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Establishing a legal research agenda for ocean energy

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ABSTRACT

The literature on ocean energy has, to date, largely focussed on technical, environmental, and, increasingly, social and political aspects. Legal and regulatory factors have received far less attention, despite their importance in supporting this new technology and ensuring its sustainable development. Building on the social sciences research agenda developed by the International network for Social Studies of Marine Energy (ISSMER) and published in *Energy Policy*, a complementary agenda for legal research linked to ocean energy was set out. Key directions for future research structured around the core themes of marine governance: (i) international law; (ii) environmental impacts; (iii) rights and ownership; (iv) consenting processes; and (v) management of marine space and resources were identified.

1. Introduction

A new industrial revolution is taking place in the oceans [79,83], challenging existing legal and regulatory frameworks and changing the way we think about marine governance [10,64,71,79]. Growing demand for marine space and resources, coupled with declining ocean health, necessitate the evolution of marine governance frameworks that can facilitate innovation and economic development, while also preserving the marine environment.

The need to balance economic, social and environmental concerns within marine governance frameworks is encapsulated by the emerging "Blue Economy" discourse. The term "Blue Economy" refers to the sustainable development the oceans as a new engine for economic growth [15,44,84]. The European Union's (EU) Blue Growth Agenda, for example, highlights the potential to "harness the untapped potential of Europe's oceans, seas and coasts for jobs and growth… whilst safeguarding biodiversity and protecting the marine environment" [25].

At the same time, the environmental imperative to decarbonise the energy system, has driven unprecedented interest in marine renewable energy (MRE) resources. MRE technologies, including wave and tidal energy,[1] have been identified by the EU as one of the five key activities that can advance the Blue Economy, delivering sustainable growth and creating new jobs [25].

Offshore wind is growing rapidly [31], with projects moving into deeper waters and new technologies being developed, such as floating turbines. In the United Kingdom (UK), for example, offshore wind meets about 3% of the country's electricity demands, but this is likely to rise to 20% to fulfil the EU 2020 renewable energy target [73].

Ocean energy technologies, utilising waves and tides to generate electricity[2] are now attracting considerable interest and

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[1] The term 'Ocean Energy' is used to denote wave and tidal technologies, whereas the broader term 'Marine Renewable Energy' (MRE) is used to denote offshore wind and ocean energy technologies.

[2] Ocean energy also encompasses ocean thermal energy technology (OTEC) and salinity gradient technology. These technologies have followed a different development pathway to wave and tidal. In this paper, 'ocean energy' is used to refer primarily to the wave and tidal technologies currently approaching commercialisation.

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investment [68]. As with other novel offshore activities, ocean energy is bringing its own unique challenges to marine governance frameworks [98]. Kerr et al. [47] note that ocean energy is:

> *More than a technically challenging extension of onshore renewable energy development. The policy environment, governance, patterns of resource use, conservation values, and distribution of ownership rights are all substantively different from the situation onshore.*

Political will and interest in developing ocean energy is high, and has attracted the attention of various key international energy governance institutions, including the International Energy Agency (IEA), which established the Ocean Energy Systems Implementing Agreement (IEA-OES) to "advance research, development and demonstration",[3] and the International Renewable Energy Agency (IRENA),[4] which has started to develop activities on ocean energy as part of its portfolio [38].

Interest in ocean energy is especially high in Europe. The European Commission has recently developed an action plan to support the ocean energy sector, convening an Ocean Energy Forum to bring together stakeholders and develop solutions. This will feed into a strategic roadmap, providing an agreed blueprint for action. There is potential for a European Industrial Initiative to be developed during a second phase (2017–2020).[5] Ocean Energy Europe, an industry association, has concurrently convened a Technology and Innovation Platform for Ocean Energy, the primary focus of which is to foster a broad consensus on priorities for technological innovation.[6] The UK, and Scotland in particular, finds itself at the vanguard of this new industry, as ocean energy enjoys a combination of political support, significant resources and technical expertise [43,48].

Academic interest is also developing, with a growing literature on various aspects of ocean energy development, including increased discussion of legal and policy issues. It is within this context that this legal research agenda has been developed to act as both a guide for ongoing reform and policy processes, and as a framework for further legal research in this developing field. This research agenda complements the social sciences research agenda previously developed by Kerr et al. [47].

This paper first discusses the development of the ocean energy literature to date, noting the emergence of a range of technical, environmental and social studies, but the relative lack of focus on important legal and regulatory issues. A legal research agenda is then developed, structured around the key themes of modern marine governance, namely: international law; environmental impacts; rights and ownership; consenting processes; and the management of marine space and resources. For each theme, an overview of key issues is provided, followed by the major research questions identified. The paper concludes with an outline of the main directions for future research.

