

<b>WP4</b>	<b>Deliverable D4.2.1</b>
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## MUSES Project

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# **MUSES (Multi-Use in European Seas) project**

## **v. 3.0**

### **MUSES Deliverable 4.2.1**

#### **Multi-Use Analysis**

**30 April 2018**



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## LIST OF ACRONYMS

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MUSES – Multi Uses in European Seas  
ASSG – Association of Scottish Shellfish Growers [Scotland]  
BEIS – Business, Energy and Industrial Strategy [UK]  
BMVBS – Bundesministerium für Verkehr, Bau und Stadtentwicklung  
BSR – Baltic Sea Region  
CFD – Contracts for Difference [UK]  
CIA – Cumulative Impact Assessment  
CLLD – Community-Led Local Development  
CMD – Common Ministerial Decisions [Greece]  
CoP – Cessation of Production  
CPF – Common Fisheries Policy  
CSR – Corporate Social Responsibility  
DEFRA – Department of Environment, Food and Rural Affairs [UK]  
EBSAs – Ecologically or Biologically Significant Marine Areas  
EC – European Commission  
EEZ – Exclusive Economic Zone  
EIA – Environmental Impact Assessment  
EMFF – European Maritime Fisheries Fund  
EMR – Electricity Market Reform  
EU – European Union  
EWEA – European Wind Energy Association  
FARNET – Fisheries Area Network  
FLAG – Fisheries Local Action Group  
GhGs – Green House Gases  
ICES – International Commission for the Exploration of the Sea  
IMTA – Integrated Multi-Trophic Aquaculture  
LNG – Liquefied Natural Gas  
MU – Multi-Use  
MPA – Marine Protected Area  
MRE – Marine Renewable Energy  
MS – Member State  
NAMP – North American Meat Processors Association  
NGOs – Non-Governmental Organisations  
O&G – Oil and Gas  
OGA – Oil and Gas Authority [UK]  
OPRED – Offshore Petroleum Regulator for Environment and Decommissioning  
ORECCA – Offshore Renewable Energy Conversion Platforms  
OSPAR – The Convention for the Protection of the Marine Environment of the North East Atlantic  
OWF – Offshore Wind Farms  
ORE – Offshore Renewable Energy  
OREI – Offshore Renewable Energy Infrastructure  
SACs – Special Areas of Conservation



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SDM – Survey, Deploy, Monitor

SMEs – Small and Medium Enterprises

SPA – Special Protected Area

SSE – Shore Side Electricity

TCT – Tidal Current Turbine

UCH – Underwater Cultural Heritage

UNESCO – United Nations Educational, Scientific and Cultural Organisation

UKCS – United Kingdom Continental Shelf

WP – Work Package

## EU countries' abbreviations

Belgium	(BE)	Greece	(EL)	Lithuania	(LT)	Portugal	(PT)
Bulgaria	(BG)	Spain	(ES)	Luxembourg	(LU)	Romania	(RO)
Czech Republic	(CZ)	France	(FR)	Hungary	(HU)	Slovenia	(SI)
Denmark	(DK)	Croatia	(HR)	Malta	(MT)	Slovakia	(SK)
Germany	(DE)	Italy	(IT)	Netherlands	(NL)	Finland	(FI)
Estonia	(EE)	Cyprus	(CY)	Austria	(AT)	Sweden	(SE)
Ireland	(IE)	Latvia	(LV)	Poland	(PL)	United Kingdom	(UK)



## 1. INTRODUCTION

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This report has been developed under work package (WP) 4 of the MUSES (Multi-Use in European Seas) project. As part of crucial steps to the preparation of the MUSES Action Plan on Multi Uses, this report provides a clear **overview of multi-use (MU) potential** (including environmental, economic and societal benefits) in European sea basins. It also highlights major barriers (inappropriate regulations, operational, environmental, health and safety, societal and legal aspects) stalling the transition of multi-use of ocean from a concept to real life recognition and practical implementation.

The report **builds on efforts undertaken under WP2 Sea Basin Comparison and WP3 Case Studies**, as well as the first MUSES stakeholder workshop (Poole, 2017) International Council for the Exploration of the Sea (ICES) MUSES workshop (Edinburgh, 2018), MUSES North Sea workshop (Dundee, 2018). More precisely, it summarizes the results and outputs from a year analysis of multi-uses in all five European Union (EU) sea basins: Eastern Atlantic (EA), North Sea (NS), Baltic Sea (BSR), Mediterranean Sea (Med) and the Black Sea (BS). The findings of this report are extracted from analysis at different scales including:

- National (all EU coastal countries) and Sea Basins undertaken under the MUSES WP2 Sea Basin Analysis (Przedrzymirska, J. et al., 2018): large scale analysis conducted for a wide variety of MU combinations. Information was collected from the desk research, including national regulatory and policy documents, plans and strategies, past MU projects, and industry sources as well as engagement with relevant stakeholders on sea basin and national level;
- Local/regional undertaken for certain MU combination under the WP3 Case Studies in nine specific locations across EU (Bocci, M. et al., 2018)<sup>1</sup>: analysis of limited number of combinations in a specific location (sub-national or local scale). Information was collected via desk research of national and sub-national documents, available studies and research deliverables as well as engagement with local stakeholders.

The objectives of this report are to:

- **Show the potentiality of ocean space** by highlighting which MU combinations have strong socio-economic and environmental drivers and which locations should be points of focus for such MU development;
- **Highlight where MU benefits could be realized**, drawing attention to possible incentives that could facilitate the implementation of the multi-use concept;
- **Analyse real and perceived barriers** of selected MU combinations at various levels/scales (national, regional and sea basin) and drawing attention to barriers that can be overcome.
- **Highlight MU good practices** and priority lines for further development.

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<sup>1</sup> All MUSES public reports are available for download at: <https://muses-project.eu/downloads/>



## 1.2 Addressing challenges

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European seas have immense resource wealth and great potential for boosting economic growth, employment and innovation. **Coastal and maritime activities are expanding rapidly** due to advancement in technology, increase in global population, economic growth, trade and rising income levels, climate change and environment. However, further growth of ocean-based industries implies **growing pressures on ocean resources** and demand for ocean space, which are already under considerable stress, while conflicts between maritime uses are also intensifying.

Realizing the full potential of the EU seas seeks for more sustainable and efficient use of maritime space for economic development. The **high demand for space** and environmental concerns within coastal waters are some of the major factors driving maritime activities, such as aquaculture development or offshore wind farm (OWF) infrastructure, to go further offshore.

On the other hand, for some coastal uses, **adopting sustainable practices** in combination with other maritime uses might be one of the options to bring them on stream and ensure their meaningful contribution to the blue growth agenda. In congested coastal areas where space is limited and there are sensitive species and habitat to protect, synergies could be created between sustainable tourism, fishing sector and environmental protection to effectively create a new sustainable economic activity in the form of *pescatourism*.

In some marine areas, **moving uses further offshore** is the only option for some sectors to develop on a wider scale. However, this comes with high capital investments. For sectors with generally low investment capacity (e.g. small-scale fishery or tourism SMEs), multi-use combination with offshore wind or another large industry player might be an opportunity to move further offshore due to savings in operations costs.

To address these challenges countries are moving from a traditional sector-by-sector management of marine activities to **more holistic and integrated approaches**. The EU, its Member States (MS) and regions, are putting in place strategic policy frameworks to address this issue (European Commission, 2014), while the maritime business community is becoming more open to consider novel and sustainable concepts that foster synergies between sectors, uses and activities and improve operational and spatial efficiency.



### 1.3 Multi-Use concept

Sustainable and efficient use of maritime space can be achieved through a combination of different maritime uses at the same location or with multi-use offshore platforms. Combining uses, both in close proximity, through joint operations, or on the same platform, can reduce the space demand and potentially offer significant socio-economic and environmental benefits. There are two main benefits associated with **ensuring spatial efficiency** and not expanding maritime uses and activities beyond the optimal area required:

- (1) the area left void of other human uses can act as “de-facto” protected area, providing a benefit to the whole ecosystem, while also
- (2) reserving ocean space for the use of currently far flung future uses such as carbon sequestration, hydrogen generation or others<sup>2</sup>.

There is no one globally accepted definition of multi-use, but their connotations are often similar. In order to discuss different aspects related to the multi-use of ocean, terms such as marine use, multi-use, user, and a resource have been defined. For the purpose of the MUSES project and its reports, partners have developed following operational definitions. The definitions are based on partners’ own understanding, definitions used in other multi use projects and initiatives (including Mermaid, MARIBE, ORECCA, TROPOS, H2Ocean and SUBMARINER) and interaction with stakeholders at the first MUSES stakeholder workshop in Poole<sup>3</sup>.

**Multi-use (MU)** - joint use of resources in close geographic proximity. This can involve either a single user or multiple users. It is an umbrella term that covers a multitude of use combinations in the marine realm and represents a radical change from the concept of exclusive resource rights to the inclusive sharing of resources by one or more users.

**Use** - a distinct and intentional activity through which a direct (e.g. profit) or indirect (e.g. nature conservation) benefit is drawn from marine resources by one or more users.

**User** - an individual, entity or group that intentionally benefits from a given resource.

**Resource** - a good or service that represents a value to one or more users (e.g. biotic, such as fish stocks; or abiotic, such as ocean space) and can be exploited through either direct (e.g. fishing) or indirect (e.g. nature conservation) uses (cf. Zaucha, J., et al., 2017).

This report classifies MUs into two distinctive groups which are representative of the two main sectors that are driving MU combinations in Europe. Analysis from the MUSES project shows that both tourism and offshore renewable energy (ORE) are the main driving sectors for MUs informing the following:

- 1) combinations with tourism sector;
- 2) combinations with energy sector.

The tourism sector is generally a driver for **‘soft’ MU combinations**, present mainly in Southern Europe, where a steady growth of tourism demand has been realised over the years. The term ‘soft’ is

<sup>2</sup> Schupp M.F., Buck B.H., 2017. MUSE Case Study 1C. Multi-use of offshore windfarms with marine aquaculture and fisheries (German North Sea EEZ – North Sea). MUSES Deliverable D.3.3.

<sup>3</sup> Report available at: <https://muses-project.eu/muses/wp-content/uploads/sites/70/2017/07/MUSES-Stakeholder-Workshop-Report.pdf>



used here as these types of MUs do not include infrastructural integration of fixed structures but are rather co-located or an existing infrastructure is used without major modifications (e.g. tourism and fishing). These uses are also 'less industrial' and usually undertaken at a small scale in coastal areas where tourism activities often take place.

The **'hard' MU combinations** involve the energy sector and the use of fixed (or floating in a single place) offshore structures (e.g. OWF and aquaculture), mainly relevant in the northern part of Europe given the availability of offshore energy resources in the Eastern Atlantic, North and Baltic Sea. However, some exceptions apply. For example, the oil and gas (O&G) sector is largely present not only in the North Sea but also in the Northern Adriatic and potential combination (or rather re-use) of decommissioned platforms with other maritime uses, such as aquaculture and tourism, have been explored in these two sea basins. Furthermore, energy sector is not always a driver for a MU. For example, in the case of wave energy generation and aquaculture development, aquaculture is the main driver. Adding the wave energy device was mainly driven by the need to support the aquaculture operations and scale up the aquaculture sector.

A key initiative in this context has been the launch of the Ocean of Tomorrow cross-thematic calls in FP7-OCEAN, which has already provided promising designs, technological solutions and models for combining activities for economic potential and less environmental impact.

The year long analysis undertaken in MUSES project show that multi-use can also have the following **benefits**:

- contribute to more efficient use of ocean space and resources;
- provide economic benefits to marine users from synergetic use;
- enable certain use to happen at all (give a chance to certain used in spaces where their development otherwise would not be possible) – e.g. aquaculture only if combined;
- provide alternative source of revenue for declining or restricted sectors;
- diversify the sectors to ease the environmental pressures and provide alternative sources of recreation and well-being.

However, multiple **barriers** are still stalling the transfer of MU from concept to real life implementation. These barriers include mainly: technological aspects, regulations, financing, environmental concerns, and stakeholders' perceptions.



## 2. SEA BASIN COMPARISON

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The EU Sea basins offer different potentials, unique resources, maritime sectors and capacity that support the formation of MU combinations. The MUSES project, therefore reviewed and analysed a variety of MU combinations at the national and sea basin level (Figure 1). In addition, the following MU combinations were analysed as part of case studies<sup>4</sup> only in given locations:

- Tidal energy development and environmental protection and monitoring in the North Coast of Scotland - Inner sound of the Pentland Firth - North Sea;
- Renewable energy generation and Desalinization in the Mykonos island - Aegean Sea - Mediterranean Sea;
- Wave and aquaculture in the West Coast of Scotland - Northern Atlantic Sea:

The case study, national and sea basin reports were compared across sea basins<sup>5</sup> to understand the state of play of MUs across Europe. The analysis shows that different factors are influencing economic development across EU sea basins and consequently the opportunities for certain MU concepts. These relate mainly to the **geomorphological characteristics** and **environmental conditions**, as well as **availability of resources and national development targets** addressing certain maritime sectors.

Availability of space is also a relevant factor influencing the development of a MU. In **small sea** areas where space is scarce, MU is seen as an opportunity to use space in a more efficient and effective way. In the **open seas**, MU is driven mainly by the economic benefits of such an approach (e.g. offshore MU platforms) rather than spatial efficiency.

In the Mediterranean, Baltic and Black Seas, where there are strong and growing pressures from human activities on the marine environment, environmental policies, stringent environmental regulations and a high level of ecological awareness might serve as drivers for combining maritime uses with environmental protection (e.g. tourism in marine protected areas). Diversifying the offer of some maritime uses (e.g. tourism and fisheries in the Mediterranean) by combining and/or adopting practices from other maritime sectors, might be a suitable option to ensure sustainability and contribute to blue growth targets. In the sea basins, where coastal tourism is one of the leading sectors (i.e. Mediterranean and Black Sea) dependence on the healthy environment and good quality water is also one of the drivers for identification and enhancement of synergies between sustainable economic uses (i.e. tourism, fishing) and environmental protection.

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<sup>4</sup> The full list of case studies with their locations is available in the Annex I of this report

<sup>5</sup> The O&G MU combination has been analysed only in the Northern Adriatic and not in the whole Mediterranean



### Sea basin wide analysis

### Case study analysis

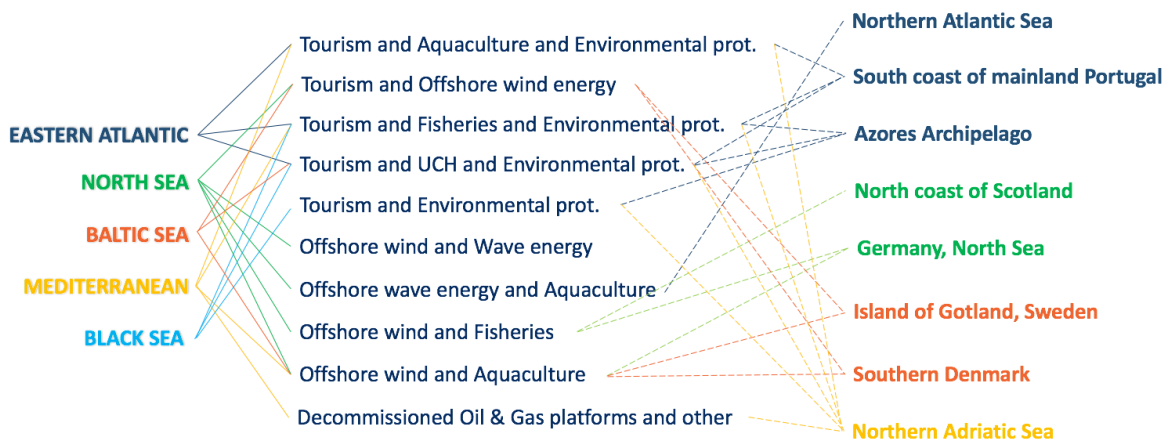


Figure 1 Analysed MU combinations across five European sea basins

The **Eastern Atlantic** hosts suitable conditions for variety of uses and activities. In the UK, the **energy** sector is dominant, as well as its combinations with aquaculture (shellfish), tourism and environmental protection. In 'rural' areas in Eastern Atlantic with little access to grid, combining **aquaculture** with wave energy generation (Mingary Bay, Scotland, UK) is driven by the need to use generated energy directly for the purpose of aquaculture operations. In Portugal, Spain and France, **tourism, fishing and environmental protection** seem to play the most pro-active role in terms of MU development. For instance, tourism and fishing sectors have taken advantage of area-based management approaches/environmental protection areas such as MPA's, Natura 2000 sites and Biosphere Reserves to promote sustainability and their activities in coastal areas. In some cases, sustainable fishing/aquaculture tourism are allowed and popular in estuaries, bays and along coastal areas of the Eastern Atlantic.

