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Legal implications of offshore CCS

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A. The regulatory framework relevant to offshore carbon capture and storage

This study was written in the framework of the collaborative project "ECO2-Sub-seabed CO_2 Storage: Impact on Marine Ecosystems" that is funded under the European Commission's Seventh Framework Programme.[1] The ECO2-project aims to develop best environmental practices and to guide the development of offshore Carbon Dioxide Capture and Storage (CCS) in the context of the European Union (EU) regulatory framework. The project intends to study the risks associated with this technology such as the likelihood of leakage of CO_2 from the storage site and to understand their potential effects on the marine environment. In this context, the transfer of scientific knowledge into a risk management framework is one of the central outcomes of the project. The present study forms an integral part of Work Package (WP) 5 of the ECO2-project that is dedicated to the development of a risk assessment and management framework of marine CCS.

The efforts to reduce greenhouse gas emissions so as to limit their adverse effects on the earth's climate have led to the development of several climate change mitigation strategies. CCS is an attempt to render fossil fuel "low carbon" by capturing CO_2 directly at the source without emitting it into the atmosphere. Even though different definitions of Carbon Capture and Storage exists,[2] the succinct definition used by the Intergovernmental Panel on Climate Change (IPCC) is used as a starting point of this discussion:

> "Carbon dioxide (CO_2) capture and storage (CCS) is a process consisting of the separation of CO_2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere."[3]

In the context of the ECO2-project, the storage in the sub-seabed will be the central focus. Consequently, the study will primarily refer to offshore or marine Carbon dioxide Capture and Storage, thus CCS-activities in sub-seabed geological formations. In order to ensure clarity and congruence, the acronyms CCS or marine CCS will be used when referring to this technology throughout the analysis.

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[1] Topic OCEAN.2010.3 Sub-seabed carbon storage and the marine environment, project number 265847.

[2] In some cases, carbon sequestration is synonymously used with carbon capture and storage, see only: J. E. Aarnes *et al.*, 'Towards guidelines for selection, characterization and qualification of sites and projects for geological storage of CO_2', 2009 *Energy Procedia* 1, no. 1, 1735–1742, 1736; IMO/LP, CO_2 Sequestration in sub-seabed formations: Considerations of proposals to amend Annex 1 to the London Protocol, LP 1/INF.2, 25.10.2006.

[3] International Panel on Climate Change, *IPCC Special Report on Carbon Dioxide Capture and Storage*, 2005, 3.

Generally, CCS entails three distinct steps in the production chain: the capture, the transport and the storage of carbon dioxide. During the capture process, a concentrated stream of CO_2 at high pressure is produced that is then transported by either vessels or pipelines to the specific storage site.[4] In a third step, the CO_2 is injected in a supercritical form into underground storage sites such as abandoned oil and gas fields or saline aquifers.[5] A particular aspect of this climate mitigation technology is the potential escape of CO_2 from the storage site, so-called leakage. The IPCC underlines in its Special Report on CCS that

> "observations from engineered and natural analogues as well as models suggest that the fraction retained in appropriately selected and managed geological reservoirs is very likely to exceed 99% over 100 years and is likely to exceed 99% over 1,00 years."[6]

Even though the risk associated with leakage of CO_2 from the storage sites is therefore estimated to be low, no complete knowledge on the requirements for an "appropriately selected and managed" storage site and the potential impacts of leaked CO_2 is available.[7]

This report aims to provide a comprehensive review of the legal framework relevant to the regulation of marine CCS. Since the overall focus of the ECO2-project is on the permanent storage and containment of CO_2 in geological formations, the study will primarily focus on this issue. However, where appropriate, reference to transportation and capture of CO_2 issues for the purpose of marine CCS will be made. Marine CCS is, due to its nature, placed at the intersection of different regulatory approaches. Its role as an option in the climate change mitigation portfolio is the fundamental reason for investment and further development of technologies that simultaneously resulted in increased regulatory responses on different levels. The legal framework of marine CCS not only relates to the corresponding regulatory climate change issues, but also integrates questions relating to the right of use and the distribution of competences to pursue such an activity in the marine environment. Amongst others, a legal study of the pertinent public international and European law rules and principles also requires an analysis of marine environmental protection questions. In accordance with the aim of the ECO2-project, particular attention will be paid to how risks and potentially adverse conse-

[4] See for a comprehensive overview: H. S. Eggleston, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, 2006, Chapter 3; S. A. Rackley, *Carbon capture and storage*, 2010, Part II.

[5] International Panel on Climate Change, supra note 3, Chapter 5; Rackley, supra note 4, 250 *et seq.*

[6] In this context, "very likely" is defined as a probability between 90 and 99%; see International Panel on Climate Change, supra note 3, 14; see also: International Energy Agency, *CO_2 Capture and Storage*, 2008, Energy Technology Analysis, 125.

[7] International Panel on Climate Change, supra note 3, 48.

quences of offshore CCS are integrated in and addressed by the pertinent international and European measures.

The following study thus sets out to outline the *status quo* of the regulatory framework of marine CCS in public international law and EU law.[8] It aims to provide a synopsis of the different developments in several fora in order to understand the various regulatory responses to sub-seabed carbon capture and storage.

Conceptual outline of the study

In the *first* section, marine CCS will be analysed within the context of climate change mitigation. After all, it is in this context that the development of CCS has necessitated the need for a specifically applicable regulatory structure. The review will thus first consider the climate change regime as established by the United Nations Framework Convention on Climate Change and the provisions of the Kyoto Protocol. A specific aspect in this regard is whether and how CCS activities can be integrated in the flexible mechanisms as envisaged by the Kyoto Protocol. Here, a focus is laid on the integration and accounting of possible CO_2 leakage from the storage site. The analysis is aimed to understand how the associated risks of CCS are addressed in this framework, and whether particular regulations are made for marine CCS projects. In a *second* step, the distribution of competences for the storage of CO_2 in the subseabed will be analysed in the context of the United Nations Convention of the Law of the Sea. It is also in this regard that the pertinent environmental protection standards relating to marine CCS activities will be examined. *Thirdly,* the specific provisions of the dumping regime established by the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and the subsequent adopted Protocol to the Convention will be assessed. In this section, the underlying risk assessment and management structures will be presented and evaluated. In a *fourth* step, the implementation and substantiation of the global legal requirements within the framework of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) will be analyzed with a view to the specific principles that govern the risks associated with marine CCS. The *fifth* section is dedicated to the regulatory framework of marine CCS in the EU. Particular attention will be paid to the CCS Directive as the central European instrument to regulate CCS. Its elements

[8] See for a discussion on the regulatory framework of CCS in South Africa: J. Glazewski *et al., Carbon Capture and Storage (CCS)*, 2012, <http://www.ernestaswanepoel.com/Carbon_Capture_Storage_Towards_a_regulatory_and_legal_regime_in_South_Africa.pdf> (last accessed on 31.03.2014).

will be analysed and contrasted with other regulatory approaches that have been included in international agreements and conventions. *Lastly*, a comparative examination of specific elements of the CCS regulatory structure and risks assessment approaches is pursued in order to understand the differences and similarities in the risk assessment methods of the various marine CCS instruments.

Terminology

Since the regulatory framework of CCS has been increasingly developing and is substantiated by different instruments, a particular aspect of the study will be the use of terminology in those agreements. The argument is made that the legal definitions of the constitutive elements of marine CCS form the baseline of evaluating and understanding the associated risks. This relates, *inter alia,* to the definitions of leakage of CO_2 from the storage site that serve as fundamental elements to describe adverse impacts and risks. The standard of threshold that is established through the use of definitions has an overall repercussion on how and when impacts are identified. In this context, issues such as the CO_2-stream composition and concepts used to describe the risks associated with CCS activities will be also examined. The aim is to understand and contextualise varying and potentially contradicting approaches and definitions in order to be able to respond to identified conceptual problems.

Approaches to the understanding of risks associated with CCS activities

In view with the mandate of WP 5 to develop a risk assessment and management framework for marine CCS, the differing approaches to address risks associated with marine CCS will be presented. To this end, the obligations arising out of conventions will be analysed and reflected with their pertinent risk management and assessment frameworks. It will be attempted to define the common elements by way of a comparative analysis. Also, potential differences regarding the material and procedural obligations will be highlighted so as to gain a comprehensive understanding of the risk assessment methodologies that encompass marine CCS.

B. The United Nations and European Union's climate change regime

In order to address the issue of climate change, two central instruments have been adopted. By agreeing to adopt the United Nations Framework Convention on Climate Change (UNFCCC) in 1992[9] and the Kyoto Protocol to the UNFCCC (hereinafter referred to as the Kyoto Protocol – KP),[10] the international community has recognized climate change as one of the major global challenges. Since they favour "the strategy of 'mitigating climate change through the reduction of GHG emissions' over the complementary strategy of 'adaptation to climate change'",[11] the role of CCS technology will be considered in this context.

I. The United Nations Framework Convention on Climate Change

The UNFCCC[12] aims to stabilize greenhouse gas emissions at a level that would prevent dangerous anthropogenic interferences with the climate system.[13] Even though the Convention stresses the importance of returning to earlier levels of anthropogenic emission levels, it does not set a specific timeline nor sufficiently specific obligations with a view to achieving this goal. In implementing its objectives, the Contracting Parties shall be guided by the "principles" to take precautionary measures and promote sustainable development.[14] In achieving the envisaged reduction, two types of activities are set out: measures that reduce the emissions of greenhouse gases into the atmosphere and the removal of already emitted greenhouse gases.

In implementing those obligations, the UNFCCC differentiates between the obligations of its Contracting Parties depending on their classification as developing or developed countries.[15] Accordingly, developed countries and countries "undergoing the process of transition to a market economy" are listed in Annex I to the UNFCCC.[16] Irrespective of these provisions, the

[9] United Nations Framework Convention on Climate Change, New York, 09 May 1992, 1771 UNTS 107 (entered into force 21 March 1994).

[10] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 11 December 1997, 1771 UNTS 107 (entered into force 6 February 2005).

[11] U. Beyerlin & T. Marauhn, *International environmental law*, 2011, 161.

[12] See supra note 9.

[13] Art.2 UNFCCC.

[14] Art.3 (3) and (4) UNFCCC. *Beyerlin* and *Marauhn* speak in this context of "precepts" with weakly formulated obligations: Beyerlin & Marauhn, supra note 11, 159. See also: L. Massai, *The Kyoto Protocol in the EU: European Community and member states under international and European law*, 2011, 33.

[15] Art.4 (2) UNFCCC.

[16] The EU is also a Contracting Party to the agreement and is listed separately to its Member States in Annex I UNFCCC.

UNFCCC, due to its nature as an umbrella Convention, lacks detailed material obligations and requirements.[17]

II. The Kyoto Protocol and its flexibility mechanisms

Only three years after the entry into force of the UNFCCC, the Kyoto Protocol (KP)[18] was adopted, which aims to provide concrete reduction targets to mitigate anthropogenic climate change.[19] The KP commits 39 industrial States listed in Annex B to the KP[20] to jointly or individually ensure that their aggregate greenhouse gas emissions do not exceed their quantified emission limitation and reduction commitments that are inscribed in Annex B to the KP.[21] Developing countries (non-Annex B States) do not have to meet any corresponding obligations, but play nevertheless a role in the regime as foreseen by the KP.[22] The EU is also a Contracting Party to the KP and is listed in Annex B to the KP.[23] Until 2012, Annex I States were required to reduce their collective greenhouse gas emissions by at least 5% from the 1990 level.[24] The amendments of the KP negotiated during the COP in Doha, Qatar, in December 2012, laid down the reduction targets for the commitment period 2013 to 2020. The

[17] Beyerlin & Marauhn, supra note 11, 163; A. Proelss & M. Krivickaite, 'Marine Biodiversity and Climate Change', 2009 *Carbon & Climate Law Review*, no. 4, 437–445, 439.

[18] See supra note 10. The KP in itself has been criticized of failing to fully operationalize the vague provisions of the UNFCCC: Beyerlin & Marauhn, supra note 11, 164.

[19] During the first Conference of the Parties to the UNFCCC (COP) in Berlin in 1995, the so-called "Berlin Mandate" was issued in which the Contracting Parties outlined to take measures beyond 2000 *ibid.*, 160. Following the Berlin Mandate, the Kyoto Protocol was adopted during COP 3 in 1997. The rule of entry into force of the KP as outlined in Art.25 KP requires that 55 Parties to the Convention must ratify or accede to the KP including the equivalent of Annex I States that account for 55% of the groups' CO_2 emissions from 1990. With the submission of the instrument of ratification by the Russian Federation, the KP entered into force in 2005: L. Massai, *European climate and clean energy law and policy*, 2012, 17. See also: M. Grubb *et al.*, *The Kyoto Protocol: A guide and assessment*, 1999, 43 *et seq.*

[20] United Nations, Doha amendment to the Kyoto Protocol, Doha, 8 December 2012, C.N.718.2012.TREATIES-XXVII.7.c, 21.12.2012, 7 <http://treaties.un.org/doc/Treaties/2012/12/20121217%2011-40%20AM/CN.718.2012.
pdf> (last accessed on 31.03.2014).

[21] Art.3 (1) KP.

[22] Art.12 KP.

[23] Therefore, the KP and the UNFCCC are so-called "mixed agreements" to which the EU acceded next to its Member States. See further in this context: V. Frank, *The European Community and marine environmental protection in the international law of the sea: Implementing global obligations at the regional level*, 2008, 107 *et seq*. See also section E.I. and II. below. The EU and the Member States shall jointly reduce their greenhouse gas emissions by 8% below 1990 levels. The so-called Burden Sharing Agreement is the result of disagreement between the EU Member States to agree on a Community-wide greenhouse gas reduction emission target. The phenomena is also referred to as the EU bubble: Grubb *et al.*, supra note 19, 86. See for an in-depth discussion on the Burden Sharing Agreement: Massai, supra note 19, 56 *et seq.*

[24] Art.3 (1) KP.

so-called Doha amendments introduced, *inter alia*, the reduction target of 18% below 1990 levels to which, however, less Contracting Parties committed than in the precedent period.[25] While Canada has withdrawn as a Contracting Party from the KP in 2012, Belarus, Japan, New Zealand and Russia have not committed to the new reduction commitment period.[26] The Contracting Parties to the KP therefore represent approximately 30% of the worldwide CO_2 emissions.[27]

In order to meet the quantified emission limitation and reduction commitments, Art.2 (1) (a) KP sets out policies and measures that should guide Annex I States in implementing mechanisms so as to achieve their emission reductions:

> "(1) Each Party included in Annex I, in achieving its quantified emission limitation and reduction commitments under Article 3, in order to promote sustainable development, shall:
>
> *(a)* Implement and/or further elaborate policies and measures in accordance with its national circumstances, such as:
>
> […] (iv) Research on, and promotion, development and increased use of, new and
>
> renewable forms of energy, of carbon dioxide sequestration technologies
>
> and of advanced and innovative environmentally sound technologies […]"

The diverging interests regarding the scope and form of this norm that emerged during the negotiations clearly influenced its content.[28] Whereas the European Union favoured a detailed catalogue of measures, the United States of America opted for a "*laissez-faire*" approach.[29] Despite the obligatory verb "shall", the list of measures does not seem to be binding in its content and can be understood to merely serve as a guideline in the use of the mentioned policies. Consequently, the reference to CCS technologies in Art.2 (1) (a) (iv) KP cannot be understood as an absolute legal obligation to implement or elaborate this technology on a national level. This assumption is also supported by the clause "in accordance with its national

[25] United Nations, supra note 20, 4. See for a comprehensive overview on the endeavors to conclude a "post 2012 climate protection regime": Beyerlin & Marauhn, supra note 11, 164 *et seq*.; R. Lyster, 'Separating the Wheat from the Chaff: Regulating Greenhouse Gases in a Climate of Uncertainty', 2007 *Carbon & Climate Law Review* 1, no. 2, 89–104, 89 *et seq*.

[26] United Nations, supra note 20, 1 *et seq*.

[27] Based on own calculations from available data from 2009: <http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=749> (last accessed 31.03.2014).

[28] Grubb *et al.*, supra note 19, 124.

[29] *Ibid.*, 124.

circumstances"[30] that allocates to the Contracting Parties a considerable scope of discretion concerning the application of this provision.

The KP accepts two strategies to achieve the reduction of greenhouse gas emissions: the reduction of emissions at the source on the one hand and the removal of greenhouse gases by sinks on the other. The distinction between sinks and sources as a means to reduce emissions in the atmosphere is important in the calculation of the specific net emission reduction target of each country. Neither the UNFCCC nor the KP mention specific provisions on CCS technology and do not make reference to its classification as a source or a sink.[31] A sink is defined as:

> "any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere",[32] whereas a source is defined as "means any process or activity which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere."[33]

While the KP and the UNFCCC do not specify any particular emission reduction measures at the source, they limit the means to remove greenhouse gases from the atmosphere by using sinks to direct human land-use change and forestry activities (Art.3 (3) and (4) KP). Consequently, the KP would need to be amended in order to integrate CO_2 storage in the flexible mechanisms.[34] The Marrakech Accords from 2001[35] further substantiated that activities falling under Art.3 (3) KP also include, besides afforestation, reforestation and deforestation, revegetation, forest management, cropland management and grazing management.[36] Based on a strict interpretation of these activities, and assuming that this list is exhaustive, CCS activities do not qualify for any of the mentioned land-uses. Thus, the question whether CCS can be

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[30] Art.2 (1) KP.

[31] S. Bode & M. Jung, *Carbon dioxide capture and storage (CCS)-liability for non-performance under the UNFCCC*, 2005, HWWA Discussion Paper, no. 325, 6 *et seq*.

[32] Art.1 (8) UNFCCC.

[33] Art.1 (9) UNFCCC.

[34] J. Friedrich, 'Carbon Capture and Storage: A New Challenge for International Environmental Law', 2007 *Zeitschrift für ausländisches öffentliches Recht und Völkerrecht* 67, 211–227, 213; A. Proelss & K. Güssow, 'Carbon Capture and Storage from the Perspective of International Law', 2011 *European Yearbook of International Economic Law* 2, 151–168, 161–163.

[35] Adopted during COP 7: Massai, supra note 19, 26.

[36] UNFCCC/KP, Report of the Conference of the Parties on its seventh session, Marrakesh 2001, FCCC/CP/2001/13/Add.1, 21.1.2002, 58. Even though the documents of the UNFCCC and the KP also refer to the time frame of the meeting, in the following the date of publication of the reports will be used when citing those documents. Bode & Jung, supra note 32, 14; S. Haefeli *et al., Carbon Dioxide Capture and Storage Issues-Accounting and Baseline under the United Nations Framework Convention*, May 2004, IEA Information Paper, 19.

considered in the mechanisms of the KP is of legal but also of technological and factual relevance. It is debatable if CCS can be classified as a greenhouse gas reducing technology.[37]

CCS activities do not *per se* lead to an actual reduction of greenhouse gases. However, the emission of CO_2 into the atmosphere is avoided by discharging it into the seabed.[38] This assumption is further qualified regarding the definition of emission as "the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time."[39] CCS consequently does not remove CO_2 from the atmosphere, but reduces emission at the source and can thus be seen as a reduction of emission. Notwithstanding the risks of non-permanence after leakage of CO_2 from the storage site, it is seen as one option in the "portfolio of mitigation measures" in the context of the climate change regime.[40]

In achieving the emission reduction targets, the KP establishes "three dimensions […] of flexibility"[41] that have been evaluated as "the most innovative feature of the Protocol's regulatory system."[42] The underlying logic of these mechanisms is that they establish "a process of compensation between a non-reduction in one place and an increased reduction in another."[43] Also, the economic approach of the use of the so-called flexibility mechanisms "allow[s] reductions to be made where it is economically speaking most efficient."[44] These flexibility mechanisms are the Clean Development Mechanism (Art.12 KP), Joint Implementation (Art.6 KP) and Emissions Trading (Art.17 KP). Whereas Annex I States are under the obligation to reduce their greenhouse gas emissions, the flexibility mechanisms not only allow for the reduction of greenhouse gas emission in cooperation with other Annex I States, but also envisage, under certain conditions, cooperation with developing countries (non-Annex I States).

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[37] Institut für Völkerrecht und Europarecht der Georg-August-Universität Göttingen & Leibniz-Institut für Meereswissenschaften an der Christian-Albrechts-Universität Kiel, *CO_2-Abscheidung und Speicherung im Meeresgrund*, Juli 2008, Forschungsbericht, 206 25 200, 198.

[38] *Ibid.*, 219 and Bode & Jung, supra note 31, 6 *et seq*.

[39] Art.1 (4) UNFCCC.

[40] International Panel on Climate Change, supra note 3, 3. Despite the potential reduction of CO_2 emissions for industrial facilities, the process chain of CCS, thus the capture, transport and storage of CO_2, produces a certain amount of CO_2 which also needs to be considered when assessing the effectiveness of CCS: N. Supersberger *et al.*, *Carbon Capture and Storage - Solution to Climate Change?*, 26.10.2006, 4. A certain risk prevails that a CO_2 leakage could also occur during the capture process.

[41] Grubb *et al.*, supra note 19, 128 (emphasis added).

[42] Beyerlin & Marauhn, supra note 11, 162.

[43] M. Bothe & E. Rehbinder, *Climate change policy*, 2005, 6.

[44] *Ibid.*, 6 (emphasis added).

1. Clean Development Mechanism

The Clean Development Mechanism (CDM) allows Annex I States to implement climate mitigation projects in the territory of non-Annex I States. Under this project-based mechanism, so-called certified reduction units (CERs) are generated that can be used to fulfil their reduction obligations under the KP.[45] Besides these provisions, CDM projects must additionally fulfil the requirement of sustainability.[46] This criterion has certain repercussions for CCS activities. On the one hand, the removal of CO_2 at the source, thus the avoidance of any emission into the atmosphere, could support an argumentation in favour of sustainable development. However, the risk of leakage associated with CCS activities implies that this approach merely establishes a temporary solution in which one type of pollution is transformed into another.

The inclusion of CCS as an option under the KP and in particular under the CDM has been introduced in 2006. Projects under the CDM must be approved by the Executive Board which is also responsible for accrediting the CERs and the maintenance of the CDM registry.[47] In order to support the Executive Board, a methodological body for CCS issues in CDM project activities was established in the form of a CCS Working Group.[48]

A final decision whether CCS is eligible under the CDM was taken during the Conference of the Parties in Cancun in 2010.[49] Accordingly, the inclusion of CCS under the CDM is linked to monitoring and site selection criteria and an *ex-ante* estimation of overall project emissions, including potential leakage emissions.[50] In December 2011, the modalities and procedures for enabling CCS projects to be eligible under CDM were adopted.[51] Also, participation require-

[45] See for a comprehensive overview of the negotiations for the CDM: Grubb *et al*., supra note 19, 133 *et seq.*

[46] R. O'Sullivan & C. Cormier, *Meeting Participating Country Responsibilities under the CDM: Designating a National Authority*, in D. Freestone & C. Streck (eds.), *Legal aspects of implementing the Kyoto Protocol mechanisms: Making Kyoto work*, 2005, 214.

[47] M. Netto & K.-U. Barani Schmidt, *The CDM Project Cycle and the Role of the UNFCCC Secretariat*, in D. Freestone & C. Streck (eds.), *Legal aspects of carbon trading: Kyoto, Copenhagen, and beyond*, 2009, 217; UNFCCC/KP, The Marrakesh Accords, UNFCCC/CP/2001/13/Add.2, 21.1.2002, Appendix D, para.1.

[48] UNFCCC/CDM – Executive Board, Terms of reference of the support structure of the CDM Executive Board, EB 67 Annex 3, 2012, 3.

[49] UNFCCC/KP, Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its sixth session, Cancun 2010, FCCC/KP/CMP/2010/12/Add.2, 15.3.2011, 27 *et seq.* See for a general discussion on the eligibility criteria under the CDM: Grubb *et al*., supra note 19, 240 *et seq.*

[50] UNFCCC/KP, Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its fifth session, Copenhagen 2009, FCCC/KP/CMP/2009/21/Add.1, 30.3.2010, 7.

