This is a postprint version of the following published document:

Abad Castelos, M. (2014). Marine Renewable Energies: Opportunities, Law, and Management. *Ocean Development & International Law*, 45 (2), pp. 221-237.

DOI: 10.1080/00908320.2014.898926

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Marine Renewable Energies: Opportunities, Law, and Management

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Marine renewable energies are still at a very incipient stage. Even so, it can be anticipated that if such energies were to be developed, multiple benefits could be achieved in the environmental, social, and economic spheres. However, these benefits are not without possible controversial aspects. This article examines the content and scope of the applicable international law of the sea regarding the use of renewable energy from the seas.

Keywords international governance, marine renewable energy

Introduction

Marine renewable energies are a form of renewable energy deriving from the various natural processes that take place in the marine environment. There are four kinds of such energy: ocean energy, wind energy from turbines located in offshore areas, geothermal energy derived from submarine geothermal resources, and bioenergy derived from marine biomass, particularly ocean-derived algae.[1] In turn, renewable ocean energy comes from six distinct sources, each with different origins and requiring different technologies for conversion, but having in common that they are all obtained from the potential, kinetic, thermal, and chemical energy of seawater. These six distinct sources are: waves, tidal range, tidal currents, ocean currents, ocean thermal energy conversion, and salinity gradients. More specifically, waves, which are generated by the action of wind on water, produce energy that can be harnessed. With regard to tides, their amplitude generates energy through the cyclical rise and fall in the height of the ocean. The same is true of tidal currents, which are generated by horizontal movements of water, their flows resulting from the rise and fall of the tide. Ocean currents, which exist in the open ocean, are another source of energy. Ocean thermal energy conversion (OTEC), on the other hand, is a technology for taking advantage of the solar energy absorbed by the oceans based on the temperature difference between the top layers of water and those at a greater depth which are much colder. However, a minimum temperature difference of 20°C between layers is needed in order to harness this energy, which therefore can be produced in only certain parts of

Received 16 August 2013; accepted 30 September 2013.
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the world such as equatorial and tropical regions. Finally, salinity gradients arise from the mixing of freshwater and seawater, which takes place at river mouths and releases energy as heat. This energy can be harnessed through a process of inverse electrodialysis, based on the difference in chemical potential between freshwater and seawater or through an osmotic power process based on the natural tendency of the two types of water to mix together.[2]

The development status of these technologies differs widely, although most of them still are either embryonic or in their infancy, ranging as they do from the conceptual stage to the prototype stage, taking in the pure research and development stage on their way.[3] The Intergovernmental Panel on Climate Change (IPCC) highlights tidal range technology as being the most advanced and the only form of ocean energy technology (excluding marine wind energy technology) that currently can be considered mature.[4] Although marine energy technologies are at an early stage of development, they could make much swifter progress if investment in them were higher. Prominent among the leaders in the development and commercialization of marine renewable energy technologies are the United Kingdom, Ireland, the United States, Australia, New Zealand, Finland, Denmark, Belgium, France, Germany, and Japan.[5] However, the economic crisis currently affecting a number of the world's developed countries will necessarily have a negative effect on the flow of investment toward technologies of this kind.

Although forecasts vary widely, depending on who is making the prediction, a prudent approach indicates that any significant development of ocean energy technologies is unlikely to occur before 2030 while commercial deployments are expected to continue expanding beyond 2050.[6] It therefore remains to be seen as to when these technologies will be able to make a significant contribution to the global energy supply. At the moment, only marine wind energy is considered to be relatively close to beginning to be competitive with fossil fuels or nuclear energy. However, in spite of the incipient status of all marine renewable energies, forecasts of their potential are on the whole optimistic. According to the IPCC, the potential for technically exploitable marine renewable energies, marine wind power excluded, is estimated at some 7,400 exajules per year.[7] This figure is considered to be more than enough to meet human energy needs not only at present, but also well into the future.[8]

Marine renewable energies, like all renewable energies, appear to be the ideal solution to two fundamental problems that affect developing and developed countries in different ways. These are, on the one hand, how to guarantee access to energy, which mainly affects developing countries (the reference here is to access to energy, not energy security); and on the other, how to reduce greenhouse gas emissions, which until recently has been a problem primarily concerning developed countries, although things have now started to change in this regard. Whatever the situation, these are two problems for which to date no solution has been found or for which solutions have not been forthcoming due to a lack of the necessary political will.

Taking all of the above into account, marine renewable energies may provide solutions. As the twenty-first century progresses, there is growing awareness that the energy potential of the seas and oceans may be so vast that it surpasses the current understanding and that marine renewable energies are steadily rising up the rankings as contributors in a near-term sustainable energy scenario.[9] However, marine renewable energies are not without their disadvantages and issues will arise regarding their development. The matter is one of enormous complexity and, not only from the technical point of view, it is indeed far more multifaceted than it may appear at first sight.

The Need to Adopt a Sustainable Development Perspective

The pros and cons of marine renewable energies must be examined from the standpoint of the three dimensions of sustainable development: economic, environmental, and social. Although the principle of sustainable development may to some extent remain within the realm of soft law, it is by no means unimportant. This is not only because the sustainable development principle raises expectations in accordance with the principle of good faith and that states are usually careful to avoid having to withdraw from political commitments, but also because it can project a much wider scope. Soft law often functions like law because it can and does guide the behavior of states, international organizations, and even private entities.[10]

Furthermore, the principle of sustainable development may also have legal consequences. The International Court of Justice can be said to have applied the principle of sustainable development on several occasions in the process of resolving conflicts between states over the use of a shared resource,[11] and at least one international arbitration tribunal has gone down the same road.[12] The Seabed Disputes Chamber of the International Tribunal for the Law of the Sea adopted a crucial dictum in 2011 when it considered the concept of the common heritage of humankind to be an integral part of the promotion of sustainable global development.[13] In the light of this evolution, one of the major challenges today is to operationalize the principle of integration of the economic, social, and environmental aspects of sustainable development, which is considered by some to be a norm of general international law.[14] Bearing this in mind, the marine renewable energies sector should be a one for which care must be taken that any new regulation (or the development of an existing one) does not ignore this principle.