2. Towards a legal research agenda for ocean energy

Academic engagement with the legal aspects of ocean energy deployment first took place in the 1970s as the oil crisis catalysed rapid development of a range of technologies, particularly in the United States (US) [72]. This period saw a drastic rise in research and development funding and investment, and the concomitant development of a distinct literature surrounding the technology.

Legal research conducted at that time focussed on the then-frontrunner, Ocean Thermal Energy Conversion (OTEC), and its international law ramifications. Much of this literature simply identified the relevant legal frameworks, however some also dealt with improving these frameworks and removing barriers to development [3,51,52,61]. Many of the issues raised by this early scholarship remain pertinent some 40 years later. For example, Knight [50] noted the "adverse effects of the late blooming jurisdictional and environmental impediments to implementation of new technologies". Such adverse effects remain a risk for modern ocean energy technologies as rapid technological advancement outpaces development of legal frameworks.

Ocean energy lay dormant for decades following the easing of the oil crisis, but a new era of climate change, renewable energy and the Blue Economy is driving renewed interest and development.[7] In this context, a range of scholarship has emerged, focusing initially on resource assessment, device design, and environmental impacts. This focus is beginning to broaden as a commercial-scale industry develops.

In 2012 the International Network for Social Studies in Marine Energy (ISSMER) was convened, bringing together those interested in the social science aspects of MRE development.[8] The first ISSMER workshop resulted in the development of a research agenda for social studies focussed on offshore renewables [48], highlighting the need for research into: economic impacts; wealth distribution and community benefits; communication and knowledge flow; consultation processes; dealing with uncertainty; public attitudes; and planning processes (the 'ISSMER Agenda'). The ISSMER Agenda consolidates and advances the growing interest in social sciences research into MRE over the last few years. Research has already focussed on issues such as community acceptance [5,58,74], attitudes of fishermen toward MRE development [2], co-existence with fisheries[13], and the economic impacts of industry development [33,82].

Far less attention has been paid to legal and regulatory aspects, despite the role marine governance regimes play in industry development and the strong linkages between these regimes and the elements of the ISSMER Agenda. Legal and regulatory issues are continually cited as a major non-technical barrier to the development of ocean energy. The ISSMER Agenda refers to broad marine governance issues, including "policy environment, governance, patterns of resource use, conservation values, and distribution of ownership rights", though legal issues in the Agenda are ultimately confined to "dealing with uncertainty" and "planning processes". While undoubtedly important, these two aspects form only part of a much broader and more complex legal situation.

A number of commentators provide a broad overview and context for legal research [42,48,64,98], though there remains no coherent agenda or framework for conducting and organising such research. It is the aim of this paper to provide such a framework. The evolving discourse on modern marine governance is used to structure this agenda around a number of key themes [64,71,85,98],

[3] This is an intergovernmental collaboration between countries, under a framework established by the IEA, rather than a regulatory body. See http://www.ocean-energy-systems.org/about-oes/.

[4] IRENA is a relatively new entrant to the international energy governance landscape. For background, see Wright [95].

[5] "European industrial initiatives are public–private partnerships that bring together industry, researchers, Member States and the Commission to set out and implement clear and shared objectives over a specific timeframe. They enhance the impact of innovative research and development and provide a platform for sharing investment risk." See http://ec.europa.eu/maritimeaffairs/policy/ocean_energy/forum/index_en.htm.

[6] See http://www.oceanenergy-europe.eu/index.php/en/tpocean/tpocean.

[7] The WAVENET project (2000–2003) was perhaps the first to reengage with ocean energy, considering the environmental and social impacts of wave energy, especially public acceptability with reference to the relevant legal frameworks [92].

[8] See http://www.issmer-network.org/.

namely: (i) international law; (ii) environmental impacts and liability; (iii) rights and ownership; (iv) consenting processes; and (v) managing ocean space and marine resources.

3. Elements of a legal research agenda

3.1. International law

Various areas of international law are potentially relevant to the development of ocean energy,[9] though it is clear that law of the sea provides the primary international legal framework [1,89]. In particular, the United Nations (UN) Convention on the Law of the Sea (UNCLOS) provides States with a clear right to exploit resources within their national jurisdiction.[10] There are, however, weaknesses regarding areas beyond national jurisdiction (ABNJ): at present there is no coherent institutional framework or governance mechanism for such areas, including for the development of ocean energy and other projects. Discussions are currently ongoing regarding the possibility of filling this gap with a new international agreement [19,99].

