

Legal and Regulatory Aspects of Carbon Capture and Storage: A Developed and Developing Country Perspective

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Abstract

Carbon Capture and Storage (CCS) is a relatively new technology designed for the long-term isolation of fossil fuel carbon dioxide (CO₂) emissions which would otherwise enter the atmosphere. This is achieved by capturing CO₂ generated from industrial and other activities and storing it deep in the subsurface of the earth. The objective of CCS is to prevent anthropogenically generated CO₂ emissions from driving further human-induced climate change. Depending on geological circumstances, the storage sites can be terrestrial or off-shore. The development of CCS-related activities worldwide has highlighted the need to have in place a satisfactory legal and regulatory regime in international, regional and national laws in anticipation of CCS becoming mainstream. This article identifies and outlines some of these issues against the backdrop of the international law climate change regime, and examines legal and regulatory developments at the regional level and in some domestic law jurisdictions.

A. Introduction

1. General Background

Carbon capture and storage (CCS) is a technology designed to prevent anthropogenic carbon dioxide (CO₂) emissions generated by industrial activities from entering the atmosphere and exacerbating climate change: a typical example would be the burning of coal and gas to generate electricity. CCS seeks to achieve this objective either by stripping CO₂, a major greenhouse gas, from the smokestack of conventional power stations, or by burning the fuel in special ways to produce exhausts of pure CO₂. The greenhouse gas is then transported and buried underground in selected sites. These sites

can be, but are not necessarily, exhausted oil and gas reservoirs depending on the circumstances of the country concerned. More succinctly, CCS has been described as “the long-term isolation of fossil fuel CO₂ emissions from the atmosphere through capturing and storing the CO₂ deep in the subsurface of the Earth”.¹

The CCS process is made up of three key stages: first is the capture of carbon, which entails the confinement and separation of CO₂ from the other gases produced when fossil fuels are burnt for power generation or when CO₂ is produced in other industrial processes; second is the transport phase where, once separated, the CO₂ is compressed and transported to a suitable site for geologic storage; thirdly comes storage, where CO₂ is injected into deep underground rock formations at the storage site, often at depths of a kilometre or more.²

Many economies around the world have initiated carbon capture and storage programmes, and the identification of storage sites for CO₂. These countries include the United States, Canada, China, member states of the European Union, Australia and South Africa.³ Geological characteristics determine the suitability of storage sites: such sites may be terrestrial or off-shore. In South Africa’s case, the bulk of potential storage sites is off-shore, but plans are underway to construct a terrestrial CCS plant for demonstration purposes.⁴

Marston and Moore make the point that, while interest in CCS is relatively new, the activity of underground injection and effective storage of large quantities of CO₂ is not.⁵ They state that in the United States the oil and gas industry has been transporting CO₂ by pipeline for injection, not for climate change mitigation-related reasons, but rather for the more expedient motive to recover oil from used gas wells. This technique, known as enhanced oil recovery (EOR), or enhanced gas recovery (EGR), has been used for well-nigh 40 years, at least in the USA, according to these authors.⁶ As a result, the authors argue that it is not necessary to develop a regulatory regime for

1 Global CCS Institute (2012:9).

2 (ibid.).

3 South Africa has undertaken a geological study to identify suitable storage sites, see Cloete (2010).

4 For a comprehensive report on CCS in South Africa, see Glazewski et al. (2012).

5 Marston & Moore (2008).

6 (ibid.:423). A composite term for Enhanced Oil Recovery (EOR) and Enhanced Gas Recovery (EGR) is Enhanced Hydrocarbon Oil Recovery (EHR).

CCS *de novo*; but rather to adapt the existing EOR regulatory regime for CCS purposes.⁷ This is the case at least in those jurisdictions where EOR has been taking place for a long period of time.

Be that as it may, CCS is a relatively new technology, particularly in those countries where oil and gas exploration and exploitation have not been taking place. In the process of developing this new technology a number of diverse legal and regulatory issues have emerged in both international and domestic law regimes. For example, the question whether off-shore CCS constitutes “dumping” as regulated under the international law of the sea; while others concern domestic law, for example whether the “storage” of CO₂ is not, in law, the “disposal” of waste under relevant national waste disposal law. There are also questions around ownership of the pore space into which the CO₂ is injected. An all-encompassing issue is the question of liability for damage should there be leakage of the CO₂ and resultant harm to the environment or human health. All of these, and other legal issues, are touched on below.

Furthermore, CCS-related activities raise some novel mining-related and environmental law issues – that is, issues which have not been encountered before. This is mainly because mining entails the extraction of a natural (usually solid) resource from the ground, while CCS entails injecting or inserting a possibly harmful substance into the ground. The nature of the substance injected is also novel in that it does not fall neatly into one of the conventional categories of “solid”, “liquid” or “gas”, but is “supercritical” in form, according to scientists; thus raising new questions around whether it is “waste”, as discussed in the next section.⁸ Thus, while mining law is linked to CCS-related activities, it is not directly applicable to it.

