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Balancing climate change mitigation and environmental protection interests in the EU Directive on carbon capture and storage

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Abstract. The EU Climate and Energy Package highlights the potential contradictions between the climate change imperative of reducing GHGs emissions and the importance to maintain environmental integrity. While the package supports climate change mainstreaming, it remains to be seen to what extent it succeeds in achieving internal environmental integration between climate change mitigation and other environment-protection objectives. Directive 2009/31/EC on the capture and geological storage of carbon dioxide (hereinafter the CCS Directive) offers a paradigmatic example of this potential conflict. One of the main regulatory challenges arising from the CCS Directive relates to finding the proper balance between the different interests involved and the not-fully-consistent objectives of environmental protection, climate change mitigation, and energy security. The present article will discuss this regulatory challenge and examine how the CCS Directive's regulatory framework for CCS permits a combination of the various interests at stake and the giving of proper weight to concerns about environmental protection. The role that the precautionary principle in conjunction with the proportionality principle may have in balancing climate change mitigation and environment-protection interests will be considered.

I. Introduction

According to IPCC estimates, a failure to contain global temperature rise within two degrees Celsius entails dramatic consequences in terms of environmental, economic, and social costs, as well as international and human security.[1] While climate change represents one of the major threats to the environment, its solution cannot be found solely in environmental measures, but requires the deployment of a comprehensive set of instruments, cutting across different sectors. The full integration of climate change concerns into a wider range of policy areas is increasingly

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[1] *Climate Change 2007: Synthesis Report*, Rajendra K. Pachauri and Andy Reisinger (eds.), IPCC (2007), at 48, available at <http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf>.

regarded as the key feature to secure a transition to a low-carbon and energy-efficient economy.[2] Linking climate policies with the more general objectives of economic growth and competitiveness is in line with the most recent approaches to the green economy,[3] which advocate a shift to an industrial and energy system based on clean and efficient technologies as the backbone for economic and social well-being. This approach is also endorsed by the European Union. In the European Commission's view, "there is a real potential to make climate-friendly policies a major driver for growth and jobs in Europe".[4]

The 2008 EU Climate and Energy Package promotes an integrated approach in this sense, combining climate and energy policies with a view to pursuing the objectives of drastically reducing GHG emissions while increasing EU energy security and strengthening EU competitiveness. The package consists of a comprehensive set of measures aimed at achieving the convergence of different sectors and policies towards the pursuit of the EU climate targets. These include a Directive on the revision of the 2003 emission trading scheme,[5] a Decision on effort-sharing among member states in the sectors not covered by the emission trading scheme,[6] a new and comprehensive Directive on the promotion of renewable energy,[7] a Directive on the capture and geological storage of carbon dioxide,[8] and a Directive setting new harmonized specifications for liquid fuels.[9]

[2] Morgan Bazilian, et al., *Opinion: An Energy Policy Approach to Climate Change*, 14 Energy for Sustainable Development 253, at 254 (2010).

[3] *Globalisation and the Environment – Global Crises: National Chaos?*, UNEP, 25th Session of the Governing Council/Global Ministerial Environmental Forum, Nairobi, Kenya, 16-20 February 2009, UNEP/GC.25/16, describing the green economy as a system whereby industries that employ clean and efficient technology and where agriculture is sustainable "serve as major engines of economic growth, job creation and poverty reduction". See also Achim Steiner, *Focusing on the Good or Bad: What Can International Environmental Law Do to Accelerate the Transition Towards a Green Economy?*, 25 American University International Law Review 843 (2010).

[4] *2020 by 2020: Europe's Climate Change Opportunity*, European Commission, Communication to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions, COM(2008) 30, at 3.

[5] *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 emission allowance trading scheme of the Community*, [2009] OJ L 140/63.

[6] *Decision No. 406/2009/EC of the European Parliament and of the Council of 23 April 2009 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*, [2009] OJ L 140/136.

[7] *Directive 2009/28/EC of the European parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*, [2009] OJ L 140/16.

[8] *Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006*, [2009] OJ L 140/114.

[9] *Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC*, [2009] OJ L 140/88.

The implementation of the EU Climate and Energy Package reveals the potential contradiction between the climate change imperative to reduce GHG emissions and the need to maintain environmental integrity. The progressive mainstreaming of the climate imperative into other sectors and policy areas is in fact often accompanied by the emergence of a new key challenge in the design and implementation of the relevant legislative framework. Such a challenge is represented by the need to reconcile not only economic and environmental interests but also potentially competing environmental goals, such as, on the one hand, climate-change-mitigation objectives and, on the other, nature-protection or landscape-conservation objectives.

Regulation in the field of climate change offers an interesting perspective from which to discuss possible ways to manage these (new) types of conflict. While the measures devised to combat global warming have a clear environmental goal, they also call for a strategic revision of current energy and development patterns. Furthermore, "internal" environmental conflicts are likely to arise when the measures and instruments adopted in response to climate change entail the risk of causing negative side effects on other environmental aspects or values.

Potential conflict between different ends and competing yet equally absolute and fundamental values inevitably arise and are not always easily reconcilable.[10] Therefore, making choices and setting priorities become an essential feature of societal governance and a necessary task for policymakers, legislators, and all those entrusted with the implementation of the law. Here it is helpful to look at whether the overarching principles of EU environmental law, and in particular the precautionary principle, may provide guidance in addressing the policy choices and trade-offs entailed in the implementation of climate change legislation and in ensuring the consistency of climate change legislation with the other objectives of EU environmental policy.