Institutional fragmentation is a key issue that affects the development of legal frameworks for ocean energy, and spans both the energy and ocean governance actors. Ocean energy potentially falls within the mandate of a dizzying array of international[11] and regional[12] marine governance institutions, as well as other international technical organisations.[13] Coordination and cooperation on ocean energy should be improved as far as possible within the existing mandates of such organisations, though experience in other areas of regional marine governance has shown that this can be a time-consuming process (see e.g. [18,41]).

At present, the link between ocean energy and existing instruments is incidental. All ocean energy projects are located close to shore, well within the territorial seas of states (12 nautical miles). This means that domestic legal issues are more urgent in the short to medium term. Ocean energy projects could theoretically be developed in the exclusive economic zone (EEZ-200 nautical miles) and even ABNJ, though this is not currently economically feasible.[14] A number of offshore wind projects are located in the EEZ and projects are moving further offshore.[15] This should be considered in the context of international ocean governance processes that may affect future ocean energy developments in ABNJ [1]. Although ocean energy has not yet been considered in the context of the ABNJ discussions, the outcome of the ongoing process will be of interest.

For completeness, it is worth mentioning the issue of international navigation. As ocean energy installations become more prevalent, it is likely that they will be increasingly sited within, or near, existing international shipping lanes. The little practical experience with this issue to date suggests that it is relatively straightforward to manage. The UK's Wave Hub,[16] for example, is situated close to a busy shipping area. Radar and AIS surveys were carried out to better understand the shipping routes used in the area[17] and the UK Government, in conjunction with the International Maritime Organization, extended an existing Traffic Separation Scheme to ensure that traffic is kept away from the area.[18] Nonetheless, it will be important to monitor this as the industry develops.

Overall, international law is an interesting, though not urgent, area of legal research. A couple of key areas warrant further research:

1. Ocean energy raises many of the same questions as other emerging industries and marine activities: How can we address institutional fragmentation, particularly as it relates to ocean energy? What would a more cohesive and functional international framework for the development of ocean energy look like, and how will competing policy objectives be balanced? Which institution(s) will take the central role? Will a new organisation be created?
2. To regulate transboundary issues, bilateral and restricted multilateral instruments could be explored between concerned States, for example whether this is best achieved through treaties, existing Regional Seas programmes, administrative agreements, memoranda of understanding, or the adoption of specific agreements for protection of investments and promotion of ocean energy developments. In a similar vein, new regional or sub-regional international frameworks or agreements among concerned states could be investigated.

3.2. Environmental impacts and liability

Ensuring that the deployment of innovative new technologies does not compromise the integrity of the marine environment is one of the defining challenges of the Blue Economy. This is particularly acute in relation to new renewable energy technologies where there is concern that governance processes will be relaxed in pursuit of carbon mitigation goals, thereby causing 'paradoxical harm' to local ecosystems [93]. On the other hand, it is also important that the positive effects of ocean energy development, including climate change mitigation, are appropriately recognised.

It is therefore essential that the discourse on marine governance and the literature on ocean energy address the questions of how new technologies are addressed in impact assessment frameworks including environmental impact assessment (EIA), strategic environmental assessments (SEA) and broader sustainability and cumulative impact assessments.

A number of potential environmental interactions of ocean energy devices has now been identified, though considerable knowledge gaps and uncertainties remain, particularly as the size of deployments grows [6,12,29,37,65,77]. Ocean energy technologies suffer from knowledge deficiency on two levels: there is limited practical experience with the deployment of devices, and the marine environment is notoriously difficult to study [78]. There is therefore limited data regarding the impact of ocean energy devices, as well as a lack of baseline data concerning the receiving environment. This presents a major challenge for developers in carrying out EIA, and for regulators in approving projects.

These data gaps are compounded by under-developed regulatory frameworks and EIA processes that have not been adapted to better manage uncertainty, improve knowledge generation and better serve emerging technologies [36,96]. In the context of imperfect information, regulatory frameworks must balance precaution and risk. Regulators have understandably taken a

[9] Including international environmental law, international development law or even some international civil aviation norms.

[10] Subject to certain conditions and the right of other states to innocent passage.

[11] E.g. the UN Division for Ocean Affairs and the Law of the Sea (DOALOS), the International Maritime Organisation (IMO), the International Seabed Authority (ISA) and the International Tribunal for the Law of the Sea (ITLOS).

[12] E.g. Regional Seas Programmes.

[13] E.g. The International Electrotechnical Commission (TC114) is proposing to consider the acoustic characterisation of MRE devices.

[14] This may be more likely for certain technologies such as OTEC and submarine geothermal energy (UNICPOLOS, 2012).

[15] E.g. in Belgium, Denmark and Germany.

[16] An undersea connection point for device testing.

