BURYING CLIMATE CHANGE UNDERNEATH THE GROUND: A CARBON CAPTURE AND STORAGE REGULATORY FRAMEWORK FOR NEW ZEALAND

Joshua McGettigan

A dissertation submitted in partial fulfilment of the degree of Bachelor of Laws (with Honours) at the University of Otago

October 2009

Acknowledgements

Ceri Warnock has been a fountain of wisdom in helping me to write this paper. I thank her for her patience, guidance, and helping me to see the forest when I lost it for the trees.

The support I have received from my flatmates (both honorary and actual) has also been extremely important. I thank them for helping me to be silly when it was required.

I am also indebted to the proof-reading skills of Honor Lanham and the technical assistance from Emma Peart.

Finally, I would like to thank my amazing family, particularly Mum and Dad, for their ongoing love and support.

TABLE OF CONTENTS

ABBREVIATIONS USED

BOI	Board of Inquiry
CCS	Carbon dioxide Capture and Storage
CETS	Carbon Emissions Trading Scheme
CO_2	Carbon Dioxide
DOC	Department of Conservation
EC	Environment Court
ECBM	Enhanced Coal Bed Methane Recovery
EOR	Enhanced Oil Recovery
EGR	Enhanced Gas Recovery
EHR	Enhanced Hydrocarbon Recovery
EPA	Environmental Protection Authority
ERMA	Environmental Risk Management Authority
EU	European Union
FCFS	First-come first-served
GHG	Greenhouse Gas
HSCGR	Hazardous Substance (Compressed Gas) Regulations 2004
HSEA	Health and Safety in Employment Act 1992
HSEPR	Health and Safety in Employment (Pipeline) Regulations 1999
HSNOA	Hazardous Substances and New Organsims Act 1996
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LA	Local Authority
MCMPR	Australian Ministerial Council on Minerals and Petroleum Resources
MPMEP	Minerals Programme for Minerals (Excluding Petroleum) 2008
MPP	Minerals Programme for Petroleum 2005
MNZ	Maritime New Zealand
MTA	Marine Transport Act 1994
nm	nautical miles

OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PA	Precautionary Approach
RMA	Resource Management Act 1991
SCPPA	Submarine Cables and Pipelines Protection Act 1996
TAG	Technical Advisory Group for the Minister for the Environment
TTWMA	Te Ture Whenua Maori Act 1993
UK	United Kingdom

INTRODUCTION

There is now scientific consensus amongst leading experts that we are in the midst of anthropogenically induced climate change,[1] and without a concerted international effort, the consequences could be dire. Predictions of the effects of climate change have included the submerging of most pacific islands, intensification of flood events, greater erosion, and more frequent landslides.[2] The carbon dioxide (CO_2) emissions from power generation and consumption, as well as other industries like iron and steel, are a substantial contributing factor to this phenomenon. However, the link between CO_2 emissions and fossil fuel use, and the perception that economic development is linked so tightly with the continued use of fossil fuels, present a significant barrier to any significant decrease in CO_2 emissions.

This context perhaps explains why Carbon dioxide Capture and Storage (CCS) has become regarded as "the most important single new technology for CO_2 savings".[3] Its consistency with the continued use of fossil fuels has made it the darling of international climate change discourse in recent times, with a raft of new investigation into, and development of, its potential. If made viable, the technology would allow industry to have its proverbial cake, and eat it too. Since 2005**,** the technology has precipitated its own journal,[4] an entirely new international working group,[5] its own global technology development institute,[6] and has been the subject of numerous international negotiations

[1] Bernstein, L. et al, "Climate Change 2007: Synthesis Report – Summary for Policy Makers", *IPCC*, November 2007, 5, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf, accessed 7 September 2009.
[2] Parry, M.L. et al, "Climate Change 2007: Impacts, Adaptation and Vulnerability", *Intergovernmental Panel on Climate Change*, 2007, 516, 517, 522.
[3] "Energy Technology Perspectives 2008 – Scenarios and Strategies to 2050: Executive Summary", *International Energy Agency*, 2008, 5, http://www.iea.org/textbase/npsum//ETP2008SUM.pdf, accessed 21 August 2009.
[4] The "Carbon Capture Journal" released its first issue for January and February in 2008. See http://www.carboncapturejournal.com/download.php?EMailAddress=?PHPSESSID=0hdd8n5ernhe9d7qennptkhm70, accessed 21 August 2009.
[5] The Carbon Sequestration Leadership Forum was formed in 2003, founded by Australia. See House of Representatives Standing Committee on Science and Innovation, August 2007, *Between a Rock and a Hard Place: The science of geosequestration*, The Parliament of the Commonwealth of Australia,, 16-17, http://www.aph.gov.au/house/committee/scin/geosequestration/report.htm, accessed 21 August 2009.
[6] The Global Carbon Capture and Storage Institute was launched in April 2009. See http://www.globalccsinstitute.com/about_gccsi/about_us.html, accessed 24 August 2009.

and reports.[7] With the technological potential having been demonstrated in several (closely watched) projects worldwide, negotiations have turned to legislative frameworks to ensure appropriate implementation and regulation of CCS. Specific amendments to international conventions such as the London Protocol and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), a European Union (EU) Directive,[8] amendments in the United Kingdom (UK),[9] and new, targeted legislation in Australia,[10] illustrate this international and national awareness of the need to legislate for CCS.

Although not to the same degree as more fossil fuel-dependent countries like Australia, the CO_2 emissions of New Zealand's power generation and carbon emitting industries are still serious contributors to its Greenhouse Gas (GHG) emissions. They are also of importance to the New Zealand economy. Together, coal and natural gas make up 33 percent of New Zealand's power generation,[11] and coal is one of our major exports.[12] New Zealand thus not only has an incentive to use CCS to secure its power generation, but demonstrating that coal power can be environmentally friendly would benefit our economy more generally. It would make our coal exports more appealing. The current political climate is also conducive to CCS. With the repealing of the Resource Management (Renewable Preference) Amendment Act 2008, a 10 year moratorium on the creation of new fossil fuel based power generators has been lifted. The

[7] For examples, see Department of Primary Industries, January 2008, *A Regulatory Framework for the Long-Term Underground Geological Storage of Carbon Dioxide in Victoria*, Victorian Government; Benson, Sally and Cook, Peter, "Underground geological storage", *IPCC Special Report on Carbon dioxide Capture and Storage*, Intergovernmental Panel on Climate Change, 195-276

[8] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006, *Official Journal of the European Union*, L140/114, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF, accessed 15 October 2009.

[9] Energy Act 2008 (UK), Chapter 32.

[10] For examples, see Offshore Petroleum Greenhouse Gas Storage Act 2008 (Cth); Greenhouse Gas Geological Sequestration Act 2008 (Vic); Greenhouse Gas Storage Act 2009 (Qld)

[11] http://www.mfe.govt.nz/environmental-reporting/energy/supply/electricity-generation.html, accessed 15 October 2009.

[12] For example, in 2005 New Zealand's coal exports generated over $200 million. See Coal Association of New Zealand, *Coal e-Newsletter*, November 2006, 1, http://www.coalassociation.org/content/files/Coal_e-news_No.22.pdf , accessed 15 October 2009.

implementation of a Carbon Emissions Trading Scheme (CETS), although delayed, is still high on the political agenda.[13] A CETS would create an economic incentive for carbon emission abatement strategies that is not currently present. Because CCS would allow large point source emitters to meet their targets without radically changing their power source, it is an appealing option for certain New Zealand industries. This is particularly so when one considers that past reliance on renewable energy sources has seen nationwide power shortages.[14] Furthermore, oil reserves in the Great South Basin, and the 4000 Megatonnes of Lignite in Southland, are currently being considered for future power generation sources.[15] Such developments would be likely to require CCS.[16] These factors, combined with New Zealand's international commitment to reducing GHG emission levels, mean that CCS is a technology that would not only be useful in a New Zealand context, but is likely to be required in the future.

Although a number of policy arguments have just been canvassed in favour of the implementation of CCS in New Zealand, the debate about the substantive merits of CCS is not one this paper engages. The paper's scope is refined to evaluating the regulation of a CCS project, if it was implemented in New Zealand, for protection against risks to the environment and public health and safety. This means that some legal concerns that CCS gives rise to are outside the paper's scope, such as refining economic incentives. The non-comprehensiveness of the paper in this respect is acknowledged, but a regulatory framework adequately protecting environmental integrity and public health and safety is an issue of concern prior to these. The consequences of not regulating the technology appropriately from this perspective are more serious than the inadequacy of economic incentives.

---

[13] The Climate Change Response (Moderated Emissions Trading) Amendment Bill was introduced into the House of Representatives on 24 September 2009, http://www.parliament.nz/en-NZ/PB/Legislation/Bills/7/a/d/00DBHOH_BILL9597_1-Climate-Change-Response-Moderated-Emissions-Trading.htm, accessed 15 October 2009.
[14] http://www.med.govt.nz/templates/MultipageDocumentTOC____39001.aspx, accessed 15 October 2009.
[15] Funnell, Rob, "Overview of New Zealand's CO_2 storage options", in *Carbon Capture and Storage: Where are we now?*, seminar paper, presented at Proceedings of the International Carbon Capture and Storage Seminar, Monday, 27 August 2009, Wellington, 26.
[16] Ibid.

Chapter One is dedicated to explaining CCS technology. Its processes, economic appeal, environmental risks, and status will all be described. The chapter also explains what kinds of CCS projects will and will not be analysed by the remaining chapters. It forms an important part of the paper, for an understanding of the technology is essential to development of an appropriate legal framework with which to regulate it.

Chapter Two breaks up the current New Zealand legal regime into the key requirements of a CCS regulatory framework. The way in which a CCS project would need to be implemented under the status quo is then considered, structuring it in terms of those key requirements.

Chapter Three identifies four fundamental problems with the current regime. Problems associated with the precautionary approach (PA) used by the Environment Court (EC) in risk assessment, allocation of storage reservoirs, long term liability, and the decision-making bodies used under the status quo will all be explained. The analysis will demonstrate that the current legislative framework's regulation of CCS projects would be wholly unsatisfactory.

Chapter Four first establishes the need for legislative intervention, as opposed to co-regulation, and then evaluates alternatives for addressing the identified four problems. Potential regulatory analogues for the risks that CCS presents are evaluated, along with some new proposals. The analysis will show that CCS raises sufficiently unique legal concerns that stand-alone legislation would be required for satisfactory regulation.

CHAPTER ONE: CCS TECHNOLOGY

1 The components of a CCS stream

A CCS stream consists of three parts: capture of CO_2 at the emission source, transportation to the storage site, and storage of the captured CO_2 underneath the ground. Each process has numerous alternative technological options, some of which have already been employed successfully in other industries such as Enhanced Oil Recovery (EOR).[17] Figure 1 illustrates two alternatives for each part of a CCS stream.

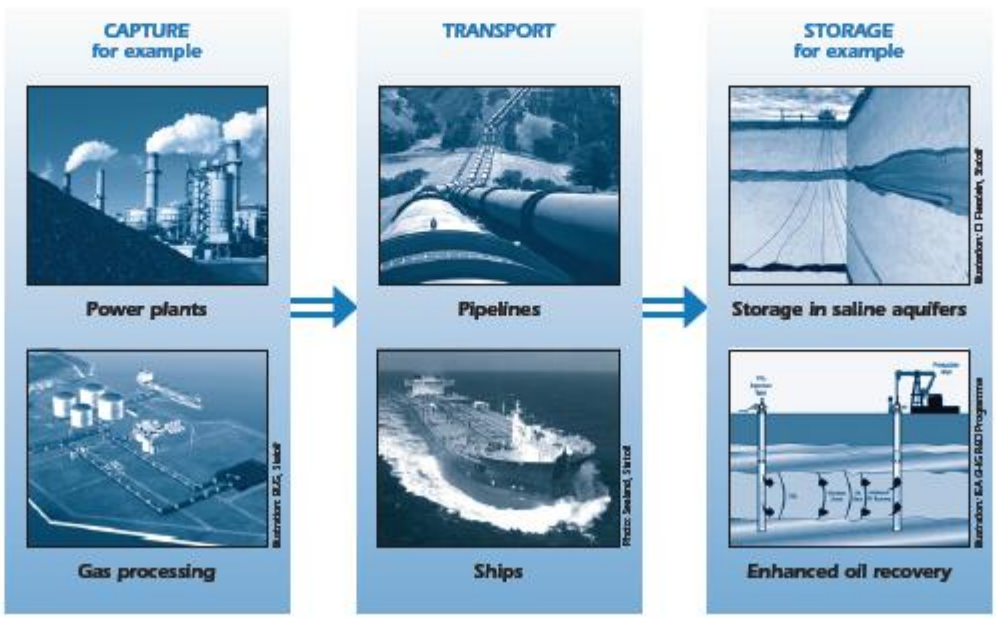

Figure 1: Illustration of processes involved in CCS stream[18]

[17] For example, The Weyburn EOR project transports (by pipeline) CO_2 captured from coal gasification in North Dakota 350km for storage in Canada's Weyburn oil field. See Kerr T., *Legal Aspects of Storing CO_2: Update and Recommendations*, International Energy Agency (IEA), 2007, 17, http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1928, accessed 24 August 2009.

[18] Image sourced from *Energy Technology Perspectives 2006*, IEA, 2006, 195, http://www.iea.org/textbase/nppdf/free/2006/etp2006.pdf, accessed 24 August 2009.

1.1 Capture

The term “capture” actually refers to two different processes: separation and compression. Separation is the severance of CO_2 from other gaseous matter in air, and compression is the increasing of the gas’s density for transport and storage. Current capture technology would capture 85-95% of emitted CO_2.[19] Research shows that between 13-18 Mt of carbon emissions in New Zealand are potentially capturable for CCS, including fossil-fuel based power plants and industrial sources such as steel works, aluminium smelters and paper manufacturers.[20] These sources, with some minor exceptions, are more concentrated in the upper part of the North Island, as seen in Figure 2 below (where the squares represent significant emission point sources). In terms of the capture technology likely to be implemented in New Zealand, post-combustion is the most likely candidate.[21]

[19] Intergovernmental Panel on Climate Change, September 2005, *IPCC Special Report: Carbon Dioxide Capture and Storage – Summary for Policymakers*, 4.
[20] Funnell, see n15 above, 22.
[21] Funnell, R., CCS Programme Leader, GNS Science, pers. comm.., 7 September 2009.

