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*by Ray Purdy**

Introduction

There is now virtually universal recognition that the earth is getting warmer and climate change is happening. In the last 150 years we have seen a rise in atmospheric concentrations of carbon dioxide ("CO_2") by nearly a half.[1] Although the international community has made some attempts to reduce emissions of CO_2, it is increasingly clear that binding targets set for 2010 under the Kyoto Protocol will not be achieved by a significant number of parties.

The situation is escalating in seriousness. Scientists have also calculated that the parts per million ("ppm") targets limiting CO_2 levels, originally considered sufficient for stabilization by 2050, could now be dangerously high and we would have to significantly reduce our emissions beyond existing target levels in order to limit average global temperature increases. It seems we currently have little alternative to continuing to burn fossil fuels for a number of decades. This, coupled with the enormous growth of the economies of China and India, has led many Governments to believe that radical action is now required to reduce atmospheric emissions of CO_2.

One increasingly supported method of reducing CO_2 emissions to the atmosphere is to capture and store the emissions in another domain — this process is known as carbon capture and storage ("CCS"). CCS is also sometimes known as carbon sequestration, although this should not be confused with biological carbon sequestration, where CO_2 that has been already emitted into the atmosphere is taken up in forests or soils. CCS involves the capture of CO_2 from large industrial point sources, such as power plants, which account for a high percentage of CO_2 emissions. In basic terms, a giant vacuum cleaner sucks up the emissions before they are released into the atmosphere. It is estimated that fitting a power plant with CCS technology could reduce CO_2 emissions by around 85 percent.

Once captured, the CO_2 is transported and stored in either offshore or onshore sources. Onshore CCS, in sites such as abandoned mines, has not been championed to the same extent as offshore CCS. For many countries, the infrastructure for onshore CCS is not in place, and for countries with smaller land masses, CCS storage sites could be in close proximity to residential areas. Although CO_2 is considered by many to be a safe gas, and one that we come across most days in products such as carbonated drinks, this could prove controversial.

Offshore disposal, where CO_2 is stored directly in the seas, is also no longer seen as a politically acceptable or favored method of disposal by the majority. Under CCS projects, CO_2 will be transported to the oceans and artificially piped or injected into large geological formations under the seabed, such as depleted oil and gas traps. These projects have already demonstrated their ability to store fluids over a period of time. Other storage options include reservoirs or deep saline aquifers under the seas.

After the CO_2 is piped or injected into sub-seabed geological formations, the exits are sealed so that the CO_2 cannot escape, allowing it to be stored for long periods of time. For CO_2 storage to be an effective way of avoiding climate change, the CO_2 must be stored for hundreds of years so it can bridge the gap from the use of fossil fuels to the transition to a hydrogen economy and other sources of clean energy.

Whether CCS can be part of the Clean Development Mechanism under the Kyoto Protocol will become increasingly important.

Legal Questions Regarding CCS

CCS in marine waters is being strongly considered by national governments and international bodies. Bodies such as the Intergovernmental Panel on Climate Change and the International Energy Agency recently examined both the feasibility and potential barriers to using CCS. These bodies concluded that there remains much ambiguity as to how the legal principles, currently in place under existing international legislation, will apply to the storage of CO_2.[2]

CCS is a relatively new concept and it does not fall easily within the remit of international legislation, as such laws were obviously not designed with this is mind. This paper will firstly consider the driving factors behind CCS. It will then set out the potential impacts of existing marine laws and set these in the context of fast moving international discussions over taking CCS forward, and possible amendments to marine conventions.

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Gt CO2	1990	2003	2010	2020	2030
World	20.076	24.128	27.698	32.518	36.868
OECD	11.026	12.776	13.794	14.824	15.341
Developing Countries	5.319	8.815	11.063	14.525	18.113

Table 1: Projected Global Emissions.[6]

Driving Factors Behind CCS

There are a number of factors driving CCS. CO_2 can be economically useful if it is pumped at high pressure into oil/gas fields to enable recovery of significant amounts of oil/gas that are not recoverable through primary methods. The CO_2 used in such enhanced oil/gas recovery operations, such as the Sleipner field in Norway, remains stored in the field. CCS also offers some potentially attractive commercial benefits to industry through potential linkages with emissions trading schemes. However, what appears to be the main driver for CCS is international climate change legislation and its potential to enable governments to meet their climate targets.

