

**A critical evaluation of the environmental law framework applicable
to Carbon Capture and Storage in South Africa**

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by

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List of abbreviations

| | |
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| AGSSA | Atlas on Geological Storage of Carbon Dioxide in South Africa |
| CCS | Carbon Capture and Sequestration |
| CDM | Clean Development Mechanism |
| CER | Certified Emission Reduction |
| COP | Conference of the Parties |
| DEA | Department of Environmental Affairs |
| DOE | Designated Operational Entity |
| DWA | Department of Water Affairs |
| EIA | Environmental Impact Assessment |
| EOR | Enhanced oil recovery |
| EU | European Union |
| GHGs | Greenhouse Gases |
| IEA | International Energy Agency |
| IPCC | International Panel on Climate Change |
| MOP | Meeting of the Parties |
| MPRDA | Mineral and Petroleum Resources Development Act 28 of 2002 |
| NEM:AQA | National Environmental Management: Air Quality Act 39 of 2004 |
| <i>NEM:ICMA</i> | National Environmental Management: Integrated Coastal Management Act 24 of 2008 |
| NEM:WA | National Environmental Management: Waste Act 59 of 2008 |
| NEMA | National Environmental Management Act 107 of 1998 |
| NETL | National Energy Technology Laboratory (US) |
| NWA | National Water Act 36 of 1998 |
| OED | Oxford English Dictionary |
| OSH | Occupational Health and Safety Act |
| OSPAR FRAM | OSPAR Guidelines for Risk Assessment and Management of Storage of CO ₂ Streams in Geological Formations |
| OSPAR | Convention for the Protection of the Marine Environment of the North-East Atlantic |
| RECIEL | Review of European Community & International Environmental Law |

| | |
|--------|---|
| SANEDI | South African National Energy Development Institute |
| SBSTA | Subsidiary Body for Scientific and Technical Advice |
| SPLUM | Spatial Planning and Land Use Management Act 16 of 2013 |
| SRCCS | Special Report on Carbon Dioxide Capture and Storage |
| UN | United Nations |
| UNFCCC | United Nations Framework Convention on Climate Change |
| US DOE | United States Department of Energy |
| WPNCCR | White Paper on the National Climate Change Response |

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Abstract

The objective of this study is to conduct a critical evaluation of the environmental law framework applicable to carbon capture and storage (hereafter CCS) in South Africa. The discussion begins by confirming that CCS has a place in environmental law as a mitigation measure. The inclusion of CCS in the clean development mechanism could incentivise the development of environmental law frameworks for CCS in South Africa. Implementation of CCS is gradual, with only eight large scale integrated CCS projects having been established around the world. An appreciation of key scientific concepts is helpful for an understanding of the CCS process.

The CCS project life cycle and related impacts on the environment provide a context for discussion of the legal requirements accompanying the CCS life cycle. The *Constitution of the Republic of South Africa*, 1996 and the *National Environmental Management Act* 107 of 1998 constitute appropriate framework legislation for CCS. Decision 3/CMP.1, *Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol* adopted by the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol held at Montreal from 28 November to 10 December 2001 March 2006 provides international legal requirements accompanying the project life cycle against which the South African legal framework is examined. Some provisions of additional South African laws and policies will be applicable to CCS depending on the nature of the specific CCS project, but specific regulations may have to be developed for South Africa. Policy documents have been gradually bringing clarity to the way forward in arriving at a legal framework for CCS, and by reference to existing local legislation and international guidance, an environmental law framework for CCS can be developed for South Africa.

Keywords: Environmental law, global warming, carbon dioxide, mitigation and carbon capture and storage.

Opsomming

Die doel van hierdie studie is om 'n kritiese evaluasie van die omgewingsregtelike raamwerk wat op "koolstofvang en stoor" (hierna CCS) in Suid-Afrika van toepassing is. Dit is bevestig dat CCS 'n plek as 'n mitigasie maatreël in omgewingsreg het. Die insluiting van CCS in die skoon ontwikkelingsmeganisme mag die ontwikkeling van 'n Suid-Afrikaanse omgewingsreg raamwerk aanspoor. Implementering van CCS is geleidelik, met net agt grootskaal geïntegreerde CCS projekte wêreldwyd gestig. 'n Verstaan en begrip van belangrike konsepte is noodsaaklik vir 'n begrip van die CCS proses.

Die CCS projek lewenssiklus en aanverwante impakte op die omgewing voorsien konteks vir die bespreking van regsvereistes wat die CCS lewenssiklus vergesel. Die *Grondwet van die Republiek van Suid-Afrika*, 1996 en die *Wet op Nasionale Omgewingsbestuur* 107 van 1998 dien as toepaslike raamwerk wetgewing vir CCS. Die sogenaamde "*Beslissing 3/CMP.1, modaliteite en prosedures vir 'n skoon ontwikkelingsmeganisme soos omskryf in artikel 12 van die Kyoto-protokol deur die konferensie van die partye wat dien as die vergadering van die partye tot die Kyoto-protokol gehou by Montreal vanaf 28 November tot 10 Desember 2001 Maart 2006*" lê internasionale vereistes neer vir die projek lewenssiklus waarteen die Suid-Afrikaanse regsraamwerk ondersoek word in hierdie studie. Van die bepalinge van Suid-Afrikaanse wetgewing sal van toepassing wees op CCS afhangende van die aard van die spesifieke CCS projek, maar spesifieke regulasies sal moontlik ontwikkel moet word vir Suid-Afrika om by 'n volledige omgewingsreg raamwerk vir CCS uittekom. Beleidsdokumente het geleidelik helderheid begin verleen aan die pad vorentoe, en met verwysing na huidige nasionale wetgewing en internasionale leiding, kan 'n Suid-Afrikaanse omgewingsreg raamwerk vir CCS ontwikkel word.

Sleutelwoorde: Omgewingsreg, klimaatsverwarming, mitigasie en "koolstofvang en stoor".

1 Introduction

A South African definition of climate change may be appropriate to contextualise any analysis of the local response thereto. According to the *White Paper on the National Climate Change Response*¹ (hereafter WPNCCR), climate change is "an on-going trend of changes in the earth's general weather conditions as a result of an average rise in the temperature of the earth's surface often referred to as global warming".² This temperature increase is widely understood to be caused by gases called "greenhouse gases" (hereafter GHG's) which intensify a natural phenomenon called the "greenhouse effect" by forming an insulating layer in the atmosphere that reduces the amount of the sun's heat that radiates back into space and therefore has the effect of warming the earth.³

Environmental law is a rapidly evolving field and includes the emerging subject of climate change law and governance.⁴ Within the climate change law and governance fraternity, it is widely agreed that combating climate change requires both mitigative measures and adaptation to its effects.⁵ Mitigation in this instance refers to efforts to reduce or prevent emission of greenhouse gases.⁶

Adaptation is "the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities".⁷ It is considered that mitigation and adaptation are not substitutable or alternative forms of response to climate change, but together form a portfolio of responses to

1 GN 757 in GG 34695 of 20 October 2011 White Paper on the National Climate Change Response Department of Environmental Affairs (WPNCCR).

2 GN 757 in GG 34695 of 20 October 2011 8

3 GN 757 in GG 34695 of 20 October 2011 8; Department of Environmental Affairs October 2011; Global CCS Institute *Global status of CCS update* June 2012 5; Metz *et al IPCC Special Report on Carbon Dioxide Capture and Storage* (hereafter SRCCS) 3.

4 UN General Assembly *United Nations Framework Convention on Climate Change* resolution adopted by the General Assembly 20 January 1994, A/RES/48/189 Art 3; Scott 2012 *RECIEL* 220.

5 Shalizi and Lecocq 2009 *World Bank Research Observer* 295.

6 UNEP Climate Change Mitigation 1, EPA Air Pollution Impacts from Carbon Capture and Storage 5 EPA 17 November 2011.

7 Field *et al* 2012 http://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf 556.

climate change, with CCS being regarded as a bridging technology towards mitigation.⁸ Several mechanisms have already been designed internationally and at the national level to mitigate and/or adapt to climate change. One of these mechanisms is carbon capture and storage (hereafter CCS) which falls within the portfolio of mitigation options.⁹ CCS is not intended to replace other mitigation options, although it is feared that it might do so, partly due to the support it enjoys from the fossil fuel industry.¹⁰

The OED defines CCS as "the process of trapping carbon dioxide produced by burning fossil fuels or other chemical or biological process and storing it in such a way that it is unable to affect the atmosphere". A further description of CCS is "CCS involves capturing of CO₂ from the flue gasses in thermal power plants, transport of CO₂ via pipelines or other means (ship, train, truck) and injection of the CO₂ in a suitable storage site."¹¹ The second description is somewhat limited in scope as it does not refer to sources other than flue gasses. The first definition does not, for example, mention transport, which can also take place by pipeline. For purposes of this dissertation CCS is understood to be a method of preventing CO₂ from entering the atmosphere by capturing it and transporting it to a location where it can be buried underground with a degree of permanence.

The Clean Development Mechanism (hereafter CDM) is one of the flexibility mechanisms established under the Kyoto Protocol.¹² Under the CDM developed countries can conduct projects to reduce emissions in developing countries to earn certified emission reduction (hereafter CER) credits for themselves.¹³ These

8 Directive 2009/31/ of the European Parliament and of the Council on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC (hereafter Directive 2009/31/EC); Shalizi and Lecocq 2009 *World Bank Research Observer* 299;

9 Metz *et al* IPCC SRCCS 22.

10 Doelle and Lukaweski 2012 *Climate Law* 49.

11 Tot 2011
http://siteresources.worldbank.org/INTENERGY2/Resources/CCS_in_Balkan_and_Southern_African_power_systems.pdf.

12 UNFCC *Kyoto Protocol to the United Nations Framework Convention on Climate Change* 16 February 2005. UN Doc FCCC/CP/1997/7/Add.1, Dec. 10, 1997; 37 ILM 22 (1998)

13 UNFCC <http://cdm.unfccc.int/about/index.html>.

saleable credits can be used by industrialised countries to meet a part of their emission reduction targets under the Kyoto Protocol.¹⁴

Under Decision 10/CMP.7 of the United Nations Framework Convention on Climate Change (hereafter UNFCCC), the modalities and procedures for CCS were adopted as a CDM project activity.¹⁵ This was a significant step in garnering interest in CCS and sets out a detailed project life cycle for the inclusion of CCS as a CDM activity.¹⁶ As is explained below, this project life cycle and the accompanying requirements will be employed as a benchmark in this study for purposes of analysing the CCS-related suitability of South African law.

Decision 10/CMP.7 further sets out the requirements for CCS as a CDM activity.¹⁷ Annex A1(a) of Decision 10/CMP.7 defines CCS as "the capture and storage of carbon dioxide from anthropogenic sources of emissions, and the injection of the captured carbon dioxide into an underground geological storage site for long-term isolation from the atmosphere".¹⁸ A geological storage site consists of a permeable and porous formation into which CO₂ can be injected, covered by a layer of cap rock which is impermeable and has low porosity to prevent migration and leakage of the CO₂.¹⁹ Regarding GHG's emissions, according to the Intergovernmental Panel on Climate Change (hereafter IPCC)"the only technology available to mitigate GHG's emissions from large-scale fossil fuel usage is CCS".²⁰

In addition, the International Energy Agency (hereafter IEA) Energy Technology Perspectives BLUE Map scenario, which assessed strategies for reducing

14 UNFCC <http://cdm.unfccc.int/about/index.html>.

15 UNFCC Conference of the Parties Serving as the Meeting of the Parties 2010 Decision 10/CMP.7 Modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities (FCCC/KP/CMP/2011/10/Add.2) 10 (hereafter Decision 10/CMP.7).

16 Shackley and Dütschke 2012 *Energy and Environment* 209.

17 Decision 10/CMP.7 13.

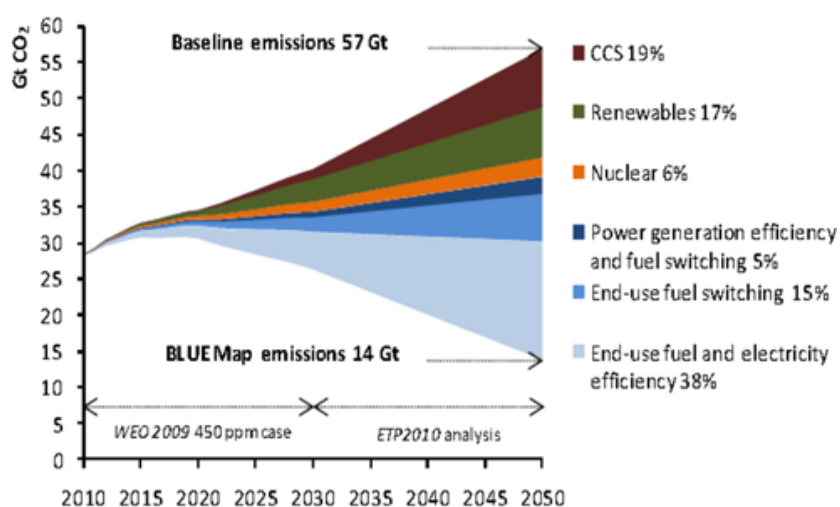
18 Decision 10/CMP.7 14.

19 Benson and Cole *CO₂ Sequestration in Deep Sedimentary Formations* October 2008 http://www.geo.arizona.edu/~reiners/geos195K/CO2Sequestration_Benson_ELEMENTS.pdf; Younger 2011 *Mine Water and the Environment* 133.

20 IEA CCS 1
<http://www.iea.org/publications/freepublications/publication/name,39359,en.html>

greenhouse gas emissions by half in 2050, concluded that CCS will need to contribute nineteen per cent of the necessary emissions reductions in 2050 to achieve atmospheric stabilisation in the most cost-effective manner.²¹ The key technologies required to reduce CO₂ emissions globally are reflected in the IEA *Blue Map Scenario*²² as illustrated by Figure 1.

Figure 1 Key technologies for reducing global CO₂ emissions²³



According to the IEA, the development of practical incentive policies for the deployment of CCS is the critical issue in the short term.²⁴ Methods for the deployment of CCS can be constructed by using policies for renewable energy as models.²⁵

21 IEA <http://www.iea.org/publications/freepublications/publication/name,39359,en.html>
 22 Remme *IEA BLUE Map Scenario* 16 November 2011 5.
 23 Adopted from Remme U *IEA BLUE Map Scenario* 16 November 2011 3.
 24 IEA *CCS is a necessity for a world hooked on fossil fuels* 1 January 2013.
 25 IEA *CCS is a necessity for a world hooked on fossil fuels* 1 January 2013.

In Europe, guidance documents have been formulated to enable governments to implement CCS in a consistent fashion.²⁶ This can provide guidance to South Africa in adopting an approach consistent with international norms and standards.

