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Strengthening the role of science in marine governance through environmental impact assessment: a case study of the marine renewable energy industry

Glen Wright [a, b, *]

[a] Australian National University, Canberra, Australia
[b] Institute for Sustainable Development and International Relations (IDDRI), SciencesPo, Paris, France

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ABSTRACT

This paper explores the role of environmental impact assessment (EIA) in advancing the 'Blue Economy'. The ability of EIA frameworks to act as the interface between science and regulation and advance scientific knowledge is assessed. This paper examines how regulators and regulatory frameworks can best use available science, as well as facilitate the generation and sharing of new scientific knowledge on environmental impacts, using the emerging Marine Renewable Energy (MRE) industry as a case study. Some reforms to traditional EIA frameworks are considered. In particular this paper represents the first contribution to the literature on the 'Deploy and Monitor' and 'Rochdale Envelope' approaches to EIA. Strategic Environmental Assessment (SEA) is also considered in the MRE context. It is argued that some simple reforms to EIA processes, as well as well-planned SEA, can augment the role of science, and contribute to a supportive regulatory environment that facilitates innovation whilst also protecting the environment.

Most things become exhausted with promiscuous use. This is not the case with the sea.

Grotius (1608)

1. Introduction

As Hugo Grotius was formulating his theory of the Freedom of the Seas in 1608, the marine environment would have seemed inexhaustible. Yet 400 years on, the oceans are looking increasingly exhausted (Rogers and Laffoley, 2011). Our growing population and appetite for resources, coupled with innovation and technological advancement, is driving unprecedented exploitation of the marine environment. The resulting increase in the number and intensity of marine activities is akin to an 'industrial revolution' of the oceans (Charter, 2007; Salcido, 2008).

This trend of ocean industrialisation has also intersected with the environmental imperative to decarbonise the energy system. While this imperative initially drove the development of solar and onshore wind power, interest has now spread offshore.[1] Offshore wind is growing rapidly (GWEC, 2013; pp. 53–57), while marine renewable energy (MRE) technologies, which utilise waves and tides to generate electricity,[2] are beginning to attract considerable interest and investment (REN21, 2013, pp. 39–40). MRE is also challenging existing marine governance frameworks (Wright, 2013, 2012).

In particular, there are concerns that MRE may cause negative environmental impacts, and scientific knowledge has developed at a much slower pace than the technology and industry. While scientific knowledge is improving, there remain considerable knowledge gaps and uncertainties, particularly as the scale of deployment grows. At the same time, the regulatory frameworks that bring this knowledge to bear in decision-making have also been slow to adapt in many jurisdictions.

The MRE industry is at the intersection of various concerns and interests: it seeks to generate clean electricity to advance carbon

* Australian National University, Canberra, Australia. Tel.: +33 145497679.
E-mail address: glen.w.wright@gmail.com.
URL: http://www.glenright.net

[1] For the most up-to-date figures on the renewable energy deployment, see the latest version of the REN21 Renewables Global Status Report at http://www.ren21.net/ren21activities/globalstatusreport.aspx.

[2] MRE also encompasses ocean thermal energy technology (OTEC) and salinity gradient technology. However, these technologies have followed a different development pathway to wave and tidal. MRE in this paper refers primarily to the wave and tidal technologies currently in development.

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reduction goals, but it is deploying devices into a complex and delicate environment; it offers potential job creation and economic growth, but there remains considerable uncertainty as to the environmental impacts of the technology; it is fledgling and innovative, but faces considerable regulatory and policy challenges.

The need to balance these economic, social and environmental concerns within marine governance frameworks is encapsulated by the 'Blue Economy' discourse (UNCSIDS, 2012). The EU's 'Blue Growth' agenda, for example, notes the need to "harness the untapped potential of Europe's oceans, seas and coasts for jobs and growth … whilst safeguarding biodiversity and protecting the marine environment" (European Commission, 2012).

Environmental impact assessment (EIA) helps decision-makers consider the environmental consequences of proposed actions (Morgan, 2012; Sadler, 1996). EIA is the main tool utilised by regulatory authorities to ensure that the environmental protection goals are met in approving projects (Sadler, 1996). EIA is also one of the key interfaces between science and regulation, ensuring that existing knowledge is well utilised and that new scientific knowledge can be generated and disseminated.

