportation by ship—which is subject to another legal regime—although the North Sea is becoming the main area for CO2 storage (Roggenkamp). However, the Directive falls short in encouraging the significant transportation networks that will likely be needed if CCS is to realize its full potential (Roggenkamp). Further, it only applies to 'pipelines connecting major point emitters and subsoil storage facilities and does not take into account other transportation networks' (Roggenkamp, 266). This in turn, leads to a different legal treatment of pipelines, especially in case of leakage in regard to the ETS (Roggenkamp). The main concern is that, because of the fact that most storage is taking place in the North Sea, a more 'integrated approach towards cross border transport via pipelines as well as ships, and the integration of pipelines used for non-CCS transport (OCAP)' is needed (Roggenkamp, 266).

(b) 'Storage'

20 For storage, the CCS Directive contains more provisions. This is also reflected in the structure of the Directive, which includes guidance for all steps of the CCS value chain, ranging from the selection of the storage sites and exploration permits (Chapter 2); storage permits (Chapter 3); and operation, closure, and post-closure obligations (Chapter 4). Carbon Storage is to be based on a competitive permitting system, using objective, published, and transparent criteria, and requiring a licence to site selection and to store (Art. 6). The CCS Directive establishes a harmonized application procedure regarding permits including harmonized conditions for the approval of a permit and the content thereof. So far Member States have different requirements in this regard. The Commission gives an opinion on the draft permit issued pursuant to Article 10. The fact that the Commission, as a superior authority, has some kind of say—even in the form of a non-binding opinion—in the issuance of such permits (Art. 10 Directive 2009/31/EC), pays tribute to the application of the precautionary principle and the (existing) scientific uncertainties. It may also generate the impression, whether or not well-founded, of further safety, thereby leading to greater public acceptance (Ricardo AEA and others, 2015a, 13 Find it in your Library). The industry sector questions this involvement, arguing that the Member States' authorities are competent enough, and that Commission intervention would only slow down the procedure (Ricardo AEA and others, 2015a, 13; Ricardo AEA and others, 2015b, 8 Find it in your Library).

21 The storage permit can only be granted to one operator in order to avoid conflicting uses. The conditions for applications for storage permits are included in Article 7 CCS Directive and include, amongst others, a proof of a valid financial security and a monitoring and provisional post-closure plan. The detailed content of the permits is included in Article 9. The operation, closure, and post-closure obligations are the central provisions of the Directive. Article 12 includes the CO^2 stream acceptance criteria and procedure, establishing that a

> CO^2 stream shall consist overwhelmingly of carbon dioxide [and that] concentrations of all incidental and added substances shall be below levels that would (a) adversely affect the integrity of the storage site or the relevant transport infrastructure; (b) pose a significant risk to the environment or human health; or (c) breach the requirements of [other] legislation. [The operator must keep] a register of the quantities and properties of the CO^2 streams delivered and injected, including the composition of those streams.

Monitoring and reporting obligations for the operator are included in Articles 13 and 14. Member States are required to organize a 'system of routine and non-routine inspections of all storage complexes', taking place at 'least once a year until three years after closure and every five years until transfer of responsibility to the competent authority' (Art. 15). Measures in case of leakages or significant irregularities are foreseen in Article 16 and include the taking of 'corrective measures', if necessary also by the competent authority.

22 Article 17 on closure and post-closure obligations state that the reservoir will be closed if the permit lapses, and amongst others if the relevant conditions stated in the permit have been met—if the reservoir is filled with CO_2. Even after closure, the responsibilities for monitoring, reporting, and corrective measures, for sealing the storage site, for removing the injection facilities, and also for surrendering ETS allowances in case of leakages stays with the operator until the responsibility for the storage site is transferred to the competent authority after a period of at least 20 years. It has however proven difficult to assess when CO_2 is permanently stored—for the transfer of responsibility (Roggenkamp). The transfer of responsibility takes place according to Article 18, 'if the following conditions are met: (a) all available evidence indicates that the stored CO_2 will be completely and permanently contained; (b) a minimum period, to be determined by the competent authority has elapsed …; (c) the financial obligations referred to in Article 20 have been fulfilled; (d) the site has been sealed and the injection facilities have been removed'.