We discuss these emerging challenges by focusing on the analysis of Directive 2009/31/EC (CCS Directive). The CCS Directive aims at creating the necessary legal framework to enable the development of a technology for the capture and underground storage of CO_2 emissions. In the European Commission's view, CCS represents an appealing mitigation option able to fulfil the two-fold goal of climate change mitigation and energy security. By avoiding CO_2 emissions through underground storage, the technology would help mitigate the impact of continued use of fossil fuels, at least until the full development of renewable energy sources. Yet, the environmental and safety aspects involved in the practical implementation of CCS raise a number of concerns, thereby requiring a careful balancing between the benefits deriving from the implementation of the technology and its real costs in terms of environmental and health risks.

We begin our discussion from the premise that the integration of the CCS Directive's climate change and energy goals within the overall framework of environment-protection policy requires a careful evaluation of all the possible environmental impacts and related risks in the development of CCS projects. To this end, after an introductory section sketching the main features and critical aspects of CCS technology, and two sections respectively explaining the EU approach

[10] Isaiah Berlin, *Two Concepts of Liberty*, in Four Essays on Liberty (1969).

to CCS and the most relevant characteristics of the CCS Directive, we consider whether, in the balancing of the different and competing interests involved, the Directive's regulatory framework for CCS allows proper weight to be given to other environment-protection concerns while aiming at climate change mitigation. In the last section we focus on the role that the precautionary principle, in conjunction with the proportionality principle, may have in balancing climate change mitigation and environment-protection interests.

II. CCS Technology: Opportunities and Risks

CCS technology is increasingly considered a viable option to mitigate climate change.[11] It consists of the capture of CO_2 emitted by power plants and industrial sources and the injection of the CO_2 emissions into a storage reservoir. The main application foreseen for CCS is in large facilities that produce significant quantities of CO_2. So far, particular attention has been devoted to the use of the technology in power-generation plants and other energy-intensive industries—such as cement manufacture, oil refining, ammonia production, and iron and steel manufacture—emitting large quantities of CO_2.

The four main phases in the CCS process are by now well known.[12] The first consists in the capture of CO_2 emitted by stationary sources and its separation from other gaseous products.[13] The second phase consists in transporting the captured CO_2 to a storage site. CO_2 could be transported in a gaseous, liquid, or solid state, and the transport could be by road, ship, or pipeline. Liquidification of CO_2 and its transport by pipeline is presently considered as the most practicable option from a technical, safety, and commercial point of view.[14] The last two phases consist of the injection and storage of CO_2 in the selected site. Three types of geological formation are considered suitable for the storage of CO_2: depleted oil and gas reservoirs, deep saline formations, and unminable coal beds.[15] Once the CO_2 has been stored, the site must be continuously monitored for leakage.[16]

[11] Heleen de Coninck and Nicole M. A. Huijts, *Carbon Dioxide Capture and Storage: Public Perception, Policy and Regulatory Issues in the Netherlands*, paper presented at the 7th International Conference on Greenhouse Gas Control Technologies, Vancouver, available at <http://www.ecn.nl/fileadmin/ecn/units/bs/CCS/vancouver-hdc_nh.pdf>.

[12] *Special Report on Carbon Dioxide Capture and Storage,* Bert Metz et al. (eds.), IPCC (2005), available at <http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#2>.

[13] Ibid, at 25. Depending on the type of plant, separation may occur either before or after combustion or through the oxy-fuel process.

[14] Wilbert Grevers and Lennart Luten, *Introduction to the CCS Chain: Technological Aspects and Safety Risks*, in Legal Design of Carbon Capture and Storage: Development in the Netherlands from an International and EU Perspective, 3, at 8-9 (Martha M. Roggenkamp and Edwin Woerdman, eds., 2009).

[15] IPPC, *Special Report on Carbon Capture and Storage*, supra note 13, at 30.

[16] Ibid., at 34. With regard to the risk that physical leakage of stored CO_2 may compromise CCS as a climate change mitigation option, the IPCC affirmed that for well-selected, designed, and managed geological storage sites, the vast majority of CO_2 will gradually be immobilized through various trapping mechanisms so that, in a longer-term perspective, "the fraction of CO_2 retained in appropriately selected and managed geological reservoirs is very likely to be 99 per cent over 100 years and to exceed 99 per cent over 1000 years".

From a technical point of view, each phase of the CCS process—capture, transport, injection, storage—has already been applied in existing projects in contexts other than climate change mitigation.[17] What is still a novelty is the integration of the different CCS phases into a process leading to the permanent underground storage of CO_2 for the purpose of the reduction of GHG emissions. CCS demonstration projects are still at an early stage, and their real impact and role in climate change mitigation is yet to be fully ascertained. International organizations such as the IPCC and the International Energy Agency endorse the implementation of CCS as an essential component of a portfolio of measures to reduce global emissions.[18] It can be assumed that technological advances by means of R&D activities and the implementation of demonstration projects will serve to validate the technique and bring costs down.[19] Yet the role that CCS can play in climate change mitigation must be assessed against a number of factors, including the economic and technical aspects involved in the development and consolidation of the technology, the possible risks to the environment and human health,[20] and the implications of the large investments absorbed by CCS for the achievement of a future energy system to be primarily based on renewables.[21]

As further explained below, a lack of integrated CCS practice coupled with the high energy costs[22] and the uncertainty over its environmental benefits make CCS technology a controversial response to climate change. Proposals to include CCS among the climate change mitigation

[17] In the United States, for example, CO_2 capture by means of its separation from a gas stream and transportation by pipelines has been extensively used in the gas-and-oil industry where, through the enhanced oil-recovery (EOR) technique, captured CO_2 streams are transported by pipeline and injected into oil wells in order to increase the output of oil (Philip M. Marston and Patricia A. Moore, *From EOR to CCS: The Evolving Legal and Regulatory Framework for Carbon Capture and Storage*, 29 Energy Law Journal 421, at 423 (2008). In the Netherlands, the CO_2 captured from an oil refinery is transported by pipelines and used as a fertiliser in greenhouse horticulture (Grevers and Luten, supra note 14, at 9).