[17] See http://www.wavehub.co.uk/about/faqs/.

[18] The amendments were adopted by IMO's Sub-committee on Safety of Navigation at its 54th session, 30 June-4 July 2008, and approved by IMO's Maritime Safety Committee at its 85th session, 26 November-5 December 2008. The amendments entered into force on 1 July 2009. See "New Traffic Separation Scheme for Lands End". Practical Boat Owner 2009. http://bit.ly/1EuTwyQ.

precautionary approach: they must be able to stand by their consenting decisions, and must therefore have sufficient evidence to underpin them; they can be legally challenged if this evidence is lacking.

As a result, ocean energy projects have attracted a "depth of scrutiny from environmental regulators and statutory nature conservation bodies that more established marine industries such as fishing and shipping have managed to escape" [59]. The resulting time and cost is a considerable barrier to development of ocean energy and hinders the generation of additional environmental and technological knowledge that could advance both ocean energy and marine governance efforts [7,96]. This potentially leaves developers to shoulder the burden of undertaking surveys and data analysis, even when the risk of environmental impact is comparatively low [69]. Developing improved regulatory approaches that can better balance precaution and risk will be crucial for ocean energy and the Blue Economy more generally.

Uncertainty must be accommodated in regulatory processes, based on adaptive and risk-based management strategies. Options include adaptive management, which allows the regulatory approach and consenting requirements to be adapted over time; the deploy and monitor approach, which permits deployment before complete certainty as to impacts [56,96]; the Rochdale Envelope, which allows a project description to be broadly defined in a consent application to allow for technological change over the life of a project [28,86,91,96]; and SEA, which can potentially strengthen and streamline EIA at the project level by identifying the scope of potential impacts and information needs at a strategic level [14]. Proportionality is central to the effective implementation of all of them.

The flexibility and risk introduced by such approaches must be carefully managed to protect regulators, but also to be useful for developers. Too much flexibility could, for example, threaten the permanence of a license and create an unstable investment environment. Balancing certainty and flexibility is therefore crucial, though few, if any, jurisdictions currently take a structured approach to this. At the very least, the legal framework needs to be predictable in the way it adapts regulatory processes to new information.

In addition, there are important practical questions regarding insurance and liability, which are increasingly relevant as projects develop. In particular, there is the "thorny question of who bears the burden of responsibility for damage to or by [ocean energy] devices" [50], as well as who is responsible for decommissioning. Indeed, the failure to decommission a deployed device may be considered dumping and can become a significant environmental burden, though there is little certainty on this due to differing definitions and legal regimes. The unfortunate case of Australian device developer Oceanlinx demonstrates the immediate relevance of these issues. The Oceanlinx flagship device sunk during transportation, resulting in a lengthy insurance dispute.[19] The company then went into receivership, raising doubts about the decommissioning of a second device that had been abandoned some four years earlier.[20]

In a similar vein, there are legal considerations surrounding health and safety, in particular, whether general provisions are sufficient in the ocean energy context, or whether specific legislation and regulations need to be developed.

The following key areas for further research are identified:

1. An overarching issue is the extent to which uncertainty can be accommodated within existing legal frameworks, in particular how adaptive and risk-based management strategies interact with more established legal principles like the precautionary principle. The extent to which the introduction of risk is legally permissible remains largely unknown in most legal systems. These important issues are at the core of the consenting problem in many jurisdictions.
2. A second and closely related issue is the development of mechanisms to introduce an element of risk into precautionary regulatory process in a structured and logical manner. This includes further research into the application of the Rochdale Envelope approach in the ocean energy context, deploy and monitor mechanisms, and adaptive management.
3. In terms of developing the scientific evidence base for the deployment of ocean energy, it is clear that the responsibility for addressing information gaps must be shared between developers and the State. However, it is not yet clear how this can be achieved, or what happens to the data collected during environmental monitoring: i.e. who reviews the data, how is it disseminated, and how is it fed back into policy and regulatory development?

3.3. Rights and ownership

Rapid technological development has opened up large parts of the oceans hitherto inaccessible to humans, making them amenable to delimitation, regulatory control, and exploitation. As States drive towards a Blue Economy, the demand for private or quasi-private rights to marine spaces is increasing, underpinning a gradual shift in the way marine space is conceptualised.

At the national level, coastal states can regulate all activities within the territorial sea, including granting exclusive access to nationals. Energy from water, currents and wind are specifically identified in UNCLOS[21]; coastal States can therefore also grant licences for ocean energy development in the EEZ.[22] In most jurisdictions, offshore areas are treated as State property, and cannot therefore be granted or sold in fee, but must be leased or contracted [57]. An added complexity is the common concept that offshore areas are held by the government in trust for the benefit of the public as a whole [57,64]. This may limit the extent of rights that can be granted at the outset, or have an influence over the exercise of rights that limits certainty for rights holders while maintaining government control and flexibility [64].