The implementation of CCS technology internationally has been gradual. A recent survey by the Global CCS Institute identified that there are currently eight large scale integrated CCS projects underway around the world.²⁷ These focus on gas processing, synthetic fuels and fertiliser production which are technically less demanding and more cost effective than CCS in the power sector.²⁸ The inclination of industry to use CCS where there may be ancillary benefits is illustrated for example in the use of CO₂ for enhanced oil recovery (hereafter EOR) at six out of the eight large scale CCS projects currently active.²⁹

Decision 10/CMP.7 adopted the modalities and procedures for CO₂ CCS in geological formations as a CDM project activity for the first time.³⁰ As already indicated, the CDM allows projects for reducing emissions in developing countries to earn CER credits, which are each equivalent to one tonne of CO₂.³¹ This inclusion makes CCS available to developed countries as a mechanism to generate CERs to assist them in reaching their emissions reduction targets using low cost mechanisms.³² In principle, developing countries benefit from improved investment flows and from those investments being used for sustainable development objectives.³³ For example, a CDM project for the installation of solar water heaters, ceiling insulation, and energy efficiency lighting has been put in place in Cape Town, benefitting residents and earning CER credits.³⁴

26 EC 2011
http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf.

27 Global CCS Institute 2013 <http://www.globalccsinstitute.com/publications/global-status-ccs-update-january-2013>.

28 Watson (ed) *Carbon capture storage: realising the potential?* 7.

29 IEA <http://www.globalccsinstitute.com/projects/12561>.

30 UNFCC Decision 10; Doelle and Lukaweski 2012 *Climate Law* 49.

31 UNFCC *About CDM* <http://cdm.unfccc.int/about/index.html>.

32 Green Tech Malaysia <http://cdm.greentechmalaysia.my/faq/faq27.aspx>.

33 Green Tech Malaysia <http://cdm.greentechmalaysia.my/faq/faq27.aspx>.

34 UNFCC CDM project co-benefits in Cape Town, South Africa
http://cdm.unfccc.int/about/ccb/CDM_Cobenefits_Kuyasa_SouthAfrica.pdf.

CCS may be seen as a bridging technology in that it is not expected to lead to a reduction in renewable energy development or in the increase in the use of fossil fuels.³⁵ This is reflected in Directive 2009/31/EC which states that CCS technology should not incentivise the proliferation of fossil fuelled power plants.³⁶ It goes on to say that CCS "should not lead to a reduction of efforts to support energy saving policies, renewable energy and other safe and sustainable low carbon technologies, both in research and financial terms".³⁷ This issue raises a number of ethical issues which some elements of civil society have taken up. For example, large scale implementation of CCS does not cure the world of its addiction to fossil fuels. On the contrary, CCS ostensibly permits fossil fuel business as usual, which might simply delay the problem of how to shift from a fossil fuel economy to a renewable economy.³⁸ The danger is that the delay might mean that a future shift away from fossil fuel will be more costly than if this step were taken earlier. Ideally, CCS should be accompanied by renewable energy development.

It is necessary to determine whether a regulatory framework to manage risks and policies to enable technological investment is necessary for large scale deployment of CCS.³⁹ This follows from the fact that essential factors which could encourage or inhibit CCS deployment include regulatory, legal and public policy considerations.⁴⁰ It is necessary to explore whether a dedicated legal and regulatory regime is required to govern CCS in South Africa,⁴¹ and that a globally consistent, nationally coordinated system of governance and risk regulation for CCS needs to be developed by domestic law and policy makers.⁴²

Apart from the policy objectives and statements contained in the WPNCCR and other instruments mentioned below, it is necessary to examine whether South

35 Lang and Mutschler http://www.germanenergyblog.de/?page_id=3061.

36 Art 4 of Directive 2009/31/EC.

37 Art 4 of Directive 2009/31/EC.

38 Referred to as a perverse effect in Doelle and Lukaweski 2012 *Climate Law* 57.

39 Wilson and Pollak 2008 http://www.irgc.org/IMG/pdf/Policy_Brief_CCS.pdf.

40 Wilson and Pollak 2008 http://www.irgc.org/IMG/pdf/Policy_Brief_CCS.pdf.

41 Glazewski, Gilder and Swanepoel
http://aduserver2.uct.ac.za/ftp/Reagola/new_Monday%20afternoon/ccs_body.pdf 8.

42 Wilson and Pollak 2008 http://www.irgc.org/IMG/pdf/Policy_Brief_CCS.pdf.

Africa has climate change specific regulatory framework.⁴³ If South Africa wishes to participate in CCS for CDM it may however have to establish a legal and regulatory framework that provides for CCS.⁴⁴ This is supported by the fact that Decision 10/CMP.7 Annex F stipulates participation requirements for the hosting of CCS projects under CDM by developing countries (such as South Africa), which includes having laws to regulate CCS.⁴⁵

The Department of Environmental Affairs (hereafter DEA) is the lead agency in relation to the South African initiatives in response to climate change.⁴⁶ The South African Department of Energy has begun with the planning and development of a CCS regulatory framework or policy to allow for a more streamlined approach to the regulation of these projects.⁴⁷ In addition, the WPNCCR refers to CCS as a flagship programme in South Africa's efforts to combat climate change.⁴⁸ The WPNCCR however also stipulates the necessity to "undertake an audit of existing policy and legislation to ensure alignment with the objectives of the National Climate Change Response Policy and promote the integration of climate change resilience into all sectoral planning instruments".⁴⁹ This illustrates a desire to embed CCS into local laws and policy.

In light of the national ambitions and international requirements for CCS it seems useful to question the regulatory potential and compatibility of South Africa's existing legal framework in relation to CCS. It seems particularly necessary to look at the country's environmental law and policy framework and the extent to which it is suitable for the regulation of CCS. What is known at this early stage is that under the current environmental law framework in South Africa, each phase of a CCS project, namely capture, transport, injection and storage, is likely to require a suite of environmental legal authorisations from the various levels and

43 Cloete *Atlas on geological storage* 17.

44 Decision 10/CMP.7 16.

45 Decision 10/CMP.7 16.

46 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

47 De Ryhove(ed) 2012. <http://www.polity.org.za/article/ccs-regulation-in-south-africa-2012-05-04>.

48 GN 757 in GG 34695 of 20 October 2011.

49 GN 757 in GG 34695 of 20 October 2011 36.

line functionaries of government, thereby requiring effective cooperative governance.⁵⁰

The purpose of this research is to determine the extent to which the existing environmental law framework in South Africa adequately provides for the regulation of CCS. The question underpinning this analysis will be addressed by means of a desk-top study. Sources include local and international legal instruments, policy, case law, international decisions such as those of the UNFCCC and writings of local and international authors. The study will begin with an initial overview of concepts, the elements of the project life cycle and impacts relating to CCS. This will be followed by an analysis of international requirements and benchmarks for the domestic regulation of CCS together with an analysis of the current situation relating to the readiness of South African environmental law and policy for CCS. This will be followed by recommendations for law and policy reform in South Africa.

2 Concepts, the project life cycle and impacts of CCS

2.1 Introduction

The nature of CO₂ and the sources of capture, transport and storage thereof are essential concepts in CCS. An analysis of these concepts relevant to the life cycle of a CCS project is necessary to form an understanding of the technical and scientific basis of CCS. The unpacking of key concepts is similarly important for understanding the nature and scope of the legal requirements during the life of a CCS project to be discussed hereafter.

2.2 Concepts relating to CCS

International environmental dynamics have been structured to a large degree by scientific progress.⁵¹ Newly emerging technologies such as carbon capture and

50 De Ryhove (ed) 2012. <http://www.polity.org.za/article/ccs-regulation-in-south-africa-2012-05-04>.

storage need to be understood to determine where they might fit into the portfolio of options for tackling climate change, generally.⁵² The meaning of the concepts outlined below are relevant to an investigation of the regulation of CCS.

2.2.1 CO₂

Unadulterated CO₂ is a clear, odourless, and non-flammable substance which can be transported as a solid, liquid, gas, or dense-phase liquid.⁵³ In the form of a dense-phase liquid, CO₂ has the viscosity of a gas, but the density of a liquid.⁵⁴

2.2.2 CCS sources

Emissions sources with high CO₂ concentrations are fossil fuel based industrial sources including power generation, cement production, refineries, and the iron, steel, and petrochemical industries.⁵⁵

2.2.3 CCS capture

Capture of CO₂ is possible through pre-combustion capture, post-combustion capture or oxy fuel combustion systems.⁵⁶ Capture is the most expensive step in CCS.⁵⁷

2.2.3.1 Pre-combustion capture

In pre-combustion carbon capture, coal is gasified in a high-pressure, controlled-oxygen environment through the application of heat and steam.⁵⁸ The resulting

51 See Friedrich 2007 *Journal of International Law* 211.

52 Friedrich 2007 *Journal of International Law* 211.

53 Pipelines International
http://pipelinesinternational.com/news/transport_of_co2_for_carbon_capture_and_storage/040204/ 1.

54 Pipelines International
http://pipelinesinternational.com/news/transport_of_co2_for_carbon_capture_and_storage/040204/ 1.

55 Metz *et al* IPCC SRCCS 22.

56 Jepma and Hauck 2010 *International Review of Environmental and Resource Economics* 226; CCS Association <http://www.ccsassociation.org/faqs/ccs-capture/>.

57 Doelle and Lukaweski 2012 *Climate Law* 51.

gas consists primarily of hydrogen and carbon monoxide gases.⁵⁹ By processing the CO in a water-gas-shift reactor, the addition of water produces CO₂ and additional hydrogen gases.⁶⁰ The highly concentrated CO₂ can be separated and stored, while the hydrogen may be cleanly combusted or used in hydrogen fuel cells.⁶¹ Pre-combustion carbon capture technologies are extremely efficient compared to post-combustion flue gas because of the increased concentration of CO₂ in the pre-combustion gas. By using pre-combustion processes, CO₂ emissions may be reduced by between ninety per cent and ninety five per cent.⁶²

2.2.3.2 Post-combustion capture

In post-combustion capture, flue gases from a power station are cooled and passed through an absorbing solution containing ammonia or an amine that captures CO₂.⁶³ The clean flue gases (with more than eighty per cent of the CO₂ having been removed) are released into the atmosphere.⁶⁴ The CO₂ is then removed from the absorbing solution by steam, compressed and cooled to form a liquid, which can be stored underground.⁶⁵

2.2.4 Oxy-fuel combustion systems

The oxy-fuel combustion process involves burning fossil fuels in oxygen as opposed to air.⁶⁶ The resulting combustion products will have CO₂ content up to about ninety per cent which produces a more concentrated CO₂ stream for easier purification prior to compression and transport to safe underground storage.⁶⁷

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- 58 Jepma and Hauck 2010 *International Review of Environmental and Resource Economics* 226; National Mining Association <http://www.nma.org/ccs/carboncapture.asp>.
59 National Mining Association <http://www.nma.org/ccs/carboncapture.asp>.
60 National Mining Association <http://www.nma.org/ccs/carboncapture.asp>.
61 National Mining Association <http://www.nma.org/ccs/carboncapture.asp>.
62 National Mining Association <http://www.nma.org/ccs/carboncapture.asp>.
63 CISRO: Post combustion capture 14 October 2011 <http://www.csiro.au/science/Post-combustion-capture>.
64 CISRO: Post combustion capture 14 October 2011 <http://www.csiro.au/science/Post-combustion-capture>.
65 CISRO: Post combustion capture 14 October 2011 <http://www.csiro.au/science/Post-combustion-capture>.
66 CCS Association <http://www.ccsassociation.org/faqs/ccs-capture/>.
67 Jepma and Hauck 2010 *International Review of Environmental and Resource Economics* 226; CCS Association <http://www.ccsassociation.org/faqs/ccs-capture/>.

2.2.5 Carbon transport

CO₂ may be transported, for the purpose of storage in a solid, liquid or gaseous state, with liquefaction being the preferred state since in this state the gas will occupy less volume in the transportation process.⁶⁸ Transportation by pipeline has been used previously for enhanced oil recovery and transport by ship is also viable.⁶⁹

2.2.6 Carbon sequestration

Carbon sequestration refers to CO₂ being injected into deep underground rock formations, often at depths of one kilometre or more, where the temperature and pressure keep the CO₂ in a dense fluid phase.⁷⁰ Potential storage methods include injection into underground geological formations, injection deep into the ocean, or industrial fixation in inorganic carbonates.⁷¹ The most likely form of storage is the injection and stabilisation of large volumes of CO₂ in the subsurface in saline aquifers, existing hydrocarbon reservoirs or unmineable coal-seams.⁷²

Figure 2 below illustrates the sources of CO₂ being coal mining, biomass sources, oil and gas extraction and refineries for steel and cement as well as chemical plants and electricity generation.⁷³ Transport for storage and the options of onshore and offshore storage are illustrated.⁷⁴ Now that the concepts relating to CCS have been clarified, the CCS project life cycle will be discussed with reference to a risk management framework.⁷⁵

68 Metz *et al* IPCC SRCCS 22.

69 Doelle and Lukaweski 2012 *Climate Law* 52.

70 Global CCS Institute <http://www.globalccsinstitute.com/ccs/how-ccs-works>.

71 Metz *et al* IPCC SRCCS 19.

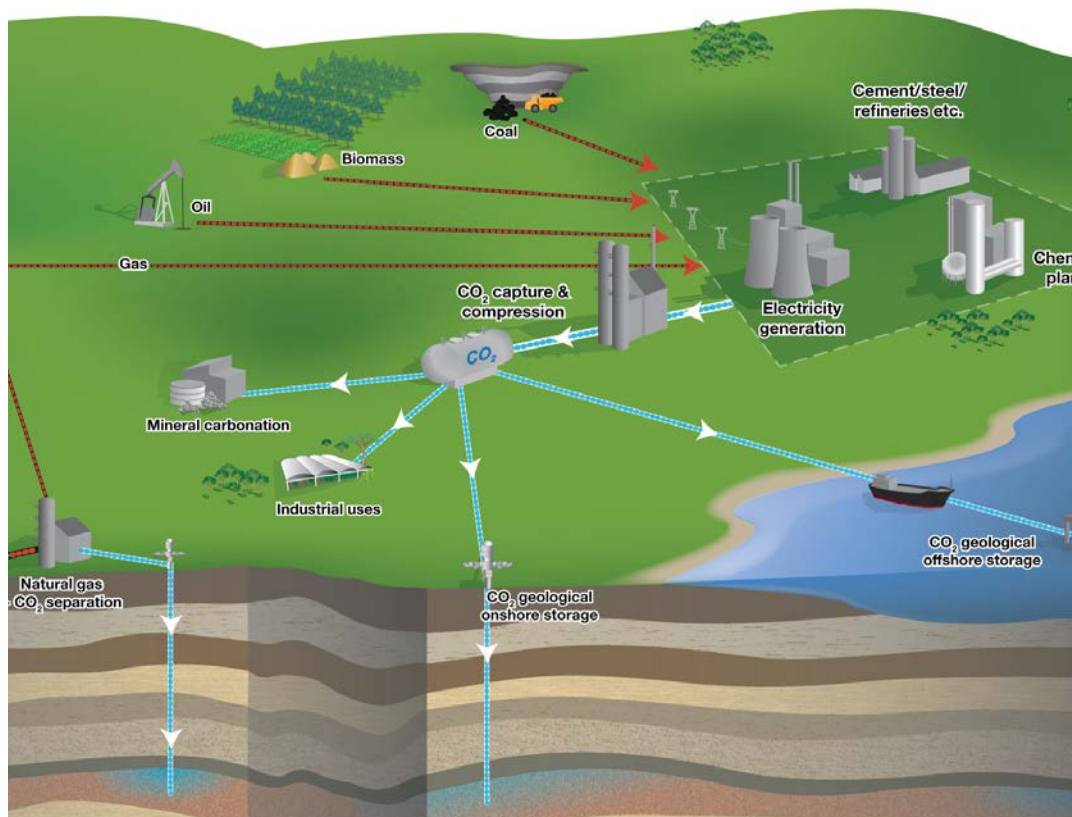
72 Jepma and Hauck 2010 *International Review of Environmental and Resource Economics* 228; Baines and Worden *Geological storage of carbon dioxide*.