Sustainable development is a pillar of a variety of strategies adopted within the United Nations. It is a significant proportion of the Sustainable Energy for All initiative, launched by the UN secretary-general in 2012 to mobilize action from all sectors of society in support of three interlinked objectives to be achieved by 2030: providing universal access to modern energy services, doubling the global rate of improvement in energy efficiency, and doubling the share of renewable energy in the global energy mix.[15] The objective of sustainable development is also one of the foundations of a number reports issued within the framework of the United Nations: the 2012 "Report of the U.N. Secretary-General on Oceans and the Law of the Sea" that focused on marine renewable energies;[16] the Intergovernmental Panel on Climate Change's "Special Report on Renewable Energy Sources and Climate Change Mitigation;"[17] and the secretary-general's report "New and Emerging Technologies."[18] Additionally, the United Nations Open-ended Informal Consultative Process on the Oceans and the Law of the Sea (UNICPOLOS), established by the General Assembly with the mandate to deal with matters relating to oceans within the context of sustainable development, devoted its thirteenth meeting, held in 2012, to discussing the subject of marine renewable energies.[19]

The Pros and Cons of Marine Renewable Energies

Pros

From an environmental standpoint, one of the most indisputable aspects of marine renewable energies is the significant contribution they can make to reducing the dependence on traditional nonrenewable sources of energy. This positive aspect generates a wide range of

additional benefits in the environmental, economic, social, and strategic spheres, the most important of these being a projected reduction in the emission of greenhouse gases.[20] This places marine renewable energies, like all other renewable sources of energy, as a powerful source of climate change mitigation.[21]

In the economic sphere the main opportunities lie in the potential for job creation, an aspect recently supported by the International Renewable Energy Agency (IRENA).[22] A further possible advantage is the progressive reduction in the cost of the majority of the technologies involved, not only as a consequence of the increasing maturity of the market but also of the advances made in recent years.[23]

Turning to social benefits, emphasis can be placed on the fact that access to modern energy services is an "important precondition for many fundamental determinants of human development, including health, education, gender equality and environmental safety."[24] Experience shows a correlation between high levels of energy consumption and higher levels of development.[25] The achievement of the Millennium Development Goals and of more equitable socioeconomic development depends on providing the poor with increased access to modern energy services.[26] At the same time, marine renewable energy sources may be "a viable and sustainable solution for coastal communities that have limited or no access to modern energy services"[27]

Cons

The most common environmental impacts of marine renewable energy technologies include:

- the alteration of benthic habitats and sediment transport or deposition by the construction activities and continuous presence of devices and structures;
- deaths or changes in the behavior of fish and mammals as a result of noise and electromagnetic fields;
- interference with the movement, feeding, spawning, and migration paths of fish, mammals, and birds;
- the release of toxic chemicals as a result of accidental spills, or leaks, or the accumulation of metals or organic compounds; and
- the reduction of the velocity of marine currents and decreases in wave height resulting from the extraction of wave or tidal energy.[28]

Consideration must be given to preventing or compensating for such problems. The starting point should be marine spatial planning to avoid protected areas, sensitive habitats, migratory pathways, and feeding, spawning, or nursery grounds and the like, followed by the introduction of specific measures for the different types of devices, installations, and sites used to generate energy.[29]

Filling the existing knowledge gap requires testing the devices in situ "and monitoring and evaluating their impacts, taking into account the precautionary approach."[30] It is essential to carefully check all the relevant assessments and subject them to as many verification processes as may be necessary since the field is one where evaluations not only differ, but are at times wholly contradictory. An example of this is the widely differing estimations of the environmental impact of the La Rance tidal barrage in France, which obtains energy from the amplitude of the tide. While one source referred to the impact as "negligible,"[31] another drew attention to the "fairly serious" environmental impact produced, including sedimentation in the river, changes in the salinity of the waters in and around the estuary, and disturbance to the aquatic ecosystem.[32]

The economic problems can easily be imagined since the scientific and technological developments needed to produce renewable ocean energy requires massive investments. This expenditure is particularly high in the near term, if compared to that needed by traditional methods of energy production.[33]

Equally necessary is a strategic association between public and private sectors since the latter requires a framework of incentives provided by the former. However, the difficulties arising as a result of the current economic situation are compounded by the problems and conflicts caused by the diversity of legal, administrative, and political frameworks involved. The absence of institutional coordination introduces barriers that are often difficult to overcome. The very novelty of the technologies concerned means that developers and investors are faced with inadequate fiscal and licensing policies due to the lack of any kind of centralized authority or competent government agency.[34]

The social challenges surrounding marine renewable energies are related above all to the opposition or concern felt by local communities over the deployment in their vicinity of the structures and devices needed to obtain energy from such sources. This opposition is motivated or based on prejudices that are, to a certain extent, completely unfounded. As a result, it is important that these communities take part in the process of deciding on the sites for such devices and their associated cabling.[35] There are also problems relating to possible conflicts arising with preexisting uses of the seas. As a result, pressure may be exerted by all the sectors that could be negatively affected by the deployment of energy-generating installations. The former would include, for example, the shipping and fishing industries, since sailing (and thus transport) and fishing rights could be prejudiced. Another sector often mentioned is the tourist industry, which is concerned about the impact on beaches, landscapes, and other amenities.

The problems referred to above are not the only possible challenges that marine renewable energies have to face. There may well be others, such as those deriving from the potential conflict between such energies and the submerged cultural heritage.[36]

Applicable Norms of International Law

Various areas of international law are relevant with respect to the development of marine renewable energies: the law of the sea, international development law, and even international civil aviation law. International law a key factor not only for ensuring harmony between the rights and obligations of states and the interests of the various users of marine spaces and the resources they contain, but also for guaranteeing the transport of the energy so generated and conserving the marine environment against known and possible future negative impacts. For all of these reasons, one of the key issues is to determine whether the international legal system is able to cover, under the umbrella of its existing norms, not only ocean energy activities but also the possible problems that may arise.

The UN Convention on the Law of the Sea (LOS Convention),[37] which in 2012 celebrated the thirtieth anniversary of its adoption, is the main legal instrument for consideration as it sets out the basics of the legal regime applicable to the oceans. The provisions in the LOS Convention applicable to marine renewable energies are summarized in the following paragraphs.

Thus far, the devices used to obtain renewable energy in or from the sea have primarily been located in areas subject to national jurisdiction with the majority of them having been deployed in internal and territorial waters as shown on a map contained in a 2012 report by the United Nations Environment Programme (UNEP) on marine renewable energies.[38]

However, there is no obstacle to such facilities being located in waters outside of state jurisdiction.