This article thus outlines and examines some of the main, emerging legal and regulatory issues from the perspective of South Africa as a developing country, as it is classified in the United Nations Framework Convention on Climate Change (UNFCCC) regime. South Africa is also a member of the BRICS group of nations (Brazil, Russia, India, China and South Africa) and a leading player on the African continent in the thrust to mitigate and adapt to global climate change.

7 Marston & Moore (2008:425).

8 As discussed below it is unlikely that this would be regarded as a “hazardous waste” as defined in the South African National Environmental Management: Waste Act 59 of 2008 discussed below.

Finally, by way of introduction, the International Energy Agency (IEA) estimates that, to achieve the greenhouse gas emission reduction target of limiting a global average temperature rise to no more than 2°C, energy-related emissions must reduce very substantially. Large-scale investments in several technologies are required in order to meet this target, with carbon capture and storage (CCS) contributing 7 Gt of the required 42 Gt emission reduction in a least-cost scenario. If CCS were to be excluded as a technology option in the electricity sector, the IEA states that investment costs over the period to 2050 would increase by 40%. CCS is a vital component of a portfolio of low-carbon technologies, as it is able to reduce CO₂ emissions substantially from both the energy sector and other industries.⁹

II. International Law Background

1. Introduction

Article 4(2) of the UNFCCC titled *Commitments* provides, among other things, that:

The developed country Parties and other Parties included in Annex I commit themselves specifically as provided for in the following:

- (a) Each of these Parties shall adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs

As such, CCS falls squarely under the mitigation category to which only developed countries are by and large obliged to commit themselves. This is in line with the principle of common but differentiated responsibilities underlying the UNFCCC whereby “countries included in Annex 1” (developed country parties) and “countries not included in Annex 1” (developing country parties) have varied obligations, acknowledging that developed countries should bear a greater burden in the transition to lower carbon economies than developing countries.¹⁰

⁹ Global Carbon Capture and Storage Institute (2012).

¹⁰ This distinction lies at the heart of the seemingly intractable negotiations which have been going on for years and is, in this writer’s view, the reason why no effective climate change legal regime has been agreed on.

This distinction is maintained in the Kyoto Protocol, which elaborates on the UNFCCC by placing more specific obligations on developed countries and Countries with Economies In Transition (CEITs).¹¹ Parties to Annex 1 (developed countries) of the UNFCCC are obliged to reduce their overall emissions of six greenhouse gases “by at least 5% below 1990 levels” between 2008 and 2012 (the first commitment period),¹² while non-Annex 1 parties (developing countries) do not have to make any comparable cuts unless they choose to do so. However, it is foreseeable that non-Annex 1 parties not currently subject to emissions reductions commitments will in the future be obliged to include reduction commitments. This would include South Africa. As such, CCS is one of many options in the portfolio of mitigation actions for stabilisation of atmospheric greenhouse gas concentrations.

This is not to say that developing countries have no mitigatory obligations under the UN climate change regime. Among the obligations that developing countries have to adhere to are the so-called Nationally Appropriate Mitigation Actions (NAMAs), a term first used in the Bali Action Plan as part of the Bali Road Map agreed to at the United Nations Climate Change Conference of the Parties (COP13) in Bali in December 2007. NAMAs refer to a set of policies and actions that countries undertake as part of a commitment to reduce greenhouse gas emissions, and recognises that different countries may take different nationally appropriate actions on the basis of equity and in accordance with common but differentiated responsibilities and respective capabilities. This notion also emphasises that developed countries should provide financial assistance to developing countries to reduce emissions.

Two terms relevant to CCS in the UNFCCC are “emissions”, which means “the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time”; and “sink”, which means “any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere”. A question arises as to which of these two categories CCS activities falls into. The general consensus appears to be that CCS falls into the former and that leakage from the CCS chain would amount to an “emission” under the system.¹³

11 Adopted at the third COP in Kyoto, Japan in 1997.

12 IISD (1997).

13 Bugge (2011:125).

2. *The Clean Development Mechanism and CCS*

Importantly, the Kyoto Protocol established three so-called “flexible mechanisms” which Annex 1 parties may utilise in complying with part of their greenhouse gas emissions reduction commitments, namely emissions trading; “joint implementation” (JI) and a “clean development mechanism” (CDM). The latter, defined in Article 12(2) of the Kyoto Protocol,¹⁴ is relevant here as it is the only flexible mechanism, which facilitates joint emissions reduction projects between Annex 1 (developed) countries and non-Annex 1 (developing) countries.