The Kyoto Protocol to the United Nations Framework Convention on Climate Change ("UNFCCC"), adopted in 1997, provides binding quantified emission limitation and reduction commitments. Under the Kyoto Protocol, which entered into force in 2005, developed countries agreed to reduce their emissions to 5.2 percent below 1990 levels over the period 2008–2012. Kyoto compliance is monitored by registries and annual inventory reports, and these tracked amounts reveal that many of the largest countries are failing to meet their targets.

Canada and Japan's projections show that they are both over 500 million tons ("MT") of CO_2 away from reaching their 2010 targets. If the United States was still a party to Kyoto, then it would be approximately 2,500 MT away from reaching its target. The European Union is also projected to narrowly miss its targets. Only Russia and Poland are expected to comfortably achieve theirs, and this is only because of a period of economic instability.[3]

Missing Kyoto targets undoubtedly increases the threat of global warming. This problem is compounded because it was thought for many years in international negotiations that what was required for stabilization was limiting CO_2 levels to 550 ppm by 2050. Global emissions of CO_2 currently stand at around around 27 gigatonnes ("Gt") a year, and will reach 44 Gt a year by 2050 if CO_2 levels are limited to 550 ppm. Many scientists now argue that even this level of CO_2 could be dangerously high. The latest evidence suggests that atmospheric CO_2 concentrations would need to stay at least below 450 ppm (an increase of 18.3 Gt a year by 2050), in order to limit average global temperature increases to two degrees Celsius above pre-industrial levels.[4]

CCS was first considered as a mitigation tool for developed[5] countries who were worried that a rapid move away from fossil fuels would cause serious disruption to their economies, but still had binding targets to meet under Kyoto. It is now clear (see Table 1), that although emissions in developed countries, such as the United States, will have to be drastically kept in check, consumption in developing countries will have the greatest impact on global atmospheric CO_2 levels, and these could eclipse any further reductions made by the European Union and other Organisation for Economic Co-operation and Development ("OECD") countries.

Increases to developing countries' emissions are primarily because China and India have around a quarter of the world's coal reserves,[7] and intend to support their rapid economic development by building vast new fleets of new coal-fired plants. China is currently installing one gigawatt of coal-powered generation a week and forecasts predict that by 2030, coal-fired power in India and China will add 3000 million extra tons of CO_2 to the atmosphere every year.[8] There is also evidence of growing economic expansion in other countries such as Brazil.

The emissions of developing countries need to be kept in check, with the support of developed countries. Developed countries have the double-edged sword of not wanting to be seen to blame the developing countries for trying to catch up in the industrial and competitive stakes, but at the same time providing assistance and incentives to react to the potentially catastrophic problems caused by such massive increases in their emissions.

Whether CCS can be part of the Clean Development Mechanism ("CDM") under the Kyoto Protocol will become increasingly important. The CDM allows industrialized countries to purchase project-based emission reduction units from developing countries. The G-77 (made up of 77 developing countries) has long been opposed to the inclusion of CCS in the CDM, with Brazil being the most vocal in its opposition. Developed countries are currently pressing ahead for its inclusion and this will again be on the agenda at the next meeting of the parties to the UNFCCC in Nairobi in November 2006.

At the current time it is still unclear whether the UNFCCC/Kyoto Protocol allows developed countries to implement CCS projects. Whilst any projects that reduce greenhouse gases at source can be counted as an emission reduction, and this could include CCS, there is nothing in the UNFCCC/Kyoto Protocol that expressly prohibits or allows for CCS storage in geological formations under the sea. There are also genuine concerns about the potential for seepage from storage sites, and this complicates issuing credits for CCS projects. Either a separate mechanism for CCS may have to be introduced under the Convention, or at the very least, inventories and accounting of greenhouse gas reductions will need to be developed and approved by contracting parties to the UNFCCC/Kyoto Protocol.

