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Climate change mitigation activities in the ocean: turning up the regulatory heat

Rosemary Rayfuse

University of New South Wales

Robin Warner

University of Wollongong, rwarner@uow.edu.au

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Abstract

The adverse impacts of anthropogenically induced climate change on the terrestrial and marine environments have been acknowledged by a succession of expert reports commissioned by global and national bodies (IPCC 2007; Preston and Jones 2006; Stern et al. 2006). The threats posed by climate change to the global environment have fostered heightened scientific and commercial interest in a range of CO₂ sequestration methods that either involve the ocean or affect the marine environment. The most developed proposals to date relate to offshore carbon capture and storage (OCCS), which seeks to capture carbon dioxide from point sources of emissions and sequester it in sub-seabed geological formations.

Keywords

change, climate, activities, mitigation, ocean, regulatory, up, heat, turning

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<cn>10. <ct>Climate change mitigation activities in the
ocean: turning up the regulatory heat

<au>**Rosemary Rayfuse and Robin Warner**

1. INTRODUCTION

The adverse impacts of anthropogenically induced climate change on the terrestrial and marine environments have been acknowledged by a succession of expert reports commissioned by global and national bodies (IPCC 2007; Preston and Jones 2006; Stern et al. 2006). The threats posed by climate change to the global environment have fostered heightened scientific and commercial interest in a range of CO₂ sequestration methods that either involve the ocean or affect the marine environment. The most developed proposals to date relate to offshore carbon capture and storage (OCCS), which seeks to capture carbon dioxide from point sources of emissions and sequester it in sub-seabed geological formations. Considerable financial and technological investment has already been made in this approach, and a regulatory framework has been developed for its implementation both at the global and at the national level in Australia. Other methods seek to boost the capacity of the oceans to capture and absorb atmospheric carbon dioxide either through the deposit of substances or wastes into the ocean, or through the deposit of structures or devices into the ocean, to increase the production of organic material in the surface ocean and

thereby promote increased draw down of photosynthesized carbon to the deep ocean. Proposals for these geo-engineering schemes include seabed deposition of biochar, increasing ocean alkalinity, increasing carbon concentrations in down-welling water, and using wave activated pumps to alter water circulation (Scientific Group of the London Protocol 2010). Most advanced are proposals for ocean fertilization, involving the deposition of iron, nitrogen or phosphorous compounds into the water column to stimulate primary productivity and increase carbon-flux to the deep ocean.

Both OCCS and marine geo-engineering schemes have the potential for as yet unknown and possibly adverse effects on the marine environment. Increasingly commentators have called for an assessment of these schemes from practical, political, social, ethical and legal perspectives (Lin 2009; Schneider 2008; Verlaan 2009). This chapter focuses on the legal challenges posed by OCCS and by marine geo-engineering methods, in particular ocean fertilization, and the progress that has been made in regulating these activities at the global and national levels. Section 2 describes these processes, their objectives and their potential impacts on the marine environment. Section 3 analyses the applicability of existing international law principles to these processes and the regulatory gaps and ambiguities in the existing international law framework for such activities. Section 4 examines the emerging policy and regulatory framework for these processes at the global and national level in Australia. Finally, in Section 5, it will be concluded that a significant contrast can be seen between the regulatory framework applied to OCCS and that applied, thus far, to ocean fertilization.

<a>2. SEQUESTERING CARBON DIOXIDE IN THE OCEANS

2.1 Sequestering Carbon Dioxide in the Seabed: Offshore Carbon Capture and Storage

Carbon dioxide (CO₂) capture and storage (CCS) involves the separation of CO₂ from industrial- and energy-related sources and its transportation to and permanent storage in geological formations such as exhausted oil and gas fields, un-mineable coal beds and deep saline formations (IPCC 2007). Application of CCS technologies can thus allow continued use of fossil fuels and other CO₂ producing processes, while simultaneously lowering CO₂ emissions. In 2005, the Intergovernmental Panel on Climate Change (IPCC) estimated that CCS could potentially contribute between 15–55 per cent of cumulative emissions reductions worldwide to 2100 (GCCSI 2009). More recently, the International Energy Agency (IEA) estimated that it could potentially contribute 19 per cent of emissions reductions by 2050 (IEA 2008).

The concept underlying CCS is not new. Direct injection of CO₂ into subsurface geological formations has been used as part of enhanced oil recovery (EOR) projects since the early 1970s (IPCC 2007, p. 199). Since the 1990s, the technology has been used to capture and store CO₂ from natural gas processing operations. In 1996, following the introduction by the Norwegian Government of a tax on CO₂ emissions, the Norwegian state oil company, Statoil, opened the world's first offshore commercial CO₂ storage site at its Sleipner oil field. In recent years, consideration of the application of CCS technologies to pre- and post-combustion processes in power generation and other industrial processes has gained considerable momentum. According to the Global CCS Institute, there are currently 213 active or

planned CCS projects globally. Of these, 101 projects are considered to be of commercial scale, proposing to sequester at least 1 Mtpa of CO₂. Of these commercial-scale projects, 62 are defined as ‘integrated’ projects, meaning that the capture, transport and storage is all undertaken by a single project owner or operator, thereby providing a ‘full source to sink CCS solution’ (GCCSI 2009, p. 9). To date, however, only seven of these projects are actually in operation (GCCSI 2009, p. 22).

The attractiveness of CCS is in part due to the potential for isolation of storage sites from population centres – particularly in offshore areas – and the perceived lack of potential for interaction with and damage to the surrounding environment. The potentially large number of storage sites, as well as the potential for adaptation of pre-existing technology and infrastructure within the oil and gas sector and other industries, has also contributed to its attractiveness as a key mitigation technology. Storage sites envisaged and already being used for CCS include both onshore and offshore depleted oil and gas fields and deep subterranean and sub-sea saline aquifers (Brewster Weeks 2007, p. 252; Scott 2005, p. 60). While, to date, offshore CCS, or OCCS, projects have taken place in waters within national jurisdiction, the potential also exists for future storage in seabed areas beyond national jurisdiction when storage sites within national jurisdiction are exhausted (International Maritime Organization – IMO 2007a).

Opponents of CCS point to a range of technological, financial, safety and regulatory issues that need to be resolved before CCS should be pursued. In the context of OCCS, the principal risk is the potential for leakage of carbon dioxide and any other substances in the carbon dioxide stream, such as heavy metals, into the marine environment, either during transport to a storage site or after storage

(Abanedes et al. 2005, p. 18). Leakage of these substances into the marine environment can alter the marine chemistry of the water column and lead to adverse effects on the interconnected web of marine species, habitats and ecosystems (Abanedes et al. 2005, p. 18; Koslow 2007, p. 160). Considerable research has been undertaken by States in conjunction with corporations to assess and minimize the environmental risks associated with sub-seabed sequestration of carbon dioxide. Nevertheless, information about its long-term effects on the marine environment is lacking (Brewster Weeks 2007, pp. 252–253; GCCSI 2009, p. 9; Scott 2005, p. 60).