In much of the world, the seas have been considered to be under common ownership for most of modern history, and there are few examples of complete ownership or exclusive rights in marine spaces [85]. However, new technological and social drivers are gradually supplanting public rights, firstly at the international level by the creation of sovereign rights, and subsequently by the creation of new private rights in marine spaces [42,48]. The rights debate is therefore characterised by a tension between economic gains for private developers versus the public/common good.

The grant and exercise of private rights to ocean space for ocean energy development is subject to an evolving body of law, and permits fall along a spectrum of strong to weak occupational rights including: spatial access privileges; tradable occupational rights; long-term leases; and quasi-private and private property rights. Many States are facing difficulties with adopting permitting processes that fairly allocate space among users and facilitate development. Meanwhile, competitors for the rights to occupy the space can prevent permitting through litigation and other tactics

[19] See http://www.victorharbortimes.com.au/story/2469811/oceanlinx-energy-generator-at-carrickalinga-is-still-considered-unsafe/.

[20] See http://www.victorharbortimes.com.au/story/2597306/carrickalinga-prohibited-zone-around-oceanlinx-wave-energy-device-attracts-big-fines/.

[21] Article 56(1)(a).

[22] Though States must have due regard to other States and act in a manner consistent with UNCLOS (Article 56(1)(a)).

[8]. Indeed, some ocean energy projects have already been subject to extensive litigation [94].

In the context of ocean energy, 'rights' to occupy the marine space and use the resource, whatever their legal form, provide the foundational basis for project development: developers will require exclusive access to marine resources and space. Even if exclusivity is not explicitly sought, the needs and modalities of the technology will nonetheless generally exclude other users, establishing a rights-like occupation.[23] Ocean energy therefore has the potential to present a major challenge to traditional conceptions of rights and may play an important role in redistributing rights in the marine environment [48].

By requiring exclusivity, ocean energy is effectively privatising a common good and creating potential conflict with: (1) public rights, e.g. to fishing and navigation [88]; (2) other quasi-private or private rights and permits in the marine environment; and (3) the rights, including 'perceived rights', of communities and existing marine users in a particular marine area [46].

Future legal research in this area should therefore focus on:

1. The extent to which rights can be granted to private users within the marine environment, including the possibility of transfer, purchase and retention of such rights for non-use (e.g. for conservation purposes).
2. Once it is acknowledged that such rights are private or quasi-private, questions arise as to how these rights will be treated. For example, if the government or regulator cancels a concession, will the right holder be compensated for their loss? In some jurisdictions, important constitutional questions may arise.[24]
3. The relationship between rights granted for ocean energy and other forms of rights, privileges and concessions in the marine environments, and how these various rights are integrated with, and organised by, marine spatial planning initiatives (MSP, discussed below).

3.4. Consenting processes

Consenting processes are a major barrier to the progress of ocean energy. Considerable regulatory uncertainty remains in many jurisdictions and information regarding the relevant process is often very difficult to obtain [4,24,53,62,63]. The problematic elements of the consenting process include: the number of authorities involved and communication between them; lack of a consenting process tailored to the needs of ocean energy; integration of offshore and ancillary onshore structures; and the time taken to obtain consents.

Poor permitting processes hinder progress toward greater efficiency and cost reduction [20]. In many jurisdictions, a clearly identifiable licensing authority is lacking and generally even small-scale test deployments have to run the full gamut of existing regulatory processes [54]. Additionally, statutorily defined timelines, whereby a regulatory authority must make its decision and communicate it to a developer within a specific time, are uncommon [62,63], although in some cases, timelines are defined by legal requirements relating to EIA, particularly in the EU.

This is changing as some jurisdictions, most notably the UK [73,97], have streamlined their regulatory frameworks, e.g. through the establishment of a one-stop-shop (OSS) institution for consenting [62,63,75]. Furthermore, several ocean energy test centres are 'pre-consented', such that developers do not usually have to undertake the full consenting process [62,63].

In general, the OSS approach has been advocated as a means for streamlining consenting processes and integrating the regulatory processes for ancillary onshore infrastructure [24,34,40]. However, implementing the OSS approach can be difficult in practice. In the UK, for example, creation of the OSS authority necessitated substantial legal amendment and updating of marine governance processes generally,[25] whereas Denmark's OSS was achieved by formalising communication channels between existing authorities. Strong political will to develop an ocean energy industry is likely to be a key factor in developing effective OSS systems [24,97].