23 A financial contribution ('[taking] into account those criteria referred to in Annex I and elements relating to the history of storing CO2 relevant to determining the post-transfer obligation' (Article 20)) has to be made available from the operator to the authority before the responsibility transfer which covers the monitoring costs for at least 30 years after the transfer (Arts 19 and 20). The contribution 'may be used to cover the costs borne by the competent authority after the transfer of responsibility to ensure that the CO2 is completely and permanently contained in geological storage sites after the transfer of responsibility' (Article 20). These Articles give significant room to the Member States to 'to decide how site operators should prove their ability to safely operate and monitor a storage site' (European Commission, 2015 Find it in your Library). According to Article 18 CCS Directive, the minimum period for the transfer of responsibility from the operator to the competent authority is 20 years (De Ridder and Haan 301–19 Find it in your Library). Currently, there is no practical experience with Article 18, meaning no transfer of responsibility has taken place so far.

24 Recital 30 further specifies that 'liability for environmental damage (damage to protected species and natural habitats, water and land) is regulated by Environmental Liability Directive (Directive 2004/35/CE) which should be applied to the operation of storage sites'. In addition, 'liability for climate damage as a result of leakages is covered by the inclusion of storage sites in the ETS Directive, which requires surrender of emissions trading allowances for any leaked emissions'. Liability for persons and objects is subject to national laws. In general, Faure makes several recommendations on how long term liability can be addressed though law and policy making, by focusing on setting appropriate goals and limits of liability rules including clarity on which acts classify as force majeure ('Only if the damage resulting from a natural disaster were to be considered totally unforeseeable and not preventable by reasonable measures taken by the operator would force majeure preclude liability', Faure 425), issue of liability attribution, the effect of regulation ('whether following regulations or, … permit conditions, would excuse an operator from tort liability', Faure 424); causation; joint and several liability; whether there should be a limit in time for long tail risks; and whether remedies should be limited in amount (Faure 424).

(c) Public opposition and awareness

25 The Barendrecht project in which a CCS project was cancelled partly due to intense public opposition illustrates public acceptance as a potential risk for CCS (Feenstra, Mikunda, and Brunsting Find it in your Library). The review of the CCS Directive indicated that the design and content of the Directive was a problem in the few existing cases involving public opposition. More concretely, industry stakeholders consider that the CCS Directive 'sends too many signals about "uncertainties and lack of safety" of CCS, and thus that the Directive is indirectly hampering public acceptance' (Ricardo AEA and others, 2015a, 8); and that public opposition and concern is best addressed at local and individual project levels. According to the draft recommendations for the review of the CCS Directive, 'both industry and one NGO … feel that the over-prescriptive requirements of the Directive and Guidance Documents are a factor in the slow progress of CCS, both directly and indirectly by *fuelling public concerns*' (emphasis added) (Ricardo AEA and others, 2015b, 8; Haszeldine 18 Find it in your Library). The stakeholders call for more 'flexibility at the MS [Member State] level [which] is key to further development of CCS' (Ricardo AEA and others, 2015a, 8). The Commission however has rejected this criticism and deems the CCS

Directive fit for purpose, regardless of the low uptake of the technology in the Union in practice.

(d) Amendments to the Large Combustion Plants Directive

26 The CCS Directive amended the Large Combustion Plants Directive, now repealed by the EU's Industrial Emissions Directive of 2010 (Directive 2010/75/EU), to require an assessment of the capture-readiness for large plants. Recital 47, in combination with Article 33 CCS Directive, explains that all original construction and operating licenses granted to cover—a rated electrical output of 300 megawatts or more—combustion plants after the entry into force of the CCS Directive have to 'have suitable space on the installation site for the equipment necessary to capture and compress CO^2 when the following conditions are met - suitable storage sites are available, - transport facilities are technically and economically feasible, - it is technically and economically feasible to retrofit for CO2 capture' (Art. 33).