73 EPA 2011 <http://www.eea.europa.eu/publications/carbon-capture-and-storage>.

74 EPA 2011 <http://www.eea.europa.eu/publications/carbon-capture-and-storage>.

75 EC 2011 8
http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf; Article 22 of Directive 2009/31/EC.

Figure 2 Schematic diagram of possible CCS systems⁷⁶



2.3 The CCS project life cycle

Directive 2009/31/EC⁷⁷ provides for the geological storage of CO₂ and is the world's first regulatory framework for CCS.⁷⁸ The European Union has also developed a guidance document for a CO₂ storage life cycle risk management framework pursuant to Directive 2009/31/EC.⁷⁹ The guidance document sets out measures to mitigate risk caused by CCS to the environment and human health.⁸⁰ The document is intended to facilitate the coherent and consistent

76 Examples of sources for which CCS technologies might be relevant, transport of CO₂ and storage options adopted from EPA 2011 <http://www.eea.europa.eu/publications/carbon-capture-and-storage>.
 77 Regulation (EC) No 1013/2006 23 April 2009.
 78 Shackley and Dütschke 2012 *Energy and Environment* 211.
 79 EC 2011
http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf.
 80 EC 2011
4
http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf.

implementation of Directive 2009/31/EC.⁸¹ The purpose of the guidance document is to address the life cycle of geological CO₂ storage activities including the phases of storage, regulatory milestones and principal activities.⁸² A risk management framework is used to achieve the objectives of Directive 2009/31/EC thereby facilitating the interaction between competent authorities and the operators of specific sites.⁸³ In this way risk management is used to ensure that risks to the environment and to human health are identified, mitigated and managed.⁸⁴

Studies of different national approaches to CCS can assist in the understanding and formulation of choices made by governments in practice.⁸⁵ It is for this reason that the steps towards consistency and uniformity in the European approach could be instructive for the formulation of a project life cycle for CCS in developing countries such as South Africa. European and other approaches have been considered in relation to South African projects such as the submission in relation to the Khanyisa coal fired power station where CCS is contemplated and guidance is relied on from the United Kingdom, European Union regulation and the Global CCS Institute.⁸⁶

An individual storage project could have a life cycle of between fifty and seventy years prior to transfer of responsibility from the person operating the CCS project to a State.⁸⁷ This entails the approval of transfer by the member state, the release of security to the operator and the state taking responsibility for the site. The CCS project life cycle typically comprises the following elements:

| | | | |
|----|---|-----------|---|
| 81 | EC | 2011 | 2 |
| | http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf . | | |
| 82 | EC | 2011 | 3 |
| | http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf . | | |
| 83 | EC | 2011 | 3 |
| | http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf . | | |
| 84 | EC | 2011 | 4 |
| | http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf . | | |
| 85 | Peeters 2010 <i>Electronic Journal of Comparative Law</i> 1-17. | | |
| 86 | Aurecon | 201223-24 | |
| | http://aurecon.webfoundryza.com/assets/files/khanyisa/eir/AURECON_FinalEIR_106468_Feb%202012_v4%20optim%20sml_Part4.pdf . | | |
| 87 | EC | 2011 | 3 |
| | http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf . | | |

- determining the requirements for a storage site and exploration requirements, culminating in obtaining an exploration permit;
- exploring potential sites to find a site with the required characteristics in terms of capacity and geological structure;
- detailed characterisation and assessment of the potential storage complex leading to the award of a storage permit;
- site development including detailed engineering design of the storage scheme including baseline monitoring;
- commissioning of the project and commencement of injection;
- start of operations on the site;
- closure upon cessation of injection and authorisation for closure;
- post closure monitoring prior to transfer;
- transfer of liability; and
- post transfer monitoring.⁸⁸

Following the project life cycle enables operators and authorities to gain security that their roles and responsibilities have been properly delineated in the CCS project.⁸⁹

2.4 CCS-related impacts on the environment

A life cycle approach, integrated to take account of the interplay of the various individual elements with each other, is necessary to assess the potential environmental impacts that CCS may have so that emissions taking place some distance from the place of capture can be taken into consideration.⁹⁰ This leads

88 EC 2011 8 http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf; Article 22 of Directive 2009/31/EC.

89 EC 2011 8 http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf; Article 22 of Directive 2009/31/EC.

90 EC 2011 9 http://ec.europa.eu/clima/policies/lowcarbon/ccs/implementation/docs/gd1_en.pdf.

to a consideration of the most significant potential impacts of CCS, namely seepage, the energy penalty, increased water demands and seismicity.

2.4.1 Seepage

The term "seepage" in relation to CCS means the movement of CO₂ from under the sea or land to the ocean or the atmosphere.⁹¹ The reason for considering seepage is the perceived risk to the deep underground storage of CO₂ caused by seepage from the place of storage with the attendant threats to the environment caused by the escape of CO₂ from storage.⁹²

2.4.2 Energy penalty

Another impact of CCS is that the capture of CO₂ requires energy, referred to as an "energy penalty" producing up to 40 per cent more CO₂ per unit of energy than would occur without CCS.⁹³ This energy penalty must be taken into account in cost and the equation used to determine the tolerable amount of leakage for storage to be viable.⁹⁴ Indirect emissions also arise from fuel preparation including the mining and transport of fuel, the treatment of solvent waste and solvent manufacture.⁹⁵ Third order emissions are also to be taken into account, including the manufacturing of infrastructure relating to the CCS project.⁹⁶

2.4.3 Water

Increasing consumption of water will be necessitated by a CCS project, particularly in relation to projects such as coal fired power stations combined with CCS.⁹⁷ The impact of the additional water use will need to be considered to ensure the availability of water for energy generation in the design phase of the

91 Par 1(g) of Appendix A to Decision 10/CMP.7.

92 Taylor 2012 <http://www.globalccsinstitute.com/insights/authors/derektaylor/2012/03/27/co2-leakage-how-important-it>.

93 Friedrich 2007 *Journal of International Law* 211.

94 Stone, Lowe and Shine 2009 *Energy and Environmental Science* 81.

95 EPA 2011 <http://www.eea.europa.eu/publications/carbon-capture-and-storage>.

96 EPA 2011 <http://www.eea.europa.eu/publications/carbon-capture-and-storage>.

97 Naughten, Darton and Fung 2012 *Energy and Environment* 265.

project, not only for security of electricity supply, but also as a result of environmental concerns, where limiting access to water might damage ecosystems.⁹⁸

2.4.4 Seismicity

The issue of seismicity – earthquakes caused by CCS, has also been raised as a CCS related risk or impact.⁹⁹ There has been recent debate over the allegation that earthquakes could be triggered by CCS, by analogy with seismicity occurring in sites where brine injection has taken place.¹⁰⁰ This has been rebutted by the view that seismicity need not necessarily result in rock fracturing and allowing leakage, but that it is quite probable that the rock will bend.¹⁰¹ It has been held that "the weight of evidence suggests that CCS technology is viable and that a combination of storage options will provide capacity for large volumes of captured CO₂".¹⁰² This furore emphasises the necessity for proper site selection, taking into account the risk of seismicity.

2.5 Concluding remarks

The discussion above has clarified the concepts of CO₂, sources for CCS and the three forms of capture being pre-combustion capture, post-combustion capture and oxy-fuel combustion systems. Technical aspects of capture and sequestration of CO₂ have been discussed. Risks and impacts are interconnected which makes an integrated approach to assessment invaluable. It is possible to conclude that the CCS process is based on sophisticated scientific concepts which require appreciation for consideration of a regulatory framework for CCS. An understanding of these technical and scientifically based aspects of CCS is

98 Naughten, Darton and Fung 2012 *Energy and Environment* 266.

99 Zoback and Gorelick 2012 *Proceedings of the National Academy of Sciences*.

100 Zoback and Gorelick 2012 *Proceedings of the National Academy of Sciences*.

101 Hill 2012 <http://www.catf.us/blogs/ahead/2012/06/20/seismic-risk-wont-threaten-the-viability-of-geologic-carbon-storage/>.

102 Hill 2012 <http://www.catf.us/blogs/ahead/2012/06/20/seismic-risk-wont-threaten-the-viability-of-geologic-carbon-storage/>.

further required for the discussion of the legal requirements for the CCS project life cycle discussed below.

3 The legal requirements accompanying the CCS project life cycle

3.1 Introduction

A legal and regulatory framework for CCS refers in a nutshell to laws and regulations in the context of which CCS can take place. A framework may be necessary in South Africa and elsewhere in the world for purposes of, *inter alia*, removing existing legal barriers and enabling environmentally safe CCS projects to be deployed.¹⁰³

Discussions towards the development of a CCS regulatory framework within a particular jurisdiction such as South Africa may benefit first of all from a review of existing laws and regulations and their applicability to CCS.¹⁰⁴ This includes an analysis of:

- the extent to which existing laws and policies can be modified to accommodate the CCS project life cycle;
- whether existing regulatory frameworks present barriers to CCS (such as groundwater legislation preventing injection into areas containing groundwater);
- unintended consequences as a result of interaction with existing laws and regulations; and
- gaps in current laws which fail to address aspects of the CCS chain.¹⁰⁵

International commitments made by states such as treaties or protocols on environmental protection also have to be taken into account, such as the impact of international treaties relating to marine conservation on sub-seabed CCS.¹⁰⁶

103 NETL 2010
http://www.netl.doe.gov/technologies/carbon_seq/refshelf/BPMSiteScreening.pdf7.

104 Beck and Garrett 2010 <http://www.energy.alberta.ca/CCS/pdfs/CCSrfaNAppD.pdf>22.

105 Beck and Garrett 2010 <http://www.energy.alberta.ca/CCS/pdfs/CCSrfaNAppD.pdf>22.

For purposes of the objective of this study, it is necessary to first discuss the South African legal framework under which CCS will take place. Thereafter, the project life cycle of CCS will be used to evaluate the CCS readiness of SA environmental law below.

According to section 2 of the *Constitution of the Republic of South Africa, 1996* (hereafter the Constitution), the Constitution is the supreme law in the Republic, and legislation or actions inconsistent with it is invalid. In terms of section 24 of the Constitution everyone has the right to "an environment that is not harmful to their health or well-being",¹⁰⁷ as well as to the intergenerational protection of the environment through reasonable legislative and other measures that prevent pollution and the environment being degraded, and ensuring development and use of natural resources that is ecologically sustainable while justifiable economic and social development is promoted.¹⁰⁸ It is arguable that this section provides the relevant foundation for the development and implementation of legislation specific to CCS as the initiation of CCS projects *inter alia* provide an environmental benefit from the abatement of CO₂.¹⁰⁹

The *National Environmental Management Act 107 of 1998* (hereafter NEMA) is the framework legislation for environmental law in South Africa.¹¹⁰ Section 28 of NEMA describes the consequences of pollution. It states that:

Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.

106 Beck and Garrett 2010 <http://www.energy.alberta.ca/CCS/pdfs/CCSrfaNAppD.pdf> 22.

107 S 24(a) of the Constitution.

108 S 24(b) of the Constitution.

109 Arendstein (ed) 2013 15 <http://www.sacccs.org.za/wp-content/uploads/2013/Quicklinks/01/Review%20of%20South%20African%20environmental%20regulatory%20requirements%20%20relevant%20to%20injection%20and%20storage%20of%20CO2%20for%20the%20Test%20Injection%20Project.pdf>.

110 Glazewski *Environmental law* 7-7.

It was originally held by the court in *Bareki v Gencor*¹¹¹ that section 28 of NEMA was not retrospective. This was determined on the basis that the obligations imposed by section 28 created a strict liability and perhaps even an absolute liability.¹¹² In light of this strict liability it was held that retrospectivity would be sufficiently unfair for the legislator not to have intended it.¹¹³ This section was then amended¹¹⁴ to apply retrospectively to situations where the pollution and apparent consequences thereof may be separated in time, as well as to changes in historical contamination.¹¹⁵ It is arguable that the application of section 28 of NEMA to a coal fired power station emitting CO₂ with the availability of CCS at hand could lead to an obligation to use CCS to mitigate those emissions.

An area in which NEMA lends itself to the advancement of the implementation of CCS is in the concept of the "best practicable environmental option", which encourages the implementation of options which cause the least damage to the environment as a whole over the long and short term and at an acceptable cost.¹¹⁶ This supports the view that if CCS can be the best practicable option for the environment in certain circumstances, that CCS implementation should be considered by decision-makers in, *inter alia*, government.

Sustainable development is the objective of NEMA.¹¹⁷ Under section 2 of NEMA, sustainable development requires the consideration in environmental development by organs of state that may affect the environment significantly of a number of factors, including:

- The avoidance, or minimisation and remedy of damage to biodiversity and ecosystems;¹¹⁸
- The avoidance, or minimisation and remedy of pollution and environmental degradation;¹¹⁹

111 2006 2 All SA 392 (T).

112 *Bareki v Gencor* 2006 2 All SA 392 (T) 200.

113 *Bareki v Gencor* 2006 2 All SA 392 (T) 402.

114 Sub-s (1A) inserted by s 12(a) of Act 14 of 2009.

115 S 28(2) of NEMA.

116 S 1 of NEMA.

117 S 2(3) of NEMA.

118 S 2(4)(a)(i) of NEMA.

- The avoidance, or minimisation, recycling and responsible disposal of waste;¹²⁰
- The responsible and equitable use and exploitation of non-renewable natural resources;¹²¹
- That the afore-mentioned use and exploitation do not jeopardise ecosystem integrity;¹²²
- The precautionary principle;¹²³
- The polluter pays principle;¹²⁴ and
- The principles of intra- and inter-generational equality.¹²⁵

Applying the above principles, CCS could be regarded as a remedial step in relation to maintaining biodiversity and ecosystems, for example in areas where there is coal mining or gas extraction. It would avoid and minimise environmental degradation by removing CO₂ from the equation of electricity generation. It would promote the responsible exploitation of coal and gas reserves. It would also need to take place in such a way that it did not jeopardise ecosystem integrity. If there were problems which arose in relation to the capture of CO₂ there would have to be a determination of apportionment of liability between those responsible for the creation and storage thereof, and the State. CCS would further have to take place in such a way that it will not impose burdens on future generations or transgress any of the NEMA principles.