Despite the prevalence of discussion of OSS in the literature, recent research suggests that the actual level of implementation and likely benefits may have been overstated [73]. The implementation of the OSS approach might merely shift the burden from developers to administrators thus resulting in the need for extra resources [76].

Consultation processes have also proved problematic. Consultation with potentially affected stakeholders is mandated in some jurisdictions, particularly in Europe via the Aarhus Convention.[26] Effective consultation can reduce risk for ocean energy projects, yet despite agreement on their importance, consultation processes are widely viewed as being ineffective [48,75,74]. Nonetheless, there are some examples of good practice, and ocean energy developers are forging their own extensive consultation processes, sometimes even in the absence of legal obligations [46].

The concept of a 'Social Licence to Operate' (SLO) is one that has developed significantly in recent years and will be relevant to ocean energy consenting processes as it is linked to public participation, stakeholder engagement, and other aspects of the ISSMER Agenda. It is clear that developers must approach this as a crucial part of their consenting process, and ideally the surrounding legal frameworks will facilitate this.

Finally, a range of terms and conditions may also be attached as part of the development consent. These can be broadly categorised into technical, administrative, environmental and managerial and cover a multitude of important issues including rents payable, environmental monitoring requirements, insurance and liability issues as well as decommissioning [62,63][27] In the EEZ, any installations or structures which are abandoned or disused must be removed to ensure safety of navigation in accordance with the accepted IMO standards[28] and decisions on non-removal or partial removal must be made on a case by case basis taking the aforementioned guidelines into account. These issues must also be accounted for as part of the consenting process.

Several important areas for further research are clear from the foregoing:

1. How best to modify consenting processes so that they reflect the scale of development and the level of risk posed, in particular by imposing more permissive procedures for small scale, time-limited deployments in areas of low environmental sensitivity.
2. How to facilitate the transition towards integration of the various competent regulatory bodies in consenting processes. In

[23] The potential for coexistence between ocean energy and other marine uses is discussed below in the context of MSP.

[24] E.g. could an occupation and/or production right be property protected by the 5th Amendment in the US?.

[25] E.g. the UK MCAA 2009 amended a substantial body of legislation to deliver streamlined consenting and a new licensing authority.

[26] The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters 1998.

[27] In Germany, for example, there is a duty to decommission offshore wind farms after 25 years of operation.

[28] IMO. 2008. Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the EEZ. IMO Resolution A.672 (16).

particular, whether it may be possible to extend the OSS approach further to also integrate grid connection, electricity licensing requirements, and other incidental approvals. In this regard, it is important to facilitate and improve communication between regulatory bodies, and clarify their respective responsibilities regarding enforcement conditions.

3. The development of simple alternatives to OSS for jurisdictions where political will is insufficient to allow for more wide ranging reforms [96].
4. Development and mainstreaming of effective consultation processes in the marine context. There are questions as to the legal feasibility of implementing a uniform and dedicated model for consenting that can apply across all maritime jurisdictional zones and streamline the current operational *ad hoc* system.[29]
5. There are also deeper questions that go to the heart of the rights and ownership issues discussed in the previous section: should decisions regarding marine resource allocation and ocean energy development consents be made at a more local or regional level rather than at a national level? Where does the balance of power currently lie with regards to taking such decisions and where should it be?

3.5. Managing ocean space and resources

Demand for exclusive use of space and increasingly private rights in the marine environment, coupled with growing environmental concerns, necessitate a paradigm shift towards a more strategic model of marine governance. There is an established need, and a desire, for a plan-led and integrated approach [62,63], and Marine Spatial Planning (MSP) has emerged as the frontrunner concept for meeting this need [17].

MSP is intended to help reconcile potential conflicts between different uses of ocean space, while achieving sustainability. In doing so, MSP effectively provides the same layer of strategic governance already present in most terrestrial planning systems, but tailored to the unique legal and environmental factors of the marine environment [39]. However, in its nascent stages, MSP can be "all things to all people". For some, MSP is a broad planning instrument with little direct legal significance, while for others it is seen as comprising, among other elements, a legally binding zone in a marine area where a specific activity is permissible.

The aims MSP should serve are also still controversial, with some agitating for the primacy of environmental protection and others arguing for MSP as a reconciliatory tool. Early experience with MSP suggests that 'soft' sustainability currently prevails, despite references to ecosystem-based management and the ecosystem approach [27]. For example, it has been argued that the EU has adopted a weak view towards sustainability and that MSP is, in fact, eroding existing environmental protections [67].

MSP can also be seen as a tool of unification, bringing together existing governance instruments under one umbrella, rather than directly replacing them. Evidence from early national MSP efforts shows an emphasis on MSP as a process aimed at increasing dialogue and understanding, but also a preference for concrete actions which translate policy outputs into real world outcomes [83].