27 Criticisms have been made that the criteria of when 'suitable storage sites are available', as well as when it is 'technically and economically feasible to retrofit for CO2 capture' are unclear and leave a lot of discretion to the Member States (Uibeleisen, 266 Find it in your Library). As for the feasibility criterion, it has been argued that it is unclear whether 'these terms are meant in the sense of a future projection or whether a retrofit with CCS-technology must be possible and storage sites must be available at the moment the original construction licence is granted' (Uibeleisen, 266 - 267). In the sense of a future projection, it can be argued that the conditions 'probably be met already today, whereas in the latter case the requirement to set aside suitable space would not yet exist due to the fact that CCS-technology is currently not yet available for large-scale industry operations' (Uibeleisen, 267). It is further argued that, 'from the meaning of the word "feasible" it might be deduced that a CCS-retrofit must actually be possible at the time the first licence is granted. Likewise, storage sites are usually only available for the operator of a power plant if respective contracts with storage site operators have already been signed or at least seem to be possible and not merely if storage sites are generally available on the territory of the respective Member State' (Uibeleisen, 267).

28 This interpretation of Article 33 CCS Directive (Art. 9a Large Combustion Plants Directive) would be in line with the findings of the 2017 Implementation Report, which has concluded that all assessments—29 in total in the EU at that point—carried out found that 'CCS is not economically feasible' (European Commission, 2017). At the same time the report noted that 'many of the permitted power plants are setting aside land for the equipment to remove and compress CO2 and are designed in such a way that CCS can be connected later on without major layout modifications, e.g. in the Czech Republic, Estonia, Germany and Poland' (European Commission, 2017). However, it has also been noted that this requirement alone is 'at least by some not considered to be sufficient for a power plant to qualify as "CCS-ready"' (Uibeleisen, 269), and that 'later technical adaptations for the installation of CCS-technology must be taken into account when building the new power plant … that detailed concepts for the later transport of the CO2 to the storage site must be presented … and that project partners for the transport and the storage of the CO2 have been identified and that a business model for the handling of the whole CCS-chain … as well as a financial blueprint for the costs of a retrofit are in place' (Uibeleisen, 269).

(e) Funding CCS projects from CO2 emissions allowance revenues

29 NER 300 is a European funding programme for innovative low-carbon technologies, such as renewable energy technologies—for example bioenergy, geothermal, wind, hydropower, and smart grids—but also CCS technologies such as pre-combustion, post-combustion, oxyfuel, and industrial applications. It was established in 2009 (Art. 10(a)(8) revised Emissions Trading Directive 2009/29/EC) and became operational in 2010 via the sale of 300 million allowances. The sale generated around 2 billion Euros for the New Entrants' Reserve ('NER') which was set up for the third phase of the EU ETS with the proceeds being distributed in two following award rounds (European Commission (Climate Action C) Find it in your Library). The rules and criteria and measures for the financing of commercial demonstration projects that aim at the environmentally safe capture and geological storage of CO2 were firstly adopted by Decision 2010/7499 and revised in 2017.

30 Despite NER 300, the lack of funding at the EU level and of co-funding from Member States, combined with the low carbon price, are one of the main reasons for the low and slow development of CCS projects (Åhmana and others Find it in your Library; Holwerda Find it in your Library). The Commission plans to discontinue NER 300 and to shift unused funds to its Innovation Fund for decarbonization in the period 2020–2030 (European Commission (Climate Action C)). This fund will also be financed by the sale of allowances for CO2 emissions under the EU ETS. It includes CCS alongside a wider range of technologies that was eligible for support under NER 300.

E. The EU as a 'Global Actor' Regarding CCS

31 At the starting point of the technology in the European Union, competitiveness of the EU economy and industry especially vis-a-vis the United States (Wilson and Gibbons 343 Find it in your Library) and Australia was recognized as a key reason for the development of CCS. However, over the years, the Union has increasingly taken the role as a 'global actor' to 'lead [the] global fight against climate change' (European Commission (Climate Action D) Find it in your Library and hence now also aims at stimulating or promoting CCS outside of the Union territory in cooperation with third countries, albeit with limited success, as will be explained in the following.

32 The EU–China initiative called the Near-Zero Emission Power Coal Initiative ('NZEC'), has (amongst others) the aim to establish 'development and demonstration of advanced, "zero emissions" coal technology based on carbon dioxide capture and geological storage' by 2020 (European Commission (Press Corner) Find it in your Library). However due to several reasons, such as 'delays in the implementation of CCS projects in the EU, data-access and co-financing in China—the next phase of the project has not been launched' (Teffer Find it in your Library). In India, the EU–India Initiative was even less substantive, as there was no flagship cooperation project involved and India has rejected the proposed co-operation on CCS, including funding opportunities by the EU (Diarmuid 156 Find it in your Library). The Indian government was 'much less willing to engage and much more defensive' than the Chinese government (Diarmuid 156). A third example for the EU's effort to push CCS projects on the international level is its collaboration with the Cooperation Council for the Arab States of the Gulf (EU–GCC): Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. In the 2019 initiative, CCS is identified as one of five working areas with focuses on sharing knowledge, research, and data regarding CCS (Annex 2 Commission Implementing Decision 2019).