As far as territorial waters are concerned, the question arises as to whether renewable energy production technologies may interfere with the right to innocent passage enjoyed by third states' vessels. This issue, which had previously been posed with regard to oil rigs, can be resolved by means of a conciliatory interpretation; in other words, it would be possible to construct such installations that do not wholly obstruct or interfere unreasonably with a foreign vessel's right of innocent passage.[39] Pursuant to Article 22 of the LOS Convention, a coastal state, with the engagement of the International Maritime Organization (IMO), may designate sea-lanes or traffic separation schemes to permit foreign ships to exercise their right of innocent passage by means of their use, in order to ensure the safety of navigation. The first state to apply the provision because of a marine renewable energy installation was the United Kingdom in 2008, between the coast of Cornwall and the Isles of Scilly.[40] In 2012, the Netherlands followed by proposing a variety of traffic separation measures to the IMO Sub-Committee on Safety of Navigation that took into account not only its offshore oil and gas production platforms, but also its renewable energy installations.[41]

Within the exclusive economic zone (EEZ), the LOS Convention explicitly states that the coastal state has "sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters suprajacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds."[42] This provision is not exhaustive and, thus, provides an umbrella for the harnessing of other types of marine energy not expressly mentioned such as geothermal energy, bioenergy, tidal barrages, the conversion of oceanic thermal energy, and salinity gradients. This is a commonly accepted interpretation.[43] Similarly, a coastal state has jurisdiction with regard to the "establishment and use of artificial islands, installations and structures,"[44] of which due notice of construction must be given.[45] Additionally, the coastal state has the right to establish reasonable safety zones around such installations and structures, of which due notice must also be given and thus must be respected by ships.[46] The breadth of such safety zones is, in principle, determined by the coastal state, but they are to be reasonably related to the nature and function of such installations and are not to exceed 500 meters measured from each point of their outer edge, except as authorized by generally accepted international standards or as recommended by the competent international organization.[47] The IMO has yet to adopt standards in this regard. In 2008 the United States and Brazil, followed by other states, proposed the drafting of the standards contemplated in Article 60 of the LOS Convention.[48] Likewise, in 2012 the IMO secretary-general, as a consequence of proposals put forward by the Netherlands, encouraged member states to revise "their existing ship routeing systems for future use of their coastal areas for sustainable development which includes development of large renewable energy projects [. . .], whilst maintaining the safety of navigation."[49]

However, no installation or structure, nor any safety zone around them, may be established if the installation or structure might interfere with the use of recognized sea-lanes essential to international navigation.[50] Further, as is logically the case, a coastal state must carry out such activities in accordance with the provisions of the LOS Convention and, therefore, respect the rights of all states whether coastal or landlocked, to enjoy the freedoms of navigation and overflight and of the laying of submarine cables and pipelines, and other internationally lawful uses of the sea related to these freedoms.[51]

As far as the high seas are concerned, among the freedoms exercisable is the laying of submarine cables and pipelines, which any state can lay in connection with a renewable

energy device. Questions have been raised as to whether it was legally possible to deploy renewable energy installations in areas beyond national jurisdiction (i.e., concerning both the high seas and the international seabed "Area").[52] During the recent UNICPOLOS meeting specifically devoted to marine renewable energy, it was emphasized that, although no renewable energy projects were currently being developed in such areas, it is a theoretical possibility and that these areas have energy-generating potential.[53] One of the obstacles commonly associated with devices connected to submarine geothermal energy is that they have to be installed at a distance from shore.[54]

States have a specific obligation to protect and preserve the marine environment expressed and developed in Part XII of the LOS Convention,[55] which implies that states have to take, individually or jointly as appropriate, the measures necessary "to prevent, reduce and control pollution of the marine environment from any source." It is clear that these duties are closely related to activities having to do with research into renewable energies and their development and exploitation. According to the LOS Convention, states must take all measures necessary to ensure that activities "under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment."[56] Although this is one of the Convention's Achilles' heels since it does not impose obligations on states beyond their national jurisdiction, particularly on the high seas, it can be concluded that a state's obligations arise from the fact that renewable energy installations are subject to its control. More specifically, there will be a duty on a state to adopt the measures with regard to such devices under its control on the high seas, akin to the obligations that arise with regard to vessels flying its flag.

There are other international instruments and rules that can be applied to marine renewable energies such as the norms concerning ships' routing, safety of navigation around offshore installations and structures, or even the removal of the latter. These matters are regulated pursuant to the 1974 Convention for the Safety of Life at Sea[57] and through various instruments adopted by the IMO.[58]

A further series of rules that need to be taken into account are those applicable to international civil aviation, given the height reached by marine wind farms in the airspace suprajacent to the sea area they occupy. This has already started to cause certain issues of confusion, and even the creation of dead zones, for radar currently used for aerial navigation or other purposes.[59] In 2009, the International Civil Aviation Organization (ICAO) agreed on the need to conduct an impact assessment whenever a wind turbine is located within a radius of 15 kilometers from a radar facility.[60] Similarly, the European Organization for the Safety of Air Navigation (EUROCONTROL), founded in 1960, has produced a series of guidelines which, among other things, propose the existence of different geographical zones, in one of which, the "safeguarding" zone, wind turbines are not to be built.[61] The World Meteorological Organization (WMO) has adopted a series of guidelines for the construction of wind turbines in the vicinity of weather radars, which foresee a minimum safety distance of 5 kilometers between the former and the latter. Further, the same document states that proposals for wind farm projects within a radius of 20 kilometers from a radar facility of this kind should be submitted to an impact study.[62] Without casting doubt on the positive nature of such measures, experts have drawn attention not only to the need to comply with the guidelines in question and negotiate all the relevant aspects with the stakeholders concerned, but also to the need for more accurate and detailed guidelines.[63]

There is also an environmental regulatory dimension, which has two sides. On the one hand, there is the preventive side in the sense that harnessing marine renewable energies can contribute to the avoidance of anthropogenic interferences with a negative impact on the climate system and stabilize greenhouse gas concentrations. Marine renewable

energy projects can be carried out as "Clean Development Mechanism" activities within the UN Framework Convention on Climate Change.[64] There are also the environmental impacts of such schemes, set out above. In this regard, the existing regulations governing environmental impact assessment apply, one of the main provisions being that contained in the Convention on Biological Diversity, which requires each contracting party to perform such an assessment for activities carried out under its jurisdiction or control, regardless of where the effects may occur.[65] Other treaties also contain specific provisions in this regard,[66] with it being important to highlight those concerning regional seas; for example, the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, adopted in Barcelona in 1995.[67]

The LOS Convention is incomplete, although it provides a framework for supervising the risks or impact of pollution and assessing the potential impact of activities on the high seas.[68] The mechanisms for carrying this out appear to be inadequate[69] Nevertheless, it is too soon to make a negative assessment concerning renewable energies since there is as yet no specific practice of this kind in spaces beyond national jurisdiction.[70] This deficiency, however, not only applies to the LOS Convention, but is a vacuum that is to be found in international treaty law in general, although apparently not so much in customary international law, as evidenced by the recent dictums emanating from international courts and tribunals.[71]

Renewable ocean energies are not covered by a single international instrument. Their regulation is dispersed not only across various areas of international law, but also in a variety of national regulations. Although marine law does make explicit reference to marine renewable energies, this is by no means a complete treatment.