In 2005, the IPCC concluded that technological, cost and regulatory issues relating to regulation of site selection, capture, transport, oversight, monitoring, remediation and liability issues remained valid. To meet these concerns, in 2008 the G8 committed to supporting the launch of 20 large-scale CCS demonstration projects globally by 2010, to support technology development and cost reduction, with a view to enabling the broad deployment of CCS by 2020. While the United States, Europe, Australia and Canada all have programmes in place to support project development, this goal has not yet been met. Nevertheless, Australia has made the development of CCS a strategic priority (CGA) and has committed \$100 million per annum to fund the Global CCS Institute; the central objective of which is to accelerate the worldwide development and implementation of commercial-scale CCS projects (GCCSI 2010).

2.2 Increasing Ocean Absorption of CO₂: Ocean Fertilization

Augmenting the rate at which the oceans absorb carbon dioxide is the fundamental objective of ocean fertilization as a climate mitigation activity. Fertilization is designed to increase phytoplankton primary productivity in iron and other nutrient

deficient areas of the ocean, thereby increasing the amount of ‘marine snow’ or organic detritus falling from the upper layers of the water column to the deep ocean (Koslow 2007, pp. 157–158; Rayfuse et al. 2008, pp. 302–303). In theory, carbon transported as marine snow into the deep ocean and finally decomposed to inorganic nutrients and dissolved carbon dioxide will remain out of contact with the surface ocean and atmosphere for the relatively long time scales associated with ocean currents and circulation (Cullen and Boyd 2008, p. 296).

At least four distinct fertilization methods have been proposed to date. The first, and most studied, involves fertilization by the deposition of large quantities of iron directly into the water column to enhance macronutrient uptake and local productivity. This technique has been proposed for use in the approximately 25 per cent of the world’s ocean surface predominantly located in the Southern Ocean, where high concentrations of macronutrients exist, but where chlorophyll (plant biomass) concentrations are low. Production in these high-nutrient low-chlorophyll (HNLC) waters is primarily limited by micronutrient supply; in particular, the supply of iron (Lampitt et al. 2008). Thirteen artificial iron fertilization experiments have been conducted since 1993; the majority of them being conducted in the Southern Ocean, with limited and inconclusive results (Aumont and Bopp 2006; de Baar et al. 2005, p. C9). Early experimental findings suggested that natural iron fertilization in HNLC regions promoted carbon export and sequestration by potentially measurable amounts. However, while the first 12 experiments clearly evidenced enhanced phytoplankton production (Boyd et al. 2007, p. 612; Buesseler and Boyd 2003, pp. 67–68; Koslow 2007, p. 159; Lampitt et al. 2008; Rayfuse et al. 2008, p. 305), they were not all designed to measure carbon export from the upper ocean and none of them was

designed to measure sequestration (Lampitt et al. 2008, p. 3929). Preliminary conclusions drawn from the results of the most recent LOHAFEX ocean iron fertilization experiment conducted in 2009 indicated that the CO₂ drawdown effect of ocean iron fertilization was low (IMO 2010b, para. 2.13; Alfred Wegener Institute 2009). The efficacy of this technique in sequestering anthropogenic carbon has therefore been questioned (Lampitt et al. 2008, p. 3930).

A second method, similar to the first, involves the introduction of micro- or macronutrients such as iron, nitrogen and phosphorous into the water column in low-nutrient low-chlorophyll (LNLC) areas to enhance nitrogen fixation, thereby increasing primary production. Approximately 40 per cent of the ocean surface, located mostly in the subtropical gyre systems, is considered to be LNLC. However, little is known about the relationship between iron supply and limiting factors such as phosphorous supply, or about the mechanisms of nutrient supply in these areas. The efficacy of this method in enhancing sequestration similarly remains unstudied (Lampitt et al. 2008, p. 3930).

These first two methods involve the supply of nutrients from ocean-based sources; in other words, from a ship. A third method involves the supply of nutrients from land-based sources. In this scenario, the fertilizing nutrients are manufactured on land and transported by submarine pipe to the deposition site. Based on comparisons with leakage of agricultural fertilizer to coastal areas, it has been hypothesized that choice of both fertilizing agent and location of injection can be used to control for local conditions, thereby maximizing sequestration potential. However, the costs of producing the fertilizing agent and piping it from land are likely to be large, with a carbon footprint that may be greater than the carbon sequestered. In addition, the

sequestration potential will be limited by the topography of the sea shelf, ocean circulation, local physics of the water column and general ecosystem dynamics and the carbon cycle, factors about which little is currently known. While initial studies costing the injection of urea, extracted from atmospheric nitrogen, suggested this was a viable proposition, the assumptions relating to nutrient supply at the injection site on which these calculations were based have been found to be incorrect, and any sequestration is likely to be only short-term and localized (Lampitt et al. 2008, pp. 3926–3927).

A fourth method involves the use of local wave power to pump deep nutrient rich water from depths of several hundred metres to the surface to enhance primary production and CO₂ sequestration. Studies have disputed the efficacy of this proposed method, noting that deep ocean waters contain elevated concentrations of dissolved CO₂, which may simply be released into the atmosphere when these deep waters reach the surface. Experimental results have been disappointing (Lampitt et al. 2008, pp. 3927–3928).

As already noted, a variety of risks and uncertainties associated with ocean fertilization have been identified by scientists and environmentalists. The effects of stimulating phytoplankton productivity on other marine organisms and marine ecosystems generally, is poorly understood (Koslow 2007, p. 159; Rayfuse et al. 2008, pp. 305–306; Scott 2005, pp. 87–88). In addition, the sinking of phytoplankton blooms into the deep ocean may reduce oxygen levels at these depths, leading to eutrophication and anoxia, with adverse consequences for fisheries and other marine organisms (Johnston et al. 1999, pp. 24–25; Lampitt et al. 2008, pp. 3926–3927; Rayfuse et al. 2008, p. 307). Increased productivity of phytoplankton may also boost

the production of other greenhouse gases such as nitrous oxide, neutralizing the positive effects of enhanced carbon dioxide drawdown (Rayfuse et al. 2008, p. 307). Scientists have also examined the relationship between ocean fertilization and ocean acidification, concluding that, with fixed emissions of CO₂ into the atmosphere, ocean fertilization moderately mitigates changes in ocean carbonate chemistry near the ocean surface, but at the expense of further acidifying the deep ocean (Cao and Caldeira 2008). Other side effects include modification of the global macronutrient balance, modification of the global iron balance and changes to both pelagic and benthic ecosystem structures (Lampitt et al. 2008, pp. 3934–3938). The sustainability of ocean fertilization as a climate change mitigation option has also been called into question on the basis of the time frames and quantities of iron or other nutrients required for the process to be effective (Johnston et al. 1999, pp. 23–24; Rayfuse et al., 2008, p. 307). One projection estimates that approximately 470 000 tonnes of iron per year, spread over as much as 25 per cent of the ocean surface and repeated for an indefinite period would be needed for this method of carbon dioxide sequestration to be effective (Johnston et al. 1999, pp. 23–24; Rayfuse et al. 2008, p. 307).