The **North Sea** offers particularly good conditions for **renewable energy generation**, including **offshore wind, wave and tide** as energy sources. Combination of these energy sectors (usually as part of the same physical platform), with the purpose of maximal energy generation from the resources at the given sea space, is something that developers are increasingly considering. For example, there is already some experience in combination of wave and tide energy in the Northern part of Scotland (Pentland Firth and Orkney waters), while a pilot test hybrid wind and wave technology is to be commissioned (Cathness). However, EU MS have different regulatory and incentive regimes in this regard. Given the large amount of offshore renewable energy projects in the North Sea, conflict with, and displacement of other uses, is a critical issue for consideration. Different approaches can be noticed across countries in regard to integration of fisheries within OWFs. On the other hand, in some countries, new **tourism** activities have already been established in relation to the OWF (i.e. renewable energy museums and visitor centres, boat tours, etc.).

The decommissioning of **oil & gas (O&G)** platforms is also a relevant topic in the North Sea. Approaches including technology that can cut down the cost of this activity such as their re-use after decommissioning for other purposes, including renewables energies (e.g. wind energy or hydrogen storage), or carbon capture and storage are being considered.





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Salinity and water quality in the North Sea provide suitable conditions for **aquaculture** development. Apart from the suitable conditions, many of the North Sea countries state development goals for aquaculture as part of their maritime policies. Multi-use with ORE is seen as an opportunity for moving aquaculture offshore and scaling it up. However, rough sea conditions still present an eminent challenge for the development of technological solutions that would enable this MU. Combinations of aquaculture and environmental protection (Natura 2000), that refer to a small-scale community based environmentally friendly seaweed and shellfish production, are also present and are deriving eminent benefits.

In the **Baltic Sea**, eutrophication is an important issue caused by the large loads of nutrients and limited water exchange (HELCOM, 2009). There are considerations of **extractive aquaculture** development as a means to combat eutrophication and reduce dependence on seafood imports. However, due to low salinity and issue of visual impact in coastal areas, siting for aquaculture is a challenge. On the other hand, significant investments are required for aquaculture to be developed further offshore. Combination with the OWF sector is seen as a potential opportunity that can reduce costs of such endeavours and open more suitable areas for aquaculture. The Baltic Sea hosts the most well preserved wooden shipwrecks which is attracting divers from all over the world to designated **Underwater Cultural Heritage** (UCH) sites. **Coastal tourism** is also an important blue growth sector in the Baltic, although with the short season (mainly summer). Tourism combined with other activities including UCH (e.g. diving and walking trails), and offshore wind (e.g. boat tours for OWF sightseeing), provides additional and innovative tourism opportunities that could potentially sustain tourism sector all year round. Such initiatives could also provide an additional sustainable source of funding for the **underwater cultural heritage** (UCH) and environmental protection.

The environmental conditions of the **Mediterranean Sea** such as warm sea, mild winters and attractive coastal landscapes makes this sea basin one of the most popular tourism destinations in Europe and world wide. The continuous growth of **tourism** (Eurostat, 2017; Piante, C., 2015) is informing the diversification of the sector where local fishing communities and fishers see the increasing demand as an opportunity to have an alternative source of income. Fishers are using their boats to engage tourists in sustainable fishing, a touristic activity which is normally referred to as 'pescaturism'.

Environmental protection and conservation have been applied in some cases to ensure sustainable use of the sea and this has formed important MU combinations with fishing, tourism and underwater cultural heritage to advance and diversify these uses. **Aquaculture** is also an eminent traditional coastal sector (especially in Greece and Italy), often combined with tourism and environmental protection. **Underwater Cultural Heritage** (including objects, artefacts and traces of human life including ship wrecks, sunken ruins and cities) is also largely present and has a potential for combination with tourism activities such as diving. Another traditional sector in place is the **O&G** extraction (especially in the Northern Adriatic Sea). There are currently 20 O&G platforms in the Northern Adriatic planned to be decommissioned in 2020. Authorities are screening opportunities to re-use existing platforms after decommissioning for other purposes such as renewables energies (e.g. wind energy or hydrogen storage), or as logistic support for aquaculture devices and as tourism attraction site (e.g. marinas, gastronomic experiences, and diving).



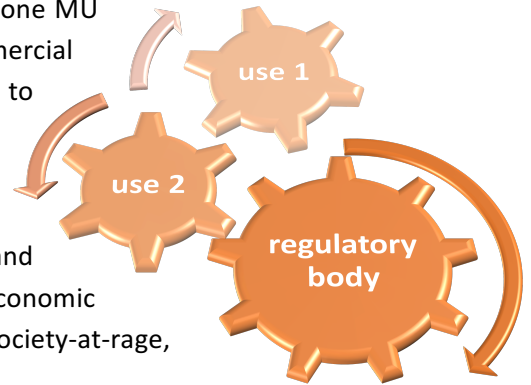
In the **Black Sea**, **environmental protection** and **tourism** are key sectors driving the MU development. The large number of environmental protection sites with rich and pristine marine environment attracts number of visitors. Governments in both, Bulgaria and Romania, provide economic and policy incentives for developing recreational and tourist activities that are in line with the environmental protection goals in these sites.

- The EU sea basins offer variety of MU opportunities depending on physical and environmental conditions and available resource;
- The MU combinations that concern the diversification of tourism and fishing sector in combination with sustainability and environmental protection goals are relevant in the Mediterranean, the Black Sea and the coastal areas of the Eastern Atlantic;
- Underwater Cultural Heritage MU combinations have strong potential in the Mediterranean and Baltic Sea and other environmental/conservation benefits of this MU have been realised;
- The North Sea and specific areas of the Mediterranean Sea (Northern Adriatic in particular) have the potential for development of innovative solutions for sustainable reuse of decommissioned O&G platforms;
- The North Sea, Eastern Atlantic and the Baltic Sea have strong offshore wind energy sector that could potentially develop further while also allowing growth in other relevant Blue Growth sectors such as tourism, fishing and aquaculture;
- Offshore wave energy can be combined with other energy sectors so that all energy sources at the given area are utilised. Or, it can be combined with aquaculture to support its operations.



### 3. ACTORS RELEVANT FOR THE DEVELOPMENT OF MUTI-USE

In general, the main actors to be involved in development of one MU are the representatives of two different uses usually commercial enterprises, and a public regulatory body. Therefore, for MU to happen, interest would need to come from at least two sides; both uses or one use and a regulatory body. The set-up of two sectors can initiate MU if the micro-economic benefits drive the co-operation (direct benefits to investors involved), one sector and regulator might start the MU in a situation of positive macroeconomic balance or (indirect benefits to investors and wider benefits for the society-at-large, with externalities included)<sup>6</sup>.



In certain cases, support for MU can be found in **key policy documents**<sup>7</sup>, maritime strategies and plans or other strategic documents (Przedzimirska, J., et al. 2018). However, further coordination between actors responsible for alignment of policy with its implementation mechanisms seem to be needed. Policy developers are therefore identified as responsible intermediaries that can communicate opportunities and bring together sectors relevant for the MU development. At the **project level**, unclear licensing and insurance implication, lack of planning and specific financial incentives targeting the MU, act as main barriers hindering the commercial advancement of MU concepts.

Certain **regulatory documents** support MU concept implementation, however, especially in relation to 'hard' MU solutions that involve energy sectors and the use of fixed (or floating in a single place) offshore structures (e.g. OWF and aquaculture), the power balance between the two sectors have been insufficiently addressed to date. This is especially the case at the operational or licensed stage. Namely, it is problematic to allow another use in the existing concession zone of offshore renewable energy infrastructure because investors of such projects did not factor in such cost and actions at the planning or initial stage and are unlikely to allow for it at a later stage. In general, the drive for such MU would need to come from policy developers and regulators by taking into consideration the limited capacity and power of the second sector to initiate such MU.

In a number of instances, business community was found to be interested in MU development. However, they have low power to affect regulatory and economic challenges. The role of clusters, network and other intermediaries is very important in fostering public-private cooperation between sectors and addressing such challenges. For example, the **French Maritime Competitiveness Cluster** fosters public-private synergy and innovation (Actions of the CMS: Corporate Communication, Operational Synergies and Lobbying). The Cluster also provides a **"label of excellence" to support projects with high innovation potential including MU initiatives** (Cluster Maritime Français, 2015). The label stands for good innovation, novelty of the project, feasible economic results and sustainability.

<sup>6</sup> Concluded after the workshops discussion and interviews with stakeholders

<sup>7</sup> The MUSES report (Przedzimirska, J., et al. 2018) provides a list of key policy document supporting the MU concept



## Actors identified in past and ongoing Multi-Use projects

It is essential that the dynamics of actors and stakeholders who have previously been involved in MU projects is understood to indicate who might be needed for and interested in supporting the MUSES Action Plan development. The following findings present an EU wide analysis of over 600 stakeholders (including 26 attendees of the first MUSES stakeholder workshop and almost all 195 MUSES interviewees<sup>8</sup>), undertaken for the **Stakeholder Profiles** report (Lukic, I. et al., 2017). The actors and stakeholders identified as part of the analysis were to some extent actively involved in MU development in Europe, be it for commercial projects or research purposes. However, it must be noted that these might not represent all stakeholders that are relevant for MU development, and a more thorough analysis will be needed at a MU project/site level to understand the local situation.

Most of the analysed stakeholders were involved in publicly (EU) funded projects, focused on engineering/concept design MU solutions involving some form of energy generation (i.e. FP 7 projects focusing on multi-purpose platforms). Thus, finding information about actors involved in these projects was easier in comparison to identifying stakeholders for the softer multi-use options (e.g. pescatourism), for which less EU wide projects have been implemented so far.

Research institutes and commercial enterprises were often in a lead role, while clusters and associations, and policy makers are in a large number permanently involved as 'associated partners' or part of the 'advisory board'. While technology and engineering are largely involved as partners, they are not so often engaged as stakeholders (interviews and workshops) in other projects. On the other hand, those working in the environmental field are more often in the stakeholder role than being part of the project partnership itself.

According to the analysis done for the Stakeholder Profiles report, most of the actors extensively involved in MU projects (be it research or commercial) are in the North Sea and in the Eastern Atlantic. This corresponds to the geographic scope of funded projects, as well as the fact that such engineering MU solutions are of most relevance in these sea basins. Germany had the highest number of actors extensively involved, followed by Spain and the UK.

**MUSES project have conducted 195 interviews** with relevant actors, from the Medierranean Sea (53), followed by Baltic Sea (48), North Sea (38), Eastern Atlantic (37), Black Sea (19) (Przedrzymirska, J. et al. 2018) to acquire MU perspectives from all sea basins.

Given that most of these projects focused mainly on combinations with some type of ORE, most of the actors who have been involved, come from the energy sector. On the other hand, MUSES have made extensive effort to also target soft MU actors and analyse solutions and actors from all the relevant fields, as well as cross-sectoral policy and regulatory bodies. For example, in the Black Sea, the most relevant stakeholders are the representatives of the environment sector, followed by fisheries and cross-sector. These are also the two driving sectors for MUs in the Black Sea. However, tourism sector has been so far underrepresented in past projects while many opportunities identified in the Black Sea are related to the tourism activities. Therefore, the MUSES project extensively involved the tourism sector in the Black Sea.

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<sup>8</sup> The interview cut off data was after this analysis was undertaken



- The concept of MU is still relatively new and has been mostly advanced by research institutes/commercial enterprises as represented by the numbers involved in the stakeholder analysis;
- To advance MU development further, public regulatory bodies including sectoral and/or cross-sectoral regulators and/or policy makers need to be more involved to act as facilitators to drive MU. Among other, this involves development of a facilitation policy that could tackle this topic, both at the strategic level and project level;
- It is important that engagement and research projects on MU identify and target actors for 'soft' combinations (i.e. fishing and tourism) to give them visibility as currently there is bias towards actors involved in energy and 'hard' MU (such as offshore wind and aquaculture);
- It is also necessary that research projects, engagement and targeted support for MU involve actors in other sea basins such as the Mediterranean, Black Sea and the Baltic as they were less represented. More knowledge and content from such areas would also advance MU;
- Recognising this need at the early stage, MUSES project engaged stakeholders from 'soft' combinations and from all EU sea basins.



## 4. MULTI-USE COMBINATIONS WITH OFFSHORE ENERGY

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Offshore renewable energy (ORE) has had strong policy drivers at the EU level and this has informed various national agendas. For example, the EU Renewable Energy Directive (European Commission, 2009) requires the EU to fulfil at least 20% of its total energy needs with renewables by 2020, to be achieved through the attainment of individual national targets. The economic, financial and planning incentives backing the renewable energy sector, especially OWF, contributes to its rapid development mainly in the Eastern Atlantic, North and Baltic Sea. MU combinations with offshore wind are driven by two main factors:

- **Spatial efficiency:** This driver is dominant in countries with a small sea space, or where only a small portion of sea space is still available for use due to extensive existing OWF infrastructure. Identifying possible synergies and combining different sectors in a multi-use concept is considered as an option for both sectors to develop and contribute to the Blue Growth targets.
- **Maximizing the economic benefit that can be derived from a given space:** This is a dominant driver for combining with wave energy in the Eastern Atlantic (UK) and the North Sea (NL, UK, DK, DE), and western Mediterranean (FR).

This chapter discusses four MU combinations with OWF component including:

1. OWF and aquaculture
2. OWF and tourism
3. OWF and fisheries
4. OWF and wave

The chapter also presents three additional MU combinations that involve the ORE sector. However, these MUs have been found to be relevant only in certain locations which were examined as part of MUSES case studies.

1. O&G decommissioning (Italy – Northern Adriatic)<sup>9</sup>
2. Wave and aquaculture (UK – Western coast of Scotland)<sup>10</sup>
3. Ports and green energy (UK – North Sea, E Atlantic)

From a **technological perspective**, there are two possible concepts for the combination of the ORE sector and another use:

**(1) Direct attachment of installations i.e. attachment of wave devices, fish cages or mussel long-lines to offshore wind turbine foundations or development of a new infrastructural solution, fully integrated multi-purpose platform.**

Application of such concepts requires that new engineering solutions are proposed already during the pre-planning phase of the OWF development. However, there is no commercial experience with such projects to date, no applicable safety and construction standards which implies unknown risks and high insurance premium. The feasibility of this MU scenario is very low for OWFs which have

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<sup>9</sup> This combination has also been partially explored in the North Sea. However, no comprehensive interview took place, as the main focus was on other combinations.

<sup>10</sup> This combination was also considered to a certain extent in the Baltic Sea (DK) and in the Mediterranean (MT).





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moved pass the planning stage or already in operation. Maritime licenses are given only to a specific use and technology, and in general cannot be revoked. Therefore, this concept is applicable only to OWFs in a pre-planning stage (before licenses have been granted) (Buck, B. H., 2107).

## (2) The co-location of installations within the security zone of the ORE farm or a single device.

This MU concept is applicable to both, existing and farms in a pre-planning stage.

There is a huge potential for the application of such concepts inside OWFs already in operation or still in the planning phase. There are **multiple models of ownership and cooperation possible**, e.g.:

- sharing the offshore and onshore **infrastructure**;
- sharing necessary **operational expenses** like the joint provision of an active safety and emergency services;
- sharing of **work force** for maintenance or surveillance activities;
- combining/sharing **monitoring activities** (hardware and/or software) and/or sharing the **facilities on land**, additional revenue to tourism sector by developing ORE information centres and museums on land, etc.;
- **Positive effects from one use to another**, e.g. sheltering effect from the rough water conditions provided by the wave device to the aquaculture farm or the energy provision for aquaculture operations, design of the OWF providing a reef effect attracting certain fish species and benefiting the environment and fisherman.