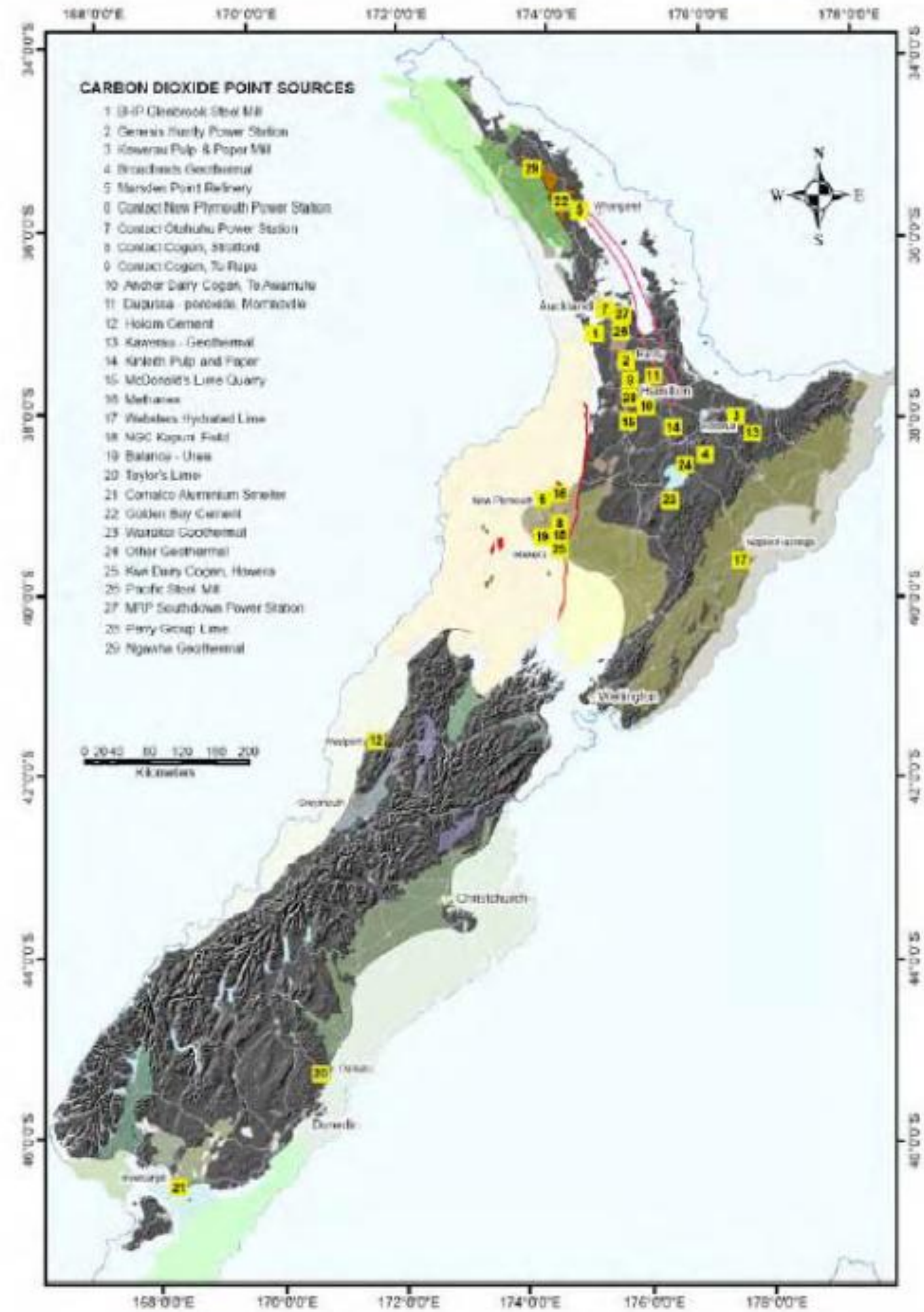

Figure 2: Point Sources of Carbon Emissions in New Zealand[22]

[22] Image sourced from Funnell, R., see n15 above, 23.

1.2 Transport

There are four options for CO_2 transportation: ship, pipeline, road and rail.[23] However, due to the quantities of CO_2 involved, pipeline and ship are the two most economically viable.[24] Transportation by pipeline will be more efficient for greater CO_2 amounts and for distances up to 1000 km, although use of ship may be more efficient for greater distances and smaller amounts.[25] Transport of CO_2 by pipeline is currently occurring in a number of CCS and EOR projects.[26] Pipelines and ships also currently transport substances (such as petroleum and natural gas) with much more dangerous properties.[27] The upside of this is that transportation of CO_2 would not pose any technological problems.[28] This is true for New Zealand, which already has over 3,400 km of high pressure gas pipelines.[29]

1.3 Storage

Storage is generally regarded as involving two parts: injection into the storage reservoir and then monitoring of the storage site. Storage is comfortably the least expensive part of a CCS stream.[30] In relation to the permanence of storage, the Intergovernmental Panel on Climate Change (IPCC) has stated that "the fraction [of CO_2] retained in appropriately selected and managed geological reservoirs is very likely to exceed 99% over 100 years and is likely to exceed 99% over 1,000 years".[31]

[23] House of Representatives Standing Committee on Science and Innovation, August 2007, *Between a Rock and a Hard Place: The science of geosequestration*, The Parliament of the Commonwealth of Australia, Canberra, 31.
[24] IPCC, see n19 above, 5.
[25] Ibid.
[26] CCS in Sleipner, and EOR in In Salah and Weyburn are examples. See Kerr, n17 above at 20-21 for a summary of the projects.
[27] For example, petroleum and natural gas are both extremely flammable.
[28] Kerr, see n17 above, 46.
[29] Abernathy, Andrew and Coull, David, "New Zealand", *International Comparative Legal Guide to Gas Regulation 2008*, Global Legal Group, 145.
[30] IPCC, see n19 above, 11.
[31] Ibid, 14. "Very likely" means a 90-99% chance, and "likely" means a 60-99% chance.

Various trapping mechanisms, which become increasingly stronger with time, make the likelihood of permanent storage so high. Potential storage sites can be grouped into three categories: geological storage, mineral carbonation, and ocean injection.

Geological storage involves pumping CO_2 to depths greater than 800m. At this depth, geochemical and physical mechanisms work to prevent its escape to the surface.[32] Geological storage facilities seen to have the most potential are deep saline aquifers, depleted oil and gas fields, and unmineable coal seams.[33] Geological storage has been implemented in a number of demonstration projects: the Sleipner project uses a saline aquifer off the coast of Norway, the Weyburn project uses an oil field in Canada, and In Salah stores CO_2 in a gas field in Algeria.[34]

Mineral carbonation works by fixating CO_2 into inorganic carbonates (rocks, effectively). However, it has a number of drawbacks counting against its implementation. It has not yet been successfully demonstrated, it is extremely expensive, it has adverse impacts on the environment, and the extent of its capacity is unknown but likely to be very small.[35] Finally, ocean injection refers to direct injection of CO_2 into the ocean water column. However, it is yet to be demonstrated and there are serious concerns about its environmental viability. It would result in an increase in the ocean's acidity, which in turn negatively effects the marine environment.[36]

In a New Zealand context, there is vast potential in geological storage reservoirs. The Maui gas field (located 35km off the Taranaki coast) is a prime example. Its storage capacity has been estimated at 300 Mt: approximately 17 times the capacity required to store all of New Zealand's currently capturable CO_2 emissions.[37] Its proximity to the

[32] Ibid, 6.
[33] Ibid, 6-8.
[34] Ibid, 6.
[35] Ibid, 11, 12 and 14.
[36] Ocean storage would have likely corollaries of increased marine life mortality, decreased growth, reproduction, calcification, circulatory oxygen supply and mobility. See Calderia K., and Akai M., "Ocean Storage", 2005, IPCC at 279.
[37] Funnell, Rob, "Overview of New Zealand's CO_2 storage options", in *Carbon Capture and Storage: Where are we now?*, seminar paper, presented at Proceedings of the International Carbon Capture and Storage Seminar, Monday, 27 August 2009, Wellington, 26.

large point sources concentrated in the North Island also makes it a convenient option, as seen in Figure 2 below (point sources are shown as yellow squares). However, more research needs to be done to confirm the gas field's viability as a storage site. Although it is unlikely to be ready for carbon injection for another 10-15 years,[38] this should not be viewed as significant. Setting up a complete CCS stream from capture to storage, particularly if it was being transported 35km offshore, would take approximately this long anyway.[39] Onshore saline aquifers, particularly in the Taranaki region, also hold promise.[40]

Geological storage, due to it being the most environmentally viable, demonstrated, and having the greatest near-term potential in New Zealand, will be the focus of this paper. It is acknowledged that CCS technology is dynamic, and should the other types of storage discussed above become more viable, the scope of this paper's applicability may become more limited. However, this is unlikely. With mineral carbonation, it is virtually certain that the fraction of CO_2 retained would be 100% after 1000 years; the risk of leakage is nil.[41] It also creates many of the same problems as large-scale surface mining such as land clearing, decreased local air quality and affected water supply, indirect habitat degradation, and the storage of waste-products such as tailings.[42] Because such projects have already been occurring in New Zealand for some time, mineral carbonation does not pose the same novel legal concerns (discussed below) as geological storage.

Ocean injection does differ in that its primary environmental impact (increasing the ocean's acidity) has a much greater degree of certainty: no "leakage" is required for it to occur. Leakage to the atmosphere from oceanic injection is also expected to occur to a

---

[38] Ibid. It is predicted that the field will be continue to be actively extracted from, and subject to contractual agreements, for this period of time.
[39] Page et al, December 2008, *Carbon Capture and Storage: An appropriate technology for New Zealand?*, University of Canterbury, Christchurch.
[40] Funnell R., see n15 above, 26.
[41] Mazzotti, Marco et al, "Mineral carbonation and industrial uses of carbon dioxide", *IPCC Special Report on Carbon dioxide Capture and Storage*, Intergovernmental Panel on Climate Change, 330
[42] Ibid, 328-9.

much greater degree than with geological storage.[43] However, these effects are essentially the same as those presented by geological storage, only they are much more likely to occur. These differences highlight a question of degree rather than quality. Although oceanic storage does pose some novel international legal problems, a domestic legal instrument would not be the appropriate place to address them.[44] Accordingly, a regulatory regime designed to cope with domestic challenges presented by geological storage should be capable of addressing the risks associated with oceanic storage.

2 Economic Viability

Capture processes make up the most expensive part of a CCS stream.[45] This is for two reasons: installation costs, and energy intensiveness. Post-combustion capture, for example, would approximately entail a 30% decrease in the output of a commercial coal-based power plant.[46] Because transport is also expensive, the degree of proximity between emission sources and storage sites should be an important consideration in determining the economic viability of CCS in a New Zealand context. In this respect, as stated above, New Zealand is in a convenient position with oil fields, gas fields and saline aquifers all located near the concentrated point sources in the North Island.

CO_2's ability to mobilise hydrocarbon fuel sources for extraction could also significantly affect the economic viability of CCS. CO_2 has this effect in depleted oil fields through EOR, depleted gas fields through Enhanced Gas Recovery (EGR), and depleted coal beds through Enhanced Coal Bed Methane Recovery (ECBM). These are together referred to as Enhanced Hydrocarbon Recovery (EHR). Some predictions even go as far to suggest that CCS, when combined with EHR, could be revenue positive.[47] If a CCS stream was to become established in New Zealand, EHR options would be important in making it

---

[43] Calderia, Ken et al, September 2005, "Ocean Storage", *IPCC Special Report on Carbon dioxide Capture and Storage*, Intergovernmental Panel on Climate Change, 292.
[44] See Rayfuse R., "Drowning Our Sorrows To Secure a Carbon Free Future? Some International Legal Considerations Relating to Sequestering Carbon by Fertilising the Oceans" 31 *U.N.S.W.L.J* 919.
[45] IPCC, see n19 above, 10.
[46] House of Representatives Standing Committee on Science and Innovation, see n23 above, 28.
[47] Kerr, T., see n17 above at 18.

economically efficient. This is particularly so when one considers that the largest potential storage reservoir is the soon-to-be depleted Maui oil and gas field.[48]

3 The environmental risks and benefits

3.1 Benefits

The principal environmental benefit of CCS is its capacity to prevent carbon emissions and hence slow down climate change. The degree of likelihood that carbon sequestration will be sufficiently permanent to achieve this is very high.[49] Therefore, the question of benefit for New Zealand concerns not the status of technology, but how many of our large carbon emitting sources are CCS-compatible, the capacity of our potential storage sites, and the proximity of the emission and storage sites to each other. As discussed above, in terms of all of these factors, the potential for CCS to be a significant contributor to reducing carbon emissions in New Zealand is promising.

3.2 Risks

The environmental risks of CCS pertain mainly to storage and the chance of leakage. The risks associated with leakage of stored CO_2 can be divided into three different categories: those associated with abrupt leakage (i.e. a sudden release of a significant amount), gradual leakage (i.e. slow release of small amounts over a long time), and other risks.

Abrupt leakage of a large amount of highly concentrated CO_2 can suffocate oxygen-breathing organisms, particularly those dwelling in low-lying areas. CO_2 is much denser than air, so large concentrated clouds will remain close to the ground. This occurred in 1986 in the Lake Nyos disaster, where a sudden dense cloud of CO_2 that rose from the

[48] It is estimated the Maui Gas Field will become depleted within the next decade. See Funnell, R. see n15 above, 25.
[49] See Chapter One, 1.3, above.

lake killed 1700 people within a 25km radius.[50] However, this is not at all representative of the type of risk presented by leakage from geological storage sites.[51]

Gradual leakage comes with numerous environmental risks. The most obvious is its repudiating of the exercise's environmental objective: reducing CO_2 emissions. CO_2 also increases the acidity of water, so it could have detrimental effects on drinking water supplies near the storage site if leakage occurred. This chemical property also means that if aquifers are chosen as the storage site, there is potential for the increased acidity to erode surrounding minerals. This would result in the escape of CO_2 into neighbouring water tables.[52] There is also a risk of soil acidification and eco-system damage.[53] The level of risk associated with such escapes is relatively unknown, as the study of large bodies of CO_2 for the time periods involved in CCS has not previously been performed. However, leading scientists opine that (with a suitable regulatory framework) the risks associated with CCS are comparable to those seen in the oil and gas industries.[54]

The other key risk with gradual leakage is its potential to interfere with other competing uses of geological storage facilities. There is clearly a shared interest in injection of CO_2 between the petroleum industry and CCS, due to EHR and the mutually beneficial information gained from exploration. However, concerns have been raised as to the potential for CO_2 injection to interfere with these industries.[55] Other research (although not in a New Zealand context) has shown that saline aquifers may be desirable in the future as sources of water for irrigation or even drinking, in arid areas.[56] This gives rise to an allocation issue: potential CO_2 storage reservoirs are likely to be subject to competing use applications. This issue arises on two levels: between competing CCS industry

[50] "1986: hundreds gassed in Cameroon lake disaster", http://news.bbc.co.uk/onthisday/hi/dates/stories/august/21/newsid_3380000/3380803.stm, accessed 26 August 2009

[51] Benson and Cook, see n7 above, 211.

[52] House of Representatives Standing Committee on Science and Innovation, see n23 above, 61-2.

[53] Benson and Cook, see n7 above, 248

[54] IPCC, see n19 above, 12.

[55] Ministerial Council on Mineral and Petroleum Resources (MCMPR), 2005, *Carbon Dioxide Capture and Geological Storage: Australian Regulatory Guiding Principles*, 19.

[56] Davidson C. et al, "Accessing the impacts of future demand for saline groundwater on commercial deployment of CCS in the United States", *Energy Procedia* 1 (2009) 1949.

applicants where the site's capacity is limited, and between CCS industry and other industry applicants for alternative uses of the geological facility.

Other risks identified with CO_2 storage sites are their potential as terrorist attack sites, and their link to seismic activity.[57] These are issues that also ought to be accounted for in determining whether CCS storage sites are appropriate, and what type of conditions ought to be attached to their establishment.

[57] Bryer, C. and Bergman, P. "Issues Related to Seismic Activity Induced by the Injection of CO_2 in Deep Salin Aquifers", *Journal of Energy and Environmental Research* [2002] 32.

CHAPTER TWO: NEW ZEALAND'S CURRENT LEGAL FRAMEWORK

This chapter will describe how New Zealand's current legal framework would apply to a CCS stream. It does not aim to evaluate or criticise the legal framework. However, minor changes to current law would result in suitable regulation of CCS activities are acknowledged. The description is divided into the various key requirements needed to provide comprehensive regulation of CCS: environmental protection, access to land, allocation of storage space, employee safety, monitoring and information requirements, and liability post-closure.