[18] *Special Report on CCS*, supra note 12, at 3. According to IEA estimates *(Energy Technology Perspectives: Scenarios and Strategies to 2050*, 2010), CCS would deliver one-fifth of the total CO_2 emission savings needed to cut global emissions by 50 per cent by 2050. The analysis further points to the significant contribution of CCS in providing "the least-cost route of reducing and stabilising CO_2 emissions in the atmosphere" (*Carbon Capture and Storage: Progress and Next Steps*, IEA, 2010, at 9, available at <http://www.iea.org/papers/2010/ccs_g8.pdf>). The report indicates that without CCS in the technology mix, the cost of climate stabilization would increase by 70 per cent.

[19] *Carbon Capture and Storage: Assessing the Economics*, McKinsey and Company, 2008, at 25, available at <http://assets.wwf.ch/downloads/mckinsey2008.pdf>.

[20] There is some evidence that the prolonged exposure to high CO_2 concentrations—such as in the case of substantial leakage as a result of accidents during transportation or storage—may cause substantial damage to human health, including respiratory problems and in extreme cases asphyxia: Chris Hendriks, M. J. Mace, and Rogier Coenraads, *Impacts of EU and International Law on the Implementation of Carbon Capture and Geological Storage in the European Union* (2005), 18.

[21] Emily Rochon et al., *False Hope: Why Carbon Capture and Storage Won't Save the Climate* (Greenpeace International, 2008), 21.

[22] According to recent studies, CCS-based power plants require between 24 and 66 per cent additional primary-energy consumption compared to plants of equivalent output that do not make use of CCS. See in particular, Wuppertal Institute for Climate, Environment, and Energy, *Comparison of Renewable Energy Technologies with Carbon Dioxide Capture and Storage* (2010), 197.

options have been the object of heated debate at all jurisdictional levels.[23] The technology has attracted the firm opposition of many environmental NGOs and met with the criticisms of the environmental protection agencies of some European member states. Opponents of CCS stress the fact that the world has so far had no experience with deliberate permanent storage of anything.[24] Despite the criticism, major world economies—China, the United States, Canada, Australia—have begun the implementation of CCS demonstration plants with the aim of gathering improved data and consolidating experience.[25] Some have also started to develop legal and regulatory responses to back up the deployment of CCS and address the specificities of the new technology.[26] The European Union, for its part, has strongly endorsed CCS by undertaking a series of initiatives aimed at preparing the ground for the fully fledged deployment of CCS and by promoting the establishment of a dedicated legislative framework for CCS.

III. The EU Approach to CCS

From an EU perspective, the decision to promote the development and large-scale implementation of the technology is based essentially on the need to combine action against climate change with the objectives of increasing security of energy supply and ensuring the competitiveness of the European economy.

The European Union's involvement in the field of CCS has developed along three main directions.[27] The initial steps were in the research sector, through the Fifth, Sixth, and Seventh Framework Programme for Research and Development administered by the European Commission's Directorate-General for Research. CCS is also one of the six "technology avenues"

[23] The inclusion of CCS in the CDM has been considered in different instances, including at the Conference of the Parties to the Kyoto Protocol and the CDM Executive Board. Ultimately, CCS gained eligibility as a CDM project activity at COP 17 in Durban (December 2011). See the article by Amelia Thorpe, *Climate Law*, this issue.

[24] Rochon et al., supra note 21, at 21.

[25] Nigel Bankes and Martha Roggenkamp, *Legal Aspects of Carbon Capture and Storage*, *in* Beyond Carbon Economy: Energy Law in Transition, at 375 (Donald Zillman et al., eds., 2008).

[26] Tom Kerr, Ian Havercroft, and Tim Dixon, *Legal and Regulatory Developments Associated with Carbon Dioxide Capture and Storage: A Global Update*, 1 Energy Procedia 4395 (2009). For an update overview of current legislative developments, see the UCL Carbon Capture Legal Programme at <http://www.ucl.ac.uk/cclp/ccsnews.php>.

[27] Action to enhance CCS in the European Union started already with the Second European Climate Change Programme (ECCP), when a working group on Carbon Capture and Storage was set up (in 2005) with the mandate to explore CCS as a means for reducing climate change. The working group made a preliminary overview of the risks, potential, and costs of CCS and published a report in 2006, where it identified possible options to promote the development of CCS in the transitional period, including the development of a European regulatory framework dedicated to CCS. Following this preliminary analysis, the European Commission recommended the development of an environmentally safe CCS policy as part of its overall climate-and-energy strategy aimed at reducing GHG emissions without undermining economic growth (*Limiting Global Climate Change to 2 degrees Celsius: The Way Ahead for 2020 and Beyond*, European Commission, Communication COM (2007) 2 final, 5-6). The European Council Conclusions of March 2007 reiterated the EU's interest in this technology and called on the Commission and the Member States "to work towards strengthening R&D and developing the necessary technical, economic and regulatory framework to bring environmentally safe carbon capture and sequestration to deployment with new fossil-fuels power plants, if possible by 2020" (Council of the European Union, Presidency Conclusions, Brussels, May 2007, 7224/1/07, Rev. 1, CONCL. 1).