[51] UNFCCC/KP, Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, Durban 2011, FCCC/KP/CMP/2011/10/Add.2, 15.3.2012, 13 *et seq*.

ments were established that must be met by non-Annex I States that wish to host a CCS project. It also sets out to establish a licensing procedure for CCS that also clearly defines the access rights of project participants. Moreover, questions of long-term liability and remedial measures are envisaged that reflect the legal obligations arising out of international agreements. Most interestingly, Decision 10/CMP.7 rules out the possibility to pursue CCS activities in international waters.[52] Irrespective of the current technical feasibility of such an undertaking, this provision is interesting regard the geographical scope of other agreements. The EU CCS Directive, for example, also only covers offshore CCS activities within the exclusive economic zone and the continental shelf of the Member States.[53] With a view to the International Maritime Organization, the geographical scope of the London Convention covers all marine waters outside the internal waters (Art.III (3) LC) whereas the London Protocol beyond that explicitly includes the sea-bed and the sub-soil of marine waters (Art.1 (7) LP. Consequently, these two Conventions allow in principle the application of CCS technologies in areas beyond the limits of national jurisdiction, provided that such an application is done in conformity with the UN Convention on the Law of the Sea.[54] The discussion on CCS in CDM projects also addresses the likelihood of leakages. However, with the adoption of Decision 10/CMP.7 this was seemingly accepted as a risk associated with CCS.[55] In order to account for potential leakage of CCS projects, a project-based CER reserve has been adopted.[56] Accordingly, each project is allocated a contingent of CERs. This has been combined with monitoring obligations that are to be conducted for at least 20 years after closure.[57] The CER reserve serves the purpose of accounting for any net reversal of storage that occurs after leakage.[58] If no leakage has occurred after this timeframe, the CDM registry administration is under the obligation to forward any CER that were deposited.[59] Besides the project-based CER reserve, a Global CER reserve has been discussed during the meeting. The purpose of the Global CER reserve is to establish an additional reserve for CCS projects under the CDM. Among the Contracting Parties, the specific role and overall purpose of the Global CER re-

[52] Para.2, Appendix B to Annex to Decision 10/CMP.7. Whether this is possible under the UN Convention on the Law of the Sea will be analysed in section C. below.

[53] Art.2 (1) CCS Directive. For further information see E.IV.

[54] See C.I.2. of this study.

[55] Para. K, Annex to Decision 10/CMP.7.

[56] Para. 19, Annex to Decision 10/CMP.7.

[57] Para. 16 (c), Appendix B to Annex to Decision 10/CMP.7.

[58] Para. 21 (b), Annex to Decision 10/CMP.7.

[59] Para. 23, Annex to Decision 10/CMP.7.

serve was differently understood. Whereas proponents of the Global CER reserve believe that it could serve as an instrument to preserve environmental integrity, the opponents argue that it would go against "equity and moral hazard"[60] and would penalize CCS projects in comparison to other climate change mitigation options by imposing an additional burden.[61] The arguments in the context referred on the one hand to the length of retainment of the Global CER reserve[62] and addressed the proposed reserve figures that ranged from 2% to 20% on the other.[63] Since no conclusion has been reached in 2011, it was decided by the Contracting Parties to the KP to postpone a decision to a later stage, namely to the forty-fifth session of the SBSTA.[64]

2. Joint Implementation

Joint Implementation (JI) projects allow Annex I States to fulfil their obligations under the KP by participating in emission reduction projects in other Annex I States.[65] In doing so, a Contracting Party provides funding for a project and receives in return a specific amount of certificates that represent the greenhouse gas reduction resulting from the activity. The reduction unit gained from JI projects are "Emission Reduction Units" (ERU).[66] These are transferred to

[60] CCS Institute, Submission to the United Nations Framework Convention on Climate Change Subsidiary Body for Scientific and Technical Advice to the UNFCCC and KP (SBSTA), 26.3.2012, 6.

[61] This relates amongst others to the opportunity costs associated with a Global CER reserve: *ibid*., 4 and UNFCCC/SBSTA, Views on the eligibility of carbon dioxide capture and storage project activities involving transport of carbon dioxide from one country to another or which involve geological storage sites that are located in more than one country; and on the establishment of a global reserve of certified emission reduction units, Submission of Australia, Bonn 2012, FCCC/SBSTA/2012/MISC.8/Add.2, 10.5.2012, 1.

[62] Nauru on behalf of the Alliance of Small Island States proposed to hold the Global Reserve for perpetuity so as to integrate the possible long-term leakage of CCS: UNFCCC/SBSTA, Views on the eligibility of carbon dioxide capture and storage project activities involving transport of carbon dioxide from one country to another or which involve geological storage sites that are located in more than one country; and on the establishment of a global reserve of certified emission reduction units, Submission of Nauru, Bonn 2012, FCCC/SBSTA/2012/MISC.8, 28.3.2012, 5.

[63] CCS Institute, supra note 60, 4.

[64] Even though the issue was addressed during the Doha Climate Change Conference in 2012, it was decided to consider this aspect during the forty-fifth meeting of the SBSTA: UNFCCC/SBSTA, Methodological issues under the Kyoto Protocol carbon dioxide capture and storage in geological formations as clean development mechanism project activities, Carbon dioxide capture and storage in geological formations as clean development mechanism project activities, Draft conclusions proposed by the Chair, Doha 2012, FCCC/SBSTA/2012/L.21, 30.11.2012, 1. Also: 'Summary of the Doha Climate Change Conference 26 November - 8 December 2012: Tuesday, 11 December 2012', 2012 *Earth Negotiations Bulletin* 12, no. 567. See for general information on this body: <http://unfccc.int/bodies/body/6399/php/view/reports.php> (last accessed on 31.03.2014).

[65] Grubb *et al*., supra note 19, 131.

[66] N. Eddy, *Public Participation in CDM and JI Projects*, in D. Freestone & C. Streck (eds.), *Legal aspects of implementing the Kyoto Protocol mechanisms: Making Kyoto work*, 2005, 88.

the financing State that uses the ERU to fulfil its emission reduction obligations. Both the credits gained from CDM and JI projects can be used by the Contracting Parties in the compliance procedure of the KP; but they can also be traded under the International Emissions Trading as envisaged under Art.17 KP.[67]

In the calculation of the specific reduction units, the baseline methodology, as outlined in the Marrakesh Accords,[68] needs to take into consideration the sequestration and storage technology at the moment of decision and any further developments in this regard.[69] The flexibility mechanisms do not envisage the monitoring or temporal storage of CO_2, but rather the permanent removal from the atmosphere. In regard to procedural preconditions, a JI project must be approved by the involved Annex I State and should be supplementary to domestic actions. The trade of carbon credits stemming from CCS activities within JI projects can only be effectively realized with other Annex I States with whom no trading scheme exists, for example Russia.[70] Currently, JI is not a widely used mechanism, and some even argue that its share will be "negligible in comparison to international emission trading in 2020."[71]

3. Emissions Trading

The Emissions Trading Scheme is established by Art.17 KP in which it is stipulated that Annex I States "*may participate in emission trading for the purpose of fulfilling their commitments" given that this trading is "supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments*."[72] This market mechanism functions as a "cap-and-trade system" and establishes an overall ceiling of total pollutant that

[67] R. de Witt Wijnen, *Emissions Trading under Article 17 of the Kyoto Protocol*, in D. Freestone & C. Streck (eds.), *Legal aspects of implementing the Kyoto Protocol mechanisms: Making Kyoto work*, 2005, 408.

[68] See section B.II.1.c. below.

[69] International Panel on Climate Change, supra note 3, 376 *et seq*.

[70] Proelss & Güssow, supra note 34, 164.

[71] M. Carmes *et al.*, *Long-term prospects of CDM and JI*, Research Report 204 41192, 2007, Climate Change, 99.

[72] Art.17 KP: "*The Conference of the Parties shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading. The Parties included in Annex B may participate in emissions trading for the purposes of fulfilling their commitments under Article 3. Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that Article*." Grubb remarks that the provisions of Art.17 KP are coined by a "creative ambiguity" that allowed to reach a consensus on its inclusion in the KP Grubb *et al.*, supra note 19, 129 *et seq*. See for a comparison of existing or planned trading schemes: S. Hirsbrunner *et al*., *Important aspects of sinks for linking emission trading systems*, UBA-FB 001447/E.2, June 2011, 15.

can be emitted by all Parties. It allots a specific amount of trade units in the form of "Assigned Amounts Units" (AAU) to each Party. [73]

Parties can trade their untapped emission reduction units with other parties that expect to exceed their specific assigned amount. In order to prevent a sell-off of emission certificates and a resulting inability to achieve the emission reductions, every Annex I State must retain a commitment period reserve of at least 90% of their AAUs or CERs and ERUs respectively.[74] This reserve is to be recorded in a national register. Under the national schemes, companies and other industrial facilities receive a certain amount of emission units that they are able to emit. If their production exceeds their overall emission allowance, additional credits from other companies that have emitted less have to be purchased. It should be noted, though, that the KP merely provides the mechanism as a form of greenhouse gas reduction, but does not establish a trading scheme in itself. Thus, a further concretization on a regional level is necessary.

Table 1: CCS in the International Climate Change Regime

- CCS activities were initially not included in the UNFCCC.
- In the KP, a reference is made to CCS technologies in the context of pertinent policies and measures that aim to achieve the quantified emission reductions (Art.2 (1) (a) (iv) KP).
- The future role of CCS activities as possible measures in climate change mitigation in the framework of the flexibility mechanisms under the KP is still under discussion.
- The emission reduction allowances serve as an incentive for the use and development of CCS technologies as a climate change mitigation measure.

III. European Union Emissions Trading Scheme

The EU and its Member States as equal Contracting Parties to the UNFCCC and the KP share the obligation to achieve those emission reduction targets.[75] The European Union Emissions Trading Scheme (EU ETS) is the first regional trading scheme that has been established in

[73] See for a comparative analysis of the crediting and access rules of the flexible mechanisms: U. Onuma, 'Suspension of Eligibility to Use of the Kyoto Flexible Mechanisms: A Review of Substantive Issues (Part 1)', 2009 *Carbon & Climate Law Review*, no. 2, 198–211.

[74] De Witt Wijnen, supra note 67, 413.

[75] On the early developments of a European Union climate change policy: Massai, supra note 19, 49.

accordance with Art.17 KP[76] and serves thus as a stepping stone for the reduction obligations under the KP.[77]

The EU ETS provides for the development of national reduction strategies (so called national allocation plans) and is established by the Directive establishing a scheme for greenhouse gas emission allowance trading in October 2003 (EU ETS Directive 2003).[78] The EU ETS Directive 2003 has been adopted before the entry into force of the KP and follows a somewhat different approach as the International Emission Trading of the KP. Whereas the KP foresees the introduction of emission trading between States, the EU ETS establishes an emissions trading system between companies.[79]

The EU ETS implements the "cap and trade" principle in which a ceiling of the total permissible emitted greenhouse gases is set. With a constant reduction of the overall ceiling, it is aimed to reduce the emissions from those sectors covered under the EU ETS by 21% compared to 2005.[80] The system can only function under a "shortage" of available allowances in the trading system in which it is beneficial not to exceed the allocated emissions.

The EU ETS started on 1 January 2005 and has developed in three distinct phases. The first phase covered 2005-2007, the second phase 2008-2012, and the third phase has started on the 1st January 2013.[81] Whereas in the two first phases, the combined emissions reduction targets of the Union and the Member States were grandfathered or allocated to specific industries, the third phase is primarily based on auctioning emission allowances.[82] From the beginning of

[76] Massai, supra note 14, 114.

[77] Proelss & Güssow, supra note 34, 163. See for an overview on JI and CDM projects in the EU: Massai, supra note 14, 125 *et seq*. The "Linking Directive" links the EU ETS with the other project-based flexible mechanisms of the KP by enabling the inclusion of gained emission reduction certificates (CERs and ERUs respectively) from CDM and JI projects in the EU ETS: Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms (OJ L 338, 13.11.2004).

[78] Directive 2003/87/EC of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ L 275, 25.10.2003).

[79] Consequently, the EU ETS only partially implements the provisions of the KP based on certain activities.

[80] Massai, supra note 19, 181.

[81] For details see E. Hey & A. Naudé Fourie, *Participation in climate change governance and its implications for interntional law*, in R. G. Rayfuse & S. V. Scott (eds.), *International law in the era of climate change*, 2012, 272.

[82] *Ibid*., 273. By 2020, free allowances will be limited to 30%, full auctioning is planned to commence by 2027: J. W. Myhre, 'Financing of CCS Demonstration Projects – State Aid, EEPR and NER Funding – An EU and EEA Perspective', 2012 *European Business Law Review* 23, no. 5, 727–787, 767.

phase III in 2013, the issued allowances decrease in a linear factor of 1,74% based on the National Allocation Plans of Phase II.

In phase I and II national registries guaranteed an accurate accounting of the issued allowances. This system has been replaced by a single Union registry in which the 31 countries participating in the EU ETS are registered.[83]

1. The two-tier approach to include aspects of CCS in the European Union regulatory framework

The integration of CCS under the EU ETS regime has been a challenge due to the question of accounting for potential leakage and the potentially temporal nature of storage in geological formations.[84] This issue is also aggravated in that CCS activities were initially not mentioned in the EU ETS Directive 2003. However, Art.24 EU ETS Directive 2003 provided for procedures to include formerly not covered additional activities and gases in the scope of the emission allowance trading.

Consequently, CCS activities have been made available as an "opt-in" during the second phase of the EU ETS from 2008 to 2012. In 2008, the European Commission initiated the "Energy and Climate Package" which is comprised of different "pillars" that include, *inter alia*, a revision and strengthening of the EU ETS Directive and a legal framework for the development of CCS activities.[85] In this context, in order to improve and extend the greenhouse gas emission allowance trading scheme of the Union, Directive 2009/29/EC (hereinafter referred to EU ETS Directive) was adopted.[86] The aim of the EU ETS Directive is to further reduce the emissions of greenhouse gas in the EU by a minimum of 20% below 1990 levels in

[83] See for further information: Union Registry: <http://ec.europa.eu/clima/policies/ets/registry/index_en.htm> (last accessed on 31.03.2014).

[84] S. Wartmann *et al*., 'Monitoring and reporting of GHG emissions from CCS operations under the EU ETS', 2009 *Energy Procedia* 1, no. 1, 4459–4466.

[85] European Commission, the Climate and Energy package, <http://ec.europa.eu/clima/policies/package/index_en.htm> (last accessed on 31.03.2014). The package also includes: Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (OJ L140/88, 05.06.2009) and Decision No 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020, the so-called Effort Sharing Decision (OJ L 140/136, 05.06.2009). See also: International Energy Agency, *Carbon Capture and Storage*, Edition 1, October 2010, 19 *et seq.*

[86] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas allowance trading scheme of the Community (OJ L140/63, 05.06.2009).

2020.[87] The functioning of the EU ETS is depending on the demand and supply of allowances in which a surplus would directly negatively affect the price of each allowance. However, the surplus of allowances had amounted to almost one billion at the end of 2011. Additionally, the overall magnitude is expected to rise up to two billion allowances by 2020.[88] This is due to the ongoing impact of the economic crisis and to a variety of regulatory provisions in the transition from auctioning phase II to III.[89] As a short-term measure the Commission adopted Regulation No 176/2014 to "back-load" 900 million allowances at the beginning of auctioning phase III which reduces the volume of allowances to be auctioned in 2013-2020.[90] To ensure that the EU ETS is made more flexible in rendering the supply of auctioning allowances so as to be more resilient in case of major disturbances of the supply-demand balance in the future, the Commission proposed the establishment of a market stability reserve.[91] By adding and removing allowances to and from the market stability reserve, the annual auction volumes are adjusted and kept in a predefined range in cases of a temporary surplus or deficit in the EU ETS. The market stability reserve is envisaged to be applied in auctioning phase IV starting in 2021.

In the third auctioning phase initiated in 2013, the EU ETS should cover "the environmentally safe capture and geological storage of greenhouse gases"[92] in a harmonised manner. The revenues generated from the auctioning in the EU ETS should be used amongst others for:

> "the environmentally safe capture and geological storage of CO_2, in particular from solid fossil fuel power stations and a range of industrial sectors and sub-sectors, including in third countries."[93]

According to the Directive 2009/31/EC on the geological storage of carbon dioxide (CCS Directive), the EU ETS Directive applies to the entire production process.[94] In this way, the

[87] Art.1 EU ETS Directive in conjunction with recital 3 EU ETS Directive. The European Commission has made several proposals to amend the overall structure of the EU ETS: European Commission, Report from the Commission to the European Parliament and the Council, COM (2012) 652 final, 14.11.2012, 4 *et seq*. The forward selling of allowances that are used to create funding for the NER300 mechanism used, *inter alia*, for CCS projects will additionally increase the supply in the short-term: *ibid*., 5.

[88] European Commission, Commission Staff Working Document, SWD(2014) 17 final, 22.1.2014, 8.

[89] European Commission, Commission Staff Working Document, SWD(2014) 50 final, 12.

[90] The "back-load" of allowances is the postponement of auctioning for some years. Commission Regulation No 176/2014 amending Regulation (EU) No 10/31/2010 in particular to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-20 (OJ L 56/12, 25.02.2014).

[91] European Commission, Proposal for a Decision of the European Parliament and of the Council concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC, COM(2014) 20/2, 20.

[92] Recital 18 EU ETS Directive.

[93] Art.10 (3) (e) EU ETS Directive.

EU followed a dual-track-approach in regulating CCS activities. The interconnection and reference to the CCS Directive ensures a harmonised and coherent approach to address the complex questions related to the implementation of CCS projects. Thus, the emission resulting from the capture of greenhouse gases, the transport of these gases and the subsequent geological storage fall under the scope of the EU ETS Directive. However, allowances which are permanently stored and therefore avoided need not to be surrendered under the scheme. This is linked to the precondition that a permit for a storage site is in place according to the CCS Directive.[95]

According to Art.10a (7) EU ETS Directive, 5% of the Union-wide allowances should be set aside for a new entrants reserve. In order to foster innovative and environmentally safe capture and geological storage of CO_2 and renewable energy technologies, 300 million allowances of the new entrants reserve are retained until 31 December 2015 (so-called NER300).[96] This "Robin-Hood-Mechanism"[97] incentivises the development of CCS technology under the EU ETS. The CCS-specific share of the NER300 is reserved for the construction and operation of up to 12 commercial demonstration projects in the territory of the European Union.[98]

The allowance is intended to support demonstration projects "in geographically balanced locations" that include a wide range of CCS projects. As a prerequisite for funding, the demonstration projects have also to be co-financed by the operator of the installation and the Member State concerned. Each project is only eligible to receive a maximum of 15% of the total

[94] Directive 2009/31/EC of the European Parliament and the Council of 23 April 2009 on the geological storage of carbon dioxide (OJ L 140/114, 05.06.2009). For an in-depth analysis of the CCS Directive see section E. below.

[95] Art.12 (3a) EU ETS Directive reads: "An obligation to surrender allowances shall not arise in respect of emissions verified as captured and transported for permanent storage to a facility for which a permit is in force in accordance with Directive2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide".

[96] Art.10a (8) EU ETS Directive. See for a detailed discussion on the new entrants reserve : M. Holwerda, 'Subsidizing Carbon Capture and Storage Demonstration through the EU ETS New Entrants Reserve: A Proportionality Test', 2010 *Carbon & Climate Law Review*, no. 3, 228–239; Massai, supra note 19, 160; European Commission, Commission Staff Working document, SWD (2012) 224 final, 12.7.2012, For a critical (economic) assessment of the new entrants reserve scheme: E. Woerdman & O. Couwenberg, 'Carbon Capture and Storage in the European Emissions Trading Scheme', *Working Paper Series in Law and Economics*, August 2009, 1–32.

[97] Connie Hedegaard, the European Commissioner for Climate Action, referred to NER300 as a "Robin Hood" mechanism in which the "polluters pay for large-scale demonstration of new low-carbon technologies," <http://ec.europa.eu/commission_2010-2014/hedegaard/headlines/news/2012-12-18_01_en.htm> (last accessed on 31.03.2014). See Myhre, supra note 82 for a discussion on the compatibility of NER300 funded projects and state aid.

[98] Art.10a (8) EU ETS Directive.

available allowance under the NER300 scheme that are granted under the condition that the avoidance of CO_2 emission is verified.[99]

The first call of proposal of the NER300 funding under EU ETS Directive ended in December 2012. However, no CCS demonstration project has been awarded for funding under the NER300 scheme in the first call.[100] In its report, the European Commission explained that the reasons for the non-consideration of CCS projects were funding gaps or the inadequate planning status.[101]

2. Accounting of potential leakage of CCS projects under the EU ETS Directive

Since the overall aim of CCS is the long-term storage of CO_2 and, therefore, the permanent removal from the atmosphere, potential leakage from the storage site could possibly lead to accounting problems under the EU ETS. A difficult endeavour is the quantification of emissions that could potentially occur along the CCS production chain and in particular in the storage site.[102] This is also important with a view to the overall cap-system of the EU ETS that creates a ceiling in CO_2 emissions. According to Art.14 (1) EU ETS Directive the Commission is under the obligation to adopt guidelines for monitoring and reporting greenhouse gas emissions from activities under the Community scheme.[103]

With the inclusion of CCS in the EU ETS, the analogue monitoring and reporting methodology had to be adapted so as to integrate suitable requirements specifically taking into account the particular needs of CCS. To this end, the Commission Decision (2010/345/EU) of 8 June 2010 amending Decision 2007/589/EC as regards the inclusion of monitoring and reporting

[99] Art.10a (8) paras.2 and 3 EU ETS Directive. A comprehensive and detailed discussion on the award criteria and overall procedure of the NER300 scheme is given in: Myhre, supra note 82, 769.

[100] European Commission, *Climate action: Commission awards EUR 1.2 billion to kick-start 23 innovative renewable energy projects*, IP/12/1385, 18 December 2012. Initially, 13 CCS-projects were submitted in the application process of the funding scheme, European Commission, supra note 91, 3.

[101] European Commission, Commission Implementing Decision of 18.12.2012 Award Decision under the first call for proposals of the NER300 funding programme, C(2012) 9432 final, 18.12.2012, 3.

[102] Wartmann *et al.*, supra note 84, 4460.

[103] In this context, the EU ETS Directive makes reference to the analytic foundations of the IPCC: "In doing so, it shall take into account the most accurate and up-to date scientific evidence available, in particular from the IPCC […]" (Art.14 (2) EU ETS Directive). The IPCC had already in its Special Report on CCS referred to accounting issues: International Panel on Climate Change, supra note 3, 372 *et seq*.

guidelines for greenhouse gas emissions from the capture, transport and storage of carbon dioxide has been adopted (hereinafter referred to as Decision 2010/345/EU).[104]

Decision 2010/345/EU contains not only monitoring provisions regarding the capture installations and transport of CO_2, but is also dedicated to the storage of CO_2 as provided for under the CCS Directive. Whereas Decision 2010/345/EU has for the most part adopted the terminology used in the context of the CCS Directive, it differentiates, in contrast to the CCS Directive, between leakage, fugitive and vented emissions.[105]

A specific provision on leakage as defined under the CCS Directive states:

> "Here leakages from a storage complex pursuant to Directive 2009/31 EC are identified and lead to emissions, or release of CO_2 to the water column, they shall be included as emission sources for the respective installation and shall be monitored accordingly as required under the provisions of Annex XVIII. The leakage may be excluded as an emission source subject to approval by the competent authority, when corrective measures pursuant to Article 16 of Directive 2009/31/EC have been taken and emissions or release into the water column from that leakage can no longer be detected."[106]

Thus, any leaked CO_2 emissions are directly attributed to the installation from which the stored CO_2 was captured. The definition is weakened by way of giving the competent authority discretion to exempt the accounting of emissions under certain circumstances. As will be demonstrated later, the referral to the corrective measures under the CCS Directive and the release to the water column can be positively assessed only with reservations.[107]

On a positive side, contrary to the CCS Directive, Decision 2010/345/EU provides further possible sources that could be referred to when determining CO_2 emissions from CCS storage sites. Amongst others, this refers to the venting at injection or enhanced hydrocarbon recovery operations, fugitive emissions at injection and leakage.[108] This ensures increased legal certainty in the accounting methodology of CCS projects under the EU ETS Directive. The monitor-

[104] OJ L 155/34, 22.6.2010.

[105] In contrast to the CCS Directive, Decision 2010/435/EU introduces two additional definitions that are not included in the CCS Directive. This refers to the definition of "fugitive emissions" as "irregular or unintended emissions from sources which are not localised, or too diverse or too small to be monitored individually, such as emissions from otherwise intact seals, valves, intermediate compressor stations and intermediate storage facilities"; (para.7 (h) Decision 2010/345/EU) and "vented emissions" meaning "emissions deliberately released from the installation by provision of a defined point of emission" (para.7 (i) Decision 2010/345/EU).

[106] Annex I EU ETS in conjunction with Section 4.1 Decision 2010/345/EU and Art.1 Annex XVIII Decision 2010/345/EU.

[107] See section E. IV. 10. below. From this wording, one may conclude that 'emissions' occur during leakage from terrestrial CCS storage sites, whereas 'release into the water column' can only occur in the context of offshore CCS projects.

[108] Art.2 Annex XVIII Decision 2010/345/EU.

ing under Decision 2010/345/EU "shall start in the case that any leakage results in emissions or release to the water column."[109] However, the obligation to monitor is on the condition that "any leakage results in emissions or release to the water column."[110] Consequently, a double-track monitoring system is established in which continuous monitoring as envisaged by the CCS Directive is to be implemented, as well as further monitoring obligations that commence after the detection of the leakage.[111]

IV. Preliminary conclusion

Even though CCS has initially not been directly considered under the regime of the UNFCCC, it is listed in the KP as one of the means to achieve the envisaged reduction targets. The flexibility mechanisms under the KP address CCS activities; however, the terms and conditions differ depending on the mechanism in question. Even though implementation standards for CCS projects in the context of the JI mechanism have not been largely developed, CCS activities in the CDM are increasingly addressed by means of a robust regulatory framework. This refers to monitoring and site selection criteria that were established through Decision 10/CMP.7 in 2011. Additionally, participation requirements that are to be met by non-Annex I States are outlined. The issue of non-permanence of CCS activities is addressed by introducing a project-based CER. Furthermore, specific monitoring obligations extending to at least 20 years after closure of the storage site are stipulated.