Under the CDM, developed country parties may implement “project activities” in developing country parties, which must result in “real, measurable and long-term benefits related to the mitigation of climate change”¹⁵; but emission reductions must be additional to those that would otherwise have occurred.¹⁶ Such emission reductions are referred to as “certified emission reductions” or “carbon credits” and they may be used by developed countries (which implement project activities in developing countries) to assist them in meeting their emission reduction targets.¹⁷ According to Article 12(5) of the Kyoto Protocol, the basic principles of CDM are: (a) voluntary participation approved by each party involved; (b) real measurable and long-term benefits related to the mitigation of climate change; (c) emission reductions that are additional to any that would occur in the absence of certified project activity. The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) has elaborated on these by developing a set of Modalities and Procedures for a Clean Development Mechanism.¹⁸ The crucial question whether CCS qualifies as a CDM project giving the opportunity for developed countries to gain certified emission reductions or carbon credits is discussed in B II below.¹⁹

14 According to Article 12(2) “... the purpose of the clean development mechanism shall be to assist Parties not included in Annex 1 in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments...”.

15 Article 12(5)(b).

16 Article 12(5)(c).

17 Article 12(3)(b).

18 Decision 3/CMP.1 (FCCC/KP/CMP/2005/8/Add.1).

19 Haines et al. (2005:1552).

III. The South African Context

South Africa is in the top 15 most energy-intensive economies in the world and emits over 400 million tonnes of CO₂ every year.²⁰ The country is ranked as the 13th largest CO₂ emitter in the world,²¹ while on a *per capita* basis it is in the top six.²² As indicated, in II.1 above carbon capture and storage falls squarely into the category of NAMA and is directly applicable to South Africa, which is the largest emitter in Africa.²³

In this vein, prior to the opening of the Fifteenth Conference of the Parties to the United Nations Framework Convention on Climate Change (COP15), held in Copenhagen, Denmark, in December 2009, South Africa's President Jacob Zuma pledged that the country would voluntarily seek to reduce its greenhouse gas emissions by 34%, below a business-as-usual emissions growth trajectory by 2020, and by 42% by 2025, provided that South Africa receives financial and technological support from developed countries.²⁴ This level of emissions reductions was developed in line with South Africa's cabinet-approved Long Term Mitigation Scenarios (LTMS). This indicated that carbon capture and storage would play a significant role in meeting the reduction targets of South Africa.

20 See generally Du Toit (2009).

21 Beck et al. (2011).

22 South Africa produced 346.84 million metric tonnes of CO₂ (Mt CO₂) from fuel combustion alone during 2010. International Energy Agency (2012:56). See also Republic of South Africa (2011).

23 South Africa's total greenhouse gas emissions in 1990 was 347,346 Gg CO₂e and 379,842 Gg CO₂e for 1994, see Republic of South Africa (2000:v).

24 The actual volume of emissions reductions represented by this voluntary pledge is uncertain, although the Integrated Resource Plan for Electricity 2010-2030 (IRP 2010) assumes a greenhouse gas emissions constraint of 275 million tonnes of CO₂e in 2024. A concerted attempt to bring some level certainty to the pledge is contained in a report entitled *South Africa's Carbon Chasm* (KPMG 2011). The report uses emissions data captured for the 2010 Carbon Disclosure Report from the top one hundred companies listed on the Johannesburg Stock Exchange, taken against the best available approximation of the country's 2020 absolute greenhouse gas emissions, namely a 34% deviation below the so-called "Growth Without Constraints" scenario in South Africa's Long Term Mitigation Scenarios. The result, concludes the report, is a "chasm" between business-as-usual greenhouse emissions and the 2020 voluntary pledge, i.e., 34% deviation below a business as usual emissions growth trajectory, of some 253 million tonnes of carbon dioxide equivalent (CO₂e).

In this light it must be pointed out that the main driver for CCS in South Africa is the fact that the country has abundant reserves of both high- and low-grade coal.²⁵ Coal has driven South Africa's energy economy in the past, and is likely to do so in the immediate foreseeable future, the government having embarked relatively recently on the development of two large-scale coal power plants. During 2009, 65.9% of electricity production came from coal.²⁶ In addition South Africa has a buoyant coal-to-gas conversion industry, which meets approximately 30% of its domestic transportation fuel-oil demand needs. The economy has thus always been, and will be in the future, highly reliant on coal.

B. International Law Issues

I. The Dumping of Wastes and Other Matter at Sea

In certain countries, including South Africa,²⁷ the optimal sites for carrying out CCS-related activities is off-shore. An international law issue is the question whether CCS falls into the international legal regime regulating the dumping of waste or other matter at sea. Three conventions are relevant here: the 1982 United Nations Convention on Law of the Sea (UNCLOS), a framework treaty which includes marine pollution provisions in Part XII; the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, as well as its anticipated successor, the 1996 Protocol which is slow in being adopted; and thirdly, the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR or Paris Convention). The latter is not dealt with here as it is a regional convention and of only indirect interest to developing countries.

