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Blue Growth: A Transitions Approach to Developing Sustainable Pathways

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1. INTRODUCTION

The sustainable management of Blue Growth is an urgent issue for coastal states, with a growing emphasis being placed on the transformation of unsustainable governance and practices (Spalding, 2016; Bennett *et al.*, 2019; Voyer *et al.*, 2021). The increased focus on Blue Growth as a fix (Brent, Barbesgaard & Pedersen, 2020) for a variety of societal issues, including climate change mitigation (Lubchenco, Haugan & Pangestu, 2020), green economic and post-COVID recovery policy (Dundas *et al.*, 2020; Northrop *et al.*, 2020), combined with the longstanding issues with the sustainability performance of marine governance mechanisms, means that instigating transformative action is difficult (Kelly, Ellis & Flannery, 2019). Marine industries have also rapidly expanded over the last two decades (Jouffray *et al.*, 2020). For example, the average size and number of offshore wind farms have increased substantially. This is exemplified by a 22% annual growth rate in the number of offshore farms in the North Sea between 2008 and 2018 (Xu *et al.*, 2020) and a 5.3% annual increase in animal aquaculture between 2001 and 2018 (FAO, 2020). Overall, the maritime economy is now estimated as being between 3.5% and 7% of global GDP (Konar & Ding, 2020) and is predicted to accelerate and intensify in the coming years (Jouffray *et al.*, 2020). This acceleration will include the adoption of floating wind farm technology, which will enable arrays to be located further offshore, and will involve a greater deployment of tidal and wave energy devices. Furthermore, technologies such as floating solar and offshore aquaculture will become more common.

The intensification of Blue Growth raises several socio-ecological issues that need to be addressed through marine governance and management. For example, there is concern that placed-based Blue Growth activities, such as wind and aquaculture farms, may displace activities such as fishing (Lester *et al.*, 2018; Young *et al.*, 2019), with knock-on impacts for local economies (Said & MacMillan, 2020) and coastal well-being (Farmery *et al.*, 2021). Blue Growth may also place considerable pressure on ocean biodiversity (Lima Junior *et al.*, 2018), increase demand for marine space (Stelzenmüller *et al.*, 2021), and may lead to stakeholder conflict (Bax *et al.*, 2021). Blue Growth must, therefore, be managed in terms of sustainability, natural resource boundaries, and coastal community well-being (European Commission, 2017).

Sustainably managing Blue Growth is challenging due to the longstanding inefficiencies and inertia of existing marine governance regimes. Marine governance regimes are, historically, fragmented and sectoral (O'Hagan, Paterson & Tissier, 2020). This approach has been unsuccessful in fostering the sustainable

use of the marine environment as it fails to account for sectoral interactions and the cumulative impacts on ecosystems (Guerry, 2005). Despite this being a well-recognised issue, fostering the transformation of these regimes has proven to be particularly difficult (Kelly, Ellis & Flannery, 2018). Various approaches such as Integrated Coastal Zone Management (ICZM), Ecosystem-Based Management (EBM) and Marine Spatial Planning (MSP) have emerged as solutions to the inefficiencies of existing governance regimes (Stephenson *et al.*, 2021). Marine ecosystem accounting is also increasingly being put forth as having the potential to support better marine and coastal governance (Chen *et al.* 2020).

There is growing evidence, however, that the implementation of these new approaches fails to address common persistent problems that inhibit regime transformation, and that many of the unsustainable institutions and practices persist after the adoption of new approaches (Kelly, Ellis & Flannery, 2018). Rather than reflecting on what institutional changes are necessary to effectively deliver on the promise of innovative approaches, implementation of new governance mechanisms is predominately facilitated within existing policy and institutional frameworks (i.e. the incumbent regime), often negating their transformative capacity (Kelly, Ellis & Flannery, 2019). Implementing innovative governance solutions in this manner has resulted in their potential being diminished by issues such as policy layering (Vince, 2015), path dependency (Jentoft & Mikalsen, 2004), institutional drift (Morrison, 2017) and resistance by powerful stakeholders (Flannery & Ó Cinnéide, 2012). For a comparison of marine governance and transitions approaches please refer to Table 1.