In 2007, the IPCC concluded that ocean fertilization was ‘speculative, unproven and with risks of unknown side effects’. Nevertheless, notwithstanding the scientific uncertainties and environmental concerns, a number of commercial ventures have shown interest in the process in recent years, hoping to reap financial benefits through the sale of carbon offsets. These activities have also demonstrated the financial and political risks associated with the process. Commercial iron fertilization activities have been proposed for areas in waters beyond national jurisdiction, raising the concerns of nearby coastal States as to the potential for damage to waters under

their jurisdiction. A common feature of proposals for other methods of fertilization appears to have been that developing countries or countries in transition with less well-established environmental impact assessment (EIA) policies and processes have been targeted as conduits for the trials, thereby also raising the concerns of the international community.

In May 2007, United States-based company Planktos Corp announced plans to dissolve 100 tonnes of iron over a 10 000 km² tract of high seas off the Galapagos Islands. This was to be the first of six large-scale pilot projects conducted by Planktos from 2007 to 2009 in the Pacific and Atlantic Oceans, each one lasting approximately four months. As a result of protests from the Ecuadorian Government, environmental NGOs and others, Planktos revised its plans, and its vessel eventually set sail in November 2007 for an unknown destination. In December 2007, the vessel was denied port entry by Spanish authorities in the Canary Islands and Planktos announced that it would be winding down its business ('Planktos shareholder update' 2007). Similarly, United States-based company, Climos, which has been active in promoting the commercial use of iron ocean fertilization as a climate change mitigation strategy, has recently ceased to conduct business activities (Climos 2011). In 2007, a proposed injection by Australian-based Ocean Nourishment Corp of 500 tonnes of urea into the Sulu Sea between the Philippines and Borneo through a pipeline from the Philippines coast was called off after it attracted criticism from local communities as well as regional and global environmental organizations concerned that adequate assessment of its impacts on the marine environment and marine biodiversity had not been undertaken (ETC Group 2007; Rayfuse et al. 2008, p. 299; Salleh 2007). More recent plans to pump urea into the Tasman Sea have been rejected

by Australia and New Zealand. However, the company is pursuing possibilities with other Asian governments.

In February 2011, the In situ Iron Studies Consortium was established ‘to resolve the impact of iron fertilization on marine ecosystems, to quantify its potential for removal of atmospheric carbon dioxide, and to improve our collective understanding of the changing ocean’ (Isis Consortium 2011). The consortium consists of 13 institutions whose scientists are ‘motivated to answer the unknowns regarding the role of iron in regulating the ocean’s capacity to remove atmospheric carbon dioxide’ (UN 1982). Consortium members have signed a Memorandum of Understanding that recommends support of open, peer-reviewed research to be conducted in accordance with international standards.

<a>3. GENERAL PRINCIPLES OF INTERNATIONAL LAW APPLICABLE TO MITIGATION ACTIVITIES IN THE OCEANS

3.1 1982 LOSC Provisions

The basic legal framework for achieving protection and preservation of the marine environment is set out in Part XII of the 1982 United Nations Convention on the Law of the Sea (LOSC) (UN 1982). At the zenith of Part XII is Article 192, which codifies the general customary international law obligations on States Parties to ensure that activities under their jurisdiction or control do not cause harm to the environment of other States or to areas beyond national jurisdiction. Article 194(1) gives content to this general obligation by codifying the duty of States to prevent, reduce and control pollution of the marine environment from any source (Boyle 1992, p. 80). The global

scope of this responsibility is manifest in Article 194(2), which refers to States Parties' duty to ensure that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas over which they exercise sovereign rights. An indicative list of the sources of marine pollution is contained in Article 194(3), which provides that States Parties shall take measures designed to minimize their effects to the fullest possible extent. Particularly relevant in the climate mitigation context, States are obliged to control the release of toxic, harmful or noxious substances, especially those that are persistent, from land-based sources, from or through the atmosphere or by dumping and pollution from other installations and devices operating in the marine environment.

In addition to these general duties to take measures to prevent, reduce and control marine pollution, Article 194(5) imposes a positive duty on States to take measures to protect and preserve rare and fragile ecosystems and the habitat of depleted, threatened or endangered species from marine pollution. This represents an early recognition of the need for ecosystem-based management of the oceans. The requirement in Article 195 that States not transfer, directly or indirectly, damage or hazards from one area to another has particular relevance to marine areas beyond national jurisdiction, as these areas have often been used as dumping grounds for vessel-source and other forms of pollution.

The practical issues of EIA and monitoring of the risks and effects of marine pollution in all areas of the sea are addressed in Articles 204 and 206, which require States Parties to assess, as far as practicable, the potential effects of planned activities under their control, which may cause substantial pollution or significant and harmful changes to the marine environment, and to communicate reports of the results of such

assessments by publishing them or providing them to the competent international organizations.

Rather than being prescriptive in character, Part XII of the LOSC recognizes the role of competent international organizations such as the IMO and diplomatic conferences in supplementing the LOSC framework on marine pollution control with regulatory instruments that address specific forms of marine pollution. Article 197 provides for a duty on the part of States Parties to cooperate on a global and, as appropriate, regional basis, in the protection of the marine environment, directly or through competent international organizations, in formulating and elaborating international rules, standards and recommended practices and procedures for the protection and preservation of the marine environment. States must also cooperate directly or through competent international organizations for the purpose of promoting studies, undertaking programmes of scientific research and encouraging the exchange of information and data acquired about pollution of the marine environment, and to participate actively in programmes to assess the nature and extent of marine pollution, exposure to it and its pathways, risks and remedies.

Where climate change mitigation activities are experimental in character, the LOSC provisions on marine scientific research will apply to their conduct. Article 87 confirms the freedom of scientific research in high-seas areas, subject to the provisions of Part VI on the Continental Shelf and Part XIII on Marine Scientific Research. Articles 256 and 257 in Part XIII reinforce this freedom, providing that all States and competent international organizations have the right in conformity with the LOSC to conduct marine scientific research in the area and the water column beyond the limits of the exclusive economic zone. However, marine scientific research

activities are expressly subject to the marine environmental protection provisions of the LOSC under Article 240(d) (Verlaan 2007, p. 211).