Article 210 of UNCLOS provides that states shall adopt laws and regulations and other measures to reduce and control pollution of the marine environment by "dumping", defined as: "the deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea."²⁸

25 South Africa is ranked in top six countries in terms of hard coal production; total output in 2009 was 247 million tonnes, see Eberhard (2011).

26 Cloete (2010); see also International Energy Agency (2011:27).

27 This is according to the *Atlas on Geological Storage*, Cloete (2010).

28 Article 1(5) of UNCLOS.

It is accordingly arguable that CO₂ storage does not fall under these UNCLOS provisions, as CO₂ for injection into the ocean floor is transported and injected through pipelines and would not therefore fall under the above-quoted definition which refers to vessels, aircraft, platforms or other man-made structures at sea. On the other hand “man-made structures at sea” could be regarded as falling under the definition. Be that as it may, the drafters of the convention in all probability did not anticipate CCS being carried out at sea, so the issue has been left to be determined by further instruments and deliberations as set out below.

The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention) and the 1996 Protocol are specifically dedicated to the dumping at sea issue. The 1972 London Convention defines “dumping” as “any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea...”.²⁹ As such, the definition excludes the disposal of waste from the normal operation of ships and aircraft. This activity is covered by the MARPOL Convention. The pertinent question here is whether the “storage” of carbon in supercritical form off-shore constitutes “dumping” as defined in the Convention. The “sea” is defined in the convention as “...all marine waters other than the internal waters of State”.³⁰ It is not clear, however, from this definition whether “all marine waters” includes the subsoil or seabed formations into which the CO₂ is injected for purposes of CCS. At face value it would appear that CO₂ storage would fall outside the ambit of the original London Convention.

Central to the operation of the London Convention are three annexes referred to in Article 4. The first annex consists of the so-called “black list” substances, the dumping of which is prohibited altogether.³¹ The second annex,³² known as “the grey list”, prescribes less harmful substances which may be dumped, but are subject to authorisation by issue of a special prior permit by the national authority of a contracting party.³³ The third annex outlines general criteria that states have to take into account when issuing permits for dumping.³⁴ Both Annex 1 and 2 were originally silent on the

29 Article 3(1).

30 Article 1(3).

31 Article 4(1)(a).

32 Armeni (2011:146).

33 Article 4(1)(b).

34 Article 4(1)(c).

question of CO₂ storage. For this reason and others mentioned above, it is suggested that CCS falls outside the scope of the original Convention. This view concurs with Armeni, who points out that, as CO₂ is not expressly included among the substances prohibited for dumping, it appears that offshore storage is permitted under the Convention. However, she goes on to indicate that in 1996 industrial waste, or specifically “waste materials generated by manufacturing or processing operations”, was added to the list of substances prohibited by Annex 1, thus reviving the issue and suggesting that the disposal of CO₂ at sea for CCS purposes is prohibited.³⁵ The issue has to some extent been superseded by further developments.

Leading authorities have pointed out that the 1972 London Convention is a ‘living’ convention which is constantly being adapted to meet changing environmental needs and circumstances and that it is generally considered a success.³⁶ As such, the more environmentally friendly 1996 Protocol to the London Convention 1996 was adopted during November 1996, and entered into force a decade later in March 2006. It will replace the London Convention.³⁷

The Protocol to the 1996 London Convention (the 1996 Protocol) represents a major change of approach to the question of how to regulate the use of the sea as a repository for waste materials, in that it adopts the reverse listing approach. Instead of prohibiting substances as per the black and grey lists outlined above, the 1996 Protocol details substances which are permitted to be dumped only on authority of a permit. In this regard, Article 4 states that the parties “shall prohibit the dumping of any wastes or other matter with the exception of those listed in Annexure 1”. Those permitted include 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, inorganic geological material; and (significantly in the current context) “CO₂ streams from CO₂ capture processes”.³⁸

35 Armeni (2011:147) points out however that there may well be an exception when “dumping” is carried out as part of EOR related operation.

36 Birnie et al. (2009:472) point out that the dumping of industrial waste has decreased from 17 million tons in 1979 to 6 million tons in 1987.