Table 1. Comparison of integrated approaches in marine governance to sustainability transitions

Governance Approach	**Description**	**Characteristics**	**Outcomes**
Integrated Coastal Zone Management (ICZM)	A tool for the integrated management of all policy processes affecting the coastal zone, addressing land-sea interactions of coastal activities in a coordinated way with a view to ensuring the sustainable development of coastal and marine areas.	• Non-statutory process (EU Recommendation) • Step-by-step approach to planning in the coastal zone • Dependent on formal adoption and funding for implementation • Operates within new or revised regulatory programmes	Previous Irish initiatives in Cork Harbour, Bantry Bay and Dublin Bay failed to progress beyond the project stage due to a number of factors including a lack of policy commitment and sustained financial backing for coastal management (Falaleeva *et al*., 2009; O'Hagan & Ballinger, 2010).
Marine Spatial Planning (MSP)	Maritime spatial planning (MSP) will contribute to the effective management of marine activities and the sustainable use of marine and coastal resources, by creating a framework for consistent, transparent, sustainable and evidence-based decision-making (EU MSP Directive 2014/89/EU)	• Statutory process (e.g. EU MSP Directive) • Follows a generic step-by-step approach to planning • Requires formal adoption and funding for implementation • Operates within new or revised regulatory programmes and management responsibilities	Evaluations of MSP suggest that it has been hampered by "power, exclusion and antagonism" (Tafon, 2017); prioritisation of economic growth over environmental and social objectives (Qiu & Jones, 2013; Domínguez-Tejo *et al*., 2016; Jones, Lieberknecht & Qiu, 2016), tokenistic participation (Lieberknecht & Jones, 2016; Flannery, Healy & Luna, 2018); and path dependency (Clarke & Flannery, 2020)
Ecosystem-based management (EBM)	A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way' (Secretariat of the Convention on Biological Diversity 2004).	• EBM approach is endorsed in EU MSP Directive • A place-based/ spatial approach to resource management • Usually focus is on the management of natural resources i.e. fisheries.	EBM approaches have struggled to deal with the complexities of coastal and marine management, due to a "perceived lack of knowledge, conflicting interests, lack of organisational/legal framework, and lack of communication" (McLeod and Leslie, 2007; Marshak *et al*., 2016, p. 5).
Sustainability Transitions	Long-term process of radical and structural change at the level of societal systems involving multi-dimensional, and fundamental transformation processes (Markard, Raven & Truffer, 2012*)*	• Continuous process spanning 25-50 years • Integrated approach • Multi-actor, multi-domain and multi-level • Aimed at innovation	Radical diagnosis of persistent problems which cannot be solved by policy alone. Integration of politics, economics, society and government as well as wider institutions and legislation. Includes historical analysis of institutional arrangements and behaviour to understand how change happens (Rotmans & Loorbach, 2010; Wittmayer et al., 2014).

Adopting a transitions approach has been advanced as a way of steering regime change so that it is not inhibited by persistent problems (Kelly, Ellis & Flannery, 2018, 2019; Rudolph *et al.*, 2020). The sustainability transitions approach provides a conceptual perspective to assess and steer the transformation of governance systems. It can help identify change drivers, conceptualise how existing regimes may respond to these drivers, how it accommodates new knowledge about alternatives approaches, how resistant it may be to innovation, and facilitate sustainable pathways to steer through these issues (Kelly, Ellis & Flannery, 2018; Rudolph *et al.*, 2020). The concept of sustainability transitions has emerged as an approach for both conceptualising and fostering the radical change that is needed to achieve sustainable development. Transitions are concerned with developing long-term processes of radical and structural changes of societal systems. The multi-level perspective adopted in transition studies is a useful analytical framing through which to analyse drivers and responses to potential changes.