1 Environmental Protection

1.1 Resource Management Act 1991 (RMA)

The RMA creates a three-tier hierarchy for decision-making about activities affecting the environment. The role of environmental management is largely delegated to regional councils, who are made responsible for managing public natural and physical resources.[58] There is right of appeal to the Environment Court for resource consent applicants and submitters on the application or review of consent conditions.[59] Central government's influence is limited generally to national policy instruments (which are interpreted and applied by LAs), although it has the power to intervene in specific circumstances.[60]

The Act aims to "promote the sustainable management of natural and physical resources", where sustainable management encompasses the (often conflicting) goals of "social, economic… cultural wellbeing and… health and safety" for the community.[61]

[58] RMA, s 30. Examples are air, water, soil, the coastal marine area and land uses that impact on water bodies.
[59] RMA, s 120(1).
[60] RMA, s 24-29. Examples are: where the matter is of environmental or national significance, where a local authority is not performing its functions under the RMA, and where an economic instrument is used to influence environmental outcomes.
[61] RMA, s 5(2).

LAs are accordingly given a wide discretion,[62] which requires them to consider and balance incommensurable values on a case-by-case basis.

A CCS stream would require a variety of resource consent approvals under the RMA. Installation of capture technology is unlikely to create any major concerns. A land-use consent would be required, depending on the terms of the relevant district or regional plan.[63] The consent authority would need to take into account the "actual and potential effects" of the activity in determining whether to allow it.[64] However, because separating and compressing CO_2 does not pose any risks in isolation, capture is unlikely to be denied. Transportation by pipeline would also require land-use consent; potentially more than one depending on how many territories the pipeline spans. It does pose a minor environmental risk in the potential for CO_2 leakage, and also minor degradation of amenity, which would both need to be taken into account.[65]

However, the more novel situation concerns storage of CO_2: both onshore and offshore. The RMA gives regional authorities various relevant functions to advance, including the mitigation or avoidance of natural hazards, the adverse effects from various uses of hazardous substances, and the maintenance of water quality.[66] The mechanism by which regional councils would be most likely to advance these functions in relation to onshore geological storage would be discharge to land permits. Injection of CO_2 into an onshore geological reservoir would be discharge of a "contaminant" into land, and so (presuming it was not permitted under the regional plan) would require a discharge permit from the relevant regional authority.[67]

Injection into an offshore, sub-seabed geological reservoir within 12 nautical miles (nm) of the New Zealand coast would also be governed by the RMA. This area is classified as

---

[62] For a discussion of various interpretations of s 5, and view that a particularly discretionary "overall broad judgment" approach is the appropriate one, see Fuller, P., "The Resource Management Act 1991: An Overall Broad Judgment" (2003) 7 *NZJEL* 243 at 244-256.
[63] RMA, s 9, s 87(a).
[64] RMA, s 104(1)(a).
[65] RMA, s 3, s 2 definition of "environment", s 7(c).
[66] RMA, s 30(1)(c).
[67] RMA, s 15(1)(d), s 2.

the "coastal marine area",[68] which means that a coastal permit would be required if the injection is "likely to have an adverse effect on the foreshore or seabed".[69] The Resource Management (Marine Pollution) Regulations 1998 give a list of substances for which dumping is deemed to be a discretionary activity under the RMA.[70] Dumping of substances not on this list is deemed to be a prohibited activity.[71] Streams from CCS for geological CO_2 sequestration is not on the list, despite it being in the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes or Other Matter 1972 (1996 Protocol), from which the rest of the list is derived.[72] This means that storage of CO_2 in geological facilities in the coastal marine area could not be applied for, and accordingly no resource consent could be granted for it.[73]

When considering a resource consent application, a consent authority must have regard to actual and potential effects of allowing the activity.[74] "Effect" is further defined in s 3 of the Act as including "any potential effect of low probability which has a high potential impact".[75] This is particularly important for the storage part of a CCS stream, which (as discussed above) involves a number of low probability but high potential impact environmental risks. Confrontation with "phantom" risks like this has seen courts apply a form of the PA.[76] The effect of this on CCS proposals is problematic and is discussed in Chapter Three.

[68] RMA, s 2.
[69] RMA, s 12(1)(d).
[70] RMMPR, s 4(2).
[71] RMMPR, s4(1).
[72] 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 29 December 1972 (2 November 2006, came into force on 10 February 2007) 1046 *UNTS* 120 (1996 Protocol), Annex 1, paragraph 1.
[73] RMA, s 77B(7).
[74] RMA, s 104(1)(a).
[75] RMA, s 3(f).
[76] *Te Aroha v Waikato Regional Council* (1993) 2 NZRMA 574; *McIntyre v Christchurch City Council* [1996] NZRMA 289; *Shirley Primary School v Christchurch City Council* [1999] NZRMA 66; see generally Somerville, R.J., "Water law: Risks, Values and Environmental Decision-Making", *Paper to the Royal Society 2003 Conference*, 14 November 2003.

1.2 Hazardous Substances and New Organisms Act 1996 (HSNOA)

The HSNOA operates alongside the RMA, but has a more limited scope. Where the RMA applies to environmental effects of all activities on a site-by-site basis, the HSNOA applies only to certain substances and organisms. The HSNOA aims "to protect the environment, and the health and safety of people and communities"[77] by regulating the use of certain substances. The HSNOA applies on a national basis, as compared with the RMA which is implemented through LAs. The Environmental Risk Management Authority (ERMA) is the regulatory body that determines substance use applications under the HSNOA, and is established in Part 4 of the Act. It is made up of legal and scientific experts.[78] Regional authorities, when determining applications under the RMA, must comply with HSNOA standards, although stricter conditions may be imposed.

"Hazardous substance" is defined as a substance with one or more of a list of "intrinsic properties".[79] To be classified as a hazardous substance, certain thresholds must be met.[80] CO_2 does not meet these thresholds.[81] CO_2 would also not fit the definitions of "new organism", nor "persistent organic pollutant", which are the other two types of substances explicitly regulated by the Act.

However, compressed gases, regardless of whether they have intrinsically hazardous properties, can have controls placed on them.[82] The controls currently placed on CO_2 as a compressed gas are contained in the Hazardous Substances (Compressed Gases) Regulations 2004 (HSCGR) and the Hazardous Substances (Tank Wagon and Transportable Containers) Regulations 2004 (HSTWTCR).[83]

[77] HSNOA, s 4.
[78] See ermanz.govt.nz (accessed 14 September 2009) for a list of the ERMA members.
[79] HSNOA, s 2.
[80] These are stated in the Hazardous Substances (Classification) Regulations 2001.
[81] Buckland, S., ERMA Compliance Co-ordination Manager, pers. comm.., 10 September 2009.
[82] HSNOA, s 140(5).
[83] See the CO_2 compressed gas approval notice at http://www.ermanz.govt.nz/appfiles/OrgCtrl/pdf/HSR001018Con.pdf, accessed 10 September 2009.

Capture of CO_2 does not involve a hazardous substance, so it would not be directly regulated by the HSNOA.[84] It also does not involve a use of CO_2 that is regulated by the controls placed on CO_2 as a compressed gas, which involve the storage and transport of compressed gases rather than their initial compression.

For transport by pipeline, the HSCGR would not apply, because its regulatory scope covers only portable containers and their fittings. Nor do pipelines come within the defined terms that govern the scope of the HSTWTCR. However, they would cover transportation by road or rail, should the instrument actually containing the compressed gas be a “tank” or a “transportable container” according to section 2. The HSNOA’s regulation of CO_2 transportation would thus differ depending on the mode of transport used.

In terms of storage, the HSNOA would not apply, again because CO_2 is not a hazardous substance. The controls placed on CO_2 as a compressed gas are also inapplicable. A geological storage reservoir is not a “tank wagon” or “transportable container” in terms of the HSTWTCR, nor is it a type of storage container covered by the HSCGR. Even if CO_2 was a hazardous substance, then the rest of the HSNOA would still not apply. Injection of CO_2 into a storage facility would not constitute “importation” or “manufacture”, which are the only hazardous substance uses regulated by the Act.[85]

1.3 Maritime Transport Act 1994 (MTA)

The RMA and the HSNOA only apply within the 12 nm territorial sea limit of New Zealand. Between this distance and either 200 nm or the edge of New Zealand’s continental shelf (whichever is further), the MTA applies instead. Seeing as there are no large point sources of emissions attributable to New Zealand beyond 12 nm, the MTA would only be relevant to the storage and transport parts of a CCS stream. The territory

[84] CO_2 is not a compressed gas. Buckland, S., pers. comm.., 17 September 2009.
[85] HSNOA s 25(1)(a).

covered by this zone is known as New Zealand's Exclusive Economic Zone (EEZ), pursuant to the 1982 United Nations Convention on the Laws of The Sea (UNCLOS).[86]

The MTA provides for the Director of Maritime New Zealand (MNZ) to issue permits for the dumping of waste for storage in the sub-seabed, in accordance with the Marine Protection Rules.[87] Part 180 of the Marine Protection Rules requires the Director to assess every permit application in accordance with "the criteria, measures and requirements for the granting of dumping permits set out in the London Convention".[88] "London Convention" is defined as including protocols thereto that have been ratified by New Zealand, which would include the 1996 Protocol.[89] It creates a ban on dumping of all substances unless they are expressly recognised in Annex 1. "CO_2 streams from CO_2 capture processes for sequestration" was added to Annex 1 in November 2006.[90] Accordingly, injecting CO_2 into the sub-seabed beyond 12 nm is a potentially permissible dumping activity.[91]

Transport of CO_2 by ships to a storage site beyond 12 nm would be subject to a voluntary code detailing good practice in ports and harbours,[92] and both voluntary and mandatory routeing requirements. A voluntary code has been published detailing good routeing practices.[93] Mandatory routeing requirements are imposed by Part 190 of the Marine Protection Rules. Transport of CO_2 by pipelines would be subject to the Submarine

---

[86] United Nations Convention on the Laws of the Sea (10 December 1982, entered into force 16 November 1994) 1833 *UNTS* 3, Article 57.
[87] MTA, s 262.
[88] Marine Protection Rules, Part 180 – Dumping of Waste or Other Matter, 180.8(c).
[89] Status of the London Convention and Protocol (2 October 2008) *LC* 30/2/1, http://docs.google.com/gview?a=v&q=cache%3AQ7jdwm45UigJ%3Awww.imo.org%2Fincludes%2FblastData.asp%2Fdoc_id%3D10252%2F2-1.pdf+1996+Protocol+to+the+London+Convention+New+Zealand&hl=en&sig=AFQjCNHmSuH82N8BMof64w499UcvPKI9vA&pli=1, accessed 16 October 2009. New Zealand ratified on 30 July 2001.
[90] The ban came into force 10 February 2007. See http://www.imo.org/, accessed 15 September 2009.
[91] This view is confirmed by the Maritime New Zealand website, see http://www.maritimenz.govt.nz/Environmental/Marine-dumping/Marine-dumping.asp, accessed 15 September 2009.
[92] New Zealand Port and Harbour Marine Safety Code, see http://www.maritimenz.govt.nz/Commercial/Ports-and-harbours/Port-and-harbour-safety-code.asp, accessed 15 September 2009.
[93] The code is called the "Voluntary Code for Ships Carrying Oil or other Harmful Liquid Substances in Bulk", http://www.maritimenz.govt.nz/Environmental/Environmental-requirements/Requirements-for-operators/Ship-routeing.asp, accessed 16 October 2009.

Cables and Pipelines Protection Act 1996 (SCPPA), which have a very wide definition of "pipeline".[94] The SCPPA imposes strict liability for damaging submarine pipelines,[95] various other protection measures to prevent damage to submarine pipelines,[96] and various obligations on their owners.[97]

2. Access to Land

Access to private land for the installation of transportation pipelines and injection of CO_2 for storage needs to be negotiated with landowners. However, if the status of the land is affected by either the Conservation Act 1987 or the Te Ture Whenua Maori Act 1993 (TTWMA), more than negotiation with owners is required.

2.1 Conservation Act 1987

The Conservation Act 1987 (Conservation Act) creates numerous statuses of land. Of particular relevance to CCS is "conservation area" land, to which the concessions regime in Part 3B applies.[98] Unless the activity falls under one of the exceptions in section 17O(3), then a concession is required from the Department of Conservation (DOC) to carry out (commercial) activities in conservation areas.[99] This is in addition to resource consents under the RMA.[100] The overlap between the Conservation Act concessions regime and the RMA has been identified as an issue requiring the legislature's attention, although any changes will not occur in the immediate future.[101]

---

[94] SCPPA, s 2.
[95] SCPPA, s 7.
[96] See for example, SCPPA, s 11.
[97] See for example SCPPA, s 19 and s 36(b).
[98] Conservation Act, s 17O(1).
[99] Recreational activities do not require concessions: Conservation Act, s 17O(4).
[100] Conservation Act, s 17P(1).
[101] Smith, N., Minster of the Environment, media release speech, 8 May 2009, http://www.beehive.govt.nz/speech/next+phase+rma+reform, accessed 23 September 2009. It was there suggested that Phase II of the RMA reforms, which encompass the interface between the RMA and the Conservation Act, will "progress at a more modest pace". The relative nature of the expression presumably refers to the pace at which Phase I of the reforms progressed, although this is not made explicit.

Because capture would be occurring at large point sources of emissions, which are not present in conservation areas, it would not require a concession. Transport by pipeline and geological storage may need access to conservation areas, and because none of the s 17O(3) exceptions would apply, a concession would need to be obtained. Various matters need to be taken into account in determining whether a concession should be granted, including the nature and effect of the activity,[102] where "effect" has the same meaning as in the RMA.[103] This means that the EC's interpretation of effect, which has seen it implement a form of the PA, is once again likely to be relevant.[104]

2.2 Te Ture Whenua Maori Act 1993

If any part of a CCS stream engaged "Maori land", [105] then gaining access to it would be complicated by the Te Ture Whenua Maori Act 1993 (TTWMA). If it engaged Maori customary land, then the land's status would need to be changed because Maori customary land cannot be alienated,[106] which implementing any part of a CCS stream would require.[107] If it was Maori freehold land, then a suitable alienation to provide for CCS processes could be made if the whole block was alienated, but alienating only an interest in the land is improbable. Interests can only be alienated to parties within the preferred classes of alienees,[108] and an entity implementing a CCS stream would be very unlikely to fall within any of these classes.[109] The procedure for alienating a block (or undivided interest) varies according to how the land is owned and what type of interest in land is sought, but will require agreement of a certain percentage of those holding an

[102] Conservation Act, s 17U(1).
[103] Conservation Act, s 2 definition of "effect".
[104] The implications of the PA are discussed in Chapter Three below.
[105] "Maori land" is defined as "Maori customary land and Maori freehold land" in s 4 of the TTWMA.
[106] TTWMA, s 145. Maori customary land can have its status changed only to under s 132, TTWMA.
[107] "Alienation" is defined very widely as including, in relation to Maori land, "the making or grant of any lease, licence, easement, profit, mortgage, charge, encumbrance or trust over or in respect of Maori land" in s 4 of the TTWMA.
[108] TTWMA, s 148.
[109] TTWMA, s 4. The classes generally consist of blood relations or fellow hapu members.

interest in the land.[110] If the alienation is by way of gift or sale, then prospective purchasers from the preferred class of alienees would have right of first refusal.[111]

3. Allocation of storage sites

3.1 The RMA and first come first served (FCFS)

As identified in Chapter One, the regulation of CCS projects is likely to involve determining priority between competing applications to use the same storage facility. Because discharge permits would need to be obtained, how storage rights are allocated would be determined partly by regional councils through the RMA. The yardstick currently used for this purpose has been coined "first come first served".[112] The approach was first established in *Fleetwing Farms v Marlborough District Council*,[113] and it gives priority to the first applicant in time. It has been suggested that priority will be determined once a consent application is ready for notification,[114] although this has not been confirmed above High Court level.[115]

There are two reasons that FCFS may not apply to CCS. The first is that *Fleetwing* may only apply where the competing applicants are trade competitors wanting to use the resource for mutually exclusive ends.[116] For example, if one applicant wanted to use the brine in a saline aquifer for CO_2 storage and another for irrigation, then FCFS may not apply because the applicants are in different trades. However, this exception is yet to have been applied. The second is that a rule-based approach like first-come first-served

---

[110] TTWMA, s 147 and 150A-D.
[111] TTWMA, s 147A.
[112] *Fleetwing Farms v Marlborough District Council* [1997] 3 NZLR 257, 265.
[113] Ibid.
[114] *Geotherm Group Limited v The Waikato Regional Council & Contact Energy Limited* [2004] NZRMA 1.
[115] In *Central Plains Water Trust v Ngai Tahu Property Limited* [2008] NZRMA 200 (CA), it was argued before the Court of Appeal that priority should be determined at the point where the application would be notifiable at [20]. However, the Court did not make a finding on the point, instead deciding the case on the policy ground that complex proposals ought not to be disadvantaged simply because, by nature, their implementation necessitates incremental resource consent applications (see [77]-[79]).
[116] *Ibid* at [36]-[37], Baragwanath J suggested that *Fleetwing* could be distinguished where the applicants are not "similar commercial competitors" advancing mutually exclusive applications for the same use of a resource.

may not remain the law for much longer, regardless of the competing applicants' trades. The Supreme Court has shown a desire to hear argument about whether a rule-based approach is appropriate, period.[117]

Chapter Three criticises the FCFS approach to allocation of storage reservoirs. Although the exceptions stated above show promise for making the rule determining allocation under the RMA more flexible, they are both speculative in nature. Accordingly, when the appropriateness of the RMA allocation of storage reservoirs is criticised in Chapter Three, it will only consider the FCFS approach.