37 See generally www.imo.org, last accessed 11 March 2013.

38 Item 8 added under amendments adopted in 2006 which entered into force in 2007.

In this writers view the injection of CO₂ for purposes of CCS does not fall under the original London Convention and thus no permit requirements are necessary, either under it or the 1996 Protocol.³⁹

II. CCS Projects and the Clean Development Mechanism (CDM) under the Kyoto Protocol

A key question touched on in section A II 2 above is whether CCS projects qualify as being “clean development mechanisms” (CDM) for the purpose of generating certified emission reductions for developed countries. As seen in that section, the CDM one of three “flexible mechanisms” established under the Kyoto Protocol and is the only flexible mechanism which can benefit developing countries, as it facilitates joint emissions reduction projects between Annex 1 (developed) countries and non-Annex 1 (developing) countries. The purpose of CDM as stated in the Kyoto Protocol is:⁴⁰

...to assist Parties not included in Annex 1 in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments

The crucial question is whether CCS qualifies as a CDM project giving the opportunity for developed countries to gain certified emission reductions or carbon credits.⁴¹ The CDM Executive Board refused to approve early CCS projects which were submitted to it in the mid-2000s on the ground that the submitted methodologies did not address the methodological and accounting issues in an appropriate way.⁴² Subsequently the issue of integrating CCS with CDM then went through a lengthy and protracted negotiation process at the various CMPs of the Kyoto Protocol commencing at Bali in 2007, through to Poznan in 2008, and Copenhagen in 2009.

39 This presumes that the “sea” as defined in the London Convention does not include the subsoil as outlined above.

40 Article 12(2).

41 Haines et al. (2005:1552).

42 See for example CDM Executive Board Recommendation on CO₂ Capture and Storage as CDM Project Activities based on the Review of Case NM0167 (The White Tiger Oil Field Carbon Capture and Storage Project in Vietnam), EB Meeting Report Annex 13, September 2006.

Eventually at the Seventh Conference of the Parties serving as the Meeting of the Parties under the Kyoto Protocol (CMP7),⁴³ held in Durban during December 2011, it was decided that CCS will be included within the CDM, but the mechanics thereof would still have to be ironed out.⁴⁴ This is subject to the proviso that CCS projects result in “real, measurable and long-term benefits related to the mitigation of climate change”,⁴⁵ achieve emission reductions that are additional to those that would otherwise have occurred,⁴⁶ and assist in enabling their host countries to achieve sustainable development. If so, such projects have the potential to earn certified emission reductions or carbon credits under the CDM.

Financial consideration no doubt played a part as it is suggested that inclusion of CCS within CDM will result in large-scale funding opportunities. The 2009 IEA Technology Roadmap: Carbon Capture and Storage suggests that 65% of projects in 2050 (approximately 3,400 projects) will have to occur in developing countries, thus it is critical that CCS be successfully deployed in non-Annex I countries. Large-scale funding through various markets will be needed. Currently the CDM is the only large-scale CO₂ market-based funding mechanism operating in developing countries. The Durban decision thus provides an important first step towards an incentive mechanism that will assist in financing, regulating and supporting CCS projects in non-Annex I countries.

At COP17 in Durban the rules of including CCS in the clean development mechanism (CDM) were adopted, paving the way for developing countries to access alternative project finance and so potentially enhancing their ability to contribute to reducing global greenhouse gas emissions.⁴⁷ The other CCS-related matters that were negotiated at these climate change negotiations included the transboundary movement of CO₂ and the establishment of a

43 COP17/CMP7.

44 Decision 7/CMP.6 on Carbon Dioxide Capture and Storage in Geological Formations as Clean Development Mechanism Project Activities (FCCC/KP/CMP/2010/12/Add.2).

45 Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998) 37 ILM 22, Article 12(5)(b). Decision 10/CMP.7 is entitled: *Modalities and Procedures for Carbon Dioxide Capture and Storage in Geological Formations as Clean Development Mechanism Project Activities*.

46 Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998), Article 12(5)(c).

47 See <http://www.globalccsinstitute.com/institute/media-centre/media-releases/carbon-capture-and-storage-ccs-accepted-un-based-carbon>, last accessed 11 March 2013.

Global Reserve of Certified Emission Reduction Units (CERs) under the CDM. This momentum continued in Doha at COP18 held in December 2012, where, among other things, CCS advocates sought to consolidate the gains made at Durban and iron out CDM technical details, while acknowledging the need to gain more on the ground experience with CCS.⁴⁸

C. Regional European Union Law Dimension

During 2009 the European Parliament and Council enacted the Directive on the Geological Storage of Carbon Dioxide.⁴⁹ It arguably provides a model legal and regulatory framework for other countries, including developing countries, to adopt and adapt for their own needs and domestic circumstances. In the words of Article 1(1): “This Directive establishes a legal framework for the environmentally safe geological storage of carbon dioxide (CO₂) to contribute to the fight against climate change”. It goes on to provide that “the purpose of environmentally safe geological storage of CO₂ is permanent containment of CO₂ 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.”⁵⁰ The stated scope of the Directive is such that it encompasses not only terrestrial storage of CO₂, but storage in member states’ exclusive economic zones and on their continental shelves within the parameters of UNCLOS.⁵¹

The Directive comprises over 40 articles and provides a regulatory regime for the selection of storage sites and exploration permits (Chapter 2, Articles 4 and 5), storage permits (Chapter 3, Articles 6 to 11), and operation, closure and post-closure obligations (Chapter 4, Articles 12 to 20). The latter chapter includes an article titled *Financial Security*, which obliges member states “... to ensure that all obligations arising under the permit issued pursuant to this Directive, including closure and post-closure requirements ... can be met.”⁵²

48 See <http://ghgnews.com/index.cfm/in-doha-ccs-advocates-look-to-iron-out-cdm-technical-details/>, last accessed 11 March 2013.