promoted under the European Strategic Energy Technology Plan (SET Plan), an initiative launched by the European Commission in January 2007 and recognized as the technology pillar of the EU's energy and climate policy.[28]

A second initiative related to the provision of funding for the implementation of large CCS demonstration projects.[29] The European Council affirmed the need for an appropriate coordination structure to facilitate funding mechanisms of sufficient size and long-term vision to reward carbon abatement through CCS.[30] To this end, the EU has planned for several large-scale demonstration projects to be in operation across the EU by 2015. It has envisaged two sources of funding for this purpose. First, in 2008 it set aside one billion euros from the EU's European Economic Recovery Plan for six CCS projects. Second, in accordance with article 10(a)(8) of the EU ETS Directive, revenues from the sale of 300 million emission permits under the EU ETS are to be directed into the so-called New Entrant Reserve and used to fund investments in up to twelve CCS demonstration plants.

The third line of action focused on the establishment of an appropriate regulatory framework aimed at enabling the development of CCS activities in Europe. Considering the uncertainty about the safety risks and environmental impacts of the technology, the regulation of CCS had to fulfil the dual objective of building public confidence in the technology while ensuring legal certainty to operators willing to manage a storage site or simply to equip their plants with carbon-capture devices.[31] It was therefore necessary to set up an appropriate risk-management framework for the implementation of CCS projects, including provisions dealing with liability for environmental damage caused by accidental CO_2 leakage. Moreover, it was important to define the role of CCS in the general context of EU environmental legislation, and to remove possible obstacles and legal barriers to the deployment of CCS projects in European territory. A proposal for a Directive on the geological storage of carbon dioxide appeared in January 2008 as part of the Climate and Energy Package. The Directive, together with the other legislative

[28] European Commission, Communication to the Council, the European Parliament, the European Social and Economic Committee, and the Committee of Regions, *A European Strategic Energy Technology Plan (Set-Plan): Towards a low carbon future*, COM (2007) 723 final.

[29] European Commission, Communication to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of Regions, *Supporting Early Demonstration of Sustainable Power Generation from Fossil Fuels,* Brussels 2008, COM (2008) 30 final. According to the European Commission, the demonstration phase is crucial in order to render CCS attractive for the European industry. It will allow for testing and development of the technology, consolidation of technical expertise, and increase of its cost-efficiency through large-scale application, thereby addressing the commercial and financial barriers arising from the huge costs related to the start-up stage of this technology. Moreover, the European Commission estimates that demonstration projects, continued research and, more significantly, information-transparency would help to provide reassurance to the public on the overall safety of the process (European Commission*, Accompanying document to the Proposal for a Directive of the European Parliament and of the Council on the geological storage of carbon dioxide: Impact assessment*, COM (2008) 18 final).

[30] Jon Gibbins and Hannah Chalmers, *Carbon Capture and Storage*, 36 Energy Policy (2008), 4317.

[31] M. J. Mace, Chris Hendricks, and Rogier Coenraads, *Regulatory Challenges to the Implementation of Carbon Capture and Geological Storage within the European Union under EU and International Law*, 1 Int'l J. of Greenhouse Gas Control 253.

measures that were part of the package, was eventually adopted in April 2009 and entered into force on 25 June 2009.[32]

IV. Basic Features of the CCS Directive

Directive 2009/31/EC on the Geological Storage of Carbon Dioxide forms an integral part of the EU Climate and Energy Package. It fills the gap represented by the absence of a specific legal framework regulating the development and implementation of CCS in the context of the European climate policy.

The EU decided to adopt a "conservative approach" to the regulation of CCS. The approach consists of relying as far as possible on existing legislation regulating activities presenting similar risks, insofar as such legislation is suitable to cope with the needs of CCS technology. Pursuant to this approach, the capture and transport components of the CCS chain are respectively regulated under the pre-existing Integrated Pollution Prevention and Control Directive (IPPC)[33] and the Environmental Impact Assessment Directive (EIA).[34] The Environmental Liability Directive (ELD)[35] is able to cover certain aspects of liability for environmental damage caused by the accidental leakage of CO_2 from storage sites.

The main aim of the CCS Directive, by contrast, is the safe geological storage of CO_2. To this purpose, it sets out a regulatory framework characterized by specific obligations on the storage-site operators and on the EU member states' competent authorities with a view to ensure that the stored CO_2 will be permanently contained in its entirety. The Directive allows storage of CO_2 to take place in the territory of member states, both on-shore and off-shore in the states' exclusive economic zones and continental shelves.[36] In line with the principle of subsidiarity which characterizes the relationship of the EU and its member states in the environmental field, a state decides which part of its territory may be used for CO_2 storage. Article 4(1) of the Directive permits member states not to allow a storage site in their territory. However, if a state were to accept the development and implementation of the CCS technology, it must identify suitable storage sites.[37] The localization of storage sites must respect certain criteria and conditions. A specific process of "characterization" and "assessment" of the potential storage site and surrounding area must be undertaken, in accordance with Annex I to the Directive,[38] in

[32] CCS Directive, Article 40.

[33] *Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control*, [2008] OJ L 24/8.

[34] *Directive 85/337/EC of the European Parliament and of the Council of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment*, [1985] OJ L 175/40 (as amended by Directives 97/11/EC and 2003/35/EC, now codified by Directive 2011/92/EU of 13 December 2011, [2012] OJ L 26/1).

[35] *Directive 2004/35/EC of the European Parliament and of the Council of 30 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage*, [2004] OJ L 143/56 (as amended by Directive 2006/21/EC).