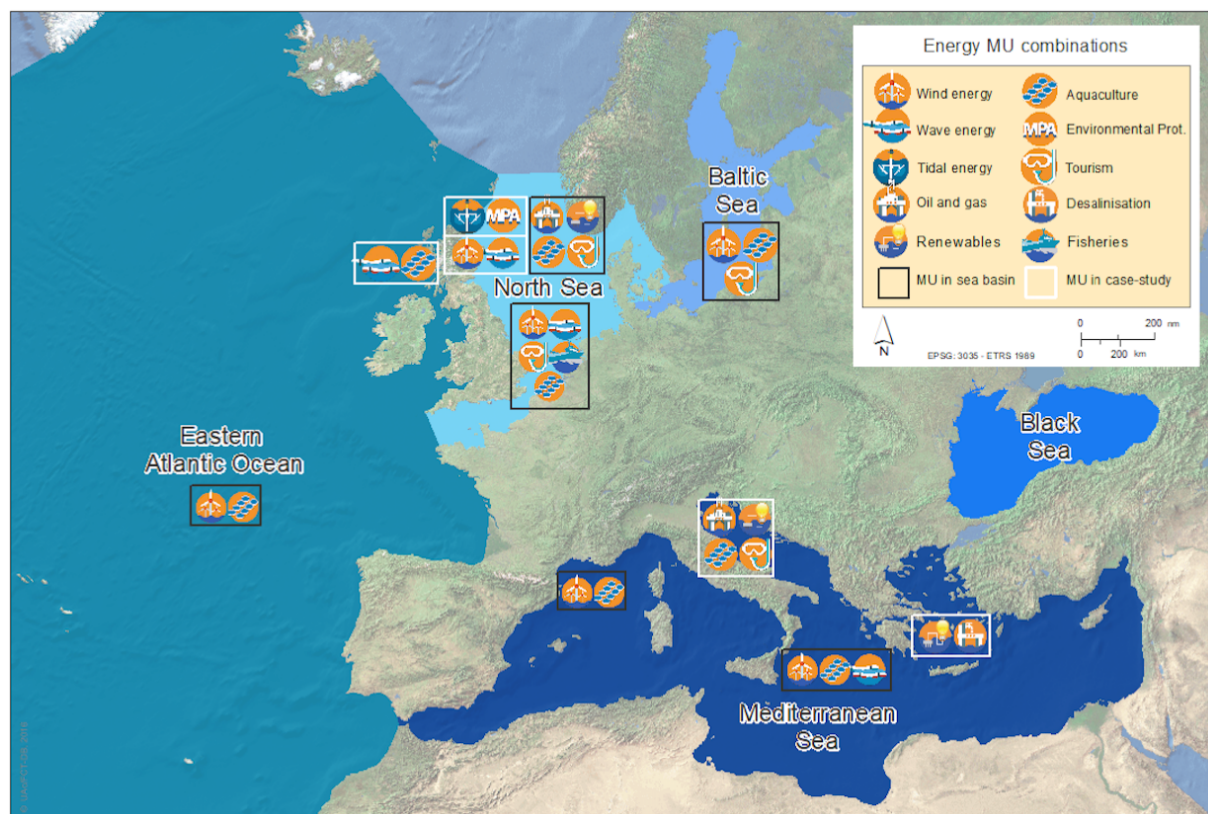


Figure 2. Location of the analyzed offshore energy MU combinations



The map illustrates MU combinations that have been identified and analysed in each EU sea basin. The geographic locations provided in the map is a provisional representation on sea basins scale where each MU have been examined and should not be considered as the exact geographical location. The discussions under each MUs gives further details about the location of the MU combinations.

## 4.1. Offshore Wind Farm and Aquaculture

### Overview of MU

### SEA BASINS & CASE STUDIES

The combination of OWF and aquaculture has mainly been led by the need to provide space and operational support for scaling up the aquaculture which is a key component of both the Common Fishery Policy (CFP) and Blue Growth Agenda. Moreover, the CFP requires each EU Member State to establish a Multiannual National Strategic Plan for the development of aquaculture activities (include the MSs' objectives until 2020 and beyond, and the funding, administrative and other measures to be pursued to achieve them). The current total objectives listed in the plans are for marine finfish aquaculture to increase production to 480,000 tonnes by 2020, a 60% increase, and to increase shellfish production from 550,000 tonnes to 680,000 tonnes by 2020, a 25%, compared to the current EU baseline (European Commission, 2016b).

To ensure that the growing gap (estimated at 8 million tonnes) between the level of consumption of seafood in the EU and the volume of captures from fisheries (European Commission, 2013) is partly filled by environmentally, socially and economically sustainable EU aquaculture, funding is provided through the European Maritime and Fisheries Fund (EMFF) (European Commission, 2016a). However, the main challenge to enhancing production of all types of aquaculture is the lack of available space in inshore sheltered areas (Buck, B. H., 2107). One of the aims of national marine spatial plans is to address this challenge; reduce pressure on sea space and resources (European Commission, 2014). MU concepts of OWF and aquaculture have been explored in order to address this challenge. However, this combination has not been established on a commercial scale in any of the MS although EU funded projects have played a major role in conceptualizing this MU. Pilot projects and theoretical case studies have been conducted to examine a number of aspects affecting the feasibility of this combination. To date, the North Sea and the southern Baltic Sea have had the most pilots in the real environment.

Aquaculture is a hugely diverse industry (Table 1), and environmental impacts cannot be generalised across the sector. Impacts vary with species, farming methods and management techniques, precise location and local environmental conditions and wildlife (European Commission, 2016c). In general, extractive aquaculture (seaweed and bivalves) are considered low maintenance aquaculture as they require less daily intervention than fish aquaculture, and as such are more suitable for combination with OWF.





By water type:	This is mainly a distinction between <b>marine</b> and <b>freshwater</b> aquaculture. Marine aquaculture can also take place in brackish waters, where sea and freshwaters mix, as well as on land (e.g. in tanks)
By species type:	Species can be classified as ' <b>n sh</b> ' (such as salmon or carp), <b>shellfish</b> (which includes bivalves, such as mussels, and crustaceans, such as prawns) or <b>plants</b> (such as seaweed or watercress).
By intensity:	In <b>intensive</b> aquaculture, managers supply the cultured species with all their feed. No feed is provided in <b>extensive</b> aquaculture as feed comes from the natural environment. In a <b>semi-intensive</b> system, managers supplement natural sources of feed.
By water flow:	In a <b>closed system</b> , such as a tank or enclosed pond, water is contained and may be tightly controlled and recirculated. In an <b>open system</b> , such as a sea cage, water from the natural environment flows freely through the farm. In a <b>semi-closed system</b> , some water is exchanged between an enclosed site and the natural environment

Table 1. Aquaculture operations broadly grouped by certain characteristics (European Commission, 2016c)

## Selection of existing cases and good practices

A number of EU wide and national projects have explored this combination and have considered different aspects from theoretical conceptualisation and suggestion of suitable technological solutions, to more detailed business models examining interaction between the two activities in terms of operations and maintenance, and identification of the most suitable type of aquaculture for the given site. However, the **following cases are just a selection**, given that in some countries, such as Germany, the Netherlands and Belgium, there is a large number of national projects on this topic as listed by Zaucha, J. et al (2016).

In the **North Sea**, in Belgium, existing cooperation between research institutes and relevant commercial actors play an important role in developing this MU. **EDULIS**<sup>11</sup> is an ongoing pilot project largely financed by private funding and facilitated by Flemish and EU funding, that studies the feasibility of mussel cultivation in two wind farms; C-Power (27 km from the coast, operational since 2013), and Belwind (46 km from the coast, operational since 2010). **Colruyt Group** is one of the partners in this project and also a major shareholder in one of the OWFs with an interest to develop local aquaculture products for retail business. The focus of the research is to measure the pressure that mussel longes will have to withstand and to what extent this form of farming is economically and ecologically sustainable. The first mussel culture system was put in place in spring 2017 and the project results are expected in two years.

In Belgium, combination of integrated aquaculture with the existing wind farms has also been of interest. The **Value@sea project**, a small-scale pilot project, implemented at the Westdiepzone near the coast at the Nieuwpoortbank, aims to test the technical, ecological and economic feasibility of integrated forms of aquaculture (oyster, scallop and sugar weed) within the OWF. The project will

<sup>11</sup> More about the project available at: <https://www.ugent.be/bw/asae/en/research/aquaculture/research/projectsa>



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investigate different ways of cultivating the three different species, also considering the potential ability of certain species to improve the water quality (bioremediation). The project started in 2017, and results are expected in the following two years. However, the size of the OWF and space available for the aquaculture should be large enough to support a profitable aquaculture module. While the scale of economy for mussel aquaculture cannot be reached due to limited space in Belgium<sup>12</sup>, the knowledge can be used and exploited in other countries.

**SOMOS**<sup>13</sup> is an ongoing pilot project in the Netherland that is investigating the potential for wind energy production in combination with **seaweed cultivation** for food, feed, bio-chemicals, energy and other valuable products. The initiative is funded by the Lloyd's Register Foundation and led by the Wageningen University & Research. In conjunction, with relevant authorities, certifiers and operators, the project is aiming to develop a methodology for assessing risks for this MU, in terms of food safety, food quality, food security, employee health risks and environmental pollution.

In the UK, trials were performed by **Deepdock Ltd**, a UK mussel cultivator, within the North Hoyle OWF (RWE) in 2010 to investigate the potential for successful mussel aquaculture within an OWF (Syvret et al., 2013). The activity involved seabed ranching/cultivation; the growth and subsequent harvesting of mussel spats collected from the wild and placed in the OWF. After successful trials, further development is expected to take place in existing and future OWFs in Wales, west England and west Scotland.

In the **Baltic Sea**, MUSES project undertook an in-depth analysis of this MU as part of the case study in Sweden (Franzén, F., et al., 2017), conducted for the **wind park Bockstigen**, situated approximately 4 km outside Burgsvik. The case has shown that longlines for mussels grown for fodder for poultry of fish farms are the most promising type of aquaculture in the OWF. However, economic factors seemed to be very influential for the contacted stakeholders (mainly local entrepreneurs or businesses in a rural area), suggesting that they may outweigh other positive factors which could play an important role. Despite interest in this MU at the given site, both offshore wind and aquaculture are businesses with low profitability and there are financial barriers for developing a pilot case.

The **SUBMARINER project**, have previously examined this MU in the Baltic Sea and information from the project reports shows that test on the biomass potential was conducted from September 2012 to August 2013 in the Rødsand 2 offshore wind farm (Christensen, P.B. et al., 2013). This OWF is located in the Baltic Sea off the south coast of Lolland where 2 different net types were arranged one after another on a straight line between two wind mills at a water depth of 10 m. The nets were kept in position by anchors, a carrying line with buoys to keep them elevated and a weight line to secure the vertical position. The local wind energy company E.ON took charge of the installation of nets in collaboration with Kingfisher, Nexø Vodbinderi and Green Center. As the E.ON's boat was not suitable for sampling, local fishermen who showed interest in the project and provided smaller fishing boats for carrying out sampling during the test period. **More recent analysis by the MUSES project** in this location (Karlson, H.L., et al., 2017), highlights, lack of dialogue between the involved sectors and mismatch between the types and financial status of relevant stakeholders as the main challenges still stalling the development of this MU. All the interviewees felt that political trends should be backed by

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<sup>12</sup> Marine spatial plan in BE specifies only two areas where aquaculture is allowed (within Belwing and C-Power wind farms)

<sup>13</sup> More about the SOMOS project available at: <https://www.wur.nl/en/project/SOMOS.htm>



some form of motivation to find a “reason to go” and that none of them had any power to influence the decision makers alone. Involvement of regulators and push from their side in form of MSP and other policies that could provide support for pilot projects and provide guidance regarding the EIA and risk assessment was emphasized as highly relevant.

In **Kriegers Flak**, southern Sweden, close to the borders of the Danish and German exclusive economic zones (EEZ), feasibility of setting up fish farms (Atlantic salmon) and seaweed (*Furcellaria sp.*) was theoretically examined by MERMAID project (Pirlet, H., 2014). Given that the site is far from the nearest port, this combination was expected to provide benefits in terms of housing and transportation. The study concluded that the most effective way of combination with OWF is to have the fish farm on the downstream/outside of the wind farm – effectively in its shadow. However, major challenges including uncertainties in terms of operational interaction when combining these two uses, as well as concerns about the environmental impact of the large-scale fish farming.

In the **Mediterranean** France, **three pilot sites for floating OWF** have been identified in the Gulf of Lion, composed of 3 to 6 turbines (about 6-8 MW capacity per turbine; QUADRAN, 2017) and are planned to be operational by 2020 with potential combination with different types of aquaculture being considered (Guiraud, O., 2017).

In Cyprus, the research project titled: “**A smart feed management data tool for Cyprus**” has developed feed management system powered by a stand-alone renewable energy sources system that provides energy independence and mobility by wirelessly transmitting important parameters onshore. It is estimated that such MU has a profitable potential given energy independence of the feeding station, green energy provision and fish feed cost saved by a prior feeding planned through better monitoring of on-site conditions.

### Multi-Use characteristics related to different types of aquaculture

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**Shellfish** – Shellfish producers in the EU are predicted to increase their output by 30 percent, by 2030, while the current annual growth rate is just 1.3 percent (European Parliament, 2014).

In most of the MSs,<sup>14</sup> **mussel aquaculture** has been considered the most promising type of aquaculture for MU with OWFs. The North Sea (UK, NL, BE, DE, DK) and the UK Atlantic (Irish Sea) are the most advanced in examining different technological options for this combination.

There is limited suitable place for cultivation of mussels in the Baltic (only some areas provide suitable salinity levels for growing mussels suitable for human consumption e.g. in Danish Småland Sea, north of Lolland and Kiel, Germany). However, low quality mussels can be used as food for poultry and fish farms on land, although it is considered as less profitable. Combination with OWF in terms of infrastructure, operations and human resources could potentially lead to larger areas in the Baltic Sea for mussel-farming.

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<sup>14</sup> Out of all countries in the EU where this MU was examined



**FISH** – A 4% annual growth trend is anticipated for marine fish aquaculture (European Parliament, 2014). However, the expansion of **finfish aquaculture** with the OWFs raises environmental concerns and the MU combination has been estimated as least feasible in the Baltic Sea due to the already high level of eutrophication. During the last ten years, the production of fish aquaculture has been reduced because of the introduction of very strict environmental regulations. In the UK, aquaculture developers are investigating a move to '*further exposed sites*' (DEFRA, 2015). Combination with OWF is seen as potential opportunity to make this move feasible and profitable. Key policy documents in the UK are promoting combination of offshore renewable energy with fish aquaculture (DEFRA, 2015). While this MU is considered the most feasible in the North Sea and Eastern Atlantic, there are still many technical challenges, especially given the harsh offshore environment.



**SEAWEED** – Production of seaweeds is relatively new in Europe, but is expected to grow in importance, especially as part of the Integrated Multi-Trophic Aquaculture (European Parliament, 2014). At present, seaweed aquaculture is mostly undertaken by small businesses, harvesting the microalgae closer to shore for culinary purposes, or as food supplements. These businesses are primarily harvesters of seaweed and often have no commercial interest in expanding activities to seaweed growing. The seaweed is harvested to be put to use in a variety of ways, primarily including alginate (i.e. thickening agent), soil fertilizers, cosmetics and nutraceuticals (dietary supplements), especially for livestock foods. Seaweed is also being harvested as biofuel.

The combination of OWF with seaweed cultivation has mainly been considered in the North Sea. Existing seaweed farms in the EU are still at a very small scale, or in a pilot stage. This implies a very limited investment capacity of the sector while such MU developments would require considerable investments for the advanced technological solutions. To allow for good growth seaweed farm needs to be placed in the areas with fresh water river inflow which implies that there are limited suitable areas for this activity.

In 2013, Wageningen University published the research paper 'A Triple P review of the feasibility of sustainable offshore seaweed production in the North Sea'<sup>15</sup>. This study concluded that there is potential for seaweed cultivation in the North Sea, especially for the production of feed additives and chemical building blocks. However, in order for seaweed production in multi-use context to become feasible, the business case needs to be further developed considering economically viable value chain, different products that could be derived from seaweed and potential risks.



**MULTI-TROPHIC** - Integrated Multi-Trophic Aquaculture (IMTA) refers to the integrated farming of several species from different trophic levels in close proximity to make best use of space and to mitigate environmental impacts (Schultz-Zehden, A. 2012, Kleitou, P., 2018.). Given that it combines different types of maritime uses, IMTA in itself presents a MU. However, in this report IMTA has been explored in combination with the OWF. The SUBMARINER project (Schultz-Zehden, A. 2012) has extensively explored challenges and opportunities for IMTA and few pilots were developed in the Baltic Sea in order to assess productivity and potential impacts on the environment.

<sup>15</sup> Study available at: <http://edepot.wur.nl/276368>



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## Actors, Drivers and Barriers

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From the aquaculture sector side, the interest and engagement with MU varies across countries depending on the level of development of the aquaculture sector, and type of aquaculture. For countries where aquaculture is more developed, **aquaculture industry groups** (e.g. UK: Shellfish Association of Great Britain), and **individual farmers** (especially mussel and fish farmers), had a strong role in past trials and are expected to develop this MU further. Due to its overall low presence in Europe, individual seaweed businesses have so far had limited capacity for engagement with MU concept. **National research centres, universities and specialized consultancies** were the main driving forces in countries where aquaculture is not yet a strong sector.

The **offshore wind developers**, have shown high level of openness towards this concept, especially at the initial stages of the project planning and as an argument for easier licensing process. However, **easier licensing for OWF is still a very hypothetical driver**. According to interviews, in two identified examples, (Belgium and Sweden), the OWF developers showed interest in considering MU as a mitigation option (to reduce impact on local communities and fishers) when applying for the space license. However, in both cases, the authorities rejected license applications. The interest in, engagement with past concept development and trial projects of national OWF associations and research institutes have also been eminent.

In certain cases, support for this MU combination or aquaculture/OWF with other sectors can be found in **key policy documents** such as Multi Annual Aquaculture Plans, integrated maritime strategies and plans or other strategic documents. However, further integration of policy in other spheres to address challenges such as **unclear licensing and insurance implication**, and **lack of planning and financial incentives targeting specifically the MU** are needed to enhance commercial drive for such concepts.