3.2 *Project life cycle phases*

There are a number of international sources which discuss elements or the whole of the project life cycle for CCS but it is submitted that the most comprehensive benchmark is contained in Decision 10/CMP.7 which sets out requirements for

119 S 2(4)(a)(ii) of NEMA.
 120 S 2(4)(a)(iv) of NEMA.
 121 S 2(4)(a)(v) of NEMA.
 122 S2(4)(a)(vi) of NEMA.
 123 S2(4)(a)(vii) and (viii) of NEMA.
 124 S2(4)(o) of NEMA.
 125 S2(4)(p) of NEMA.

CCS under the CDM.¹²⁶ The requirements set out therein will be the benchmark for this evaluation of the environmental law framework applicable to CCS in South Africa.¹²⁷ Using this method will mean emphasis on the elements contained in Decision 10/CMP.7 at the expense of a more comprehensive discussion on CCS readiness and CO₂ transport. The requirement under Decision 10/CMP.7 will be described followed by consideration of implementation thereof in South Africa. These international requirements have however not yet been incorporated into local legislation as required before an international agreement becomes law in South Africa.¹²⁸ The essential elements of the CCS project life cycle will now be conceptually discussed, including elements of CCS that traverse the whole life cycle.

3.2.1 Selection and characterisation

For site selection and characterisation, what is required under CCS for CDM is that there must be no risk of seepage, no significant health or environmental risks and the site must comply with all of the laws and regulations of South Africa.¹²⁹

The consequence of seepage of CO₂ is that it presents risks to human health, including irreversible effects such as convulsions and coma, adverse effects such as headache, difficulty breathing and shortness of breath, increased blood pressure, tremors, and sweating.¹³⁰ Seepage could affect water causing lower pH, dissolved solids and increased mobilisation of metals, thereby affecting the environment.¹³¹ Seepage also may lead to a net reversal of storage, negating the objective of storage.¹³²

126 Decision 10/CMP.7 13.

127 Decision 10/CMP.7 23.

128 S 231(4) of the Constitution.

129 Decision 10/CMP.7 13; Directive 2009/31/EC has been criticised for requiring absolutely no seepage, widely regarded as impossible, say Shackley and Dütschke 2012 *Energy and Environment* 211.

130 Trabucchi *et al* Valuation of Potential Risks arising from a Model, Commercial Scale CCS Project Site 2-1 Industrial Economics Incorporated 2010.

131 Trabucchi *et al* Valuation of Potential Risks arising from a Model, Commercial Scale CCS Project Site 2-1 Industrial Economics Incorporated 2010.

132 Decision 10/CMP.7 15.

The concept of seepage is used in the *Mineral and Petroleum Resource Development Regulations* where the rules relating to the management of residual stockpiles relating to mining contemplate that it may be necessary to determine the potential rate and quality of seepage of water from the stockpile.¹³³ Under section 22(e) of the *National Water Act* 36 of 1998 (hereafter the NWA) seepage or runoff from water derived from a water source must be returned to that source. It would thus appear that seepage is a term currently used in South African law. This term has however not yet been contextualised in relation to CCS in South African law.

The second issue for consideration in site selection is that there must not be health or environmental risks associated with the selected site.¹³⁴ An analysis of the geology of the site through geological characterisation is necessary to determine whether the site bears health or environmental risks.¹³⁵ Internationally, protecting human health relates to occupational health and safety to prevent exposure of workers to the release of CO₂ as well as protecting human populations in the area of the site.¹³⁶ Safety legislation in South Africa is contained within the *Occupational Health and Safety Act* (hereafter OHS Act). In the long title to the OHS Act the health and safety of persons at work and using plant and machinery or connected therewith are catered for. The OHS Act may be considered relevant because it sets out general principles relevant to work in an industrial environment, for example setting out provisions relating to the treatment of employees.¹³⁷ Protection in relation to specific health risks linked to CCS is not embodied in current South African legislation.

The third aspect of site selection is an analysis of whether there are CCS related environmental risks. An example would be the risk of acidification of water

133 GNR 527 in GG No 26725 of 23 April 2004.

134 EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 3.

135 Global CCS Institute <http://www.globalccsinstitute.com/publications/global-knowledge-sharing-framework/online/89771>.

136 Beck and Garrett 2010 <http://www.energy.alberta.ca/CCS/pdfs/CCSrfaNoAppD.pdf> 39.

137 S 8 of the OHS Act.

resulting from seepage.¹³⁸ Determining whether this is dealt with under South African legislation must begin with an analysis of the scope of application of NEMA. The long title to NEMA states that it is applicable to "matters affecting the environment" and since CCS affects the environment¹³⁹ it would fall within this ambit. NEMA sets out a procedure for obtaining environmental authorisations designed to ensure that activities which have an impact on the environment are conducted in a methodical fashion.¹⁴⁰ In terms of NEMA, the definition of pollution includes substances emitted from any activity which has an adverse effect on the environment, human health or will have such an effect in future.¹⁴¹ By this definition, CO₂ emissions fall within the definition of pollution in terms of NEMA. As a consequence CCS activities would require authorisation to the extent that there was the possibility of CO₂ emissions from such activities.

A directly related requirement for site selection under Appendix B to Decision 10/CMP.7 is that there must be compliance with all laws and regulations of the host party.¹⁴² This means that the activity must be lawful in the host country. This may presuppose that the host country has laws and regulations which set provisions for site selection, characterisation and development as is required in CCS for CDM.¹⁴³

It is required under Appendix B to Decision 10/CMP.7 that the geological site must not be located in international waters.¹⁴⁴ This avoids the necessity to resolve conflicts with international treaties. These treaties include, for example, the IAEA *Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*,¹⁴⁵ the *International Atomic Energy Agency*

138 Beck and Garrett 2010 <http://www.energy.alberta.ca/CCS/pdfs/CCSrfNoAppD.pdf>45.

139 As discussed in par 2.4 above.

140 S 28 of NEMA.

141 S 1 of NEMA.

142 Decision 10/CMP.7 23.

143 Decision 10/CMP.7 16.

144 Decision 10/CMP.7 23.

145 IEA 29 December 1972

Risk Assessment and Management Framework,¹⁴⁶ and the Council of the EU Decision concerning the approval on behalf of the EU, of the Amendments of Annex II and Annex III to the Convention for the protection of the marine environment of the North Atlantic (the Oskar Convention) in relation to the storage of CO₂ streams in geological formations.¹⁴⁷

Since the geological site may not be situated in international waters, it is necessary to determine what constitutes internal waters under South African law. Section 2 of the *Maritime Zones Act* 15 of 1994 stipulates baselines, which subject to certain smoothing effects are set at the tidal low water mark.¹⁴⁸ According to section 1 of the *Merchant Shipping Act* 57 of 1951, the term nautical mile means a distance of 1 852 metres. The boundary of twelve nautical miles of internal waters amounts to 22.2 kilometres. This would be a consideration in determining available areas for CCS such as is reflected on the map in the Atlas on Geological Storage of Carbon Dioxide in South Africa (hereafter AGSSA).¹⁴⁹

Parallels under South African legislation to site selection in CCS for CDM are also found in the *National Environmental Management: Integrated Coastal Management Act* 24 of 2008 (hereafter NEM:ICMA). In terms of NEM:ICMA "waste" is a substance which is "surplus, unwanted, rejected, discarded, abandoned or disposed of".¹⁵⁰ Several of the characteristics of CO₂ for CCS fall into this category since CO₂ may be considered to be surplus and unwanted and the process of storage could conceivably be considered to constitute disposal. The definition of "waste" in NEM:ICMA contains further requirements that the generator thereof has no further use of that substance to reprocess, consume or produce something, which accords with the principles of CCS in which there is no current intention to use CO₂ for such a purpose. The final hurdle for qualification

146 adopted at the joint session of the 28th Consultative Meeting of Contracting Parties under the London Convention and the 1st Meeting of Contracting Parties under the London Protocol European Union 30 October to 3 November 2006.

147 Discussed by Friedrich 2007 *Journal of International Law* 211-216.

148 S 4 of the *Maritime Zones Act* 15 of 1995 states that these extend out to sea for twelve nautical miles and constitute the internal waters of South Africa, with the waters beyond those being international waters.

149 Cloete *Atlas on geological storage* 48.

150 S 1 of *NEM:ICMA*

as "waste" under the definition thereof in section 1 of NEM:ICMA is that there must be a possible detrimental effect on the environment from such deposition, which accords with the concerns around leakage in the case of CCS.

The definition of "dumping at sea" in section 1 of NEM:ICMA lists several alternative activities which can constitute "dumping at sea" including deliberate disposal of waste into the sea, and storage of waste or other material on the seabed or in the substrata below the sea bed. CCS contemplates storage in substrata below the sea bed which ties in with this definition.

Section 70(1)(e)(i) of NEM:ICMA prohibits dumping at sea of waste or other material without a dumping permit. Since CO₂ is inorganic and inert it falls within the list of items in section 71(3) in respect of which the Minister may grant a dumping permit. In terms of section 74(4)(b)(i) of NEM:ICMA the Minister cannot grant a permit for the dumping of that material if it is likely to cause irreversible or long-lasting effects which are not capable of satisfactory mitigation. The ability to mitigate the effects of CCS will have to be shown for a permit to be considered. Although an EIA is not required for a permit it is necessary under section 71(2)(c) of NEM:ICMA for the possible impact on the environment of the proposed activity to be considered before a permit may be issued. It appears from the above that it is theoretically possible for a permit to be issued under NEM:ICMA for CCS to take place at sea.

A further requirement in site selection and characterisation in CCS under CDM is that all available evidence indicates that storage will be permanent.¹⁵¹ The necessity for permanent storage is integral to the mitigation objective of CCS.¹⁵² Permanence is indicated by obtaining and analysing data and matching historical data with current data.¹⁵³ Internationally, there has been experience in permanent storage of CO₂ such as in the Sleipner West storage conducted by Statoil where

151 Decision 10/CMP.7 23.

152 Discussed in Chapter 1.

153 Decision 10/CMP.7 23.

more than one million tons of CO₂ has been stored annually since 1996.¹⁵⁴ Permanent underground storage has not yet been undertaken in South African legislation.

Characterisation of the storage site is also required as part of site selection and characterisation.¹⁵⁵ This involves steps which are specific to the geological formations under consideration to determine their viability as storage sites. The closest similar considerations under South African legislation includes references in mining to "geological plans, drawn to a legible scale, depicting geological features that could affect mining" contained in regulations to mining legislation.¹⁵⁶

Characterisation of the site involves assessing the structures which are known and inferred in the site to determine how they would influence the migration of the injected CO₂.¹⁵⁷ The term "site development" as used in the steps in characterisation under Appendix B to Decision 10/CMP.7¹⁵⁸ is used in South African legislation. It is contained in section 37 of the *Land Use Planning Ordinance* (hereafter LUPO) 15 of 1985. This stipulates that the council of a responsible municipality must receive and evaluate a site development plan for approval.¹⁵⁹ Section 12 of the *Spatial Planning and Land Use Management Act* 16 of 2013 (hereafter the SPLUM Act) provides that the national and provincial spheres of government as well as municipalities must develop coordinated frameworks for the development of land in South Africa. A CCS installation would need to form part of a uniform, effective and comprehensive spatial planning and land use management system in South Africa.¹⁶⁰ This illustrates that South African legislation is familiar with the concept of site development facilitating its acceptance as a concept in relation to CCS. Neither *LUPO* nor the *SPLM Act* traverses the particular requirements of CCS.

154 Statoil 1996
<http://www.statoil.com/en/TechnologyInnovation/NewEnergy/Co2Management/Pages/SleipnerVest.aspx>.

155 Decision 10/CMP.7 23.

156 GNR 93 in GG 34308 of 15 January 1997.

157 Decision 10/CMP.7 23.

158 Decision 10/CMP.7 24.

159 S 37(2) of the *Land Use Planning Ordinance* 15 of 1985.

160 S3(1) of the *Spatial Planning and Land Use Management Act* 16 of 2013.

Paragraph 5 of Appendix B to Decision 10/CMP.7 sets out specific data and information to be used for the process of characterisation.¹⁶¹ This concerns obtaining geological information relating to the rock and tectonics in the area where injection is contemplated.¹⁶² The practice of obtaining geological information is also acknowledged in South African environmental law. It is used to garner information in relation to disaster risk management¹⁶³ and in relation to mining where the *Mineral and Petroleum Resources Development Act* (hereafter MPRDA) refers to reconnaissance operations consisting of geological, geophysical and photogeological surveys including searches using remote sensing techniques to find minerals or petroleum.¹⁶⁴

Geophysical information includes information relating to the cap rock, faults, and regarding wells.¹⁶⁵ Geophysical magnetotelluric methods comprising deep imaging of magnetic fields to determine structure of rock has been applied in the analysis of areas viable for CCS.¹⁶⁶

The necessity for obtaining geomechanical information¹⁶⁷ is also found in other areas where excavation is occurring in South Africa, such as in tunnelling operations.¹⁶⁸ Although this concept may be familiar in South African law, it has not been incorporated in legislation applicable to CCS.

Rights to store are necessary in relation to site selection. A common law principle which could be applicable to the rights of land ownership and CCS states "*cuius est solum, eius est usque ad caelum et ad inferos*" which means that the owner of land also owns that which is above the land and below it.¹⁶⁹ If this maxim were to be applied independently to CCS it would mean that areas of migration of plumes

161 Decision 10/CMP.7 24.

162 Decision 10/CMP.7 24.

163 GN 654 in GG 23574 of 29 April 2005.

164 Definition of "reconnaissance operation" in s 1 of the MPRDA.

165 Decision 10/CMP.7 24; EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 15.

166 Khosa Quantifying South Africa's carbon storage potential using geophysics 1.

167 Par 5(c) of Appendix B to Decision 10/CMP.7.

168 *Compagnie Interafricaine de Travaux v South African Transport Services* 1991 2 All SA 155 (A).

169 *Rocher v Registrar of Deeds* 1911 TPD 311.

of gas in terrestrial sequestration would have to match land ownership in the land above such areas. Departure from this rule would be required as is the case in mining discussed below.