This paper provides an overview of EIA and its role in connecting science to the regulatory process, utilising two MRE case studies. The dichotomy between precaution and risk in project-level decision-making is discussed, and it is concluded that some environmental risk is desirable in order to allow for generation of new scientific knowledge. The paper then discusses three methods for better balance environmental protection with knowledge generation and innovation through the EIA process: 'deploy and monitor'; adaptive management; and the 'Rochdale Envelope'. Finally, Strategic Environmental Assessment (SEA) and Marine Spatial Planning (MSP) are discussed in the MRE context.

The paper concludes that application of EIA processes must be adapted if they are to better serve science and better balance competing goals. A risk-based EIA process is needed to utilise existing knowledge and factor it into decision-making processes, while also encouraging the generation of new knowledge. It is argued that the incorporation of the regulatory mechanisms discussed can achieve this by providing for environmental protection in the absence of complete scientific certainty, while also allowing for the generation of new knowledge through considered, risk-based permitting and deployment of MRE devices. Strategic marine governance initiatives can play a complementary role in filling knowledge gaps and providing scientific certainty regarding new technologies in the marine environment.

2. Environmental impact assessment

The first formal EIA system was established in the United States in 1970 by legislation that was primarily a political response to the changing nature and scale of post-World War II development.[3] Public interest and concern regarding the environmental impacts of development was growing, and the adequacy of existing decision-making tools was criticised (Caldwell, 1988).

EIA is now a well-developed concept in environmental law, having been adopted in over 100 jurisdictions and in many bilateral and multilateral aid and funding agencies (Petts, 1999). While the exact nature of the process can vary, EIA generally follows a series of similar stages:

1. *Screening* the proposed development to determine whether there are likely to be significant effects on the environment.
2. *Scoping* the available environmental data and key issues at the proposed deployment site. This identifies additional studies that will be required in order to make a proper assessment.[4]
3. *Baseline studies* provide baseline data on the status of the receiving environment. At this stage, studies identified during the scoping phase will also be undertaken.
4. An *assessment of impacts* will then be made to assess the significance of potential identified interactions. Options to mitigate these impacts will be considered, and any residual effects will be detailed.
5. *Environmental reporting,* whereby the proponent compiles a statement of effects and supporting documentation.
6. *Submission and consenting.* The proponent submits the statement of effects and the appropriate consent applications and supporting documentation. Consenting and regulatory bodies then undertake a determination process set out by the relevant legislation and regulations to determine whether the project is permitted, and under what conditions.[5]

EIA will form a key part of the regulatory process for MRE in most, if not all, jurisdictions. Existing EIA regulation is likely to be applied unaltered to MRE proposals. This is partly because EIA is intended to be generally applicable. However, this is also a common pattern with new technologies, which are initially developed in the context of existing legal frameworks, but inevitably elicit new legal responses as commercialisation approaches Nyhart (1974, p. 830). It is in this context that some specific regulatory responses for development of new offshore technologies, particularly MRE, are considered later in this paper.

2.1. EIA as the interface between science and the regulation

In recent years, much has been written about the role of science in EIA (e.g. Cashmore, 2004; Lemons, 1994; Morrison-Saunders and Bailey, 2003), including EIA theory and practice, and empirical studies examining the scientific content of EIA documents (Culhane et al., 1987; Malik and Bartlett, 1993). Despite widespread adoption and the considerable literature on the topic, EIA has only had limited success in advancing environmental protection and the results "appear most favourable when compared with past neglect and failings, rather than when measured against sustainable development goals" (Cashmore, 2004, p. 404). This limited success may stem from EIA's poor theoretical basis: it is a quasi-scientific process that has emerged from a political, rather than scientific, imperative, such that EIA practice began before there was adequate scientific capacity to support it (Lee et al., 1995).

Later, broader theoretical conceptualisations of EIA developed, building on evaluative research and appropriating theoretical frameworks from other disciplines (Cashmore, 2004). As a result, the theoretical underpinnings of EIA have been lamented as being an uneven mixture of science, planning, social, economic and biological theories, with the process as a whole representing much less that than the sum of its parts (Lawrence, 1997).

This lack of theoretical direction has given rise to a number of different conceptions of EIA, how it does and should operate, and the role of science in the process. The approach to the role of science EIA can be separated into two overlapping paradigms: EIA as applied science and EIA as civic science (Cashmore, 2004, p. 406). Under the former conceptualisation, EIA is a process by which objective scientific knowledge is brought to bear on practical

[3] National Environmental Policy Act of 1969 (NEPA).

[4] There may also be a formal process for engaging with consultees.

[5] These conditions will generally include monitoring and compliance, which could alternatively be viewed as a separate step in the process.