In addition, where climate change mitigation activities are conducted in high-seas areas above an area of extended continental shelf, States Parties and flag vessels under their jurisdiction or control must also have due regard for the sovereign rights of the relevant coastal State in relation to the living and non-living resources of the shelf. For example, Article 79(2) of the LOSC provides that although a coastal State may not impede the laying or maintenance of pipelines on the continental shelf beyond its territorial sea, it has the right to take reasonable measures for the prevention, reduction and control of pollution from such pipelines.

Implementation of these principles in areas under national jurisdiction falls under the control of the coastal State. However, in areas beyond national jurisdiction, implementation of these principles is largely dependent on flag State responsibility. Under Article 217 of the LOSC, flag States must ensure compliance by vessels flying their flag, with applicable international rules and standards established through the competent international organization and with their own laws and regulations for the prevention, reduction and control of marine pollution from vessels, including pollution by dumping (Birnie and Boyle 2002, p. 370; Molenaar 1998, p. 99). Flag States must provide for the effective enforcement of such rules, standards, laws and regulations, irrespective of where a violation occurs. The system of flag State jurisdiction over all forms of vessel-source pollution depends on the commitment and resources of States to monitor the compliance of their own fleets and take enforcement measures against delinquent vessels.

3.2 Complementary Principles for Regulating the Marine Environment

Since the 1972 Stockholm Declaration on the Human Environment (UN 1972), a number of other conservation principles have emerged that also apply to the protection of the marine environment, both within and beyond national jurisdiction (Verlaan 2007, pp. 210–211). Although generally expressed as being consistent with the provisions of the LOSC, and qualified with the prescription that they must be implemented consistently with the rights and obligations of States under the LOSC, these principles have followed a separate development trajectory. Thus, climate change mitigation activities in ocean areas are also subject to the evolving body of marine environmental protection principles; in particular, those articulated in the Rio Declaration (UN 1992) and the Convention on Biological Diversity (CBD) (1992).

<c>3.2.1 The Rio Declaration and Agenda 21 Oceans chapter

The Rio Declaration, which grew out of the United Nations Conference on Environment and Development (UNCED) process (Freestone 1994, p. 216) sets out a number of principles applicable to the preservation and protection of the marine environment. One notable inclusion is that of the precautionary principle. Principle 15 of the Rio Declaration specifies that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation. Application of the precautionary principle has particular relevance for marine areas beyond national jurisdiction because of the still developing state of scientific knowledge in relation to most aspects of the deep-sea environment and the wide array of new and emerging uses of these areas. This embryonic state of knowledge arguably

imposes an even greater responsibility on the international community to adopt preventive strategies to protect this part of the global environment, as evidenced, for example in the number of global instruments in which the burden of proof is reversed, making it impermissible to conduct an activity in areas beyond national jurisdiction unless it can be shown that it will not cause unacceptable harm to the environment (Birnie and Boyle 2002, p. 118). The use of EIA processes for proposed activities that are likely to have a significant adverse impact on the environment is also encouraged in Principle 17 of the Rio Declaration.

Many of the principles contained in the Rio Declaration, including the precautionary approach and the recommendation that States conduct EIAs for proposed activities, are further elaborated in the UNCED Action Plan, Agenda 21 (UN 2009). Of particular relevance here, the Oceans chapter, Chapter 17, recognizes the underlying unity of the oceans, describing the oceans and all seas and adjacent coastal areas as ‘an integrated whole that is an essential component of the global life support system’ (UN 2009, para. 17.1). The primacy of the LOSC as the governing framework for the protection and sustainable development of the marine and coastal environment and its resources is acknowledged, but the need for fresh approaches to marine and coastal management that are ‘integrated in content’ and ‘precautionary and anticipatory’ in ambit is clearly stated (UN 2009, para. 17.1). The general obligation of States to protect and preserve the marine environment in Article 192 of the LOSC is expanded upon by specification of a set of objectives to guide States’ efforts in arresting the degradation of the marine environment. Many of these are derived from the principles contained in the Rio Declaration. They include the application of preventive, precautionary and anticipatory approaches to reduce the

risk of long-term and irreversible damage to the marine environment, the prior assessment of activities that may have significant adverse impacts on the environment, the integration of marine environmental protection considerations into social and economic development policies, incentives such as the ‘polluter pays’ principle to encourage the application of clean technologies, and other means consistent with the internalization of environmental costs (UN 2009, para. 17.22(a–d)).

3.2.2 1992 Convention on Biological Diversity

The provisions of the CBD are closely linked to the vision expounded in the Rio Declaration and Agenda 21 of integrated and ecosystem-based management of the environment, including of marine areas beyond national jurisdiction (Grubb et al. 1993, pp. 75–76). Biological diversity is an all-encompassing term, defined in Article 2 of the 1992 CBD as ‘the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part’, and including ‘diversity within species, between species and ecosystems’. The obligation to conserve biodiversity contained in the CBD requires protection of a range of interlinked components in the marine environment, including species, habitats, ecosystems and genetic material, and takes into account the social, economic and political factors affecting the various components of marine biodiversity (Grubb et al. 1993, pp. 644, 646). Under Article 14 of the CBD, Contracting Parties must introduce EIA procedures for proposed projects that are likely to have significant adverse effects on biodiversity to avoid or minimize such effects. In the case of biological diversity beyond national jurisdiction,

Article 5 of the CBD limits the obligations of Contracting Parties to a duty to cooperate in its conservation and sustainable use directly or through competent international organizations. Arguably, the obligations of States to protect and preserve the marine environment under Part XII of the LOSC must now be interpreted in the light of the provisions of the CBD (Birnie 1997, p. 338; Kimball 1995, pp. 769–771).

<a>4. THE EMERGING LEGAL AND POLICY FRAMEWORK FOR MITIGATION ACTIVITIES IN THE OCEANS

4.1 Regulating Offshore Carbon Capture and Storage

<c>4.1.1 Developments at the global level

As noted above, the LOSC requires States to take, individually and jointly, all measures necessary to prevent, reduce and control pollution of the marine environment, to prohibit the transfer, either directly or indirectly, of damage or hazards from one area to another, and to prohibit the transformation of one type of pollution to another (UN 1982, arts 192–196). Pollution is defined as:

<quotation>the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the seas, impairment of quality for use of sea water and reduction of amenities. (UN 1982, art 1(4))</quotation>

It is not the nature of the substance, *per se*, that matters, but rather its potential for deleterious effects. Neither is the nature or purpose of the polluting activity

relevant. States are to prevent, reduce and control pollution from all sources, whether generated from scientific research or from commercial operations, and whether transmitted from land-based sources, through the atmosphere, or from vessels, including from 'dumping' (UN 1982, art 196).