There is a multitude of challenges to be faced and issues in need of clarification, some of them not only from a legal perspective. The international legal instruments currently applicable to marine renewable energies are already, in the words of Alain Piquemal, a conciliatory factor between such energies and the legitimate uses of the seas as well as a factor for the development and promotion of international scientific cooperation.[72]

Recent Institutional Developments

IRENA, established in 2009, headquartered in Abu Dhabi since 2011, and currently having 118 member states,[73] is the most important recent institutional development with respect to marine renewable energy. The principal objective of IRENA is to promote "the widespread and increased adoption and the sustainable use" of all forms of renewable energies,[74] including marine renewable energies.[75] To this end, the agency aims to become a "centre of excellence" for technology and to act as a "facilitator and catalyst, providing experience for practical applications and policies."[76] Its activities include helping countries to benefit from the transfer of knowledge and technology[77] since the challenges posed by renewable energies in the economic, technological, research, and capacity-building sense are particularly daunting for developing states. The scope of the mandate of IRENA is extremely limited since, as is explicitly acknowledged in its statute, it performs its functions "without obligations on Members' policies."[78] This may be part of the reason why IRENA has not been actively involved in the field of marine renewable energy. This lack of initiative on the part of IRENA in relation to marine energies was highlighted during the thirteenth UNCPO-LOS meeting in 2012.[79] It was pointed out that the International Energy Agency (IEA) was more actively engaged in marine renewable energies that IRENA. Attention was drawn to the desirability of adopting a specific agreement with respect to marine renewable energies

between the IEA and IRENA[80] as well as establishing channels of cooperation between IRENA and the UN Division for Ocean Affairs and the Law of the Sea (DOALOS).[81]

Should Renewable Energies be Managed Internationally?

An important issue is whether there should be an international institution responsible for managing, or having some specific power of control over, marine renewable energies, at least in the marine areas beyond national jurisdiction. If so, would this be an existing institution that would be granted new powers, or would it be better to create an entirely new institution? Is it feasible for an international organization to assume responsibility for managing marine renewable energies in areas not subject to the jurisdiction of any state?

The marine areas beyond national jurisdiction that are suitable and fit for the purposes of exploration and exploitation of renewable energies are considerable and currently untouched. What will occur if the use of marine renewable energies, as seems foreseeable, continues to expand? Will there then be, as also seems foreseeable, a greater risk of interference with the freedom of navigation or with other ocean freedoms? Will certain locations become saturated? In all probability, the answer to all of these questions will be in the affirmative. This being the case, would the LOS Convention, grounded on the obligation of cooperation between states and supported by no institutional framework other than the International Seabed Authority (ISA, or the Authority) and the International Tribunal for the Law of the Sea, suffice to keep order? The answer to this latter question would appear to be a negative one.

In this context, marine spatial planning (MSP) may be useful in reducing conflicts.[82] In 2006, the UN Educational, Social and Cultural Organization (UNESCO) took the initiative to propose a public procedure of this nature with the intention being to achieve a rational organization of spaces subject to national jurisdiction.[83] Planning for the Area came under the competence of the ISA with regard to activities within its mandate.[84] Since then, arguments have been put forward to extend the scope of MSP to the high seas.[85] The underlying reason for proposing extension of MSP is the same one that justifies its application to spaces subject to the competences of states: the need to avoid conflicts between the various human uses of the sea as well as between such uses and the protection of the marine environment.[86] To this can be added the use of principles such as the ecosystem approach and sustainable development.[87] Planning on the high seas and for the Area should take into account, when it becomes technically possible to do so, marine renewable energy technologies. As has been said with regard to the Arctic, so to regarding marine renewable energies, "once new economic activities begin [. . .], it will be difficult for policy makers and managers to put limits on them. Planning for the future begins today."[88]

The starting point is the nature of the high seas and the Area as a common good. This calls for an international institution to be responsible, at least in part, for the management required by research into marine renewable energies and their harnessing in such spaces. It would be possible to progress toward global governance of marine renewable energy and the regulation of crucial aspects such as, eventually, planning for specific spaces to be excluded from activities of this kind or even introducing mechanisms for protecting investment within a multilateral framework. Nevertheless, and despite the obvious attractions of such an idea, it has to be acknowledged that at present the idea may generate more uncertainties than guarantees. Even though it may be feasible from a legal point of view, it may encounter obstacles at a political level and opposition from certain states. Nevertheless, international law offers powerful arguments in favor of an international regime for the management of renewable energies in areas beyond the limits of national jurisdiction in both the high seas

and the Area. For this management to be international, there must be institutional elements that confer on its administration universality, permanence, predictability, and legal certainty. The institution chosen to perform such tasks of managing marine renewable energies in spaces not subject to the jurisdiction of any state could either be an existing one, possible candidates being the ISA, the IMO, the UNESCO Intergovernmental Commission, and IRENA, or an institution reporting to the UN General Assembly, or an new international organization created specifically for the purpose.

Are states willing to accept management of this kind and, as a result, forfeit their capacity to act unilaterally in the high seas? States have the freedom to engage in scientific research, to lay submarine cables and pipelines, and to construct artificial islands and other installations permitted under international law in the high seas. Nevertheless, these prerogatives in the LOS Convention are not wholly unrestrained. Article 87(2) states: "[t]hese freedoms shall be exercised by all States with due regard for the interests of other States in their exercise of the freedom of the high seas, and also with due regard for the rights under this Convention with respect to activities in the Area." To this can be added that there appears to be growing awareness of the existence of other limits.