3.2 Crown Minerals Act 1991 (CMA)

The CMA reserves to the Crown, in all land alienated from the Crown on or after the 1st of October 1991, "every mineral existing in its natural condition in the land".[118] It also reserves all "petroleum" whether or not the land has been alienated.[119] Seeing as UNCLOS reserves sovereign rights for coastal states to sub seabed resources in their EEZ, the CMA governs the allocation of onshore and offshore minerals.[120] No Crown owned minerals may be prospected, explored or mined without a permit granted under the Act.[121] Therefore, if a geological storage reservoir is considered a mineral, then allocation of storage space could also be subject to the permits regime under the CMA. Obviously, for land that has been privately owned since before 1 October 1991, allocation of minerals contained beneath the surface (except petroleum) would not be governed by the permits regime, but by negotiation with the landowner and the mineral owner (if a different person).[122]

---

117 *Ngai Tahu Property Limited v Central Plains Water Trust* [2009] NZSC 24.
118 CMA, s 11. The s 2 definition of "minerals" includes "fuel minerals", which includes coal and petroleum.
119 CMA, s 10.
120 UNCLOS, see n86 above, Article 56(1)(a).
121 CMA, s 8(1)(a). "Crown owned mineral" is defined in s 2 as "minerals that are the property of the Crown".
122 Christensen, S., (2004) "The law and mining", *Handbook of Environmental Law,* Harris, Rob (ed), Royal Forest and Bird Protection Society of New Zealand, Inc, Wellington, 280.

Three permits can be issued under the Act: prospecting (determining what land is likely to contain minerals), exploration (determining more precisely where the minerals are, drilling, and other activities prior to extraction), and mining. The policies for allocation of these permits are contained in mineral programmes.[123] There are different minerals programmes for different groups of minerals.[124] However, the allocation procedures under both currently operative minerals programmes contrast starkly with first-come first-served. Under the Minerals Programme for Minerals (Excluding Petroleum) 2008 (MPMEP), wherever "newly available acreage" becomes available,[125] or the Minister considers there will be "significant competitive interest for exploration or mining permits",[126] or "merit in using competitive tender allocation",[127] allocation methods may be used that involve directly comparing competing applicants.[128] Under the Minerals Programme for Petroleum 2005 (MPP), allocation usually occurs by a method of public tender.[129] Unless the permit holder owned the land, it would then also need to obtain an access arrangement to carry out activities pursuant to the permit,[130] which is likely to specify a number of restrictions such as the parts of land the permit holder may carry out the activity on and compensation.[131]

However, before this more sophisticated allocation regime will apply to CCS, the Crown must either own the land, or the geological storage formation must be qualified as a "mineral". Mineral is defined in the CMA as "a naturally occurring inorganic substance beneath or at the surface of the earth, whether or not under water".[132] It is clear that all geological storage reservoirs are naturally occurring and beneath the surface of the earth. However, "inorganic" is not further defined in the Act. In the Oxford Shorter English

[123] CMA, s 12.
[124] The minerals programmes currently in force are the Minerals Programme for Minerals (Excluding Petroleum) 2008 and the Minerals Programme for Petroluem 2005.
[125] MPMEP, s 3.5-3.6.
[126] MPMEP, s 3.9(1). In this situation, either "cash bonus bidding" or "staged work programme" bidding may be used.
[127] MPMEP, s 3.9(2). In this situation, "competitive tender bidding" may be used.
[128] Where applications have equal priority, the criteria considered vary depending on the type of permit being applied for. See MPMEP, Part 4.
[129] This is achieved through "Petroleum Permit Block Offers". See MPP, s 5.4.5.
[130] CMA, s 53-54.
[131] CMA, s 60.
[132] CMA, s 11.

Dictionary, it is defined as “not having the characteristics of living organisms”, with the alternative: “substances which do not contain carbon… except in some simple cases”.[133] The simple cases refer to substances that contain carbon, but which are generally considered inorganic nonetheless.[134] The phrase “whether or not under water” implies that water itself is not a mineral. Otherwise the phrase would be redundant – it would mean that minerals were minerals, whether or not they were underneath one particular type of mineral. This would also be in line with the delegation of water management to regional councils under the RMA.[135] Accordingly, saline aquifers, which are comprised of salt water, are not minerals within the CMA.

The main difficulty in classifying other geological storage reservoirs as minerals comes from the class created by the non-exhaustive list of examples given.[136] The list identifies materials that all have two other things in common: they are valuable natural resources, and their value is realised by extraction from land. The first of these qualities is present in all storage reservoirs. The second is not present. This supports the notion that geological storage reservoirs were generally not intended to come within the scope of the CMA.

Support also comes from the nature of the permits regime – particularly mining permits. “Mining” means “to take, win, or extract, by whatever means, a mineral existing in its natural state in land… for the purpose of obtaining the mineral”. [137] Injecting CO_2 into a storage reservoir is accordingly not mining, because it is not done for the purpose of obtaining the storage reservoir. This would make the application of the Act to CO_2 storage particularly awkward. It would enable prospecting and exploring for reservoirs, but not the use that actually makes those activities worthwhile: injection of CO_2. The complimentary nature of permits exacerbates this awkwardness. An entity that is granted a prospecting permit gains a subsequent right to an exploration permit, and the same right

[133] Oxford Shorter English Dictionary (2007), Oxford University Press, 1390.
[134] Ibid.
[135] RMA, s 30(1)(e). Regional councils are delegated “control of the taking, use, damming, and diversion of water”.
[136] “Minerals” definition, s 2, CMA.
[137] CMA, s 2 definition.

attaches to a prospecting permit for a mining permit.[138] Such a regime does not make sense in relation to a resource that is not mined.[139] This suggests that the CMA was not intended to apply to storage reservoirs.

Two counter-arguments can be made. The first is that the nature of the permit regime is determined by minerals programmes, and minerals programmes are not necessarily issued for all mineral groups. The Act explicitly acknowledges that permit applications may be received for minerals that do not have minerals programmes.[140] Therefore, arguing from the perspective of what minerals programmes indicate does not necessarily reflect what materials fall within the scope of the Act. Although this point is technically correct, something as fundamental as the type of permits offered across all other minerals programmes should not be dismissed as irrelevant so quickly. The three types of activities relating to minerals that the Act enables are also stated within the Act,[141] and the minerals programmes are created with a view to implementing the Act's requirements.[142] The nature of the permit programmes is a relevant yardstick for determining the intended scope of the CMA.

The second is that the class created by the minerals definition does not have to be as restrictive as outlined above. The definition states the relevant qualities required for classification as a mineral, and the examples are just that: examples. It is feasible that Parliament wanted to create a wide definition so as to cover minerals discovered to be valuable for reasons not apparent at the time of enactment. This counter-argument is the strongest. It means that whether geological storage reservoirs are minerals comes down to the question of what class the definition creates, which is debatable. However, the context

[138] CMA, s 32(1), s 32(3). However, this is subject to the relevant minerals programme: s 22(1)(a). For example, the Minerals Programme for Petroleum 2005 overrides the subsequent right attaching to a prospecting permit: s 5.3.6.
[139] Another example of this is in MPMEP, s 5.4, which states that whether exploration activities are likely to "maximise extraction of a saleable commodity" is an ordinary consideration in determining their approval. These observations suggest that the CMA was not intended to apply to storage reservoirs
[140] CMA, s 13 states: "where a mineral to which no minerals programme applies is (or in the opinion of the Minister, is likely to be) the subject of an application for a permit under this Part, the Minister shall exercise all his or her powers under this Part to ensure that a minerals programme is issued in respect of that mineral as soon as practicable".
[141] For examples, see CMA, s 2, 35 and 30.
[142] CMA, s 12.

of the Act, which sees extractability as a necessary element in a mineral, suggests the narrower interpretation is more appropriate. The long title is of no assistance,[143] and the complimentary nature of permits under the allocation regime makes applying it to storage reservoirs particularly awkward. This is accordingly an issue of some uncertainty. On the basis of the above assessment, saline aquifers are certainly not minerals, and other geological storage reservoirs are probably not minerals, but this is very hard to predict.[144] The appropriateness of this situation is considered in Chapter Three.

3.3 Beyond 12 nm: the MTA

There is a lack of policy direction given, both from central government,[145] and the courts,[146] about the allocation of sub-seabed storage space and the nature of dumping permits under the MTA. The issue is one that appears not to have been previously considered, presumably because the ocean and sub-seabed as waste dumping resources are not likely to become scarce.

4. Employee Safety

The Health and Safety in Employment Act 1992 (HSEA) promotes the prevention of harm to people in workplaces.[147] It is usually administered by the Department of Labour, but MNZ enforces the Act in the maritime sector.[148] Neither capture nor storage would seem to present significant problems for the application of this Act. Possible hazards to employees associated with capture machinery or a storage facility would be covered by the general duty imposed on employers to maintain a “safe working environment”.[149]

---

[143] The long title simply states that the CMA is “an Act to restate and reform the law relating to the management of Crown owned minerals”.
[144] “Minerals” refers to the way that term is defined in the CMA.
[145] The MTA itself contains no reference as to how storage space should be allocated, nor the nature of a dumping permit.
[146] There has been no litigation under s 262 of the MTA (Brookers case law search, 28 September 2009). The courts have accordingly not even had an opportunity to develop policy for these concerns.
[147] HSEA, s 5.
[148] http://www.osh.dol.govt.nz/law/hse.shtml, accessed 14/9/09.
[149] HSEA, s 6(a).

For transport by pipeline, the Health and Safety in Employment (Pipeline) Regulations 1999 (HSEPR) would apply. They require employers to take practicable steps to ensure pipelines are operated with a current "Certificate of Fitness" issued by a recognised certifying authority.[150] If the Certificate is no longer satisfied, then the pipeline must either cease to operate, or continue under conditions specified by a certifying authority.[151] The purpose of the Certificate of Fitness is to demonstrate that a pipeline (and associated equipment) complies with one of the recognised Codes or Standards listed. [152] Where there is no Code or Standard applicable to the pipeline, generally accepted industry practice will suffice.[153]

NZS/AS 2885 is a Standard that the Act recognises, and that would be readily adaptable to CO_2 transmission.[154] NZS/AS 2885 specifies design and construction requirements for steel pipelines used to transport hydrocarbon fluids, such as natural and manufactured gas, liquefied petroleum gas and natural gasoline.[155] CO_2 has some different properties to these substances, such as being corrosive when mixed with water, heavier than air, odourless, and not flammable.[156] These would need to be accounted for in adapting the Standard. The risk assessment process established in Australia under the Standard involves identifying the potential risks associated with transporting a gas on a metre-by-metre basis, which are then eliminated either by the design or management of the pipeline.[157] This type of thoroughness would make the Standard suitable for regulating the potential risks of CO_2 transport.

[150] HSEPR, s 11(1).
[151] HSEPR, s 11(5)(a).
[152] "Guidelines for a Certificate of Fitness for High-Pressure Gas and Liquids Transmission Pipelines", *Occupational Health and Safety*, February 2002, at 6; HSEPR, s 8(1).
[153] HSEPR, s 8(2).
[154] HSEPR, s 8(1), MCMPR, see n above,
[155] MCMPR RGP at 33.
[156] Ibid.
[157] Ibid.

5. Monitoring and Information Requirements

Related to proper management is the requirement of monitoring and reporting of information gathered about storage sites. Awareness of the volume and location of CO_2 present in the reservoir, and the amount (if any) which has leaked, would be important for the prompt employment of remediation strategies, engendering public confidence in the CCS process, and would also be useful for administering a CETS.[158] Without a CETS, monitoring requirements would be created through conditions on resource consents.[159] LAs would accordingly be the regulatory body approving of monitoring and information requirements, through the RMA.

6. Long-term liability

Given that the risks posed by CCS continue indefinitely, the issue of long-term liability is one of the key issues for regulating it appropriately. The current framework has two main tools through which liability for environmental degradation could be imposed: the RMA and the common law.

6.1 RMA

For storage onshore and up to 12 nm, an application for an enforcement order can be brought under the RMA.[160] However, many types of enforcement order cannot be made where the adverse effects the application is based on have been expressly recognised by a decision-maker.[161] The risks posed by CCS are known, so this would prevent most enforcement orders being made. Other orders could still be made if the adverse effect breached a resource consent, but given that resource consents are likely to have expired in the time frame being considered here, this is of no consequence.

---

[158] Ibid, 37.
[159] RMA, s 108(1). For the requirements of a valid condition, see *Waitakere City Council v Estate Homes* [2007] 2 NZLR 149 at [61]-[68].
[160] RMA, s 319(1)(a).
[161] RMA, s 319(2)(b).

Bonds can be used to encourage compliance with resource consent conditions, which can continue beyond the expiry of the resource consent.[162] The ability of this approach to deal with the long-term nature of liability presented by CCS is considered in Chapter Three.