With regard to International Emission Trading, the most significant implementation with regard to CCS activities has been made in the relation to the Emission Trading Scheme as established in the EU. The EU ETS Directive has provided incentives for employing CCS by reserving a certain amount of NER allowances for CCS demonstration projects. The EU ETS Directive is linked to the provisions of the CCS Directive in order to provide for increased and coherent application of the constituent definitions and obligations in the European regulatory context. A particularly laudable aspect is that the entire process chain of CCS is included under the scope of both the EU ETS and the CCS Directive itself. With regard to achieve legal certainty in accounting emission sources of CCS storage sites, a decision laying down specific monitoring obligations has been adopted in 2010. It is based on different scenarios of

[109] Art.3 (1) Annex XVIII Decision 2010/345/EU.

[110] Art.3 Annex XVIII Decision 2010/345/EU.

[111] See, e.g., the suggestion made in the framework of the FRAM of the London Protocol, see section C.II.2.d. below.

leakage and emission of CO_2 along the CCS process chain. In case CO_2 is emitted in the atmosphere through leakage, the amount in question is allocated to the specific installation under the EU ETS Directive. That said, the competent authority enjoys wide discretion in determining the emission source and the referral of allowances to the installation of origin.

Table 2: CCS in the EU climate change regulatory regime

- Whereas initially CCS-based emission allowances were not included in the EU ETS or had the status of an "opt-in", the entire process chain of CCS (capture, transport and storage of CO_2) is now part of the EU ETS. In this context, reduction credits gained from implementing CCS activities can be traded. The integration of emission reduction credits stemming from CCS activities serve as the fundamental initiative to further develop and make use of CCS technology in the EU.
- In order to incentivise CCS projects at an early stage, 300 million allowances of a so-called new entrants reserve will be kept for the construction and operation of up to 12 commercial demonstration projects in the territory of the European Union until 31 December 2015.
- The inclusion of CCS-derived emission allowances is directly linked to the CCS Directive. Accordingly, in case of leakage as defined in the CCS Directive, the emitted amount is directly accounted as an emission source of the installation.

C. Offshore CCS activities in the international regulatory framework

With the development of CCS-related measures in the framework of the international climate change regime, a regulatory framework for CCS activities had to be established. The legal regime addressing marine CCS projects has developed under the challenge to integrate diverse legal questions. This system has to ensure that on the one hand, the underlying goal of CCS to reduce greenhouse gas emissions is not deterred by an overly strict and limiting regulatory structure, while at the same time the risks associated with CCS are taken into consideration with due care.

I. The legal framework of the United Nations Convention on the Law of the Sea

In the assessment of offshore CCS activities, the 1982 UN Convention on the Law of the Sea (hereinafter referred to as UNCLOS) is the starting point for the evaluation of any law of the

sea issues.[112] The agreement is, due to its global scope and 165 Contracting Parties, considered as the "constitution for the oceans". Both the spatial as well as the material scope of UNCLOS are relevant with regard to offshore CCS activities.

1. CCS under the marine environmental protection regime of UNCLOS

The Contracting Parties of UNCLOS are under the obligation to "protect and preserve the marine environment."[113] Marine environmental protection runs like a common thread through UNCLOS and is substantiated in Part XII UNCLOS. It stipulates a comprehensive protection approach that recognizes that "the problems of ocean space are closely interrelated and need to be considered as a whole."[114] This is also reflected in the integration of internal waters and the seabed and subsoil.[115] The protection approach on which the UNCLOS is based is primarily pollution-based: The general environmental protection obligations are further substantiated by Art.194 UNCLOS that addresses "measures to prevent, reduce and control pollution of the marine environment."[116] Pollution is defined in Art.1 (1) (4) UNCLOS as:

> "the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities."

Bearing in mind the consequences of CO_2 leakage from storage sites, the definition of pollution as prescribed in Art.1 (1) (4) UNCLOS could potentially be applicable to CCS activities. A deleterious effect could occur if CO_2 leaks from the storage site either through small fissures, fractures or diffuse migration.[117] An isolated application of that definition and the substantive provisions concerning the protection of the marine environment would, however, ignore the original aim of CCS as an option to mitigate climate change.[118] In this relation, the risk associated with the use of marine CCS has to be contrasted with its potential benefits. It is

[112] Montego Bay, 10.12.19821, 833 UNTS 31363 (entered into force 16.11.1994).

[113] Art.192 UNCLOS.

[114] Preambular third indent UNCLOS.

[115] Art.1 (1) (4) UNCLOS and Art.2 (2) UNCLOS respectively.

[116] See for a general discussion on this topic: P. W. Birnie *et al.*, *International law and the environment*, 3rd ed., 2009.

[117] See for a discussion on possible leakage pathways of stored CO_2: International Panel on Climate Change, supra note 3, 242 *et seq*.

[118] Proelss & Güssow, supra note 34, 156.

submitted that in this context the precautionary principle represents a suitable legal tool for the necessary balancing process (see infra section F. I.).

UNCLOS contains further obligations regarding the introduction of substances which are relevant for marine CCS. The Contracting Parties are obliged to take measures that "minimize to the fullest possible extent: (a) the release of toxic, harmful or noxious substances, especially those which are persistent, from land-based sources, from or through the atmosphere or by dumping."[119] Despite the absence of a reference to the precautionary principle, the broad scope of the pollution definition and the reference to activities that are *likely* to result in adverse effects demonstrate a "precautionary spirit."[120] With a view to certain activities, UNCLOS requires Contracting Parties to conduct an environmental impact assessment when there are "reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment."[121] This obligation is based in the inherent due diligence obligation of Art.194 (2) UNCLOS that stipulates that "States shall take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States."

The scientific uncertainty of CCS activities regarding the associated risks requires a stringent risk assessment procedure so as to prevent environmental harm.[122] The environmental protection approach of UNCLOS relates to international rules and national legislation to prevent, reduce and control pollution of the marine environment.[123] An analysis of the rights and obligations of States intending to undertake CCS activities is consequently in order. The maritime zones as laid out by UNCLOS will be assessed with a view to which States are entitled to undertake offshore activities in each zone.

[119] Art.194 (3) (a) UNCLOS.

[120] S. Marr, *The precautionary principle in the law of the sea: Modern decision making in international law*, 2003, 52 and Birnie *et al*., supra note 116, 388.

[121] Art. 206 UNCLOS.

[122] Cf. Birnie *et al.*, supra note 116, 389; A. Proelß, *Das Urteil des Internationalen Gerichtshof im Pulp Mills-Fall und seine Bedeutung für die Entwicklung des Umweltvölkerrechts*, in M. Ruffert (ed.), *Dynamik und Nachhaltigkeit des öffentlichen Rechts*, 2012, 614 *et seq*.

[123] Birnie *et al*., supra note 116, 388.

2. The rights of the coastal State to conduct CCS activities

The functionally limited right of a coastal State to explore and exploit its natural resources poses questions regarding CCS activities on the continental shelf. The wording of Art.77 (1) UNCLOS seems to suggest that the coastal States' competences concerning activities on the continental shelf are limited to the rights as stipulated in Art.77 UNCLOS. In this context, coastal States may "exercise [...] sovereign rights for the purpose of exploring it and exploiting its natural resources."[124] It needs to be determined whether the exploitation of natural resources includes CCS activities. After all, the CCS technology does not necessarily envisage an exploitation of natural resources. In an isolated reading, this would imply that the coastal State could only conduct CCS activities if these relate to undertakings of enhanced oil and gas recovery that are linked to the exploitation of oil and gas on the continental shelf for example.[125]

A somewhat different interpretation can be based on Art.60 (1) (b) and 80 UNCLOS that confer the coastal State the exclusive right to construct installations and structures for *any economic purpose* and to authorize and regulate the construction, operation and use of these. This is also confirmed by Art.81 UNCLOS that assigns to the coastal State the exclusive right to authorise and regulate drilling on the continental shelf for "all purposes" and to lay tunnels in the subsoil (Art.85 UNCLOS). With these provisions in mind and the factual similarities between CCS activities and resource exploitation, it can arguably be concluded that the coastal State has the exclusive authority to regulate access to all CCS activities on its continental shelf. In case a third State intends to make use of the exploitation of the continental shelf in accordance with Art.77 (1) UNCLOS, it requires the express consent of the coastal State.[126]

However, depending on the factual circumstances UNCLOS allows for the extension of the breadth of the continental shelf beyond the 200 nautical miles from the baseline. In this case, the continental shelf of a State would be under its jurisdiction, while the adjacent water column would be considered as falling under the High Seas regime.[127] According to Art.82 UNCLOS the coastal State continues to have an exclusive right to exploit the natural resources, but is obliged to make payments "in kind in respect of the exploitation of the non-living re-

[124] Art.77 (1) UNCLOS.

[125] Proelss & Güssow, supra note 34, 155 *et seq*.

[126] See Art.77 (2) UNCLOS; see also Proelss & Güssow, supra note 34, 155 *et seq*.

[127] R. R. Churchill & A. V. Lowe, *The law of the sea*, 4th ed., 1999, 156.

sources" to the International Seabed Authority.[128] With regard to CCS activities, the question remains whether and how the "production at the site" falls under the mandate of the ISA. In this context, the access and benefit regime that is governed by ISA is restricted to measures in relation to the exploitation of the mineral resources of the Area. It is fairly evident that CCS does not fall under this regime.

The provisions of the High Seas apply to "all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State."[129] The freedom of the high seas essentially stipulates that any activity may be carried out either in the water column or on the seabed as long as UNCLOS, or customary international law respectively, does not provide for a specific rule to the contrary.[130] This seems to suggest that CCS activities could be admissible in areas beyond national jurisdiction (if technically feasible) under the provisions of Art.87 (1) UNCLOS according to which States enjoy the freedom to lay submarine cables and pipelines or construct artificial islands and installations.[131] However, a specific regime exists for activities in the Area (i.e., the seabed and subsoil thereof located seaward the continental shelf) that covers "all activities of exploration for, and exploitation of, the resources of the Area."[132] Art.137 UNCLOS prohibits any claim for or exercise of sovereignty or sovereign rights over any part of the Area or its resources. Hence, it must be evaluated whether CCS activities can be understood as including a claim for the exercise of sovereignty as stipulated under this provision. In this respect, the fact that the construction of artificial islands and other installations is permitted under Art.87 (1) (d) UNCLOS and is thus considered forming an integral part of the freedom of the high seas suggest a negative answer.[133]

In summary, even though UNCLOS does not explicitly refer to marine CCS, an interpretation of its provisions leads to the conclusion that CCS activities may be undertaken within the lim-

[128] *Ibid.*, 156.

[129] Art.86 UNCLOS.

[130] A. Proelss, 'Marine Genetic Resources under UNCLOS and the CBD', 2008 *German Yearbook of International Law* 51, 417–446, 430.

[131] Art.87 (1) (c) and (d) UNCLOS. U. Jenisch, 'Seerecht und Klimawandel: Herausforderungen für Schifffahrt, Offshore-Industrie und Seerecht', 2008 *Natur und Recht* 30, no. 4, 227–237, 230. According to the Decision 10/CMP.7 on the modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities, CCS projects under the CDM must not take place in "international waters" UNFCCC/KP, supra note 51, 23.

[132] Art.1 (3) UNCLOS.

[133] Proelss & Güssow, supra note 34, 158.

its of the rights and duties assigned to States by the Convention. It provides a framework for all anthropogenic activities in the marine environment.[134]

Table 3: CCS in the context of UNCLOS

• Even though CCS activities are not explicitly mentioned in UNCLOS, the disposal of CO_2 is permissible within the legal limits established by this framework. This is particularly relevant since UNCLOS is based on a broad protection-oriented approach under which emitted CO_2 ought to be considered as "pollution".

II. Offshore CCS activities under the dumping regime

The intention to dispose of CO_2 suggests that CCS could potentially fall under the regime established by Art.210 UNCLOS concerning dumping. Dumping is defined in Art.1 (1) (5) (a) UNCLOS as "any deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structure at sea." The general obligations regarding marine environmental protection measures as contained in Art.192 and 194 UNCLOS remain fairly broad and are further substantiated in section 5 of Part XII UNCLOS.

In this regard, dumping is further addressed by Art.210 UNCLOS which provides that "States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment by dumping." Referring to this, "[…] regulations and measures shall not be less effective in preventing, reducing and controlling such pollution than the global rules and standards."[135] The reference made to "global rules and standards" is generally understood as referring to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention, LC)[136] and the London Protocol to the Convention on

[134] S. Schlacke, 'Klimaschutz durch CO_2-Speicherung im Meeresboden-völkerrechtliche Anforderungen und europarechtliche Herausforderungen', 2007 *Zeitschrift für Europäisches Umwelt-und Planungsrecht*, no. 2, 87–95, 91; I. Havercroft & R. Purdy, *Carbon Capture and Storage - A legal perspective*, 10.9.2007, 3 and C. Armeni, *Legal Developments for Carbon Capture and Storage under International and Regional Marine Legislation*, in I. Havercroft *et al.* (eds.), *Carbon capture and storage: Emerging legal and regulatory issues*, 2011, 157. It has been proposed to include a reference to CCS activities in UNCLOS in order to "build a more integrated legal framework for CCS operations offshore" *ibid*., 157.

[135] Art.210 (4) UNCLOS.

[136] London, 29 December 1972, 11 ILM 1294 (entered into force on 30 August 1975). There are currently 87 Contracting Parties to the Convention: <http://www.imo.org/OurWork/Environment/SpecialProgrammes AndInitiatives/Pages/London-Convention-and-Protocol.aspx> (last accessed on 31.03.2014).

the Prevention of Marine Pollution by dumping of Wastes and other matter (London Protocol, LP).[137]

1. The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

The London Convention entered into force in 1975 and can be seen as the first relevant international agreement that applies to dumping. The Contracting Parties to the London Convention adopted in 1996 the London Protocol with a view to bringing the Convention in "line with the modern approach to waste management and emerging principles of international environmental law."[138] Irrespective of the two agreements, the institutional setting is shared, implementing a vision of "two instruments – one family."[139]

The LC aims to protect the marine environment from dumping of waste and other matter that is "liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate use of the sea."[140] The regulatory approach of the LC does not entail an entire prohibition of dumping, but pursues a "listing approach."[141] The London Convention strictly prohibits the disposal of Annex I substances, such as oil and radioactive matters. The dumping of wastes or other matters listed in Annex II require a prior special permit. All other wastes or matters that are not listed in Annex I and II to the Convention require a prior general permit.[142] As in UNCLOS, dumping in the context of the LC is defined as "any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structure at sea […].[143] "Waste or other matter" is defined as "material and substances of any kind, form or description" (Art.III (4) LC)." With a view to CCS

[137] London, 7 November 1996, 36 ILM 7 (entered into force in force on 24 March 2006). For those Contracting Parties that have ratified the Protocol, it substitutes the obligations arising from the London Convention. There are currently 42 Contracting Parties to the LP: <http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx> (last accessed on 31.03.2014).

[138] Frank, supra note 23, 295.

[139] IMO/LC/LP, Report of the twenty-eighth Consultative Meeting of Contracting Parties to the London Convention and the Meeting of Contracting Parties to the London Protocol, LC 28/15, 6.12.2006, 12. Even though the documents of the London Convention and the London Protocol refer to the time frame of the meeting, in the following the date of publication of the reports will be used when citing those documents.

[140] Art.I LC.

[141] Art.IV LC.

[142] Art.IV (c) LC.

[143] Art.III (1) (a) (i) LC.

activities, it is interesting that reference is always made to disposal at sea, in which "sea" is defined as "all marine waters other than the internal waters of States."[144] However, legal uncertainty remains as to whether "sea" in the framework of the London Convention includes the seabed and its subsoil.[145]

The LC provides two exemptions to the prohibition of dumping. These read as the following:

> "(i) the disposal at sea of wastes or other matter incidental to, or derived from the normal operations of vessels, aircrafts, platforms or other man-made structures at sea and their equipment, other than wastes or other matter transported by or to vessels, aircraft, platforms or other man-made structures at sea, operating for the purpose of disposal of such matter or derived from the treatment of such wastes or other matter on such vessels, aircraft, platforms or structures;
>
> (ii) placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of the Convention;"[146]

Following these preliminary remarks, it must be determined whether and to what extent the LC applies in the context of marine CCS considerations. With a view to stored CO_2 of CCS activities, its classification in the different Annexes remains questionable as no reference is made to this substance in any of the Annexes to the LC. Consequently, the legal status of CO_2 under the LC remained unclear and was indeed controversially discussed in the Consultative Meeting of the Contracting Parties to the LC.[147] The central question of the classification of CO_2 from CCS activities in the LC thus related whether it could be subsumed under previously existing substance categories.

Whereas the Convention's Scientific Group, which has an advisory status, classified CO_2 from fossil fuel as "industrial waste", not every Contracting Party shared this view.[148] The exemption of "normal operations" under Art.III (1) (b) (i) LC was seen by some Contracting Parties as potentially applying to CO_2 produced in petroleum production that is "disposed of as an integral part of the operation process."[149] Other Contracting Parties argued that the exemption under Art.III (1) (b) (ii) LC was relevant if the storage of CO_2 from CCS-activities

[144] Art.III (3) LC.

[145] IMO/LC, Sequestration of CO_2 in sub-seabed geological structures: Compatibility with the London Convention and Protocol: Legal Issues, LC 27/6, 23.8.2005, 15.

[146] Art.III (1) (b) LC.

[147] *Ibid.*, supra note 145, 22 *et seq.*; also: IMO/LC, Report of the twenty-seventh Consultative Meeting of the Contracting Parties to the London Convention, LC 27/16, 16.12.2005, 22.

[148] Havercroft & Purdy, supra note 134, 3.

[149] IMO, supra note 145, 6. Similar: S. Schlacke & S. Much, 'Rechtsprobleme der CO_2-Sequestrierung', 2010 *Schweizerische Zeitschrift für internationales und europäisches Recht* 20, no. 3, pp. 287–310, 294.

would not considered as mere disposal, but as a placement. This could in particular apply to CO_2 storage as an option in the climate mitigation portfolio or as an enhanced oil or gas recovery.[150]

2. London Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter

The London Protocol replaced the London Convention for those States that have ratified the LP and came into force on 24th March 2006. The objective of the LP is that the

> "[c]ontracting Parties shall individually and collectively protect and preserve the marine environment from all sources of pollution and take effective measures, according to their scientific, technical and economic capabilities, to prevent, reduce and where practicable eliminate pollution caused by dumping or incineration at sea of wastes or other matter. Where appropriate, they shall harmonize their policies in this regard."[151]

Whereas the London Convention does not make referral to the seabed, the London Protocol explicitly includes it in Art.1 (7) LP in that "sea" refers to "all marine waters other than the internal waters of the States, as well as the sea-bed and the sub-soil thereof."

In its regulatory approach, the LP reversed the listing approach as applied by the LC as it generally prohibits the dumping of any substances with the exception of those that are listed in Annex 2 LP.[152] In the original version of the Protocol from 2006, seven categories of waste were included in Annex 1 LP which were: dredged material, sewage sludge, fish waste or material resulting from industrial fish processing operations, vessels and platforms or other man-made structures at sea, inert, organic geological material and bulky items.[153] The LP follows a permit approach in which the dumping of Annex 1 substances requires a permit that must meet the permission conditions as outlined in Annex 2 LP and comply with the general obligations of the LP.[154] In implementing the LP, the Contracting Parties are to

> "apply a precautionary approach to environmental protection from dumping of wastes or other matter whereby appropriate preventative measures are taken when there is reason to believe that wastes or oth-

[150] R. Purdy & R. Macrory, *Geological carbon sequestration: critical legal issues*, January 2004, Tyndall Centre Working Paper, no.45, 23.

[151] Art.2 LP.

[152] According to Art.20 LP, Annexes form an "integral part to the Protocol."

[153] Art.1 (1)-(7) Annex 1 LP.

[154] Art.4 (1) (b) LP.

er matter introduced into the marine environment are likely to cause harm even when there is no conclusive evidence to prove a causal relation between inputs and their effects."[155]

Furthermore, the LP imposes on the permitting authority the obligation to ensure that the operator pays the expenses arising out of the pollution prevention and control requirements.[156]

a. Offshore CCS activities under the London Protocol

The application of the reverse listing approach of the LP necessitated the amendment of the material scope of the LP so as to include marine CCS as one of the waste categories of Annex I LP. Even though a decision of amendment or non-amendment of the LP might *prima facie* appear to be a fairly easy task, the complex requirements of adequately regulating marine CCS activities and the reservations of some Contracting Parties towards the realisation of such projects aggravated the negotiations.[157]

The arising legal questions associated with the regulation of marine CCS under the LC as well as the LP were addressed by way of establishment of a Legal Working Group on CCS.[158] During the 28th Consultative Meeting of the Contracting Parties to the LC, some Contracting Parties saw possible amendments regarding CCS more suitable for the LP than to the LC.[159]

However, negotiations towards the amendment of the LP to include CCS were coined by fierce discussions on the compatibility with the precautionary approach as embodied in the LP.[160] Both opponents and proponents relied on the application of the precautionary approach taken by Art.3 (1) LP as a reason to take or respectively not to take action.[161] The delegations in favour of the amendment of the LP to include CCS made recourse to the role of CCS as a measure to mitigate ocean acidification and climate change. In contrast, delegations opposing

[155] Art.3 (1) LP.

[156] Art.3 (2) LP.

[157] See for an early account of the challenge to include CCS-activities in a regulatory framework: E. J. Wilson *et al.*, 'Regulating the Ultimate Sink: Managing the Risks of Geologic CO_2 Storage', 2003 *Environmental Science & Technology* 37, no. 16, 476–3483.

[158] T. Dixon *et al.*, 'International marine regulation of CO_2 geological storage. Developments and implications of London and OSPAR', 2009 *Energy Procedia* 1, no. 1, 4503–4510, 4505.

[159] IMO/LC, supra note 147, 22.

[160] IMO/LC/LP, Report of the twenty-eighth Consultative Meeting and first meeting of Contracting Parties, LC 28/15, 6.12.2006, 23.

[161] *Ibid*., 23. Issues of concern where the scientific uncertainty of CCS and the need to have a regulatory framework in place before large scale project will commence.

an amendment argued that many scientific uncertainties regarding site-selection, acceptable leakage rates and long-term monitoring were still prevailing.

Two central issues that were primarily discussed were those of the CO_2 composition of the CO_2-stream and potential leakage. These two aspects are of particular concern as certain substances in the CO_2-stream could have a consequence on the CO_2-rock interaction such as reduced permeability and increased pore pressure.[162] Since CO_2 was not listed among the category of wastes of Annex 1 LP, Australia submitted in 2006, together with the co-sponsors France, Norway and the United Kingdom, a proposal to amend Annex 1 LP to include offshore CCS.[163]

Only shortly after the submission of the proposal, and notwithstanding the initial opposition by some of the Contracting Parties, the proponents were able to achieve acceptance of their proposition. The amendment of the LP was done by way of adopting a resolution on the agreed changes. The adoption of resolution LP.1 (1) to amend Annex 1 LP was only made possible after a compromise relating to a specific assessment clause on the CO_2-stream had been agreed upon.[164] Subsequently, on 2 November 2006, pertinent amendments to Annex 1 LP were made in order to regulate CCS activities under the LP.[165] These amendments came into force on 10 February 2007.[166] In this context, a new category of waste was added to the reverse list, thus creating a legal basis for marine CCS activities within the context of the LP.

Hence, "carbon dioxide streams from carbon dioxide capture processes for sequestration" were added to the seven substances that may be considered for dumping. However, according to paragraph 4 Annex 1 LP, a carbon dioxide stream may only be considered for dumping when:

> "1. the disposal is into a sub-seabed geological formation; and

[162] E. J. Wilson & D. Gerard, *Risk Assessment and Management for Geologic Sequestration of Carbon Dioxide*, in E. J. Wilson & D. Gerard (eds.), *Carbon capture and sequestration: Integrating technology, monitoring and regulation*, 2007, 102 *et seq.*

[163] The amendment of Annex 1 LP was submitted on 28 April 2006: IMO/LP, CO_2 Sequestration in sub-seabed formations: Consideration of proposals to amend Annex 1 to the London Protocol, LP 1/6, 28.4.2006.

[164] IMO/LP, supra note 2.

[165] IMO/LC/LP, LC 28/15, supra note 160, 6.

[166] IMO/LP, Notification of entry into force of the "CO_2 Sequestration" amendments to Annex 1 to the London Protocol 1996, LC-LP.1/Circ.11, 16.2.2007, 1. For Canada the amendments entered into force on 29 January 2007. According to Art.22 (4) LP, "*amendments to the Annexes shall enter into force for each Contracting Party immediately on notification of its acceptance to the Organization or 100 days after the date of their adoption at a Meeting of Contracting Parties."*

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."