Water, air, currents, tides, and salinity gradients are resources that do not appear to share the same characteristics as minerals that can be found on or in the deep seabed such as manganese, copper, nickel, cobalt, molybdenum, and zinc.[89] It is well known that these resources, and the intention that such wealth should be considered the common heritage of humankind and used only for its benefit, were behind the revolutionary proposal that the international area of the seabed be subject to a regime governed by such principles. A regime which, although initially established in the LOS Convention has over time been emptied of content with the introduction of the principles of market economics and free enterprise through the 1994 Amendment Relating to the Implementation of Part XI of the U.N. Convention on the Law of the Sea.[90] Nevertheless, the Area is still a space subject to an international management regime as far as the exploration and exploitation of its mineral resources are concerned, giving rise to obligations for all the states that are party to the LOS Convention. One may wonder whether there are sufficient similarities between the resources in question to justify the international management of marine renewable energies.

Among experts in international legal matters, there is a growing tide of opinion in favor of the view that certain natural resources shared by all, precisely because they are a common heritage, deserve to be protected and administered by means of an international regime.[91] Along the same lines, it should be noted that the Seabed Disputes Chamber of the ITLOS, in *Advisory Opinion* answered three specific questions regarding the legal responsibilities and obligations of states sponsoring persons and entities with respect to activities in the Area. One analysis of the decision concluded that the *Advisory Opinion* represents "a milestone in the life of Seabed Authority and the Law of the Sea"[92] and another has stated that "[c]ommon heritage may have become a rather historic and iconic idea in international politics—indeed, a little like deep seabed mining itself–but the Chamber has done much to present it as very much an active principle of international law, as well as being a fundamental, if a discrete, element of the promotion of global sustainable development."[93]

Establishing an international institution with broad authority with regard to marine renewable energies would bring with it a wide range of benefits. It would reduce fragmentation and bring order to the matter. It would institutionalize the exchange of information, which in turn would increase the transparency of states' actions, clarity, and legal certainty. It would be possible to avoid duplication of effort and going ahead with failed projects as well as to bring down costs. International management would guarantee and respect the principle of nondiscrimination in the assignment of zones. Indeed, care would need to be

taken to avoid interfering with other freedoms of the seas such as fishing or navigation, but it would be possible to ensure the protection of the marine environment and its biodiversity and to apply the principles of precaution and the ecosystem approach. Specific guidelines concerning technology transfer could be introduced, which would provide additional criteria of distributive justice. It would help to ensure that states act with due diligence in the fulfillment of their obligations.

Moreover, the potential for investment in marine renewable energies or for the assignment to an existing one not only to act as a mitigating factor in climate change, but also to contribute to the sustainable development of states and of humankind, is a sufficient justification for calling for the creation of an international institution for the management of the exploration and exploitation of renewable energies, particularly in marine areas beyond any national jurisdiction.

During the 2012 meeting of UNICPOLOS, the possibility was mooted of considering marine renewable energy as a "bio-derived resource" in order to justify extending the scope and jurisdiction of the ISA.[94] If such an option were to go forward, it could have the effect of extending the Authority's current supervisory mandate, which refers only to the extraction of mineral resources, to also include the exploitation of marine renewable energies. This proposal is an interesting one and would have the effect of making good the institutional shortcomings on a global level regarding activities carried out in spaces within the Area. The Authority currently has power over only mineral resources, not genetic ones. Although a number of states have proposed that the Authority should also be responsible for marine genetic resources (and the idea has been well received in doctrine[95]) instead of creating a new international organization with powers in this sphere, agreement has yet to be reached on this matter. Not only is there a lack of consensus as to the institution that could assume the management of the activities in question, but agreement is absent on the need to adopt an international agreement at all.

Even though the ISA is a good model for the purposes of the exploitation of marine renewable energies in seabed areas beyond national jurisdiction, the major difference between the regime governing mineral resources in the Area and the current situation regarding marine renewable energies is that commercial exploitation is closer to becoming a reality in the case of renewable energies (marine wind energy in particular) than in that of the Area's mineral resources. As of early 2013 negotiations on the rules governing exploitation activities in the Area had not begun, and there was only a regulatory framework governing exploration and prospecting activities.[96] Nevertheless, it is clear that the legal framework for the Area, negotiation of which seems to be imminent, will undoubtedly be a useful model for the purposes of marine renewable energies.

Even if all the above obstacles can be overcome, is there any justification for the ISA to have responsibility for managing all activities relating to marine renewable energies in areas beyond national jurisdiction; in other words, with respect to activities taking place in suprajacent waters in the high seas as well as in the Area. During the 2012 UNICPOLOS session, there was no discussion of whether or not the Authority could (or should) extend its mandate to include activities taking place in suprajacent waters. However, it is not unreasonable to raise the question. While the ISA's powers are seen by some as being much wider than is usually believed,[97] it must be acknowledged that extending its mandate to a space other than the Area would mean introducing a significant change of its spatial application—a change that would undoubtedly affect its nature.

If the Authority could extend its powers to include the management of marine renewable energies in (but not above) the Area, what would happen with regard to the management of the suprajacent waters in the high seas pertaining to marine renewable energies? Can two

different entities–namely, the Authority and another organization—be justified? Common sense dictates a negative answer. Leaving any legal difficulties aside, problems may arise for reasons of coherence, efficiency, and safety. Many projects carried out beyond national jurisdiction might impinge on both spaces simultaneously and it would be artificial, not to mention counterproductive, to divide something that for all practical purposes would be indissoluble. Furthermore, it is only reasonable to assume that a satisfactory outcome for the evaluation and implementation of many projects will depend on being able to deal with them comprehensively and systematically in order to ensure the necessary coordination of the activities taking place in the waters of the high seas and those taking place on the seabed in the Area.

While this article suggests the convenience of an entity with responsibilities regarding marine renewable energies, it does not propose what this institution should be or look like. Our seas and oceans need some kind of institution (not necessarily a new one) to carry out the mission of their governance and to perform certain general international administrative activities regarding marine spaces, which at the very least entails coordination. The starting point should be that certain areas (those beyond national jurisdiction) and certain aspects or sectors (the protection of biodiversity or the management of genetic resources, among others) are in need of management, or at least coordination, at an international level that currently does not exist but toward which efforts are being made. The plea here is that the management of marine renewable energies in such spaces should not be left out of this process.