Although certain policy and regulatory documents have been found to support this MU, the **power balance between the two sectors have been insufficiently addressed to date**. As a general rule, OWF operators of the already licensed or operational OWFs, where 500 metre safety zone applies after the OWF has been commissioned, have the priority over other potential MU users (aquaculture, fisheries). For example, the German Federal Marine Facilities Ordinance (SeeAnIV), allows for setting up aquaculture sites at already existing wind power installations, as long as the aquaculture site does not become an obstacle for the general maintenance. In general, project finance is acquired at a certain estimated risk level. This gives the OWF operators a de-facto veto right against any development deemed hindering or even detrimental to their activities in the area.

Belgium is specific in the sense that their available space is limited. As specified in the Belgium marine spatial plan, the only areas where commercial aquaculture activity can take place are in the wind farms C-Power and Belwind, areas of 18 km<sup>2</sup> and 19.84 km<sup>2</sup> respectively. For these projects to be realised the requirement is that: 1) eutrophication must fall or stay neutral 2) permission of the concessionaire is required. To allow another use in the concession zone at this stage is very problematic as **the financiers did not consider it in their initial decision and are unlikely to allow for it at a later stage**. Also, in general, the net financial benefit of an OWF sector to combine with for example a seaweed farm is very small for the added risk. **Aquaculture sector in the EU, on the other hand, has a much smaller investment capacity** to initiate this MU and take on any additional costs that



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could be required (adjusting technology, insurance premium, etc.). This lopsided power balance makes for a difficult transition from single to a multi-use.

There have been numerous efforts to develop technological solutions for such concepts by research institutes, engineering firms and other technology development organisations, mainly funded by the EU research funds. However, their implementation depends highly on **policy support and regulatory regimes in the given MS acting as 'supply push'**, as well as the **market and investors willingness to invest in such projects, 'market pull'**. While the technology might be viable (referring to the high technology readiness level), its **application depends on Commercial Readiness Level<sup>16</sup>** of such solutions. This implies that a deep understanding of the target application and market needs to be conducted, including

- a comprehensive cost-performance model created to further validate the value proposition;
- financial model built with initial projections for near- and long-term costs, revenue, margins, etc., and
- response to all certification and regulatory requirements in the given location.

### Aquaculture in the Baltic Sea

In the Baltic Sea, development of the fish aquaculture is very limited due to strict environmental regulations, given the already high levels of the eutrophication in the Baltic.

On the other hand, the ability of extractive aquaculture (mussels and seaweed) to take up nutrients has been of interest. The theoretical calculations of yearly biomass production (mussels and seaweed) in the Rødsand 2 offshore wind farm off the south coast of Lolland imply that considerable amounts of nitrogen could be reduced with this activity, potentially contributing to the lower levels of eutrophication in the Baltic (Schultz-Zehden, A., 2013).

To highlight the potential of mussel farming in the Baltic Sea, a pan-Baltic map on viable regions for mussel growth (salinity > 5psu and chlorophyll > 1µg/l) is being developed by the **Baltic Blue Growth<sup>17</sup>** project partners will be available in April 2018.

Due to salinity and water dynamics in the Baltic Sea, in most cases, mussels do not become big enough for human consumption, but may be used for fodder for poultry of fish farms.

<sup>16</sup> More information about the Commercial Readiness Level available at:

<https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKEwiliYX7ysHaAhWLLFAKHXYiAQ4QFggzMAI&url=https%3A%2F%2Farpa-e.energy.gov%2Fsites%2Fdefault%2Ffiles%2Fdocuments%2Ffiles%2FARPA-E%2520Tech-to-Market%2520Plan%2520Instructions%2520%2526%2520Template%2520Nov%25202012.docx&usg=AOvVaw373CtzzwqHwL1zS8akfk7j>

<sup>17</sup> More about the project available at: <https://www.submariner-network.eu/projects/balticbluegrowth>



## General Conclusions

- This MU can potentially provide significant benefits to the aquaculture sector, and indirect benefits to offshore wind energy developer. In case there is no direct economic benefit for each single sector, but the combination can provide wider societal benefits (sum of benefits per square kilometer is larger than that of single use in the same given area), then there is the need for government to intervene to drive the MU;
- Currently there is no facilitation policy to drive this MU at a strategic and project level. The role of regulators in driving MSP and other policies that could provide support for pilot projects, provide guidance regarding EIA and risk assessment was emphasized as highly relevant;
- This MU could enable aquaculture to be developed at locations where it otherwise could not be developed on its own (i.e. far offshore or rough sea conditions). Hence, it can foster spatial efficiency, reducing conflicts in coastal areas, reduce environmental impacts (water quality and visual impacts) by moving aquaculture activities further offshore;
- The establishment of this MU is capital intensive, while the aquaculture sector in the EU has a low investment capacity. Therefore, involvement of regulators and policy makers is crucial to enable any real development. The power imbalance between the two sectors need to be sufficiently addressed to enable the development of the MU.





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## Main Actors, Drivers and Barriers of the OFW and Aquaculture MU

### EU/Sea Basin Level

✗ Lack of information about impacts from aquaculture

### National/Local Level

✗ access to site and immediate O&M is a priority

✗ no proven nor assessed commercial benefit – hypothetical

✓ potentially easier permitting - hypothetical

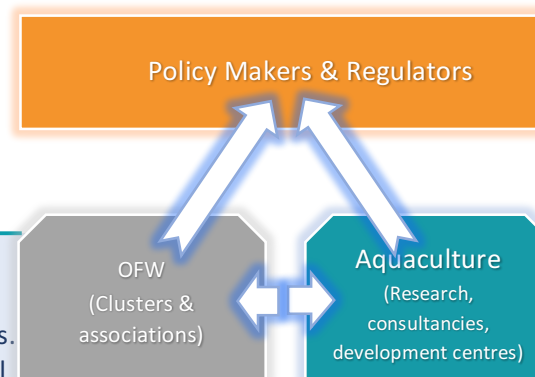
✓ interest in additional revenue (mainly where OWF expansion as such is not possible – e.g. Sweden Bockstigen OWF)

### EU/Sea Basin Level

✗ Environmental concerns

✓ sustainable development & spatial efficiency (e.g. WestMed strategy)

✓ due to reef+sheltering effect there is an opportunity for restocking of certain fish species (i.e. turbot, sole)



### EU/Sea Basin Level

✓ EU and Sea Basin level funding (EMFF, INTERREG, etc)

### National/Local Level

✗ low investment capacity for expanding the scope of their business to a multi-use construction (\*local actors EU scale barrier).

✗ uncertain insurance premium implications  
✗ uncertain safety issues due to lack of pilots testing different aquaculture technologies and modes of cooperation with OWF

✗ long waiting time for OWE licensing  
✗ OWFs are usually >10km out from the coast implying more expensive day-to-day operations for the aquaculture

✓ expansion of the aquaculture offshore (beyond 12nm) and to areas with high productivity (i.e. within existing OWF zones)

✓ potential cost reduction - hypothetical

The main driver for this MU is spatial conflict/efficiency, the potential for sharing the costs and scaling up the aquaculture further offshore, this way satisfying the high-level policy goals for both sectors. While some technological concepts have been developed, this MU still faces number of barriers related to its commercial employment including regulation (especially related to the environment), funding (limited funding schemes apart from the public support i.e. EU and specific national fund support) and implications derived from interactions of these two uses at the site (combined cumulative effects, health and safety, synchronisation of operations). In general, the push would need to come from the policy and regulators side taking into consideration in general low power of the aquaculture sector to initiate such development, involving large capital investments and long-term perspective.





## 4.2 OWF and Fisheries

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### MU Overview

### SEA BASINS & CASE STUDIES

Despite significant benefits from new OWF projects, including contribution to national and EU renewable energy targets, spatial conflicts with fisheries as traditional users of the seas is usually a concern. Both offshore wind farms and commercial fisheries seek access to locations, which share the same physical characteristics (e.g. shallow areas, specific depth ranges, sediment types, proximity to coast, etc.). Not only that fishers are often concerned about the issue of exclusion, but this also raises concerns about range of direct and indirect, positive and negative, economic, social and environmental effects on individual fishers, the fishing industry, fishery-dependent coastal communities and wider society (Kafas, et al., 2017).

Different regulations apply to OWF exclusion zone during the development stage, as well as after the OWF commencement, directly affecting certain type of fisheries. This combination is mainly of relevance in the North Sea. In some countries (NL, DE, BE) fisheries are displaced due to  $\geq 500\text{m}$  safety zones during the OWF operation.

The current practice of OWF does not allow for multi-use as cables are not dug underground, for which bottom stirring (majority of total commercial fishery) is not possible. One important issue is, therefore, to design future OWFs in such a manner that it allows for commercial fishery. Here lessons can be drawn from OWFs in the UK and France, which have to take account of other forms of use and hence, in these countries cables are put underground.

However, OWF developers have been active in the initial stages of the project planning to explore opportunities for combination/interaction with fishing sectors. Apart from **sharing space**, interactions may also include **access to the same pool of human resources** (e.g. access to technical staff), as well as **infrastructure and other technical resources** (e.g. vessel access, port facilities). Moreover, **emergency systems and protocols**, as well as **monitoring systems** can also be integrated (Schupp M.F., Buck, B.H., 2017).

The combination of OWF and fisheries is relevant in all the MSs where OWFs are present or possible in the future. However, the MUSES project only explored this MU in detail as part of the case study analysis in German North Sea and Scotland.

### Selection of existing cases and good practices

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In **Belgium**, a study was carried out in 2011 to investigate the feasibility of fishery and aquaculture in and near OWFs. Fishermen who use passive fishing methods were allowed to fish in OWF zones under strict legal conditions. Many fish and crustacean species e.g. seabass, crab and lobster are expected to increase in these zones and can be caught by a small-scale passive fishing method without impacting the sea floor.

There is considerable interest in the value of turbine bases, and any scour protection material, as artificial reefs for attracting commercially targeted and other marine species (Van Koningsveld M., 2017). There may be opportunities to maximise any fisheries value through the use of specific base



designs or through the use of greater quantities or specific designs of scour material (Blyth-Skyrme R.E., 2010).

In **Germany**, fisheries do not have assigned priority areas under the German MSP due to the high spatial variability of their fishing grounds. These special considerations have to be taken into account by users and permitting authorities during the permitting process of OWFs according to the ordinance on offshore installations (SeeAnIV2)<sup>18</sup>. The German MSP recognizes that fisheries cannot easily be restricted to certain priority areas and therefore grants fisheries special considerations, but not rights, inside other uses' priority areas. Fisheries should not hinder nor endanger construction, operation or maintenance of the OWF (BMVBS, 2009). This provision, though legally binding, does not yet compel multi-use. This has led to a state in which fishing operations, whether active or passive, are de-facto not permitted inside the security zone of OWFs.

The displacement of fishermen, often small scale or family run enterprises, from these priority areas causes them to have to move farther offshore, increasing their costs of operations to maintain the same catch levels, threatening their livelihoods.

There is, however, growing pressure from the fisheries sector about changing the status quo and this argument has recently reached the public discourse (Nicolai and Wetzel, 2017). This multi-use combination has also already been the subject of past and future research projects in Germany (e. g. COEXIST). Nonetheless, there is a clear power disparity between the two users in that, even though the fisheries sector has a long tradition in the structurally weaker coastal communities, the wind energy industry has much larger operations and profit margins while employing a significant number of people across Germany. Due to the increasing pressure from multiple stakeholder groups, regulators and users alike are also now considering this MU in the German North Sea EEZ.

The barrier perceived as the most relevant in the German North Sea EEZ stemmed from the perceived risk of fishing operations within the windfarm and the resulting need for prohibitively high insurance costs. Another important barrier is the need to integrate other users into established health, safety and emergency concepts while they are operating within the windfarm. This can prove to be problematic since those concepts are different from operator to operator and integration could only be attempted on a case by case basis at the current point. The negative impact of this multi-use combination is that with the permitting of fisheries inside offshore windfarms the de-facto fishing free zones and any possible environmental benefit they might possess will be lost. It is, however, important to note here that this potential environmental benefit of a fishing free zone inside windfarms is not recognised or stipulated in the relevant laws (Schupp M.F. & Buck B.H., 2017).

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<sup>18</sup> More about the standard available at: <https://www.jurion.de/gesetze/seeanlv2/>



**The following conclusions were derived from the MUSES case study (Schupp M.F. & Bela, H.B., 2017) which examined drivers and barriers of combining the OWFs and fisheries in Germany (North Sea):**

- Germany is lacking frameworks for multi-use cumulative impact assessments (CIA) to assess (1) the environmental and (2) socio-economic effects (positive or negative) of multi-uses.
- Within this framework, a clear structure for responsibilities (conducting assessments and providing data) needs to be established between regulators and users.
- Multi-sector SEA need to be conducted by regulators during strategic planning stage to identify best multi-use locations and combinations.
- Pre-existing data (e.g. catch and fleet statistics, spatial information etc.), if accessible, can often act as a starting point for socio-economic impact assessments of multi-use combinations but needs to be supplemented by further studies on effects of e. g. fisheries displacement.

In **Scotland**, commercial fisheries (especially static gears) and OWFs are considered compatible and colocation of their activities is possible. Furthermore, the policy framework in Scotland and the UK as a whole encourages the reinstatement of commercial fishing activity, after the construction of a wind farm. The lessons learned from Scotland regarding combination of fisheries and offshore wind, have been presented in one of the MUSES case studies<sup>19</sup>. It is argued that these are easily transferable to a number of other multi-use locations around the UK, North Sea and other EU sea basins.

The Scottish case study has concluded that there is a great value for society and local economy for enhancing this MU combination. Added values include better use of marine space, positive contribution towards food security, promotion of longevity of the fishing industry, support to fisheries management, engagement of the fishing industry to the scientific world, building of trust with local fishermen, innovation in fishing methods as well as in offshore wind foundations, installation methods, protection measures etc. Moreover, environmental benefits include potential for artificial reefs enhancement by providing protected habitats for marine species, as well as the provision of nurseries and sheltered areas contributing to strategic fisheries management as marine protected areas, if carefully placed. However, consultation issues are estimated to be the strongest barriers to this MU. Identified Issues are related to the consultation timing, frequency, insincere support, governance structure, representation, power imbalances, attitudes, and conflicts of interests.

**According to the Scottish Case Study (Kafas, A., 2017), it is possible to strengthen this MU. Interviewees mentioned various avenues for potential extensions, including:**

- Enhancing the artificial reef effects. Wind turbine foundations can be engineered to host marine life or foundations can be further enhanced with additional rock armouring around their base. There was particular reference to crustaceans, specifically lobster hatchery;
- Supporting the establishment of alternative fishing practices targeting new species within OWFs. Furthermore, developers can subsidise marketing costs to support the niche markets;

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<sup>19</sup> Kafas A., 2017. MUSES Case Stud 1A: Offshore wind and commercial fisheries in the East coast of Scotland. MUSES Deliverable D.3.3



- Offering of services/benefits from the offshore wind to the fishing industry as a mitigation measure for cases obstruction. This may include covering costs for certification/ labelling of sustainable fishing practices, new safety equipment, electrifying energy intensive processing plants, providing electricity to fishing vessels (linked to a long-term vision of hydrogen-fuelled transportation), or funding scientific research (e.g. fisheries stock assessments, gear modification studies, audiograms of fish species to aid in environmental assessments);
- Combining OWFs with other activities, such as offshore storage in the form of hydrogen might eliminate OWF export cables would eliminate fisheries-cable interactions.

### Actors, Drivers and Barriers

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The major driver for this MU is the need to ensure spatial efficiency and ensure the livelihood of fishing communities are still maintained and fishers are not displaced during the certain stages of OFW development. Since, OFW turbines and its immediate surroundings act as valuable fishing grounds, combining fishing activities with OWF provides socio-economic benefits.

In the North Sea, the co-existence in the context of sharing of space of the two activities is set forward by the policy framework only in few occasions (e.g. UK, where fishers are excluded from OWF areas only during construction and maintenance). However, key stakeholders (commercial fishers) mention that although the policy framework may promote co-existence, safety of operations concerns (navigation hazards) associated with fishing within OWF areas might prevent them from fishing therein.

However, major barriers in the North Sea include limited access of fishers to OFW sites during operations especially in countries like Germany, Netherlands and Belgium. Another barrier at a sea basin level are the issues of safety of fishing operations within the windfarm and the resulting financial and insurance cost involved. Regulators are important actors in promoting this MU especially by pushing the adoption of clear regulatory guidelines and policy that promotes coexistence.