Paragraph 4.2 takes into consideration that along the process chain some substances are added so as to serve as a tracer or to facilitate the storage process. The term "overwhelmingly" was introduced because the Contracting Parties were not able to agree on a concrete threshold regarding a quantitative limit for CO_2 purity in order to minimize contaminants levels of the CO_2-stream.[167] Greenpeace International proposed to replace the term "overwhelmingly" by a concrete limit of 99% CO_2 as a justifiable and readily achievable purity limit, however this proposal was not followed up.[168] Notwithstanding the legitimate criticism of the vague and ambiguous term, the wording allows for a case-by-case analysis in which a variation of the CO_2-stream composition according to the particular capture and transport conditions can be accounted for.[169]

b. Transboundary movement of CO_2: amendment of Art.6 LP

The prohibition of Art.6 LP to export waste or other matter for the purpose of dumping at sea poses legal difficulties for the Contracting Parties wishing to implement joint CCS projects.[170] This could be the case if Contracting Parties do not have suitable geological formations within their territory that allow for CO_2 storage, but nevertheless intend to make use of CCS. Due to interpretational uncertainty regarding the exact scope and content of "export", different options were discussed that also included the transboundary migration of CO_2 within the storage formation.[171] In order not to undermine the general prohibition of exporting waste as a fundamental principle of the LP, a restrictive exception only applicable to CO_2 from CCS activities was stipulated.[172] Based on the work of the legal and technical working group on trans-

[167] IMO/LP, supra note 2.

[168] IMO/LP, CO_2 Sequestration in sub-seabed formations: Consideration of proposals to amend Annex 1 to the London Protocol, LP 1/6/2, 8.9.2006, 2.

[169] Dixon *et al*., supra note 158, 4506. See further: International Panel on Climate Change, supra note 3, 220.

[170] IMO/Legal and Technical Working Group on transboundary CO_2 sequestration issues, Report of the first Meeting of the Legal and Technical Working Group on transboundary CO_2 sequestration issues, LP/CO_2 1/8, 3.3.2008, 3.

[171] *Ibid*., 3; IMO/LC/LP, Report of the thirty-first Consultative Meeting and the fourth meeting of Contracting Parties, LC 31/15, 30.11.2009, 24.

[172] IMO/Legal and Technical Working Group on transboundary CO_2 sequestration issues, supra note 170, 4.

boundary CO_2 sequestration issues,[173] the Contracting Parties adopted in 2009 resolution LP 3.4 "on the amendment of Article 6 of the London Protocol."[174] The amendment reads as follows:

> "2. Notwithstanding paragraph 1, the export of carbon dioxide streams for disposal in accordance with annex 1 may occur, provided that an agreement or arrangement has been entered into by the countries concerned. Such an agreement or arrangement shall include:
>
> 2.1 confirmation and allocation of permitting responsibilities between the exporting and receiving countries, consistent with the provisions of this Protocol and other applicable international law; and
>
> 2.2 in the case of export to non-Contracting Parties, provisions at a minimum equivalent to those contained in this Protocol, including those relating to the issuance of permits and permit conditions for complying with the provisions of Annex 2, to ensure that the agreement or arrangement does not derogate from the obligations of Contracting Parties under this Protocol to protect and preserve the marine environment.
>
> A Contracting Party entering into such an agreement or arrangement shall notify it to the Organization."

However, only two Contracting Parties have ratified the amendment so far,[175] which is why it has not entered into force until this date.[176] In order to adequately address arising consequences following the amendment of the procedural framework, the Scientific Group to the LP was invited to work on the necessary amendments of the CO_2 Specific Guidelines.[177] In 2010, an Intersessional Correspondence Group was established that was mandated to work on the review of the CO_2 Specific Guidelines. The procedure commenced in 2011 and was finalized in 2012.[178] One of the objectives of the review was to include aspects arising out of the amend-

[173] The first meeting of the working group was convened in February 2008 in Bonn: *ibid*., 1.

[174] IMO/LC/LP, supra note 171, 27. IMO, Resolution LP.3(4) on the amendment to Article 6 of the London Protocol, <http://www.imo.org/blast/blastDataHelper.asp?data_id=27230&filename=03(4).pdf> (last accessed on 31.03.2014).

[175] LC 35/15, 17. Additionally, the Netherlands and Canada suggested in October 2013 that ratification by their Parties are potentially possible in 2014.

[176] The conditions for the amendment of the Protocol are outlined in Art.21 and 22 LP. It has been suggested that it may take several years until the adoption of Art.6 LP; see A. Haan-Kamminga et al., 'Legal Uncertainties of Carbon Capture and Storage in the EU: The Netherlands as an Example', 2010 *Carbon & Climate Law Review*, no. 3, pp. 240–249, 243.

[177] The Scientific Group was requested to consider the need for amendments to the "Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations" in order to give further specific guidance in cases of export of such streams to other countries for disposal and issues related to the management of transboundary movement of CO_2 after injection IMO/LC/LP, supra note 171, 24; IMO/Scientific Group to the London Convention and London Protocol, Report of the thirty-fourth meeting of the Scientific Group of London Convention and the fifth Meeting of the Scientific Group of the London Protocol, LC/SG 34/15, 24.5.2011, 8. See for a discussion on the role of the Scientific Group in the context of the CCS debate: Dixon *et al.*, supra note 158, 4504 *et seq*.

[178] IMO/Scientific Group to the London Convention and London Protocol, supra note 177, 8.

ment of Art.6 LP.[179] During the Meeting of the Scientific Group in October 2011, several issues, primarily of legal nature, in relation to the amendment of the 2007 CO_2 Specific Guidelines regarding the transboundary movement of CO_2, emerged. These in particular referred to the permits both for transport and for the receiving States, and liability and monitoring questions.[180] The Scientific Group agreed on a distinction to be made between the "export" prior to the injection and the transboundary movement within storage sites, and that these should be considered in separate documents.[181]

The 2012 CO_2 Specific Guidelines were adopted by the Contracting Parties in 2012.[182] The Contracting Parties agreed not to integrate specific Art.6 LP aspects ("export"), but to annex a particular document on this issue to the Guidelines.[183] With regard to Art.6 LP, the LP legal and policy correspondence group, one of the correspondence groups which were established to review the CO_2 Specific Guidelines, concluded in 2012 that further guidance is needed on how to interpret and apply "agreement or arrangement" of Art.6 LP.[184] It was suggested that "agreement" relates to a legally binding agreement such as a treaty, and that "arrangement" could be seen as a non-binding "something"[185] such as a Memorandum of Understanding.[186] Canada introduced in 2012 a draft text on the "Development and implementation of arrangements or agreements for the export of CO_2 streams for storage in sub-seabed geological formations".[187] After further revision, the draft "Guidance on the implementation of article 6.2 on the export of carbon dioxide streams for disposal in sub-seabed geological formations for the purpose of sequestration" was adopted in October 2013.[188]

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[179] IMO/Scientific Group to the London Convention and London Protocol, supra note 177, 8.

[180] IMO/Scientific Group to the London Convention and London Protocol, supra note 177, Annex 3..

[181] IMO/LC/LP, Report of the thirty-fourth Consultative Meeting and the seventh meeting of Contracting Parties, LC 34/15, 23.11.2012, 14.

[182] IMO/LC/LP, Report of the thirty-fourth Consultative Meeting and the seventh meeting of Contracting Parties, LC 34/15, supra note 181, 15.

[183] IMO/LC/LP, Report of the thirty-fifth Consultative Meeting and eighth meeting of Contracting Parties, LC 35/15, 21.10.2013, 16.

[184] IMO/Scientific Group to the London Convention and London Protocol, CO_2 Sequestration in Sub-Seabed Geological Formations (LP): Review of the 2007 CO_2 Sequestration Guidelines, Report of the LP legal and policy Correspondence Group and LP-scientific and technical Correspondence Group, LC/SG 35/4, 16.03.2012, Annex 3, 2.

[185] *Ibid.*

[186] *Ibid*.

[187] IMO/Scientific Group to the London Convention and London Protocol, LC/SG 35/4, supra note 184, 1.

[188] IMO/LC/LP, Report of the thirty-fifth Consultative Meeting and eighth meeting of Contracting Parties, LC 35/15, supra note 183, 17.

Table 4: CCS in the overall structure of the LC and LP

- In the absence of reference to CCS in both instruments, the legal questions regarding the consideration of CCS in the LC and LP concerned its status as waste or other matter and the intention of disposal.
- It was opted to consider amending the LP rather than both instruments to include CCS activities.
- Opponents and proponents of the idea to include CCS in the LP argued by reference to the precautionary approach as embodied in Art.3 (1) LP. Central issues that were primarily discussed were those of the CO_2 composition of the CO_2-stream and potential leakage.
- On 2nd November 2006 pertinent amendments to Annex 1 LP were made in order to regulate CCS activities under the LP. In this context, a new category of waste has been added to the reverse list, consequently creating a legal basis for offshore CCS activities in the LP.

c. The permit process according to Annex 2 of the LP

With the amendment of Annex 1 LP to include CCS activities, the storage of CO_2 from CCS projects is thus subject to the provisions outlined in Art.4 (1) (b) LP which reads:

> "The dumping of wastes or other matter listed in Annex 1 shall require a permit. Contracting Parties shall adopt administrative or legislative measures to ensure that issuance of permits and permit conditions comply with provisions of Annex 2."

The obligations under Annex 2 LP relate to, *inter alia*, a waste prevention audit, dump-site selection and the assessment of potential effects and permit and permit conditions. These components form the basis of the decision whether waste or other matter may be dumped. It is only then that dumping permits may be issued when all "impact evaluations are completed and the monitoring requirements are determined."[189]

According to Annex 2 LP, a permit shall include information on the type and sources of dumped materials, the dumping site, the method of dumping and data on monitoring and reporting requirements. The provision of the permit should ensure "as far as practicable, that environmental disturbance and detriment are minimized and the benefits maximized."[190] The

[189] Annex 2 (17) LP.

[190] Havercroft & Purdy, supra note 134, 3.

permits and the permit conditions should be regularly reviewed so as to integrate the results of monitoring and the objectives of monitoring programmes.[191]

With a view to paragraph 2 and 3 of Resolution LP 1.1 amending Annex 1 LP for the purpose of including CCS, the Contracting Parties agreed on further guidance "so that sub-seabed geological sequestration of carbon dioxide can be conducted in a manner that is safe for the marine environment."[192] For this purpose, the *Guidelines for the assessment of wastes or other matter that may be considered for dumping*[193] were complemented by specific guidelines for categories listed under Annex 1 LP. These are established to offer guidance to competent authorities in assessing applications for dumping in accordance with the obligations arising under the LP and the LC. In the establishment of an environmental impact and risk assessment framework specific to the circumstances and particularities of marine CCS, the Scientific Group produced two documents. These are the *Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures (FRAM)* in 2006,[194] which was then further "refined and transposed"[195] by the *Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into sub-seabed geological formations (CO_2 Specific Guidelines).*

The CO_2 Specific Guidelines were adopted in 2007 and subsequently amended in 2012[196] in order to provide "guidance on permitting and permit contents."[197] All Guidelines "embody a mechanism to guide national authorities in evaluating applications for dumping of wastes in a manner consistent with the provisions of the London Convention 1972 or the 1996 Protocol

[191] Annex 2 (18) LP.

[192] Resolution LP.1(1). IMO/LC/LP, supra note 160, Annex 6. According to Art.4 (1) (b) LP "Contracting Parties shall adopt administrative or legislative measures to ensure that issuance of permits and permit conditions comply with provisions of Annex 2".

[193] IMO/LC, Report of the nineteenth Consultative Meeting of the Contracting Parties to the London Convention, LC 19/10, 14.11.1997, Annex 2. These are referred to as Generic Guidelines.

[194] IMO/LC/LP, supra note 160, Annex 5; IMO/SG Intersessional Technical Working Group on CO_2 Sequestration, Report of the meeting of the Intersessional Technical Working Group on CO_2 Sequestration, LC/SG-CO_2 1/7, 3.5.2006, Annex 3.

[195] Dixon *et al*., supra note 158, 406.

[196] IMO/LC/LP, Report of the twenty-ninth Consultative Meeting and the second meeting of Contracting Parties, LC 29/17, 14.12.2007, Annex 4. For the purpose of developing these Specific Guidelines, an Intersessional Correspondence Group under the leadership of the United States of America was established: IMO/LP, supra note 163, 19. See C.II.1.b. When referring to the CO_2 Specific Guidelines, the 2012 version of the Guidelines is meant.

[197] Dixon *et al*., supra note 158, 406.

thereto."[198] They are addressed to national authorities responsible for "regulating the dumping of waste."[199] That such an approach is also an application of the precautionary approach under the LP is visible in the formulation that "when applying these Guidelines, uncertainties in relation to assessments of impacts on the marine environment will need to be considered and a precautionary approach applied in addressing these uncertainties."[200] In the following, the development of the permitting and the risk assessment process in the regime of the LP and LC will be analysed by demonstrating the content of the FRAM as well as the Generic and the CO_2 Specific Guidelines. An attempt is made to present the different procedural elements so as to be able to contribute to the planned outcome of Work Package 5.

Table 5: The purpose of the permit approach under the LP

- With the amendment of the LP to include CCS, any CCS activity is subject to the permit approach as stipulated in Annex 2 LP.
- The role of permits for any activities listed under Annex 1 LP is to ensure that the activity is only conducted under the previously defined conditions.
- A permit shall include information on the type and sources of dumped materials, the dumping site, the method of dumping and data on monitoring and reporting requirements. The provision of the permit should ensure that environmental disturbance and detriment are minimized and the benefits maximized.
- In order to provide guidance on permitting and permit contents of offshore CCS activities, two guidelines were proposed that serve as a mechanism to guide national authorities in evaluating applications for dumping of wastes in accordance with the provisions of the LC and the LP.

[198] IMO/LC/LP, Report of the thirty-third Consultative meeting and the sixth meeting of Contracting Parties, LC 33/15, 8.11.2011, 19.

[199] CO_2 Specific Guidelines, 2.

[200] CO_2 Specific Guidelines, 2. See also Proelss, supra note 122, 615. In the context of other initiatives, risk assessments have also been developed. See for example, the Joint Industry/Public Project "CO_2QUALSTORE" that were developed by DNV, Gassnova SF and Norwegian Petroleum Directorate (NPD): Aarnes *et al*., supra note 2. For a comprehensive overview on the role of risk assessment prior to the pertinent amendments of the LP: C. H. Hendriks *et al*., Impacts of EU and International Law on the Implementation of Carbon capture and Geological Storage in the European Union, ECS04057, June 2005, Chapter 2.

d. The Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures (FRAM)

The FRAM was adopted at the Joint Session of the 28th Consultative Meeting of the Contracting Parties of the London Convention and the 1st Meeting of the Contracting Parties to the LP in November 2006.[201] As the inclusion of CCS activities under the LP was decided at the same meeting, the FRAM "is developed to ensure compatibility with Annex 2 LP, identify gaps in knowledge and reach a view on the implications of CCS for the environment."[202] It thus serves two distinct goals: first to provide further information on how CCS activities fit into the overall aim of the LP, and second to obtain further information on the risks related to the storage of CO_2. The FRAM primarily serves in this context as a guidance in order to address the following issues:

> "1. characterise the risks to the marine environment from CCS on a site-specific basis; and
>
> 2. collect the necessary information to develop a management strategy to address uncertainties and any residual risks."[203]

In the following, the FRAM will be analysed with a view to its role in the development of a risk assessment procedure regarding marine CCS. It is a first step to systematize the challenges and risks associated with CCS activities in the structure of the LP and LC framework.[204] As the OSPAR Convention regime equally applies a risk assessment and management framework, the constituent elements of the FRAM will be demonstrated and outlined. The analysis will serve as a basis for comparison between the two regimes with the aim of filtering general elements that shape the risk assessment in both the framework of the LP and LC as well as the OSPAR Convention.

Risk Management in the context of FRAM is defined as:

> "a structured process that begins with identifying and quantifying the risks associated with a given process, modifies the process to minimize risk and implements appropriate monitoring and intervention strategies to manage remaining risks."[205]

The site specific assessment framework of FRAM is based on the IPCC Special Report on Carbon Dioxide Capture and Storage[206] and envisages a broad screening process that includes

[201] IMO, supra note 194, Annex 3.

[202] FRAM, 2.

[203] FRAM, 2.

[204] FRAM, 25.

[205] FRAM, 20.

the storage integrity, the suitability of the surrounding and the geological formation, potential migration and leakage pathways.[207]

The six steps of the Risk Assessment and Management Framework are (1) problem formulation (definition of boundaries of the assessment; outlines scenarios and pathways of CO_2 leakage), (2) site selection and characterisation (collection of data of the physical, geological, chemical and biological conditions at the site which form the basis of the site selection and evaluation), (3) exposure assessment (depicts the movement of the CO_2-stream within the geological structures and the marine environment and assesses processes and pathways for migration of CO_2 from geological storage reservoirs and leakage to the marine environment, during and after CO_2 injection can be assessed), (4) effects assessment (collects the information in order to describe the response of receptors in the marine environment, such as the sensitivity of species and communities as well as human health; assesses temporal and special issues of effects; identification of uncertainties and data gaps), (5) risk characterisation (determines the likelihood and severity of impacts on the marine environment; establishes relationships between stressors, effects and ecological entities; provides an overall assessment of potential hazards; impact hypothesis), and (6) risk management (identification of preventative measures to avoid leakages: design and construction, reservoir flow and fracture propagation prediction; monitoring of migration of CO_2 within and above the reservoir and of mitigation of CO_2 escaping the formation; prevention of CO_2 escape from formations following decommissioning).

One of the fundamental elements contained in the FRAM are the monitoring techniques that refer to two categories: first, monitoring of contained CO_2 within the storage formation and secondly, monitoring approaches when leakage is suspected.[208] The FRAM focuses primarily on oil and gas reservoirs and deep saline formations and does not cover coal beds, basalts, oil and gas shales.[209] Regarding the effects assessment, the following null-hypothesis is proposed: No impact on human health, the marine environment and other legitimate uses of the sea will occur.[210] This hypothesis is to be tested against the different scenarios that were de-

[206] International Panel on Climate Change, supra note 3, 225 *et seq*. and Eggleston, supra note 4.

[207] Dixon *et al*., supra note 158, 4505.

[208] *Ibid*., 4505. In the EU, this differentiated monitoring approach has been established on the one hand by means of the monitoring obligations under the CCS Directive and on the other hand through Decision 2010/345/EU in conjunction with Art.14 EU ETS Directive. See section B.III.2. above.

[209] FRAM, 8.

[210] FRAM, 14.

veloped under the Problem Formulation and include, *inter alia*, the resilience of the marine ecosystem.[211] With a view to the controversial discussion during the amendment of Annex 1 LP to include marine CCS, the proposed definition of leakage in the FRAM is of particular interest.

"Leakage" is defined in the framework of the FRAM as "in respect of carbon storage, the escape of CO_2 from the storage formation in the water column and the atmosphere."[212] Even though the FRAM are not legally binding, they do express consensus of the Contracting Parties and serve as guidance in the implementation and application of the provisions of the LP. The definition of leakage in the framework of the FRAM is linked to a measurable threshold that relates to the contact of CO_2 with the atmosphere and the water column. In contrast to other instruments addressing offshore CCS, the FRAM appears to be more permissive of leakage and seems to provide room for balancing the risks involved.[213] As will be demonstrated elsewhere in this study, the terminology used in the context of the FRAM differs from other concepts governing leakage of CO_2 from storage sites.[214]

e. The assessment of waste or other matter that may be considered for dumping under the LP

The assessment of waste forms an integral part of the regulatory approach of the LP. The prominent role of CO_2 purity level criteria during the negotiations leading up to the amendments of the LP demonstrates its significance in both preventing the dumping of matters other than CO_2 and evaluating the risks associated with the chemical and physical characterization of the CO_2-stream composition.

While the LP applies to storage of CO_2-streams in geological formations, Annex 2 LP does not remove the obligation to "make further attempts to reduce the necessity for dumping."[215] A particular focus of the CO_2 Specific Guidelines is on the associated risks related to leakage of CO_2 and other substances mobilized by the CO_2-stream. Consequently, the CO_2 Specific Guidelines address primarily the risk of leakage over the entire timespan of the project and in

[211] FRAM, 14 *et seq.*

[212] FRAM, 31.

[213] For comparative remarks regarding the definitions of leakage and the perception of risks see section F.II and III. below.

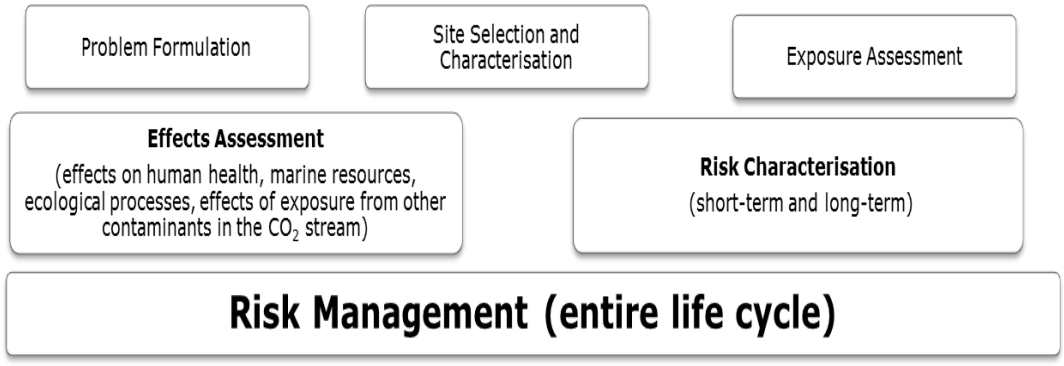
[214] See the discussion on the CCS Directive, section E. below.

[215] Para. 1 Annex 2 LP; Generic Guidelines, 1; CO_2 Specific Guidelines, 2.

particular on their potential impacts on the marine environment in close proximity (locally and regionally) to the storage site.[216]

Table 6: The role of the FRAM in systematizing the challenges and risks associated with CCS activities in the context of the LP framework

- The FRAM is based on the IPCC Special Report on Carbon Dioxide Capture and Storage from 2005.
- The FRAM is characterized by focussing on oil and gas reservoirs and deep saline formations; it does not cover coal beds, basalts, oil and gas shales.
- Leakage in the framework of the FRAM is defined as "in respect of carbon storage, the escape of CO_2 from the storage formation in the water column and the atmosphere."
- Elements of the FRAM:



In order to substantiate open questions arising out of the LP (such as the composition of the CO_2-stream), the CO_2 Specific Guidelines outline different substances that can be distinguished in the stream.[217] Accordingly, the CO_2-stream consists of CO_2 and "incidental associated substances that are derived from the source material and the capture and sequestration process."[218] These so-called associated substances can be traced to three different sources: (1) the source and process derived substances that are included in the CO_2-stream, (2) added substances that facilitate the capture and sequestration process, and (3) so-called mobilized substances that result in the disposal of CO_2.

[216] CO_2 Specific Guidelines, 1.

[217] CO_2 Specific Guidelines, 1..

[218] *Ibid.*

Even though the CO_2 Specific Guidelines aim to substantiate and specify the LP, no further information on the CO_2 content in the stream is given. It is, however, emphasized that the CO_2-stream "may contain low concentrations of incidental associated substances and that the actual components of the stream depend manly the source material and the type of capture, the transport and the injection process."[219] In the following, the assessment procedure for CO_2-streams for disposal into sub-seabed geological formations will be outlined.

aa. Chemical and physical properties of the CO_2-stream composition

As mentioned above, a particular focus of the CO_2 Specific Guidelines is on the CO_2-stream composition. This reflects the understanding that a correct and comprehensive characterization of the CO_2-stream is a prerequisite to gain a complete picture of its potential environmental and health impacts. If the characterization of the CO_2-stream is insufficient, it is an inadequate basis for decision and the issuing authority is advised not to grant a permit for disposal.[220] The characterization of the CO_2-stream includes both the CO_2 and any incidental associated substances and shall cover the chemical and physical characteristics of the substances as well as the potential for interactions among those components.[221] Consequently, the evaluation of the CO_2-stream includes: (1) origin, amount, form and composition, (2) properties: physical and chemical, and (3) toxicity, persistence, potential for bio-accumulation.[222]

bb. Action lists

This tool is intended to analyse the substances in question with a view to their potential impact on human health and the environment. Such a list provides for a screening mechanism of the disposal of CO_2 into geological formations and the composition of the stream. A particular focus is set on the "presence and magnitude of incidental associated substances derived from the source material and the capture and sequestration processed used."[223] In the screening process, the role of incidental substances in the transport, injection and storage process of CO_2 is underlined. Consequently, acceptable considerations of those incidental substances are

[219] CO_2 Specific Guidelines, 5.

[220] *CO_2 Specific Guidelines,* 4.