Marine Laws and CCS

A number of international marine laws are relevant to CO_2 storage under the seas. This includes the United Nations Convention on the Law of the Sea ("UNCLOS"), which regulates all aspects of the use and protection of the sea. UNCLOS does not specifically control dumping or prohibit CO_2 storage offshore, but requires states to take individually, or jointly, all measures necessary to prevent, reduce, or control pollution of the marine environment.[9]

UNCLOS is a framework law, leaving the elaboration of precise rules to be made in other more specific laws. The London Convention and its 1996 Protocol are the global laws that control and regulate the deliberate disposal of wastes at sea. The 1996 Protocol, which came into force in 2006, goes beyond the provisions of its predecessor and aims to provide greater protection for the marine environment. Whereas the London Convention aims to regulate dumping, the Protocol seeks to prevent, reduce, and where practicable eliminate pollution, and adopts a precautionary approach as a general obligation.

Parties to both the London Convention and the 1996 Protocol are encouraged to create regional agreements that further their objectives. There are many regional agreements around the globe, which provide for protection of the marine environment in particular jurisdictions.[10]

Whilst these marine conventions envisage compliance with other more specific or regional conventions, and indeed operate together in strengthening environmental protection, states are only bound to follow the conventions that they ratify or accede. All of the above international marine conventions have entered into force: UNCLOS with 149 parties; the London Convention with 82 parties; and the 1996 Protocol with 27 parties.[11] In practice, if a party is signed up to more than one marine convention, (*e.g.*, the UK is a party to all of the marine conventions) and there is overlap, a state would need to apply the standard of the most specific and stringent treaty. This article will examine the London Convention and its 1996 Protocol.

The problem remains that the majority of the world's commercial energy needs are met by fossil fuels and we are no closer to the end of the fossil fuel era.

The London Convention and its 1996 Protocol

There are four important considerations in determining the legality of CO_2 dumping/storage under the London Convention and 1996 Protocol. The first consideration is whether geological formations under the sea fall under the Convention's jurisdiction. The London Convention seeks only to control dumping at "sea" and would probably not cover CO_2 storage. The Protocol goes beyond the scope of the Convention and applies to dumping in the "sea, seabed and subsoil."

Legality of CO_2 Storage

It is arguable whether CO_2 storage may be prohibited under the Protocol, and this turns upon the definitions of "seabed" and "subsoil" and how far down they go. One interpretation is that the subsoil is just a layer of rock immediately under the seabed, whereas another interpretation, and one this author would favor, is that the Protocol was drafted to cover all areas below the sea column.[12]

The next consideration is whether CO_2 can be considered to be a waste. The London Convention prohibits the disposal of all wastes specified in Annex I. CO_2 is not specifically referred to in any of the lists that are prohibited for disposal in Annex I, but will probably fall under the "industrial waste" category in the Annex if it can be shown that it derived from a manufacturing or processing operation. The Protocol is simpler as it places a general prohibition upon the dumping of wastes, with the exception of those wastes or matter to be found listed in Annex I. It is most unlikely that CO_2 will fall within the categories approved for dumping in Annex I. It is therefore suggested that as CO_2 would fall within the definition of waste under the Convention and Protocol and, as a result, dumping it would be prohibited. The definition of "dumping" in both conventions also refers to "wastes or *other matter*," so technically this could also be sufficiently broad enough to include CO_2.

The third consideration is the method of actual disposal. The Convention and the Protocol both define "dumping" to be "any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea." Therefore, the Convention and Protocol only apply to activities using ships or platforms to dispose CO_2 into the marine environment and there are no controls governing pipeline discharges direct from land based sources. This can be supported further by a provision in the Protocol stating that its remit does not extend to sub-seabed repositories accessed only from land. It is there-

fore suggested that the transportation of CO_2, by pipeline, from land-based courses direct to sub-sea repositories, will not fall foul of these Conventions.

The fourth consideration is whether there are any exceptions within the Conventions, which may also provide a basis for the storage of CO_2. Both of the Conventions exclude from the definition of "dumping" the disposal or storage of wastes or other matter directly arising from, or related to the exploration, exploitation, and associated off-shore processing of seabed mineral resources. This would suggest that where CO_2 ends up in storage, following enhanced oil/gas recovery operations, this is permissible under the Convention and Protocol.

The second possible exception is that both Conventions exclude from the definition of "dumping" the "placement of matter for a purpose other than the mere disposal." It could be argued that the CO_2 is not in fact disposed of, but temporarily placed until the climate situation is bought under control. It is unclear what "placement" is intended to constitute or what is its scope, but one could guess it is intended to cover things such as the placement of artificial reefs.[13] On balance, it seems unlikely that one can succeed in arguing that the CO_2 will be temporarily stored rather than disposed of, particularly as it could gradually leak from the storage site and there are no plans to recover it later.