This paper reports on four case studies that use the multi-level perspective and transitions thinking as a broad analytical framework through which to understand institutional dynamics, drivers and responses within core marine sectors. The next section describes how the multi-level perspective and transition management helped to identify and understand change drivers. This is followed by an account of case study methodologies. Key findings from each case study are then presented. The paper concludes with a discussion of case study findings in relation to emerging EU and national policy and with reflections on the utility of the multi-level perspective.

2. MULTI-LEVEL PERSPECTIVE: UNDERSTANDING CHANGE DRIVERS AND RESPONSES

The multi-level perspective adopted in the sustainability transitions approach differentiates between three functional levels, which distinguish between different forces for change in socio-technical systems (Van Der Brugge, Rotmans & Loorbach, 2005). These levels frame how a transition may take place. These levels are niches, regimes and landscapes (see Fig.1).

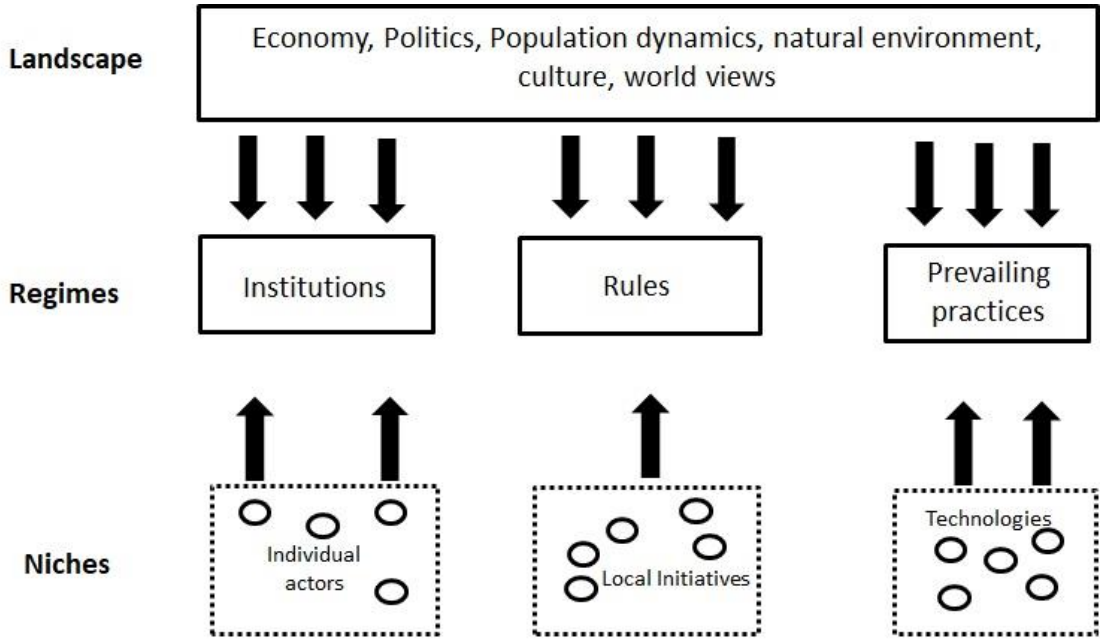

Figure 1. The Multi-Level Concept in Transition Studies. Source: Adapted from Geels, 2002

The management regime is the amalgamation of the dominant practices, rules, institutions, and norms that structure activity within a particular policy area. Change pressures can be characterized as landscape pressures and niche practices. Landscape pressures operate at the macro level and include issues such as economic, political, environmental, and demographic dynamics. These dynamics put pressure on the existing regime to change but cannot be directly controlled by the regime. For example, population growth will place pressure on food and energy regimes to scale up production. Niche pressures are micro-level innovations that exert pressure for regime change from below. Niches can be the actions of individual actors, the development of alternative technologies and local management practices that do not conform to established practices and put pressure on the regime to adapt to accommodate them. For example, the development of autonomous vessels will put pressure on port and shipping regimes to accommodate novel navigation systems. Landscape pressures and niches are, therefore, vital seeds for change and are crucial for path-breaking innovations. Transition management focuses on the development of sustainable

pathways that can overcome barriers and maximize opportunities revealed through the application of the multi-level perspective. Transition management can steer innovations to become established within reformed and more sustainable regimes.