F. Future (Regulatory) Perspectives of the Technology and Conclusion

33 Despite the need for the technology to reach the targets of the Paris Agreement and efforts on the international, but also national level to stimulate the growth of the technology also by creating more legal certainty, the technology is not operating at a large commercial level yet. The CCS Directive did not create an enabling framework as originally proclaimed. Due to low carbon prices and other complications (European Commission, 2013, 16), CCS has not been viewed as a viable technology by investors (Langlet 198 Find it in your Library; Boute 74 Find it in your Library; Woerdman and Couwenberg 106–23). Despite the past track record of CCS in the EU, the Commission has stressed, in the contexts of the European Green Deal and its aim of climate neutrality by 2050, that carbon dioxide removal, including CCS alongside nature-based solutions, plays a role in reaching this aim. It confirms that the technology is needed for certain, hard to decarbonize, industry sectors, and also that BECCS 'is required to generate negative emissions if we are to achieve climate neutrality' (Velkova 8 Find it in your Library). However, the exact future scale of CCS deployment will be seen in the coming decade and depends on the cost of the technology and on the societal debate on acceptance of the technology (Global CCS Institute, 2020 Find it in your Library).

34 Large-scale public investment for the financing of demonstration projects and a detailed regulatory framework have been used to try and make the technology work in practice (Havercroft and Macrory Find it in your Library). For the period after 2030, several steps have been recommended to be taken in order to make the technology viable:

> policy should focus on improving the investment case for both CCS as well as low carbon industrial products that carbon capture makes possible. This includes specific financing models that account for the high capital intensity of CCS, regional variation in industrial clusters, infrastructure and storage availability as well as the need to combine both private and public money (Elkerbout and Bryhn 2019b Find it in your Library).

As the Commission noted itself

> despite the continuous lack of positive assessment for technical and economic feasibility for CCS retrofitting, power plants are nevertheless setting aside land should the conditions change in the future … A considerable number of Member States and Norway continue to support or plan to support in the near future, through their national programmes or funds, research and demonstration activities on CCS. Furthermore, many countries are involved in a number of European research and collaborative projects (European Commission, 2019 Find it in your Library).

35 An alternative for or modification of the 'classical' CCS technology, has emerged in the last years: carbon capture and utilization ('CCU') or carbon capture, utilization, and storage ('CCUS'). The former technology, instead of storing the carbon underground, aims at recycling the carbon for further use, for example, for the production of substances or products, such as plastics, concrete, or biofuel. One backdrop is however that until now, there is 'limited demand for processes where CO2 is used, while not being released into the atmosphere at a later stage' (IOGP, 2019; Elkerbout and Bryhn 2019a). CCUS is a mixture of carbon storage and utilization, such as for example in enhanced oil recovery operations or in building materials. According to the International Energy Agency, since 2017, more than 30 integrated CCUS facilities have been planned globally, the majority of them in the United States and the European Union, as well as in Australia, China, Korea, the Middle

East and New Zealand (IEA Find it in your Library). It is estimated that, when all projects materialize, three times as much CO2 could be captured as is currently the case, amounting to 130 Mt per year (IEA). As the preceding brief regulatory analysis shows, creating the appropriate regulatory frameworks to provide legal certainty for investors, but also addressing the associated risks and concerns regarding public perception, environmental protection and long-term liability are pre-conditions for realizing this intention in practice.