Given the lack of agreement on precisely what MSP is, development of MSP in practice has been far from homogenous. EU efforts have been motivated in large part by economic goals, such as renewable energy targets, while much of the early support for MSP in the US was generated by the academic and environmental advocacy communities, who saw MSP primarily in terms of marine conservation [32].

In Belgium, Germany, the Netherlands and the UK, the promotion of offshore wind energy has been a strong driving force behind the development of national MSP frameworks [67]. However, ocean energy has not yet been one of the primary drivers of MSP processes [22], and few existing MSP processes have considered ocean energy in depth, though this is changing in parts of Europe (see, e.g. [16]). The most notable example is Scotland, which has undertaken an extensive and ambitious programme of MSP driven in large part by ocean energy [45,55,62,63]. Discussion of ocean energy's role and place in MSP processes has to date been limited to either merely asserting that MSP is crucial for the development of the ocean energy industry [22,87], or considering how MSP applies to ocean energy projects on a practical level [62,63,90].

One of the main problems MSP tries to tackle is the fragmentation of ocean governance and the resultant legal 'instability'. In order to combat fragmentation, integration would have to take place on several different levels such as between legal instruments, different branches of government and different sectoral interests [21]. MSP thus goes to the heart of the previous discussion on OSS: MSP could function as an umbrella under which different instruments of governance can be organised, thereby contributing to achievement of a OSS or similarly streamlined mechanism.

In a similar way, MSP may be able to alleviate some of the issues relating to EIA and consenting, in particular by taking a future-oriented and strategic approach to balancing precaution and risk, providing flexibility, and lending a level of predictability and consistency to the overall governance framework [81]. The geographical proximity of ocean energy devices and the attendant onshore infrastructure raises the possibility that MSP may be an appropriate mechanism to link emerging marine governance systems with terrestrial planning [48,80]. This will be increasingly important as ocean energy projects begin to drive the development of additional harbour and port infrastructure, onshore facilities, and grid extensions.[30]

A major question within MSP processes is the prioritisation of uses, and this is already a live issue for ocean energy. In Oregon, for example, the MSP process was somewhat limited by a 'negative' approach which excluded ocean energy deployment in areas with existing users, focusing on constraints rather than opportunities [30]. By contrast, Scotland's approach has been much more inclusive, developing separate policies for each existing activity in order to make considered trade-offs between users. However, to enable these trade-offs, and to establish effective MSP, accurate and comprehensive data on the existing uses of the marine areas, their interactions and condition of the environment are required. Prior to establishing priorities between uses one has to have a clear view how and to what extent different marine interests do collide and whether these problems can be alleviated by temporal and spatial allocation [17].

In this regard, the potential for coexistence of ocean energy and other marine uses has been much discussed, particularly regarding offshore wind and the potential for *de facto* marine protected areas [11,26,35,60,66], and the fishing industry [70,13]. There is some suggestion that co-location of marine activities is feasible from an environmental and legal perspective, but that the success and extent are site-specific [11]. Indeed, the current reality for offshore wind is that there is no right of third party access, so there are already impediments to coexistence that would need to be

[29] A number of States do not have a consenting system in place that is applicable to MRE developments beyond the Territorial Sea. The UK addressed this in its Energy Act 2004 through the creation of a Renewable Energy Zone.

[30] There is already some literature that uses terrestrial planning as a basis for understanding MSP [49] and proposes using experience with novel marine governance mechanisms to inform and improve terrestrial planning [85].

alleviated in the development of licensing frameworks and insurance policies. In the majority of jurisdictions, consents are limited to a single use in a single location, so the possibility of multi-use licences for larger areas would need to be considered.

It is, however, not yet clear that ocean energy devices, densely sited in nearshore areas, will be amenable to co-existence. As ocean energy by its nature requires exclusive occupation of a specific marine space with particular resources it may instead be preferable to 'zone' such uses, either within MSP processes (zoning itself can be regarded as one the elements of MSP), or outside of them. There has already been some debate as to the relationship between zoning and MSP that may be relevant to the ocean energy sector and other industrial users [23].

A related issue is the co-existence of ocean energy projects as between themselves. There may be some difficulties in allocating resource access under a MSP as developments may affect the availability of resources downstream. Unfortunately, the physics of tidal resources and their interactions with devices are simply not sufficiently well enough understood at present to factor this into MSP processes. This again highlights that flexibility will be needed to integrate additional knowledge as our understanding advances.