The common law principle of *accession* can also be considered in relation to CCS. In terms of this principle the owner of land might become the owner of CO₂ stored on the land, particularly if the CO₂ becomes mineralised and bonds with the rock which is owned by the landowner under the *cuius est solum* principle.¹⁷⁰ In South Africa this maxim has been affected by the MPRDA. Section 90 of the MPRDA effectively places mineral and petroleum resources under the control of the state, and effectively limits the rights of the landowner to the areas beneath their land. In terms of section 4(2) of the MPRDA, that act overrides the common law to the extent of a conflict. If CCS were to be terrestrially based, these rules under the MPRDA might be extended to apply to CCS.

The maxim, "*sic utere tuo ut alienum non laedas*" states that an owner of land must use and enjoy his land in such a way that his neighbour is not prejudiced.¹⁷¹ These principles would apply in the context of CCS storage on land. They would preclude an owner of land from allowing disturbance of a neighbour's land as a consequence of their use of land.¹⁷² The environmental clause as set out in section 25 of the Constitution extends the private common law neighbour law doctrine, expressed in the *sic utere tuo* maxim, into the public law realm.¹⁷³ A notional application of the maxim in relation to CCS can be envisaged if, for instance an owner of land experiences an outflow of CO₂ on their land as a result of a CCS project conducted by a neighbour, they would conceivably have grounds for action in terms of the law of neighbours.

170 Glazewski, Gilder and Swanepoel *Carbon Capture and Storage* 22.

171 *Regal v African Superslate* 1963 1 SA 102 (A) 106-107.

172 *Herschel v Mrupe* 1954 3 SA 489 (A).

173 Glazewski *Environmental law* 652.

3.2.2 Risk and safety assessment

The risk and safety assessment is the second element in the project life cycle in CCS for CDM.¹⁷⁴ Appendix B to Decision 10/CMP.7 paragraphs 6 to 9 set out what is required in relation to the assessment of risk and safety for CCS project activities.¹⁷⁵ Paragraph 6 of Appendix B to Decision 10/CMP.7 states that a comprehensive risk and safety assessment is needed to determine the integrity of the storage site and its impact on the environment and on people in the proposed storage area.¹⁷⁶ Corresponding South African legislation in relation to risk assessments is contained in the OHS Act. It is clear that this legislation is tailored to the specific circumstances contemplated by the OHS Act, which in section 7 deals with risk assessments by contractors working on specific sites. It deals with identification, analysis, documentation and review of risks which may seem sufficiently general to be extrapolated to CCS.¹⁷⁷ However when compared with the particularity contained in sections 7 and 8 of Appendix B to Decision 10/CMP.7, these factors are too vague to be of application to CCS. Those sections deal with particularities such as specific risks associated with containment failure and seepage.¹⁷⁸

The contamination of underground sources of drinking water is a factor to be taken into consideration in the risk and safety assessment.¹⁷⁹ Under the Constitution everyone has a right to access to sufficient water.¹⁸⁰ In terms of the preamble to the NWA water is a scarce resource deserving of protection. The desire for protection of water resources resonates with local legislation. A water use licence for which an EIA is required may conceivably be necessary for under section 40 of the NWA for CCS.

174 Decision 10/CMP.7 25.

175 Decision 10/CMP.7 25-26.

176 Decision 10/CMP.7 25; EC *Characterisation of the Storage Complex, CO2 Stream Composition, Monitoring and Corrective Measures* EC2011 33.

177 S 7(1) of the OHSAct.

178 Decision 10/CMP.7 24.

179 Decision 10/CMP.7 24.

180 S 27(1)(b) of the Constitution.

The scope of the risk and safety assessment set out in paragraph 8 of Appendix B to Decision 10/CMP.7¹⁸¹ is unique to CCS and encapsulates the following:

- Coverage of the entire CCS chain and the environment around it;
- Assurance that safe containment will take place during operations;
- Determination of the appropriate data for the purposes of the site development and management plans including appropriate pressure of injection to prevent leakage;¹⁸²
- Consideration of consequences for the environment and public and effects on the global climate of the project;
- Determining where and how monitoring should take place;
- Plan for remediation of the site including addressing possible seepage; and
- Communication planning.

Steps to be taken in the risk and safety assessment in CCS for CDM are set out in paragraph 9 of Appendix B to Decision 10/CMP.7.¹⁸³

The first step is hazard characterisation under paragraph 9(a) of Appendix B to Decision 10/CMP.7.¹⁸⁴ This is a concept not found in South African legislation.

Exposure assessment is the second step in risk assessment under paragraph 9(b) of Appendix B to Decision 10/CMP.7 and explains that the exposure assessment assesses the consequence of migration of CO₂ from storage on surrounding populations and ecosystems.¹⁸⁵ Similar provisions can be found under the *National Environmental Management: Waste Act* 59 of 2008 (hereafter NEM:WA). In terms of draft norms and standards for rehabilitation of

181 Decision 10/CMP.7 25; Younger 2011 *Mine Water and the Environment* 127-140.

182 EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011.

183 Decision 10/CMP.7 25.

184 Decision 10/CMP.7 25; EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 47.

185 Decision 10/CMP.7 25; EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 47.

contaminated waste sites, action must be taken to avoid the migration of harmful compounds and storage must be undertaken in such a way that potential migration of such harmful compounds does not occur.¹⁸⁶ These considerations are similar to those taken into account in the exposure assessment for CCS internationally.¹⁸⁷ Regulations under NEM:AQA may be used to measure certain chemicals as is required for CCS¹⁸⁸ but do not currently extend to the measurement of CO₂.¹⁸⁹ CO₂ may be able to be categorised as "hazardous waste" under NEM:WA¹⁹⁰ in which case it could be regulated therein. CCS may be viable for inclusion in listed activities under NEM:WA.

The third step in risk assessment under paragraph 9(c) of Appendix B to Decision 10/CMP.7¹⁹¹ is the effects assessment where the consequences of leakage from geological storage sites are examined, including the effects thereof on species, communities, habitats and processes.¹⁹² Under NEM:ICMA when dealing with dumping at sea an assessment is undertaken of the effects of different potential disposal options, leading to an "Impact Hypothesis" which provides a basis for acceptance or rejection of the proposed disposal option and the definition of environmental monitoring requirements.¹⁹³ Similarly to the consideration of the effects assessment under international guidelines for sequestration, it is part of a decision of whether to allow the disposal to take place.¹⁹⁴ Under NEM:ICMA it is considered necessary to "assess the potential effects on the environment, human health, living resources, amenities and other legitimate uses of the sea".¹⁹⁵ Such assessment "must define the nature, temporal and spatial scales and duration of expected impacts based on reasonably conservative assumptions".¹⁹⁶ The assessment must take into account "human health risks, environmental costs,

186 GN 233 in GG 35160 of 19 March 2012.

187 EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 50.

188 Decision 10/CMP.7 29-30.

189 GN 248 in GG 33064 of 31 March 2010.

190 S 1 of NEM:WA.

191 Decision 10/CMP.7 26.

192 Decision 10/CMP.7 25.

193 S 11 of Schedule 2 of NEM:ICMA.

194 EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 50.

195 S 12 of Schedule 2 to NEM:ICMA.

196 S 12 of Schedule 2 to NEM:ICMA.

hazards, (including accidents), economics and exclusion of future uses", and options may be rejected if insufficient information is available or if the option of permitting such dumping at sea is shown through the comparative assessment to be less preferable.¹⁹⁷ It is not clear whether this option is required to be less preferable to dumping at that particular location, on land or at all and may thus be considered somewhat vague. In any event, the above illustrates South African law's growing acquaintance with effects assessments.

Risk characterisation is the fourth step in risk assessment under paragraph 9(d) of Appendix B to Decision 10/CMP.7 and consists of the assessment of the site remaining safe and intact during the period of storage as envisaged in the plan for development and management of the site.¹⁹⁸ This process is also referred to in the *Invitation for public comments on the Technical Background Document for the Development of a National Ambient Air Quality Standard for Sulphur Dioxide*.¹⁹⁹ According to this notice risk characterisation involves an integrated examination of hazard assessment, dose response (toxicological) assessment and risk assessment to determine ambient air quality.²⁰⁰ This is the only legislative document in which this phrase appears which means that it is not a widely used term in South African law. Furthermore, due to the particularity of the application of such assessments to their subject matter, it may be necessary for a CCS specific standard for risk characterisation to be established in South African law.

3.2.3 Monitoring

Monitoring is the fourth element in the project life cycle in CCS for CDM.²⁰¹ Under paragraph 10 of Appendix B to Decision 10/CMP.7 monitoring is to take place to assure the safety and integrity of the site, confirm containment and ensure predictable movement of CO₂, and ensure that site management follows the site

197 S 13 of Schedule 2 of *NEM:ICMA*.

198 Decision 10/CMP.7 25.

199 GN 1404 in GG 22134 of 1 June 2001.

200 S 1.1.1 of GN 1404 in GG 22134 of 1 June 2001.

201 Decision 10/CMP.7 25.

development and management plans.²⁰² In addition the rate and volume of seepage and remedial measures applied thereto are considered, as well as the reductions in anthropogenic emissions as a result of the activity.²⁰³

The closest South African legislative provisions are found under the *National Nuclear Regulator Act 47* of 1999, where an application is needed for the siting of a nuclear installation to have a site safety report.²⁰⁴ The content of the site safety report is set out in the *Regulations on the Licensing of Sites for New Nuclear Installations*.²⁰⁵ This regulation sets out the prescribed contents of the safety report which include reasons for the choice of location of the site to ensure limited effect on human population, technologies to be used on the site including safety features thereof, an assessment of hazards, a probabilistic risk assessment, an analysis of the effect of the site on the public and demonstration of a viable emergency plan.²⁰⁶ These factors echo paragraph 6 of Appendix B to Decision 10/CMP.7 which indicates that similar factors are taken into account locally in relation to nuclear installations and under CCS for CDM.²⁰⁷ Clearly issues such as the rate and volume of seepage and remedial measures in relation to those are specific to CCS are not to be found South African legislation. Specific legislation would thus be required domestically.

Further in relation to the monitoring requirement, according to paragraph 11 of Appendix B to Decision 10/CMP.7, the requirements for a monitoring plan set out in the annex to decision 3/CMP.1, *Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol*,²⁰⁸ should be taken into account in CCS for CDM. The Annex to decision 3/CMP.1 sets out the rules according to which CDM activities are undertaken, which rules apply to CDM project activities in general.²⁰⁹ The monitoring plan therein envisages data

202 Decision 10/CMP.7 26.

203 Decision 10/CMP.7 26.

204 S 3 of the *National Nuclear Regulator Act 47* of 1999

205 GNR927 in GG 34735 of 11 November 2011.

206 Sub-reg 3 of GNR 927 in GG 34735 of 11 November 2011.

207 Decision 3/CMP1 27.

208 Decision 3/CMP1.

209 Decision 10/CMP.7.

collection relating to emissions by sources of greenhouse gases which are attributable to the project activity and the conducting of an environmental impact assessment (hereafter EIA). South Africa is familiar with such CDM projects, having 67 registered CDM projects as at July 2013.²¹⁰ Such an EIA is currently used in relation to CCS for CDM in such projects in South Africa. For example, in the project design document form it is necessary to state the environmental impacts of the CDM project.²¹¹

EIAs are dealt with in regulations promulgated under NEMA.²¹² These regulations would have to be analysed in the context of each project. Since sequestration is akin to storage, regard may be had to Listed Activity 3 under NEMA which deals with the "construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres".²¹³ In analysing whether this activity is applicable reference may be made to SANS 10234: 2007 in the definition of "dangerous goods".²¹⁴ SANS 10234: 2007 does not list CO₂ as a "dangerous good". Consequently the treatment of dangerous goods under several of the listed activities excludes carbon dioxide. Neither is CO₂ specifically regulated under the regulations under section 24 of NEMA. Amendment of listed activities or insertion of listed activities specific to CCS would be required for these regulations to better deal with CCS. NEM:AQA does not regulate this either.

Also in relation to the monitoring requirement, paragraph 11(a) of Appendix B to Decision 10/CMP.7²¹⁵ requires that the monitoring plan reflect codes of good practice for the monitoring of geological storage sites set out in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereafter "*IPCC Guidelines*").²¹⁶ The purpose of the guidelines is to provide uniform and

210 Department of Energy http://www.energy.gov.za/files/esources/kyoto/kyoto_sa.html.

211 UNFCCC http://cdm.unfccc.int/Reference/PDDs_Forms/PDDs/PDD_form05.pdf.

212 GNR 544, R545 and R546 in GG 33306 of 18 June 2010.

213 GNR 545 in GG 33306 of 18 June 2010.

214 GNR1159 in GG 33842 of 10 December 2010.

215 Decision 3/CMP127.

216 Eggleston *et al* 2006 *IPCC Guidelines* Energy 5.15.

consistent methods which countries could use to estimate their greenhouse gas inventories for reporting to the UNFCCC.²¹⁷

The method of monitoring geological storage sites is set out in Volume 2 to the *IPCC Guidelines* which deals with energy. The requirement to determine whether a site has a suitable monitoring plan is set out in paragraph 5.7.1.4 of Volume 2 to the *IPCC Guidelines*.²¹⁸ This encompasses monitoring the volume and rate of injection of CO₂, the background emissions not relevant to storage and leaks resulting from storage after site closure.²¹⁹ Potential monitoring technologies in relation to CO₂ storage are contained in Annex 5.1 to Volume 2 to the *IPCC Guidelines* and include various monitoring techniques using light and sound.²²⁰ A pragmatic approach is taken in that the method or methods chosen should be determined on the basis of obtaining the best results.²²¹ Monitoring of corrosion and degradation of transport facilities and the assessment of remedial measures in cases of seepage are highlighted in paragraph 11(i) of Appendix B to Decision 10/CMP.7 as an important element in monitoring.²²²

South Africa has a statute dedicated to the science of geology in the *Geoscience Act* 100 of 1993. The objective of geoscience in South Africa is the exploitation of minerals, research advice and services in the field of geoscience.²²³ Since geoscience is involved in the fields of geochemistry (the composition of rocks, soils and water), geochronology (determining the age of rocks, fossils and sediment), geohazards (determining the likelihood of harm from geological conditions) and geotechnical investigations using geotechnical information,²²⁴ this area of expertise could be used when monitoring geological storage sites.²²⁵ Storage and monitoring for CCS have not yet taken place in South Africa.

217 Eggleston *et al* 2006 *IPCC Guidelines* General Guidance and Reporting 1.3.

218 Eggleston *et al* 2006 *IPCC Guidelines* Energy 5.15.

219 Eggleston *et al* 2006 *IPCC Guidelines* Energy 5.15.

220 Eggleston *et al* 2006 *IPCC Guidelines* Energy 5.15.

221 Eggleston *et al* 2006 *IPCC Guidelines* Energy 5.22.

222 Decision 3/CMP127.

223 S 3 of the *Geoscience Act* 100 of 1993.

224 S 1 of the *Geoscience Act* 100 of 1993.

225 EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 30.

The codes of good practice required under CCS for CDM²²⁶ have not been incorporated into South African law either. If they were to be so incorporated, the requirements for monitoring and available techniques are sufficiently measurable to be contained in legislation. It may be feasible for suggestions from the operator to be taken into consideration in monitoring.²²⁷ Legislative requirements to publish monitoring activities may also be considered.²²⁸

Monitoring in relation to CCS also contains requirements particular to the inherent nature of the activity of storing CO₂.²²⁹ These include the detection of CO₂ stored, possible seepage and the rate thereof.²³⁰ This will require regulation in terms of dedicated domestic legislation forming part of NEMA or specific CCS regulation as it is essential that these variables are measured in CCS projects to determine safe storage.