[221] *Ibid.*

[222] *Ibid.*

[223] CO_2 Specific Guidelines, 5..

related to "their potential impacts on the integrity of the storage sites and relevant transport infrastructures and the risk they may pose to human health and the marine environment."[224]

cc. Site selection and characterisation

In order to guarantee long-term storage of CO_2 injected into geological formations, the CO_2 Specific Guidelines prioritize in their sixth step the proper selection and characterization of suitable geological formations.[225] A harmonised framework for the selection of storage sites is to be developed, based, *inter alia*, on the following information: (1) physical, chemical and biological characteristics of the water-column and the seabed, (2) location of amenities, values and other uses of the sea in the area under consideration, (3) assessment of constituent fluxes associated with dumping in relation to existing fluxes of substances in the marine environment, and (4) economic and operational feasibility.[226]

In order to categorize the necessary information, the assessment entails three specific elements: the characterization of the sub-seabed geological formation, a characterization of the marine area under consideration and an evaluation of potential exposure.[227] With regard to the specific requirements in the context of the ECO2-project, the characterisation of the marine area under consideration is particularly relevant. Here, further data in regard to the use and amenities of the surroundings of the storage and injection site as well as physical, hydrological and hydro-dynamical information should be provided. Such an analysis could include the following amenities, uses and biological factors: (1) coastal and marine areas of environmental, scientific, cultural or historical importance, such as marine protected areas or vulnerable ecosystems, e.g. coral reefs, (2) fishing and mariculture areas, (3) spawning, nursery and recruitment areas, (4) migrations routes, (5) seasonal and critical habitats, (6) shipping lanes, (7) military exclusion zones, and (8) engineering uses of the seafloor, including mining, undersea cables, desalination or energy conversion sites.[228]

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[224] *Ibid.*

[225] Para.11 Annex 2 LP. See in this regard arguments on the importance of a detailed site characterisation: O. Eiken *et al.*, 'Lessons learned from 14 years of CCS operations: Sleipner, In Salah and Snøhvit', 2011 *Energy Procedia* 4, 5541–5548.

[226] CO_2 Specific Guidelines, 5-7.

[227] CO_2 Specific Guidelines, 6-8. These elements are specific to the assessment of the site selection and characterisation of the disposal of carbon dioxide streams into sub-seabed geological formations. The Generic Guidelines speak in this context of "size of the dumping-site and the site capacity," 6 *et seq*.

[228] CO_2 Specific Guidelines, 7.

Consequently, a variety of pressures and uses of the surrounding marine environment are to be assessed in order to gain a clear image of potential consequences in case of leakage of CO_2 from the storage site.

dd. Assessment of potential effects

The assessment of effects is intended to outline the nature, temporal and spatial scales and duration of potential impacts after leakage. In this regard, the CO_2 Specific Guidelines propose certain indicators that could be used when assessing the potential effects of CO_2 leakage. This aspect could be potentially relevant in the determination of the threshold of "adverse consequences" and could help to clarify the risks associated with CCS.[229] In the evaluation the following aspects should be regarded:

- Sensitive ecosystems or species
- Sensitive areas and habitats (such as spawning, nursery or feeding areas and coral reefs)
- Migratory species and marketable resources
- Effects on human health
- Effects on living resources, amenities and other legitimate uses of the sea

Risk assessment

These elements should consequently be used to evaluate and describe the risk of leakage with regard to its impact on the surrounding environment. The risks associated with the storage of the CO_2 are described "as the likelihood of exposure, i.e. leakage of the carbon dioxide streams and associated effects on habitats, processes, species, communities and uses."[230] In the assessment of risks, a site-by-site analysis should be applied that also takes into consideration the capacity to intervene or mitigate in the event of leakage. Risks outlined and defined during the risk assessment form the variables and serve as the basis of the monitoring scheme. In this regard a particular focus should be put on biological effects, habitat modification and

[229] See only this aspect in the context of the aim of the ECO2-project to study the potential effects of leakage on benthic organisms and marine ecosystems.

[230] CO_2 Specific Guidelines, 9.

physical and chemical change. Due to the long-term timeframe of the project, the CO_2 Specific Guidelines propose to pursue a risk characterization at different stages of the project. That said, it remains silent on proposing a specific timespan.

Impact hypothesis

The Impact Hypothesis should be developed after the risk characterization. It contains a "concise statement of the expected consequences of the disposal"[231] and forms the basis for the decision to issue or refuse a permit for disposal. Key elements in the development and testing of the Impact Hypothesis are: (1) characterisation of the CO_2-stream, (2) conditions at the proposed storage site(s), (3) preventive and/or mitigating measures (with appropriate performance standards), (4) injection rates and techniques, (5) potential release rates and exposure pathways, (6) the potential impacts on amenities, sensitive areas, habitat, migratory patterns, biological communities and marketability of resources and other legitimate uses of the seas, including fishing, navigation, engineering uses, areas of special concern and value, and traditional uses of the sea, and (7) the nature, temporal and spatial scales and duration of expected impacts.

ee. Permit and permit conditions

According to paragraph 17 Annex 2 LP, a permit should only be issued after all impacts evaluations are finalized and the requirements for monitoring established. These include:

- An adequate site characterization
- An assessment of the likelihood for migration and leakages and associated impacts
- And a suitable risk management plan.[232]

According to the CO_2 Specific Guidelines, a permit should only be issued if adequate information is provided and no significant risks are to be expected.[233] The permit for the storage of the CO_2-stream in geological formation must contain the following information: (1) purpose of the permit, (2) the types, amounts and sources of materials in the carbon dioxide stream,

[231] CO_2 Specific Guidelines, 10.

[232] *Ibid.*

[233] CO_2 Specific Guidelines, 14.

including incidental associated substances, to be disposed intop the sub-seabed geological formation, (3) the location of the injection facility and sub-seabed geological formation, (4) the method of carbon dioxide stream transport, and (5) a risk management plan that includes: (a) monitoring (both operational and long-term) and reporting requirements, (b) a mitigation or remediation plan, and (c) a site closure plan including a description of post-closure monitoring and mitigation or remediation options.[234]

In the permitting process, the CO_2 Specific Guidelines "recommend that opportunities are provided for public review and participation in the permitting process."[235] In order to take into account any changes to the composition of the CO_2-stream as well as the results of the monitoring process, the permit should be reviewed at regular intervals. However, no further specification is given in regard to the exact timescale of this review.

Table 7: Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into sub-seabed geological formations (CO_2 Specific Guidelines)

- CO_2 Specific Guidelines are not legally binding.
- They refine and transpose the FRAM and stipulate detailed steps on the different controversial elements of CCS activities (stream composition, evaluation of potential exposure).

The FRAM and CO_2 Specific Guidelines are the first CCS risk assessment frameworks. This status as "pioneer" approaches has necessitated a detailed analysis of their elements. They reflect a common understanding of the Contracting Parties on indispensable requirements for ensuring safe CCS, and they contribute to a further clarification of open questions such as the composition of the CO_2-stream. Their constitutive elements are a permit approach, comprehensive monitoring schemes and the consideration of the entire life cycle of the project. The permit conditions establish the requirements that ought to be fulfilled by both the operator of a storage site as well as the competent State agency. Both guidelines apply a procedural-based approach in which procedural questions and requirements of a risk assessment are outlined, however without delimiting the temporal boundary of the risk assessment.[236]

[234] *Ibid.*

[235] *Ibid.*

[236] Wilson *et al.*, supra note 157, 3482.

The site specific approach of the CO_2 Specific Guidelines ensures that the specific characteristics of a storage site such as potential migration and leakage pathways are adequately recognized. Due to the non-binding nature of the document, it can be seen to establish best practices regarding the risk assessment and management of CCS-projects.

III. Preliminary conclusion

CCS activities in the framework of the dumping regime established by the LC and the LP have been made possible by amending the LP. Despite the initial controversies on certain elements such as the purity criteria of the CO_2-stream and the risks associated with leakage, the LP was amended in 2006 so as to create a legal basis for CCS activities by adding a new category of waste. There remain, however, open issues such as the transboundary movement of CO_2 under Art.6 LP. Even though the Contracting Parties adopted a resolution so as to amend the LP, the amendment has not entered into force yet.

The underlying permit approach of the LP applies to all marine CCS activities. This entails that any CCS activity has to be assessed in accordance of the provisions of Annex 2 LP. In this context, the implementation of the permit approach is to be guided by so-called risk assessment guidance documents. These have been developed in order to serve as mechanisms to guide national authorities in evaluating applications for dumping of wastes in accordance with the provisions of the LP. Both the FRAM as well as the CO_2 Specific Guidelines are not legally binding and serve as an "all purpose tool", as they have to apply to various marine CCS activities worldwide. A further assessment indicates that the elements of both FRAM and the CO_2 Specific Guidelines can be traced back to the IPCC Special Report on Climate Change. This indicates that a certain harmonisation of risk assessment elements regarding marine CCS activities is discernible. That said, the underlying risk assessment and management approach has certain limitations regarding its material scope. For example, the FRAM focuses primarily on oil and gas reservoirs and deep saline formations and does not cover coal beds, basalts, oil and gas shales.

D. Offshore CCS in the context of the Convention for the Protection of the Marine Environment of the North-East Atlantic

The development of a regional offshore CCS regulatory framework has been achieved in the context of the Convention for the Protection of the Marine Environment of the North-East

Atlantic (OSPAR Convention)[237] that applies to the protection of the marine environment of the North-East Atlantic.[238] In the following, the development towards integrating marine CCS in the OSPAR Convention regime will be presented. Particular attention will be paid to the underlying risk assessment framework as contained in primary and secondary OSPAR instruments.

The territorial scope of the OSPAR Convention comprises the Atlantic and Arctic Oceans and their dependent seas.[239] The provisions of the Convention apply to areas that cover the "internal waters and the territorial seas of the Contracting Parties, the sea beyond and adjacent to the territorial sea under the jurisdiction of the coastal state to the extent recognized by international law, and the high seas, including the bed of those waters and its sub-soil."[240]

I. General obligations relevant for CCS activities

The OSPAR Convention establishes marine environmental protection standards that primarily address the introduction of pollution.[241] In fulfilling these obligations, the Contracting Parties are guided by the precautionary and the polluter-pays-principle.[242] The precautionary principle in the framework of the OSPAR Convention reads as follows:

> "by virtue of which preventive measures are to be taken when there are reasonable grounds for concern that substances or energy introduced, directly or indirectly, into the marine environment may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects."[243]

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[237] Paris, 22.09.1992, 32 ILM 1069 (entered into in force on 25.03.1998).

[238] See for the "attention" of the work in this fora in the International Maritime Organisation: IMO/Scientific Group, CO_2 Sequestration in geological structures, LC/SG 28/INF.6, 14.3.2005.

[239] Art.1 (a) (i) (1) OSPAR Convention. The territorial scope of the Convention does not include the Baltic Sea and the Belts, the Mediterranean and parts of the Atlantic Ocean that lie north of 59◦ north latitude and between 44◦ west longitude and 42◦ west longitude. The Contracting Parties are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxemburg, the Netherlands, Portugal, Spain, Switzerland and the United Kingdom. Additionally, the European Union is also a Contracting Party to the Convention.

[240] Art.1 (a) OSPAR Convention.

[241] During the meeting of the OSPAR Contracting Parties in Sintra, Portugal in 1998, Annex V OSPAR Convention on the Protection and Conservation of the Ecosystem and Biological Diversity of the Maritime Areas was adopted. It substantiates amongst others Art.2 (1) (a) OSPAR Convention and implements the duty as set out in Art.2 Convention on the Biological Diversity to develop strategies for conservation and sustainable use of biological diversity (Preambular, paras. 5 and 6 Annex V OSPAR Convention).

[242] Art.2 (2) (a) and (b) OSPAR Convention.

[243] Art.2 (2) (a) OSPAR Convention.

The duty to apply the precautionary principle is also highly relevant in the context of CCS activities. Since within the OSPAR framework the burden of proof is on the Contracting Party that relies on the environmental soundness of its activity,[244] the application of this principle automatically touches upon the risks associated with CCS activities.

A shortcoming of this definition is the required threshold of a "reasonable grounds for concern."[245] Thus, the definition contains a subjective element and provides the Contracting Parties with a considerable scope of discretion as to when it should be applied. The precautionary principle as entailed in the OSPAR Convention is placed in the context of pollution control. Even though the principle refers to circumstances in which substances or energy are introduced, it potentially excludes other harmful activities which are usually included in the material scope of the treaty such as the protection of biodiversity or the ecosystem.[246] Notwithstanding this consideration, the precautionary principle can be understood as an "action-guiding"[247] principle that is to be taken into account when pursuing any potentially harmful activities in the maritime area of the OSPAR Convention. This approach is also reflected in the obligation to use best available techniques and best environmental practices including clean technology.[248]

II. The anti-pollution standards of the OSPAR Convention and their compatibility with marine CCS

The OSPAR Convention obliges its Contracting Parties to "take all possible steps to prevent and eliminate pollution and […] take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practical, restore marine areas which have been adversely affected."[249] The overall aim of the Convention is thus not only aimed at generally prohibiting

[244] R. Lagoni, 'Regional Protection of the marine Environment in the Northeast Atlantic Under the OSPAR Convention of 1992', in: Nordquist/Moore/Mahmoudi (eds.), *The Stockholm Declaration and Law of the Marine Environment*, 2003, 183; A. Proelß, *Meeresschutz im Völker- und Europarecht*, 2004, 203 et seq.; E. Hey, 'Global Environmental Law', 2008 *Finnish Yearbook of International Law* 19, 18.

[245] Marr, supra note 120, 61.

[246] J. Ebbesson, 'A Critical Assessment of the 1992 Baltic Sea Convention', 2000 *German Yearbook of International Law* 43, 45.

[247] Marr, supra note 120, 63.

[248] See Art.2 (3) (b) (i) OSPAR Convention in conjunction with See Appendix 1 OSPAR Convention. Armeni, supra note 134, 148.

[249] Art.2 (1) (a) OSPAR Convention. See for further information: E. Franckx, 'Regional Marine Environment Protection Regimes in the Context of UNCLOS', 1998 *The International Journal of Marine and Coastal Law* 13, no. 3, 307–324; Churchill & Lowe, supra note 127, 367 *et seq*.

pollution, but rather to cover all negative anthropogenic activities.[250] The comprehensive pollution prohibition approach of the OSPAR Convention encompasses treaty obligations which are further substantiated by annexes that relate to specific sources of pollution. In this regard, four sources of pollution are identified: land-based, dumping or incineration, offshore sources and other sources.[251] In the context of marine CCS, the regulation of pollution from dumping and from offshore sources is particular relevant. Whereas the former is regulated by Art.4 OSPAR Convention in conjunction with Annex II, the latter is covered by Art.5 OSPAR Convention in conjunction with Annex III. Art.4 OSPAR Convention obliges the Contracting Parties to take either "individually or jointly all possible steps to prevent or eliminate pollution by dumping or incineration of wastes or other matter." Waste is negatively defined in that substances not listed are considered as waste.[252] Dumping includes "any deliberate disposal in the maritime area of wastes or other matter from vessels, aircraft or offshore installations or the disposal of vessels, aircrafts, offshore installations or offshore pipelines."[253] According to Art.1 (g) OSPAR Convention, dumping does, *inter alia*, not include "the placement of matter for a purpose other than the mere disposal thereof, provided that, if the placement is for a purpose other than that for which the matter was originally designed or constructed." Accordingly, in order to be permissible under the dumping provisions as stipulated by the OSPAR Convention, the stored CO_2 must be considered as a placement which has another purpose than originally intended.

In order to address the ensuing legal questions, the OSPAR Commission already in 2002 mandated the Group of Jurists and Linguists (JL) to provide guidance on the permissibility of CO_2 storage in the sub-seabed under the OSPAR Convention.[254] In its report, the JL differentiated between the offshore storage from land-based CO_2 and the disposal of CO_2 from offshore installations.[255] It was argued that

[250] Art.1 (d) OSPAR Convention. Preambular indents 2 and 4 OSPAR Convention. J. Hilf, 'The Convention for the Protection of the Marine Environment of the North-East Atlantic - New Approaches to an Old Problem?', 1995 *Zeitschrift für ausländisches öffentliches Recht und Völkerrecht* 55, 580–603, 582.

[251] Art.3-5 and 7 OSPAR Convention respectively.

[252] The substances listed in Art.1 (o) OSPAR Convention are (i) human remains; (ii) offshore installations; (iii) offshore pipelines and (iv) unprocessed fish and fish offal discarded from fishing vessels.

[253] Art.1 (f) OSPAR Convention.

[254] Armeni, supra note 134, 148. See for an account of a different time frame of the developments in the OSPAR Convention: Dixon *et al*., supra note 158, 4507.

[255] In Armeni, supra note 134, 148: OSPAR Commission, Report from the Group of Jurists and Linguists on Placement of Carbon Dioxide in the OSPAR Maritime Area, OSPAR 04/23/1-E, Annex 12, 28.6.2004.

> "since the OSPAR Convention contains, in effect, three separate régimes [Annex 1 - land based sources; Annex II - dumping; Annex III - offshore sources], the results it produces are complex. Since the applicable régime is determined by the method and purpose of placement, and not by the effect of placement on the marine environment."[256]

In 2005/2006, the OSPAR Biodiversity Committee proposed to include CCS in the work programme of its Offshore Industry Committee. Here, a review of the risk characterisation for selection of potential sites in the OSPAR maritime area for the storage of CO2 and a review of appropriate monitoring and surveillance mechanisms for the purposes of detecting leakage of CO_2 from sub-seabed reservoirs and releases of CO_2 into the marine environment was pursued.[257] The OSPAR Contracting Parties mirrored the approach taken in the framework of the LP[258] and proposed the adoption of three documents. These included a draft measure on the storage of carbon dioxide streams in sub-seabed geological formations", a draft OSPAR guideline for risk assessment and management of CO_2 in sub-seabed geological formations; and a draft Framework for Risk Assessment and Management of storage of CO_2 in sub-seabed geological formations (FRAM), as part of the guidelines.[259] Even though at this point, no consensus on the legal status of the "draft measure" had been reached,[260] only three months later the OSPAR Contracting Parties unanimously decided to amend Annex II and III so as to allow for the storage of CO_2 in geological formations.[261]

Accordingly, under Art.3 (2) (f) Annex II OSPAR Convention the disposal of „carbon dioxide streams from carbon dioxide capture processes for storage" are permissible subject to the condition that:

> "i. disposal is into a sub-soil geological formation;

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[256] Para.32 *ibid*. See for a comprehensive review of the preliminary work of OSPAR's Group of Jurists and Linguists: Hendriks *et al*., supra note 200, 100 *et seq*.

[257] OSPAR Commission, Placement of CO_2 in Subsea Geological Structures, Publication Number: 284/2006, 2006, Biodiversity Series. To the end of coordinating the review on marine CCS, an Intersessional Correspondence Group convened by the United Kingdom and Norway was established OSPAR Commission, Meeting of the Biodiversity Committee (BDC), BDC 05/13/1-E, 21.2.2005, 28.

[258] Already from an early stage, the drafting of the pertinent documents in the OSPAR Convention was closely associated with the work of the LP: IMO/LC/LP, supra note 139, 21; IMO/Scientific Group, supra note 238.

[259] OSPAR Commission, Meeting of the Biodiversity Committee (BDC), BDC 07/12/1-E, 26.3.2007, 35.

[260] *Ibid*., 35.

[261] OSPAR Commission, Meeting of the OSPAR Commission, Annex 4 (Ref. §2.10a), 25.6.2007. Concurrently, the Contracting parties ruled out the possibility to store CO_2 in the water column or on the seabed: OSPAR Commission, Meeting of the OSPAR Commission, Annex 5 (Ref. §2.10b), 25.6.2007. The amendment entered into force on 23 of July 2011 for the 7 Contracting Parties (Norway, Germany, United Kingdom, Spain, European Union, Luxembourg and Denmark) and on 28 October 2011 for the Netherlands. Ratification of OSPAR carbon capture and storage measures, 28 October 2011, <http://www.ospar.org/content/news_detail.asp?menu=00600725000000_000018_000000> (last accessed on 31.03.2014).

ii. the streams consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture, transport and storage processes used;

iii. no wastes or other matter are added for the purpose of disposing of those wastes or other matter;

iv. they are intended to be retained in these formations permanently and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area."

The amendment of Art.3 (3) and (4) Annex III OSPAR Convention provides, besides the above mentioned exception, for procedural obligations that need to be fulfilled before a geological storage of CO_2 can be pursued. In this respect, Art.3 (4) Annex III OSPAR Convention obliges the Contracting Parties to ensure that CO_2 is only stored in sub-soil geological formations with authorization by a competent authority. It is furthermore outlined that such an "authorisation or regulation shall, in particular, implement the relevant applicable decisions, recommendations and all other agreements adopted under the Convention."[262] Even though these provisions indicate a similar spirit than the approach taken by the LP, the OSPAR Convention "goes further by including a permanence requirement for storage and a guarantee of no significant adverse effects."[263] Despite the far-reaching approach, the wording of the amendments itself does not further define the exact content of both the permanence condition as well as the understanding of "significant adverse consequences."[264] However, it is argued that a further substantiation is necessary in this regard in order to ensure a high standard of environmental protection. Since the wording relates to the risk associated with marine CCS, the assumption "that there are certain risks relating to environmental quality, which are simply intolerable, is reflected in the precautionary principle."[265]

III. The challenge to establish and define thresholds of harm in the context of CCS activities

A recourse to the precautionary principle as codified in Art.2 (2) (a) OSPAR Convention is necessary in order to provide a threshold in the determination of the consequences. The terminology "significant adverse consequence" indicates that a threshold of harm exists. Arguing *e*

[262] Art.3 (4) Annex III OSPAR Convention.

[263] Armeni, supra note 134, 153.

[264] *Ibid*., 153 and Proelss & Güssow, supra note 34, 161.

[265] K. R. Gray, 'International Environmental Impact Assessment: Potential for a Multilateral Environmental Agreement', 2000 *Colorado Journal of International Environmental Law and Policy* 11, no. 1, 83–128, 98.

contrario this implies that there is a minimum threshold of significant harm and that certain impacts and consequences are negligible. Consequently, Kiss and Shelton exclude from significant consequences "minor incidents causing minimal damage."[266] In this context, together with the application of the precautionary principle, this provision leaves a margin of appreciation for the authorities to determine what constitutes a significant adverse consequence. Trouwborst argues that an indicator to assess whether an activity has the potential to cause a significant adverse consequence is "the breach of substantive norms of public international law, such as internationally agreed quality standards for river water or air purity, or commitments regarding the conservation of particular populations of wildlife."[267] Furthermore, it is submitted that a decision on whether a threshold has been surpassed has to be based on a risk balancing based on the precautionary principle.

However, this approach is limited by the choice of substantive norms that could be applied in establishing whether a significant adverse consequence occurs. One possible option could be the inclusion of the pertinent OSPAR Convention provisions. Even though a reference is made to the marine environment, human health and other legitimate uses of the sea, no concrete standards are given in this instance. Furthermore, since neither in the LP nor in the OSPAR Convention a specific numerical threshold is defined, the interpretation of what constitutes significant is generally "not without ambiguity."[268] In the following, it will be demonstrated that the avoidance of significant adverse consequences is closely linked to a CCS-specific risk assessment framework which has been developed in the context of the OSPAR Convention.

In order to provide guidance on the interpretation and implementation, the OSPAR Commission has adopted OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations[269] and has created a risk assessment and management framework (OSPAR FRAM).[270] OSPAR Decision 2007/2 specifies that through the application of the OSPAR FRAM, "authorities shall ensure that carbon dioxide streams, which are stored in geological formations, are intended to be retained in these formations permanently and will not lead to

[266] A. C. Kiss & D. Shelton, *International environmental law*, 2nd ed., 2000, 269.

[267] A. Trouwborst, *Precautionary rights and duties of states*, 2006, 52.

[268] International Law Commission, 'Draft Articles on the prevention of transboundary harm from hazardous activities: Report of the Commission to the General Assembly on the work of its fifty-third session', 2001 *Yearbook of the International Law Commission [YILC]*, Volume II (Part 2).

[269] OSPAR Commission, Meeting of the OSPAR Commission,, OSPAR 07/24/1-E, Annex 6, 25.6.2007 (OSPAR Decision 2007/2); Proelss & Güssow, supra note 34, 161.

[270] OSPAR Commission, Meeting of the OSPAR Commission, Annex 7 (Ref. §2.10d), 25.6.2007.

significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area."[271] It outlines procedural obligations regarding the granting of permits and sketches the elements that should at least be contained in a permit to pursue marine CCS in the OSPAR Conventions area. Granted permits are to be regularly reviewed and should take into consideration the results of the monitoring.[272] Decision 2007/2 establishes that any authorisation to pursue CCS in geological formations shall follow the OSPAR FRAM. Furthermore, "a decision to grant a permit or approval shall only be made if a full risk assessment and management process has been completed to the satisfaction of the competent authority and that the storage will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area."[273]

Consequently, the application of the OSPAR FRAM is made legally binding through its reference in OSPAR Decision 2007/2. However, the content and elements of OSPAR FRAM are distinguished by flexible specifications, and the Contracting Parties only have to apply these "to the extent possible."[274] In the following, the OSPAR FRAM will be further analysed and contrasted with the pertinent requirements as established in the framework of the LP.