3. METHODOLOGY

Adopting an in-depth case study approach, the multi-level concept underlying the transition management approach was used in case studies about key marine sectors, including: port and shipping, marine and coastal tourism, aquaculture and marine renewable energy. While all of the case studies used the multi-level concept as a base analytical framework, they all employed different methodological approaches to assess each management regime.

Belfast Harbour, in Northern Ireland, was selected as a case study to critically evaluate the potential opportunities and challenges facing the port and shipping sector in transitioning towards a more sustainable growth path. Drawing on the multi-level perspective and transition management, a Future Pathways Analysis (FPA) approach was developed to assess the differing ways the port regime might respond to specific change drivers in to the future. Given that Belfast Harbour had already developed its vision for the next 15 years, the research focused on 'Future Thinking' with an emphasis on horizon scanning and the application of innovation and technology. The FPA approach focused on: a) identifying change drivers likely to impact the development of Belfast Harbour over the short, medium and long-term until 2050; and b) refining them as part of future pathways that chart consequences of certain decisions and actions. To undertake the pathway analysis, interviews and workshops were undertaken with port staff and key stakeholders.

The Wild Atlantic Way, a 2500 km coastal touring route along the west coast of Ireland, was selected as a second case study through which to assess tourism management regimes. As part of the case study, documents and policy related to the coastal and marine tourism regime in Ireland were reviewed to identify niches and landscape pressures. This was followed by an extensive tourist survey and in-depth collaborative research with a local community situated on the Wild Atlantic Way to identify the pressures, preferences and development trends relevant to coastal tourism. In conjunction with local stakeholders, a sustainable pathway for the growth of the tourism trail sector was then developed.

For the aquaculture sector, a case study was conducted on the Portuguese Centro Region's aquaculture sector. The focus of the case study was to assess the

level of sustainable aquaculture achieved in the region. This case study focused on analysing aquaculture information from scientific and policy publications, statistical datasets and included interviews with key actors. Using the transition management framework, the potential of Blue Growth is identified by comparing drivers and barriers likely to impact the growth profile of aquaculture and assessing how the sector could respond to sustainably realise its potential.

Finally, a multi-level case study was used to assess the offshore renewable energy (ORE) regime in Brittany (France). In Brittany, the ORE sector is currently at an initial start-up phase and there is a strong willingness to support its development by regional authorities. The study focused on analysing the strategies and regulations that frame the growth of the ORE sector and workshops with developers and stakeholders on specific projects were conducted to understand the main drivers of sustainable blue growth development for the ORE sector.

4. BLUE GROWTH PATHWAYS FOR PORTS

International seaborne trade continues to increase, driven by continued growth in global demand. This has intensified the need for greater sustainability in ports and shipping. Ports are complex organisations with varying functions, roles, and assets that are affected by the economy, culture, policies, local communities, geographical locations and administrations. These characteristics make it difficult to govern and manage ports in an integrated manner. Port authorities need to adopt and implement appropriate incentives to ensure the necessary technological improvements and operational measures are taken to encourage and deliver sustainability. This requires a transformation of port governance that embraces innovation and technology but also ensures resilience to risk and disruption and adaptation to change.