Several issues related to the management of marine space can be identified for further investigation:

1. A foundational question is whether the development of MSP is the best available option for integrating ocean energy development into an increasingly crowded marine environment. Despite the rapid advancement of MSP, other tools, such as zoning, may be able to achieve the same aims in relation to ocean energy and perhaps other unique cases. In Europe, pursuant to the MSP directive,[31] states are obliged to pass MSP legislation and draft plans, though there are no strict substantive requirements. In other jurisdictions, there may remain substantial latitude to implement specific measures for ocean energy where appropriate.
2. Assuming that MSP continues to develop as the preferred response, there are questions as how best to integrate ocean energy and other industrial uses into MSP processes. In any MSP process, the key concern will be how different activities will be prioritised as against each other. As noted above, in the ocean energy context, this has been achieved in different cases through an exclusionary approach and a plan-based approach. Further research is needed to develop good practice for MSP, particularly in relation to new and emerging industries. Regardless of the approach taken, issues regarding conflict resolution, coexistence and compensation will also arise.
3. Related to prioritisation is the question of co-existence. Clearly further research is needed into a range of non-legal questions regarding feasibility of this, though subsequently there will be a need to develop appropriate legal and regulatory mechanisms to establish multi-use sites.
4. It is crucial that the sustainability dimension of MSP is not lost in a rush to develop new resources. Sustainability criteria for MSP could be developed, possibly using similar criteria from other environmental governance instruments as a model [9]. This could be a step toward recognising the environmental benefits of renewable energies within legal processes and 'levelling the playing field' with established marine activities.

4. Conclusion: advancing legal research for ocean energy

This paper has provided an overview of the key elements of modern marine governance systems and how they currently interact with ocean energy. Several key priority areas constitute the proposed legal research agenda for ocean energy:

- In terms of **international law**, there is a need to focus on the role of the law in coordinating and facilitating national efforts. Perhaps the most important next step is to identify the competences of relevant institutions and elaborate a blueprint for cooperation and coordination of ocean energy activities.
- The legal and regulatory frameworks surrounding **environmental impacts** are clearly a priority area. Research is needed into the integration of risk-based management processes into traditionally cautious regulatory regimes, the mechanisms for facilitating this integration, and the role of legal frameworks in ensuring that relevant scientific knowledge is generated, disseminated appropriately, and used by regulators.
- Questions surrounding **rights and ownership** are proving to be an interesting aspect of ocean energy development, and fertile ground for developing research with broader implications for the future of marine governance. There are a number of potentially useful ways to advance this discourse. Future studies should consider the possibility and effects of 'privatising' the oceans, and elaborate how any new private interest will interact with other interests, both new and pre-existing.
- **Consenting processes** continue to be a major barrier to ocean energy, and future research could focus on how to modify such processes and transition to OSS systems, or towards jurisdiction-appropriate alternatives. Further discussion regarding effective consultation in this new context is needed, including the SLO concept and how it relates to ocean energy. Finally, there is considerable opportunity for research into the broader questions regarding balance of power and the role of national and regional bodies in relation to consenting.
- With regards to **managing ocean space and marine resources**, MSP is the clear growth area, and looks set to continue to develop quickly in Europe. Further study is required of the interaction of ocean energy with MSP processes, approaches to prioritisation of activities, the possibilities for co-existence, and the balance between industrialisation and sustainability. It may also be useful to elaborate more clearly the relationship between zoning and MSP and how this may be relevant to the ocean energy context.

This agenda is not intended to be a comprehensive identification of all the potential legal and regulatory issues surrounding ocean energy, rather a broad framework for organising existing research and guiding the direction of future research. Indeed, it is likely that new and unforeseen issues will emerge as the ocean energy industry develops.

This research agenda would be helpfully advanced through further primary research into the needs and preferences of developers and regulators, in much the same way that primary research into other stakeholders has advanced the social sciences research agenda. Comparative studies between jurisdictions will also highlight best practices and suggest paths forward.

At the same time, ocean energy provides an interesting general case study for a range of research regarding the development of marine governance in an industrialising ocean. In this regard, future research could utilise the ocean energy industry as a case study for exploring a range of issues, such as EIA and marine rights. In this way, the advancement of legal research on ocean energy has the potential to contribute to evolving discourses on marine governance, and to substantive questions in various related fields.

This research agenda therefore presents an opportunity for legal scholars to be involved in the development of appropriate governance structures from the beginning of the industry.

[31] 2014/89/EU.

Understanding and developing the legal aspects of this technology will be a major factor in determining whether ocean energy technologies can become a successful commercial-scale industry, generating clean energy, and respecting the marine environment. As ocean industrialisation progresses, collaborative, strategic and forward-thinking legal research clearly has a crucial role to play.

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