IV. OSPAR Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formations (OSPAR FRAM)

The OSPAR FRAM were adopted one year after the adoption of FRAM within the LP. They mirror the principle of FRAM of the LP and apply the same structure.[275] Risk assessment in the context of OSPAR FRAM is defined as "part of a risk-management system, consisting of exposure assessment, effect assessment and risk characterization."[276] Despite their objective to provide "generic guidance"[277] for the Contracting Parties, their development aims to ensure that in case leakage should occur, it does not "lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime areas."[278] It is

[271] Para. 2.1., OSPAR Decision 2007/2.

[272] Para. 3.3., OSPAR Decision 2007/2.

[273] Para. 3.1., OSPAR Decision 2007/2.

[274] OSPAR FRAM, 2.

[275] OSPAR, FRAM, 1.

[276] OSPAR FRAM, 30.

[277] OSPAR FRAM, 2.

[278] OSPAR FRAM, 6.

important to note that the OSPAR FRAM is primarily intended to apply to storage sites not deeper than 500 m[279] and focuses on issues related to the CO_2 storage phase (injection and post-injection).

The OSPAR FRAM establishes three central elements: (1) the assessment of the suitability of a potential injection site, (2) a site specific characterization of the risks to the marine environment from the storage site, and (3) a concerted monitoring approach that streamlines the collection of necessary information which is used to establish measures for hazard reduction, remediation and mitigation in case of leakages.[280] OSPAR FRAM takes into consideration the variety of potential storage sites and only obliges Contracting Parties to follow the requirements "to the extent possible when issuing permits."[281] It outlines five phases that need to be considered in the planning and operation of marine CCS-projects. These phases are embedded in a "life cycle" of a CO_2 storage project that consists of the planning, construction, operation, site-closure and post-closure stage.[282] As the six phases of the OSPAR FRAM risk assessment approach overlap and are applied in several life cycle steps, only the core elements will be presented in the following. A particular focus is put on the comparison between the FRAM as adopted within the LP in order to understand the underlying elements of a risk assessment procedure in the context of CCS.

The problem formulation is used in the planning step in order to scope the framework of the risk assessment. This assessment foresees the elaboration of a model that is directed to ensure a permanent containment of the stored CO_2 and at the same time identifies potential gaps and uncertainties that could become a risk. In this assessment, a report on potential migration and leakage must be given. An additional account must be provided in regard to migration and leakage occurring during the injection and post-injection phases. Whereas no threshold or further definition of what constitutes "leakage" is proposed, a distinction is made regarding the "spatial and temporal nature of the leakage."[283] Any problem formulation should preview

[279] OSPAR FRAM, 2. Sites under waters deeper than 500m may necessitate a further update of the guidance document due to differing exposure and effects pathways.

[280] OSPAR FRAM, 1.

[281] OSPAR FRAM, 2.

[282] OSPAR FRAM, 2.

[283] OSPAR FRAM, 10.

"precautionary measures" to mitigate leakage during injection and also during the operational phase that occur either abruptly or diffusely.[284]

The site selection and characterization phase takes place during the planning, construction and operation phase and aims to ensure that the specific site characteristics are compatible with the expected long-term storage and any conflicting or future uses of the marine environment. At this stage, the storage capacity of the selected storage site should be assessed by integrating factors such as the volume of the site, the porosity and permeability of the geological formation as well as the possibilities for monitoring, remediation and/or mitigation. In order to streamline and harmonise the important issues that ultimately play a role in the risk assessment, some pertinent information for the site selection are provided in Appendix I.[285] These considerations form a baseline that is furthermore used during monitoring.

The exposure assessment is applied during the entire life cycle of the CO_2 storage project and assesses and characterizes the movement of the CO_2 stream "within the geological formation or, potentially the marine environment."[286] It establishes the basis for the following effects assessment in that it covers three different potential migration processes and pathways of the CO_2 stream. These are (1) the exposure and leakage from the injection equipment, (2) the geological storage formation, and (3) the surrounding water or biosphere. In this regard, characterization and detailed knowledge concerning the composition of the CO_2 stream including any incidentally associated substances is indispensable in order to identify uncertainties.[287]

The subsequent effects assessment aims to complete the knowledge on possible impacts for the marine environment and human health after the exposure to CO_2. This phase is a tool to fulfil the obligation arising out of Art.3 (2) (f) (iv) Annex II OSPAR Convention to prevent the "significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area" and consequently forms the basis for management approaches. The OSPAR FRAM is based on the assumption that in particular due to the long-term time frame, the CO_2 storage includes a significant level of uncertainty. In regard to the effects assessment, this uncertainty is integrated in Appendix II OSPAR FRAM that outlines

[284] *Ibid*.

[285] These include information about the CO_2-stream, geographical and geological factors as well as uses of the possible injection site. Furthermore, specific characteristics such as the specificities of the surrounding marine environment and economic and regulatory issues are also included.

[286] FRAM, 7.

[287] In the discussion leading to the adoption of the amendment of the OSPAR Convention, the issue of associated substances in the CO_2-stream had been a concern; see OSPAR Commission, supra note 259, 35.

the need for further research with a particular focus on the impact predictions on the effect of leaked CO_2 on species and ecosystems.

V. Preliminary conclusion

The OSPAR Convention plays a particular role in regulating marine CCS since it is the first regional seas conventions in which marine CCS has been addressed. As the use of marine CCS had no explicit legal base under the Convention, a subsequent amendment of its material scope was necessary in order to achieve legal certainty regarding its applicability. The discussion on amending the Convention was joined by the need to safeguard application of the precautionary principle, a legally binding element of the OSPAR Convention, in order to take into account potential risks associated with marine CCS.

The classification of marine CCS in the overall structure of the OSPAR Convention was a central issue during the negotiation phase. Notwithstanding these discussions, the Contracting Parties adopted in 2007 amendments to the OSPAR Convention so as to provide a legal basis for marine CCS. In this context, Annex II and II OSPAR Convention, dealing with pollution by dumping and offshore sources respectively, were amended.

Similar to the discussion under the LP, the OSPAR Convention Contracting Parties were not able to agree on a specific composition requirement of the CO_2-stream. While the wording of the amendments is oriented to the "overwhelmingly"-approach of the LP, the OSPAR Convention additionally envisages permanence and impacts requirements. However, despite these specifications, legal uncertainty remains regarding the threshold of the adverse consequences as well as the temporal scale of the provisions. Simultaneously, with the amendment to allow for sub-seabed storage of CO_2, the OSPAR Contracting Parties prohibited the storage of CO_2 in the water column.

In order to further guide the implementation of the newly introduced provisions, the Contracting Parties adopted OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations in 2007. It institutes a permit system for marine CCS activities in which the Contracting Parties are to supervise the implementation of the obligations arising out of the OSPAR Convention. Following the example of the LP, the OSPAR Contracting Parties are to ensure the long-term and safe storage of CO_2 by way of a suitable risk management and assessment procedure. For this purpose, the OSPAR FRAM serves to provide generic guidance to the Contracting Parties in implementing the provisions. Even though the appli-

cation of OSPAR FRAM is indirectly made legally binding through OSPAR Decision 2007/2, its provisions must only be implemented "to the extent possible."

E. Offshore CCS under the EU regulatory framework

The following part addresses the regulatory framework established in the EU regarding CCS activities. Since their integration in the climate change regime has been analysed elsewhere, this section will primarily address the issue of storage of CO_2.[288] In the following, the regulatory approach taken in the EU will be studied by way of an examination of pertinent primary law as established by the Treaty on the Functioning of the European Union (TFEU) and subsequent secondary law.[289] In line with the previous sections, particular reference will be made to the underlying risk assessment and management approach. Where possible, an attempt is made to compare the different methods towards regulating CCS activities and to contrast, in a comparative manner, the obligations arising out of the aforementioned international agreements.

I. The EU regulatory framework in the context of international obligations

The development of a regulatory framework regarding CCS activities in the EU does not stand in an isolated manner, but is integrated in the overall international context that has been discussed in the chapters above.[290] The issue of external relations of the EU vis-à-vis international organisations or agreements is a complex question. It affects the so-called external competence of the EU on the one hand and the distribution of competences regarding the Member States on the other.

Even though the TFEU contains a clause on the cooperation of the EU and Member States regarding third countries and international organisations in the sphere of environmental protection (Art.191 (4) TFEU), this provision does not explicitly confer an external competences to the EU, but rather assumes that such a competence exists. Whether the EU may act in this regard thus depends on its competence to adopt internal rules. Whereas previously, a referral

[288] See section B.II. above.

[289] See for an overview on the development of EU primary law P. Craig & G. de Búrca, *The evolution of EU law*, 2nd ed., 2011. With regard to EU environmental law: J. H. Jans & H. Vedder, *European environmental law*, 4th ed., 2012, 3 *et seq*.

[290] R. Purdy & I. Havercroft, 'Carbon Capture and Storage: Developments under European Union and International Law', 2007 *Journal for European Environmental & Planning Law* 4, no. 5, pp. 353–366, 365.

to the doctrine established by the European Court of Justice in the AETR case was necessary,[291] the TFEU introduced a new article so as to clarify this situation.

In this regard, Art.216 TFEU relates to the "implied power doctrine" which signifies that "internal competences can also be used in respect of external policy":[292]

> "1. The Union may conclude an agreement with one or more third countries or international organisations where the Treaties so provide or where the conclusion of an agreement is necessary in order to achieve, within the framework of the Union's policies, one of the objectives referred to in the Treaties, or is provided for in a legally binding Union act or is likely to affect common rules or alter their scope.
>
> 2. Agreements concluded by the Union are binding upon the institutions of the Union and on its Member States."

The legal base for the adoption of environmental protection acts by the EU institutions is Art.192 (1) TFEU. Accordingly,

> "The European Parliament and the Council, acting in accordance with the ordinary legislative procedure and after consulting the Economic and Social Committee and the Committee of the Regions, shall decide what action is to be taken by the Union in order to achieve the objectives referred to in Article 191."

In line with Art.216 TFEU, this provision does not only establish internal competences but also empowers the EU to conclude conventions with organisations or third States and adhere to multilateral environmental agreements that lie in the scope of competences of the EU.

II. The implementation of mixed agreements under EU law

Agreements to which both the EU and EU Member States are Contracting Parties are called mixed agreements.[293] Since the EU is, next to its Member States, a Contracting Party to some of the international agreements analysed above, the regulatory framework for CCS activities in the EU has to be consistent with provisions arising out of these conventions.[294] With regard to mixed agreements, both the Member States and the EU are responsible to implement the

[291] ECJ, Case-22/70 *AETR/ERTA* [1971] ECR I-273.

[292] J. H. Jans & H. Vedder, *European environmental law*, 3rd ed., 2008, 59.

[293] This presupposes an accession clause according to which a regional economic organisation may become a Contracting Party to the agreement. Some conventions demand a participation declaration of the EU and its Member in which the extent of competence to act is declared.

[294] See for the legal implications of so-called „mixed agreements": Frank, supra note 23, 77 *et seq.* The EU is, besides some of its Member States, a Contracting Party to the OSPAR Convention.

provision according to their sphere of competences and acting in close co-operation.[295] In this context, obligations arising out of such an agreement automatically form an integral part of the EU legal order from the moment on they enter into force, if and to the extent to which their provisions are self-executing.[296]

Since the development and application of CCS technologies in the EU is heavily influenced by the development and implementation of international commitments and initiatives, this naturally influences the approach taken by the EU.[297]

III. Competence to enact legally binding measures concerning environmental protection

A further substantiation of EU primary law is achieved by the adoption of secondary legislation by the EU institutions.[298] Since the institutions of the EU may only exercise power in the framework of their conferred competences, the choice of the legal base is vital. The competence of the EU to act on environmental protection issues has a clear legal basis in Art.192 TFEU.[299] If measures are adopted under Art.192 TFEU, Art.193 TFEU allows the EU Member States to implement stricter laws under the premise that these are compatible with the TFEU, and that the European Commission is notified.[300] The competence to adopt legally binding measures on environmental issues is shared by the Union and the EU Member States.[301]

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[295] ECJ, Case-25/94 *Commission v Council* [1996] ECR I-1469, paras.35 and 36.

[296] The EU has therefore adopted a monist approach in which no further act of implementation or transposition of the international standards is necessary. See also Art.216 TFEU and ECJ, Case-104/81 *Kupferberg* [1982] ECR-I 3641, paras.11-13. Relevance of the self executing-requirement is emphasized by A. Proelss, 'European Community Law and WTO Regulations: The Direct Effect Doctrine Revisited', in: P.J.J. Welfens/C. Ryan/S. Chirathivat/F. Knipping (eds.), *EU–ASEAN Facing Economic Globalization*, 2009, 193-204.

[297] M. Holwerda, 'Deploying carbon capture and storage "safely": The scope for Member States of the EU to adopt more stringent CO_2 stream-purity criteria under EU law', 2011 *Climate Law* 2, no. 1, 37-61, 41.

[298] The potential forms of secondary acts are listed in Art.288 TFEU.

[299] The chosen legal base also has a consequence on the decision-making procedure. Art.192 (1) TFEU refers for example to the "ordinary legislative procedure" which is established in Art.289 TFEU.

[300] The Commission may not prohibit the law establishing stricter environmental standards, but could, as the case may be, initiate an infringement procedure under Art.258 TFEU. M. Kotzur, *Art.193 AEUV* , in R. Geiger *et al.* (eds.), *EUV, AEUV: Vertrag über die Europäische Union.* Vertrag über die Arbeitsweise der Europäischen Gemeinschaft, 5th ed., 2010, 654. Also, the ECJ stated that *"[…] the Community rules do not seek to effect complete harmonisation in the area of the environment*" ECJ, Case‑6/03 *Deponiezweckverband Eiterköpfe* [2005] ECR I-2753, para.27.

[301] Art.4 (2) (e) TFEU. See for a general discussion on the question and implication of exclsuive, shared and complementary competence: M. Cremona, *External relations and external competence of the European Union*, in P. Craig & G. de Búrca, *The evolution of EU law*, 2nd ed., 2011, 244 *et seq*.

In adopting measures on environmental protection policy, the environmental principles as outlined in Art.191 (2) TFEU are to be taken into consideration.[302] Even though these are not directly enforceable and do not require specific environmental measures, they guide the implementation of EU primary law and could serve "to review secondary legislation."[303]

The reference to the precautionary principle as stipulated in Art.191 (2) TFEU is particularly relevant in the context of risk assessment and management frameworks applicable to CCS activities. Even though the principle is referred to in primary law, no definition regarding its scope or application is provided.[304] Consequently, the European Commission has issued a non-binding Communication on the topic with the aim to clarifying its approach towards the application and use of the principle in taking measures.[305] It establishes that:

> "the precautionary principle should be considered within a structured approach to the analysis of risk which comprises three elements: risk assessment, risk management, risk communication. The precautionary principle is particularly relevant to the management of risk."[306]

Furthermore, the reliance and application of the precautionary principle "in a given situation is thus the result of a political decision, a function of the risk level that is "acceptable" to the society on which the risk is imposed."[307] Therefore, application of the principle is subject to political judgement in which the societal risk perception is a leading benchmark.

IV. Removing legal barriers: The CCS Directive

The development of a policy and legal framework in the EU regarding CCS has been influenced both by amendments to international instruments[308] and the need to agree on specific

[302] Art.191 (2) TFEU. "Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay." See for a comprehensive overview: R. Macrory, *Principles of European environmental law: Proceedings of the Avosetta Group of European Environmental Lawyers*, 2004. Additionally, Art.11 TFEU requires the integration of environmental concerns in all EU policies: "Environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development."

[303] N. de Sadeleer, *Environmental principles: From political slogans to legal rules*, 2002, 322 and K. Meßerschmidt, *Europäisches Umweltrecht*, 2011, 283.

[304] European Commission, Communication from the Commission on the precautionary principle, COM(2000) 1, 02.02.2000, 3.

[305] *Ibid.*, 3.

[306] *Ibid*., 3.

[307] *Ibid.*, 16.

[308] Purdy & Havercroft, supra note 290, 365.

European climate change and environmental protection targets.[309] The EU approach to address and regulate CCS can be compared to a dual-track approach. On the one hand, the issue is integrated into the EU climate change regulatory context,[310] one the other a regulatory framework for the implementation of CCS projects is established.

The road towards adopting a regulatory instrument for CCS activities in the EU has been paved by the Commission Communication "Winning the Battle Against Global Climate Change"[311] in 2005, which highlighted the potential benefits of CCS in the EU. Subsequently, under the Second European Climate Change Programme, a Working Group on Carbon Capture and Geological Storage was established with the purpose to illustrate the role of CCS in mitigating climate change.[312]

In 2007, the Commission Communication "Sustainable power generation from fossil fuels: aiming for near-zero emissions from coal after 2020" delineated the role of CCS in the EU. It raised three central requirements that were seen as indispensable in regulating CCS:

> "(1) ensure the environmentally sound, safe and reliable operation of CCS activities; (2) remove unwarranted barriers to CCS activities in current legislation and (3) provide appropriate incentives proportionate to the CO2 reduction benefits."[313]

In the same year, the Council of the European Union recognized the role of CCS and envisaged a deployment of CCS "by 2020 if possible."[314] The EU institutions were thus faced with the challenge to balance private interests of investors to develop CCS initiatives and public interests to adequately embrace potential risks in the form of a solid legal framework.[315]

In 2008, the European Commission published an initial proposal to address CCS in the EU. Whereas at first, the option to integrate the different elements of CCS into already existing legislation was examined, the proposal was made to address CCS in an individual legislative act.[316] Consequently, only one year later in 2009, the CCS Directive was adopted. Judging

[309] European Commission, Green Paper-Towards a future Maritime Policy for the Union: A European vision for the oceans and seas, COM(2006) 275 final, 07.06.2006,15.

[310] See section B.II. above.

[311] European Commission, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, COM(2005) 35 final, 9.2.2005, 7.

[312] European Commission, Commission staff working document, SEC(2008) 54, 23.1.2008, 9.

[313] European Commission, Communication from the Commission to the Council and to the European Parliament, COM(2006) 843 final, 10.01.2007, 8.

[314] Council of the European Union, Presidency Conclusions, 7224/07 CONCL 1, 09.03.2007, 22.

[315] Haan-Kamminga *et al.*, supra note 176, 241.

[316] European Commission, supra note 312, 3.

from other experiences to codify CCS in a legal framework, the speed of the decision making progress constitutes a remarkable achievement.[317]

With a view to the long-term developed, the European Commission proposed in January 2014 its framework for climate and energy in the period from 2020 to 2030.[318] The 2030 framework provides for a 40% emissions reduction target below the 1990 level by 2030, an increase of 2,2% of the annual reduction in the cap on emissions in the EU ETS after 2020 and an EU-wide binding target for renewable energy of at least 27% in 2030. As before, CCS is still viewed as an important technology in order to meet the long term greenhouse gas reduction targets of the 2030 framework, for example where GHG emissions are unavoidable and where efficiency is at its limits. Especially for fossil fuel-based power generation, CCS could be a key technology to reduce GHG emissions.[319]

1. The aim and approach of the CCS Directive

The CCS Directive[320] was adopted as part of the "Climate and Energy Package" in order to provide a common legal framework for CCS in the EU. It aims to remove legal barriers that are associated with CCS.[321] CCS is seen as a bridging technology that "should not lead to a reduction of efforts to support energy saving policies, renewable energies and other safe and sustainable low carbon technologies, both in research and financial terms."[322]

The purpose and main focus of the Directive is the safe geological storage of CO_2 that guarantees a permanent containment of CO_2 "in such a way as to prevent and, where this is not possible, eliminate as far as possible negative effects and any risk to the environment and human

[317] C. Clarke, *Long-term Liability for CCS: Some Thoughts about Specific Risks, Multiple Regimes and the EU Directive*, in I. Havercroft *et al.* (eds.), *Carbon capture and storage: Emerging legal and regulatory issues*, 2011, 190.

[318] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A policy framework for climate and energy in the period from 2020 to 2030, COM(2014) 15 final, 22.1.2014

[319] *Ibid*., 15.

[320] See supra note 94. See for a discussion: 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 *et al.* (eds.), *Carbon capture and storage: Emerging legal and regulatory issues*, 2011.

[321] See for an overview on the development of the CCS Directive: Schlacke & Much, supra note 149, 296.

[322] Recital 4 CCS Directive. This perception has, judging from the EU's Energy Roadmap 2050, changed substantially European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2011) 885 final, 15.12.2011, 8.

health."[323] Recitals 12,[324] 13 and 14 of the CCS Directive already indicate that an effective regulation of offshore CCS cannot be achieved in an isolated manner by the EU, but underlines the significance of obligations arising out of the London Protocol and the OSPAR Convention.[325]

The key mechanism of the CCS Directive is the permit approach that ensures the compliance with the provisions of the Directive and safe geological storage.[326] Due to the economic scale and role of CCS in the EU's climate mitigation policy, the Directive does not apply to projects that intend to store less than 100 kilotonnes. In its methodological approach, the CCS Directive distinguishes between the different elements of the CCS chain. Whereas it only marginally covers aspects of the capture and transport of CO_2,[327] its primary aim is to provide a regulatory framework of CO_2 storage.[328]

2. The integration of CCS-related issues in the context of the EU regulatory framework

With a view to creating a harmonised regulatory framework, it has been opted to amend pre-existing instruments. This relates on the one hand to Directive 2008/1/EC of 15 January 2008 on Integrated Pollution Prevention and Control (IPPC Directive) which has been revised so as to address the capture of CO_2 from installations that are covered under the Directive.[329] The IPPC Directive has been incorporated in the Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (Industrial Emissions Directive) which has entered into force in 2010.[330] Furthermore, the transport and capture of

[323] Art.1 (2) CCS Directive. F.-J. Peine *et al*., *Rechtsfragen der Abscheidung und Speicherung von CO_2 (CCS): Unter besonderer Berücksichtigung der Rechtslage in Brandenburg*, 2011, 66.

[324] Recital 12 CCS Directive states that "At the international level, legal barriers to the geological storage of CO_2 in geological formations under the seabed have been removed through the adoption of related risk management frameworks under the 1996 London Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1996 London Protocol) and under the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)." Critical towards this statement Haan-Kamminga *et al*., supra note 176, 243.

[325] Institut für Völkerrecht und Europarecht der Georg-August-Universität Göttingen & Leibniz-Institut für Meereswissenschaften an der Christian-Albrechts-Universität Kiel, supra note 37, 169.

[326] Recital 24 CCS Directive.

[327] Art.31 CCS Directive.

[328] European Commission, Proposal for a Directive of the European parliament and of the Council on the geological storage of carbon dioxide and amending Council Directives 85/337/EEC, 96/61/EC, Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC and Regulation (EC) No 1013/2006, COM(2008) 18 final, 23.01.2008, 5; Clarke, supra note 317, 190.

[329] Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control (OJ L 24, 29.01.2008).

[330] OJ L 334, 17.12.2010. See Holwerda, supra note 297, 6. The IPPC Directive will be replaced by the Industrial Emissions Directive as of 7 January 2014; cf. J.H. Jans & H. Vedder, supra note 292, 364.

CO_2 for the purpose of geological storage are covered by the Environmental Impact Assessment Directive from 5 July 1985.[331] By amending pre-existing instruments a double regulation has therefore been avoided.

3. The structure and approach of the CCS Directive with particular reference to the underlying risk management framework

As the overall aim of the CCS Directive is long-term storage, this phase logically constitutes the primary focus of the instrument. In order to achieve permanent storage, the underlying "CO_2 storage life cycle risk management framework" forms the basis of assessing the associated risks.[332] This framework includes the assessment of the storage capacity, the characterization and assessment of the storage complex, the site development, the operation of the site, the post-closure pre-transfer monitoring phase and post-transfer phase. In order to facilitate the implementation of the CCS Directive, the responsible Directorate-General in the European Commission, DG CLIMA,[333] has issued four so-called Guidance Documents. These non-binding instruments provide advice for the implementation of certain provisions contained in the Directive.[334] The four issues address the implementation of the CO_2-Storage Life Cycle Risk Management Framework (Guidance Document 1),[335] Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures (Guidance Document 2),[336] Criteria for Transfer of Responsibility to the Competent Authority (Guidance Document 3)[337] and the Financial Security Framework (Guidance Document 4).[338] In the fol-

[331] Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (Environmental Impact Assessment Directive) (OJ L 175, 05.07.1985). Meßerschmidt, supra note 303, 529 *et seq.*

[332] European Commission, Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide, Guidance Document 1, 2011.

[333] Directorate General for Climate Action: <http://ec.europa.eu/dgs/clima/mission/index_en.htm> (last accessed on 31.03.2014).

[334] European Commission, supra note 332, 1.

[335] *Ibid.*

[336] European Commission, Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide, Guidance Document 2, 2011.