6.2 Common law

There are four torts under which liability could be established for harms emanating from CCS: negligence, private nuisance, public nuisance, and strict liability.[163] Negligence liability attaches where harm is caused by a duty of care breach, imposed where the defendant ought reasonably to foresee that the plaintiff would be affected by her act or omission.[164] Nuisance liability attaches where there is an activity causing ongoing unreasonable interference with a person's right to enjoyment of an interest in land.[165] It is generally no defence that reasonable precaution and skill was used in undertaking the activity.[166] Public nuisance liability could also potentially attach due to the pervasive nature of risks posed by CCS. It attaches where an interference "which materially affects the reasonable comfort and convenience of a class of Her Majesty's subjects".[167] Finally, strict liability attaches where a non-natural use of land leads to an isolated escape of something harmful causing damage.[168] Reasonable care is again not relevant.[169]

---

[162] RMA, s 108A(1).
[163] "Strict liability" refers to the action first recognized in *Rylands v Fletcher* (1868) LR 3 HL 330 (HL), which has been described in the New Zealand Court of Appeal as a subset of private nuisance rather than a separate action in its own right: *Hamilton v Papakura District Council* [2000] 1 NZLR 265 at 283. However, there are important differences between the two torts that mean they ought to remain distinct: see Smillie, J., "The Rule in *Rylands v Fletcher*", *The Law of Torts in New Zealand*, Todd, S. (ed.), 5th ed., 2009, at 517-518.
[164] *Donaghue v Stevenson* [1932] AC 562, 580 (HL).
[165] Smillie, J., "Nuisance", *The Law of Torts in New Zealand*, Todd, S. (ed.), 5th ed., 2009, 462.
[166] Ibid, 483-4. Where the nuisance is caused by an unauthorized third party or someone over whom the occupier has no control, then the occupier must adopt or continue the nuisance to be liable: see *J L Tindall v Far North District Council* 20/10/06, Winkelmann J, HC Auckland, CIV-2003-488-135, [65]-[70].
[167] See for example *Attorney-General v Abraham and Williams Ltd* [1949] NZLR 461 (CA); *Amalgamated Theatres Ltd v Charles S Luney Ltd* [1962] NZLR 226; *Lower Hutt City Council v Attorney-General ex rel Moulder* [1977] 1 NZLR 184, 190-91 (CA).
[168] *Rylands v Fletcher* (1868) LR 3 HL 330 (HL); *Hamilton v Papakura District Council* [2000] 1 NZLR 265, 283 (CA).
[169] *Hamilton v Papakura*, Ibid.

Causation would also need to be demonstrated. A defendant is not liable for harm unless her conduct caused it.[170] A "but-for" test is used to determine this, which questions whether the specific plaintiff would have suffered the loss but for the particular defendant's conduct.[171] It will be shown in Chapter Three that this element could cause difficulties in imposing liability.

7. Summary of areas which are and are not adequately regulated

In summary, the areas of uncertainty and unsatisfactory regulation pertain almost entirely to the storage phase of a CCS stream. Capture and transportation are activities that essentially present no novel problems, and current regulations would adequately protect the environment and public health and safety. However, the problems associated with the regulation of storage are of real concern. That such an activity was not envisaged at the time of enactment of most pieces of legislation considered here is clear, with only one being adapted which relates to the subseabed "dumping" of CO_2 beyond 12 nm.[172] Bizarrely, no equivalent amendment has been made to the regulations pertaining to the area within 12 nm of the coast, meaning that CO_2 storage would be a prohibited activity in this area. Serious problems with determining the scope of the CMA and concerns with leaving long-term liability to the common law or the RMA are also pressing. These concerns are elucidated in Chapter Three.

---

[170] Todd, S., "Causation", *The Law of Torts in New Zealand*, Todd, S. (ed.), 5th ed., 2009, at 942,
[171] Ibid.
[172] The MTA is the Act being referred to. See above, Chapter Two at 1.4.

CHAPTER THREE: PROBLEMS WITH THE CURRENT REGULATORY FRAMEWORK

Chapter Two described the current regulation of CCS, concluding that the capture and transportation processes would not present any significant problems. Chapter Three accordingly focuses on the storage aspect of CCS, identifying four fundamental problems: implementation of the PA, lack of an appropriate system for the allocation of storage space, liability for adverse environmental effects in the long-term, and the decentralised nature of key environmental regulatory bodies. Ways of altering this framework to more satisfactorily regulate CCS are reserved for Chapter Four.

1 The PA as it is currently implemented

1.1 Background and description of the PA

For decisions made about acceptable levels of risk to be coherent, there needs to be a consistently applied policy for dealing with potential adverse effects on the environment. The PA is one such policy. It requires the taking of precautionary measures even where there is no certain link between an activity and adverse environmental effects. [173] It has become common in international environmental law,[174] and its influence has also reached New Zealand courts.

1.2 The application of the PA in New Zealand courts

The PA is relevant to the Court's decision-making process in two senses. The first is risk assessment – when evaluating evidence to determine if a posited risk fits the section 3

[173] Principle 15 of the declaration states that "the PA shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."
[174] The approach has even been described as "customary international law", see Agius, J., "International Environmental Law and State Sovereignty" (1998) 3 *Asia Pacific JEL* 269, 275.

definition of "effect".[175] The second is risk management – after determination of the inquiry regarding which risks constitute "effects", the PA can be used to determine an appropriate strategy for management of the risks.[176] The discussion here predominantly relates to risk assessment.

In relation to risk assessment, the Court in *Shirley Primary School v Christchurch City Council*[177] identified an important ambiguity in section 3(f) of the RMA. The Court noted that it could either refer to low statistical probability (the chance of a scientifically certain effect occurring) or low scientific probability (whether there is actually a link between an effect and an activity).[178] The analysis below will show that the Court employs a strong PA where the uncertainty is only statistical, but is unwilling to invoke it where the uncertainty is scientific.

Te Aroha Air Quality Protection Group v Waikato Regional Council[179] is an example of the EC applying the PA to find a statistically uncertain risk unacceptable. The case concerned an application for discharge of contaminants to air from a rendering plant near a motor camp and racecourse. There was a plausible risk, albeit of low probability, that the discharge would be odorous and negatively affect the surrounding area. The Court held that this potential effect would "degrade the amenity values" of neighbouring properties and require neighbours to "endure objectionable effects for periods of up to two hours". Consequently, the application was declined.[180]

McIntyre v Christchurch City Council[181] and *Shirley* are two examples of scientific uncertainty cases where the PA was not employed for risk assessment. Both of these

[175] Implementation of the approach here notoriously relates to informing whether an environmental risk is "a potential effect of low probability and high potential impact", as stated in the RMA s 3(f).
[176] Examples of the types of measures a court could employ in implementing the approach in this sense include utilisation of best practicable options, contingency plans and environmental audits. See Somerville, R.J., "Water law: Risks, Values and Environmental Decision-Making", *Paper to the Royal Society 2003 Conference*, 14/11/2003, 22.
[177] [1999] NZRMA 66.
[178] Ibid at [134].
[179] (1993) 2 NZRMA 574.
[180] Ibid.
[181] [1996] NZRMA 289.

cases concerned the potential adverse consequences to human health of proximity to power transmission lines. In *McIntyre*, the hypothesis was that living in close proximity to power lines causes health problems such as cancer. The lack of any "real" evidence to support this hypothesis meant that no regard was had to the risk. It was too scientifically improbable to be considered an "effect". Similar reasoning was employed in *Shirley*. It concerned the possibility of telecommunications facilities harming the health of people at a nearby primary school. The Court again refused to take this risk into account, because it was lacked an evidential foundation.[182]

1.3 Effect of the PA on CCS

The risks posed by CCS are risks of statistical uncertainty; their science is proven. CO_2 makes water more acidic, is dangerous to oxygen-breathing organisms if its atmospheric concentration exceeds two percent,[183] can kill vegetation if it accumulates in soil,[184] and is the main GHG contributing to climate change.[185] The uncertainty relates to the probability of leakage actually occurring to such a degree it would have these effects. Therefore the risks posed by CO_2 storage are distinguishable from *McIntyre* and *Shirley*, where the risks lacked foundation in scientific evidence. Rather, CCS is analogous to the odorous discharges from the rendering plant in *Te Aroha*, where the probability of malfunction was the concern, not uncertainty regarding the effect an odorous discharge would have on the neighbouring environment.

Accordingly, the PA of New Zealand courts may result in many CO_2 storage applications being declined. The Court would not be able to dismiss the potential effects as "mere hypotheses" like the posited harms in *McIntyre* and *Shirley*, because they are based on scientific evidence. Furthermore, they are also much more serious in degree. If an

[182] *Shirley*, see n76 above at [147].
[183] Benson and Cook, see n7 above, 152.
[184] Benson and Cook, see n7 above, 154.
[185] The IPCC concluded that anthropogenic greenhouse gases are "very likely" to be the cause of observed increase in global temperatures, and described CO_2 as "the most important anthropogenic greenhouse gas", due to its significantly greater concentration than any other GHG. See IPCC, 2007: "Summary for Policymakers", in *"Climate Change 2007: The Physical Science Basis, Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* 2, 10.

uncertain potential to affect people's "appreciation of pleasantness" of an area for two hours at a time is considered serious enough to justify declining a discharge permit,[186] then contaminating groundwater, inducing earthquakes, contaminating surface soil, and adversely affecting respiration of oxygen-breathing organisms would certainly qualify.

A counter-argument is that the effect of the PA is such that, if adaptive risk management is employed, the approach does not have to result in a prohibition on CO_2 storage proposals. For example, in *Clifford Bay Marine Farms v Marlborough District Council*,[187] a mussel farm that posed a risk to hector's dolphins was not declined, rather a condition was imposed requiring scientific research into the significance of the area for the dolphins after which the application would be determined.[188] Applying this to CCS, a condition requiring the gathering of scientific data about the likely effects of injecting CO_2 into the particular storage site concerned ought to mean the project can still be allowed. However, the Court would be unlikely to employ this strategy in relation to the risks associated with CO_2 storage. *Clifford Bay* concerned scientific uncertainty about the impact of an activity on hector's dolphins – not the probability of an effect occurring. The court has not shown the same flexibility towards risks with only statistical uncertainty.

This outcome is unsatisfactory for two reasons. Firstly because it does not allow for proper consideration of the significant national benefits associated with CCS. It contributes to the mitigation of harmful climate change, is likely to benefit New Zealand's coal exports, and give New Zealand greater energy security. When the probability of risk is so low, and the magnitude of benefits so high, the approach ought to be more flexible. Secondly because the primary method by which a risk can be shown as acceptable is through actually implementing it, even if on a small scale to begin with. The way CCS has been tested and developed in other countries is through initial small scale

[186] As it was in *Te Aroha*, see n76 above, 12.
[187] C 129/2005, Environment Court, Christchurch, Judge J R Jackson, 16 September 2005
[188] Ibid at [136].

temporary tests, often called "pilot" projects, before upsizing to a commercial scale.[189] The PA would prevent this from occurring in New Zealand.

2 Lack of Appropriate System for the Allocation of Storage Space

2.1 RMA versus the CMA

Chapter One stated that CO_2 storage in geological formations has the potential to negatively impact on other minerals in the subsurface, and that storage formations are likely to be subject to competing use applications. Chapter Two identified uncertainty in whether the CMA would apply, and described the FCFS approach under the RMA. The allocation of storage space, in light of these observations, is inadequate for five reasons.

The first is identifying the allocation regime that needs to be considered. Whether the CMA is applicable is uncertain, but it appears only to engage minerals that have their value realised in extraction. When the alternative allocation regime under the RMA is starkly contrasting, uncertainty about which regime applies is problematic. It significantly increases transaction costs for early CCS proponents, who (without legislation) can only have certainty provided through a clear appellate court judgment. Waiting for this to happen, which will necessarily have to involve a policy choice based on ill-designed legislation, is not a satisfactory solution.

Secondly, neither the RMA nor the CMA contain policies that would address the concern that injection of CO_2 into the subsurface could negatively impact on the exercise of entitlements to other subsurface minerals. This raises the question of the nature of permits, and the type of rights they confer. The MPMEP allows permits to be granted over the same area of land for different mineral groups, without resolving the potential for there to be adverse impact of exercising that permit on rights-holders of other

[189] This has occurred, or is occurring, in Germany, Australia, USA, Japan, China, Canada, and the Netherlands. See Benson and Cook, n7 above, 201.

minerals.[190] Simply allowing conflicting permits to exist would undermine security of the rights attaching to those permits. This conflict requires direct consideration.

Third is the rule for RMA's allocation rule, FCFS. Chapter Two found that allocation of all geological formations was more likely to fall outside of the CMA, which means that resource consent allocations would determine how competing uses are prioritised. This has three fundamental problems. Firstly, FCFS prevents comparison of competing applications on their merits. Although this provides certainty, where sustainable management of natural resources is the aim, a more contextual approach is called for.[191] Secondly, it creates a perverse incentive structure in which applicants prioritise submitting earlier rather than to a higher standard. Environmental regulation that encourages bare compliance, rather than best practice, does not ensure resources are allocated to the end users who will best utilise them. Thirdly, because the rule has been used to justify conceiving of resource consents through a property paradigm,[192] the granting of a discharge permit would block out future, potentially more desirable uses of storage reservoirs. For example, if it became apparent after approval of a permit to discharge CO_2 into a saline aquifer that it would be a useful drinking water source, nothing could be done to derogate the permit to instead utilise it for this purpose, regardless of the public interest.

Fourth is the impact of drawing a distinction between saline aquifers and other formations (if the CMA does encompass those other formations). This distinction can partially be justified on the basis that ground water use is of much greater significance to regional communities than use of, for example, unmineable coal seams. Allocation should therefore be the prerogative of regional councils. However, the desirability of this distinction from the perspective of appropriately regulating the CCS industry is dubious. Choosing to exempt saline aquifers from the more onerous and competitive allocation procedure under the CMA would make them much more appealing as storage options.

[190] See the Minerals Programme for Minerals (Excluding Petroleum) 2008, s 2.4.
[191] Baragwanath J makes this point in the context of freshwater allocation in *Central Plains Water Trust*, see n115 above, at [97].
[192] For example, in *Aoraki Water Trust v Meridian Energy* [2005] 2 NZLR 268 at [31] the High Court decided that resource consents gave "an exclusive right to [a] resource."

They would be sought out over other geological reservoirs. This would mean that the type of storage reservoir with the most obvious alternative use would become the resource that most often had alternative uses blocked out.

Finally, if the CMA does actually encompass storage reservoirs, then its permits regime is ill-equipped to deal with the CCS industry. There is no such thing as an "injection" permit, and exploration and prospecting permits are to be interpreted with a view to advancing goals associated with mining, such as maximising extraction of a commodity. Applying this concept to storage formations is awkward. If the CMA was to sensibly regulate CO_2 injection, then the permits regime would need to be significantly reformed.

2.2 MTNZ and offshore storage beyond 12 nm

Chapter Three assumed that the lack of policy guidance on allocation of the sub-seabed as a waste-dumping resource is due to its abundance for that purpose. Given that the major sub-seabed storage reservoir, the Maui gas field, is estimated to contain enough storage space to hold more than 17 times the amount of capturable CO_2 emissions New Zealand currently generates, this assumption holds true for CCS.[193] Due to the lack of jurisprudence on this issue and the lack of need for any, providing a detailed and specific critique would be inappropriate. However, the thrust of the arguments made above for onshore storage still apply: the issue is one that (if it arises in an offshore context) needs a framework that allows for flexible and comprehensive consideration, which is not currently provided.

3 Long term liability

A liability scheme addressing the risks posed by CCS would need to serve two main functions: remediation of damages, and compensation of victims. From this perspective, the imposition of bonds under the RMA can be conceived as attempting to perform the first. The common law, given the ongoing and sometimes irreversible nature of harms

[193] Funnell, R., see n15 above, 26.

posed by CCS and its *post facto* imposition, is more suited for performing the second. It is against this background that the inefficacy of the current law on long-term liability will be demonstrated.

3.1 Bonds as conditions on resource consents

Bonds can be required as security for the performance of conditions imposed on resource consents.[194] Bonds may continue after the resource consent has expired,[195] making them an appropriate tool for guarding against post-closure environmental harms. They have been commonly employed in the mining industry to ensure proper site cleanup during closure, particularly where mining is on conservation land.[196] However, there are two serious problems with using one-off bonds on a site-by-site basis as a safeguard against the long term risks of CCS. They are both based on the premise that, for a bond to be effective, it would have to be approximately as large as the cost of remedying the harm. This premise is justified because the long timeframes involved with CCS mean that the site operator may no longer exist when the harm giving rise to liability occurs. If the site operator no longer exists, and the bond they put down is not sufficient to cover remediation, then the burden of the risk is effectively shifted to the community. Such a situation is not defensible.