Regarding monitoring in South Africa, in relation to the requirement for an EIA, the MPRDA stipulates that every person who has applied for a mining right must conduct an EIA and submit an environmental management programme.²³¹ The programme must set out baseline information about the affected environment to determine remedial measures, protection and environmental management objectives.²³² The programme must detail the environmental impact, the socio-economic impact on affected persons and the impact of the project on heritage resources.²³³ The programme must also describe steps which can be taken to "modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation, contain or remedy the cause of pollution or degradation and migration of pollutants and comply with any prescribed waste

226 Decision 10/CMP.7 27.

227 Such as under s 386 of the Australian *Offshore Petroleum and Greenhouse Gas Storage Act* 14 of 2006.

228 Such as under s 465 of the Australian *Offshore Petroleum and Greenhouse Gas Storage Act* 14 of 2006.

229 Decision 10/CMP.7 27.

230 Decision 10/CMP.7 27.

231 S 39(1) of the MPRDA.

232 S 39(3)(a) of the MPRDA.

233 S 39(3)(b) of the MPRDA.

standard or management standards or practices".²³⁴ The applicant must also be able to demonstrate that it has done so or has access to the capacity to rehabilitate and manage negative impacts on the environment.²³⁵ Joint and several liability is imposed on directors of a juristic person in the event of unacceptable negative impact on the environment including inadvertent damage, degradation or pollution of the environment.²³⁶ This is similar to what is required under CCS for CDM.

Monitoring of corrosion and degradation of transport facilities and the assessment of remedial measures in cases of seepage are highlighted in paragraph 11(i) of Appendix B to Decision 10/CMP.7 as an important element in monitoring.²³⁷ The purpose of this monitoring is to ensure that possible seepage during transport is detected and addressed. Corrosion by dry supercritical CO₂ of steel is low.²³⁸ There is no provision in the *Petroleum Pipelines Act* 60 of 2003, the MPRDA or in the *National Energy Regulator Act* 40 of 2004 relating to corrosion of pipelines. In terms of Listed Activity 9 under NEMA an EIA is required for constructing "facilities or infrastructure for the bulk transportation of sewage and water, including storm water, in pipelines with an internal diameter of 0,36 metres or more or a peak throughput of 120 litres per second or more".²³⁹ Impacts in this instance may include seepage from damaged pipes.²⁴⁰ It is submitted that the listings requirements could be extended to cover leakage of CO₂ from CCS transport facilities.

Paragraph 12 to Appendix B to Decision 10/CMP.7 requires the process of history matching and the updating of numerical models used in characterisation by conducting fresh simulations to determine safe storage of CO₂.²⁴¹ History matching is valuable in assessing efficiency of CO₂ storage and the likelihood of

234 S 39(3)(b) of the MPRDA.

235 S 41 of the MPRDA.

236 S 38(2) of the MPRDA.

237 Decision 10/CMP.7 27.

238 Metz *et al* IPCC SRCCS 182.

239 GNR 544 in GG 33306 of 18 June 2010.

240 Endangered Wildlife Trust <http://www.eiatoolkit.ewt.org.za/legal/listing1.html>.

241 Decision 10/CMP.7 27; EC Characterisation of the Storage Complex, CO₂ Stream Composition, Monitoring and Corrective Measures EC 2011 27.

migration of CO₂.²⁴² This term is not present in South African legislation. It is debatable whether this degree of detail, even for CCS, is required in legislation. History matching is currently used in the oil industries and in relation to reservoirs even though it is not currently contained in South African legislation.²⁴³

Updating of the assessments, boundaries and plans will be necessary if history matching shows significant deviation from original data or in the case of renewal of a crediting period is required under paragraph 13 to Appendix B to Decision 10/CMP.7. The purpose thereof is to ensure that recalibration takes place as required. Similar provisions are found under section 34 of the *Disaster Management Act 57 of 2002*. Updating of disaster management plans is required in a process of measuring performance and evaluating plans in relation to disaster risk management.²⁴⁴ While this act reflects the adoption of concepts relating to risk management and the updating of plans in that regard, there is still an absence of CCS specific legislation.

The frequency of monitoring in the case of CCS for CDM is stipulated in paragraph 16 of Appendix B to Decision 10/CMP.7 where monitoring must take place sufficiently prior to injection for a baseline to be established, must be done at regular intervals and must only terminate if no seepage is observed for ten years or for at least twenty years from the end of the last crediting period.²⁴⁵ The purpose hereof is to have sites monitored until it is evident that seepage is unlikely. Under South African legislation, in terms of section 62 of the *Mineral and Petroleum Resources Development Regulations*, the application for closure of a mine must set out the monitoring which is intended to take place upon closure including the steps which have taken place for the purpose of decommissioning the area used.²⁴⁶ This legislation illustrates that South African law is familiar with the concept of monitoring upon closure of facilities. It is, however, not entirely

242 Eggleston *et al* 2006 IPCC Guidelines Energy 12, 56.

243 EC <http://www.fossilfuel.co.za/understanding-and-predicting-fayetteville-shale-gas-production-through-integrated-seismic-to-simulation-reservoir-characterization-workflow/>.

244 S 34(a) of the *Disaster Risk Management Act 57 of 2002*.

245 Decision 10/CMP.7 28.

246 GNR 527 in GG 26725 of 23 April 2004.

appropriate to CCS where monitoring is necessary to detect the threat of seepage with its attendant environmental consequences.

3.2.4 *Financial provision*

The requirement of financial provision does not fall into a specific CCS phase but is covered in all phases of a CCS project. Financial provision is intended to provide for legal and regulatory obligations of project participants during the establishment, operation and up to transfer of liability.²⁴⁷ Financial provision must meet legal obligations arising from the project activity, allow for the storage site to be safely maintained under applicable law, address the risk of project participant insolvency, be able to compensate communities in the event of seepage, enable liability transfer, and cover costs of approvals to transfer liability to authorities.²⁴⁸

A search for similar concepts in South African law leads one to mining. Under the MPRDA, financial provision is "the insurance, bank guarantee, trust fund or cash that applicants for or holders of a right or permit must provide" to guarantee performance of the necessary work programmes and rehabilitation.²⁴⁹ The MPRDA comprises reference to financial provision in relation to closure where operations on a mine must be terminated in terms of a closure certificate.²⁵⁰ The closure certificate is contemplated to be issued after execution of the closure plan.²⁵¹ The closure plan must set out what long-term maintenance and management might be expected as well as cost of closure and financial provision for monitoring, and management after closure.²⁵² The holder of a permit must rehabilitate the environment affected by the operations "as far as it is reasonably practicable", to a land use consistent with sustainable development or to its natural state.²⁵³ In terms of the MPRDA, the applicant for a prospecting or mining right or mining permit must make financial provision for remediation of

247 Decision 10/CMP.7 29.

248 Decision 10/CMP.7 29.

249 S 1 of the MPRDA.

250 S 43 of the MPRDA.

251 S 43(3)(d) of the MPRDA.

252 Ss 62(g) and 62(h) of the MPRDA.

253 S 38(1)(d) of the MPRDA.

environmental damage, which is a suspensive condition to the granting of the authorisation.²⁵⁴

If environmental damage such as degradation or pollution necessitating urgent remedial measures occurs, the Minister of Minerals and Energy can direct the holder of a right to investigate and report on the event and take remedial measures by a specified time.²⁵⁵ If the applicant fails to remediate such environmental damage, the Minister can apply that financial provision to do the remediation.²⁵⁶ Alternatively the Minister can recover the costs thereof from the holder of the right.²⁵⁷ The applicant must review and assess the financial provision annually, or if the Minister is not satisfied with it, has to top it up as needed.²⁵⁸ A portion thereof may be retained by the Minister for post-closure rehabilitation.²⁵⁹

In mining the holder is liable inside or outside the boundary of operations for ecological degradation, environmental damage or pollution.²⁶⁰ CCS for CDM takes a different approach with the same result where the project boundary encompasses the extent of the CO₂ plume over the closure and post-closure phase.²⁶¹ So in both cases the whole area susceptible to pollution is included. It is submitted that these similarities may be used as a touchstone for the development of a regulatory framework for CCS in South Africa.

There is provision under section 24P of NEMA for financial provision for management, closure and rehabilitation in an area where prospecting, mining, exploration or production is undertaken.²⁶² This is similar to the requirement for the cost of on-going monitoring under CCS for CDM where legal costs of

254 S 41(1) of the MPRDA.
255 S 45(1) of the MPRDA.
256 S 41(2) of the MPRDA.
257 S 45(2) of the MPRDA.
258 Ss 41(3) and 41(4) of the MPRDA.
259 S 41(5) of the MPRDA.
260 S 38(1)(e) of the MPRDA.
261 Decision 10/CMP.7 29.
262 S 24P(1) of NEMA.

remediation, the cost of monitoring, verification and certification as well as the cost of addressing seepage must be provided for.²⁶³

Section 24P(2) of the MPRDA gives authorities the ability to use the holder's security to effect rehabilitation where the holder cannot or will not attend to the rehabilitation or management of the environmental impact. It is considered that this provision could be extended to apply to CCS in South Africa as it would be a logical extension of mining legislation.²⁶⁴

According to NEMA the applicant must annually assess and adjust their financial provision.²⁶⁵ The Minister of Water and Environmental Affairs may appoint an assessor if dissatisfied with the degree of financial provision.²⁶⁶ This does not have a corresponding provision in CCS for CDM but the provision in NEMA may also be extended on a similar basis as described in the previous paragraph.

The *Insolvency Act* 24 of 1936 does not apply to financial provision required in terms of section 24P.²⁶⁷ This is similar to the requirement in paragraph 18(c) of Appendix B to Decision 10/CMP.7 which stipulates that the financial provision must address the risk of project participant insolvency.²⁶⁸ According to paragraph 20 of Appendix B to Decision 10/CMP.7 details of the financial provision must be contained in the project design document.²⁶⁹ It is submitted that these requirements are sufficiently similar to CCS for CDM for the harmonisation of local and international provisions in relation to the risk of insolvency. It is contemplated in section 24P(7) of NEMA that the financial provisions can be extended to other areas. This admits the possibility of the extension of these provisions to CCS.

263 According to the definition of the project boundary under Decision 10/CMP.7 18.

264 Decision 10/CMP.7 29.

265 S24P(3) of NEMA.

266 S 24P(4) of NEMA.

267 S 24P(6) of NEMA.

268 Decision 10/CMP.7 29.

269 Decision 10/CMP.7 29.

Where there are requirements under NEMA and under the MPRDA the question arises as to determination of the competent authority. As laid out by the South African Constitutional Court,²⁷⁰ when listing or specifying activities in terms of section 24(2) of NEMA the Minister of the DEA, or a MEC with the concurrence of the Minister, must identify the competent authority responsible for granting environmental authorisations in respect of those activities.²⁷¹ Section 24C of NEMA prescribes that the Minister for Mineral Resources be identified as the competent authority where an activity constitutes mining or a related activity occurring within mining. Consequently it will have to be decided in each case whether the CCS activities are coupled with a mining activity. This determination will identify the competent authority. There is also provision in section 24O of NEMA for consultation between state authorities, which means that all Ministries involved will be able to make a contribution, irrespective of which one constitutes the designated competent authority.

3.2.5 Liability

The issue of liability relates to how obligations arising from a CCS project will be allocated.²⁷² This is particularly important where liability changes, with the project participant being liable up to a point, followed by a transfer of liability to the State.²⁷³ Paragraph 22 of Appendix B to Decision 10/CMP.7 prescribes that liability for seepage during the phases of the project must be allocated by the project participant during the operational, closure and post-closure phases of the project until transfer.²⁷⁴ Under CCS for CDM, liability remains with the project participant during the operational phase.²⁷⁵ Liability transfers to the host party on termination of monitoring and compliance with the original letter of approval issued by the host party and with the laws and regulations of the host party.²⁷⁶

270 *Maccsand v City of Cape Town (Chamber of Mines of South Africa and Another as Amici Curiae)* 2012 7 BCLR 690 (CC) 695.

271 S 24(1) of NEMA.

272 Decision 10/CMP.7 30.

273 Decision 10/CMP.7 29-30.

274 Decision 10/CMP.7 30.

275 Decision 10/CMP.7 29-30.

276 Decision 10/CMP.7 29.

The provision of South African legislation regarding mining activities is comparable to those under CCS for CDM in relation to liability. The MPRDA states that the person conducting mining activities retains environmental liability for pollution or ecological degradation, and the management thereof, up to the issue of the closure certificate.²⁷⁷ This means that after the issue of the closure certificate liability of the miner would cease. Under the MPRDA the Minister of Minerals and Energy retains that portion of the financial provision which he considers necessary for rehabilitation of latent or residual environmental impacts.²⁷⁸ There are thus similarities between the transfer of liability for CCS and in relation to mining, despite no specific treatment of transfer of liability for CCS under South African law.

3.2.6 *Environmental and socio-economic impact assessments*

Environmental and socio-economic impact assessments are assessments of air emissions, solid waste generation and water use associated with a particular CCS project.²⁷⁹ The objective of these assessments is to ensure excellent protection of the environment and potentially affected communities.²⁸⁰ These include embodiment of assessments in legislation including the necessity to obtain and consider comments from local communities in the validation of a project activity.

Regarding air emissions, Activity 2 under Listing Notice 1 promulgated under NEMA refers to the facilities or infrastructure constructed for the storage of coal or ore for which the *National Environmental Management: Air Quality Act 39 of 2004* (hereafter NEM:AQA) requires an atmospheric emissions licence.²⁸¹ This requires a discussion of what NEM:AQA provides in this regard.