Select Bibliography

M Åhmana et al, 'Demonstrating climate mitigation technologies: An early assessment of the NER 300 programme' (2018) *Energy Policy* 100–107. Find it in your Library

S Akerboom, S Waldmann, A Mukherjee, C Agaton, M Sanders, and G Jan Kramer, 'Different This Time? The Prospects of CCS in the Netherlands in the 2020s' (2021) 9 *Frontiers in Energy Research* 644796 available at: https://www.frontiersin.org/articles/10.3389/fenrg.2021.644796/full. Find it in your Library

A Boute, 'CCS Under the Project-Based Kyoto Mechanism' in MM Roggenkamp and E Woerdman (eds) *Legal Design of Carbon Capture and Storage: Developments in the Netherlands from an international and EU perspective* (Intersentia 2009) 61–95. Find it in your Library

M Brus, 'Challenging Complexities of CCS in Public International Law' in MM Roggenkamp and E Woerdman (eds) *Legal Design of Carbon Capture and Storage: Developments in the Netherlands from an international and EU perspective* (Intersentia 2009) 19–59. Find it in your Library

CESAR, 'Co2 Enhanced Separation and Recovery' available at: http://www.co2cesar.eu. Find it in your Library

CEPS, 'An enabling framework for carbon capture and storage in Europe' available at: https://www.ceps.eu/wp-content/uploads/2019/09/RB2019_03_An-enabling-framework-for-carbon-capture-and-storage-in-Europe.pdf. Find it in your Library

K De Ridder and A Haan, 'The Role of the Competent Authority in regulating CCS' in MM Roggenkamp and E Woerdman (eds) *Legal Design of Carbon Capture and Storage: Developments in the Netherlands from an international and EU perspective* (Intersentia 2009) 301–19 Find it in your Library

T Diarmuid, *European Climate Leadership in Question: Policies Toward China and India* (MIT Press 2015) 156. Find it in your Library

T Dixon, ST McCoy, and I Havercroft, 'Legal and Regulatory Developments on CCS' (2015) 40 *International Journal of Greenhouse Gas Control* 431. Find it in your Library

M Doppelhammer, 'The CCS Directive, its Implementation and the Co-financing of CCS and RES Demonstration Projects under the Emissions Trading System (NER 300 Process)' in I Havercroft, R Macrory, and RB Stewart (eds) *Carbon Capture and Storage: Emerging Legal and Regulatory Issues* (Hart Publishing 2011). Find it in your Library

M Elkerbout and J Bryhn 'An enabling framework for carbon capture and storage (CCS) in Europe: An overview of key issues' (CEPS, 23 September 2019a) available at: https://www.ceps.eu/wp-content/uploads/2019/09/RB2019_03_An-enabling-framework-for-carbon-capture-and-storage-in-Europe.pdf. Find it in your Library

M Elkerbout and J Bryhn,'Sinking to Zero' (CEPS, 22 January 2019b) available at : https://www.ceps.eu/ceps-publications/sinking-zero-role-carbon-capture-and-negative-emissions-eu-climate-policy/. Find it in your Library

European Commission (Climate Action A), 'Carbon Capture and Geological Storage - Ensuring safe and environmentally sound CCS' available at: https://ec.europa.eu/clima/policies/innovation-fund/ccs_en. Find it in your Library

European Commission (Climate Action B), 'Implementation of the CCS Directive', available at: https://ec.europa.eu/clima/policies/innovation-fund/ccs/implementation_en#tab-0-1. Find it in your Library

European Commission (Climate Action C), 'NER 300 Programme' available at: https://climate.ec.europa.eu/eu-action/funding-climate-action/ner-300-programme_en#:~:text=NER%20300%20is%20a%20funding,commercial%20scale%20within%20the%20EU. Find it in your Library

European Commission (Climate Action D), 'The European Union continues to lead global fight against climate change' (2019) available at: https://ec.europa.eu/clima/news/european-union-continues-lead-global-fight-against-climate-change_en. Find it in your Library

European Commission (EU Science Hub), 'Carbon capture, utilisation and storage' available at: https://ec.europa.eu/jrc/en/research-topic/carbon-capture-utilisation-and-storage. Find it in your Library

European Commission (Press Corner), 'EU and China Partnership on Climate Change' (MEMO/05/298, 2 September 2005) available at: https://ec.europa.eu/commission/presscorner/detail/en/MEMO_05_298. Find it in your Library

European Commission, 'Communication on the Future of Carbon Capture and Storage in Europe', 27 March 2013, COM(2013) 180. Find it in your Library

European Commission, 'Report on review of Directive 2009/31/EC on the geological storage of carbon dioxide: Accompanying the document Report from the Commission to the European Parliament and the Council Climate action progress report, including the report on the functioning of the European carbon market and the report on the review of Directive 2009/31/EC on the geological storage of carbon dioxide', 2015, COM(2015) 576 final. Find it in your Library