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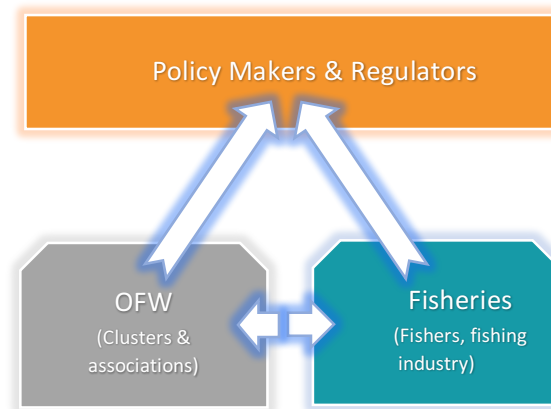
## Main Actors, Drivers and Barriers of the OFW and fisheries MU

### National/Local Level

✓ OFW turbines act as fish attracting devices due to the special ecosystem their foundations offer, increasing the available biomass in their immediate surroundings and creating valuable fishing grounds.

✗ Certain fishing methods (i.e. dredging) might damage cables connecting turbines in Netherland and Germany

The need to access marine space with similar physical characteristics drives the need to ensure coexistence and spatial efficiency between these two uses. The socio-economic driver behind fishers accessing OFW site which acts as valuable fishing grounds forms a MU. However, barriers such as limited policies and guideline that supports coexistence and safety/insurance issues related to accessing OFW calls for the role of policy makers and regulators to advance this MU



### National Level

✓ Need for spatial efficiency to maintain livelihood especially in coastal communities

✗ Risk of fishing operations within the windfarm and the resulting need for prohibitively high insurance costs

✗ Limited integration users such into established health, safety and emergency concepts while they are operating within the windfarm

### National Level

✗ Currently, no sailing is allowed in near distance of wind farms in the Belgium and in Netherlands vessels are allowed to transverse but not fish

✓ Policy framework in UK promotes co-existence as an exclusion zone is not set for OFW farms. Fisheries is being awarded special considerations by the German MSP inside the priority areas for Offshore Wind Farms

✗ Integration into existing Health and Safety Concepts of operational OFWs is too complex and would currently have to be solved on a case by case basis



## General Conclusions

- **Regulatory implications differ across countries, and therefore stages of integration are also different.** While in some countries (e.g. UK), multi-use of sea space is already taking place and discussions are on-going in relation to innovative ways for integration, in other countries (e.g. Germany) unknown effects and regulatory aspects are still a major barrier. In Belgium, exceptions to regulations have been made to facilitate several experimental research projects for this MU to gain more knowledge about the implications to the environment;
- **Environmental impacts and safety risks of fishing within the wind farms are also perceived differently by involved actors (authorities, developers, fishers) across countries<sup>1</sup>,** serving as the major argument for setting different regulatory frameworks;
- **Difficulties during consultation process by the offshore wind energy developers** with the fishing sector appears to be an important factor stalling the advancement of this MU as shown in studies. In some cases, stakeholder perception was that most of the consultation exercises are undertaken only because it is a legal requirement to do so, timing and frequency is varying, and it was perceived that in some cases there may be no sincere drive to reach any kind of mutually beneficial agreement at meetings. This, coupled with weak representation of fishing interests, power imbalances between the sectors and overall cautious attitudes has caused many discussions of MU to be derailed;
- **Current role of mitigation strategy, EIA and potential for addressing MU during the SEA process and in maritime spatial plans.** Basis of the mitigation hierarchy is “avoid, reduce, remedy”. On the basis of fisheries existing in an area e.g. New-shore areas in Scotland, the first policy would be to maintain sea access for fisherman. If not possible, then options to compensate this by establishing a complementary activity, like an aquaculture (not finfish) would be explored. This is tackled via the EIA process and the aquaculture sector hopes that the offshore wind sector can meet their expansion plans. This would be tackled by SEA process and future marine plans that would be multi-use plans;
- From a macro-economic, socio-economic and food security side, treating aquaculture as mitigation for the loss of the food producing fisheries sector, could be a suitable option. Exclusion of the bottom species fishery is always the case e.g. clam fishery. However, aquaculture is rarely considered as a mitigation for the loss of fisheries and acceptance of this idea by the fishermen is generally low. In Germany, this is mainly due to following:
  - Structure of fishery companies is mostly small scale and they lack the necessary financial resources or planning security to set up costly marine aquaculture ventures;
  - Aquaculture requires a completely different business model and know-how on the technical and biological sides of the business as compared to fisheries.



## 4.3 OWF and Tourism

### MU Overview

### SEA BASINS & CASE STUDIES

OWF and tourism results from the multi-use of shared sea space, on and offshore infrastructure and operational activities (e.g. surveillance and data collection). Tourism activities in relation to the OWF can be developed in several ways busting innovation and entrepreneurship. This includes on and offshore information centres, combined on and offshore tours, mobile exhibitions, observation platforms with telescopes, helicopter flights around offshore wind farms, specially designated areas/facilities for divers and sailors in the vicinity of OWF, offshore restaurants and promotional products<sup>20</sup>, artificial ground for sightseeing offering information for the wind park and the potential for watching seals, art at the monopiles, potentially in combination with light and/or water shows. Moreover, diving around the OWF, 'hunting or treasure' is an up and coming trend in Denmark. This MU can provide important benefits to the local communities in terms of job opportunities and new sources of recreation. In some rural (or declining population/slow economy) areas, increased number of tourists would benefit other local services, like restaurants and gas stations to sustain them in the area. A number of studies show that initiatives that combine OWF sector with tourism and education, have positive effects for public acceptance (Wizelius, T., 2007).

### Selection of existing cases and good practices

In the **Baltic Sea, Sweden, Denmark and Germany**, boat tours and information centres on land are to a certain degree common social outreach strategy of the OWF sector for obtaining social acceptance, and improving their corporate social responsibility. These also show the readiness of OWF developers to increase interest in, and provide support to, additional activities at the OWF site. However, the OWF sightseeing tours are currently not organised on a permanent and commercial basis. The public interest in these types of initiatives is high, as long as the attraction is on land or close to shore. Boat OWF visiting tours that go further offshore and take long hours usually need to provide an additional 'kick', to be attractive for a wider market and to be able to charge the high price (determined by the long working hours and fuel consumed). Suggestions on how to make OWFs more attractive for tourists include OWF light show, innovative design of an OWF<sup>21</sup>, or storytelling on board. Nevertheless, a good weather is a precondition for such tours.

The role of partial private ownership and reinvestments is also relevant as shown in **Sweden** and **Denmark**. Blekinge Offshore Company, founded to build an OWF in Hanöbukten (Sweden), intends to annually reinvest 1% of total revenues from the OWF in a fund for local environmental and economic development projects, which can also strengthen employment in the country. In the south of Copenhagen (Denmark), three demonstration turbines are partially owned by private individuals and due to their proximity to shore tourists can reach them via the footbridge and walk around them at no

<sup>20</sup> More about these smart solutions in the Baltic available at: [www.southbaltic.eu/smart/005](http://www.southbaltic.eu/smart/005)

<sup>21</sup> An example in this regard is the unique and attractive design of the Middelgrunden, first cooperatively owned OW farm in Denmark. The wind farm follows the one curved line design, continuing the Copenhagen city structure which has the shape of a super-ellipse represented by the old defense system west of Copenhagen. More information available at: <https://wwec2017.com/wp-content/uploads/2017/06/Middelgrunden-Offshore-Wind-Energy-Farm-15.06.2017.pdf>





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cost, while there are also information boards at each turbine. The museums and information centres have an important role in developing new innovative models for educating and entertaining visitors, which on the other hand diversifies their portfolio and opens new perspectives (South Baltic Programme, 2014.).

In **Germany**, national authorities see the opportunity in educational and recreational activities related to the OWF sector, including development of the tourism segment that focuses on the fascinating facts about the OWF technology (DENA, 2008a), or concepts based on topical “wind holidays” (e.g. OW energy, kite surfing and sailing) or zero emission holidays, which could even be linked to major events related to wind farm construction phases (DENA, 2008b). **Danish** national authorities and intermediaries also have an interest in advancing this MU through the State of Green (State of Green, 2018) initiative that connects a number of public and private actors in tourism and energy sectors. However, existing State of Green tours are only offered to businesses, politicians, civil servants and media correspondents, or offered for a high fee at conferences such as EWEA OFFSHORE (EWEA, 2015).

Existing examples of this MU in the **UK North Sea** include the Scroby Sands OWF in Great Yarmouth (E.ON, 2004: fully commissioned) and the Sheringham Shoal OWF (Statoil, 2012: fully commissioned, visitor centre open: 2011) both in Norfolk, England (German offshore wind energy foundation, 2013; Sheringham shoal, 2017). This MU can also consider the development of OWF sector related onshore tourist information centres and museums. The Scroby Sands visitor centre attracts over 35,000 visitors each year (E.ON, 2017). Other OWFs have also been successfully incorporated with tourism (e.g. North Hoyle OW, Wales, NE Atlantic). In the UK, considerable funds are provided by OWF developers to local communities, with many of the funds directed to tourist activities. Although, the practice may not be specifically intended to promote the MU, its intended purpose to win local support for project developments, as in the case with other commercial activities, can serve as a key driver for the MU. In the case of the Gwynt y Mor OWF, funds were designated by the OWF developer to support tourist activities during OWF construction.

The current regulatory framework e.g. Scottish National Marine Plan (SNMP), also promotes this MU (Marine Scotland, 2015a). Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision-making processes, when consistent with policies and objectives of the plan. Examples of the MU include the Scroby Sands OWF and Great Yarmouth, with regular boat trips to the location of the OWF (aprox. duration 3 hours). Seals are also present in the sandbanks in the vicinity of the OWF, constituting another tourist attraction. Recently, the Royal Society for the Protection of Birds (RSPB), a key non governmental organisation (NGO), formed a partnership with the OWF developer (E.ON) for safeguarding the wildlife in the OWF location.

In **Belgium**, a guided tour to the first Belgian OWF (Thorntonbank wind farm, located at 30 km from the coastline) is possible and provides explanation concerning renewable offshore wind power (Franlis, 2018).





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## Actors, Drivers and Barriers

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Tourism synergies with OFW is partly a driver to mitigate negative impacts on excluded maritime users to enhance livelihood diversification. In the UK, national and sub-national plans promote co-location of maritime activities. Also, considerable funds are allocated for integration of tourism with OFW in rural areas in UK.<sup>22</sup>

Barriers of the MU relate to difficulties in its development in offshore areas, due to high wind and wavy environment, especially in more exposed OFW locations and a greater distance from the shore is mostly not appealing for tourist visits. There is no permitting system dedicated only to the MU rather each use is permitted separately and local communities and key maritime users (e.g. fishers) might object to OFW development. Actors to drive this MU are policy makers and regulators, who must develop specific permitting system for the MU.

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<sup>22</sup> See further at: <http://www.offshorewind.biz/2013/12/13/gwynt-y-mor-tourism-fund-backs-new-tourism-venture-along-north-wales-coast/>



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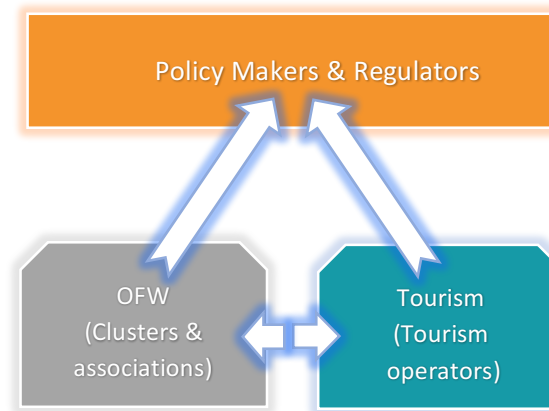


## Main Actors, Drivers and Barriers of the OFW and Tourism MU

### National/Local Level

- ✗ Exposed OFW sites and physical environment conditions (wind, wave) may be unsuitable for tourist
- ✗ Local communities, key maritime users (e.g. fishers) might object OFW development
- ✗ A greater distance of OFW sites from the shore, may not be appealing for tourist visits

There is a socio-economic drive to indulge tourist in OFW related activities and experiences. However, physical, geographical and environmental conditions of the OFW sites sometimes serve as barriers to promote the development of this MU. To advance the MU, it is necessary that a permitting system dedicated to this specific MU is developed by policy makers and regulators in most of the Member States where the MU is relevant



### EU/Sea Basin Level

- ✓ Tourism synergies with OFW might partly mitigate negative impacts on excluded maritime users – livelihood diversification

### Local Level

- ✓ Considerable funds allocated for integration of tourism with OW by OWF in rural areas in UK

### National Level

- ✗ No permitting system dedicated only to the multi-use rather each use is permitted separately in most Member States
- ✓ In the UK, National and sub-national Plans promote co-location of marine/maritime activities
- ✗ Policy-makers and regulators have no experience in licencing MUs, specifically, and this may complicate future licensing



## General Conclusions

- This combination supports **variety of solutions and presents a big opportunity for innovative and creative entrepreneurship**. **Boat tours to OWFs perhaps have the most challenges to overcome** (i.e. long hour's onboard, blocked access to the wind farm, high fuel consumption, and requirements for suitable weather conditions). However, it appears that there are also plentiful creative solutions to overcome these challenges;
- Tourism opportunities in relation to the OWFs are offering/facilitating alternative employment opportunities for local fishers;
- The **tourism boards and intermediaries** seem to have an important role for the promotion and advancement of this MU. They are opening new perspectives for new business partnerships by gathering all relevant tourism stakeholders and maintaining a network of local tour operators;
- **Diverse funding sources** can be noted, ranging from partial private ownership and reinvestments, to initiatives resulting from private and public partnerships, and community (incl. tourism) benefit funds (links to CSR) from the OWF developer.



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## 4.4 Offshore wind and wave energy generation

### MU overview

### SEA BASINS

The **North Sea** particularly offers good conditions for ORE generation, including offshore wind, wave and tide. Combination of these energy sources is possible as part of the same physical platform (Figure 3), or as a more indirect connection via same cable array, operations, monitoring, etc.

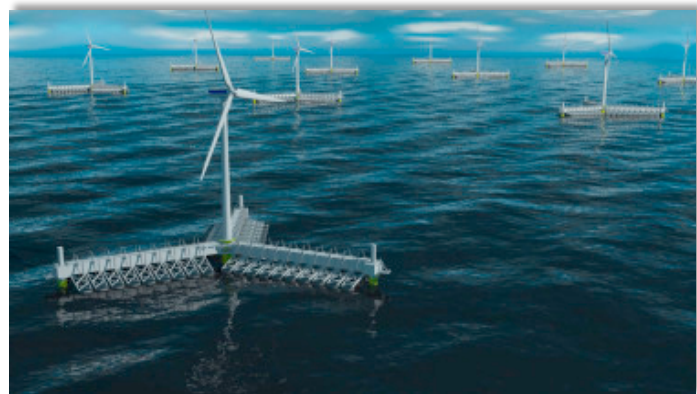


Figure 3. Wind and wave energy generation MU concept<sup>23</sup>

### Selection of existing cases and good practices

There is already some experience in combination of wave and tide energy in the Northern part of **Scotland**, while a pilot test hybrid wind and wave technology is to be applied in Caithness, Scotland. It is anticipated that the project will be commissioned by 2020. A study has developed a **Search Group Algorithm** (Bossuyt S. et al., 2017) to be applied on both wind and wave farm layout optimization. The algorithm allows calculating the optimal geometric layout of the devices within farms, in order to achieve an optimal power output. At the same time, device interactions are taken into account and minimal distances between the devices are respected (e.g. necessary for maintenance).

While testing of wave energy generation device was conducted in **Denmark**, this combination was never meant to be employed commercially in the Baltic Sea. The MU technology developed for the North Sea and Eastern Atlantic conditions was rather only tested in the Baltic (Danish Wave Energy Test Center). In Denmark, electricity from renewable sources is mainly promoted through a premium tariff and net-metering. The premium tariff for offshore wind parks is awarded through tenders.

### Incentive regime as a major factor for MU development

While the UK has locations with highly suitable conditions, the government incentive scheme Contracts for Difference (CfD)<sup>24</sup> currently supports marine renewable energy (MRE) technologies, although not collectively as MU combinations of MRE technologies. In **the UK**, the generation of electricity from renewable sources is supported through a combination of a feed-in tariff system, CfD, a quota system in terms of a quota obligation and a certificate system and a tax mechanism. Under the feed-in tariff, accredited producers whose plants have a capacity of less than 5 MW can sell their

<sup>23</sup> See further: <https://ars.els-cdn.com/content/image/1-s2.0-S1364032114008053-gr5.jpg>

<sup>24</sup> Contract for Difference (CfD) - a private law contract between a low carbon electricity generator and the Low Carbon Contracts Company introduced as part of the Electricity Market Reform (EMR) programme where a generator party to a CFD is paid the difference between the 'strike price' – a price for electricity reflecting the cost of investing in a particular low carbon technology – and the 'reference price' – a measure of the average market price for electricity in the Great Britain market.



electricity at fixed tariff rates established by the Gas and Electricity Market Authority (Ofgem). The scheme is applicable to England, Wales and Scotland only.

Under a feed-in tariff, eligible renewable electricity generators (which can include homeowners and businesses) are paid a premium price for any renewable electricity they produce. Different tariff rates are typically set for different renewable energy technologies, linked to the cost of resource development in each case, to enable a diversity of projects (wind, solar, etc.) to be developed while investors can obtain a reasonable return on renewable energy investments. The old FIT scheme closed on 14 January 2016, followed by a new one with different tariff rates and rules - including a limit of the number of installations supported.