Bearing this in mind makes the problems with bonds apparent. The first problem is quantifying the cost of remediation. The cost of remediation for leaky sites was unknown in a recent investigation,[197] and because risk assessment methodologies are developed with time, research and experience, none is likely to be adequately developed for CCS for some time. This is a major distinguishing feature between CCS and the mining industry, where bonds are used. In the mining industry there is a long history and wealth of knowledge allowing for costs to be more reasonably estimated.[198] By contrast, determining the appropriate quantum for a CCS bond is unrealistic. The second is that

[194] RMA, s 108(2)(b).
[195] RMA, s 108A(1).
[196] Stimpson and Co, *Aquaculture Risk Management Options*, December 2007, 49.
[197] Benson and Cook, see n7 above, 69.
[198] Stimpson & Co., see n196 above, 49.

imposing a bond at this level is likely to make the cost of gaining a discharge permit prohibitively high. This is inappropriate because careful site selection and sound regulatory oversight can make the risks comparable to other industries.[199] Imposing bonds effectively would therefore create an incredibly strong deterrent for CCS, without environmental justification. The third is the temporal duration of the bond. Although the possibility of leakage and harm being caused by stored CO_2 continues indefinitely, the bond would have to be temporary. The crux of a bond is to encourage performance of obligations, and if it lasted forever there would be no incentive. The options are therefore either to impose the bond for an indefinite amount of time, giving the site operator no incentive to perform the obligations; or impose the bond temporarily, and then have no entity responsible for the continued monitoring and maintenance of the site. It is clear that one-off bonds on resource consents are not an appropriate way to solve the liability problem.

3.2 The common law

Firstly, the element of causation would make establishing liability extremely difficult, even if harm was realised. The "but for" test described above is problematic due to the nature of CCS risks. For example, research suggests that storage of liquids in the subsurface merely shifts seismic events that would eventually occur anyway to the present.[200] The harm would therefore not have technically been "caused" by the CO_2 storage, for the purposes of tort liability. Causation also requires proof that the particular CO_2 storage project lead to the particular harm claimed for.[201] Demonstrating that leakage from a CO_2 storage site has occurred would not prove that it was the source of groundwater leakage causative of harm.[202] This makes the common law weak as a deterrent against preventing environmental harm, and ineffective as a tool for compensating victims.

---

[199] IPCC, see n19 above, 12.
[200] Cypser, D., & Davis, S., "Induced Seismicity and the Potential for Liability under U.S. Law" (1998) *Tectonophysics* 239.
[201] Todd, S., see n170 above, 942.
[202] This problem has caused litigants problems in establishing liability in toxic tort litigation. See de Figueiredo, Mark Anthony, *The Liability of Carbon Dioxide Storage* (PhD thesis, Massachusetts Institute of Technology, February 2007), 170.

Secondly, the very procedure of establishing common law liability makes it unsatisfactory. It is costly, time-consuming and pertains to individual actions when group actions are likely to be needed for proper remediation.[203]

Thirdly, where the site operator is insolvent or no longer exists, which is likely given the long time-frames involved, tort law is completely ineffectual. Indeed, the risk of tortious liability actually provides an incentive for site operators to either dissolve their companies post-closure, or transfer their assets and capital to a different company. Given that using the corporate structure to guard against potential future liabilities is not illegal, it is a practice likely to be adopted.[204]

These problems with current long-term liability mechanisms mean that the burden of risk associated with CCS is shifted to the community. Given that it is the body most likely to suffer environmental harms and the least likely to profit from CCS, imposition of such serious risks is unacceptable.

4 Environmental Regulatory Bodies

As described in Chapter Two, the regulatory agencies and enactments that would potentially be engaged by a CCS project are numerous. However, by far the most pervasive piece of legislation for environmental regulation of storage onshore and offshore up to 12 nm is the RMA. Therefore the appropriateness of the regulatory bodies administering the RMA is most important. Evaluation of the other agencies will come secondarily. For clarity, the bodies considered here are evaluated in terms of their appropriateness as primary decision-makers, or first ports-of-call, under the current framework.

---

[203] Somerville, R., *Risk, regulation and the Resource Management Act 1991: the case of electricity generation and transmission* (PhD thesis, University of Otago, Dunedin, 2001), 407.

[204] *Adams v Cape* [1990] Ch 433. There is an alternative approach which would hold those behind a company liable where not doing so would cause a "substantial injustice" which the Court "cannot countenacnce", but it has not yet actually been applied by a New Zealand Court: see *Chen v Butterfield* (1996) 7 NZCLC 261,088, 261,092.

4.1 Local Authorities (LAs)

It is acknowledged that there are a number of benefits to decentralisation of authority for environmental decision-making. Pragmatically, decentralisation results in a more participatory process in which those who will be most affected by an adverse environmental effect are given a fair opportunity to influence the outcome. Their elected representatives are the decision-makers. It also means that trust is likely to develop over the long-term between developers and the community.[205]

However, the decisiveness of the role that the community plays in the process is actually one of the greatest drawbacks from LAs. If the community is prepared to tolerate a high risk of an adverse impact on the environment because of, for instance, the socioeconomic benefits from an activity, then environmental objectives are actually thwarted. An example of this is *An Application by ECNZ to the Bay of Plenty Regional Council for resource consents in the matter of the refurbishment of the Matahina Dam.*[206] In this case, reluctance to the building of a hydroelectric dam on an earthquake fault-line was relaxed when the proponent gave assurance that a temporarily shifted school would be able to return to its former site. The potential for adverse effect on the environment was not the community's concern. Furthermore, this is not an isolated example.[207]

Applying a community-oriented approach to CO_2 storage would be problematic. Its potential to bring socioeconomic benefits by itself is minimal, as storage is the least expensive part of a CCS stream, and it poses serious risks to the local environment. It is

[205] For a summary of arguments in favour of having LAs as decision-makers, see Somerville, n203 above, 276-279.
[206] *Bay of Plenty Regional Council file no. 050879*. For a summary of the case, see Ibid, 230.
[207] *Trans Power v Rodney District Council* 14 November 1994, Sheppard J, PT Auckland A85/94; and *Proposed Taranaki Power Station – Air Discharge Effects: Report and Recommendations of the Board of Inquiry pursuant to section 148 of the Resource Management Act 1991* cited in Ibid, 223, 246-269, are further examples that show a similar trend. See generally Somerville, n203 above, 296-309.

therefore likely to attract community opposition.[208] Given LAs' tendency to prioritise community perceptions, the decision is unlikely to be in favour of CO_2 storage, nor to give appropriate weight to environmental objectives. Whether a project goes ahead should be based on objective scientific evidence about the risk actually posed, and wider considerations policy concerns such as the reduction of carbon emissions, not the degree of community buy-in.

The nature of the risks storage presents also means that LAs' community-centric focus is problematic. One of the risks with storage is migration of the CO_2 to contaminate other resources. Permission to inject CO2 into a reservoir could accordingly be given in one jurisdiction, but have adverse effects on constituents of different regions outside that jurisdiction.[209] A council concerned only with the environment and public perceptions of risk within its own community is accordingly not in a qualified position to be judging the appropriateness of CO_2 storage applications.

Finally, in New Zealand there is a mismatch between needs and resources at a regional level for dealing with costly environmental issues that require employment of skilled technical staff.[210] Jurisdictions that would be confronted with storage applications may not have the expertise to properly process them.

Given that LAs often prioritise community buy-in over more relevant criteria for assessing the acceptability of risks, they are not in a position to be determining inter-jurisdictional risks and they lack expertise, LAs are an inappropriate CCS regulatory body.

---

[208] In the United States, the implementation of CCS has precipitated an outspoken citizen-initiated opposition group called "citizens against carbon sequestration". See http://citizensagainstco2sequestration.blogspot.com/, accessed 24 September 2009.

[209] Department of Primary Industries, January 2008, *A Regulatory Framework for the Long-Term Underground Geological Storage of Carbon Dioxide in Victoria*, Victorian Government (Aus) 67.

[210] Technical Advisory Group (TAG), February 2009, *Report of the Minister for the Environment's Technical Advisory Group*, Ministry for the Environment, 59-60.

4.2 Environment Court (EC)

The EC could be a primary decision-maker under the RMA if the call in provisions were used. The RMA allows a matter to be "called in" if it concerns a "proposal of national significance".[211] In determining this, three factors that relate to CCS are expressly listed as relevant:[212]

> (d) affects or is likely to affect or is relevant to New Zealand's international obligations to the global environment; or
> (f) involves or is likely to involve technology, processes or methods which are new to New Zealand and which may affect the environment; or
> (i) affects or is likely to affect more than 1 region or district.

These mean that a CO_2 storage application is likely to be called in. Accordingly, it could be referred to a board of inquiry (BOI) or the EC as the first port-of-call.[213]

The EC has legal expertise and competence in evaluating evidence about environmental risks. It is particularly well placed to interpret and apply policy direction from central or local government. As a judicial body, this is its specialty. Because of its detachment from the local community, its decisions about potentially hazardous activities are also less susceptible to inappropriate prioritisation of non-environmental factors.

However, two main reservations apply. The first is that the influence of LAs within the RMA regulatory framework is not confined to their position as decision-makers. Although the EC can hear cases de novo,[214] it would still be applying regionally made policy statements and plans.[215] This means that the concerns outlined above about inappropriate prioritisation of issues pertaining to the local community could still prevent sound decision making. The second is that the Court is overworked. One of the major

[211] RMA, s 142(1).
[212] RMA, s 142(3).
[213] RMA, s 142(1).
[214] RMA, s 290(1).
[215] RMA, s 104(1)(b)(iii)-(iv).

motivations for recent reform proposals of the RMA has been how slow hearings are.[216] Because CCS projects would need to begin soon to be worthwhile,[217] using a body already clogged up with other applications is undesirable.

4.3 Boards of Inquiry

If a BOI is the preferred option after an application has been called in, the Minister must appoint between three and five members to the board, including a current, former or retired EC judge as the chairperson.[218] This is a body which, given that its members would be appointed based on experience in relevant matters,[219] is likely to have the expertise to regulate the risks involved with a CCS proposal. Furthermore, its more centralised nature means it is more likely to give due weight to the wider significance of CCS. Although the board would be ad hoc by nature, only a very small number of CO_2 storage applications are likely to be made due to New Zealand's limited CCS potential. Ad hoc meetings would therefore be a likely feature of an appropriate regulatory body anyway.

However, the appointment of BOIs is still at the Minister's discretion. They are designed to handle exceptions for the unexpected. When the alternative primary decision-makers are not appropriate for CCS regulation, leaving it to the whim of the Minister to determine whether an alternative body hears the application is unsatisfactory. Their involvement would need to be made mandatory in order for the regulatory body engaged by the RMA to be appropriate.

This would not sit well with the pervasive decentralised philosophy of the RMA. As noted above, LAs could still exercise influence through plans, for example by classifying the activity. Decentralisation would result in prioritisation of inapposite concerns, and relegation of benefits of a wider national nature. This would mean that, to have a board

[216] TAG, see n210 above, 4.
[217] Page, see n39 above, 6.
[218] RMA, s 146.
[219] RMA, s 146(4)(b).

able to make decisions appropriately, LA influence through plans and policy instruments would need to be removed. The framework would then be one of mandatory centralised decision-making without regard being had to plans – which goes against the thrust of the the Act's decentralised nature. It is therefore clear that, if BOIs were to be used for regulating the environmental effects associated with CCS, the RMA would not be the appropriate Act under which they should be brought together.

4.4 Other regulatory agencies

None of the criticisms levelled against LAs or the EC above apply to MNZ, DOC or ERMA. They are centralised bodies, with expertise in their respective fields, and which do not have significant workload issues. There is accordingly no problem with them being the decision-makers for the roles they play in the regulatory framework. Furthermore, DOC and ERMA are not ultimately responsible for the holistic assessment of the environmental effects of activities, like the bodies administering the RMA. Their appropriateness is accordingly of less importance.

5 Summary of problems with the current regulatory framework

The current implementation of the PA in the EC may result in either denial of many storage applications or very careful site selection. The uncertainty associated with the approach, the lack of scope it provides for considering environmental benefits, and its lack of allowance for pilot projects combine to make it inappropriate when applied to CO_2 storage regulation.

The allocation of storage reservoirs may be subject to either the RMA, the CMA, or both. There are four problems with this: the uncertainty regarding which regime applies, the inappropriateness of first-come first-served under the RMA, the effect of treating saline aquifers under a distinct regime, and the awkwardness of regulating allocation using the CMA. Where there is such potential for competition from other CCS proponents and other industries, a more coherent and context-specific allocation framework is required.

The primary concern with long-term liability is the very long timescale involved. The potential for adverse environmental effects long after the site has closed down means that site operators may not exist when liability for environmental harm actually arises. This concern makes the use of bonds under the RMA, and tortious liability in the common law, unsuitable for enforcing long-term liability. The causation element in tort also means that establishing liability against site operators would be difficult even if they still exist when liability arises.

The chief decision-makers under the current environmental regulatory framework, LAs, are too decentralised to be appropriate CO_2 storage decision-makers. Their tendency to prioritise community interests, inability to balance inter-jurisdictional risks and lack of expertise are problematic. Although the EC is a competent judicial body, it is over-worked. BOIs appear appropriate, but the pervasive decentralised philosophy of the RMA would still hamper their ability to make appropriate decisions. Other regulatory agencies within the framework do not have the same flaws.

CHAPTER FOUR: A NEW REGULATORY FRAMEWORK FOR CCS

1 Introduction

Having described the ill-designed nature of the current regulatory framework in Chapter Two, and elaborated on four fundamental problems in Chapter Three, it is now necessary to consider how to alter the current framework for CCS. This chapter argues that the regulatory challenge presented by CCS would be best addressed through standalone legislation.

2 Policy for dealing with risks of adverse environmental effects

Chapter Three described how the PA would effectively prohibit CO_2 storage proposals. Any amendment of the current regulatory framework with a view to accommodating the CCS industry would need to address this problem. Discussion of how this might be achieved is divided into three parts. The first defines the scope for using policies to assess and manage risks as opposed to creating specified bottom lines. The second concerns, where it is appropriate to use policies, whether the PA is the appropriate one to employ. This paper argues that it is. The third is how the current PA as implemented under the RMA ought to be altered for more appropriate regulation of CCS.

2.1 The scope for regulatory bottom-lines

The inappropriate use of regulatory bottom lines can stifle innovation, lead to worse environmental outcomes, and make industry requirements overly bureaucratic.[220] However, appropriate use provides certainty and ease of implementation that cannot be replicated by policy employment on a case-by-case basis. Accordingly, identifying which risks can appropriately be regulated using bottom lines is a task that should be approached carefully. Whether there is sufficient (statistically quantifiable) certainty of

[220] Somerville, see n203 above, 410-415.

environmental effects would seem to be an obvious criterion for determining their appropriateness. Applying such logic to CCS shows that firstly, due to its immaturity, many of its effects would not be suitable for regulation using rigid bottom-lines. Secondly, using bottom-lines alone would be inappropriate for CCS in any event because factors relevant to determining whether the risk posed is acceptable are so site-specific, including proximity to groundwater reserves, permeability of the storage formation and perceptions of the local community. The final decision on storage proposals would therefore be more appropriately determined on a case-by-case basis, for which the use of a policy to make decisions consistent and principled is the best option.