Using the case study of Belfast Harbour, we implemented a future pathway approach to sustainable blue growth solutions. This work included identifying change drivers likely to impact the development of ports over the short-, medium-, and long-term until 2050 and assessing how the port could respond to them through three different future pathways. The drivers included landscape pressures and niche activities that could put pressure on the existing regime to change. These drivers were characterised using the Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) framework and divided into short-term, medium-term, and long-term drivers of change. The future timeframes were 2025, 2035, and 2050. The PESTLE drivers are represented by their initial letter in brackets in the following sections.

Short-term change drivers within the port included:

- implementation of trade arrangements post-Brexit (P);
- maximising the commercial capacity of the port and supporting incumbent businesses (E);
- realising waterfront potential and addressing community needs in city ports (S);
- upgrading outdated port technologies (T);
- responding to regulatory changes and compliance requirements (L); and
- addressing long-term data for global climate change (E).

Medium-term change drivers included:

- evolving political and administrative changes (P);
- growing global competition amongst maritime industries (E);
- restructuring of employment sectors and expansion of new sectors (S);
- advancements in autonomous/virtual management (T);
- international and national statutory energy targets (L); and
- addressing environmental and health crises (E).

Long-term change drivers included:

- the creation of new political realities, relationships and regulatory changes (P);
- collapsing of new port industries and loss of employment (E);
- widening disparities within society, leading to increased civic action and disruption (S);
- rising utilisation of artificial intelligence, and augmented and virtual reality in port management (T);
- fragmenting governance systems and restructuring of public services (L); and
- increasing occurrence of storm surges, flooding and extreme temperatures (E).

Future pathways were then developed as three different responses to these drivers and were categorised as *stable future*, *disruption and resilience*, and *managed innovation*. The *stable future* pathway reflected short-term change and is based on past experiences and predictions of the future to enhance economic stability. The *disruption and resilience* pathway was based around fostering resilience, adaptability and a capacity to respond to unexpected shocks with a

focus on the medium term. The *managed innovation* pathway focused on utilising innovation to flexibly steer towards managed, long-term change.

The findings from the case study revealed that adopting a *managed innovation* approach was necessary to transition to greater sustainability over the longer term. Interviews highlighted that this pathway should address the lack of urgency around climate change mitigation and adaptation. Despite climate change being considered a major threat, many interviewees felt that the pathway presented an opportunity for ports and shipping to decarbonise and seek zero carbon emissions instead of a transition to a low carbon future. The pathway should also include fiscal incentives to help the port and local authorities transition to zero carbon emission. Investment was considered necessary for training in new technologies, engineering, manufacturing and design. It was also highlighted that traditional port businesses are dependent on port authorities implementing innovative changes, e.g. new infrastructure, cranes, greener processes and technology advancements. Therefore, the capacity of port businesses to transition is tied to the capacity and willingness of the port authorities to be a driver of change.

5. BLUE GROWTH PATHWAYS FOR MARINE AND COASTAL TOURISM TRAIL DEVELOPMENT

As part of the EU's Blue Growth strategy, marine and coastal tourism is viewed as one of five focus maritime areas with the potential to foster a smart, sustainable and inclusive Europe. This represents a key external/ landscape driver of change for economic development. However, while marine and coastal tourism are vital economic activities for a wide range of coastal regions across the EU, the sector faces increasing sustainability challenges due to increasing demand and the accompanying social consequences for local communities and environmental consequences for local coastal and marine resources. There is, therefore, a need to establish a comprehensive understanding of the impacts of marine and coastal tourism on local communities and the natural environment, niche or local initiatives as responses to this change driver and to accurately estimate the potential impact of new policy measures being introduced and implemented at the regime level.