The lack of a strike price for large hydro, tidal range (including tidal lagoon and tidal barrage), and nuclear means that there is currently no generic competitive CfD allocation mechanism applicable to projects using these technologies (unless introduced in the next round of CfD bids). There are five eligible renewable and low-carbon technology types eligible for FiTs, leading to the question how an MU would fit into the list:

1. Solar photovoltaic (PV) – Up to 5MW Total Installed Capacity (TIC)
2. Wind - Up to 5MW TIC
3. Hydro - Up to 5MW TIC
4. Anaerobic digestion - Up to 5MW TIC
5. Micro combined heat and power (CHP) – Up to 2kW TIC

However, countries have different regulatory and incentive regimes in this regard.

The renewable energy incentive system in **the Netherlands** has been recognised as a potential good practice that could be replicated to other countries. The Netherlands is committed to a legally binding target of sourcing 14 percent of its final energy consumption from renewable energy sources by 2020 under the Renewable Energy Directive (Directive 2009/28/EC). To achieve this target, several instruments and policies have been adopted to incentivise investment in renewable energy such as the SDE+ premium feed-in scheme (premiums on top of the wholesale price). The support scheme grants a premium on top of the market price (depends on the annual electricity market price) in order to compensate for the difference between the wholesale price of electricity from fossil fuel sources and the price of electricity from renewable sources. For offshore wind, a tendering scheme is available under the SDE+ which resulted in three OWF projects receiving €4.5 billion of subsidy in 2010. In addition, investments in ORE are supported via loans and various tax benefits. Table 2 presents a summary of the support schemes for renewables in the North Sea Region countries.



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Means of support	UK	BE	NL	DE	DK	SE	NO
Feed-in tariff	Up to 5MW		SDE+ premium feed-in scheme	Up to 100 kW	For biogas only	Photovoltaic installations	
Quota system	Renewables obligation scheme	Certificates trade					Certificate trading scheme
Tax regulation mechanism	Carbon price floor (tax levy on fossil fuels)		Tax credits exist for biofuel and hydrogen		Heating generation exempt from tax	Tax privileges for wind	
Tenders	Contracts for difference (CfD scheme)		Tendering scheme for offshore wind	Market premium scheme through tender	Premium tariff through tender		
Other		Priority to grid connection; training programmes; R&D programmes	Loan support; training and certification facilities; innovation contracts	Low interest loans			

Table 2. Summary of the support schemes for renewables in the North Sea Region countries.

## Actors, Drivers and Barriers

The combination is driven by maximal energy generation from all the energy resources at the given sea space, and potential reduction of operational, maintenance and investment costs. Developers are increasingly considering this MU in the UK. The challenges that this MU is facing are similar to other MU solution that involves development of large scale hard structures offshore such as OWF and aquaculture. In addition, this combination is not specifically addressed by any of the policy documents. The EIA process in the licensing process presents some of the major challenges on the regulatory side. Currently, in UK, hybrid technologies have to deal with permitting regulators twice (once for each technology). Moreover, government incentive scheme, CfD in UK does not support MU combinations of MRE technologies. For the employment of such MU in the Baltic, major barriers are same as those for wave as a single sector, and include small waves, ice in the winter, no suitable technology to addresses given conditions and no market.



## General Conclusions

- This combination, contrarily to other MU, presents many operational synergies and operations that can be conducted by the same entity, which according to stakeholders is an important advantage;
- Unaligned government financial incentives (feed in tariff) appear to be an important challenge for this capital-intensive MU. More detailed comparative case studies that analysed suitable conditions for this MU would be of benefit.

## 4.5 Wave energy and Aquaculture

### MU Overview

### SEA BASINS & CASE STUDY

This MU combination considers the combination of aquaculture farm and the wave energy generation either as part of the same structure or co-located side by side. This combination enables the use of generated wave energy directly for the purpose of aquaculture operations (especially in 'rural' areas with little access to grid). The MU has been considered as most promising for smaller-scale wave energy technologies, suitable for operating in less exposed sites (Aquateira Ltd., 2014). While so far this combination was mainly considered for purposes of supplying the aquaculture operations, it could potentially evolve into a real MU where apart from aquaculture, wave energy is also supplied to the national grid or to other businesses. Infrastructure sharing between the two users, could involve cables, anchors, accommodating platforms and vessels (Aquateira Ltd., 2014).

### Selection of existing cases and good practices

Past studies and projects (Aquateira Ltd., 2014; MARIBE) have mainly reviewed the feasibility of combining wave energy with different types of aquaculture. The MU has already been implemented (commercial use) in Mingary Bay in Scotland. The aquaculture development (finfish) was already in place; the company was approached by the wave energy developer and the two agreed to jointly start the MU. The generated wave energy was intended to cover part of the energy requirements of the aquaculture developer. The aquaculture developer was keen on the MU for '*green credentials*', particularly relevant in the case of *premium quality* Scottish salmon. The MU could be advantageous for the wave developer, as it could enable easy and profitable distribution and selling of produced energy. Sites for further MU development are sheltered locations of appropriate wave energy resources. Potential and further development of '*offshore*' aquaculture could also incorporate additional types of ORE, such as offshore wind e.g. in Scotland. However, more offshore locations may limit wave energy development potential (Onyango V. and Papaioannou E., 2017).

The combination of aquaculture (scale nets and pods, finfish mostly, also molluscs) and wave energy generation (multiple point absorbers) as a MU of space (not the joined platform) was





developed as a pilot in Malta in the framework of the EU funded research project MARIBE (2016)<sup>25</sup>, involving two private companies Albatern (wave energy) and AquaBioTech (aquaculture). The concept included large-scale aquaculture farm, with energy supplied by autonomous wave energy devices. The maturity of this MU was at a demonstration level. The roadmap for commercialisation of this concept is provided in Table 3.

Level	Year of Implementation	2016	2017	2018	2019	2020	2021
TRL6	Mingary Bay, Scotland						
TRL7	Malta TRL7 Pilot						
TRL9	Malta Commercial Case						
TRL10	Ready for Market						

Table 3. MARIBE case commercialization roadmap (MARIBE (2016))

Testing for offshore wave energy generation and mussel aquaculture has been conducted at the wave energy testing site (the Danish Wave Energy Test Centre) a fjord in the northern part of Denmark. However, this combination was not mean to be employed commercially in Denmark, but rather just tested. The design and employment of the wave device solely for the purpose of the aquaculture operation is deemed to be costly and not yet considered by aquaculture operators in the Baltic Sea.

### Actors, Drivers and Barriers

Potential **joint benefits** for both businesses include reduced project development costs (pre-development), while further reducing operational and maintenance costs. Some identified advantages from the **perspective of seaweed developers** is that this MU can potentially provide economical energy supply as compared to the use of diesel, reduction of aquaculture's environmental impact due to the use of clean energy, and potential reduction of aquaculture impact on coastal areas due to use of offshore sites near wave energy generation.

This MU could potentially increase the amount of operational days and protect from potential damage. The energy from the wave as well as the device itself can be used for remote monitoring of the site and autonomous operations i.e. lowering the seaweed when the conditions are rough (i.e. storms) or organising the feed according to the current conditions at the site. This situation could further enable seaweed farms moving to more exposed locations as the industry, develops further and space becomes a pressing issue. Another is possible sheltering effect that could be achieved if

<sup>25</sup> More information available at <http://maribe.eu/>



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aquaculture is placed behind the wave device which amortizes the wave power that could otherwise impact the aquaculture.

The **benefits for the wave developer** include guaranteed sale of electricity to aquaculture customer, low electrical losses and cabling costs due to proximity of customer. Moreover, electricity could also be provided to onshore enterprises and national grids especially in constrained grid environment with high power costs. However, the MU combination has not been largely applied, either at a commercial or trial/pilot level, also due to the low levels of commercialization of wave energy conversion technology (Aquaterra Ltd., 2014). An important element framing the MU potential is the fact that operational cycles of users might differ. For instance, if the aquaculture developer scales up, increased production would imply increased energy demands, potentially providing wave developer an opportunity to consider scaling-up supply. Therefore, an integrated approach to MU development is an effective entry point.

Other challenges facing this MU, include storage and use of the produced extra energy, especially if aquaculture is the only customer for the wave energy. Interviews with key stakeholders showed a general lack of data and knowledge about number of aspects relevant to this combination, including safety and other risks, insurance implications and operational problems caused by unknown consequences of the interaction between the two uses. Interaction between fish growth and wave energy devices is unknown while there is a possible increase of fouling due to increase of nutrients from fish farming. Moreover, the procedure for getting license for such combined use is also not clear and would most likely complicate the aquaculture licensing process. At this time costs are estimated to override the benefits of such MU.



## General Conclusions

- Further development of this MU first of all requires the demonstration of technological and commercial readiness for wave technology;
- This is a MU that can potentially support scaling up of the aquaculture, especially to areas further offshore. Certain concepts have been developed, but a number of challenges, including the knowledge gap about interactions in the real environment seem to be still stalling the implementation of the concepts;
- Some experience with this MU exist and the opinion is that development is more feasible if a more integrated approach in terms of operational and business planning is undertaken, to harness and optimise synergies;
- As with other combinations this MU can potentially provide an opportunity for obtaining 'green credentials' and green certification for aquaculture. However, the full value chain needs to be analysed for better insights into other opportunities;
- This MU's potential to provide energy beyond the MU to include nearby settlements could also be considered. This is particularly promising for island and 'rural' areas with little access to grid. However, if aquaculture is not the only energy consumer (wave energy not employed solely for aquaculture operations) then the different development speed of these two businesses need to be carefully considered.

## 4.6 Shipping terminal and Green energy generation

### MU Overview

### CASE STUDY

Linking ports with MRE (wind, wave, and tide) typically involves ports as the 1) assembly/manufacturing; 2) installation; and/or 3) operation and maintenance base for MRE. Key services include the manufacturing (assembly) and storage; handling (e.g. lay down and pre-assembly); transportation of OW turbines; and maintenance (e.g. response to faults) of OWF. This link is particularly relevant in the North, Baltic and Eastern Atlantic Sea Basins, where the ORE industry is rapidly developing. Major ports in the North Sea are increasingly being involved in related economic activities. Moreover, several ports are linked with OWF as grid connection and/or export cable points, with onshore substations located in ports. One of MUSES case studies explored the potential for a MU combination between ports and marine renewable energy. The MU would involve the generation of energy from MRE sources, its transmission to a port substation and the energy being used to cover (part of) the energy demands of the port. Specifically, the potential of the energy used to power auxiliary engines of berthed vessels - shore side electricity (SSE) – was assessed.



## Actors, Drivers and Barriers

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No examples of this MU exist in the case study area (West Coast of Scotland, UK), or broader vicinity, either pilot or commercial, but future mid- to long-term development is possible. Other investigated cases included ports in South-East England (East Sussex), North England (Northumberland) and Scotland (Firth of Forth; Firth of Tay).

In the study area, SSE generated by Alternative Maritime Powers (AMP) could take place in small docks, and accommodate essential connections provided by certain ferry routes to islands and remote mainland areas ('lifeline' services). Specific locations would include the sites and ports identified in the National Renewables Infrastructure Plan (N-RIP) (Map 10, SNMP, Marine Scotland 2015a). MU would be promising for ports with disused facility areas (e.g. Pembroke Port, Milford Haven) that could benefit as 'demo centres' for testing the MU. Energy could come from planned and ongoing marine renewable projects (wave, tide) in the area.

From the ports/harbour authorities' perspective, the interest and engagement with the MU in the future, will depend on: policy framework; existing links with OWF (e.g. as operation and maintenance bases); port ownership status and governance (e.g. public/community, private ports); ports specificities (e.g. position of berthed vessels with reference to SSE supply), and size and type of accommodated vessels (for instance tanker vessels, or cargo vessels will not readily diversify to SSE).

Certain port authorities, especially public ports, national and international policy makers and regulators, could drive the implementation of the MU. Renewable energy developers' interest in the MU is framed by the opportunity for them to connect to the grid (ports are generally strategically located and well-connected to the grid), and directly distribute part of their produced energy. The key actors (Crown Estate, the Crown Estate Scotland) showed a positive attitude towards this MU. Research and technology clusters (e.g. Marine Energy Wales) could drive the pilot testing of SSE within 'demo zones' (e.g. Pembroke Port, Milford Haven).

The main drivers for the MU relate with the policy framework, especially the targets for reducing green house gas (GHG) emissions, also from shipping and ports. A recent policy breakthrough includes the 'Initial IMO strategy on the reduction of GHG emissions from ships' (UN IMO, 2018) that seeks to reduce emissions by shipping companies at least 50 percent from 2008 levels by 2050. Moreover, the Directive 2014/94/EU makes reference to 'shore-side electricity facilities as clean power supply'<sup>26</sup>. Other drivers relate to sharing of infrastructure between the two users, most notably the grid connection of the OW to the port.

Key barriers to the development of the MU relate with **technical capacity**, for instance the unsteady supply of MRE and energy transmission and storage in ports, in conjunction with the huge energy demands required to fuel certain size classes and types of vessels. **Administrative barriers** relate to the licensing of the activity as a MU; moreover, especially for ports with no jurisdiction in the locations of suggested MRE development, a lease from the competent seabed authority (e.g. The Crown Estate or Crown Estate Scotland) would further complicate the process. Other barriers, include the fact that other alternative sources of energy are currently more viable/cost-effective for ports and

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<sup>26</sup> Articles 34/35



vessels to invest on (e.g. onshore wind, solar, LNG). Moreover, from the viewpoint of the port, investment in onshore renewables is a considerably easier administrative process.

The lack of commonly agreed standards and framework for the conversion of ports and shipping infrastructure to SSE and timelines of implementation, could introduce substantial costs (e.g. loss of revenue to port, increased fuel costs and emissions, conversion) and risks (e.g. displacement) to investors. A major consideration should be ensuring vessel displacement does not occur as a result of implementing the MU in a particular port. If the MU is imposed without taking into account this factor, vessels that cannot readily shift to SSE, such as tankers etc., will shift activity to other ports and travel further to find suitable energy sources. To prevent such a condition, MU facilitation and policy development is necessary and needs to derive from an EU level, because otherwise certain ports and developers will become uncompetitive.

### General Conclusions

- This MU can potentially provide significant benefits to both the port (energy provision) and OW user (grid connection; infrastructure). However, there is a need for regulatory framework that standardises the conversion to SSE and addresses the risk for investors, highlighting the environmental and health benefits associated with MU;
- The case study showed that the MU could have potential for small docks, and accommodate essential connections provided by certain ferry routes to islands and remote mainland areas. There is potential for disused port facilities for the pilot testing of SSE, including offshore marine renewables ('demo zones');
- The potential of the MU in other locations depend on existing links between ports with OWF; ownership status and governance of ports, ports specificities, size and type of accommodated vessels;
- There is a need for a transboundary and coordinated approach to the development of this MU as top-down approaches at solely regional/national level, might result in the displacement of vessels to other ports, with negative impacts. The lack of adequate port infrastructure provision might result in OWF developers using other ports, outside the country of origin. To that end, the role of the EU is crucial in facilitating the development of this MU.

## 4.7 Tidal energy generation and environmental protection (and monitoring)

### MU Overview

### CASE STUDY

A degree of environmental monitoring is generally implemented throughout the lifecycle of various maritime activities, often conditional via regulatory requirement depending on the national regulation and the scope and scale of given activity. Monitoring can be done by integrating various types of monitoring equipment such as passive acoustic, sonar, audio and visual on a platform or a vessel, or co-locating it with another maritime use and/or infrastructure. Apart from providing



the necessary information to authorities and obtaining the data required for controlled functioning of a given activity, information collected from monitoring programmes could also be used to inform research, environmental protection, or information provision to a wider range of maritime users (e.g. about the weather or changes in the environmental conditions). While such monitoring can be potentially combined with a wide range of maritime uses including aquaculture, fishing, and offshore renewable energy, this chapter presents only the potential for integrating Tidal Energy Development and Environmental Protection and Monitoring analysed only as part of the case study,<sup>1</sup> conducted in the Inner Sound of the Pentland Firth off the north coast of Scotland between Caithness on the Scottish mainland and the island of Stroma (Sangiuliano S. J., 2017.).

This case study area has some of the best conditions for tidal energy generation, while Scotland in general has up to 25% of Europe's potential tidal energy resource (Marine Scotland, 2013). The area hosts an industry leading project, MeyGen, system prototype demonstration of the gravity base, submerged, horizontal axis tidal current turbine (TCTs), and accounting for an aggregate capacity of 6MW in operational environment headed by Atlantis Resources Ltd. The MeyGen site is located within the North Caithness Cliffs Special Protected Area (SPA) for specified bird species under the Birds Directive 2009/147/EC forming a European belt of protected areas under the Natura 2000 belt (European Commission, 2009b). While there are no marine protected areas (MPAs) within the study area which are specifically designated to protect other species, including marine mammals and migratory fish (e.g. Special Areas of Conservation (SACs)), amongst other various fauna, these species are also key primary receptors which occur within the case study area and are thus investigated in the case study. The data produced from the environmental monitoring programme of the MeyGen project can inform whether MU between tidal energy development and environmental protection areas is sustainable.