277 S 43(1) of the MPRDA.

278 S 43(5) of the MPRDA.

279 Decision 10/CMP.7 30.

280 Decision 10/CMP.7 30.

281 GNR544 in GG 33306 of 18 June 2010.

The object of NEM:AQA is to protect the environment by protecting the quality of air, protecting air against pollution and environmental degradation and balancing the need for ecologically sustainable development against justifiable economic and social development.²⁸² Section 21 of the Act provides for listing of activities which result in atmospheric emissions affecting the environment and health. These are listed in the Regulations.²⁸³ They are categorised into standards for various industries including for combustion installations, activities of the petroleum industry, carbonisation and coal gasification, the metallurgical industry as well as mineral processing, storage and handling.²⁸⁴ The emissions measured are particulate matter, oxides of nitrogen, sulphur dioxide, volatile petrochemical organic compounds, carbon monoxide, hydrogen sulphide and fluoride, dioxins, heavy metals and chemicals such as ammonia.²⁸⁵ These measurements would be applicable to CCS where it is necessary to determine the levels of similar chemicals to those listed above, which might be incidentally present in the CO₂ stream.²⁸⁶ An atmospheric emissions licence may be required under NEM:AQA for the facility to which the CCS process was attached if the chemicals in the Regulation were required to be measured. A licence may be required for the CCS process itself should this be categorised as disposal of general waste and should those regulations be amended to include CO₂ measurement, which is not currently the case.²⁸⁷ This means that an air emissions licence would not currently be required for CCS under the listing notice.²⁸⁸ According to section 21(1)(b) of NEM:AQA this list may be amended by adding items to or removing them from the list which could facilitate the inclusion of CO₂.

The definition of "waste" in section 1 of NEM:WA includes matter "that is surplus, unwanted, rejected, discarded, abandoned or disposed of", or is surplus to production or requires treatment or disposal or is identified as such by the Minister of the DEA. This would appear to include CO₂ since it is surplus to

282 S 2 of NEM:AQA.

283 GN 248 in GG 33064 of 31 March 2010.

284 Reg 1 GN 248 in GG 33064 of 31 March 2010.

285 Reg 10 to 19 GN 248 in GG 33064 of 31 March 2010.

286 Decision 10/CMP.7 30.

287 Reg 17 of GN 248 in GG 33064 of 31 March 2010.

288 GNR 544 in GG 33306 of 18 June 2010.

activities and arguably being disposed of. The definition of "waste" in section 1 of NEM:WA does exclude a portion of waste which is recycled or recovered, and it may be that the process of extracting CO₂ from the relevant installation constitutes recovery. This uncertainty illustrates that clarification is needed regarding the classification of CO₂. If CO₂ is waste then by its nature as an inorganic substance with characteristics which has an impact on health or the environment it would fall within the definition of "hazardous waste" also defined in section 1 of NEM:WA. The general duties regarding waste in section 16 of NEM:WA include the disposal thereof in an environmentally sound manner. This is consistent with the objective of CCS to which is to permanently store CO₂ in an environmentally sound manner.

Section 19 of NEM:WA stipulates that the Minister of DEA may publish a list of activities that have or may have a detrimental effect on the environment. The *List of waste management activities which have or are likely to have a detrimental effect on the environment*,²⁸⁹ is provided under section 19(1) read with section 73 of NEM:WA. These include categories of waste and the treatment thereof, requiring either a basic assessment or scoping and EIR.²⁹⁰ None of the activities specified appear to be applicable to CCS. There are draft regulations replacing these regulations, not yet in force.²⁹¹ One of these regulations provides for the storage of over one hundred cubic metres of general or eighty cubic metres of hazardous waste, the storage of which requires compliance with requirements laid down by the Minister.²⁹² Given the volume of storage required for CCS, measured in millions of tons, this regulation would be applicable to CCS activities.²⁹³

The third requirement under CCS for CDM is for comprehensive socio-economic and EIA's on the effect of CCS on water use.²⁹⁴ The NWA contains provisions for environmental impact assessments relating to water, in particular situations such

289 GN 718 in GG 35718 of 3 July 2009.

290 GN 718 in GG 35718 of 3 July 2009.

291 GN 779 in GG 35718 of 28 September 2012.

292 Reg 5 of GN 779 in GG 35718 of 28 September 2012.

293 Cloete *Atlas on geological storage* 48.

294 GNR 545 in GG 33306 of 18 June 2010.

as for the storage or transport of water.²⁹⁵ The impact of CCS activities on water, however, will be taken into account as part of the examination of the effect of those activities on the environment in the EIA as part of the implementation of the principle of integrated environmental management.²⁹⁶ Permissible water uses²⁹⁷ will also have to be considered from a compliance perspective in the case of CCS.

It is required in CCS for CDM that comments from local stakeholders be considered.²⁹⁸ This is essentially a requirement for public participation. It is clear from international guidance that public participation is essential to having a CCS project come to fruition with the understanding and acceptance of the public.²⁹⁹ Public participation is found in a South African context and is a process where potential interested and affected parties are given an opportunity to comment on or raise relevant issues in relation to the assessment of the environmental impact of an environmental authorisation application.³⁰⁰ Public participation is also required in terms of the *Local Government: Municipal Systems Act* 32 of 2000. Chapter 4 of this act provides for the involvement of communities in decisions and could apply to CCS projects in cases where municipal authorisations are required. In terms of section 152(e) of the Constitution the objectives of local government include involving communities and community organisations in their activities. There is specific mention of this obligation on municipalities, where this is financially possible, in section 152(2) of the Constitution. This means that where CCS activities are to be considered by a municipality, such as in relation to zoning, community involvement is required.

One of the objectives of integrated environmental management is to ensure adequate and appropriate opportunity for public participation in decisions that

295 Listing activities 9 and 11 in GNR 544 in GG 33306 of 18 June 2010.

296 S 2 of NEMA.

297 S 22 of the NWA.

298 Decision 10/CMP.7 30.

299 Terwel and Daamen 2012 *Climate Policy* 289; Beck and Garrett 2010 <http://www.energy.alberta.ca/CCS/pdfs/CCSrfNoAppD.pdf> 48.

300 Definition of “public participation” in s1 of NEMA.

may affect the environment.³⁰¹ This is set out comprehensively in Regulations under NEMA.³⁰² This includes extensive provisions relating to notifications to be given to interested and affected parties, the need to keep a register of such parties, and the need to give such parties the opportunity to comment on submissions to authorities.³⁰³ These requirements are considered to be comparable to the UNFCCC guidelines for public participation under CCS.³⁰⁴

The table below reflects a summary of the South African CCS legal and regulatory framework *status quo* in relation to individual phases in the project life cycle. These are set out in the same sequence as is contained in this chapter and aim to provide a synopsis of the position set out in more detail above.

301 S 23(1)(d) of NEMA.

302 GNR 385 in GG 28753 of 21 April 2006.

303 Ss 56, 57, 58 and 59 of NEMA.

304 Decision 10/CMP.7 30.

Table A: Evaluation of the South African CCS legal and regulatory environment in relation to international benchmarks

| Item | Project life cycle phase | Equivalent articulation in South African legislative / regulatory provision | Comment / Recommendation |
|------|--|--|--|
| 1 | Selection of storage site ³⁰⁵ | Seepage, environmental or health risks are dealt with in NWA(s 22(e)), MPRDA Regs, NEMA (preamble) and OHS Act (s 8). | Similar terminology used but is not specifically applicable to CCS. |
| 2 | Characterisation of storage site | Site development is contained in LUPO. Characterisation is integral to mining and petroleum reconnaissance mentioned in the MPRDA (s1). | Characterisation for CCS is currently unregulated. |
| 3 | Risk and safety assessment ³⁰⁶ | The OHS Act (s 1) contains provisions of general application. | The OHS Act may provide guidance in the formulation of CCS specific legislation. |
| 4 | Monitoring ³⁰⁷ | Monitoring is required under the <i>National Nuclear Regulator Act 47 of 1999</i> and the <i>Disaster Management Act 57 of 2002</i> | Monitoring requirements under these statutes can provide guidance for the compilation of CCS specific legislation. |
| 5 | Requirements for financial provision ³⁰⁸ | Financial provision is required under the MPRDA (ss 38(1), 41 and 45) and NEMA (s 24P). | Financial provision is not linked to circumstances specific to CCS. |
| 6 | Liability | This is a relationship between the miner and the state under the MPRDA. | The more intricate relationship between the project participant and host party is unregulated. |
| 7 | Environmental and socio economic assessment ³⁰⁹ | Air emissions are monitored under NEM:AQA (s 21), waste is dealt with under NEM:WA and the NWA deals with licensing for certain uses of water resources. | NEM:AQUA listed activities could be modified to accommodate CCS, the question is whether CO ₂ constitutes waste for the purposes of NEM:WA and a "dangerous good" under NEMA. |

305 Decision 10/CMP.7 23.
 306 Decision 10/CMP.7 25.
 307 Decision 10/CMP.7 26.
 308 Decision 10/CMP.7 29.
 309 Decision 10/CMP.7 30.

3.3 Conclusion

Section 24 of the Constitution and the definitions in NEMA and section 24 of NEMA lend themselves to the advancement of CCS. The Constitution and NEMA are considered to be appropriate framework legislation for CCS.

There are a number of areas where specific CCS legislation is necessary. The principles relating to site selection include seepage risks are already required for mining but are not found specifically for CCS and would have to be specifically set out in relation to CCS for consistency with international standards.³¹⁰ The requirement of compliance with local laws would require the formulation of those laws in South Africa before participating as a host party under CCS for CDM.³¹¹ There are currently no local laws specifically applicable to CCS. Permanence of storage will be novel to South African legislation. Similarities are found in characterisation with local legislation and CCS for CDM,³¹² and these may provide guidelines for CCS specific legislation. The risk and safety assessment in CCS for CDM requires a hazard characterisation, exposure and effects assessment, and risk characterisation.³¹³ Some of these provisions resonate with local legislation, but are generally insufficiently specific to be applied to CCS.

A requirement for financial provision is found in both mining,³¹⁴ under NEMA³¹⁵ and CCS for CDM.³¹⁶ In particular there is provision in NEMA for the extension thereof which may be viable as local legislation for the purposes of CCS, where appropriate legislation is absent.³¹⁷

310 Decision 10/CMP.7 23.
311 Decision 10/CMP.7 16.
312 Under the MPRDA.
313 Decision 10/CMP.7 25-26.
314 S 43 of the MPRDA.
315 S 24P of NEMA.
316 Decision 3/CMP1.
317 S24P(7) of NEMA.

Liability in the case of CCS remains with the project participant until termination of monitoring and compliance with the letter of approval and laws of the host party.³¹⁸ Under the MPRDA, liability transfers when the closure certificate is issued.³¹⁹ Current legal provisions are thus not applicable to CCS but could be applicable in drafting new or amended legislation for CCS.

There are some areas where CCS specific legislation is not required. The provision that the geological site must not be located in international waters requires a determination of the extent of South Africa's internal waters.³²⁰ This is a matter of objective determination and does not require CCS specific legislation.

Regarding the requirement of monitoring, part of what is required is already currently used in South African CDM projects³²¹ and the geophysical analysis integral to monitoring is already in use in South Africa.³²²

There are areas where South African legislation is applicable, but need to be supplemented with CCS specific legislation. EIA's are necessary in CCS for CDM in relation to air emissions, solid waste generation and water use.³²³ Regulations under NEM:AQA may be extended to apply to CCS. CCS may be viable for inclusion in activities listed under section 19 of NEM:WA. The NWA will be applicable to CCS in relation to general requirements for water use. The intentional recharging of an aquifer with waste is a controlled activity under the NWA and requires authorisation under the act before it can take place.³²⁴ Considerations for the issue of authorisation are set out in the NWA.³²⁵ Comments from local stakeholders required for CCS is similar to public

318 Decision 10/CMP.7 29-30.

319 S 43(1) of the MPRDA.

320 Decision 10/CMP.7 23.

321 Decision 3/CMP1.

322 In the *Geoscience Act* 100 of 1993.

323 Decision 10/CMP.7 30.

324 S 37 of the NWA.

325 S 27 of the NWA.

participation requirements under NEMA³²⁶ and could be applied to CCS activities.

In the light of the lack of legislation regulating CCS it will be instructive to determine the status of policy in South Africa to determine the form that the legal and policy framework for CCS might take.

4 Policy steps towards a regulatory framework

4.1 Introduction

As discussed and explained earlier, a regulatory framework entrenched in law does not as yet exist in South Africa for CSS, specifically.³²⁷ Nor are there policies specifically dedicated to CCS. Key policies advancing CCS will be discussed in order to succinctly set out the status of South African policy in relation to CCS.³²⁸ Steps in this direction have however been initiated by the Long Term Mitigation Scenarios Process Report.³²⁹ After this the AGSSA was published indicating possible storage locations for South Africa.³³⁰ The WPNCCR followed setting out the vision of the South African Government "for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society". Recent CCS initiatives are contained in the 2013/2014 Department of Energy Annual Performance Plan.³³¹ These policies provide an understanding of the direction that law and policy may be required to take in determining the legal and policy framework for CCS in South Africa.

326 S 23(1)(d) of NEMA.

327 Cloete *Atlas on geological storage* 17.

328 Glazewski, Gilder and Swanepoel
http://aduserver2.uct.ac.za/ftp/Reagola/new_Monday%20afternoon/ccs_body.pdf 15.

329 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSPProcess_Report.pdf.

330 Cloete *Atlas on geological storage* 17.

331 Department of Energy 2013/2014
<http://www.energy.gov.za/files/aboutus/DoE%20APP%202013-14.pdf> 116.

4.2 Long Term Mitigation Scenarios Process Report

The *Long Term Mitigation Scenarios Process Report* was prepared for the then Department of Environmental Affairs and Tourism in 2007.³³² The objective of the report was to emphasise the focus of South Africans on long term mitigation scenarios,³³³ prepare for dialogue in relation to climate policy, and negotiate and approve such policy.³³⁴ One of the mitigation measures considered in the report was CCS, in relation to expanded coal-to-liquids production.³³⁵

The legal relevance thereof is that it is clear that by October 2007 the concept of CCS was already present in the minds of policy makers as a precursor to the consideration thereof by lawmakers as a mitigation option with CCS readiness being a consideration.³³⁶ The report does not specify however how CCS might impact the legal and regulatory environment.

4.3 Atlas on Geological Storage of Carbon Dioxide

The AGSSA developed by the Council for Geosciences and the Petroleum Agency of South Africa in 2010 formed the foundation for future work in relation to CCS in South Africa.³³⁷ It emphasises the necessity for CCS, in that fossil fuels account for ninety per cent of the primary energy in South Africa,³³⁸ and CCS is a means to reduce the carbon footprint of such fossil fuel powered installations.³³⁹ It is relevant to this discussion because it clarifies the South

332 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

333 These comprise a range of ambitious but realistic scenarios of climate action in the future for South Africa, mainly dealing with long term emissions and their costs, based on the best available evidence, according to Raubenheimer2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

334 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

335 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

336 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

337 Cloete *Atlas on geological storage* 17.

338 Cloete *Atlas on geological storage* 9.

339 Cloete *Atlas on geological storage* 4.

African landscape on sequestration, which clarity is required for the development of effective regulation.

There are five stages contained in the CCS roadmap.³⁴⁰ The first stage of analysing CCS potential is complete.³⁴¹ The AGSSA discusses a number of potential storage sites and concludes that the estimated capacity in South Africa for CCS is 150GT, with most of this being located in the Mesozoic basins along the coastline.³⁴² This implies that the law relating to coastlines and the sea will be relevant to CCS projects, should such sites be selected.