This case study focused on the Wild Atlantic Way, a 2500 km coastal touring route along the west coast of Ireland. The study suggests that to support sustainable coastal tourism transitions, close collaboration at the community level is required. Locals at tourist destinations not only drive the tourism product itself but live with the consequences of tourist activities in the area, and, therefore, have

an increased motivation to develop and promote sustainable pathways. The study identified a number of key impacts on marine and coastal trail development in Ireland resulting from tourism drivers, including: environmental degradation (erosion, litter, pollution, etc.); overburdened infrastructure; politics of participation; alienation of locals; lengthening of tourism season; reduction of day-trip tour operations; regulations on tourist admission numbers; and commodification of culture and traditions**.**

Utilising both qualitative and quantitative research approaches, the MOSES project team in Ireland developed an extensive tourist survey and conducted in-depth collaborative research with a local community situated on the Wild Atlantic Way to develop sustainable pathways for the growth of the tourism trail sector. The survey was designed to determine tourist characteristics, expenditure and activities during their stay on the Wild Atlantic Way. Respondents were also questioned on their perceptions of the Wild Atlantic Way, including quality of facilities and perceived levels of tourism pressure. The sample consisted of 603 tourists who were surveyed for approximately 10 minutes each during the period 15th–31st July, 2019 (close to the peak summer season in Ireland). The surveys were undertaken at six locations along the Wild Atlantic Way. Core findings and drivers of change include tourist insights and perceptions of endogenous pressures such as the numbers of tourists, level of overcrowding and quality of the transport infrastructure along the Wild Atlantic Way (Further results available from: www.mosesproject.eu). The community of Rathmullan, situated along the Wild Atlantic Way in Co. Donegal was selected for participation in the MOSES case study.

Results derived from employing a community-generated collaborative framework included identifying needs and working collaboratively to address the following:

- providing improved infrastructure (telecommunications, shared facilities, etc.);
- identifying and responding to environmental damages in line with national-level frameworks and directives;
- identifying and developing the unique experiences and draws that entice visitors to stay longer (‘hidden gems’);
- reduction of some pressures by developing policies aimed at extending the tourist season;
- identifying and reducing environmental pressures and damages early;
- reducing the emphasis on day-trips (where tourist money is often diverted from locals); and

- fostering community engagement by supporting cultural and traditional experiences as visitor experiences and learning from local niche initiatives.

A key piece of policy advice that countries need to integrate into all coastal and marine tourism strategies and plans if this sector is to lead to sustainable Blue Growth is that continued community collaboration and engagement with local initiatives is essential from the outset of development. Regional policymakers are well-placed to undertake this work and benefit from the exchange of experience with the local communities and initiatives facing these challenges.

6. BLUE GROWTH PATHWAYS FOR AQUACULTURE

Globally, aquaculture production is rising rapidly and is being driven by increasing demand for global food security and economic growth. This growth should, however, be in line with sustainable development standards, a task that both governments and businesses must undertake. How sustainable Blue Growth in aquaculture may be further enhanced through the application of a transition management approach was examined using the case study of Portugal's Centro region aquaculture sector. The multi-level perspective was used to help to identify policy, governance, administrative, economic, societal, environmental, and scientific/technological drivers and barriers to sustainable Blue Growth goals. From this analysis, key recommendations to develop a pathway towards sustainable Blue Growth in aquaculture were developed.

The economic drivers identified included:

- high demand for fish products by the Portuguese;
- the existence of EU and national or local funding mechanisms;
- better quality of local vs imported products which can justify higher prices and branding;
- growing local and foreign demand for delicatessen products such as organic seaweed, organic clams and locally produced oysters and corvine;
- the cost for licensing and using public land/sea sites is not very high; and
- increased spending for research on feeding and the impacts of introducing new species.

Administrative drivers relate largely to improvements in licensing processes, especially in terms of requirements and duration, although for some actors this process is still time consuming and difficult to navigate. Governance drivers include the management of conflict with other users in spatial plans that allow

some types of aquacultures in protected areas or provide official negotiation processes. Finally, scientific knowledge and advanced research in areas like biotechnology are also important drivers for sustainable aquaculture in the Centro Region.