However, there are limited aspects of CCS that would be suitable for regulation by bottom-lines. For example, induced seismicity is a risk that has been observed and studied to a significant degree with subsurface fluid injection in the United States. The risk is induced not by any particular chemical properties of substances injected, but by the quantity and rate of fluid injection.[221] Accordingly, this experience is readily transferable to CO_2 storage.[222] Imposing a regulatory bottom line on injection pressures may be a suitable measure for protection against the risk of induced seismicity. Other discrete risks may also reach this stage with experience. Because ERMA has the scientific expertise to determine whether an effect is certain enough to justify regulatory standards, and it has experience in imposing them, it would seem to be an obvious body to create such standards. Placing further controls on CO_2 as a compressed gas would be a practical way of implementing this, through regulations made under section 140(1)(c) of the HSNOA.

2.2 Why the PA is the appropriate policy

The PA is not the only policy available to deal with uncertain risks. Economists argue that it is inappropriate, because of the opportunity cost it entails if environmental concerns are shown to be unfounded.[223] They instead argue that proposals should be allowed where there is an uncertain risk of future environmental effects, so that enough

[221] Benson and Cook, see n7 above, 249.
[222] Ibid, 250.
[223] Somerville, see n203 above, 401.

resources are generated for future generations to resolve the uncertainty.[224] This policy is known as the “resilient approach”.

There are two reasons that the resilient approach should be rejected in favour of the PA. Firstly, it displays a perverted sense of intergenerational equity. Where the potential effects are serious or irreversible, further economic resources or scientific knowledge are not sufficiently compensate future generations. Seriously or irreversibly impacting their environment is not vindicated by the potential for short-term economic gain. By contrast, the PA does fairly treat future generations. It recognises that the opportunity cost of temporarily limiting economic development is less than the cost associated with irreversible impacts on the environment. Secondly, the PA need not necessarily stifle development. The adoption of adaptive risk management strategies can ensure that uncertainties are treated with caution, but without preventing progress. As described above,[225] this was seen in *Clifford Bay Marine Farms v Marlborough District Council*.[226] The PA is the appropriate policy for addressing uncertain risks of future environmental effects. The question is which particular formulation of it is appropriate for CCS.

2.3 How the PA’s implementation needs to be altered for CCS

An Act that regulates the environmental concerns associated with CCS should therefore ensure that there is no scope for enforcement of an inappropriately rigid PA. It should be made clear that strategies for relaxing the approach, such as adaptive risk management, can apply to statistically uncertain risks like those involved with CCS. One option for effecting this change would be having a relaxed standard where the benefits of a proposal are great. This could potentially already be achieved through the RMA, which requires consideration of effects – not just adverse effects – when determining resource consent application.[227] Given the discretionary nature of this option, its effectiveness depends on the appropriateness of the decision-maker. Given that the RMA does not have any

[224] Wills, I.R., *Economics and the Environment*, Allen & Unwin, St Leonards, NSW, 1997, 239.
[225] See above, Chapter Three, 1.3.
[226] Unreported, C131/2003, Christchurch Environment Court, Judge Jackson, 22 September 2003.
[227] RMA, s 104(1)(a).

appropriate bodies to be decision-makers for CCS, using this option is unlikely to be effective.

A more direct option would be making express enabling provisions for CCS "pilot projects", which have been a common stepping stone towards larger-scale application of the technology.[228] The process of injecting the CO_2 in practice would not only increase knowledge about the storage site, but (if successful) could also favourably alter community perceptions. This would mean that the integrated assessment of community values and levels of risk required for commercial scale operations would more likely lead to CCS approval. This approach is desirable because it would encourage significant knowledge-gathering about the storage site, for which appropriate selection is one of the most effective ways of lowering risk.[229] Because of the effects-based nature of the RMA, placing an activity-specific exception like this would sit awkwardly in the Act. Use of a new Act would be more apposite.

3 Allocation of rights to storage formations

Chapter Three pointed out five serious problems with allocation of geological storage reservoirs under the current framework. Remedying these problems would require amendment in four broad areas: clarifying the regime that applies, suitable tailoring of the permits allocable under the regime, resolving potentially conflicting entitlements where storage could adversely affect other subsurface minerals, and determining priority between competing users. The discussion will be informed by reference to approaches taken in recently enacted Australian legislation. Two standalone state-level Acts regulating onshore CCS are considered: Queensland's Greenhouse Gas Storage Act 2009 (Qld) (Queensland Act) and Victoria's Greenhouse Gas Geological Sequestration Act

[228] Examples are Germany, Australia, USA, Scotland, and the Netherlands. See Benson and Cook, see n7 above, 200.

[229] IPCC, see n19 above, 12. A monitoring system and appropriate regulatory oversight are the other two key measures stated.

2008 (Vic) (Victorian Act), and one federal amendment Act regulating offshore CCS: the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (Federal Act).[230]

3.1 Clarifying the regime that applies

The first step in clarifying the regime that applies is to clarify ownership of storage reservoirs. Seeing as it is desirable for their allocation to be consistent and subject to public administration due to the public concerns CCS raises, expressly reserving storage reservoirs to the Crown is a sensible option. This would be in line with the Queensland and Victorian Acts, which explicitly vest ownership of storage reservoirs in their respective states.[231]

The second step would be to identify broadly what type of regulation model ought to be used for allocation. Although storage space allocation will require similar procedures to those used under the CMA, CCS also raises other concerns quite distinct from extraction of minerals. For example, it involves injection of CO_2 into underground formations for the purpose of long-term storage rather than extraction of commodities, and it poses novel environmental risks in terms of timeframe and nature.[232] Accordingly, a model similar to the CMA ought to be used, but allocation of storage space raises concerns too dissimilar to allocation of minerals for the CMA to be the appropriate place to deal with them.

3.2 Tailoring the permits regime to suit CCS

As noted in Chapter Three, the CMA's permits regime lacks provision for injection permits, and the application of some considerations related to determining applications

---

[231] Queensland Act, s 27(1); Victorian Act, s 14(1). The Federal Act does not expressly vest ownership, presumably again because UNCLOS gives coastal nations sovereign rights over resources within their EEZ. See UNCLOS, n86 above, Article 57.

[232] This logic was also used in deciding that CCS regulation in Victoria should be achieved through standalone legislation: see "A Regulatory Framework for the Long-Term Underground Geological Storage of Carbon Dioxide in Victoria", *Department of Primary Industries*, Victorian Government (Australia), January 2008, 11.

for exploration and prospecting permits would be awkward. The Australian schemes address this problem by creating three types of permits: prospecting (for searching for a reservoir and determining the capacity for injection), lease tenure (which grants title over the reservoir for an extended period of time – to allow for injection not being possible immediately), and then a licence to inject and store CO_2. This type of specified approach should be followed, because it allows for more appropriate, specific regulation of the activities peculiar to CO_2 storage.

3.3 Resolving adverse impact on entitlements to other mineral resources

The potential for CO_2 storage activities to impinge on existing and future entitlements to other mineral resources is an issue that raises concerns about the security of rights associated with minerals permits. Each Australian Act deals with the issue slightly differently. The Federal Act draws a distinction between existing (and future pre-commencement),[233] and future petroleum permits.[234] If the Minister is satisfied that the GHG storage activity does not pose a "significant risk of significant adverse impact" on post-commencement titles then approval can only be given to storage activities if consent of the title-holder has been gained, or granting approval would be in the public interest.[235] For pre-commencement titles, storage related rights can only be obtained by agreement with title-holders.[236] The Victorian Act takes a slightly less rigid approach, requiring CCS proponents to take "all reasonable steps" to obtain consent of existing rights holders,[237] but if not obtained, the Minister can still grant CCS permits if it is in the public interest.[238] The Queensland Act is more relaxed still. Storage tenures can be granted over existing mining and petroleum tenures. Existing rights holders can lodge submissions opposing an application,[239] but ultimately discretion resides with the Minister.[240]

---

[233] "Pre-commencement" refers to when the provision in question came into force, Federal Act, s 7. A timetable for commencement of the provisions is given in s 2.
[234] Federal Act, s 321.
[235] Ibid, s 321.
[236] Ibid, s 321(11).
[237] Victorian Act, s43.
[238] Ibid, s 42(1)(b).
[239] Queensland Act, s 199(1).
[240] Ibid, s 201.

For New Zealand, the “significant risk of significant adverse impact” test, with the “public interest” caveat, would appear to be appropriate for safeguarding post-commencement titles. Together, they ensure that future use of minerals is not jeopardised, unless in the public interest. However, allowing existing rights to be impinged upon provided it is in “the public interest”, even without the existing right-holder’s consent, does significantly endanger the security of mineral tenements. New Zealand’s smaller potential for CCS and large estimated relative storage capacity mean that it could be prudent to recommend alternative storage sites rather than give scope for impinging on mineral resources. Detailed information about the location and nature of New Zealand’s storage capacity is yet to be publicly available.[241] In the absence of such information, it is hard to say with certainty whether a public interest test would be necessary for New Zealand. However, on principle, because mitigating climate change is of greater importance than exploiting local minerals, significant adverse impacts on mineral resources from CO_2 storage are justifiable in the public interest. Accordingly, the public interest test should be included in a new Act regulating CCS.

3.4 Determining priority between competing users and uses of storage reservoirs

A suitable system for determining how CCS permits are awarded when there are competing applicants would be necessary. Because storage reservoirs have the same economic qualities of minerals – being natural resources that can valuably be exploited – the allocation systems used in the CMA, such as competitive tendering, would be appropriate.[242] This could also utilise synergies with the minerals regime. Concerns about the operator’s ability to carry out proper remediation strategies and keep up monitoring of the storage site should be among the relevant criteria used to compare applicants.

[241] GNS Science has been involved in a series of investigative projects looking at the carbon storage potential of New Zealand. The reports have been completed, but are not yet publicly available: Funnell, R., *pers. comm*.., 26 August 2009.

[242] MPMEP, s 3.9.

There also needs to be a priority rule for allocating storage reservoirs where there are competing inconsistent use applications. Where there are competing applications that relate to the use of minerals, the public interest test canvassed above could be used to determine which use is more appropriate. However, where the competing use was not the extraction of minerals, an added layer of complexity arises. A prime example of this is where the storage reservoir is a saline aquifer, and the competing use is to desalinate the brine it contains for irrigation or drinking water purposes. This use would normally come under the jurisdiction of regional councils, but if saline aquifers were made subject to a new CCS Act, there is the problem of competing uses being assessed under divergent legislation. A water use permit under the RMA would be competing against a storage reservoir permit under a new CCS Act. This is a legitimate concern about how overlap between the RMA and a new CCS Act would be addressed. Either one Act would need to take priority, or the interfaces between the two Acts would need to be expressly clarified. This is a task too large to be properly tackled in this paper. However, it is tentatively submitted that situations like this would best be dealt with by giving the CCS Act priority, because of the inappropriateness of the primary decision-makers administering the RMA in dealing with the issues posed by CCS.

4 Long-term liability

Chapter Three pointed out that a long-term liability scheme needs to be able to provide both remediation and compensation for adverse environmental effects. It then described how the imposition of bonds could not provide appropriate remediation if the risks posed by CCS were realised, and how the common law was unsatisfactory as a compensation mechanism. The discussion below evaluates the ability of two alternative liability models to perform these functions: mandatory private insurance with a liability cap, and a publicly administered trust fund.

However, one other aspect of a liability scheme must first be briefly canvassed. That is identifying a body responsible for continuing to monitor the storage site post-closure. Imposing responsibility indefinitely on site operators would be impracticable due to their finite nature – if company circumstances changed, or the company became bankrupt, then there would be no responsible entity. Accordingly, at some point post-closure, responsibility for monitoring the site ought to shift to the state. It is the most sensible option, and has been accepted as such by international investigations.[243] It would also bring New Zealand in line with Australian approaches.[244]

4.1 Mandatory private insurance with a liability cap

Nuclear power generation, like CO_2 storage, poses a serious risk of long-term environmental harm. In the United States this was addressed by the Price-Anderson Act 1957 (USA), which required all Nuclear power plant operators to take out the maximum amount privately insurable ($500 million), and deposit a bond with the EPA for secondary liability. Federal Government agreed to pay any resulting liabilities that exceeded this amount. Its biggest strength was that it imposed a very high level of insurance on all operators, which is a level they would not have voluntarily insured themselves to. However, there are two main weaknesses in this type of approach. Firstly, the costs associated with damage from a project above the liability cap are externalised to taxpayers and injured parties. Secondly, insurance policies invariably have a temporal limit on them. This is unsuitable for the risks presented by CCS, because they continue indefinitely. Thirdly, environmental insurance policies can only be crafted with thorough understanding of the risks posed by an activity. The model is therefore likely to be met with resistance from private insurers, due to the lack of understanding of risk methodology associated with CCS.[245] Consequently, this model is inappropriate, because while it may cover the costs of remediation and allow for some compensation, it transfers part of the risk onto the public, and its practicability is dubious.

---

[243] For examples, see House of Representatives Standing Committee on Science and Innovation (Aus), n23 above, 100; and de Figueiredio, see n202 above, 394.
[244] Victorian Act, s 7(g); Federal Act, s 400.
[245] Benson and Cook, see n7 above, 250.

4.2 Publicly administered trust fund

A more suitable option is to have an industry funded and publicly administered trust fund.[246] It would entail the creation of a fund into which operators pay a levy proportional to the amount of CO_2 injected.[247] Dispersing the level of payment into the fund across more than one operator would allow for lower payments than needed with bonds, reflecting the low probability of harm, but providing more total capital should a risk be realised. Although the small number of likely CCS operations means there will possibly be some residual cost borne by the community, this is unavoidable due to the lack of established risk assessment methodologies for CCS.[248] Trustees would be required to administer the fund, and determine compensation entitlements. This is unlikely to be an onerous burden because of the small CCS potential in New Zealand.

The trustees of the fund would need direction on what warrants compensation. An appropriate rule would be to grant compensation where the harm occurred due to CCS activities.[249] This would remove the problematic requirements of proving operator default or association with a specific CCS project, as with the common law.[250] Compensation would accordingly be based on justice for the victim, rather than technical elements of a tort. The approach would also not have the practicability concerns associated with having private insurers managing the money. A publicly administered trust fund is accordingly the most appropriate way to address the long-term liability concerns associated with CCS.

There is no analogous public fund in New Zealand environmental law. There are therefore no synergies that can be utilised by creating this fund under the RMA, or any other piece of current legislation. Providing for it in the RMA would be to essentially create a new part of the Act, and would be the same as legislating for it separately. Given

[246] De Figueiredo, see n202 above, 391-400.
[247] This could be conceived as analogous to the royalties paid for extraction of minerals under the CMA.
[248] Benson and Cooke, see n7 above, 250.
[249] De Figueiredo, see n202 above, 391-400.
[250] Ibid.

the numerous other inadequacies with the RMA, it would be more appropriate to provide for the compensation fund in new legislation.

5 Environmental Regulatory Body

5.1 The requirements of an appropriate regulatory agency

Chapter Three concluded that the bodies concerned with regulating environmental effects under the RMA would be unsuitable for making decisions about CCS. Administration of the various new regulatory requirements associated with CCS would require a primary decision-maker with scientific and legal expertise, an ability to evaluate environmental risks without inappropriately prioritising certain factors, and an appreciation of the national significance of CCS projects. This discussion evaluates three bodies to fill the role of environmental regulator: ERMA, the proposed Environmental Protection Authority (EPA) and a case-by-case BOI.

5.2 ERMA

As pointed out in Chapter Two, ERMA is a centralised body with significant scientific and legal expertise. It would therefore be well placed to set any uniform standards where appropriate, as elucidated above.[251] However, ERMA does not have any experience in undertaking the type of complex integrated assessment necessary to determine whether CCS activities should be allowed. LAs and the RMA account for the more site-specific aspect of activities affecting the environment in the current framework. ERMA may have scope for determining regulatory bottom-lines, but it would not be a suitable body for holistically overseeing the management and allocation of storage reservoirs.