Conclusions

When the principal aspects of marine renewable energies are analyzed, what emerges is a mainly positive view of their possibilities. It is also true that there are risks, challenges, and obstacles to overcome, but for this to happen investment in research needs to increase. Taking into account the relevant factors and the current state of knowledge, the advantages clearly outweigh the disadvantages. Reducing greenhouse gases and mitigating climate change are two powerful reasons in favor of marine renewable energies, to which can be added the need to use secure nonpolluting sources of energy to supply a population that is rapidly expanding and whose demand for energy is predicted to multiply over the coming years. Thus, the first message in this article is that a commitment to the use of marine renewable energies is wholly justified, even though there are weaknesses and challenges that have to be overcome.

International law provides a regulatory framework that is broadly suitable for the development of these energies, although it does have gaps. What is most obviously missing is an institutional framework or governance mechanism that has or can take responsibility for these matters at a global level.

Although the IRENA is a newly created international organization with a mandate covering all forms of renewable energy, marine ones included, its powers are limited. This lack of institutions or mechanisms for international governance is not restricted to marine renewable energies, but is a more widespread deficiency that affects the management of other aspects of the oceans. There is currently an ongoing discussion in various forums as to the necessity of having an authority, whether new or already in existence, which will carry out or take part in tasks relating to increased international oceans governance and management. This is a major issue, for example, with regard to the protection of marine biodiversity in areas beyond national jurisdiction. The plea in this article is to include marine renewable energies in any new initiatives with respect to international oceans governance.

Funding and Acknowledgments

This article has been written within the framework of the research project "La Convención de las Naciones Unidas sobre el Derecho del Mar frente a los cambios acaecidos en la sociedad internacional: propuestas de desarrollo y de revision" [The United Nations Convention on the Law of the Sea in the face of changes in international society: proposals for development and review], awarded by the Spanish Ministry for Science and Innovation (DER 2010-21732). The author also received a grant from the Spanish Ministry of Education to fund a stay as a visiting research fellow at the Lund University Centre for Sustainability Studies (LUCSUS), Sweden (from 1 June 2012 to 31 August 2012). The author is grateful not only to its codirectors Stefan Anderberg and Lennart Olsson, but also to all the members of its excellent multidisciplinary team, for making her welcome and giving her the opportunity to exchange points of view, which has undoubtedly served to enrich the content of this article.

Notes

1. Intergovernmental Panel on Climate Change (IPCC), "Special Report on Renewable Energy Sources and Climate Change Mitigation" (2011), 164.
2. *Ibid*., at 503 ff.
3. *Ibid*., at chap. 6.3.1.
4. *Ibid*.
5. The list of leading countries in this sector varies according to the source consulted. See, for example, the countries mentioned in "Report of the U.N. Secretary-General, Oceans and the Law of the Sea," UN Doc. A/67/79, 4 April 2012, 8.
6. IPCC, "Special Report," supra note 1, at 527.
7. *Ibid*., at 501.
8. *Ibid*.; "Report of the U.N. Secretary-General," supra note 5, at 6–7.
9. J. K. Sterne, T. C. Jensen, J. Keil, and R. Roos-Collins, "The Seven Principles of Ocean Renewable Energy: A Shared Vision and Call for Action," *Roger Williams University Law Review* 14 (2009): 600, at 600.
10. M. Goldmann, "Soft Law and Other Forms of International Public Authority–The View from Discourse Theory: A Reply to Jaye Ellis," *Leiden Journal of International Law* 25 (2012): 373.
11. See Gabcíkovo-Nagymaros Project (Hungary v. Slovakia), [1997] *I.C.J. Reports* 7, at 70, 75; Kasikili/Sedudu Island (Botswana v. Namibia), [1999] *I.C.J. Reports* 1045, at 1087, 1088; and Pulp Mills on the River Uruguay (Argentina v. Uruguay), [2010] *I.C.J. Reports* 135, at 180.
12. See the Award of the Arbitral Tribunal in the Iron Rhine ("Ijzeren Rijn") Railway Case (Belgium v. Netherlands) (2005), 28–29, 49, at the Permanent Court of Arbitration Web site, www.pca-cpa.org.
13. Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area (Advisory Opinion), paras. 159 and 163, available at the International Tribunal for the Law of the Sea Web site, www.itlos.org/. See P. Holcombe Henley, "Minerals and Mechanisms: The Legal Significance of the Notion of the 'Common Heritage of Mankind' in the Advisory Opinion of the Seabed Disputes Chamber," *Melbourne Journal of International Law* 12 (2011): 373, at 394.
14. See M. C. Cordonier Segger, "The Role of International Forums in the Advancement of Sustainable Development," *Sustainable Development Law and Policy* 10 (2009): 4, at 10.
15. U.N. Secretary General's High Level Group on Sustainable Energy for All, available at www.un.org/wcm/content/site/sustainableenergyforall/home/Initiative.
16. "Report of the U.N. Secretary-General," supra note 5.
17. IPCC, "Special Report," supra note 1.
18. Report of the Secretary-General, "New and Emerging Technologies: Renewable Energy for Development" (Economic and Social Council), UN Doc. E/CN.16/2010/4, 8 March 2010.

19. See "Report of the Work of the U.N. Open-ended Informal Consultative Process on Oceans and the Law of the Sea at its Thirteenth Meeting," UN Doc. A/67/120, 2 July 2012.

20. "Report of the U.N. Secretary-General," supra note 5, at 19.

21. For other advantages, for example, the virtue of marine renewable energy installations in dissuading fishing vessels from carrying out certain destructive practices such as bottom trawling in their immediate vicinity, see *ibid*., at 20.

22. According to a working paper of the IRENA, "Renewable Energy Jobs: Status, Prospects and Policies" (2011), 4, gross employment in the renewable energy industry in 2010 was estimated at over 3.5 million jobs.

23. "Report of the U.N. Secretary-General," supra note 5, at 19–20.

24. *Ibid*., at 21; IPCC, "Special Report," supra note 1, at 120.

25. "Report of the U.N. Secretary-General," supra note 5, at 21.

26. *Ibid*.

27. *Ibid*.

28. *Ibid*., at 22.

29. *Ibid*., at 22–23.

30. *Ibid*., at 22.

31. "Tidal Energy," Ocean Energy Council—News & Information About Ocean Renewable Energy, available at www.oceanenergycouncil.com.