From a transition management perspective, it is apparent that there are differences within the aquaculture sector and hence its management regime, which is mainly connected to the diversity of the production systems as well as the type of products, varying environmental conditions and consumption patterns among regions and countries. These differences combine to hinder a more uniform management regime across the Atlantic Arc or even the EU. Despite these differences, the current aquaculture management regime in Portugal corresponds well to the change pressures set by both the landscape pressures and the niche practices through a strong institutional framework and strategic planning practices already in place. The landscape pressures result mainly from the increasing demand for fish and seafood as well as the need for sustainable food production; the need to address overexploitation of the marine resources; and the need to address adaptation to climate change. In parallel, at a niche level, key actors such as research institutions, investors, producers, government agencies, consultants and clusters have strongly interlinked interests in the blue economy and aquaculture within it. These actors make an important contribution to aquaculture to ensure a good balance between economic, environmental, societal and governance objectives as well as realising sustainable blue growth.

Several transition obstacles were also identified. The most pressing obstacles relate to governance and economic barriers. Governance obstacles emerge when there is more than one aquaculture spatial planning framework and a lack of conflict management between aquaculture and other uses of the marine environmental space. There is also a lack of enthusiasm for collaboration and communication between the same or different categories of key actors (researchers, companies or others operating in the supply chain) as well as a distinct lack of promotion for aquaculture products to consumers. Economic obstacles include: cheap imported aquaculture products that compete with local production; disproportional allocation of funding; lack of investment in marketing of aquaculture products; difficulties for new actors to enter the sector; and the emergence of illegal activities from producers to address uncertainties around production.

Based on the balance between drivers and obstacles identified previously there is potential for the aquaculture sector in the Centro Region to transition

faster towards sustainable Blue Growth. Actions included in the pathway developed in this case study include:

- simplify the administrative processes to reduce the deadlines and administrative steps needed for licensing;
- facilitate better spatial planning to identify areas with higher potential for aquaculture and reduced environmental impact;
- reinforce the competitiveness of the aquaculture sector and promote equal conditions for the EU operators, to increase, diversify and add value to national aquaculture production;
- encourage greater investment in production methods that can ensure higher food safety standards, and;
- promote additional research and planning for offshore aquaculture.

To advance these objectives, stronger and more effective collaboration is required between these key actors working across the sector at the local, national, and regional levels.

7. BLUE GROWTH PATHWAYS FOR MARINE RENEWABLE ENERGY

The sustainable growth of the offshore renewable energy (ORE) sector, driven by the need to mitigate climate change, has become a critical issue for the development of energy supply in the EU and elsewhere. This case study considered the sector as it is developing in the EU, the Atlantic Area, and Brittany (France). ORE in Brittany is currently at an initial start-up phase and there is a strong willingness to support the development of this niche technology by regional authorities. Floating turbines can be more easily installed far from the coast, but the technology constrains other activities, especially fisheries. For the ORE sector, the cost of a sustainable Blue Growth pathway is significant in both environmental and economic terms. Avoiding the most important environmental externalities generates high costs, and floating wind is not the cheapest option. However, worldwide competition is emerging between businesses as well as countries for floating farm technology leadership. This landscape pressure may encourage member states' regimes to develop strategies and accelerate development to rapidly lower the levelised cost of energy (LCOE) associated with floating turbines. To verify a sustainable pathway, regular monitoring and evaluation of the economic and environmental impacts would be critical in the short, medium and long term.