'Dumping' is defined in the LOSC as 'any deliberate disposal of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea' (IMO 1972, art 1; IMO 1996, art 1; UN 1982, art 1(5)). All States are required to adopt national laws to prevent and regulate dumping, and these laws must be no less effective than internationally agreed upon global rules and standards (UN 1982, art 210). These rules and standards are found in the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Convention or LC) and the 1996 Protocol to the London Convention (London Protocol or LP). The LC applies to 'any deliberate disposal at sea of waste or other matter from vessels, aircraft, platforms or man-made structures at sea' (IMO 1972, art III 1(a)). Dumping of certain listed materials is wholly prohibited, while dumping of non-prohibited substances is only allowed subject to the requirements of prior EIA, permitting and on-going monitoring as set out in Annex III of the Convention. The LP was negotiated in 1996 to replace the LC. Although it has entered into force, it has limited participation (38 States Parties) and the two regimes operate in parallel. A fundamental premise of the LP is that Contracting Parties should avoid using the sea for the dumping of wastes and that any exceptional dumping of wastes at sea should be subject to rigorous risk assessment and control and scientifically based procedures for disposal (IMO 1996, art 2). Dumping of any waste or other matter is therefore

strictly prohibited under the LP, except for those few materials specifically listed in Annex I (IMO 1996, art 4).

The LC makes no mention of the seabed or sub-seabed. Therefore, it is generally considered that the LC does not apply to OCCS. However, when the LP was negotiated, the definition of dumping was expanded to prohibit ‘any storage of wastes or other matter in the seabed and the subsoil thereof from vessels, aircraft, platforms or other man-made structures at sea’ (IMO 1996, art 1(4)(3)), except for those materials specifically listed in Annex I (IMO 1996, art 4). Annex I includes ‘inert, inorganic geological material’ and ‘organic material of natural origin’. It is unlikely that carbon dioxide would fall into either of these categories. Nevertheless, as already mentioned, the direct injection of CO₂ into subsurface geological formations has been used as part of EOR projects since the early 1970s (GCCSI 2009; IPCC 2007, p. 199). These operations are generally considered to fall under the exception to dumping as ‘placement for a purpose other than the mere disposal thereof’. However, since the 1990s, the technology has also been used to capture and store CO₂ from natural gas processing operations and, as mentioned in the discussion of carbon sequestration above, in 1996, the Norwegian oil company Statoil opened the world’s first commercial offshore CO₂ storage site. While EOR operations might fall under the exception, the deliberate disposal of excess atmospheric CO₂ into commercially operated sub-seabed sites does not.

With some States increasingly promoting the concept of CCS as a means of alleviating atmospheric CO₂ levels, the LP was amended at the First Meeting of the Contracting Parties immediately after it came into force in 2006 to permit storage of carbon dioxide under the seabed (IMO 2007c). As amended (and entering into force

on 10 February 2007 for all Contracting Parties to the Protocol), the LP allows for the dumping of 'carbon dioxide streams from carbon dioxide capture processes for sequestration' where disposal is into a sub-seabed geological formation and the streams consist overwhelmingly of carbon dioxide (they may contain incidental associated substances derived from the source material and the capture and sequestration processes used), and no wastes or other matter are added for the purpose of disposing of those wastes or other matter. In June 2006, the Scientific Group adopted a Risk Assessment and Management Framework to provide for characterization of the risks posed by CO₂ sequestration on a site-specific basis and to enable the collection of all necessary information for developing a management strategy to 'address uncertainties and any residual risks' (IMO 2006, Annex 3). Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations were adopted by the Parties in November 2007 to supplement the Guidelines for the Assessment of Wastes or Other Matter that May be Considered for Dumping, adopted in 1997 (IMO 2007b).

The Specific Guidelines take a precautionary approach to the process requiring Contracting Parties, under whose jurisdiction or control such activities are conducted, to issue a permit for the disposal, subject to stringent conditions being fulfilled (IMO 2007b, s. 9). The chemical and physical properties of carbon dioxide streams proposed for sub-seabed sequestration must be rigorously analysed and alternative methods of land-based disposal appropriately considered (IMO 2007b, ss. 3, 4). In addition, permit applicants must provide a geological assessment of the proposed site, which includes information on its long-term storage integrity, potential migration and leakage pathways over time, potential effects on the marine environment of leakage of

carbon dioxide, and possibilities for monitoring, mitigation and remediation if leakage occurs (IMO 2007b, s. 6.2). Permit applicants must also provide information on the biological features and uses of the proposed site, including the presence of vulnerable ecosystems, critical habitats, spawning, nursery and recruitment areas for fish, shipping lanes, migration routes, military exclusion zones and engineering uses of the sea, such as undersea cables and energy conversion (IMO 2007b, s. 6.6). Applications for permits are required to evaluate the potential effects of a leakage of the carbon dioxide stream on human health, living resources, amenities and other legitimate uses of the sea (IMO 2007b, s. 7.6). This evaluation leads to an impact hypothesis forming the basis for a monitoring programme aimed at ensuring effective management of the disposal site and triggering mitigation or remediation plans if necessary (IMO 2007b, s. 7.11). In May 2008, a special reporting format was adopted to ensure adequate and accurate reporting on CO₂ streams for disposal into sub-seabed formations (IMO 2008, Annex 8).

In October 2009, the LP was further amended to allow the export of CO₂ for OCS purposes. As originally adopted, Article 6 prohibits the export of wastes or other matter to other countries for dumping or incineration at sea. As amended, Article 6 now allows the export of carbon dioxide streams for disposal in accordance with Annex 1, provided that an agreement or arrangement has been entered into by the countries concerned and that agreement or arrangement includes confirmation and allocation of permitting responsibilities between the exporting and receiving countries and, in the case of export to non-Contracting Parties, provisions are, at a minimum, equivalent to those contained in the LP. Use of the word 'export' rather than 'trans-boundary movement' excludes migration of CO₂ after injection, thereby ensuring

responsibility continues for trans-boundary migration after injection, while the requirements for agreement with non-Contracting Parties ensure that the Contracting Parties cannot contract out of their obligations under the LP. Until the amendment comes into force, export of CO₂ streams for OCCS will continue to be prohibited under the LP. Nevertheless, a work plan was adopted by the Scientific Groups in October 2010 for review of the Specific Guidelines to establish guidelines for the export of CO₂ for disposal in anticipation of the amendment coming into force (IMO 2010b).

While these comprehensive guidelines have been designed to avert the potential risks of this form of waste disposal at sea, it must be remembered that they only apply to the limited number of States Parties to the London Protocol. Nevertheless, these States are obliged to enact domestic legislation consistent with their international obligations. It is therefore germane to examine developments in national jurisdictions.