[36] CCS Directive, Article 2.

[37] CCS Directive, Article 4(2).

[38] CCS Directive, Article 4(3).

order to estimate the available storage capacity and to verify the absence of significant risks of leakage or of other negative impacts on the environment or human health.[39]

A prominent feature of the risk-management framework of the CCS Directive is the permit requirement. A permit is mandatory for exploration and characterization activities directed at selecting and assessing the suitability of sites (article 5) as well as for the underground injection and geological storage of CO_2 (article 6). Articles 7–9 of the Directive specify the details of permit applications, as well as a permit's conditions and content. Once a permit is granted, the site operator must comply with a number of obligations in order to ensure the safety of the site and the permanent containment of CO_2, during both the operational phase and the site's closure and post-closure phases. The operational period is characterized by a specific regime of monitoring,[40] reporting,[41] and inspections[42] in order to detect leakage, significant irregularities, and any adverse effects on the surrounding environment. In the event of any leakages or significant irregularities, the operator is to immediately notify the competent authority, and must implement the necessary "corrective" measures, including measures to protect human health.[43]

Articles 17 and 18 of the Directive regulate the closure and post-closure phases and deal with the delicate question of determining the respective roles and responsibilities of the operator and the competent authority following closure of the site and cessation of the CO_2 injection. In order to address the reluctance of the operators to indefinitely retain responsibility for a storage site and the likely much shorter life-span of a corporation when compared with the desired life of a storage site, the EU legislature has made possible the transfer of responsibility for the site from the operator to a competent authority. Once responsibility has been thus transferred, the operator is released from any further obligations relating to monitoring and to corrective measures. The Directive specifies that such transfer is possible only after the lapse of a certain period of time, to be determined by the competent national authority but in any case to be no shorter than twenty years from the closure of the site. Moreover, article 18 conditions the transfer of responsibility to the fulfilment of certain restrictive conditions, namely that all available evidence indicates that the CO_2 will be completely and permanently stored; that the operator has made a financial contribution to the competent authority such as to cover the anticipated costs of monitoring for at least thirty years; and that the site has been sealed and the injection facilities removed.

With respect to liability, the CCS Directive distinguishes liability for damage to the environment from "climate change liability" deriving from accidental leakage of CO_2 from the storage site into the atmosphere. The former type of liability falls, in the case of damage to water, protected species, and natural habitats, under the ELD. The latter type of liability is treated as an emission for the purposes of the Kyoto Protocol and the EU ETS. While CO_2 emissions captured and

[39] CCS Directive, Article 4(3).
[40] CCS Directive, Article 13.
[41] CCS Directive, Article 14.
[42] CCS Directive, Article 15.
[43] CCS Directive, Article 16.

permanently stored are not considered as "emitted" for the purpose of surrendering allowances,[44] the obligation to surrender allowances or to acquire the relevant amount of credits remains for the leakage of CO_2 from CCS installations.[45] Therefore, pursuant to the EU ETS directive, the person responsible for the leakage—the operator, another party, or the competent authority—is required to acquire allowances corresponding to the emissions.

While the CCS Directive is mostly concerned with risk management and regulation of the safe geological storage of CO_2, it includes (in chapter 7) a number of provisions aimed at clarifying the legality of CCS activities under existing EU legislation and removing potentially obstructive provisions that would hamper the fully fledged deployment of the technology.[46] In particular, article 32 amends the Water Framework Directive[47] to allow CO_2 storage in saline aquifers; articles 35 and 36 amend the Waste Framework Directive and the Regulation on the shipment of waste,[48] respectively, so as to exclude CO_2 storage from their scope of application. Moreover, the IPPC Directive, the EIA Directive, and the ELD are also amended to regulate specific aspects of the CCS chain. This is in line with parallel developments at the international level, where several conventions and protocols have been amended to bring CCS within their remit, thereby adding much-needed legal clarity.[49]

The CCS Directive does not address economic and market issues. Certain forms of incentive for the development of CCS are in fact regulated by other policy and legal instruments, including the revised EU ETS directive. The latter, in particular, provides for the inclusion of CCS in a harmonized EU ETS[50] and envisages specific mechanisms to promote and accelerate the demonstration of the first commercial CCS facilities in Europe. To this effect, it provides that a certain number of allowances from the New Entrants' Reserve will be set aside to provide a guaranteed reward for up to twelve CCS facilities in EU territory.[51]

[44] Article 12(3a) of *Directive 2003/87 of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community, as amended by Directive 2009/29/EC* reads "An obligation to surrender allowances shall not arise in respect of emissions verified as captured and transported for permanent storage at a facility for which a permit is in force in accordance with Directive 2009/31/EC of the European Parliament and the Council of 23 April 2009 on the geological storage of carbon dioxide".

[45] See articles 11(4), 17(2), and 18(1) of the CCS Directive, which clearly refer to the obligation of the operator or of the responsible party to surrender allowances in the event of leakage pursuant to Directive 2003/87/EC.

[46] Kerr et al., supra note 26, 4395-4402.

[47] *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community Action in the field of water policy*, [2000] OJ L 327/1.

[48] *Regulation EC 1013/2006 of the European Parliament and of the Council of 14 June 2006 on the shipments of waste*, [2006] OJ L 190/1.

[49] Catherine Redgwell, *International Legal Responses to the Challenges of a Lower-Carbon Future: Climate Change, Carbon Capture and Storage, and Biofuels*, *in* Beyond Carbon Economy: Energy Law in Transition (Donald Zillman et al., eds., 2008), 85, 103.