49 Directive 2009/31/EC on the geological storage of CO₂ [2009] OJ L140/114.

50 Article 1(2).

51 Article 2. See generally Doppelhammer (2011).

52 Article 19(1).

D. Some Key Legal Issues

I. Ownership of Pore Space

In the context of CCS, “pore space” is the space into which the CO₂ is injected and exists within geological formations identified for CO₂ storage purposes, usually for the long-term. While this space might be fairly large, e.g. instances where depleted natural gas reservoirs are used for CCS, there is also the possibility that the space is microscopic, e.g. the spaces existing within porous rock, or that the space is not completely empty prior to the injection, e.g. where the injection is into the pore space provided by an underground saline aquifer.

A two-fold question arises: who owns the pore space itself and who owns the CO₂ once it is injected. These two questions need to be differentiated and are relevant to the question of liability discussed below. Various other considerations flow from this differentiation. For example, the likelihood exists that the owner of the pore space and the owner of the CO₂ will need to conclude a rental agreement for the utilisation of the pore space for CCS. Such a rental agreement will in all likelihood assign, to either of the parties, those responsibilities that usually follow ownership and/or control of land, but which can be modified by contract, in particular the vital question of liability for damage that might be caused by activities undertaken on land.

The question of ownership of pore space is a matter of national law and may differ from jurisdiction to jurisdiction; in the case of the USA, for example, land law differ from state to state. In addition, the law may also differentiate between onshore and offshore sites as a different legal regime invariably applies below, as opposed to above, the high watermark.

In South Africa, the question first has to be considered from the perspective of the Roman Dutch common law, as well as statute law, particularly concerning minerals legislation, although we are not dealing with minerals law directly. In this regard, the ancient Roman Law principle of *cuis est solum* (whoever owns the soil, owns the air above and soil below the surface) is relevant. This principle was reiterated in South African law in *London and SA Exploration Co v Rouliot* (1891) 8 SC 75,⁵³ and more recently was confirmed by the Supreme Court of Appeal, in *Anglo Operation Ltd v Sandhurst Estates (Pty) Ltd and Others* (2006) SCA 146 (RSA), in which it was held

53 *London and SA Exploration Co v Rouliot* (1891) 8 SC 75, at 83.

that the “the owner of the land not only owns the surface of the land but everything below and above it”.⁵⁴ Thus the owner of the surface of the land located above the pore space not only owns the surface of the land, but everything below it, including the subsurface pore space in the absence of legislative and/or contractual provisions to the contrary. It follows that once the CO₂ has been injected into the pore space it will no longer continue in the ownership of the owner of the liquid CO₂, but ownership will be subsumed to the owner of the surface under the common law principle of *accessio* or accession.

However, in the United States context, Marston and Moore point out that while pore space similarly is owned by the surface owner, the issue becomes nuanced in some important aspects if one examines the question in the context of oil and gas activities. These authors point out that the incidental CO₂ storage in EOR operations involves injecting an extraneous substance (CO₂) into the reservoir, whereas natural gas storage involves injecting only more natural gas into the reservoir.⁵⁵ The important implication of this difference, according to these authors, is that the surface owner only owns the *available* pore space that is not occupied by natural oil and that a significant portion of the pore space in an EOR project will in fact not be available at the end of an EOR project because of the presence of that residual oil which may be potentially recoverable.⁵⁶

II. Long-term Liability

An important issue regarding underground storage of CO₂ in the context of CCS is the risk of damage as a result of unwanted events after the closure of the site and resultant questions of liability. Elizabeth Wilson et al. describe two scenarios which may occur, namely surface leakage due to abandoned aquifer wells and groundwater quality impacts from metals mobilisation.⁵⁷

54 *Anglo Operation Ltd v Sandhurst Estates (Pty) Ltd and Others* (2006) SCA 146 (RSA), at 16.

55 Marston & Moore (2008:475).

56 (*ibid.*:476).