European Commission, 'Annex to the report from the Commission to the European Parliament and the Council on implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide', 1 February 2017, COM(2017) 37 final. Find it in your Library

European Commission, 'Report from the Commission to the European Parliament and the Council on implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide', 31 October 2019, COM(2019) 566 final. Find it in your Library

Michael Faure, ‘Liability and Compensation for Damage Resulting from CO2 Storage Sites’ (2016) 40(2) William & Mary Environmental Law and Policy Review 387. Find it in your Library

CFJ Feenstra, T Mikunda, and D Brunsting, ‘What Happened in Barendrecht? Case Study on the Planned Onshore Carbon Dioxide Storage in Barendrecht’ The Netherlands Energy Research Centre of the Netherlands, Petten (2010). Find it in your Library

C Fouillac, ‘CO2 Capture Transport and Storage, a Promising Technology for Limiting Climate Change’ in J Bernard Saulnier and MD Varella (eds), *Global Change, Energy Issues and Regulation Policies* (Springer 2013) 121–41. Find it in your Library

J Friedmann, A Zapantis, B Page, I Havercroft, and others, ‘Net-Zero and Geospheric Return: Actions Today for 2030 and Beyond’ (Center on Global Energy Policy, SIPA and Global CCS Institute, September 2020) available at: https://www.globalccsinstitute.com/wp-content/uploads/2020/09/Netzero-and-Geospheric-Return-2.pdf. Find it in your Library

MB Gerrard and J Gundlach, ‘CCs in the US climate Change Policy Context’ in I Havercroft, R Macrory, and RB Stewart (eds), *Carbon Capture and Storage Emerging Legal and Regulatory Issues* (Hart Publishing 2020). Find it in your Library

J Gibbins and H Chalmers, ‘Carbon capture and storage’ (2008) 36(12) *Energy Policy* 4317. Find it in your Library

Global CCS Institute, ‘New wave of CCS activity: Ten large-scale projects announced’ (29 October 2019) available at: https://www.globalccsinstitute.com/news-media/press-room/media-releases/new-wave-of-ccs-activity-ten-large-scale-projects-announced/. Find it in your Library

Global CCS Institute, ‘CCS Talks: The European Green Deal & CCS Fireside chat with DG CLIMA’s Artur Runge-Metzger’ (20 May 2020) available at: https://www.globalccsinstitute.com/resources/multimedia-library/ccs-talks-the-european-green-deal-ccs-fireside-chat-with-dg-climas-artur-runge-metzger/. Find it in your Library

W Grevers and L Luten, ‘Introduction to the CCS chain: Technological aspects and safety risks’, in Martha Roggenkamp and Edwin Woerdman (eds), *Legal design of carbon capture and storage: developments in the Netherlands from an international and EU perspective* (Intersentia 2009). Find it in your Library

S Haszeldine, ‘Geological Factors in Framing Legislation to Enable and Regulate Storage of Carbon Dioxide Deep in the Ground’ in I Havercroft, R Macrory, and RB Stewart (eds) *Carbon Capture and Storage: Emerging Legal and Regulatory Issues* (Hart Publishing 2011) 7–23. Find it in your Library

I Havercroft and R Macrory, ‘Pulling the Threads Together’ in I Havercroft, R Macrory and RB Stewart (eds), *Carbon Capture and Storage: Emerging Legal and Regulatory Issues* (Hart Publishing 2011) 277–96. Find it in your Library

I Havercroft, R Macrory, and RB Stewart, ‘Introduction’ in I Havercroft, R Macrory, and RB Stewart (eds), *Carbon Capture and Storage Emerging Legal and Regulatory Issues* (Hart Publishing 2020). Find it in your Library

M Holwerda, ‘Subsidizing Carbon Capture and Storage Demonstration through the EU ETS New Entrants Reserve: A Proportionality Test’ (2010) 3 CCLR 228. Find it in your Library

IEA, ‘Special Report on Carbon Capture Utilisation and Storage: CCUS in Clean Energy Transitions’ (IEA, 2020) available at: https://www.iea.org/reports/ccus-in-clean-energy-transitions/a-new-era-for-ccus. Find it in your Library