### Actors, Drivers and Barriers

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This MU is driven by the opportunity to:

- further inform risk criteria thereby contributing to standardized, streamlined licensing, consenting, and monitoring procedures;
- reduce scientific uncertainty prompting an enhancement in private investment;
- increase the knowledge base on tidal energy development and environmental interactions. This will further facilitate the dissemination of information to the public, thereby educating the public on real as opposed to perceived interactions which may help secure community buy-in and therefore potentially streamline the uptake of tidal energy technology.

According to the case study, the **lack of scientific baseline knowledge** on tidal energy deployment and environmental interactions will inhibit the siting of TCT arrays within environmental protection areas. This barrier would suggest that it is too early in the development of the tidal energy industry to promote MU with environmental protection areas as more data is required, both environmental baseline and TCT monitoring data, to make informed decisions regarding the sustainability of MU. This real barrier occurs on an international, EU, sea basin, national, regional, and local scales as much environmental baseline characterization and TCT interaction data must be produced in different marine environments and standardized in order to allow for proper analysis. This barrier cannot be



controlled nor influenced; rather, a considerable amount of time is required for more developments to take place which produce more data on environmental interactions.

According to the case study, **government regulators and the tidal energy industry** are the key stakeholders promoting and enabling this MU. The majority of barriers for this MU cannot be controlled nor influenced by a single actor.

### General Conclusions

- In a way, the tidal energy industry already practices MU with environmental monitoring through the Survey, Deploy, Monitor (SDM) policy guidance, but environmental data gathering is not effectively subsidized by public funds;
- Early developers are bearing the costs of environmental characterization for further developments of other potential companies to come to fruition in the near future;
- If public subsidies were provided, the environmental data could be made public and possibly used not only for tidal energy developments, but the baseline data could also be gathered to such an extent as to inform environmental management regimes throughout the Scottish marine environment;
- In order to proliferate the commercialization of the tidal energy industry in Europe, national authorities of EU MS should provide an effective subsidy mechanism (e.g. FIT) tailored to tidal energy in order to make tidal energy competitive with other forms of electricity generation. Without a commercial tidal energy industry, MU with environmental protection will not materialize on a considerable scale.

## 4.8 Oil & Gas (decommissioning) MU combinations

### MU Overview

### SEA BASINS AND CASE STUDY

Many O&G structures have been in operation for several decades and are approaching retirement<sup>27</sup>. After being decommissioned and cleaned, offshore platforms are dismantled and removed completely, left in place, or removed partially, depending on legal requirements in the MS. All three options can potentially have positive or negative environmental impacts and decisions are made on a case-by-case basis.

Although, the O&G industry has brought significant benefits to the sea basin economies (Huijskes, T. D., 2017), their complete removal is expensive, both to O&G companies and the taxpayer (The conversation, 2018). It also leaves operators facing the problem of what to do with the recovered material. These high decommissioning costs arise from the immaturity of the decommissioning industry and a lack of direct experience by operators and the supply chain<sup>28</sup>.

<sup>27</sup> See further at: <https://cld.bz/BoPAqso/6/>





The **North Sea** has more than 300 O&G fields with an infrastructure, more than 5,000 wells, and over 10,000km of pipelines (OSPAR 2010). This sums up to **more than 550 platforms and undersea production facilities**, virtually all of which are set **to be decommissioned in the next 30 years** (Royal academy of engineering, 2018), mostly in the UK, Netherlands and Denmark. A total future cost for **decommissioning in the North Sea is estimated to be about 86 billion euros** (UKCS Decommissioning, 2017). An estimated bill for decommissioning on the UK Continental Shelf alone is £17.6 billion between 2016 and 2025, with a £2-billion price tag on decommissioning costs for 2017 alone. Decommissioning activity is forecast to take place around 2024 and 2025, which can commence up to ten years prior to decommissioning. As a response, **the UK has set in place “Decommissioning Relief Deeds”, to provide tax incentives and certainty for the sector** (HM Treasury, 2012). This could be an entry point for introducing and prioritized incentives for MU-related decommissioning projects.

OSPAR regulation (decision 98/3) in the North Sea **asks for the seabed to be left clean**, restraining MU application; although possible derogations are described under paragraph 3.

In the **Adriatic Sea**, 21 platforms will be decommissioned by 2021-2022 (MISE-UNMIG, 2017) (8 in the MUSES Case Study area “Northern Adriatic”). Total cost of decommissioning in this period is estimated in about **500 million euros** (Da Riz W, 2017). This could underpin the potential MU combinations concerning decommissioning of O&G platforms together with renewables energies or tourism and aquaculture (and potentially other MU combinations). An important element to be considered to address potential reuses is related to the technical characteristics (e.g. monotubular, cluster, reticular, etc.) of the platforms to be decommissioned.

Emilia-Romagna Region (Italy) located along the Northern Adriatic Sea represents a special test and operative case, as it is the sea area with highest density of offshore O&G in Italy and in the Mediterranean. In Ravenna, reuses are potentially favoured, due to the close distance to the coast, industrial port and O&G base of Ravenna, well-developed coastal and maritime tourism and aquaculture sector. Some detailed, although preliminary, proposals on where and how to operate are presented in Barbanti et al. (2017). This MU looks into how the decommissioned offshore platforms can take on a new life without being removed or being removed and reused in the marine environment. Namely, decommissioned oil and gas (O&G) platforms in the Northern Adriatic can potentially be reused to:

- support recreational activities (e.g. diving, recreational fishing, environmental education, marinas, gastronomic experience);
- support monitoring, observing and research activities;
- function as structural and or logistical support for aquaculture installations;
- support renewable energy devices: wave energy devices, wind energy, solar panels;
- support carbon capture and storage;
- convert into artificial reefs, as a so called ‘rigs to reefs’ concept.

### Selection of good practices and existing examples

Shell U.K. Limited is preparing to decommission four of its giant Brent oil rigs in the North Sea (Vaughan, The Guardian, 2017), located about 136 km east of the Shetland Islands and about 480 kilometers north of Aberdeen. The UK Oil and Gas Authority (OGA) launched a search for operators to



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participate in a programme to find ways to share work and cut costs. The remote nature of the rigs, deep and hostile waters, together with the unusual concrete construction of three of the rigs, pose a unique challenge.

Shell have proposed to remove the entire 24,000-tonne topside of the Delta platform but leave most manmade structures in the North Sea. The company wants an exemption from removing everything, arguing that 1) the platforms were never designed to be removed; and 2) it is the safest and most environmentally-friendly option to leave the 300,000-tonne concrete bases beneath three of the platforms although environmentalists are opposing this proposal (Vaughan's, 2017).

Some 40 decommissioning programmes have been submitted to the government's Department for Business, Energy and Industrial Strategy (BEIS) – the government body that regulates the decommissioning of offshore O&G installations and pipelines in the UK<sup>29</sup>. The decommissioning of offshore O&G installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998, enforceable under the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) which sits within BEIS.

OPRED provides **guidance on the regulatory requirements for decommissioning** and has recently consulted on updated guidance: a potentially crucial entry point for MU. The need for effective, good-value decommissioning in the North Sea is becoming an industry in its own right, with options such as MU, to make socio-economic and environmental sense, where possible. This echoes the Oil and Gas Authority (OGA), obliged to maximise the economic recovery of the country's petroleum resources.

In the **Netherlands**, two bright orange oil rig escape pods now serve as floating accommodation designed by the Dutch architect Denis Oudendijk. Moreover, there are proposals for off-shore platform jackets to be repurposed to take on wind farms or scuba-diving stations (See Gagan, 2017). Obsolete oil rigs have great potential as artificial reefs, supporting fish larval production, and acting as homes for delicate plant and marine life. Rigs-to-Reefs organisation puts the cost of a single rig-to-reef conversion at \$800,000, compared with around \$5 million for dismantling and removing a rig entirely (Gagan 2017)<sup>30</sup>.

## Actors, Drivers and Barriers

The reuse of decommissioned platforms could potentially bring a number of benefits. At the EU level, this MU is driven by the requirement that O&G structures fit in the Large Plant Directive and therefore have to reduce their emissions under EU legislation. In the Northern Adriatic, such solutions could promote further development of aquaculture (Emilia-Romagna is presently the first producer of shellfish in Italy and there is unexploited potential for fish farming), **moving offshore farming areas**, and **support the development of coastal tourism** promoting diversification of the offer and experience-based tourism, through a residential, recreational, leisure boating use of decommissioned platforms located close to the coast and **"rigs to reefs" solutions**. The use of decommissioned jackets to create new artificial reefs, valuable for environmental and biodiversity protection and for tourism

<sup>29</sup> More information available at: <https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines>

<sup>30</sup> More information available at: <https://www.raconteur.net/business/decommissioning-the-north-sea-oil-and-gas-rigs-a-great-opportunity-for-the-uk>



(e.g., diving, recreational fisheries) could potentially be viable for any decommissioned platform type (mono-tubular, bi-tubular, reticular, cluster), provided that a careful selection (i.e. ecosystem evaluations, navigation safety, proximity to ports and marinas, other uses affected) of reefing sites is carried out.

In the North Sea, O&G structures are not well located for MUs (i.e. too far offshore and often harsh environmental conditions for aquaculture and tourism activities). Therefore, opportunities in the North Sea mainly consider **retrofitting infrastructure (pipelines) to accommodate carbon storage**, or the application of the 'rigs to reefs' solution. The OSPAR and Decom North Sea (Decom North Sea, 2018.) at regional, continental sea basin level create force-acting regulations that could create frameworks for licensing MUs, funding MUs, create a market niche for MU products; support insurance policies or risk-removing incentives. In the North and Adriatic Sea, the combination of uses and synergies can involve other compartments of the energy sector: decommissioned platforms can become storage / distribution stations for energy produced by OWF installed in their surroundings, while feasibility studies are considering the potential reuse of platforms as LNG docking stations.

Moreover, reuse options can **stimulate research and innovation** towards new uses and technologies and are considered as an opportunity to boost and renew the traditional existing O&G sector, capitalising on the well-established expertise and knowledge. Nevertheless, several important barriers are present, hindering the development of MUs related to O&G decommissioning.

**Various legal, administrative and procedural instruments are still missing** or lack clear indications, on how to deal with this issue. For this purpose, the Italian Ministry of Economic Development together with the Ministry for Environment, Land and Sea are preparing a set of guidelines for O&G platform decommissioning and reuse, while involving a wide pool of relevant actors in the discussion ("Forum on the future of Platforms").

**Responsibility and liability** on the infrastructures to be reused, during and after the reuse period, still remains a relevant issue, requiring specific solutions (several options can be considered, based on existing practices and present national legislations) in line with reuse sustainability.

Reuse options are face problems in terms of **economic and social sustainability**, that require detailed business plans, intense interaction with stakeholders and an approach that valorizes the whole value chain and social benefits (e.g. indirect benefits related to revitalization of an industrial area or the development of new high-tech sectors). Moreover, they have to overcome resistances to the introduction of new solutions from operators offering standard solutions and services (i.e. the standard way of dismantling platforms). In some cases, **technological barriers** can be important, where they are in fact key enablers for potential reuses (e.g. retrofitting infrastructure to to accommodate carbon capture sequestration, or to fit innovative aquaculture technologies, or technologies to store or/and transport energy and fuels).

Finally, **environmental concerns** have to be considered and managed. They refer both to solutions where the platform remains in place (concern that no one will take care of the correct final dismantling, or that this cost will be charged on the community as a whole, without any compensation) and where parts of the platforms are used to build artificial reefs (concern that reefing sites are not properly selected, environmental impacts are not properly estimated in the medium-long term, monitoring and management of the sites are underestimated). The question of when in the life cycle of the oil rig can the decision on appropriate re-use option and site for the final destination e.g. as a "reef" be



determined also emerged in discussions with stakeholders. Specifically, when can the concept of “designing for end of life / recycle / re-use” (Krivet, A., 1995) be integrated in the design of the oil rig e.g. within a MU approach? Can this be guided by a regulatory framework to allow for better management of expectations and predictability? Perhaps a “take back” law requiring O&G owners or manufactures to take back specified amounts of their rigs can be useful. Success within the EU on take back for cars can be found in Mohamed et al. 1996.

### General Conclusions

- Due to the fact that Adriatic O&G fields are closer to shore than in North Sea, there is a different focus in terms of which solutions can be implemented. For example, while tourism is more suitable for the Adriatic, the carbon capture and storage is considered only in the North Sea;
- There is the need for clearer legal framework, complemented by detailed, technical and permitting guidance, to promote and allow operators and stakeholders to develop reuse projects;
- Raising awareness on reuse options, potentials and limitations among all actors is also relevant. There is a need for joint identification of viable options, support in the design process, and establishment of proper conditions (transparency, trust, share of knowledge and practices) for the evaluation of social sustainability of projects under development and a faster permitting process. The “Forum on the future of Platforms” activated by the Italian Ministry for Economic Development is an example of such initiative;
- Pilot studies to test options, technologies, impacts, etc. would be highly valuable. A demonstration project which fosters cooperation between operators, engineering companies, administrations, research institutes and universities would easily become a showcase, at local, national and international level. The EU support for this type of pilot project by the EC-DG RTD is evident from the latest “BG-05-2019: Multi-use of the marine space, offshore and near-shore: pilot demonstrators” that also referred to “reconversion/reuse of decommissioned platforms”.



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## 4.9 Marine renewable energy and Desalinization/Hydrogen

### MU Overview

### CASE STUDY

The combination of MRE and desalination was explored as part of the case study (pilot conceptual/demonstrative phase) in the Mykonos Island, Cyclades region (Greece) (Maniopoulou, M, et al., 2017). This MU is driven by the increasing need for freshwater, particularly during the high demand summer season, the unstable and high electricity pricing of diesel generators that are currently used, and the impact of discharges in the marine ecosystem of the land-based plants producing desalinated water. The advantages of this MU are the energy independence of the desalination unit, mobility of the (floating) installation, green energy provision, and spatial conflict minimization.

The wave powered desalination pre-feasibility study was conducted in 2009 in Mykonos. Although the results were considered as promising, the project was only discussed at the municipal level. There was no continuation of the operation of the platform due to conflicting interests at the local level. Furthermore, there was no interest by decision makers at national scale to fund more projects or other ways of subsidization in other locations. The main barriers for the latter were mainly linked to legal/policy gaps, huge bureaucracy causing dysfunction and uncertainty and hence stalling investments, and lack of political will to promote ideas that administrators identified as advantageous as mentioned above; the latter "bad practice" institutional approaches were also projected at the local level.

The institutional, legal, and private stakes, as well as the overlapping competencies and sectorial approaches in institutional and governance levels, are the most important barriers blocking either the transition of pilot research projects to commercial/bankable ones (e.g. Ydriada) or the initiation of new efforts (institutional, economic).

Additionally, there is a reluctance to explore new practices/methods as a higher risk is perceived when deriving from traditional attitudes and is related to the poor economic conditions prevailing in Greece, as well as a low awareness of the local communities (economic, social). Moreover, economic and technical barriers, such as the higher cost of a sea-based than of a land-based renewable energy installation, maintenance, damage repair, monitoring and connection with the water and electricity supply network (economic, technical), the visual pollution caused by installations in the sea (social), especially in a small island with laced shores and coasts which is a high end, luxurious touristic destination offering beautiful landscapes and romantic sunsets to the Aegean Sea, were also quite prominent.



### General Conclusions

- The option of developing and installing an MU combining renewable energy and desalinization at sea must be first compared with the option to install it on land. Major reason for installing it at sea is the better quality of winds offshore than on land and the possibility for the floating “platform” to move from one place to the other accommodating needs for desalinated water ad hoc. However, the latter is important only when there is lack of space on land and/or when land is very expensive;
- If it is clear that such an MU is more beneficial and viable when placed at sea, then other economic, environmental and social costs and benefits of such a decision must be assessed by a wide range of stakeholders at both local and national level. Hence collaboration is another important requirement in order to decide whether, how and when such an MU can be developed.



## 5. MULTI-USE COMBINATIONS WITH TOURISM

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Tourism has been identified as a main driver for MU combinations especially in coastal communities of Southern European Countries. Areas with **high coastal and maritime tourism** intensity has been recorded in Greece, Spain, Italy and France where the sector is also the highest maritime employer (Eurostat, 2015). In line with the EU Blue Growth agenda and the efficient use of maritime resources in coastal areas have contributed to spatial and temporal synergies between soft uses such as tourism, fishing, aquaculture and environmental protection to create various MU combinations. Many of MUs using biotic objects or components (soft uses) aim at diversifying tourism offer and extension of tourism season in coastal areas with **focus on small scale eco-tourism offers**. In this context, MUs involving these soft uses act as a socio-economic instrument to create employment and as a deterrent for depopulation especially in coastal communities, peripheral coastal regions and islands.