57 Wilson et al. (2007:5946).

These authors point out that establishing causal linkages of damage from carbon storage in court may prove difficult as could attribution and partition of damage between multiple actors injecting into the same reservoir.⁵⁸

The primary responsible person on whom liability will initially fall is the “operator”, defined in the EU CCS Directive, as outlined in C above, as meaning “any natural or legal, private or public person who operates or controls the storage site or to whom decisive economic power over the technical functioning of the storage site has been delegated according to national legislation”.⁵⁹ According to the model provided in the EU Directive, it is the potential operator who applies for an exploration permit for the selection of a storage and once successful, obtains a storage permit.⁶⁰ And it is the operator who has to comply with conditions imposed during the operation, closure and post-closure phases of CCS. The EU model is useful and may be applied beyond the EU countries which have adopted CCS technologies as outlined in Section E below.

The question of potential long-term liability is however particularly contentious in that environmental damage that may occur many decades after the injection of the CO₂. However particularly contentious is the question of potential long-term liability, by which time the operator may no longer exist as a legal entity. The EU CCS Directive addresses this issue in Article 18, titled *Transfer of Responsibility*, by providing that where a storage site has been closed “... all legal obligations relating to monitoring and corrective measures pursuant to the requirements laid down in this Directive ... shall be transferred to the competent authority ...”.⁶¹ However, four conditions have to be met, namely that all available evidence indicates that the stored CO₂ will be completely and permanently contained; that a minimum period, recommended as 20 years, has elapsed; that certain financial obligations in the form of financial security to take account of assessed risk of leakage and estimated cost of obligations arising under the permit have been fulfilled; and, lastly, that the site has been sealed and injection facilities have been removed.

58 (ibid.:5948).

59 Article 3(10).

60 Articles 5 and 6.

61 Article 18(1).

III. The Definition of Waste

A particular novel question which has arisen at both regional (EU) level as well as in national jurisdictions is whether the liquid (or supercritical carbon, as it is also known) which is deposited indeed amounts to either “waste” or “hazardous waste” for purposes of domestic regulatory regimes governing waste. In the regional EU context, the Waste Framework Directive⁶² lays down general rules that apply to all categories of waste, defined as any substance or object in the categories set out in Annex 1 “which the holder discards or intends or is required to discard”. Included in Annex 1 is the item “residues of industrial processes,” while Annex 2 goes on to define waste “disposal” to include any of the operations listed in that Annex and includes depositing into land, deep injection procedures, and release into the seas and oceans. Thus one can only conclude that CO₂ captured for the purposes of underground storage must be regarded as waste. As such, all the substantive obligations of the Waste Framework Directive must be complied with in the case of geological storage of CO₂. However, the EU Framework Directive on waste was amended to specifically exclude CO₂ captured and transported for the purposes of geological storage.⁶³

While this may be the situation in the EU, the position is likely to be different in other jurisdictions. The position in South Africa as regards this issue is taken up in Section E below.

E. Domestic Law Aspects

I. EU Member States

A number of countries within the EU have adopted the EU CCS Directive and domestic legislation in this regard, for example the Netherlands.⁶⁴ It has been pointed out, however, that the national approach in EU member states has not been entirely uniform in that some member states have introduced separate legal frameworks requiring a dedicated storage licence to develop a subsoil storage facility, while other member states regard a gas storage facility as part of the production licence and thus rely on the petroleum leg-

62 2006/12/EC of 5 April 2006.

63 Doppelhammer (2011:99).

64 A good model is the Netherlands, see Roggenkamp & Woerdmann (2009).

isolation.⁶⁵ The Norwegian Petroleum Act is an example of the latter, although Norway is not a member of the EU. Be that as it may, legal regimes impose licensing requirements in the Netherlands (Mining Act), France (Mining Act), Italy (Law 170/74, as amended) and Spain (Mining Act).

II. Australia

Outside the EU member states, Australia is arguably one of the more advanced countries to have developed a regulatory regime for CCS operations.⁶⁶ More specifically the Australian Commonwealth government has published a draft set of regulatory principles for CO₂ “geo-sequestration”, while the state of Western Australia has promulgated dedicated regulations under the Barrow Island Act of 2003. In addition to these domestic CCS regulatory frameworks, the Australian government has demonstrated a commitment to CCS by volunteering to host the Global CCS Institute and committing AUS\$100 million annually for five years to fund this Institute.⁶⁷ This is as a result of a mandate which it has obtained from the Group of Eight (G8) countries to facilitate and drive the global uptake of CCS.

III. Canada

The province of Alberta in Canada has most potential for CCS-related projects. A survey undertaken by the Interstate Oil and Gas Compact Commission during the mid-2000s on regulatory issues presented by CCS concluded that the existing regulatory regimes for EOR provide a sufficiently robust regulatory regime to provide short-term assurance of regulatory storage and that the relevant laws could be applied to CCS storage projects.⁶⁸ Bachu has undertaken a review of the Canadian provincial and federal legislation and regulations and confirms that the existing legal and regulatory Canadian regime is reasonably sufficient, with some modifications, to ac-

65 Roggenkamp (2009:218).

66 Zakkour & Haines (2007:98).

67 Gibbs (2011).

68 Zakkour & Haines (2007:98).

commodate the active injection phase of CO₂ capture and storage (CCS) operations.⁶⁹

IV. South Africa

1. CCS and the Waste Question

South Africa has not yet embarked on a comprehensive CCS programme, but is planning to have a demonstration project in place by 2017. As such, it is only commencing a review of its legal regulatory regime.⁷⁰ However, the novel legal question raised in Section D III above, namely whether CCS amounts to waste disposal for the purposes of domestic law, is outlined here in the South African context, as the same issue no doubt arises in other jurisdictions.