[50] *Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending 2003/87/EC Directive as to improve and extend the greenhouse gas emission allowance trading scheme in the Community*, [2009] OJ L 140/63, Preamble, para 39.

[51] Article 10(a), para. 8, and preamble para. 20, Directive 2003/87/EC (as amended by Directive 2009/29/EC).

V. Regulatory Challenges in the Implementation of the CCS Directive

The CCS Directive offers an interesting standpoint from which to discuss some of the main issues emerging in relation to the development of certain policies and legislative measures adopted to combat climate change. In many respects the Directive is a typical environmental measure. It has its legal basis in article 175(1) of the EC Treaty (currently article 192(1) of the TFEU), which is the provision allowing the EU to adopt minimum harmonization measures in the environmental field. Its preamble expressly refers to the objective of ensuring a high level of environmental protection. Moreover, as part of the EU's Climate and Energy Package, it aims to protect the environment from the deleterious effects of climate change, by substantially contributing to GHG reductions. Yet a careful evaluation of the Directive and the arguments put forward by the European Commission in support of CCS technology reveals the law to be also very much about energy security, the continued use of fossil fuels, and the preservation of EU competitiveness worldwide. The reasoning surrounding the EU's choice to include a directive regulating the implementation of CCS in the package of measures to combat climate change reflects the evolution in the European approach to climate change. While action against climate change remains a priority in EU environmental policy, there is increasing recognition that a coordinated and integrated approach is needed which brings together the environmental dimension, energy policy considerations, and economic and industrial concerns. From this point of view, the adoption of the Climate and Energy Package and the transfer of climate change policy from the Directorate-General for the Environment to the purpose-made Directorate-General for Climate Action have marked a significant threshold in EU climate policy, which has come to assume the status of an autonomous discipline.

In this context, the coexistence of different policy objectives—i.e. the protection of the environment from the negative effects of climate change alongside the search for appropriate ways to enhance energy security and promote cost-effective sustainable development and growth—are a characteristic feature of climate change regulation. However, finding the proper balance between the different interests at stake and giving proper weight to "other" environmental considerations, such as those relating to nature protection or landscape conservation, is still a major challenge facing regulation in the field of climate change. Recent environmental legislation adopted at both the EU and state levels appears to be characterized by the co-existence of (i) traditional types of conflict between economic and environmental interests, and (ii) new-generation types of conflict between the two competing environmental goals of climate change mitigation and environmental protection.[52]

The CCS Directive reflects both types of conflict, and therefore provides an interesting case study on trends in EU climate legislation from an environmental-protection perspective. On the one hand, the interests related to economic development, reflected in the Directive's underlying objectives of ensuring security of energy supply and strengthening the competitiveness of European industries, ought to be reconciled with the need to combat climate change by means of a

[52] Colin T. Reid, Aylwin Pillai, and Andrew R. Black, *The Emergence of Environmental Concerns: Hydroelectric Schemes in Scotland*, 17 Journal of Environmental Law 361, at 382 (2005).

drastic reduction of GHG emissions. On the other hand, the climate change benefits, in terms of emission reductions, which could be achieved with the deployment of CCS in Europe must be balanced with the risks for the environment and human health entailed by the utilization of this novel and complex technology. Therefore, in the implementation of the CCS Directive, both EU institutions and member-state authorities are confronted with the difficult task of finding the right balance between competing goals. Policy studies have identified a number of features that the appropriate regulatory framework for this technology should ideally have, namely contributing to CO_2 emission reduction while being economically feasible, acceptable to society, and environmentally sound.[53]

In practice, given the special features of CCS technology, and its yet unknown long-term environmental effects, the development of CCS projects must strike a careful balance among the various factors. We now turn to consider whether, in the delicate assessment of the different and competing interests involved, the Directive's regulatory framework for CCS is able to adequately address environmental protection concerns.

VI. Role of General Legal Principles

As discussed, article 4 of the CCS Directive provides for the characterization and assessment of storage sites. A geological formation may be selected for storage only if "there is no significant risk of leakage, and if no significant environment and health risk exist": article 4(4). The steps in Annex I for characterization and assessment are data collection; building a three-dimensional static geological model; and characterization of the site's dynamic behaviour, sensitivity, and risk. The last step, and in particular the risk assessment, deserves particular attention. Within the framework for risk assessment there is a sub-activity called "risk characterisation" which includes "an assessment of the safety and integrity of the site in the short and long term, including an assessment of the risk of leakage under the proposed conditions of use, and of the worst-case environment and health impacts". Thus, all possible negative impacts on the environment and human health related to the CCS project should be evaluated by the competent authorities of the member states. Moreover, "the risk characterisation should include an assessment of the sources of uncertainty identified during the steps of characterisation and assessment of storage site, and when feasible, a description of the possibilities to reduce uncertainty". Such reference to the sources of uncertainty surrounding characterization and assessment justifies invoking the precautionary principle, one of the fundamental principles upon which EU environmental law is based, for improving the interpretation and application of the CCS Directive.

According to the European Commission's view, recourse to the precautionary principle is triggered by the existence of a situation "where scientific information is insufficient, inconclusive, or uncertain and where there are indications that the possible effects on the environment, or human, animal or plant health may be potentially dangerous and inconsistent with the chosen level of

[53] Hendriks, supra note 20, at 2.

protection".[54] It would seem, then, that reference to the precautionary principle in the interpretation and application of the CCS Directive is appropriate, in particular with regard to storage sites. The application of the principle may help decision-makers to choose the most appropriate course of action despite the degree of scientific uncertainty remaining after a scientific evaluation of the risks.