32. D. Wilhelmsson et al., eds., "Greening Blue Energy: Identifying and Managing the Biodiversity Risks and Opportunities of Offshore Renewable Energy" (International Union for the Conservation of Nature, 2010), 69–70. The Spanish Renewable Energies Plan admits that, in addition to the "visual and structural impact" on the coastal landscape of power generating installations of this kind, and the magnitude of the civil engineering work involved in their construction, they usually cause a 3-hour delay in the tidal cycle, with all the implications that this entails. "Plan de Energías Renovables 2011–20," Instituto para la Diversificación y Ahorro de la Energia (IDAE), Madrid, 193, available at www.idae.es/index.php/mod.documentos/mem.descarga?file=/documentos_11227_PER_2011-2020_def_93c624ab.pdf.

33. Furthermore, costs can differ according to the variables involved. Thus, for example, the cost of wind energy depends on the area where the turbines are located. Another problem affecting renewable energies is the lack of reliability in supplying energy to the grid, at least when compared to fossil fuel energy sources. Electricity generation fluctuates according to factors such as the time of day, the season of the year, and weather events. This intermittence, characterized by peaks and troughs in the flow of energy, creates a series of problems and obstacles, although innovative measures are being taken to alleviate such effects. M. Esteban and D. Leary, "Current Developments and Future Prospects of Offshore Wind and Ocean Energy," *Applied Energy* 90 (2012): 128, at 134–135.

34. See "Report of the U.N. Secretary-General," supra note 5, at 23; and E. Schroeder, "Turning Offshore Wind On," *California Law Review* 98 (2010): 1659.

35. In the case of the United States, it is estimated that over half the total population lives on or near the coast. U.S. Commission on Ocean Policy, "An Ocean Blueprint for the 21st Century: Final Report" (2004), 1.

36. See A. Evans, A. Firth, and M. Staniforth, "Old and New Threats to Submerged Cultural Landscapes: Fishing, Farming and Energy Development" (2009), 11 *Conservation and Management of Archaeological Sites* 11 (2009): 1–43.

37. U.N. Convention on the Law of the Sea, 10 December 1982, 1833 *U.N.T.S*. 397.

38. U.N. Environment Programme, "Green Economy in a Blue World: Synthesis Report" (2010), 12.

39. See H. Esmaeli, *The Legal Regime of Offshore Oil Rigs in International Law* (Aldershot: Ashgate Dartmouth, 2001), 73.

40. International Maritime Organization (IMO), "Routing of Ships, Ship Reporting and Related Matters, Amendments to the Traffic Separation Scheme 'Off Lands End, Between Longships and Seven Stones,'" IMO Doc. NAV 54/3/5, 28 March, 2008.

41. "Address of the Secretary-General at the Opening of the Fifty-Eighth Session of the Sub-Committee on Safety of Navigation," 2 July 2012, available at www.imo.org/MediaCentre/SecretaryGeneral/Secretary-GeneralsSpeeches/Meetings/Pages/Sub-Committee-on-Safety-of-Navigation-(NAV)-58th-session.aspx.

42. LOS Convention, supra note 37, art. 56(a).

43. "Report of the U.N. Secretary General," supra note 5, at 10.

44. LOS Convention, supra note 37, art. 56(b)(i).

45. *Ibid*., art. 60.3.

46. *Ibid*., art. 60.4.

47. *Ibid*., art. 60.5.

48. International Maritime Organization (IMO), "Development of Guidelines for Consideration of Requests for Safety Zones Larger than 500 Metres Around Artificial Islands, Installations and Structures in the Exclusive Economic Zone (Submitted by the United States and Brazil)," IMO Doc. MSC 84/22/4, 4 February 2008.

49. IMO, "Address of the Secretary-General," supra note 41.

50. LOS Convention, supra note 37, art. 60, paras. 4–7.

51. *Ibid*., arts. 58, 87.

52. T. Nakamura, "Overview of Emerging and New Uses of the Ocean Areas Beyond National Jurisdiction," presentation 6 May 2013, Intersessional Workshop on Conservation and Management Tools, including Area-Based Management and Environmental Impact Assessments, available at www.un.org/Depts/los/biodiversityworkinggroup/workshop2_nakamura.pdf.

53. "Report of the Work of UNICPOLOS," supra note 19, at para. 44.

54. Nakamura, "Overview," supra note 52.

55. LOS Convention, supra note 37, chap. XII, specifically art. 192.

56. *Ibid*., art. 194.2.

57. Convention for the Safety of Life at Sea, 1 November 1974, 1184 *U.N.T.S*. 2.

58. For example, General Provisions on Ships' Routeing, IMO Resolution A.572(14), 20 November 1985; Safety Zones and Safety of Navigation Around Offshore Installations and Structures, IMO Resolution A.671(16), 19 October 1989; and Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone, IMO Resolution A.672(16), 19 October 1989. Some of the resolutions have been amended. Available at www.imo.org/KnowledgeCentre/Indexofresolutions/Pages/Assembly-(A).aspx.

59. See J. Keller, "Air Force Eyes Modeling Software to Understand How Wind Farms Create Radar Dead Spots," 18 November 2013, available at www.militaryaerospace.com/articles/2013/11/wind-farm-modeling.html.

60. International Civil Aviation Organization (ICAO), "European Guidance Material on Managing Building Restricted Areas," Technical Report, ICAO Eur. Doc. 015 (Paris: European and North Atlantic Office of ICAO, 2009).

61. M. Borely, "Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors," Technical Report, EUROCONTROL Guide 130 (Brussels: EUROCONTROL, 2010).

62. WMO, Technical Report, WMO-No. 1046, "Commission for Instruments and Methods of Observation" (Helsinki: WMO, 2010); "Statement of the OPERA Group on the Cohabitation Between Weather Radars and Wind Turbines," available at www.knmi.nl/opera/opera3/OPERA_2010_14_Statement_on_weather_radars_and_turbines.pdf.

63. See D. De la Vega, J. C. G. Matthews, L. Norin, and I. Angulo, "Mitigation Techniques to Reduce the Impact of Wind Turbines on Radar Services," *Energies* 6 (2013): 2859, at 2869.

64. U.N. Framework Convention on Climate Change, 1771 *U.N.T.S*. 107.

65. Convention on Biological Diversity, 1760 *U.N.T.S*. 79, Article 14.

66. See, for example, Espoo Convention on Environmental Impact Assessment in a Transboundary Context, 25 February 1991, 1989 *U.N.T.S*. 309.

67. Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, 1102 *U.N.T.S*. 27, Article 4(d).