Changing the Law

Contracting Parties to the London Convention and Protocol have recently been discussing the legal implications of CO_2 storage. A questionnaire asking Parties for their legal opinions to a number of questions was circulated by the Secretariat in 2004. The results of this questionnaire were discussed at the 27th Meeting of the Parties in October 2005. There was no agreement amongst parties as to whether the Convention or the Protocol were compatible with CCS activities, apart from in some instances that CCS may be allowed (in enhanced oil and gas recovery for example). It was agreed that it may be expedient to either reach agreements on the interpretation of the Protocol and Convention or consider making amendments to the legislation.

An Intersessional Legal and Related Issues Working Group on CO_2 Sequestration was established to develop and clarify the legal issues. This was with a view to facilitating and/or regulating CCS, and, if appropriate, drafting potential amendment options to the Protocol or Convention.[14] The Scientific Technical Group to the Conventions was also instructed to make an assessment of the potential risks to the marine environment.[15]

After the legal and technical working groups met in April 2006, it became clear that the Protocol would be amended in the first instance. Australia put forward a proposal, co-sponsored by France, Norway, and the UK, recommending an amendment to Annex I of the Protocol, thus bringing the regulation of CO_2 into line with the regulation of other substances eligible for dumping or storage. The proposal would allow for carbon dioxide streams from CCS consisting "overwhelmingly of CO_2" to be stored in geological formations.[16]

An amendment to the Annex was pursued because it is easier to change an Annex rather than a main text of the Convention. It would have also been considered easier to amend the Protocol in the first instance as it has less contracting parties. The next meeting of the Contracting Parties (the 28th Meeting) will be held in November 2006 and to amend the Protocol will require a two-thirds agreement of those present at the meeting. The amendment will then enter into force immediately for any party agreeing to it, and for all other Parties (whether they agreed to it or not) after a period of 100 days following the relevant meeting, unless a declaration against acceptance is made by a Party within that period.

CCS was first considered as a mitigation tool for developed countries who were worried that a rapid move away from fossil fuels would cause serious disruption to their economies, but still had binding targets to meet under Kyoto.

Conclusion

In an ideal world, it is obviously not a flawless plan to store/dump CO_2 in geological formations in marine waters. Many will find transferring pollution from one source to another to be morally abhorrent, as well as potentially illegal. The problem remains that the majority of the world's commercial energy needs are met by fossil fuels and we are no closer to the end of the fossil fuel era. The sad truth is that government and industry has been aware of the threat posed by climate change since the Rio Summit over fifteen years ago, but have been slow to react and invest in new clean technologies.

If we carry on adopting a "business as usual" approach, global temperatures will continue to increase, sea levels will rise, and extreme weather events will intensify. This is exacerbated by the economic growth in Asian countries. A toolkit of responses is necessary to deal with the urgency of global warming, and although CCS could prove unpopular in some quarters, it will probably have to be deployed worldwide if we want to continue using fossil fuels up to 2030.

Humans are faced with the difficult environmental choice of either increasing the CO_2 in the atmosphere to dangerous levels, or possibly polluting marine waters if CO_2 is not successfully stored. Although stored CO_2 has the capacity to leak into the sea,

it should prevent it reaching the atmosphere, which in the author's opinion is probably worth the risk. CCS could also protect the seas because as things stand, there is growing evidence of ocean acidification caused by higher levels of atmospheric CO_2 being absorbed by the oceans. This is thought to be already exerting a detrimental effect on marine ecosystems.

It also seems unlikely that CO_2 storage projects will take place over huge maritime areas. Under UNCLOS, nations have the greatest amount of coastal jurisdiction and control over the waters closest to shore, with increasing responsibility to accommodate uses by other nationals as the distance from shore increases. It is suspected that most storage sites will therefore be in countries' own exclusive economic zones or continental shelves. There are also only a limited number of suitable storage sites in international waters and economic restrictions will mean that the majority of projects will take place where there is existing infrastructure and the geology is known.

Many will find transferring pollution from one source to another to be morally abhorrent.