As to the precise boundaries and scope of application of the precautionary principle within the realm of EU environmental law, it is well known that the TFEU itself does not provide further explanation on these issues, and that the only guidelines are to be found in the EC's Communication on the Precautionary Principle.[55] However, through the years the principle has become a frequent source of inspiration and reference by the EU courts, as well as by national courts of member states.[56] For instance, the ECJ's Court of First Instance (now General Court) referred to the precautionary principle as "a general principle of Community Law" which can be used to give precedence to public health and environmental requirements over economic interests.[57] Similarly, the Court of Justice has called it a "fundamental principle" of environmental protection in the context of the release of modified living organisms into the environment.[58] It could generally be said that the case law of the Court of Justice and the General Court has focused on the pivotal role that the precautionary principle can play in guiding national authorities and legislatures in situations where the decision-making process is affected by uncertainty about the risks to the environment and human health of a particular substance, product, process, or activity. In a nutshell, "where there is uncertainty as to the existence or extent of risks to the health of consumers, the institutions may take protective measures without having to wait until the reality and the seriousness of those risks become fully apparent".[59]

[54] *Communication from the Commission on the Precautionary Principle*, European Commission, COM(2000)1 final, at 8.

[55] Ibid.

[56] Nicolas De Sadeleer, *The Precautionary Principle as a Device for Greater Environmental Protection: Lessons from EC Courts*, 18 Review of European Community and International Environmental Law 3-10 (2009); Nicolas De Sadeleer, *Environmental Principles: From Political Slogans to Legal Rules* 110 (2002).

[57] In the case T-74/00, *Artegodan GMbH and Others v. Commission* [2002] ECR II-4945, the Court of First Instance affirmed that "the precautionary principle can be defined as a general principle of Community law requiring the competent authorities to take appropriate measures to prevent specific potential risks to public health and the environment, by giving precedence to the requirements related to the protection of those interests over economic interests".

[58] In the case C-121/07, *Commission v. France* [2008] ECR I-9159, paras 74-75, the Court of Justice held that "as is apparent from Article 1 and recitals 6 and 8 of the preamble to Directive 2001/18, the rules laid down in that directive are based on the precautionary principle and the principle that preventive action should be taken, which are fundamental principles of environmental protection, as referred to in particular in Article 174(2) EC". Moreover, it affirmed that "as stated at recitals 4 and 5 in the preamble to Directive 2001/18, living organisms, whether released into the environment in large or small amounts for experimental purposes or as commercial products, may reproduce in the environment and cross national frontiers, thereby affecting other Member States. The effects of such releases on the environment may be irreversible. The protection of human health and the environment also requires that due attention be given to controlling risks from the deliberate release into the environment of GMOs".

[59] Case C-157/96, *National Farmers' Union* [1998] ECR I-2211, para. 63, regarding emergency measures adopted by the European Commission to protect against bovine spongiform encephalopathy, which imposed, on a temporary basis, a total ban on exports of bovine animals, bovine meat, and derived products. See also case C-236/01, *Monsanto*

As to the correct way to apply the principle, in a case concerning authorization to market a certain plant-protection product, the Court of Justice held that "a correct application of the precautionary principle presupposes, first, identification of the potentially negative consequences for health of the proposed use of the substance at issue, and, secondly, a comprehensive assessment of the risk to health based on the most reliable scientific data available and the most recent results of international research".[60] According to the Court, "where it proves to be impossible to determine with certainty the existence or extent of the alleged risk because of the insufficiency, inconclusiveness or imprecision of the results of studies conducted, but the likelihood of real harm to public health persists should the risk materialise, the precautionary principle justifies the adoption of restrictive measures, provided they are non-discriminatory and objective".[61] A similar approach was taken by the Court in a case regarding the limits to the use of certain substances (metallic additives) in petrol, imposed by EU Directive 2009/30 on the quality of liquid fuels, which is part of the EU Climate and Energy Package.[62] The Court of Justice affirmed that in the circumstances the European Union legislature was entitled under the precautionary principle to take protective measures without having to wait for the reality or the seriousness of those risks to be fully demonstrated.[63]

In sum, because of the uncertainty surrounding the impacts of CCS technology on the environment and human health, the precautionary principle could have a positive role in calibrating the weight given to environmental considerations in decision-making under the CCS Directive, especially concerning the characterization and assessment of the storage sites pursuant to article 4(3) and Annex I of the Directive. It becomes crucial, next, to determine which potentially conflicting interests are at stake in the implementation of the Directive, with particular regard to the site-characterization and assessment phase. The most relevant likely conflict in the implementation of the CCS Directive is the competing and possibly conflicting goals discussed earlier of climate change mitigation, on the one hand, and human-health and other environmental issues, on the other. The following basic questions need to be addressed: in the case of a potential conflict between these concerns, should priority (always) be given to climate change mitigation goals over other environmental protection objectives? And which instrument should be used to promote a careful balance between these concerns?

In our opinion, the answer to the first question is that since the CCS Directive falls within the framework of the EU environmental legislation and has its legal basis in article 175(1) of the EC Treaty (now 192(1) of the TFEU), it is not acceptable that precedence should be always given to climate change protection over other forms of environmental protection. This is also

Agricoltura Italia and Others [2003] ECR I-8105, para. 111, and case C-77/09 *Gowan Comércio Internacional e Serviços* (*Gowan*) [2010], para. 72.

[60] Case C-77/09 *Gowan Comércio Internacional e Serviços* [2010], para 75. See also case C-333/08 *Commission v. France* [2010] ECR I-757, para. 92.