The second step is generating the AGSSA itself, presenting an overview of the South African energy economy, plans for the future regarding CCS and to show what progress had been made to date.³⁴³ The third is to bring to fruition a test injection in 2016,³⁴⁴ the fourth a demonstration Plant in 2020³⁴⁵ and the last commercialisation of CCS in 2025 with storage of millions of tons of CO₂.³⁴⁶

Site characterisation is considered and comprises the characterisation of a suitable, well managed site which is not prone to seismic activity.³⁴⁷ Monitoring, reporting and verification are considered necessary to ensure that the CO₂ remains in the area where it is injected, and that leaks can be detected.³⁴⁸ Much of the AGSSA is technical, covering the scientific analyses required for such site selection and monitoring.³⁴⁹ This will inform legislation specific to monitoring of CCS projects to be incorporated into South African law.

340 Cloete *Atlas on geological storage* 16.

341 Cloete *Atlas on geological storage* 16.

342 Cloete *Atlas on geological storage* 50.

343 Cloete *Atlas on geological storage* 2.

344 The CO₂ Test Injection Project planned for 2016 aims to sequester in the order of 10,000-50,000 tonnes of CO₂. Global CCS Institute <http://www.globalccsinstitute.com/location/south-africa>.

345 Aimed at sequestration of hundreds of thousands of tonnes of CO₂ Cloete *Atlas on geological storage* 16.

346 Cloete *Atlas on geological storage* 16.

347 Such sites are typically depleted oil and gas reservoirs, deep saline formations and unmineable coal beds. Zillman *et al Carbon Economy Energy* 366; Cloete *Atlas on geological storage* 27.

348 Cloete *Atlas on geological storage* 27.

349 Cloete *Atlas on geological storage* 31-49.

4.4 White Paper on National Climate Change Response

The WPNCCR³⁵⁰ sets out South Africa's strategy for dealing with climate change.³⁵¹ It is acknowledged that government has an obligation to "formulate, implement, publish and regularly update policies, measures and programmes to mitigate its emission of GHGs". CCS is discussed initially in the WPNCCR as a mitigation measure for the synthetic fuels industry in the short and medium term.³⁵² The near-term priority flagship programmes are identified, with frameworks being developed for each programme.³⁵³ These frameworks include plans for implementation, analysis of outcomes, a proposal for benefits such as employment and poverty alleviation and a reporting format.³⁵⁴

CCS is listed as a flagship programme under the WPNCCR.³⁵⁵ All that is set out hereunder is that the Department of Environment together with the South African Energy Research Institute³⁵⁶ will develop a Carbon Capture and Sequestration Demonstration Plant to store the emissions from an existing high emissions facility.³⁵⁷ What is to be done under this flagship programme is not spelled out in detail, with reference to "other initiatives" which are not detailed.³⁵⁸

4.5 Department of Energy performance plan

The Department of Energy takes the lead in relation to CCS matters.³⁵⁹ Its Annual Performance Plan sets out anticipated developments in relation to CCS.³⁶⁰ During the 2013 and 2014 period, the South African National Energy

350 GN 757 in GG 34695 of 20 October 2011.

351 GN 757 in GG 34695 of 20 October 2011.

352 GN 757 in GG 34695 of 20 October 2011.

353 GN 757 in GG 34695 of 20 October 2011.

354 GN 757 in GG 34695 of 20 October 2011.

355 GN 757 in GG 34695 of 20 October 2011.

356 Which established the South African Carbon Capture and Storage Institute.

357 GN 757 in GG 34695 of 20 October 2011.

358 GN 757 in GG 34695 of 20 October 2011.

359 Glazewski, Gilder and Swanepoel
http://aduserver2.uct.ac.za/ftp/Reagola/new_Monday%20afternoon/ccs_body.pdf 16.

360 Department of Energy 2013/2014
<http://www.energy.gov.za/files/aboutus/DoE%20APP%202013-14.pdf>.

Development Institute (hereafter SANEDI) is anticipated to receive state funds for research into CCS.³⁶¹ As part of the clean energy programme a regulatory framework is also anticipated to be developed in support of the objective of test injection by 2016.³⁶² This constitutes concrete planning of milestones to be reached towards conducting CCS.

4.6 Conclusion

Policy documents contain some guidance on the way forward for South Africa in reaching an environmental law framework applicable to CCS in South Africa as can be seen by the contextualisation of CCS on the environmental law framework. CCS began to be considered as an option for mitigation in the *Long Tern Mitigation Scenarios Process Report*.³⁶³ The AGSSA sets out the steps to be followed under the CCS Roadmap³⁶⁴ and determined sites with CCS storage potential.³⁶⁵ The WPNCCR lists CCS as a flagship programme and expresses the need to establish a demonstration facility.³⁶⁶ Accommodating CCS in the regulatory and legislative landscape of South Africa is considered in the Annual Performance Plan.³⁶⁷ The statements contained in the various policies show the emerging clarity of a course of action leading to the implementation of CCS, culminating in the concrete steps for advancement towards CCS in the Department of Energy's Annual Performance Plan.

361 Department of Energy 2013/2014
<http://www.energy.gov.za/files/aboutus/DoE%20APP%202013-14.pdf> 20.

362 Department of Energy 2013/2014
<http://www.energy.gov.za/files/aboutus/DoE%20APP%202013-14.pdf> 116.

363 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

364 Cloete *Atlas on geological storage* 16.

365 Cloete *Atlas on geological storage* 50.

366 GN 757 in GG 34695 of 20 October 2011.

367 Department of Energy 2013/2014
<http://www.energy.gov.za/files/aboutus/DoE%20APP%202013-14.pdf> 116.

5 Conclusion and recommendations for law and policy reform in South Africa

5.1 Introduction

This study started out by indicating that environmental law is a rapidly evolving field and includes the emerging subject of climate change law and governance. It was also stated that within the climate change law and governance fraternity, it is widely agreed that combating climate change requires both mitigative measures and adaptation to its effects where mitigation refers to efforts to reduce or prevent emission of greenhouse gases and adaptation being the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities.

Several mechanisms have already been designed internationally and at the national level to mitigate and/or adapt to climate change. One of these mechanisms is CCS which falls within the portfolio of mitigation options. The importance of CCS was highlighted with reference to the support it enjoys from the fossil fuel industry, for example.

Against this background and based on the environmental threats and opportunities that CCS may hold, the objective of this dissertation was to conduct a critical evaluation of the environmental law framework applicable to CCS in South Africa. In light of the national ambitions and international requirements for CCS it seemed useful to question the regulatory potential and compatibility of South Africa's existing legal framework in relation to CCS. It seemed particularly necessary to look at the country's environmental law and policy framework and the extent to which it is suitable for the regulation of CCS.

The discussion began in Chapter 1 where it was confirmed that CCS has a place in environmental law as a mitigation measure.³⁶⁸ The inclusion of CCS in the CDM has been a substantial step which could incentivise the development of environmental law frameworks for CCS in potential host countries, such as South Africa.³⁶⁹ The gradual implementation of CCS technology is shown by there being only eight large scale integrated CCS projects around the world.³⁷⁰

In Chapter 2 key scientific concepts helpful for an understanding of the CCS process were explained. The project life cycle and CCS related impacts on the environment provide a context for discussion of the legal requirements accompanying a life cycle in a CCS project.

The Constitution and NEMA constitute appropriate framework legislation for CCS. CCS for CDM provides international legal requirements accompanying the project life cycle against which the South African legal framework are examined in Chapter 3.³⁷¹ This comprises site selection and characterisation, a risk and safety assessment, monitoring, financial provision, liability and environmental and socio-economic impact assessments.³⁷² Some provisions of South African legislation will be applicable to CCS depending on the nature of the specific CCS project, but specific regulations will need to be developed for South Africa to arrive at an environmental framework for CCS.

In Chapter 4 policy documents comprising the *Long Term Mitigation Scenarios Process Report*,³⁷³ the AGSSA³⁷⁴ and the WPNCCR are discussed.³⁷⁵ It may be deduced from these documents that the place of CCS in South African legislation has not been settled.

368 Metz *et al* IPCC SRCCS 22, see pg 2 above.

369 Decision 10/CMP.7 29.

370 Global CCS Institute 2013 <http://www.globalccsinstitute.com/publications/global-status-ccs-update-january-2013>.

371 Decision 10/CMP.7.

372 Decision 10/CMP.7.

373 Raubenheimer 2007 http://www.erc.uct.ac.za/Research/publications/07Raubenheimer-LTMSProcess_Report.pdf.

374 Cloete *Atlas on geological storage* 16.

375 GN 757 in GG 34695 of 20 October 2011.

5.2 Recommendations for law and policy reform

Whether or not South Africa is desirous of participating in CCS for CDM as a party not included in Annex 1 to the United Nations Framework Convention on Climate Change, it is submitted that the requirements for doing so set out a useful guide as to what may be required in the South African environmental framework. These are contained in the participation requirements specific to CCS for CDM.³⁷⁶ This dissertation accordingly concludes with recommendations that speak to these requirements as well as with some of the most prominent needs and law and policy gaps that have been identified in this study.

5.2.1 Site selection

Site selection is a requirement under CCS for CDM for laws which establish procedures for selection, characterisation and development of appropriate sites.³⁷⁷ Legislation is not currently in place for selecting a site which does not have a risk of seepage or health or environmental risks.³⁷⁸ Risk of seepage is a material issue which needs to be legislatively addressed.³⁷⁹ Health or environmental risks particular to CCS are not completely provided for in legislation under the OHS Act.³⁸⁰ For CCS to be lawful there must be legislation which sets out how it is to be done. These laws need to prescribe procedures for choosing a site with integrity and safety to minimise the risk of seepage and the consequences thereof on human health and the ecosystem.³⁸¹

5.2.2 Characterisation

The consideration of potential storage sites and assessing the structures present in relation to the requirement of storage may be developed with

376 Decision 10/CMP.7 16.
377 Decision 10/CMP.7 16.
378 As discussed in paragraph 3.2.
379 As discussed in paragraph 3.2.
380 As discussed in paragraph 3.2.1
381 Doelle and Lukaweski 2012 *Climate Law* 61.

reference to the provisions contained in LUPO in relation to the composition of site development plans and the SPLUM Act requiring coordination between authorities, but requires specificity to cater for CCS.

5.2.2 Rights to store

It is necessary under CCS for CDM for there to be legislation conferring rights to store CO₂ and access pore space, which is not currently catered for.³⁸² Some regulation may be found at common law but if ownership could be spelt out as is the case in mining, CCS could proceed with greater certainty.

5.2.3 Liability for seepage

It is necessary for specific liability rules regarding CCS to be established under CCS for CDM since common law is unlikely to be of assistance in a situation where the operator no longer exists.³⁸³ Liability regimes internationally include funds financed by industry levies, provision of security and strict liability for operators, as well as the transfer of liability to the State.³⁸⁴ South Africa needs to choose an option for there to be certainty amongst participants in CCS projects as well as those potentially affected by seepage. Provision for redress of damage to the environment must also be made, which may follow the precedent of the MPRDA for operator liability and the provision of security.³⁸⁵

5.2.4 Host party liability

There must be measures for host parties to fulfil their obligations for net reversals of storage, should such obligations be accepted.³⁸⁶ This follows on from the determination of when liability transfers to the State. It is essentially an acceptance of liability by the State to take responsibility for redress of CO₂ emissions from storage facilities. A decision must be made by the South

382 Decision 10/CMP.7 16.

383 Zillman *et al Carbon Economy Energy Law* 366.

384 Zillman *et al Carbon Economy Energy Law* 366-371.

385 Ss 39 and 41 of the MPRDA.

386 Decision 10/CMP.7 16.

African government as to whether it may admit the prospect of such liability, and that decision must be translated into legislation.

5.2.5 Recommendations for related law and policy gaps and incidental concerns

It is recommended that legislation in relation to areas unique to CCS be developed. Regulations relating to site selection and characterisation would bring certainty in dealing with the risk of seepage where remedial measures might be specified in legislation. This would include the allocation of liability amongst project participants in the event of seepage. Specific health risks such as in relation to acidification of water could be dealt with.³⁸⁷ Specific legislation drawing on the *Maritime Zones Act* 15 of 1994 and NEM:ICMA³⁸⁸ could be formulated specifying offshore areas where CCS could take place.

The confusion surrounding the categorisation of CO₂ for the purposes of NEM:ICMA could be clarified by specifically excluding the CCS process as an activity involving waste and regulating it separately.³⁸⁹ The steps in the risk and safety assessment particular to CCS as contained in paragraph 8 of Appendix B to Decision 10/CMP.7 could be embodied in specific legislation as they are unique to CCS.³⁹⁰ The area of hazard characterisation is not specifically found in South African law. This includes analysing potential hazards from CCS, determining potential seepage pathways and the extent and magnitude thereof, as set out in paragraph 9 of Decision 10/CMP.7.³⁹¹

5.2.6 Remaining areas in need of research

The scope of this study has been limited to the environmental law framework. Further research is required into the economic aspects of CCS where the costs

387 As discussed in Paragraph 3.2.1.
388 As discussed in Paragraph 3.2.1.
389 As discussed in Paragraph 3.2.1.
390 As discussed in Paragraph 3.2.2.
391 As discussed in paragraph 3.2.2.

of different CCS methods and the comparison of CCS to other mitigation measures are considered.³⁹² Much of the discussion in literature in relation to CCS focuses on scientific aspects thereof upon which there is considerable ongoing research, such as that under the auspices of UN General Assembly Subsidiary Body for Scientific and Technological Advice.³⁹³ The political context of CCS is another area of potential research, with countries being dependent on energy while having ambitions to limit global warming and be on a path of sustainable development.

5.2.6 Conclusion

Finally, one can only concur with Glazewski who states that:

...the mainstay of the South African economy has traditionally been mining involving taking natural products out of the ground and processing it; while CCS technology entails the converse. Our legal system is sufficiently malleable to take this novel technology in its stride.³⁹⁴

The South African environmental framework applicable to CCS is still in its infancy. Current legislative provisions can be applied to isolated areas of a CCS project where they may find specific application. There is, however, no dedicated and definitive legislation to accommodate the specific requirements of CCS in South Africa. It is hoped that the development thereof will keep pace with the scientific progress in this fascinating area of law.

392 As referred to in paragraph 3.2.4.

393 UN General Assembly *Carbon dioxide capture and storage in geological formations as clean development mechanism project activities* Subsidiary Body for Scientific and Technological Advice Thirty-third session Cancun Draft decision -/CMP.16 30 November to 4 December 2010 FCCC/SBSTA/2010/L.24

394 Havercroft 2012 <http://www.globalccsinstitute.com/insights/authors/ian-havercroft/2012/10/10/south-africa%E2%80%99s-legal-and-regulatory-regime-%E2%80%93-insight>.

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