---

[251] See Chapter Four, 2.1 above.

5.3 EPA

The Resource Management (Simplifying and Streamlining) Amendment Act 2009, created a new body – the Environmental Protection Authority (EPA).[252] The body is part of a range of measures designed to advance the broader objective of greater clarity and guidance in dealing with proposals of national significance. Applications for call in can be made directly to the EPA, and it recommends to the Minister whether the matter ought to be called in.[253] In this sense, the EPA is not really a "regulatory body" insofar as its function currently extends, because its powers merely relate to recommending which other body would be the appropriate decision-maker for an application.

Although elaborating on the role and function of the EPA has been reserved for Phase II of the RMA reforms, administrating the new CCS regulatory framework could be an appropriate expansion of its function. Given that the body is centralised, concerns about the inappropriate prioritisation of local community concerns would not apply. Also, it has been suggested that administrating the use of resources in the EEZ could be an appropriate expansion of its function.[254] Given that the largest geological storage reservoir New Zealand has is the Maui gas field, there could be some synergy in having the EPA also administer a new CCS Act. Accordingly, administering the new CCS regulatory framework would be best achieved through expanding the EPA's function.

6 Conclusion: Summary of changes required for an appropriate regulatory framework

For determining whether the risks posed by CCS are acceptable, there is some scope for regulatory bottom lines, but a policy is needed to address the site-specific concerns of a storage application. The PA is the appropriate policy to employ in attempting to ensure consistent decisions are made for commercial employment of CCS. However, the approach ought to be relaxed for pilot-projects, as important stepping stones to larger

[252] RMA, s 42B.
[253] RMA, s 145.
[254] Smith, N., see n101 above.

scale deployment of the technology. Having such activity-specific provisions in the RMA would cut against its effects-based philosophy.

Addressing concerns relating to the allocation of storage reservoirs requires four areas of change: clarifying ownership and the model of allocation, tailoring of that model to suit CCS activities, resolving the potential adverse impact of CCS on other minerals, and determining priority between competing use applications for storage reservoirs. The volume and significance of the changes required shows that CCS gives rise to concerns unable to be dealt with by minor amendment to existing regimes.

Long term liability would best be dealt with using a publicly administered trust, funded by site operators. This would ensure funds are available for compensation and remediation of sites without deterring CCS proponents or requiring victims to endure time-consuming and costly procedures like the common law. Given that there is no synergy to be gained in any other form of environmental regulation in New Zealand, this would also require new legislation.

There is some scope for ERMA to be involved in creating bottom-lines for certain aspects of CO_2 storage as experience is accumulated, but it would be out of its depth making final decisions about whether CO_2 injections should be approved. Rather, this would be an appropriate expansion of the proposed EPA’s role. The body would be appropriately centralised, not have problems with expertise, and using it to regulate CCS permits would harness synergies with the proposed administration of EEZ resources.

CONCLUSION

CCS poses many serious and low probability environmental risks, which give rise to novel legal concerns. Accordingly, it is necessary that the conduciveness of the current political and scientific environment to the uptake of CCS in New Zealand is responded to appropriately. This is particularly so when one considers the significant environmental and economic benefits associated with the technology. It is the only carbon emissions abatement strategy consistent with the continued use of fossil fuels.

Examination of the current regulatory framework shows that implementing a CCS project would engage much different legislation. Although the capture and transport processes involved with CCS could be accommodated with minor amendments, examination also shows the current framework to be awkward, uncertain and wholly inappropriate in regulating CO_2 storage.

The legal status quo is deficient in four respects. Firstly, in risk assessment, the implementation of the precautionary approach under the RMA would effectively act as a prohibition on storage permits. There is limited scope for bottom-lines to be used, but a policy will be required. The precautionary approach is the most appropriate policy to use for assessing CO_2 storage's risks. However, it ought to be relaxed to allow for pilot projects.

Secondly, allocation of storage reservoirs currently sits in an uncertain position between the RMA and the CMA. A new regulatory framework would need to clarify what regime applies, and appropriately tailor allocable permits under it to CO_2 storage activities. In addition, any framework must also resolve the potential for CO_2 injection to negatively impact on other subsurface resources, and determine priority between competing use applications.

The third way in which current law is deficient concerns a lack of a long-term liability scheme. Such a scheme must perform two main functions: remediation of harm and compensation of victims. The mechanisms under the current framework – the RMA and tort law – are incapable of performing these functions. This is due to the unlimited timescale involved with CO_2 storage risks, difficulties with quantifying the costs involved in remedying the potential harms, and difficulties in proof of causation under the common law. A publicly administered trust fund would be a more appropriate way of addressing any long-term harms created by CCS.

Finally, reliance on decentralised decision-makers is problematic. Examination of LA decisions under the RMA shows that they are prone to inappropriately prioritising community perceptions, which means prudent environmental outcomes would not be achieved. Cross-jurisdictional issues with potential harms and lack of expertise also make LAs unsuitable. The other regulatory bodies under the RMA are also inappropriate, due to the decentralised philosophy that pervades the Act. However, there is limited scope for ERMA to be involved with setting bottom lines for part of CO_2 storage if sufficiently knowledgeable. Despite this, the role of primary decision-maker under a new CCS Act is best filled through an expansion of the EPA's role. This is firstly because of its centralised nature and secondly because synergy with its proposed expansion to administer EEZ would be utilised.

BIBLIOGRAPHY

STATUTES

New Zealand

Conservation Act 1987

Crown Minerals Act 1991

Gas Act 1992

Hazardous Substances and New Organisms Act 1996

Health and Safety in Employment Act 1992

Maritime Transport Act 1994

Petroleum Act 1937

Resource Management Act 1991

Resource Management (Simplifying and Streamlining) Amendment Act 2009

Te Ture Whenua Maori Act 1993

Australia

Offshore Petroleum Greenhouse Gas Storage Act 2008 (Cth)

Greenhouse Gas Geological Sequestration Act 2008 (Vic)

Greenhouse Gas Storage Act 2009 (Qld)

United States of America

Price-Anderson Act 1957

REGULATIONS/ DELEGATED LEGISLATION/VOLUNTARY CODES

Health and Safety in Employment Act 1992

Health and Safety in Employment (Pipeline) Regulations 1999

Hazardous Substance (Compressed Gas) Regulations 2004

Hazardous Substances and New Organisms Act 1996

Marine Protection Rules Part 180 – Dumping of Waste or Other Matter

Minerals Programme for Minerals (Excluding Petroleum) 2008
Minerals Programme for Petroleum 2005

INTERNATIONAL AGREEMENTS

Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009, *Official Journal of the European Union*, L140/114, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF, accessed 15 October 2009.

1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (29 December 1972, entered into force on 7 November 1996) 1046 *UNTS* 120

United Nations Convention on the Laws of the Sea (10 December 1982, entered into force 16 November 1994) 1833 *UNTS* 3

Rio Declaration on Environment and Development (June 14, 1992), www.unep.org, accessed 15 October 2009

CASES

New Zealand

Amalgamated Theatres Ltd v Charles S Luney Ltd [1962] NZLR 226
Aoraki Water Trust v Meridian Energy [2005] 2 NZLR 268
Attorney-General v Abraham and Williams Ltd [1949] NZLR 461 (CA)
Central Plains Water Trust v Ngai Tahu Property Limited [2008] NZRMA 200
Chen v Butterfield (1996) 7 NZCLC 261,088
Clifford Bay Marine Farms v Marlborough District Council C 129/2005, Environment Court, Christchurch, Judge J R Jackson, 16 September 2005.
Fleetwing Farms v Marlborough District Council [1997] 3 NZLR 257

Geotherm Group Limited v Waikato Regional Council [2004] NZRMA 1
Hamilton v Papakura District Council [2000] 1 NZLR 265
J L Tindall v Far North District Council 20/10/06, Winkelmann J, HC Auckland, CIV-2003-488-135
Lower Hutt City Council v Attorney-General ex rel Moulder [1977] 1 NZLR 184
McIntyre v Christchurch City Council [1996] NZRMA 289
Ngai Tahu Property Limited v Central Plains Water Trust [2009] NZSC 24
Shirley Primary School v Christchurch City Council [1999] NZRMA 66
Te Aroha v Waikato Regional Council (1993) 2 NZRMA 574
Waitakere City Council v Estate Homes [2007] 2 NZLR 149

United Kingdom
Adams v Cape [1990] Ch 433
Cambridge Water Company v Eastern Counties Leather [1994] 2 WLR 53
Donaghue v Stevenson [1932] AC 562 (HL)
Rylands v Fletcher (1868) LR 3 HL 330 (HL)

BOOKS & BOOK CHAPTERS

Christensen, S., (2004) "The law and mining", *Handbook of Environmental Law*, Harris, Rob (ed), Royal Forest and Bird Protection Society of New Zealand, Inc, Wellington

Smillie, J., "Chapter 11: The Rule in *Rylands v Fletcher*", *The Law of Torts in New Zealand*, Todd, S. (ed.), 5th ed., 2009,

ARTICLES AND PAPERS

Agius, J., "International Environmental Law and State Sovereignty" (1998) 3 *Asia Pacific JEL* 269

Bryer, C. and Bergman, P. "Issues Related to Seismic Activity Induced by the Injection of CO_2 in Deep Saline Aquifers", (2002) *Journal of Energy and Environmental Research* 32

Davidson C. et al, "Accessing the impacts of future demand for saline groundwater on commercial deployment of CCS in the United States", *Energy Procedia* 1 (2009) 1949

De Figueiredo, Mark Anthony, *The Liability of Carbon Dioxide Storage* (PhD thesis, Massachusetts Institute of Technology, February 2007)

Fuller, P., "The Resource Management Act 1991: An Overall Broad Judgment" (2003) 7 *NZJEL* 243

HTC Purenergy, "HTC Purenergy – focused on environment, economy and energy security", (2009) 9 *Carbon Capture Journal* 4

Kharaka Y., Cole D., Hovorka S., Gunter W. "Gas-water-rock interactions in Frio Formation following CO2 injection: implications for the storage of greenhouse gases in sedimentary basins", (2006) 34 *Geology* 577

Kirman, C., Gould, E. & Somerville, C., "Carrying the Burden: Considering the appropriate evidential tests in resource management decisions" *Resource Management Journal*, August (2006)

Page et al, December 2008, *Carbon Capture and Storage: An appropriate technology for New Zealand?*, University of Canterbury, Christchurch

Rayfuse R., "Drowning Our Sorrows To Secure a Carbon Free Future? Some International Legal Considerations Relating to Sequestering Carbon by Fertilising the Oceans" 31 *UNSWLJ* 919

Somerville, R., *Risk, regulation and the Resource Management Act 1991: the case of electricity generation and transmission* (PhD thesis, University of Otago, Dunedin, 2001)

CONFERENCE PAPERS

Funnell, Rob, "Overview of New Zealand's CO_2 storage options", in *Carbon Capture and Storage: Where are we now?*, seminar paper, presented at Proceedings of the International Carbon Capture and Storage Seminar, Monday, 27 August 2009, Wellington

Sommerville, R.J., *Water law: Risks, Values and Environmental Decision-Making*, Paper presented to the Royal Society Conference, 14 November 2003

GOVERNMENT & LOCAL GOVERNMENT SOURCES

New Zealand

New Zealand Biodiversity Strategy February 2000

Occupational Safety and Health Service, February 2002, *Guidelines for a Certificate of Fitness for High-Pressure Gas and Liquids Transmission Pipelines*, Department of Labour

Rosier, J., May 2004, *Independent Review of the New Zealand Coastal Policy Statement*, Report Prepared for the Minster of Conservation

Stimpson and Co, December 2007, *Aquaculture Risk Management Options*, Ministry for the Environment, http://www.mfe.govt.nz/publications/oceans/aquaculture-risk-management/aquaculture-risk-management.pdf, accessed 15 October 2009

Technical Advisory Group, February 2009, *Report of the Minister for the Environment's Technical Advisory Group*, Ministry for the Environment

Australia

Department of Primary Industries, January 2008, *A Regulatory Framework for the Long-Term Underground Geological Storage of Carbon Dioxide in Victoria*, Victorian Government

House of Representatives Standing Committee on Science and Innovation, August 2007, *Between a Rock and a Hard Place: The science of geosequestration*, The Parliament of the Commonwealth of Australia, Canberra.

Ministerial Council on Mineral and Petroleum Resources, 2005, *Carbon Dioxide Capture and Geological Storage: Australian Regulatory Guiding Principles*

United States

Hansen, M.C., "Earthquakes in Ohio", (2007) Ohio Department of Natural Resources, http://www.dnr.state.oh.us/tabid/9526/Default.aspx, accessed on 4 September 2009.

INTERNATIONAL BODY PUBLICATIONS

Abernathy, Andrew and Coull, David, "New Zealand", *International Comparative Legal Guide to Gas Regulation 2008*, Global Legal Group, 145-151

Benson, Sally and Cook, Peter, "Underground geological storage", *IPCC Special Report on Carbon dioxide Capture and Storage*, Intergovernmental Panel on Climate Change, 195-276

Hennessy, K.B. et al, (2007) "Australia and New Zealand", *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Intergovernmental Panel on Climate Change, 515-540

Intergovernmental Panel on Climate Change, November 2007, *Climate Change 2007 Synthesis Report: Summary for Policy Makers*, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf, accessed 7 September 2009

Intergovernmental Panel on Climate Change, September 2005, *IPCC Special Report: Carbon Dioxide Capture and Storage – Summary for Policymakers*

International Energy Agency, (2008) *Energy Technology Perspectives 2008 – Scenarios and Strategies to 2050: Executive Summary*, OECD, http://www.iea.org/textbase/npsum//ETP2008SUM.pdf, accessed 21 August 2009

International Energy Agency "Energy Technology Perspectives 2006", 2006, http://www.iea.org/textbase/nppdf/free/2006/etp2006.pdf, accessed 24 August 2009

Kerr, T., (2007) "Legal Aspects of Storing CO_2: Update and Recommendations", *International Energy Agency*, http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1928, accessed 24 August 2009

Calderia, Ken et al, September 2005, "Ocean Storage", *IPCC Special Report on Carbon dioxide Capture and Storage*, Intergovernmental Panel on Climate Change, 279-311

Mazzotti, Marco et al, "Mineral carbonation and industrial uses of carbon dioxide", *IPCC Special Report on Carbon dioxide Capture and Storage*, Intergovernmental Panel on Climate Change, 321-338

PERSONAL COMMUNICATION

Austen, Rose, policy analyst, Ministry of Economic Development
Buckland, Simon, ERMA Compliance Co-ordination Manager
Funnell, Rob, CCS Programme Leader, GNS Science

NEWS RELEASES AND OTHER INTERNET SOURCES

"1986: hundreds gassed in Cameroon lake disaster", http://news.bbc.co.uk/onthisday/hi/dates/stories/august/21/newsid_3380000/3380803.stm , accessed 26 August 2009

Coal Association of New Zealand, *Coal e-Newsletter*, November 2006, 1, http://www.coalassociation.org/content/files/Coal_e-news_No.22.pdf , accessed 15 October 2009.

Smith, N., Minster of the Environment, media release speech, 8 May 2009, http://www.beehive.govt.nz/speech/next+phase+rma+reform, accessed 23 September 2009

LECTURES

Blunt, Martin J, "Design of carbon dioxide storage", *Department of Earth Science and Engineering*, Imperial College, London

WEBSITES

http://www.carboncapturejournal.com
http://citizensagainstco2sequestration.blogspot.com/
http://www.callideoxyfuel.com
http://www.ermanz.govt.nz
http://www.imo.org
http://www.maritimenz.govt.nz
http://www.osh.dol.govt.nz