68. LOS Convention, supra note 37, Articles 204–206.

69. *Ibid*., Article 206 states, under the heading "Assessment of potential effects of activities," that "[w]hen States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments [. . . .]"

70. During the 2012 meeting of UNICPOLOS, a question was raised on whether impact assessment reports for marine renewable energies were publicly available in the light of Articles 205 and 206 of the Convention. A panelist clarified that, although examples of publicly available assessments do exist, others were carried out by private companies when it was considered that the results were commercially sensitive. This was the reason why this information was not made publicly available. "Report of the Work of UNICPOLOS," supra note 19, at para. 60.

71. The International Court is firmly of the view that there is an obligation to conduct a transboundary environmental impact assessment. Pulp Mills Case, supra note 11, at paras. 203–204. However, the Court recognized the lack of a clear definition of the scope and content of such an assessment (at para. 205). The Seabed Disputes Chamber in the State's Responsibility in the Area Case, supra note 11, at para. 145, acknowledged both that the obligation to conduct an environmental impact assessment is a general obligation under customary international law (and also "a direct obligation under the [LOS] Convention") and that there is little guidance as to its scope and content. Nevertheless, the Seabed Disputes Chamber, at para. 144, pointed out that the indications in the regulations, adopted by the International Seabed Authority, especially in the Recommendations for the Guidance of the Contractors for the Assessment of the Possible Environmental Impacts Arising from Exploration for Polymetallic Nodules in the Area, made it possible to determine the content and obligation as it applies to activities in the International Seabed Area.

72. A. Piquemal, "An Overview of the Current Implementation Frameworks for the Marine Renewable Energies: An Evolving Context," presentation at UNICPOLOS, 29 May–1 June 2012, available at www.un.org/Depts/los/consultative_process/icp13_presentations-abstracts/2012_icp_presentation _piquemal.pdf.

73. International Renewable Energy Agency (IRENA), Statute, 26 January 2009, available at www.irena.org/menu/index.aspx?mnu=cat&PriMenuID=13&CatID=126. As of 8 August 2013, see www.irena.org/adsw/index.aspx.

74. *Ibid*., art. II.

75. *Ibid*., art. III.

76. *Ibid*., art. IV.A.

77. *Ibid*., art. IV.

78. *Ibid*., art. IV.A.1(a).

79. *Earth Negotiations Bulletin* 25, No. 88 (4 June 2012): 3, available at www.iisd.ca/download.pdf/eng.2588e.pdf.

80. "Report of the Work of UNICPOLOS," supra note 19, at para. 27.

81. *Earth Negotiations Bulletin*, supra note 79, at 4.

82. Intergovernmental Oceanographic Commission (IOC), "Marine Spatial Planning. A Step-by-Step Approach Toward Ecosystem-Based Management," 18, defines "marine spatial planning" as "a public process of analyzing and allocating the spatial and temporal distribution on human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process."

83. *Ibid*., at 20–23.

84. See LOS Convention, arts. 145, 152(1), 153(1), in particular, art. 157(2). See also the ISA Web site, referring to the broadness of its mandate, available at http://www.isa.org.jm/en/efund/.

85. J. Ardron, K. Gjerde, S. Pullen, and V. Tilot, "Marine Spatial Planning in the High Seas," *Marine Policy* 32 (2008): 832–839.

86. Taking this into account, "the full application of MSP in the high seas will be a challenge, but one which the international community will need to address to ensure long-term productivity and resilience of high seas ecosystems and services." *Ibid*., at 832.

87. IOC, "Marine Spatial Planning," supra note 82, at 10, 18, and 20. At 18, it is stated that, for planning of this kind to be effective, it must be "ecosystem based [. . .]; integrated, across sectors and agencies, and among levels of government; place-based or area based; adaptive, capable of learning from experience; strategic and anticipatory, focused on the long-term; participatory, stakeholders actively involved in the process."

88. C. N. Ehler, "Perspective: 13 Myths of Marine Spatial Planning," *Marine Ecosystems and Management* 5 (2012): 3.

89. J. M. Markussen, "Deep Seabed Mining and the Environment: Consequences, Perceptions, and Regulations," *Green Globe Yearbook of International Co-operation on Environment and Development* (1994): 31–39.

90. Agreement Relating to the Implementation of Part XI of the U.N. Convention on the Law of the Sea, 1836 *U.N.T.S*. 3.

91. Although it is also often considered as compatible with the maintenance of national powers. J. Yu, and W. Ji-Lu, "The Outer Continental Shelf of Coastal States and the Common Heritage of Mankind," *Ocean Development and International Law* 42 (2011): 317, at 326, comment that "safeguarding the common heritage of mankind is the common responsibility of the international community. Each member of the international community, including coastal states, landlocked states, and geographically disadvantaged states as well as relevant international organizations have the responsibility to care and safeguard the Area against infringements."

92. D. Freestone, "Advisory Opinion of the Seabed Disputes Chamber," *ASIL Insights* 15 (2011), available at www.asil.org/pdfs/insights/insight110309.pdf.

93. D. French, "From the Depths: Rich Pickings of Principles of Sustainable Development and General International Law on the Ocean Floor—The Seabed Disputes Chamber's 2011 Advisory Opinion," (2011), 26 *International Journal of Marine and Coastal Law* 26 (2011): 525, at 567.

94. "Report of the Work of UNICPOLOS," supra note 19, at para. 25. LOS Convention, supra note 37, Article 133, provides: "a) 'resources' means all solid, liquid or gaseous mineral resources in situ in the Area at or beneath the seabed, including polymetallic nodules; b) resources, when recovered from the Area, are referred to as 'minerals.'"

95. See T. Scovazzi, "Mining, Protection of the Environment, Scientific Research and Bioprospecting: Some Considerations on the Role of the International Sea-Bed Authority," *International Journal of Marine and Coastal Law* 19 (2004): 383–409.

96. See "Special Issue on Marine Areas Beyond National Jurisdiction (ABNJ)," 4 May 2012, Global Ocean Forum News, available at www.globaloceans.org/sites/udel.edu.globaloceans/files/GOF-ABNJ-Newsletter-SpecialIssue.pdf.

97. Scovazzi, "Mining," supra note 95, at 391ff, indicates that the powers of the ISA not only refer to activities relating to mineral resources, but also include the protection of the underwater cultural heritage, the protection of the marine environment, and marine scientific research; for a detailed explanation of its broad mandate, *ibid*.