[337] European Commission, Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide, Guidance Document 3, 2011.

[338] European Commission, Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide, Guidance Document 4, 2011. See for a discussion on this specific document: S. Hazeldine, *Geological Factors in Framing Legislation to Enable and Regulate Storage of Carbon Dioxide Deep in the Ground*, in I. Havercroft *et al.* (eds.), *Carbon capture and storage: Emerging legal and regulatory issues*, 2011, 20 *et seq.*

lowing, these Guidance Documents will be taken into consideration when assessing the relevant provisions of the CCS Directive. The subsequent analysis aims to depict the powers and duty of the authorities to ensure safe CCS and the corresponding obligations of the operators intending to deploy this technology. To this end, the examination follows the steps as entailed in the Directive in order to systematically understand the context of the provisions in a logical manner.

4. Assessment of storage capacity – Selection of storage site and storage permits

According to Art.2 (3) CCS Directive, geological storage of CO_2 can be pursued within the territory of the Member States, but also, as far as offshore storage is concerned, extends to their EEZ and continental shelves. The CCS Directive prohibits CO_2 storage in sites that extend beyond these areas. Furthermore, it lays out that CO_2 storage in the water column, defined as "the vertically continuous mass of water from the surface to the bottom sediments of a water body",[339] must not be permitted.[340] The Member States have the right to determine whether and where on their territory geological CO_2 storage is allowed.[341] In this regard, the Member States have wide discretion to decide whether to allow for the deployment of CCS technology on their territories. They can entirely prohibit the storage of CO_2 or open only certain parts of their territories for storage. The selection of suitable geological formations must be based on a characterization and assessment procedure and includes the formations themselves, the direct storage sites as well as the storage complexes as a whole. So as to find suitable storage complexes, the Member State can explore the storage capacity of parts or their entire territory by way of granting exploration permits.[342] The storage complex is defined as "the storage site and surrounding geological domain which can have an effect on overall storage integrity and security, that is, secondary containment formations."[343] The storage site is the "defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities."[344] The geological formation

[339] Art.3 (2) CCS Directive.

[340] Similar to the provision in the OSPAR Convention; see above section D.

[341] Art.4 (1) CCS Directive. This aspect has not been included in the initial proposal: European Commission, supra note 328; European Commission, supra note 312.

[342] Art.4 (2) in conjunction with Art.5 CCS-Directive.

[343] Art.3 (6) CCS Directive.

[344] Art.3 (3) CCS Directive.

should only be selected if under normal operation "there is no significant risk of leakage and if no significant environmental or health risks exist."[345]

5. Storage permits

The storage permit is considered as the key instrument to ensure the correct implementation and enforcement of the obligations arising out of the CCS Directive.[346] Consequently, the geological storage of CO_2 must not be pursued without a storage permit.[347] The procedure of granting the storage permit should be objective and transparent and also available for everyone that has the necessary capacities.

In order to avoid conflicting uses of storage sites only one operator should use the storage site.[348] With the aim of providing a general and harmonized framework, the CCS Directive prescribes certain information that must be included in the application. According to Art.7 CCS Directive, this information must cover the entire life cycle of the storage project. It ought to include evidence of the technical competence of the provider, the outcome of the characterization and exploration procedure as outlined in Art.4 (3) CCS Directive, the quantity of total CO_2 to be injected in the storage site and also the monitoring plan and corrective and post-closure plans.

The Directive only provides little discretion for the executing authority when issuing permits, since criteria are given that have to be met by the operator so as to be able to attain the storage permit.[349] In this process, the operator must prove that he is solvent and has adequately trained staff. As an additional criterion, the operator is obliged to demonstrate that any requirements, including corrective measures in case of irregularities, can be met by making a so-called financial security available.[350] In the course of the project, the financial security has to be ad-

[345] Art.4 (4) CCS Directive. In case that a Member State allows for the geological storage of CO_2, the site selection can be pursued by issuing exploration permits. See for the importance of site selection in achieving permanent storage: D. Kramer, 'Scientists poke holes in carbon dioxide sequestration', 2012 *Physics Today* 65, no. 8, 22–24. See for a comprehensive discussion on site selection criteria: International Panel on Climate Change, supra note 3, 213.

[346] M. Doppelhammer, 'Richtlinienvorschlag der Europäischen Kommission zur geologischen Speicherung von Kohlendioxid', 2008 *Zeitschrift für Umweltrecht* 19, no. 5, 250–254, 252.

[347] Art.6 (1) CCS Directive.

[348] Clarke, supra note 317, 191.

[349] Art.8 CCS Directive.

[350] Even though the concept of financial security is not defined in the Directive itself, Guidance Document 4 outlines options and criteria that can be used by the Member States in implementing the CCS Directive. Accord-

justed, taking into account changes to the assessed risk of leakage and estimated costs of corrective measures.[351] If more than one storage site is designated in a hydraulic unit,[352] it must be assured that any potential pressure interactions do not jeopardize the obligations arising out of the CCS Directive.

6. Content of storage permits

The importance of the storage permit in the overall achievement of guaranteeing a high protection standard is further reflected in detailed provisions relating to the content of the storage permit. Art.9 CCS Directive outlines that the storage permit shall include the following elements:

- the name and address of the operator
- the precise location and delimitation of the storage site and storage complex including information on the hydraulic unit
- the total quantity of authorized CO_2 that is geologically stored, the reservoir pressure limits and the maximum injection rates and pressures
- the requirements for the composition of the CO_2-stream and the CO_2 acceptance procedure
- the approved monitoring plan
- the requirement to notify the competent authority in the event of leakages or significant irregularities , the approved corrective measures plans
- the conditions for closure and the approved provisional post-closure plan
- any provisions on changes, review updating and withdrawal of storage permit
- the requirement to establish and maintain the financial security.

Member States are under a reporting obligation as they shall transmit applications within one month of receipt to the European Commission. To this end, the Member States' competent

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ingly, the Member States could establish deposits or an irrevocable trust fund as a financial security European Commission, supra note 338, 3 *et seq.*

[351] Art.19 (2) CCS Directive. See also in this regard: *ibid.*

[352] Defined as: "hydraulically connected pore space where pressure communication can be measured by technical means and which is bordered by flow barriers, such as faults, salt domes, lithological boundaries, or by the wedging out or outcropping of the formation" (Art.3 (7) CCS Directive).

authority should include also any other information that is taken into consideration for deciding upon the granting of a storage permit. The European Commission can, within four months after receipt of the permit application, issue a non-binding opinion.[353] In case the European Commission decides not to issue an opinion, it is obliged to notify this to the Member States within one month after the receipt of the draft permits while stating the reasons for doing so.[354] Besides the reporting obligations regarding the draft permits, the competent authority is also under an obligation to report the final decision on the storage permit and, should this decision deviate from the opinion expressed by the European Commission's opinion, state the reasons for doing so.[355]

In February 2012, the European Commission issued its first Commission opinion as envisaged under Art.10 (1) CCS Directive on the draft permit for the ROAD[356] project on the Dutch Continental Shelf.[357] While in March 2013 all the preliminary technical and regulatory requirements of the project were completed, the adoption of the final investment decision (FID) has been pending since mid-2012. Due to CO_2 price projections, the ROAD project is experiencing financial difficulties that are delaying the decision. It was outlined that after discussions with investors, the investment decision was expected to be issued at the end of 2013. The operational phase of the ROAD project is scheduled for 2016.[358]

[353] Art.10 CCS Directive. The time period in which the European Commission is required to act was in the initial draft of the CCS Directive set at 6 months after the receipt of the draft permit, but was reduced in the following negotiations. Cf. Art.10 (1) sent.2 European Commission, supra note 328.

[354] Art.10 (1) sent.4 CCS Directive.

[355] Art.10 (2) CCS Directive.

[356] Rotterdam Opslag en Afvang Demonstratieproject (Rotterdam Capture and Storage Demonstration Project). The ROAD project is initiated by E.ON Benelux and Electrabel Netherlands/GDF SUEZ Group. Initially, the ROAD project comprises a CO_2 capture installation from Maasvlakte Power Plant 3 that is located in the port and industrial area of Rotterdam. The CO_2 will be transported from the capture installation via a pipeline of 25 km length to an offshore platform and will be then injected into a storage reservoir at 3 km depth. The maximum amount of stored CO_2 is 8.1 Mt.

[357] European Commission, Commission Opinion of 28.02.2012 relating to the draft permit for the permanent storage of carbon dioxide in block section P18-4 of block section P18a of the Dutch continental shelf, in accordance with Article 10(1) of Directive 2009/31/EC of April 2009 on the geological storage of carbon dioxide, C (2012) 1236 final.

[358] European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Future of Carbon Capture and Storage in Europe, COM(2013) 180, 27.3.2013, 27).

7. Storage site operation

The CCS Directive covers the following elements of the operational phase: (1) the purity of the CO_2-stream, (2) the monitoring and measuring of migration or leakage of CO_2 from the storage site or within the storage complex, and (3) inspection and reporting obligations.

a. Capture of CO_2

The capture of CO_2 under the Directive is addressed by reference to the IPPC Directive, now Industrial Emissions Directive, which establishes a permitting regime for certain industrial activities. Accordingly, all operators of capture installations have to obtain a permit under the IPPC Directive which also entails the use of "best available techniques" for capture, monitoring obligations and rights of public participation in the permit procedures.[359]

Art.33 CCS Directive refers to the amended Directive 2001/80/EC of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants.[360] Through this amendment, the CCS Directive stipulates a "Carbon Capture Readiness (CCR)" requirement for large combustion plants. Accordingly, operators of combustion plants with a rated electrical output of 300 mega-watts or more, for which the original construction licence or the original operating licence is granted after the entry into force of the CCS Directive, have to assess whether CCS would be an option to mitigate CO_2 emissions from that plant.[361] In light of the fact that a CO_2 capture installation does *per se* not sufficiently preserve the aims of the CCS Directive, the operators should assess whether suitable storage sites are available and the transportation to these sites is technically and economically feasible. The necessary assessment entails the question whether it is technically and economically feasible to retrofit for CO_2 capture.[362] In this regard, the competent authority a certain degree of dis-

[359] Art.9 and 15 IPCC Directive.

[360] Directive 2001/80/EC of the European Parliament and the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (OJ L309/1, 27.11.2001).

[361] Art.36 Industrial Emissions Directive is pertinent (formerly, Art.9 (a) Directive 2001/80/EC). See for a further discussion on this aspect: I. Chrysostomidis & E. Stamatiou, *Update on selected regulatory issues for CO_2 capture and geological storage*, November 2010, 8 and IEA Greenhouse Gas R&D Programme (IEA GHG), *"CO_2 capture ready plants"*, May 2007.

[362] For a technical description of retrofitting for capture capability: Rackley, supra note 4, 85.

cretion to determine whether those conditions have been met.[363] In the affirmative, it has to ensure that suitable space for the pertinent installations is reserved.

b. Transport

In case CCS will be deployed at large-scale, the development of a transportation infrastructure that connects the capture installation with the storage site is indispensable. For the purpose of CCS, the transportation of captured CO_2 is done by either using ships or pipelines.[364] The CCS Directive establishes a regime for third-party access to both the transportation network and the storage sites.[365] Member States are accordingly obliged to ensure that access of potential users to transport networks and storage sites is based on transparent and non-discriminatory criteria.[366] In providing this access, Member States can consider certain factors such as the storage and transport capacity of a network that can reasonably be made available. An additional aspect includes the proportion of their CO_2 reduction obligations that is intended through the use of CCS.

Moreover, the CCS Directive prescribes factors that could be used in the argumentation against third-party access. Accordingly, a refusal of access could be motivated by technical incompatibilities that cannot be reasonably overcome.[367] Furthermore, access could be refused due to lack of capacity.[368] However, the Member State has to ensure that the operator refusing access on the grounds of capacity or lack of connection makes necessary changes "as far it is economic to do so", or when the interested customer is willing to pay for them. In case of

[363] See for the approach of the Dutch Ministry of Economic Affairs in this regard: Haan-Kamminga *et al.*, supra note 176, 244.

[364] Rackley, supra note 4, 331 and International Panel on Climate Change, supra note 3, Chapter 4. See for a discussion on the European legal framework of CO_2 transport and its implementation in Germany: C. Kuznik, *Abscheidung, Transport und dauerhafte Speicherung von Kohlenstoffdioxid im Genehmigungs- und nationalen Planungsrecht: Umsetzung der Richtlinie 2009/31 EG durch ein CCS-Gesetz*, 2012, 79 *et seq*. Also: Haan-Kamminga *et al.*, supra note 176, 244 *et seq*. The Snøvhit pipeline extends for example over 153km and has a diameter of 0,2m. Currently, the fleet of operating CO_2 carriers is very limited and only includes few vessels that have the capacity to transport between 1000 and 1500 m^3 liquefied food-grade CO_2 at a pressure of 1.8-2.0 MPa: Rackley, supra note 4, 342.

[365] Art.21 CCS Directive. See for an account of potential competition law issues: Haan-Kamminga *et al.*, supra note 176, 242 and H. Vedder, *EC Competition Law and the Organisation of CCS* , in M. M. Roggenkamp & E. Woerdman (eds.), *Legal design of carbon capture and storage: Developments in the Netherlands from an international and EU perspective*, 2009.

[366] Consequently, the CCS Directive establishes a system of third party access in which the operator determines the access of third parties, rather than providing for a "system of common carriage in which third parties could have continuous access": Haan-Kamminga *et al.*, supra note 176, 246.

[367] Art.21 (2) CCS Directive.

[368] Art.21 (3) CCS Directive.

disputes concerning access to transport networks and storage sites of third-parties, Art.22 CCS Directive establishes the obligation to provide dispute settlement arrangements. This entails the involvement of an independent authority that has all the necessary information regarding the dispute so as to be able to settle the issue "expeditiously."[369] In case of cross-border disputes, dispute settlement arrangements of the Member State which has jurisdiction over the storage site or transport network shall be applied. If one or more Member States have jurisdiction over the network or the storage site, Art.22 (2) CCS Directive establishes an obligation to cooperate with the aim of a consistent application of the Directive.

c. CO_2-stream acceptance criteria

According to Art.12 CCS Directive, the CO_2-stream that will be inserted in the storage site must fulfil a "purity" criterion. The CO_2-stream is defined as "a flow of substances that results from CO_2 capture processes."[370] For the purpose of disposing CO_2, the stream "shall consist overwhelmingly of carbon dioxide."[371] The choice of wording in this context has been adopted in conformity with the LP as well as the OSPAR Convention.[372] Similar to the LP and OSPAR Convention provisions, the use of "overwhelmingly" has been criticized as being too vague and failing to provide a concrete threshold in the form of a minimum content of CO_2 or a ceiling for pollutants in the CO_2-stream.[373] Notwithstanding this criticism, the European Commission has so far refrained from setting concrete standards, but decided to adopt the wording used in the LP.[374] That said, whereas the LP only regulates additional elements of the CO_2-stream composition in a fragmented manner, the CCS Directive further refines those incidental substances that are present in the CO_2-stream:

> "A CO_2 stream shall consist overwhelmingly of carbon dioxide. To this end, no waste or other matter may be added for the purpose of disposing of that waste or other matter. However, a CO_2 stream may contain incidental associated substances from the source, capture or injection process and trace substances added to assist in monitoring and verifying CO_2 migration. Concentrations of all incidental and added substances shall be below levels that would:

[369] Art.22 (1) CCS Directive.

[370] Art.3 (13) CCS Directive.

[371] Art.12 (1) CCS Directive.

[372] Proelss & Güssow, supra note 34, 168.

[373] Doppelhammer, supra note 320, 96.

[374] Proelss & Güssow, supra note 34, 168; Doppelhammer, supra note 320, 96.

(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 applicable Community legislation." [375]

These assessment criteria are more or less suitable to clarify conceptual issues regarding the CO_2-stream composition.[376] Whereas it is not completely clear what would adversely affect the integrity of a storage site, the definition of "significant risk" as "a combination of a probability of occurrence of damage and a magnitude of damage that cannot be disregarded without calling into question the purpose of this Directive for the storage site concerned" indicates that a threshold towards significant risk exists.[377] The threshold of what constitutes a significant risk to the environment or human health is substantiated by reference to the concentrations of pollutants provided in the IPPC Directive, the Large Combustion Plants Directive or the Industrial Emissions Directive.[378]

In order to clarify the issue of additional substances, the European Commission has opted to issue Guidance Document 2 on the composition of the CO_2-stream. Accordingly, the impurity of the CO_2 stream results from three possible sources: (1) the specific nature of the feedstock (coal, gas, biomass for example), (2) substances taken up during the capture process, or (3) substances that are incidentally or intentionally added to prevent hazard during the transportation or injection process.[379] Furthermore, tracer substances can be added to trace movement of CO_2 in the storage formation or to quantify solubility trapping.[380]

The composition of the CO_2-stream is subject to a risk assessment that ensures the compliance with the conditions as outlined in Art.12 (1) CCS Directive. Consequently, the operator can only accept and then inject the CO_2-stream into the storage site after the completion of the risk assessment. The quantities and properties of the injected CO_2-streams are to be maintained in a register.

[375] Art.12 (1) CCS Directive.

[376] See for a discussion on the possibility of the Member States to introduce more stringent CO_2-purity criteria: Holwerda, supra note 297.

[377] Art.3 (18) CCS Directive.

[378] European Commission, supra note 336, 58.

[379] *Ibid*., 59.

[380] International Panel on Climate Change, supra note 3, 236.

8. The role of monitoring and reporting obligations in the CCS Directive

The monitoring obligations rest on the operator and extend to the monitoring facilities, the storage complex (including, if possible, the CO_2 plume) and, "where appropriate", the surrounding environment.[381] Within the framework of the CCS Directive, monitoring serves several purposes. Amongst others, it is applied to gain comprehensive knowledge on whether modelled behaviour of CO_2 in the formation and storage site actually coincides with the actual behaviour.

Furthermore, monitoring schemes are to be established with a view to ensure the permanent storage of CO_2 that could be jeopardized by leakage, migration or significant irregularities. Having these aims in mind, it seems indispensable to monitor the surrounding environment. Monitoring as laid out in the CCS Directive is risk-based and specific to a storage site and complex.[382] This implies that the monitoring should be oriented along the initial risk assessment element and particularly focused on the specific risks of a storage site.[383]

With a view to streamline the monitoring efforts, the operator is obliged to establish a monitoring plan following the criteria as provided by Annex II CCS Directive.[384] Here, criteria are listed that should be used when establishing and updating the monitoring plan as outlined in Art.13 (2) CCS Directive. The monitoring obligations of Annex II CCS Directive relate to all stages of a CCS-project and cover baseline, operational and post-closure monitoring schemes. The concrete parameters include, *inter alia*, fugitive emission of CO_2 at the injection facility, chemical analysis of the injected material and reservoir temperature and pressure.[385] In accordance with the review provision of Art.13 (2) CCS Directive, an update of the monitoring plan is necessary if "new scientific knowledge and improvements in best available technology" have been developed. Furthermore, Annex II CCS Directive also prescribes possible monitoring technologies.[386]

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[381] Art.13 CCS Directive.

[382] European Commission, supra note 336, 90.

[383] *Ibid*., 91.

[384] Art.13 (2) CCS Directive.

[385] Para.1.1., Annex II CCS Directive.

[386] In this context, „technologies that can detect the presence, location and migration paths of CO_2 in the subsurface and at surface or technologies that provide information about pressure-volume behaviour and areal/vertical distribution of CO_2-plume to refine numerical 3-D simulation to the 3-D geological models[…]" could be potential and appropriate technologies (para.1.1. (j) and (k) Annex II CCS Directive).

Generally, the plan shall be updated and then submitted to the competent authority for approval every five years in order to integrate new scientific knowledge as well as considering changes to the assessed risks.[387] All results of the monitoring must be communicated from the operator to the competent authority at least once a year.[388]

Besides the monitoring and reporting obligations on the side of the operator, the Member States shall ensure compliance with the requirements of the Directive through inspections.[389] These inspections cover routine as well as non-routine inspections. Routine inspections should be carried out on an annual basis until three years after closure, and from this point on a five-year basis until the transfer of responsibility has taken place. Whereas routine inspections are conducted on a regular basis to inspect injection and monitoring facilities, non-routine inspections are intended to investigate serious complaints related to the environment or human health. Again, the competent authority enjoys a margin of discretion to inspect installations since the Directive provides the mandate to do so "in other situations where the competent authority considers this appropriate."[390] Based on the results of the monitoring, the operator is under the obligation to notify the competent authority in case it detects leakages or significant irregularities.[391]

9. Measures in cases of leakage or significant irregularities: the role of the precautionary principle

With a view to the aim of permanent storage as well as in light of risks and economic considerations associated with leaked CO_2, one of the key elements in the CCS regulatory framework is the definition of leakage of CO_2.

[387] Art.13 (2) CCS Directive.

[388] Art.14 (1) CCS Directive.

[389] Art.15 CCS Directive.

[390] Art.15 (4) CCS Directive.

[391] Art.16 (1) CCS Directive.

a. Definition of leakage under the CCS Directive

Leakage is defined in the CCS Directive as "any release of CO_2 from the storage complex (Art.3 (5) CCS Directive).[392] Significant irregularities are defined as "any irregularity in the injection or storage operations or in the condition of the storage complex itself, which implies the risk of leakage or risk to the environment or human health."[393] Bearing in mind that the storage complex is comprised of the storage site and the surrounding geological formations,[394] the determination of a case where leakage has occurred is difficult to establish. Based on a strict interpretation of this provision, leakage of CO_2 from the storage complex would already occur if any of the stored CO_2 is released from the storage complex. A migration of CO_2 outside of the storage complex that does not reach the water column could thus be considered as a leakage. The standard established by the definition of "leakage" under the CCS Directive constitutes an extreme application of the precautionary principle. The "zero-leakage" approach implies that the risks associated with the consequence of leakage are estimated as being so high that no minimal threshold of leakage would suffice. This approach clearly differs from past statements by the European Commission concerning the application of the precautionary principle, according to which

> "[…] the measures envisaged must make it possible to achieve the appropriate level of protection. Measures based on the precautionary principle must not be disproportionate to the desired level of protection and must not aim at zero risk, something which rarely exists."[395]

Viewed from this perspective, the strict interpretation of leakage in the CCS Directive does not seem to be consistent with the overall understanding of the implementation of the precautionary principle as envisaged by the European Commission. From a factual point of view, applying a zero-leakage approach to the situation of a geological setting is problematic as no storage complex is self-contained. The approach on which the CCS Directive is based has

[392] During the negotiations towards the adoption of the CCS Directive, the European Parliament has proposed to phrase the definition of leakage as follows: "'leakage' means any measurable release of CO2 from the storage complex to the ground surface, atmosphere or hydrosphere confirmed, if necessary, by monitoring systems using best available technology"; see European Parliament, Draft Report on the proposal for a Directive of the European Parliament and of the Council on the geological storage of carbon dioxide and amending Council Directives 85/337/EEC, 96/61/EC, Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC and Regulation (EC) No 1013/2006 (COM(2008)0018 – C6-0040/2008 – 2008/0015(COD)) Committee on the Environment, Public Health and Food Safety, 05.06.2008, 13.

[393] Art.3 (17) CCS Directive.

[394] Art.3 (6) CCS Directive.

[395] European Commission, supra note 304, 17.

essentially had the effect of creating an obstacle to the implementation of sub-seabed storage of CO_2.

b. Consequences in case of leakage

Whereas leakage is any release of CO_2, a significant irregularity occurs in relation with the injection or storage process or the complex in general. Should any irregularities or leakage be observed, so-called corrective measures are to be taken. The competent authority can at any time adopt corrective measures. It can rely on the corrective measures plan as envisaged by Art.7 (7) CCS Directive or exceed or deviate from those.[396]

The power conferred to the competent authority is not linked to any threshold of evidence that would justify its intervention. Consequently, the authority enjoys wide discretion of when to act and what measures to apply. Besides the concrete references to measures aimed at protecting human health, no specific provisions exist that would sketch out the envisaged measures.[397] The measures in the corrective measures plan as provided by the operator thus only serve as a minimum standard.[398]

The corrective measures regime is closely linked to issues of liability relating also to the incurred costs recovery.[399] In this regard, a differentiation is to be made between local environmental damage and "climate damage."[400] In the context of the CCS Directive, the issue of environmental damage is regulated by reference to Directive 2004/35/EC of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (Environmental Liability Directive) which was accordingly amended to integrate CCS activities.[401] Environmental Damage is defined in Art.1 (a) Environmental Liability Directive as

> "damage to protected species and natural habitats, which is any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species. […]."

In case of "emitted CO_2", the liability is covered by reference to the EU ETS Directive. Whereas stored CO_2 would usually not be considered as emitted in this framework, the opera-

[396] Art.16 (2) and (3) CCS Directive.

[397] Art.16 (1) CCS Directive. Clarke, supra note 317, 192.

[398] Art.16 (2) CCS Directive.

[399] See for a comprehensive discussion on this aspect: *ibid*., 192 *et seq*.

[400] Doppelhammer, supra note 320, 97.