IOGP, ‘The potential for CCS and CCU in Europe’ (Report to the thirty second meeting of the European Gas Regulatory Forum, June 2019) available at: https://ec.europa.eu/info/sites/default/files/iogp_-_report_-_ccs_ccu.pdf. Find it in your Library

IOGP (2021), ‘CCUS Projects in Europe’ (April 2021) available at: http://gtw1h238bgv3dmbvo37kcoow-wpengine.netdna-ssl.com/wp-content/uploads/2020/06/IOGP_Map-of-EU-CCS-Projects.pdf. Find it in your Library

IPCC, ‘Special Report on the Carbon Capture and Storage, Summary for Policymakers’ (2005a), available at: https://archive.ipcc.ch/pdf/special-reports/srccs/srccs_summaryforpolicymakers.pdf. Find it in your Library

IPCC, ‘Special Report Carbon Capture and Storage – Technical Summary’ (2005b) available at: https://archive.ipcc.ch/pdf/special-reports/srccs/srccs_technicalsummary.pdf. Find it in your Library

L Krämer, ‘Germany: a county without CCS’ in I Havercroft, R Macrory, and RB Stewart (eds), *Carbon Capture and Storage Emerging Legal and Regulatory Issues* (Hart Publishing 2020). Find it in your Library

D Langlet, ‘Transboundary Dimensions of CCS: EU Law Problems and Prospects’ (2014) 8(3) *Carbon And Climate Law Review* 198–207. Find it in your Library

R Maddahi, ‘Carbon capture and storage under the Paris Agreement: a legal appraisal of compatibility and opportunities’ (2021) 31(5) *Environmental Law and Management* 183–192. Find it in your Library

A McHarg and M Poustie, ‘Risk, Regulation, and Carbon Capture and Storage: The United Kingdom Experience’ in A McHarg, DN Zillman, A Bradbrook, and L Barrera-Hernandez (eds), *The Law of Energy Underground: Understanding New Developments in Subsurface Production, Transmission, and Storage* (Oxford University Press 2014) 249. Find it in your Library

L Reins, ‘The CCS Directive: Did it Stifle the Technology in Europe’ in I Havercroft, R Macrory, and RB Stewart (eds), *Carbon Capture and Storage Emerging Legal and Regulatory Issues* (Hart Publishing 2020). Find it in your Library

Ricardo AEA, et al, ‘Support to the review of Directive 2009/31/EC on the geological storage of carbon dioxide - Task 2: Assessment of the CCS Directive on the basis of evaluation and prospective questions – progress report’ (2015a) available at: http://

www.ccs-directive-evaluation.eu/assets/Summary-of-emerging-findings.pdf. Find it in your Library

Ricardo AEA, et al, ‘Support to the review of Directive 2009/31/EC on the geological storage of carbon dioxide - Task 3: First Draft Recommendations’ (2015a) available at: http://www.ccs-directive-evaluation.eu/assets/CCS-Directive-evaluation-Draft-recommendations.pdf. Find it in your Library

M Roggenkamp ‘Transportation of carbon dioxide in the European Union: some legal issues’ in I Havercroft, R Macrory, and RB Stewart (eds), *Carbon Capture and Storage Emerging Legal and Regulatory Issues* (Hart Publishing 2020). Find it in your Library

MM Roggenkamp and E Woerdman, ‘Looking Beyond the Legal Uncertainties of CCS’ in MM Roggenkamp and E Woerdman (eds), *Legal Design of Carbon Capture and Storage: Developments in the Netherlands from an international and EU perspective* (Intersentia 2009) 345–53. Find it in your Library

K Romanak, M Fridahl, and T Dixon, ‘Attitudes on Carbon Capture and Storage (CCS) as a Mitigation Technology within the UNFCCC’ (2021) 14(3) *Energies* 629. Find it in your Library

MW Slagter and E Wellenstein, ‘Drivers and barriers towards large scale Carbon Capture and Storage (CCS) deployment and possible government responses: current insights from the Dutch perspective’ (2011) 4 *Energy Procedia* 5738 available at: https://www.researchgate.net/publication/271562855_Drivers_and_barriers_towards_large_scale_Carbon_Capture_and_Storage_CCS_deployment_and_possible_government_responses_Current_insights_from_the_Dutch_perspective. Find it in your Library