<c>4.1.2 Developments in Australia

Australia, as one of the world's largest coal producers and exporters has emerged as a leading proponent of CCS projects both onshore and offshore. The Commonwealth Government had already developed the *Australian Regulatory Guiding Principles for Carbon Dioxide and Geological Storage* (Guiding Principles) in 2005, prior to the adoption by the LP of the Specific Guidelines in 2007. For OCCS projects, the Guiding Principles led to the Offshore Petroleum Amendment (Greenhouse Gas Storage) Act 2008, which amended the Offshore Petroleum Act 2006. The

consolidated Act is now entitled the Offshore Petroleum and Greenhouse Gas Storage Act 2006.

The Guiding Principles were designed to facilitate a nationally consistent approach to carbon dioxide capture and geological storage across Commonwealth and State Governments in Australia's Federal System. They cover the assessment and approvals process for CCS activities; access and property rights to CCS sites; protocols on transport of CCS streams; requirements for monitoring and verification of the quantity of gas captured and stored; the net abatement of carbon dioxide emissions and the identification of and accounting for leakage; liability and post-closure responsibilities; and financial issues associated with the taxation liabilities of CCS projects and post-closure liabilities.

The Guiding Principles recognize the need for the Australian regulatory framework for CCS activities to be consistent with Australia's obligations under international law and to safeguard public interest, particularly to minimize risks to health, safety, environment, economic consequences and government accountabilities. These Principles are based on the Ecologically Sustainable Development Principles accepted by the Council of Australian Governments (COAG), which in turn reflect established international law principles on environmental protection. For example, COAG's agreed upon Ecologically Sustainable Development Principles are influenced by the precautionary principle, intergenerational equity and the 'polluter pays' principle, as well as by the need for decisions and actions on CCS activities to provide for broad community involvement on issues that affect those communities. The Guiding Principles recognize the applicability of the LC, its 1996 Protocol and the LOSC to OCCS activities, as well as the customary international law duty not to

cause trans-boundary environmental damage; although no recognition is made in the Principles of the need not to cause trans-boundary damage to areas beyond national jurisdiction.

The need to subject CCS activity proposals to EIA processes prior to approval of a project is fully acknowledged in the Guiding Principles. The Principles recommend that existing legislation and regulations relating to CCS activities be modified and augmented where necessary to provide for consistent assessment and approval processes across all parts of a CCS project. For OCCS projects, this approach is consistent with Article 206 of the LOSC and Article 3 of the CBD, which require States Parties to conduct prior EIAs of activities or projects with the potential for significant adverse impacts on the marine environment and its biodiversity. In Australia's case, a proposed OCCS activity in an area beyond three nautical miles from the territorial sea baseline would be subject to an EIA process under the Environment Protection Biodiversity Conservation Act 1999 (Cth). At the stage when the carbon dioxide is being sequestered, the activity would also require a permit under the Environment Protection (Sea Dumping) Act 1981 (Cth), which implements Australia's obligations under Annex 2 of the LP relating to Waste Assessment.

In relation to access and property rights to greenhouse gas storage sites both onshore and offshore, the Guiding Principles recommend that surface and subsurface rights for CCS should provide certainty to rights holders of their entitlement and obligations and that these rights should be based on established legislative and regulatory arrangements, custom and practice. The Principles also recommend that additional governmental regulation be introduced to define property rights in relation to CCS. These recommendations were implemented in the 2008 amendments to the

Offshore Petroleum and Greenhouse Gas Storage Act 2006. These amendments introduced a system of greenhouse gas assessment permits and greenhouse gas holding leases over blocks in Australia's offshore area, through which permit holders can explore the area for potential greenhouse gas storage sites and eventually be granted a greenhouse gas injection licence. These permits, leases and licences are granted by the Minister for Resources, Energy and Tourism and administered through the Department for Resources, Energy and Tourism. In approving grants for greenhouse gas assessment permits, the Minister must consider whether greenhouse gas storage operations in a particular offshore area would have a significant adverse impact on existing petroleum exploration or recovery operations.

The Guiding Principles emphasize the need for monitoring and verification of the stored CCS streams to ensure operationally safe performance and to minimize the risk of leakage into the surrounding environment. They specify the content of both the monitoring information and the transparency measures in relation to the information obtained. The regulatory framework should provide for the accuracy, quantity, composition and location of gas captured, transported, injected and stored and the net abatement of emissions. Regulation should also provide for appropriate monitoring and verification requirements, enabling the generation of clear comprehensive, timely, accurate and publicly accessible information that can be used to effectively and responsibly manage environmental, health, safety and economic risks. The Environmental Guidelines for Carbon Dioxide Capture and Geological Storage issued by the Environment Protection and Heritage Council in 2009 endorse these principles, specifying that CCS projects that become operational in the next decade must include comprehensive monitoring regimes including in hole geo-chemical monitoring,

geophysical, including seismic, monitoring, and modelling of the carbon dioxide plume. This will be an essential condition of approval for all CCS projects. For CCS projects in the Commonwealth marine area beyond three nautical miles, development of the monitoring and verification conditions is likely to be part of the EIA process and final project approval. Under the Offshore Petroleum and Greenhouse Gas Storage Act 2006, decommissioning reports must be submitted to the Minister for Resources, Energy and Tourism, together with suggestions for monitoring, measurement and verification. The requirement for a site-closing certificate includes a thorough assessment of the migratory behaviour of the injected greenhouse gas.

The Guiding Principles identify the need to define liabilities and post-closure responsibilities associated with CCS projects. The key liability foreshadowed in the Principles is the potential monetary compensation arising from a leakage of the CCS stream because of negligence during any part of the CCS process. During the currency of the CCS operation, the liability to pay monetary compensation would fall on the project operator, who has a duty to take reasonable care to avoid harm to a person or property, but may have failed to do so. The Principles also indicate the need to develop a policy for acceptance of post-closure responsibilities arising from risks associated with long-term storage of the carbon dioxide following the decommissioning of the storage site. These recommendations have been implemented in the 2008 amendments to the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth). The Act imposes statutory liability for damages on the holder of a greenhouse gas injection licence until a site-closing certificate has been issued. It also contains a provision on transfer of long-term liability from the operator to the Government at the end of a closure assurance period, which is to be a minimum of

five years. The Act includes a 20-year sunset period on the proponent's liability for damages.

The evolving regulatory environment for offshore carbon capture projects in Australia is defined by its complex and fragmentary character. The commercial and environmental viability of future CCS activities in Australia's offshore areas will depend on strong collaborative governance and adaptive management across Commonwealth and State jurisdictions and relevant industry sectors. Within the Asia-Pacific region, Australia is the first country to pass dedicated carbon capture and storage legislation, although such activities in other Asia-Pacific jurisdictions will undoubtedly fall within established regulatory frameworks for EIA, planning, pollution prevention and waste disposal.