[401] Directive 2004/35/EC of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (OJ L 143/56, 30 April 2004). See also Art.34 CCS Directive.

tor would, in case of leakages be obliged to surrender the equivalent amount of emission allowances under the EU ETS.[402]

10. Changes, review, update and withdrawal of storage permits

In order to guarantee continuity and compliance with the conditions of the storage permit, the operator is under an obligation to inform the competent authority of any occurring changes that could affect the operation. Should substantial changes to the operation occur, a new or updated storage permit must be issued. The threshold of what signifies substantial changes in the context of the CCS Directive is furthermore outlined by Art.11 (3) and includes, *inter alia*, the occurrence of leakage or significant irregularities. In case the operator does not comply with the permit conditions, the permit may be withdrawn.[403] Subsequently, the competent authority can either close the storage site or opt to prepare a new permit. In the latter case, the competent authority assumes temporarily all obligations, including the CO_2 injection process, monitoring and corrective measures as envisaged by the Directive.

11. Closure of the storage site and post-closure obligations

In case there are risks of non-compliance with the permit conditions or there are risks of significant irregularities, a storage site can be closed by the operator. Furthermore, this scenario is also envisaged for those storage sites for which the active injection has ceased and the permit conditions are fulfilled.[404]

Every measure that is taken in the closure procedure is to be based on a post-closure plan that must be submitted together with the storage permit application according to Art.7 (8) CCS Directive. The obligations of the operator do not only include the sealing of the storage site and the removal of the injection facilities,[405] but also extend to the requirements outlined in Annex II to the CCS Directive.[406] Since a long time span will usually be covered between the application for a storage permit and the actual closure of the storage site, an updated version,

[402] Doppelhammer, supra note 320, 97. A deterring effect of course presupposes that the price of surrendered allowances affect the operator: Clarke, supra note 317, 192.

[403] Art.11 (3) CCS Directive.

[404] Art.17 (1) CCS Directive.

[405] Art.17 (2) sent.2 CCS Directive.

[406] Para.2, Annex II CCS Directive.

integrating best practice and technological improvements, of the post-closure plan must be submitted and approved by the competent authority as a final post-closure plan.[407]

The operator remains responsible for monitoring, reporting and corrective measures as envisaged by the Directive, as well as for the surrender of allowances in case of leakage and preventive and remedial actions until the transfer of responsibility to the competent authority.[408]

In case the competent authority has withdrawn the storage permit according to Art.17 (1) (c) in conjunction with Art.11 (3) CCS Directive, the competent authority assumes the responsibility regarding monitoring and corrective measures as well as the surrender of allowances after leakage. The accrued costs for these services are to be recovered from the operator.[409]

12. Transfer of responsibility

The transfer of responsibility is the final step in the life cycle of a CCS project. After closure of the storage site the competent authority assumes the legal obligations relating to the monitoring and corrective measures, the surrender of allowances in case of leakage as well as preventive and remedial actions. The transfer of responsibility may only be undertaken if certain conditions are fulfilled. These relate to procedural aspects such as the sealing of the site and the financial obligations on behalf of the operator as set under the financial mechanism of Art.20 CCS Directive.[410]

Furthermore, "all available evidence [that] indicates that the stored CO_2 will be completely and permanently contained" need to be provided.[411] A literal interpretation of this requirement creates the challenge to select relevant scientific knowledge and fields that need to be considered when integrating *all* evidence.[412] The CCS Directive remains silent on further methods of

[407] Art.17 (3) (a-c) CCS Directive.

[408] Art.17 (2) CCS Directive.

[409] Art.17 (4) and (5) CCS Directive.

[410] The financial mechanism under the CCS Directive as set out in Art.20 CCS Directive provides for a financial contribution of the operator to the competent authority before the transfer of responsibility. The amount should be calculated in order to cover the anticipated cost for monitoring during a 30 years period and could also made available to guarantee the permanent storage of CO_2 after the transfer of responsibility. See also: European Commission, supra note 338. The use of financial security to address liability is an emerging instrument in legal practice: M. Peeters, *The regulatory approach of the EU in view of liability for climate change damage*, in M. Faure & M. Peeters (eds.), *Climate change liability*, 2011, 118.

[411] Art.18 (1) (a) CCS Directive (emphasis added).

[412] Clarke, supra note 317, 194.

evaluation that are relevant in providing such evidence,[413] even though the Guidance Document on the transfer of responsibility stipulates information in this regard.[414] However, as mentioned above, this document is not binding and thus different standards and approaches can be developed on a national level. The burden of proof in this regard remains with the operator who has to prove that three conditions are fulfilled: (1) conformity of the actual behaviour of the injected CO_2 with the modelled behaviour, (2) the absence of any detectable leakage, and (3) the development of a storage site towards a long-term stability.[415]

Besides these procedural obligations, the post-closure period is determined by way of Art.18 (1) (b) CCS Directive to a minimum period of 20 years before the transfer of responsibility to the competent authority can be pursued. This time standard can be reduced if all evidence is indicating that a permanent and complete CO_2 storage is ensured before the end of that period.[416]

13. Implementation of the CCS Directive

The provisions of the CCS Directive were to be implemented into national law by 25 June 2011. The European Commission adopted Commission Decision of 10 February 2011 introducing a questionnaire to be used for the first report on the implementation of Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide (hereinafter referred to as Commission Decision on the reporting questionnaire).[417] The questionnaire addresses the major element of the CCS Directive such as the provisions of the permits conditions and the CO_2-stream acceptance criteria.[418] The implementation process of the CCS Directive has been quite slow. In July 2011, infringement cases for non- or incomplete implementation were initiated by the Commission against 25 Member States. Another case was opened against a Member State in November 2011. Whereas by January 2012 seven cases were closed, 19 Member States had by that date not remedied the situation. The reasons for non-implementation range from opposition towards the use of CCS technology among the public (Germany) to issues of technical feasibility to deploy CCS tech-

[413] *Ibid*., 193.

[414] European Commission, supra note 337, 13.

[415] Art.18 (2) (a)-(c) CCS Directive.

[416] Art.18 (1) (b) 2 sent. CCS Directive.

[417] OJ L 37, 11.2.2011.

[418] Paragraphs 5 and 8 Commission Decision on the reporting questionnaire.

nology in the territory of the Member State (Finland).[419] The Commission received notifications of implementation measures from all Member States by October 2013 and was able to close 19 of the 26 infringement cases by November 2013. However, six Member States have not yet completed their implementation measures and the Commission issued reasoned opinions to these Member States in November 2013.[420]

14. Review of the CCS Directive by 31 March 2015

The CCS Directive foresees an overall review of its provisions by 31 March 2015. In this regard, the European Commission is obliged to assess, on the basis of the experience of the implementation and with a view to the technical progress and scientific knowledge, several provisions.[421] This relates in particular to whether the permanent containment of CO_2 has been sufficiently demonstrated so as to "prevent and reduce as far as possible negative effects on the environment and any resulting risk to human health and the environmental and human safety."[422] Moreover, the Commission is called upon to examine whether the draft storage permits as outlined in Art.10 CCS Directive and the draft decisions on the transfer of responsibility as stipulated under Art.18 CCS Directive are still necessary.[423] The Member States are under the obligation to share their experience regarding the CO_2-stream acceptance criteria as well as the provisions of third-party access to the transport network and storage.[424] Also, the necessity and relevance of the "Carbon Capture Readiness" clause pursuant to Art.33 CCS

[419] See for detailed studies on the transposition of the CCS Directive in the Case Studies published by University College London, Centre for Law and the Environment, Carbon Capture Legal Programme, <http://blogs.ucl.ac.uk/law-environment/2012/11/14/carbon-capture-legal-programme-eu-case-studies> (last accessed on 31.03.2014). Germany: L. Krämer, Case studies on the implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, Germany, November 2011; Norway: H. C. Bugge & A. Lamark Ueland, Case studies on the implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, Norway, November 2011; Romania: M. Józon, Case studies on the implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, Romania, November 2011; Spain: L. Krämer, Case studies on the implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, Spain, November 2011 and the United Kingdom: C. Armeni, Case studies on the implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, United Kingdom, November 2011.

[420] European Commission, Report from the Commission to the European Parliament and the Council on the implementation of Directive 2009/31/EC on the geological storage of carbon dioxide, COM(2014) 99 final, 25.2.2014, 3. The member States that have received the reasoned opinions are: Austria, Cyprus, Hungary, Ireland, Sweden and Slovenia. One Member State which received a letter of formal notice for non-communication notified its implementation measures at time of drafting of the European Commission report.

[421] Art.38 CCS Directive.

[422] Art.38 (2) first indent CCS Directive.

[423] Art.38 (2) second indent CCS Directive.

[424] Art.38 (2) third and fourth indents CCS Directive.

Directive shall be assessed. Should the technical and economic feasibility of CCS have been demonstrated at this stage, the European Commission shall moreover assess the practicability of establishing mandatory emission performance standards for new-electricity combustion installations.[425] This would imply that a statutory limit of emitted CO_2 from a plant would be determined by the governments which could be achieved by the installation of emissions control technologies or the use of a cleaner energy feedstock.[426] The constant review of the Directive reflects a "learning by doing approach":[427] It safeguards that new technical and scientific developments are taken into account.[428]

V. The Marine Strategy Framework Directive in the context of CCS

Marine CCS projects also potentially interact with other EU environmental legislation. In this regard, the Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive – MSFD)[429] could play an important role in assessing potential impacts of marine CCS activities.[430] The MSFD forms the environmental pillar of the Maritime Policy of the EU. It sets out marine strategies that should lead to a "good environmental status" (GES) of the marine environment by 2020.[431] GES means:

> "the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of

[425] R. Wolf, 'CCS, Anlagengenehmigungsrecht und Emissionshandel', 2009 *Zeitschrift für Umweltrecht* 20, no. 12, 571–579.

[426] See for a further discussion on this aspect: Global CCS Institute, CCS Ready Policy and Regulations-The state of play, August 2012, 15.

[427] Haan-Kamminga *et al*., supra note 176, 249.

[428] In 2011, the University of Bergen discovered a 3km long fracture of the seafloor 25 km north of the Sleipner CO_2 storage site. Follow-up cruises demonstrated that the fracture is 1 to 10m wide and penetrates 150-200m deep into the sub-surface. The fracture is vertically separated from the Utsira Sand by several low permeability sedimentary seals. However, Klaus Wallmann, the ECO2-project coordinator states that "this discovery shows that there are still surprises awaiting us as we further investigate the seabed, even in waters we think we know well. It demonstrates the importance, both for on-going and planned storage projects, to map and monitor the seabed using available cutting-edge technologies" <http://www.eco2-project.eu/newsarticles/items/north-sea-fracture-discovered.html> (last accessed on 31.03.2014).

[429] OJ L 164, 25.06.2008.

[430] European Commission, Contribution of the Marine Strategy Framework Directive (2008/56/EC) to the implementation of existing obligations, commitments and initiatives of the Member States or the EU at EU or international level in the sphere of environmental protection in marine waters, COM(2012) 662 final, 16.11.2012.

[431] See further: A. Barreira, 'The legal protection of the marine environment: The Marine Strategy Framework Directive and its implementation in Spain', 2012 *Environmental Law Network International*, no. 2, 46–53.

> the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations, i.e."[432]

The MSFD provides an "umbrella" regime for measures by Member States to attain the GES. The GES is to be achieved by establishing marine strategies, which are to be elaborated according to a plan of action that sets out two elements: First, a timeline for the determination of the specific environmental standards and future targets by 2012 and the establishment of a monitoring programme for on-going assessment which is to be implemented by 2014, and secondly, a programme of measures to be developed by 2015 at the latest, which is to become operative by 2016.

The geographic scope of the MSFD applies to all marine waters which are according to Art.3 (a) MSFD defined as

> "waters, the seabed and subsoil on the seaward side of the baseline from which the extent of territorial waters is measured extending to the outmost reach of the area where a Member State has and/or exercises jurisdictional rights, in accordance with the UNCLOS."

Consequently, any issue relating to transport and storage of offshore CCS triggers the applicability of the MSFD. Even though CCS activities are not directly mentioned, the obligation to "protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected" is relevant in this regard.[433] Also, the obligation to "prevent and reduce inputs in the marine environment, with a view to phasing out pollution as defined in Article 3(8), so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea"[434] clearly resembles in its wording other thresholds of impacts such as those of the OSPAR Convention.

In the application of the MSFD, the Member States have to take account of pressures and impacts as outlined in table 2 Annex III MSFD when establishing environmental and monitoring

[432] Art.3 (5) MSFD.

[433] Art.1 (2) (a) MSFD. See the broad applicability of the MSFD vis-à-vis other European Union policies and legislation: European Commission, Contribution of the Marine Strategy Framework Directive (2008/56/EC) to the implementation of existing obligations, commitments and initiatives of the Member States or the EU at EU or international level in the sphere of environmental protection in marine waters, COM(2012) 662 final, 16.11.2012.

[434] Art.1 (2) (b) MSFD. Pollution is defined as "the direct or indirect introduction into the marine environment, as a result of human activity, of substances or energy, including human-induced marine underwater noise, which results or is likely to result in deleterious effects such as harm to living resources and marine ecosystems, including loss of biodiversity, hazards to human health, the hindering of marine activities, including fishing, tourism and recreation and other legitimate uses of the sea, impairment of the quality for use of sea water and reduction of amenities or, in general, impairment of the sustainable use of marine goods and service" (Art.3 (8) MSFD).

targets. In this regard, physical loss caused by man-made structures and other physical disturbances from, for example, underwater noise of shipping are aspects that have to be considered. The element of "systematic and/or intentional release of substances" appears to be of key importance in relation to offshore CCS activities. Accordingly, the "introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or intentional release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions" should be particularly considered when establishing measures under the MSFD.

Even though the aforementioned requirements seem to apply to offshore CCS, they cannot be interpreted as generally prohibiting or restricting such activities. What can be concluded, though, is that these provisions result in increased and concrete monitoring obligations. Marine strategies of the Member States must thus consider planned or conducted CCS activities that are located in one of the sub-regions established under Art.4 MSFD. This implies that procedural obligations regarding the assessment of the marine environment as envisaged by Art.8 MSFD should also contain reference to pressures arising from CCS activities.[435] Furthermore, since pertinent impacts that could also be associated with CCS activities are indicated in table 2 Annex III MSFD, the Member States are additionally under the obligation to establish monitoring plans that integrate these aspects.[436]

VI. Preliminary conclusion

The regulation of CCS in the EU has been pursued by way of a dual-track approach: Whereas on the one hand, the incentive to deploy CCS is established by means of its integration in the climate change regime, the CCS Directive creates a regulatory framework in order to address the associated potential risks on the other. The CCS Directive relies on a permit approach. The risks associated with CCS are addressed by a site selection procedure, a comprehensive and long-term monitoring scheme as well as measures addressing the entire lifecycle of the storage process that are intended to prevent or react to leakage or significant irregularities. However, this comparatively robust regulatory framework is limited by uncertainties relating to the definition of leakage. The zero-risk approach that is associated with the current definition of leakage reflects an extreme interpretation of the precautionary principle in addressing

[435] Art.8 (1) (b) (i) MSFD.

[436] Art.11 (1) MSFD.

the associated risks. Even though a comprehensive and detailed risk assessment is indispensable for safe conduct of CCS activities, the current form does not sufficiently take into account the factual situation of storage complexes. Furthermore, legal uncertainty relates to the CO_2-stream acceptance criteria and the concrete extent of corrective measures that are inextricably linked to the transfer of responsibility and the closure and post-closure obligations. In contrast, the monitoring obligations stemming from the CCS Directive are strengthened by the provisions of the MSFD in which certain parameters are listed that directly or indirectly address offshore CCS.

F. Conclusion: Comparative remarks regarding risk assessment procedures contained in the different instruments

The risks associated with CCS activities relate to leakage of CO_2 that could have adverse consequences. In the following, a comparative analysis of the different risk assessment and management schemes adopted within the frameworks of the London Protocol, the OSPAR Convention and the CCS Directive will be provided in order to clarify the underlying concepts. The pertinent risk assessment schemes differ with regard to their scope, legal nature and definitions of risk elements. The following section thus aims to highlight the central conclusions of the legal assessments provided in this study.

I. The role of the precautionary principle in assessing risks associated with offshore CCS

The role of the precautionary principle as codified in the LP, the OSPAR Convention and the TFEU guides the structure and content of the risk assessment and management approaches. It has been convincingly submitted that that principle can be used to weigh the risks of potentially harmful activities against the overall aim of the agreements concerned. The role of the precautionary principle can thus be described as a "balancing tool to measure the environmental benefits arising out of a certain activity against its potentially negative impacts on another part of the environment."[437] This reading is arguably supported by the 2001 Communication of the European Commission where it observed that:

[437] Proelß & Krivickaite, supra note 17, 445.

> "[…] the precautionary principle should be considered within a structured approach to the analysis of risk which comprises three elements: risk assessment, risk management, risk communication. The precautionary principle is particularly relevant to the management of risk."[438]

Thus, the application of the precautionary principle in a offshore CCS context entails a risk assessment and management framework within which the scientific uncertainties associated with long-term storage and possible negative impacts of CCS are addressed. From this logic it can be deduced that the potential risks of marine CCS can be accepted under certain circumstances if and to the extent to which marine storage of CO_2 is considered as a central cornerstone of a future national and European climate policy.

II. The risk assessment frameworks under public international law and European law

The fundamental elements of risk assessment related to CO_2 were first proposed in the 2005 IPCC Special Report on Carbon Dioxide Capture and Storage.[439] The elements listed therein are also reflected in the FRAM, the CO_2 Specific Guidelines as well as the OSPAR FRAM. They relate to the following four points: (1) a careful site selection, (2) a comprehensive monitoring scheme, (3) an effective regulatory framework, and (4) the implementation of remediation measures.[440] Whereas the FRAM and the CO_2 Specific Guidelines adopted within the framework of the LP merely provide detailed (non-binding) guidance in the application and implementation of the substantive provisions of the Protocol, the OSPAR FRAM is made legally binding by way of integration into OSPAR Decision 2007/2.[441] Notwithstanding this, the application of the OSPAR FRAM is not legally binding in absolute terms, since the wording of its provisions is subject to discretion by the Contracting Parties.

From a substantive and procedural point of view, the risk assessment and management framework of CCS activities in the EU is hardly comparable to the FRAMs adopted under the auspices of the LP and the OSPAR Convention. Even though the CCS Directive is also based on the elements of monitoring, CO_2-stream requirements and site selection and characterisation, it regulates the planning, operation and closing phases in greater detail. The associated liability structure and the envisaged surrender of allowances demonstrate the far-reaching legal consequences of violations of the substantive obligations. The regime of the CCS Di-

[438] European Commission supra note 304, 2.

[439] International Panel on Climate Change, supra note 3.

[440] *Ibid.*, 251 *et seq.*

[441] Dixon *et al.*, supra note 158, 4507.

rective is equipped with an "integrated" risk assessment framework in which the different steps of the permitting procedure automatically entail aspects of risk assessment and management.

Table 8: Overview on risk assessment and management instruments and approaches for CCS activities under public international and European Law

International level	**IPCC Special Report on CCS**	IPCC Special Report on Carbon Dioxide Capture and Storage (2005).
Global international law	**UNFCCC**	Decision 10/CMP.7 Modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities from 2011.
	LP	Risk Assessment and Management Framework for CO_2 Sequestration in Sub-seabed Geological Structures (FRAM) from 2006. Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into sub-seabed geological formations (CO_2 Specific Guidelines) from 2012.
Regional international law	**OSPAR Convention**	OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations and the OSPAR Guidelines for Risk Assessment and Management of Storage of CO_2 Streams in Geological Formations (OSPAR FRAM) from 2007.
European Union law	**CCS Directive**	Permit approach with integrated risk assessment (storage permit: information on site selection, monitoring plans, corrective measures plan, closure and post-closure measures and transfer of responsibility) adopted in 2009. (Non-binding) CO_2-Storage Life Cycle Risk Management Framework (Guidance Document 1) from 2011.

III. Terminology of CCS in a comparative analysis

The regulatory approaches and risk assessment frameworks provided by the aforementioned instruments are based on CCS-specific concepts and terms, the most important of which being "leakage" and the threshold of "adverse consequences".

Definition of leakage

Because the ultimate objective of CO_2 storage is the permanent containment of CO_2, the definition of leakage should be the central starting point when assessing the terminology of CCS. As has been mentioned above, the IPCC Special Report on CCS has been an important step in the establishment of an international CCS regime. The term "leakage" is defined in the IPCC report as "the escape of injected fluid from storage."[442] However, in conjunction with the definition of storage as "a process for retaining captured CO_2 so that it does not reach the atmosphere",[443] the exact scope of the definition remains subject to interpretation. Storage is defined in a process-oriented manner: "a process" that is difficult to subordinate with the concept of leakage.

The FRAM has adapted this definition by referring to leakage as "the escape of CO_2 from the storage formation into the water column and the atmosphere."[444] OSPAR FRAM further refines this definition by stipulating that leakage is "the escape of that CO_2-stream from the storage formation into overlying formations, the water column and the atmosphere."[445] These three definitions demonstrate that the concept of leakage has been evolving since 2005 and is indeed differently developed. Whereas in the framework of the FRAM, leakage occurs once the CO_2 has reached the water column or the atmosphere, the OSPAR FRAM sets a lower threshold in that leakage already occurs as soon as CO_2 escapes from the storage formation into overlying formations. The different concepts and nuances that are used in defining key elements of CCS could have legal consequences regarding the permanence requirements as outlined in, e.g., Art.3 (2) lit. f (iv) Annex II OSPAR Convention.

Within the EU, the definition of leakage differs again from the above mentioned concepts: "Leakage" occurs following "any release of CO_2 from the storage complex."[446] The introduced standard of "zero-leakage" represents a particularly strict application and understanding of the precautionary principle.

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[442] International Panel on Climate Change, supra note 3, 407. Storage has been defined in OSPAR FRAM and FRAM as "a process to retain captured CO_2 streams in deep geological formations so that it does not reach the atmosphere" (FRAM, 33 and OSPAR FRAM, 31).

[443] International Panel on Climate Change, supra note 3, 412.

[444] FRAM, 31.

[445] OSPAR FRAM, 29.

[446] Art.3 (5) CCS Directive.

Threshold of adverse consequence

In a second step, the definition of adverse consequences of leakage is taken as a parameter in the regulatory framework. The wording of the OSPAR Convention, outlining that the storage of CO_2 should not lead to "significant adverse consequences", implies that a threshold of impact exists. This suggests that there could also be impacts which are non-adverse and that are consequently acceptable under the OSPAR Convention regime.[447] This approach primarily focuses on the role of scientific knowledge that is used to determine when harm or environmental degradation has taken place. It is challenging to integrate precise thresholds in legal instruments, since emission standards are constantly evolving with increasing knowledge on the impacts and consequences of a substance. Establishing a benchmark of "harm" is particularly difficult, as it could refer to significant adverse consequences for an individual organism, for a population or for the surrounding marine environment in general. This is where the CO_2 Specific Guidelines come into play. The elements suggested therein such as spawning and nursery areas or seasonal or critical habitats could be used as an indicator in such an assessment. That said, the undefined boundaries of the concepts assign to the Contracting Parties a wide scope of discretion when individually establishing baselines against which risks and adverse consequences are to be measured.

Table 9: The use and application of legal terminology and their implication for CCS activities

International level	**IPCC Special Report on CCS**	Leakage: "The escape of injected fluid from storage."[448] Storage: "A process for retaining captured CO_2 so that it does not reach the atmosphere."[449]	• Non-binding • Vague definition
Global international law	**London Protocol**	Leakage: "in respect of carbon storage, the escape of CO_2 from the storage formation in the water column and the atmosphere."[450]	• Non-binding

[447] J. S. Gray, *Integrating Precautionary Scientific Methods into Decision-Making*, in D. Freestone & E. Hey (eds.), *The Precautionary principle and international law: The challenge of implementation*, 1996, 133.

[448] International Panel on Climate Change, supra note 3, 407.

[449] *Ibid*., 412.

	(FRAM)	Storage: "a process for retaining captured CO_2 in deep geological formations so that it does not reach the atmosphere."[451] Formation: "a body of rock of considerable extent with distinctive characteristics that allow geologists to map, describe, and name it."[452]	
Regional international law	**OSPAR Convention**	No definition of leakage in the OSPAR Convention, but: "adverse consequences" and "permanence" requirements. OSPAR FRAM: "leakage is the escape of that CO_2 stream from the storage formation into overlying formations, the water column and the atmosphere."[453]	• role of threshold setting
European Union law	**CCS Directive**	Significant irregularity: "any irregularity in the injection or storage operations or in the condition of the storage complex itself, which implies the risk of leakage or risk to the environment or human health" (Art.3 (17) CCS Directive). Leakage: **"**any release of CO_2 from the storage complex"(Art.3 (5) CCS Directive).	• Strict application of the precautionary principle

[450] FRAM, 31.

[451] FRAM, 33.

[452] FRAM, 30.

[453] OSPAR FRAM, 29.