In the short term, Brittany will develop a fixed-foundation wind farm off the north coast, a floating pilot project off the south coast, and will continue to test current submarine turbines on the west coast. In the medium term, two floating farms (250 and 500 MW) off the south coast are likely to be built if funding is available, and acceptance is secured at the regime level by authorities willing to mitigate economic (fisheries) and social (coastal communities) impacts. Before advancing the objectives of the region, monitoring of the impacts created by floating generators will inevitably be required to help better understand the economies of scale, the impacts on biodiversity and waves, as well as issues linked to social acceptance. Under the assumption that the current submarine turbine LCOE can decrease and the region confirms its willingness to develop this technology, the same mechanism of monitoring applies. This will also require monitoring the impacts created by the development of such generators in terms of cost as well as on local marine currents. The development of these two technologies will take place as several countries are implementing similar strategies, especially for floating turbines. Such massive development requires research and monitoring of external drivers i.e. the state of the world market for the basic commodities consumed by the generators, especially metals. A floating wind generator contains around one ton of rare earths, and more than 90% of rare earths are currently supplied by China. At present, tensions also appear in markets of certain battery-critical metals, used for electric cars and wind generators (IEA, 2021). Secondly, it also requires monitoring the development of green hydrogen a niche technology in this ORE sector. At a long distance (more than 80 km), an alternating current cable is less efficient to link the farms to the shore. Hydrogen electrolysis represents an alternative considered by several oil companies and may become an important driver in the future evolution of ORE technologies. Most of these conclusions are applicable across the Atlantic Action Area in general, as the development of floating farms is an objective in all the countries participating in the Atlantic maritime strategy (European Commission, 2020).

8. DISCUSSION AND CONCLUSIONS

Adopting the multi-level perspective and transitions thinking as a broad analytical framework demonstrated how potential change can materialise in marine sectors from innovative niches and external pressures. In all case studies, analysis of the landscape identified change drivers that can be leveraged through a transition management approach to develop more sustainable forms of Blue Growth. For example, increasing international trade was seen as a change driver in ports and shipping while environmental degradation was identified as a change driver in coastal and marine tourism. The regime level was used in each of the case studies to examine the institutions, rules and regulations, processes and values involved in

the management of each of the marine sectors. This was critical in interpreting the nature and type of trajectory used to steer change in the marine sectors. For example, regimes are inherently stable and while innovation still occurs, it is often incremental. In the case of offshore renewable energy, implementation at the national level is not in keeping with international ambition and targets and is often hampered by inadequate legislation and policy. The niche level was used in all case studies to identify innovations and novelty. Novelties are based on knowledge and capabilities and are aimed at addressing problems of existing regimes. They can include technologies, new ways of thinking and management and have the potential to challenge shortcomings in the dominant or prevailing paradigms of the regime. In the aquaculture sector, the development of alternative technologies and the cultivation of new indigenous species are examples of innovation in this sector.

Transforming marine governance so that it better responds to these landscape pressures and niche activities will be challenging. While the multi-level perspective was useful in revealing these issues, the adoption of transition management as a means of steering this transformation is vital. This is especially important if marine sectors are to sustainably contribute to key EU initiatives, including, for example, Atlantic Action Plan II, the EU Green Deal and the Biodiversity Strategy 2030. Transition management focuses on coordinating a wide range of actors to achieve long-term sustainability. Transition management aims to facilitate and accelerate transitions through a participatory process of visioning, learning and experimentation (Rotmans, Kemp and van Asselt, 2001; Loorbach & Rotmans, 2010). It is based on the coordination of multi-actor processes at different levels to achieve long-term sustainability through the creation of a joint problem perspective and long-term vision, developing innovation networks and fostering experimentation (Van Der Brugge, Rotmans & Loorbach, 2005).

Our case studies analysis reveals several significant pressures for regime change within key marine sectors. These pressures need to be addressed through the adoption of a transition management approach within these sectors across our study areas. By adopting this approach and engaging key stakeholders, national and EU marine governance authorities can develop sustainable Blue Growth pathways that minimise the impact of continued growth on communities and the marine environment, maximising the implementation of sustainable practices and addressing issues such as biodiversity loss and climate change. Failure to address the unsustainable aspects of Blue Growth and the unsuitable nature of the current governance regime will have major socio-environmental consequences which

could be avoided by the development of sustainable transition plans for each marine sector.

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