[61] Case C-77/09 *Gowan Comércio Internacional e Serviços* [2010], para 76. See also case C-333/08 *Commission v. France* [2010] ECR I-757, para 93.

[62] Case C-343/09, *Afton Chemical Limited v. Secretary of State for Transport* [2010] ECR I-7023, paras 60-62; see also C-333/08 *Commission v. France* [2010] ECR I-757, paras 91-93.

[63] *Afton Chemical Limited v. Secretary of State for Transport* [2010] ECR I-7023, para. 62.

indirectly confirmed by the wording of article 1(2) of the Directive, which limits the development of CCS projects with reference to environmental and human-health protection.[64] In relation to the second question, the underlying conflict is one which often arises between economic goals and environment-protection objectives. It is present in several areas of EU law and has given rise to a very broad case law, in particular in the field of the free movement of goods within the internal market and the limits which may be imposed on trade on the basis of environmental and health concerns.[65] The main principle used by the EU courts to resolve these so-called "trade and environment" controversies is the proportionality principle—another fundamental general principle of EU law.[66]

Recent case law of the Court of Justice has recognized the possibility of applying the proportionality principle in conjunction with the precautionary principle to address an issue regarding the admissibility of trade-restrictive measures banning the use of certain substances. The Court stated that "the principle of proportionality, which is one of the general principles of Community law, requires that measures adopted by Community institutions do not exceed the limits of what is appropriate and necessary in order to attain the objectives legitimately pursued by the legislation in question; when there is a choice between several appropriate measures, recourse must be had to the least onerous, and the disadvantages caused must not be disproportionate to the aims pursued".[67] As can be seen, the Court essentially identifies three criteria which must be fulfilled by a measure and be followed by courts to judicially review the correct application of the proportionality principle as a balancing instrument between competing interests. First, there is the test of the suitability of the measure; it must be appropriate in general terms to achieve a legitimate purpose. Second, there is the "proportionality *strictu sensu*" of the measure, which must be limited to what is strictly necessary to achieve the desired objective. Third is the rule of "least restrictiveness", according to which the measure must be the least onerous possible in relation to other interests.

In the CCS case, the application of the proportionality principle might prove more complex than in most Court of Justice case law so far, as we are facing a new type of conflict between competing goals, not so much related to the traditional dichotomy of "economic v. environmental" interests but one internal to the environmental dimension. Given the parallel situation existing in this case with the more traditional type of conflict, it seems that an analogy may be made between the two

[64] Pursuant to Article 1(2) of the Directive, "the purpose of environmentally safe geological storage of CO_2 is 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 health*" (emphasis added).

[65] See for instance Gerd Winter, *Risks, Costs and Alternatives in European Community Environmental Legislation: The Case of Registration, Evaluation, and Authorisation of Chemicals (REACH)*, *in* Implementing the Precautionary Principle: Approaches from the Nordic Countries, EU and USA, (Nicholas De Sadeleer, ed., 2007), 313. See also André Nollkaemper, *Habitat Protection in European Community Law: Evolving Conceptions of a Balance of Interests*, 9 Journal of Environmental Law 271, at 280 (1997).

[66] See Jan H. Jans and Hans H. B. Vedder, *European Environmental Law* (4th edn, 2012), 282.

[67] See *Afton Chemical Limited v. Secretary of State for Transport* [2010] ECR I-7023, para. 45. See also case C-189/01, *Jippes and Others* [2001] ECR I-5689, para. 81; case C-558/07 *S.P.C.M. and Others* [2009] ECR I-5783, para. 41; and Joined Cases C-379/08 and C-380/08 *ERG and Others* [2010] ECR I-2007, para. 86.

situations, and that it would be reasonable to adopt the proportionality principle as the reference instrument to correctly address the conflict. A meaningful application of the proportionality principle in conjunction with the precautionary principle in the context of the CCS Directive could have the positive effect of making more flexible, and more justiciable, the application of the Directive's provisions.[68] Non-climate environmental and human-health considerations could be given a more appropriate position alongside climate change mitigation objectives, and thus the public interest in environmental protection and climate change mitigation would be better balanced in decision-making.

VII. Concluding Remarks

The foregoing analysis of the CCS Directive has focused on the main regulatory challenge surrounding the implementation of the Directive, which relates to the ascertainment of whether, in balancing the competing interests involved, its regulatory framework allows a proper consideration of environment-protection concerns. Besides featuring the traditional type of conflict between economic and environmental interests, the CCS Directive represents an interesting case study in the new-generation conflict that may arise between related environmental interests: climate change mitigation and other environmental protection. This is well illustrated by the Directive's main objective, which is the promotion of the geological storage of CO_2 in furtherance of climate change mitigation, which must be pursued without causing negative effects or risks to the environment or human health.

The competent national authorities of EU member states must carry out a risk characterisation to evaluate possible negative impacts on the environment and human health related to the development of a CCS project. This phase must also include an assessment of the "sources of uncertainty" associated with CCS projects, inviting use of the precautionary principle to support the further interpretation and application of the CCS Directive. Next, in order to promote a balance between the two aforementioned potentially conflicting environmental interests, our analysis has shown that the appropriate instrument to invoke is the proportionality principle. It is the most suitable instrument to address the new type of intra-environmental conflict, promote a careful balance of the competing interests at stake, and lead to a better implementation of the CCS Directive.

[68] Nicolas De Sadeleer, *The Effect of Uncertainty on the Threshold Levels to Which the Precautionary Principle Appears to be Subject*, *in* Environmental Law Principles in Practice (Maurice Sheridan and Luc Lavrysen, eds., 2002), at 37.