4.2 Regulating Ocean Fertilization

The long-term environmental impacts of ocean fertilization are still uncertain and the regulatory framework for this process is still developing. In part, development of a single coherent regulatory approach is complicated by the range of proposed and actual fertilization techniques. Different legal considerations arise depending on the technique used (for example, ocean-based fertilization, land-based fertilization or wave-mixing machines suspended in the water column) and the locus of the fertilization (that is, whether fertilization activities occur in areas beyond national jurisdiction or in areas within national jurisdiction) (Rayfuse 2008, p. 920). In addition, this complex matrix of legal relationships and regulatory possibilities may be further complicated when the purpose of the fertilization is considered. This is because fertilization for climate mitigation purposes might, arguably, be

distinguishable from fertilization for ocean nourishment and fish propagation purposes. While ocean fertilization activities conducted in marine areas within national jurisdiction will be subject to coastal State control, this jurisdiction must be exercised consistent with international obligations. It is thus appropriate to examine the emerging global framework for the regulation of ocean fertilization activities.

Like OCCS, it is in the context of the international regime for the control of dumping that debates over regulation of ocean fertilization have received most attention. As noted above, for States Parties to the LC, dumping of non-prohibited substances is only allowed subject to the requirements of prior EIA, permitting and on-going monitoring as set out in Annex III of the Convention. For parties to the LP, the dumping of all waste and other matter is prohibited – with the exception of the five listed categories of substances, the dumping of which is nevertheless subject to the stringent assessment, permitting and on-going monitoring requirements of Annex 2 of the Protocol. None of the fertilizers proposed for use in ocean fertilization fall into any of these categories (Freestone and Rayfuse 2008, pp. 227–233; Rayfuse et al. 2008, p. 307). In other words, the use of these ‘fertilizers’ is *prima facie* banned.

The central issue for ocean fertilization is whether it is exempt from the ban on dumping by virtue of the operation of the exception to the definition of dumping found in the LOSC, LC and LP (Freestone and Rayfuse 2008, pp. 307–317). Stated in the same terms in each Convention, dumping is defined as *not* including ‘placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of’ the relevant Convention. This qualification on the definition of dumping potentially excludes ocean fertilization from the general prohibition on dumping if the fertilization is for the purpose of climate mitigation or

other commercial and environmental purposes, such as fisheries enhancement. However, in view of its potentially adverse effects on the marine environment, even the experimental phases of ocean fertilization may be regarded as contrary to the marine environmental protection aims of the LOSC, the LC and/or the LP (Rayfuse et al. 2008, pp. 313–315). If this is the case then, for States Parties to the LC, ocean fertilization activities will be subject to the permitting requirements set out in the Convention. However, for States Parties to the more stringent LP, ocean fertilization is prohibited.

In May 2007, the parties to the LC and LP were confronted for the first time with proposals for large-scale commercial ocean iron fertilization projects. As noted in Section 2.2 above, a number of United States and Australian companies were promoting ocean fertilization as a tool to buffer ocean acidity, replenish the marine food chain and sequester CO₂, while inviting investors and green co-sponsors to finance their activities in return for the provision of carbon credits to offset investors' CO₂ emissions. A 'statement of concern' adopted by the Scientific Groups of the LC/LP in July 2007 'noted with concern the potential for [ocean fertilization activities] to have negative impacts on the marine environment and human health' and recommended that the parties to the LC and LP consider the issue with a view to its regulation (Scientific Groups of the London Convention and the London Protocol 2007). This statement of concern was endorsed by the States Parties during their joint annual meeting in November 2007, at which the parties agreed that while it was within the purview of each State to consider proposals for ocean fertilization projects on a case-by-case basis in accordance with the Convention and/or Protocol, knowledge about the effectiveness and potential environmental impacts of open-ocean

fertilization was currently insufficient to justify large-scale projects. They also agreed that ocean fertilization falls within their regulatory competence and that they would ‘further study this issue from scientific and legal perspectives with a view to its regulation’ (IMO 2007b).

In May 2008, the Scientific Group reviewed the evidence on open-ocean fertilization and concluded that ‘based on scientific projections, there is the potential for significant risks of harm to the marine environment’, even if direct scientific evidence on the environmental impact was still lacking. This decision prompted the Conference of the Parties of the CBD, at their ninth meeting in May 2008, to request parties and urge other governments:

<quotation>in accordance with the precautionary approach to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global transparent and effective control and regulatory mechanism is in place for those activities; with the exception of small scale scientific research within national jurisdiction. (COP-9 2008, s. C)</quotation>

An exception was noted in the case of ‘small scale scientific research studies within coastal waters’, which:

<quotation>should only be authorised if justified by the need to gather specific scientific data, and should also be subject to a thorough prior assessment of the potential impacts of the research studies on the marine environment, and be strictly controlled, and not be used for generating and selling carbon offsets or any other commercial purposes. (COP-9 2008, s. C)</quotation>

In October 2008, the parties to the LC/LP adopted a non-binding resolution agreeing that:

<quotation>given the present state of knowledge ocean fertilization activities other than legitimate scientific research should not be allowed ... [and that] ocean fertilisation activities other than legitimate scientific research, should be considered as contrary to the aims of the Convention and Protocol and not currently qualify for any exemption from the definition of dumping. (IMO 2008, paras 4.1–4.18, Annexes 2, 5) </quotation>

They identified the need for preparatory work on technical and scientific issues and agreed to consider further a potentially legally binding resolution or an amendment to the LP at their 2009 session. An intersessional Technical Working Group on Ocean Fertilization was established to develop an Assessment Framework for Scientific Research Involving Ocean Fertilization to provide a mechanism for assessing, on a case-by-case basis, whether proposals for ocean fertilization activities represent legitimate scientific research (IMO 2008, para. 2.3). The draft Assessment Framework (IMO 2010a, Annex 2) was reviewed by the Scientific Groups in June 2009 and adopted as a ‘work in progress’ (IMO 2010a, paras 2.18–2.29). The draft was tabled again during an extraordinary session of the Scientific Groups in October 2010 (IMO 2010a, Annex 5), at which time further revisions were made and it was adopted, by consensus, in a non-binding resolution at the October 2010 meeting of the parties (IMO 2010b, Annex 5).