P Teffer (2019), ‘EU-funded CO2-capture in China to miss 2020 deadline’ (2019) available at: https://euobserver.com/eu-china/144579. Find it in your Library

M Uibeleisen, ‘CCS-Technology: Implications for New Power Plants under German and European Law’ (2011) *Carbon & Climate Law Review* 264. Find it in your Library

M Velkova, ‘European Green Deal and CCS strategy for Europe’ (DG Climate Action, CO2GeoNet Winter Webinar, 2 February 2021) available at: http://www.co2geonet.com/media/68746/maria-velkova-eu-green-deal-and-ccs-strategy.pdf. Find it in your Library

EJ Wilson and AJ Gibbons, ‘Deploying Carbon Capture and Storage in Europe and the United States: A Comparative Analysis’ (2007) 4(5) *Journal for European Environmental & Planning Law* 343. Find it in your Library

E Woerdman and O Couwenberg, ‘CCS in the European Emissions Trading Scheme’ in MM Roggenkamp and E Woerdman (eds), *Legal Design of Carbon Capture and Storage: Developments in the Netherlands from an international and EU perspective* (Intersentia 2009) 97–125. Find it in your Library

DN Zillman, A McHarg, L Barrera-Hernandez, and A Bradbrook, ‘Introduction’ in A McHarg, DN Zillman, A Bradbrook, and L Barrera-Hernandez (eds), *The Law of Energy Underground: Understanding New Developments in Subsurface Production, Transmission, and Storage* (Oxford University Press 2014) 13. Find it in your Library

Select Documents

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 30 August 1975) UNTS 138 (London Convention).

Convention for the Protection of the Marine Environment of the North-East Atlantic (adopted 22 September 1992, entered into force 25 March 1998).

Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (adopted 17 November 1996).

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (23 October 2000**)** [2000] OJ L327/22 (Water Framework Directive).

Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (23 October 2001) [2011] OJ L309/1 (Large Combustion Plant Directive).

Directive 2004/35/CE of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage (21 April 2004) [2004] OJ L143/56 (Environmental Liability Directive).

Regulation (EC) No 1013/2006 on shipments of waste (14 June 2006) [2006] OJ L190/1 (Waste Shipment Regulation).

International Maritime Organization, 'Notification of amendments to Annex 1 to the London Protocol 1996' (27 November 2006) LC-P.1/Circ.5 available at: https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/LP1_1%20CO2.doc.

OSPAR Commission, 'OSPAR Decision 2007/02 on the Storage of Carbon Dioxide Streams in Geological Formations' (2007a) available at: https://www.ospar.org/documents?v=32643.

OSPAR Commission, 'OSPAR Decision 2007/01 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed' https://www.ospar.org/documents?v=32641.

OSPAR Commission, 'Guidelines for Risk Assessment and Management of Storage of CO2 Streams in Geological Formations (2007-12)' (2007b).

Directive 2008/1/EC of the European Parliament and of the Council concerning integrated pollution prevention and control (15 January 2008) [2008] OJ L24/8 (Integrated Pollution Prevention and Control Directive).

Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives (19 November 2008) [2008] OJ L312/3.

Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (23 April 2009) [2009] OJ L140/114 (CCS Directive).

International Maritime Organization, ‘Resolution LP.3(4) on the amendment to article 6 of the London protocol’ (adopted on 30 October 2009) available at: https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20LP-3(4).doc.

Commission Decision C (2010) 7499 laying down criteria and measures for the financing of commercial demonstration projects that aim at the environmentally safe capture and geological storage of CO 2 as well as demonstration projects of innovative renewable energy technologies under the scheme for greenhouse gas emission allowance trading within the Community established by Directive 2003/87/EC of the European Parliament and of the Council (3 November 2010) [2010] OJ L290/39–48.

Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) (Recast) (24 November 2010) [2010] OJ L334/17 (Industrial Emissions Directive).

Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (13 December 2011) [2012] OJ L26/1 (EIA Directive).

Commission Implementing Decision C (2019) 3277 on the 2019 Annual Action Programme for cooperation with third countries to be financed from the general budget of the European Union, Action Document for EU-GCC Clean Energy Technology Network III (6 May 2019), available at: https://fpi.ec.europa.eu/system/files/2021-05/28_Partnership%20Instrument%202019.pdf.