Therefore, even though CCS in geological marine formations could attract criticism, there are imperative reasons for such projects to go ahead. It is debatable whether a two-thirds majority will support amending the Protocol when Parties meet in November 2006. If the vote goes against those pushing for CCS, then it is very likely it will be back on the agenda for amendment in 2007. If CO_2 storage does receive the two-thirds majority go-ahead in November 2006, then it is also feasible that the London Convention and other regional agreements might also be amended.

Although the international acceptance of CCS is gathering pace, there will still be a number of challenges even if marine laws are changed to expressly allow it. Firstly, the international community still has to determine how CO_2 in geological formations under the sea will fit in with Kyoto. Greater clarification and certainty is needed in relation to crediting and CDM inclusion. Secondly, there will also need to be regulatory frameworks at international and national levels covering capture, transport, and storage sites, as well as agreements in place on monitoring and liability. The EU has already stolen a march on this and has recently announced plans for a draft legislative proposal for an enabling CCS framework.[17]

CCS is arguably at the forefront of current climate change policy and thinking, and this is reflected in the unusual pace of international policy and legal developments. Interestingly, CCS reflects contemporary challenges in environmental law because it not only highlights the overriding importance of interdisciplinary cooperation, but it also requires competing environmental interests (*e.g.*, air and water) to find legal solutions and make concessions to achieve common goals. This poses real and compelling challenges for environmental lawyers, who have an increasing responsibility in helping determine difficult environmental choices.

Endnotes: The Legal Implications of Carbon Capture and Storage

[1] Lord Ronald Oxburgh, *Capturing the Moment*, Parliamentary Monitor, July 21, 2006.

[2] Intergovernmental Panel on Climate Change [IPCC], Working Group III, *Carbon Dioxide Capture and Storage* (2005); The International Energy Agency [IEA], *Legal Aspects of Storing CO_2* (Mar. 2005).

[3] IPCC website, http://www.ipcc.ch (last visited Sept. 18, 2006).

[4] IPCC, IPPC Third Assessment Report: Climate Change 2001 (2001), *available at* http://www.ipcc.ch/pub/online.htm (last visited Sept. 18, 2006).

[5] *See* Kyoto Protocol to the United Nations Framework Convention on Climate Change, annex 1, Dec. 10, 1997, 37 I.L. M 32.

[6] Table compiled in 2006 by Martin Hession of Defra, UK. (On file with the author).

[7] Oxburgh, *supra* note 1.

[8] House of Commons Science and Technology Committee, *Meeting UK Energy and Climate Needs: The Role of Carbon Capture and Storage*; First Report of Session 2005–06; Volume 1; HC 578-I; Stationary Office Ltd. (2006).

[9] United Nations Convention on the Law of the Sea art. 194, Dec. 10, 1982, 1833 U.N.T.S. 397.

[10] *E.g.*, Convention for the Protection of the Marine Environment of the North-East Atlantic, Sept. 22, 1992, 32 I.L.M. 1069.

[11] These numbers are current as of April 2006.

[12] R. Purdy, *Geological Carbon Dioxide Storage and the Law, in* Capturing Carbon: The Prospects for Carbon Dioxide Capture and Storage in the UK (C. Gough & S. Shackley eds., 2006).

[13] R. Purdy & R. Macrory, *Geological Carbon Sequestration: Critical Legal Issues* (Tyndall Centre for Climate Change Research Working Paper No. 45, 2004), *available at* http://www.tyndall.ac.uk/publications/working_papers/wp45.pdf (last visited Sept. 18, 2006).

[14] International Maritime Organization (IMO), *Provisional Agenda for the meeting of the CM Intersessional Legal and Related Issues Working Group on CO_2 Sequestration*, IMO, LC/CM-CO2 1/1, Jan. 26 2006.

[15] IMO, *Provisional Agenda for the meeting of the SG Intersessional Technical Working Group on CO_2 Sequestration*, IMO, LC/SG-CO2 1/1, Jan. 30, 2006.

[16] IMO, *CO_2 Sequestration in sub-seabed formations: Consideration of Proposals to Amend Annex I to the London Protocol*, LP 1/6, Apr. 28, 2006.

[17] European Commission 2006/s102-108792, *Contract: Technical Support for an Enabling Policy Framework for Carbon Capture and Geological Storage* (2006).