The Assessment Framework (AF) describes itself as a ‘tool ... to determine if the proposed activity constitutes legitimate scientific research that is not contrary to the [LC/LP] aims’. It sets out a two-stage process involving an Initial Assessment and

an Environmental Assessment. The purpose of the Initial Assessment is to determine whether the proposed ocean fertilization activity constitutes legitimate scientific research. To qualify as such, the proposed activity must have ‘proper scientific attributes’, which means:

<nl>

1. The proposed activity should be designed to answer questions that will add to the body of scientific knowledge. Proposals should state their rationale, research goals, scientific hypotheses and methods, scale, timings and locations with clear justification for why the expected outcomes cannot reasonably be achieved by other methods.
2. Economic interests should not influence the design, conduct and/or outcomes of the proposed activity. There should not be any financial and/or economic gain arising directly from the experiment or its outcomes. This should not preclude payment for services rendered in support of the experiment or the future financial impacts of patented technology.
3. The proposed activity should be subject to scientific peer-review at appropriate stages in the assessment process. The outcomes of the scientific peer review should be taken into consideration by the Contracting Parties. The peer-review methodology should be stated and the outcomes of the peer review of successful proposals should be made publicly available together with the details of the project.
4. The proponents of the proposed activity should make a commitment to publish the results in peer-reviewed scientific publications and include a

plan in the proposal to make the data and outcomes publicly available over a specified period.</nl>

Proposals that meet these criteria may then proceed to the next stage, the Environmental Assessment, which includes requirements of risk management and monitoring. The Environmental Assessment stage entails a number of components, including the problem formulation, a site selection and description, an exposure assessment, an effects assessment, risk characterization and risk management sections (IMO 2010b, Annex 6). Only after completion of the Environmental Assessment is it decided whether the proposed activity constitutes legitimate scientific research that is not contrary to the aims of the LC/LP, and whether it should thus be permitted to proceed.

Importantly, every experiment, regardless of size or scale, is to be assessed in accordance with the AF. This is fully consistent with the LOSC, which requires all activities affecting the marine environment to comply with its marine environmental provisions (Verlaan 2007, p. 216). While it is acknowledged that the information requirements will vary according to the nature of each experiment, it would be incompatible with the AF for parties to establish their own national thresholds to exempt some experiments. The AF is thus also consistent with, and possibly more stringent than, the CBD moratorium.

The AF represents a significant achievement in providing an environmentally responsible mechanism to assess and control ocean fertilization activities. However, as noted above, the AF is non-binding. In 2009, an intersessional Working Group on Ocean Fertilization was established to ‘focus on deepening the understanding of the

implications of legally binding options to enable the informed consideration and discussion of the governing bodies' (IMO 2009).

Numerous options for a legally binding measure on ocean fertilization have been identified and these can be essentially divided along two lines. Some States support a legally binding interpretative resolution that considers ocean fertilization for legitimate scientific research purposes to be 'placement for a purpose other than the mere disposal thereof' and thus not dumping. Ocean fertilization for all other purposes would be contrary to the aims of the LC/LP, and thus dumping. The advantages of this approach are that it would not require an amendment to the LC/LP or their annexes; it would address both the parties to the LC and the LP; and it would be adaptable to regulation of other marine geo-engineering activities in the future. However, a key disadvantage is that any legitimate scientific research ocean fertilization activities that had been approved through the AF process would not be subject to the legally binding permitting regime required for approved dumping operations, including its consultation and reporting requirements. Other States support adoption of an amendment to some or all of Annex 1 of the LP, the definition of dumping, the exclusions for dumping, or inclusion of a new stand-alone article in the LP on ocean fertilization (IMO 2010a). Under these various proposals, ocean fertilization for legitimate scientific purposes would be permitted under the LP and subject to its permitting requirements. Australian and New Zealand in particular take the position that an amendment to Annex 1 of the LP specifically permitting legitimate scientific research ocean fertilization activities is necessary to ensure its effective regulation through the permitting regime. In effect, this would put such

activities on the same footing as OCCS. Other States remain strongly opposed to any regulation of ocean fertilization whatsoever.

Of course, even adoption by the LC/LP parties of a legally binding option, whatever it might be, will not wholly guarantee the effective regulation and control of ocean fertilization activities, particularly where they take place in areas beyond national jurisdiction. The LC and LP are only binding on their parties. No matter how strict an approach they take, the very real potential exists for proponents of ocean fertilization to undermine the LC/LP regulatory efforts by conducting their activities through non-contracting parties. In this respect, given its near global adherence, the CBD moratorium on ocean fertilization represents a critically useful adjunct to the work of the LC/LP.

Indeed, the CBD may be seen as something of a catalyst to the LC/LP process. Having provided impetus to the LC/LP discussion with respect to ocean fertilization, the CBD may now also have set the agenda for further action on the broader issue of marine geo-engineering in general. In 2009, the parties to the LC/LP considered whether the scope for regulation should be widened to cover other emerging marine geo-engineering proposals, or whether regulation should remain focused only on ocean fertilization as a sub-set of marine geo-engineering. At the time, it was agreed to maintain the focus on ocean fertilization, but that an exploration of other marine geo-engineering activities and their possible impacts on the marine environment would be conducted in the future (IMO 2009, para. 4.20). In 2010, the parties to the CBD took a more decisive step by extending the moratorium on ocean fertilization to encompass all climate-related geo-engineering activities that may affect biodiversity (COP-10 2010). Clearly, whatever procedures are adopted by the parties to the LC/LP

to deal with ocean fertilization, these will have resonance for the regulation of other marine geo-engineering activities in the future.

<a>5. CONCLUSION

The alacrity with which the LP was amended to allow for OCCS has been criticized by commentators who consider the amendment to be both inconsistent with Article 6 of the LP and a fundamental violation of Article 195 of the LOSC, which prohibits the transfer of pollution from one area to another (Verlaan 2009, p. 457). A different regulatory path has been followed for ocean fertilization.

The risk-assessment process adopted for ocean fertilization under the LC/LP for legitimate and small-scale scientific experiments provides a model for States Parties to apply modern international environmental law principles to protect the marine environment and conserve biodiversity, particularly where experiments occur beyond national jurisdiction. However, this model has obvious limitations, as it is designed for a specific activity that falls within the regulatory scope of the LC/LP, only binding States Parties to the LC/LP and relying on individual flag State responsibility for the implementation of the risk-assessment process. Other climate change mitigation activities involving the oceans may be subjected to similar examination in the future by the LC/LP Scientific Groups if such activities fall within the regulatory ambit of these conventions. However, the proliferation of such activities suggests the need for a more integrated system of global, sectoral and regional instruments to provide a more comprehensive system of prior EIA and on-

going monitoring of the long-term effects of such activities on the receiving environment.

Arbitrary human intrusions into previously undisturbed marine domains have the potential to harm the intricate links between complex marine ecosystems and to erode components of marine biodiversity. Protection of the vast tracts of ocean from the adverse impacts of new and emerging uses such as climate change mitigation activities requires concentrated global, regional and national investment into coordinating and extending environmental protection regimes and developing assessment frameworks. Enhanced environmental protection for the oceans will require concerted action by the international community to put in place best practice guidelines and measures to assess and minimize the adverse impacts of emerging climate change mitigation activities on all areas of the ocean.

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