The South African National Environmental Management: Integrated Waste Act 59 of 2008 (the Waste Act) defines “waste” as:⁷¹

any substance, whether or not that substance can be reduced, re-used, recycled and recovered –

- (a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of;
- (b) which the generator has no further use of for the purposes of production;
- (c) that must be treated or disposed of; or
- (d) that is identified as a waste by the Minister...

and includes waste generated from the mining, medical or other sector, but:

- (i) A by-product is not considered waste; and
- (ii) Any portion of waste, once re-used, recycled or recovered, ceases to be waste.

From a reading of (a) to (c) above it seems clear that “supercritical carbon dioxide” falls into the definition of “waste”. The implication of this is that the proponent will have to comply with the licensing provisions of the Waste Act, which include requirements for the storage and handling of waste, especially hazardous waste. These are more onerous than the requirements for the handling of substances or products including by-products used in industrial processes.

69 Bachu (2008).

70 See generally Glazewski et al. (2012).

71 Section 1.

However, the question which then arises is whether the supercritical carbon amounts to a “by-product” because, if it does, it will be excluded from the definition of “waste”. The term by-product is defined in the Waste Act as “a substance that is produced as part of a process that is primarily intended to produce another substance or product and that has the characteristics of an equivalent virgin product or material”.⁷² Again in the South African context the further, and related, question is whether the supercritical carbon injected into the storage space amounts to “hazardous waste”. The Waste Act defines “hazardous waste” very widely, namely:⁷³

any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment

It appears that supercritical carbon is likely to fall into this broad definition. These requirements will have to be carried out by the “holder of waste”. The latter term is defined as: “... any person who imports, generates, stores, accumulates, transports, processes, treats, or exports waste or disposes of waste”.

While this may be the situation in South Africa, the position may be very different in other jurisdictions. Thus, the EU Framework Directive on waste was amended specifically to exclude CO₂ captured and transported for the purposes of geological storage.⁷⁴

2. CCS and Carbon Tax

Finally, the issue of the imposition of a carbon tax is arguably a relevant potential driver for CCS in any jurisdiction, including South Africa. The South African National Treasury published a discussion paper in December 2010 titled *Reducing Greenhouse Gas Emissions: The Carbon Tax Option*,⁷⁵. This discussion paper sets out the background to climate change, including its projected impacts on South Africa, as well as the contribution of South Africa to global climate change in terms of its greenhouse gas emission levels.⁷⁶ It emphasises that climate change is a result of environ-

72 See section 1.

73 Section 1, the National Environmental Management: Waste Act 59 of 2008.

74 Doppelhammer (2011:99).

75 Republic of South Africa (2010).

76 (ibid.:11-19).

mental costs not being included in market prices; and highlights the role that government can play by intervening and controlling pollution through the imposition of policy instruments, such as command and control regulations and market-based instruments.⁷⁷

The discussion paper endorses the approach taken in the *Long-Term Mitigation Scenarios* document, namely to put a lower initial price on carbon, and increase it gradually over time.⁷⁸ The result will be to “provide a strong price signal to both producers and consumers to change their behaviour over the medium to long term”.⁷⁹ The environment-related taxes and tax incentives that have thus far been introduced in South Africa are set out, and the discussion paper considers the policy documents and other literature that have been published regarding market-based instruments.⁸⁰ The paper also endorses the imposition of a carbon tax at levels starting around R75 per ton of CO₂, and increasing to around R200 per ton of CO₂.⁸¹ It is expected that a second discussion paper will be published during 2013.⁸²

F. Conclusion

The point of departure of this survey has been that CCS is a significant means of getting both Annex 1 and non-Annex 1 parties of the climate change regime to comply with their respective obligations under the UNFCCC and Kyoto Protocol. From a legal perspective what remains is to put in place an effective legal and regulatory regime at domestic level and in particular to deal with the challenge of providing for a long-term liability regime. A survey of regional and national developments reveals that a start has been made in a number of jurisdictions on a carbon capture and storage regulatory regime.

77 (ibid.:21).

78 (ibid.:17, see also 26).

79 (ibid.:29).

80 (ibid.:52–55).

81 (ibid.:55).

82 Lazenby (2012).

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