The decline of fish stocks, have caused a significant decrease in catches and economic value, requiring a diversification towards forming synergies with tourism and aquaculture. This has resulted in cases where fishers have indulged in offering touristic activities for visitors to diversify their sources of income and also **create public awareness** about traditional fishing activities and heritage. The link between tourism and environment protection have also ensured that areas for tourism activities are attractive for tourist due to the quality and abundance of marine life and underwater cultural heritage for diving, snorkelling among other recreational tourism.

Synergies between environmental protection and the other soft uses can provide needed funds to **improve the management of MPA's and UCH sites**. Indeed, these MU combinations offer an opportunity to develop new forms of eco-cultural tourism, increasing the attractiveness of the area and **improving the local economy** through the commercialization of local and traditional products. The integration of users into these soft MUs should be recognised as a bioeconomy chain<sup>31</sup> which generates added value through sustainable management of resources, sustainable food production, reduce environmental impacts and contribution towards coastal development (McCormick and Kautto, 2013). The aim of the bioeconomy chain is to **reduce the dependence on natural resources**, transform manufacturing, and promote sustainable production of renewable resources from land, fisheries and aquaculture and their conversion into food, feed, fibre, bio-based products and bio-energy, while growing new jobs and industries (EC-H2020, 2018).

The following sections review three of the most popular and important tourism related MU combinations in Europe that were identified through the MUSES project including:

1. Tourism, Fisheries and Environmental Protection;
2. Tourism and Aquaculture;
3. Aquaculture and Environmental Protection;
4. Tourism, Underwater Cultural Heritage and Environmental Protection.

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<sup>31</sup> The bioeconomy concept refers to the sustainable exploitation of renewable biological resources for the production of food and feed, bio-based products and bioenergy





These sections give details on the locations of the MU above (Figure 4), what is driving the formation of the MU combinations, the barriers and challenges to the development of these MUs and the major actors who are and can support further development of the MU. It also gives a general conclusion on the MU based on the information gathered and findings from MUSES case study reports, sea basin reports and desktop research. This map does not show this differentiation between case study and sea basin level analysis as none of the MU combinations with tourism was explored as part of the case study only.

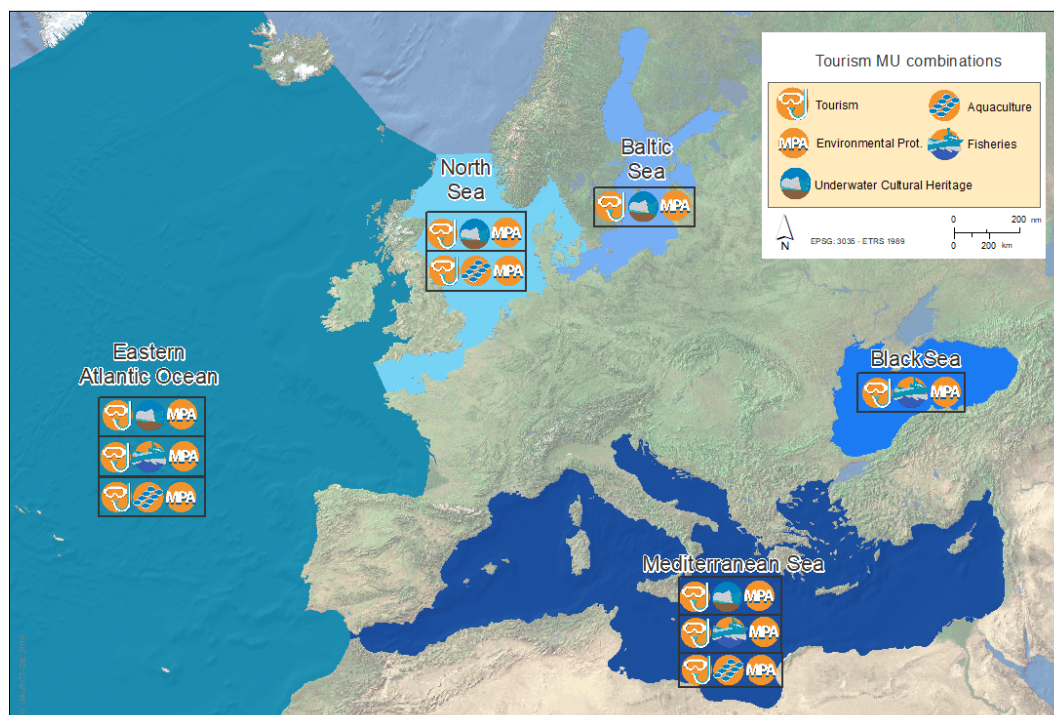


Figure 4: Location of MU with environmental protection combinations



## 5.1 Tourism, Fisheries and Environmental Protection

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### MU Overview

### SEA BASINS & CASE STUDIES

The Tourism, Fisheries and Environment Protection MU normally exist combining only two uses including **fisheries and tourism** (mostly *pescatourism*). However, in general, some form of conservation and sustainability measures are applied during *pescatourism* activities which contributes indirectly to protecting marine resources and brings out the environmental protection aspect of the MU combination. Compliance of sustainability measures through *pescatourism* have also been seen as a way of reducing illegal, unreported and unregulated fisheries. However, when these two uses (as single uses or *pescatourism*) are developed in locations of environmental protection areas (e.g. MPAs that permit maritime uses of low impact) the MU presents direct added values of environmental benefits such as surveillance, monitoring etc.). The sections below therefore discuss the MU in two parts: when *pescatourism* (or fisheries and tourism) occurs outside/within environmental protection areas (Figure 5).

The overexploitation of fishery resources to meet growing demand for food has led to pressure on marine ecosystem, decline in fish stock and has also resulted in unemployment especially in fishing communities. Measures that have been applied to solve this situation have not always led to the desired outcomes as for example imposing catch limits for a given fish stock in many cases have led to catch limits being reached early in the fishing season, which causes decrease in profits and employment instability in coastal communities. The huge demand for goods and services created by tourism have been seen as one way of creating jobs. The current socio-economic crisis in the fishery sector and decline in fish stocks have led to fishers considering synergies with tourism as a way of diversification.

**Fisheries merging with the tourism** has been considered as a solution that can limit excessive exploitation of fishery resources and create an alternative source of income for fishers. This synergy provides extra revenue for fishers especially in those periods when catches are low (or when caught species are of low value) whiles tourist are actively involved in fishery operations (e.g. casting and pulling of nets, fishing and eating freshly caught fish) and or observe fishers at work and promotes sustainable tourism. It also offers fishermen the opportunity to improve the image of their profession, and coastal communities use this as a tool to promote local social identity. This normally leads to a MU combination which is also known as *pescatourism* and involves professional fishermen, mainly from small-scale fisheries, welcoming a certain number of tourists on to their boats with the purpose of being involved in a tourism/recreational activity to discover the world of fishing with the commercial fisher becoming a tour guide (Burch, 2011).

Another form of *pescatourism* is developing where regulations and licences are given for fishing vessels to be rented out to tourist (mostly anglers) to perform fishing activities. This type of *pescatourism* has been located in Cyprus around the Zygi Village (Larnaka District) and in Pafos (Piasecki et al., 2016). It is important that the resulting use/activity (*pescatourism*) is recognised as a different activity from fisheries tourism, or recreational fishing and angling. Two types of *pescatourism* have been identified so far in Europe which include: *pescatourism* as a complementary activity to a fisherman's regular activity and *pescatourism* as a commercial tourist activity in its own right and conducted as a parallel activity to fishing. *Pescatourism* activities may be carried out by individual vessel owners, fishermen cooperatives or consortia. The fishermen/consortia are required to have a



valid fishing licence, registered fishing vessel, and authorisation to operate within coastal or short range fisheries zone. Vessels taking tourist on board must meet certain safety standards and must be equipped properly. Only certain types of fishing vessels are permitted to engage in this type of activity. The preferred tools and fishing gears for *pescatourism* are predominantly static fishing gears (e.g., gill nets or trammel nets), long lines, hand lines and harpoons (Saba et al. 2013).

- **Marine Protected Area** (National and International MPA categories) – “Geographically distinct zones for which conservation objectives can be set. They are often established in an attempt to strike a balance between ecological constraints and economic activity, so that the seas may continue to allow for goods and services to be delivered”. (EEA, 2015; Smith et al., 2009).
- **Natura 2000 Network** – Natura 2000 “is a network of core breeding and resting sites for rare and threatened species and natural habitat types listed under both the Birds Directive and the Habitats Directive and are protected through conservation sites and measures to ensure the long-term survival of Europe's most valuable habitats and species”.
- **Biosphere Reserves** – “Areas comprising terrestrial, marine and coastal ecosystems which promotes solutions reconciling the conservation of biodiversity with its sustainable use. These reserves apply interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems by setting zones including core, buffer and transitional area”.
- **Ecologically or Biologically Significant Marine Areas** (EBSA's) – “Area of the ocean that has special importance in terms of its ecological and biological characteristics and are judged through a technical process to meet one or more scientific criteria”.

Figure 5. Types of Environmental Protection sites

One major advantage for this MU is that it is potentially easy to engage in as the level of entry and investment into fisheries, tourism and *pescatourism* in general is not high as compared to other sectors such as ORE, which involves huge investment. Again, both uses are normally located in coastal areas and use similar resources (especially infrastructure, logistics, and experienced labour/know-how) which are essential socio-economic and technical enabling factors for this MU.

The European Maritime and Fisheries Fund (EMFF) apart from supporting efforts to make fisheries and aquaculture more sustainable and profitable have focused on diversifying local economies for the sustainable development. This has mostly been implemented through Fisheries Area Network (FARNET) which is a community of people implementing Community-Led Local Development (CLLD) and brings together Fisheries Local Action Groups (FLAGs). The FLAGs are local partnerships or groups involving key actors in a given local fisheries area that develop and implement strategies at a local level and have in many of the European countries funded and promoted *pescatourism* as a means of sustainable diversification for fisheries communities. Their strategies and activities have been a major drive for *pescatourism* in Europe, however, the effectiveness of the FLAGs and the development of



*pescatourism* greatly depends on current legislation framework for *pescatourism*, demand of the tourism sector and decision-making processes in each MS. Only **Italy, France<sup>32</sup>, Portugal (autonomous region of the Azores), Greece, Spain and Cyprus**, have some form of legal framework for *pescatourism*, while there is a lack of clear legislation in rest of the EU countries.

**Southern European Countries** are an international tourism hub (UNTWO, 2018) and coastal and maritime tourism contributes an estimated value of €25.3 billion, which is 40% of the total Blue Economy GVA of the Mediterranean.<sup>33</sup> Mediterranean origins of fisheries-related tourism can be easily understood by considering the optimal climate, local tradition, experience and the well-known cultural heritage of the region, making it a very attractive area for tourists for example in Italy *pescatourism* has been in existence for about twenty years (Piasecki, W., et al, 2016). The tourism sector, therefore, offers a starting point and main driver for the development this MU in the Mediterranean countries. The combination tourism, fisheries and environmental protection exist (including pilots) in six out of eight Mediterranean countries including **Italy, Spain, France, Cyprus, Greece and Malta**. The MU is also proposed and planned in **Croatia and Slovenia**.

### *Tourism and fisheries - Pescatourism*

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In many of the Mediterranean countries, *pescatourism* involves a tourist boarding a real fishing boat where they engage and observe the daily professional fishing operations, and to participate in activities that take place on board with the commercial fisher becoming a tour guide. Another form of *pescatourism* is developing where regulations and licences are given for fishing vessels to be rented out to tourist (mostly anglers) to perform fishing activities. This type of *pescatourism* has been located in Cyprus around the Zygi Village (Larnaka District) and in Pafos.

In **Italy**, *pescatourism* has been formed mainly with the aim of protecting marine resources, limiting coastal erosion and degradation of coastal environment and lagoons, reducing overfishing, promoting the consumption of lesser known species, enhancing old fishing methods and integrating the most vulnerable groups in the labour market (Saba 2015). It has advanced to a level where the experience has been used as a model to start similar activities in other countries (Cataudella, C. and Spagnolo, M., 2011) and the model has been documented in a manual “*Manuale di Pescaturismo – Manual for Pescatourism*” (Ministero delle Politiche Agricole e Forestali, 2005). *Pescatourism* in Italy, is now regulated under the Decree No. 293 of the Ministry for Agricultural and Forestry Policies of 13 April 1999. Currently, tourists have an option to spend a day or more in the house of a fisherman, renting a room and having traditional and local meals with his family and getting involved in the everyday routine/chores of the fishermen. This new and extended form of *pescatourism* is called *ittitourism* based on exploring local social-cultural fishing activities closely linked to coastal communities and the sea.

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<sup>32</sup> A ministerial report on the development of fishing tourism (*pescatourism*) is being undertaken in France (Ministère de l'environnement, de l'Énergie et de la Mer, 2017). Other policies such as the *National Strategy for the Sea and Coast* consider aspects of this MU [https://www.ecologique-solidaire.gouv.fr/sites/default/files/SNML%20version%20ENG\\_MTES.pdf](https://www.ecologique-solidaire.gouv.fr/sites/default/files/SNML%20version%20ENG_MTES.pdf) [19 October 2017]

<sup>33</sup> See further at: <https://sustainable-tourism.interreg-med.eu/news-events/news/detail/actualites/thematic-paper-1-identifying-challenges-and-gaps-towards-sustainable-tourism-in-the-mediterranean/>



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Pescatourism activity in **Sardinia** is very well developed and serves as a best practice for other European nations and regions. The fishing sector in Sardinia has taken advantage of the constant growth of the tourism sector and high quality and level of accommodations and restaurants to develop *pescatourism*. Tourists are also involved in land-based activities such as visits to aquaculture sites and offering opportunities to eat freshly caught local fish in restaurants run directly by fishing associations. A research illustrated that out of a sample of 105 tourists that were surveyed in Sardinia, 82% assigned a maximum score of satisfaction. The most significant attributes in shaping maximum satisfaction level by tourist in Sardinia include the demonstration of fishing (activities carried out linked to fishing); land excursion (activities carried out not linked to fishing); traditional recipes used to prepare the fish for lunch (food experience) (Lai et al. 2016). The Sardinia East Coast's FLAG local development plan also targets some priority areas and actions to develop *pescatourism* such as increasing the value added of fish products, development and protection of the environment and local cultural heritage, upgrading and integration of tourism supply and skill enhancement and empowerment of fishermen. In this particular case, it can be realised that the link between *ittitourism* and *pescatourism* has led to the development of this MU for example the Tortoli Fisherman's Cooperative welcome about 30,000 visitors per year.

In 2004, Italian enthusiasts of *pescatourism* established the PescaTour—a national association that promotes fisheries related activities particularly *pescatourism* and *ittitourism*. PescaTour and the Fisheries Local Action Group (FLAG) of Eastern Sardinia are working together in order to present a European legislation draft on *pescatourism* to ensure that all coastal fishing communities can reap the same benefits and through the application of best practices applied in Italy in order to bridge the gap of experience gained in the last two decades.

In **France**, *pescatourism* has been formed as part of sustainable local development for maritime space. During this activity, the person on board is not authorized to fish but justifies his/her presence by the desire to discover the profession of fisherman. Thus, *pescatourism* contributes to the valorisation of the profession and to public awareness. A number of projects have been carried out in France in cooperation with the FARNET to develop *pescatourism* including Equal/DEFIS (2006–2007), PRESPO (2009–2011), Pescatourisme 83 (2009–2011), and PescAtlantique (2012–2013 and 2014–2015). The development of *pescatourism* has been mainly strengthened by the pilot project Pescatourisme 83 which was set up in the Var department. However, a decline in *pescatourism* activities have been realised after the end of these projects and *pescatourism* currently only existing in the Arcachon Bay and Basque-Sud Landes Region. In the Archon FLAG, 11 fishermen have diversified their activity into tourism and more than 1159 tourists undertook *pescatourism* in 2014.

The MUSES Project identified 4 coastal areas where *pescatourism* is being undertaken as demonstration/pilot sites including: (1) Corsica, (2) Etang de Thau et sa bande côtière de Frontignan à Agde (Languedoc-Roussillon Region), (3) Pyrénées – Méditerranée and (4) various coastal areas in Provence Alpes Côtes d'Azur. Pescatourism as an activity is a legally regulated and can only be practised under well defined conditions. As a result, the owners of professional fishing- or fish-farming vessels must hold an authorization on their navigation permit issued by the Departmental Directorate of Territories and the Sea (DDTM). Some regulations about *pescatourism* have been seen as too restrictive for example in the French Mediterranean fewer fishermen practice *pescatourism* on a regular basis due to compulsory regulations related to safety, training, medical skills amongst others





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which they consider as too costly. From a taxation point of view, *pescatourism* is not subject to VAT if the fishermen's activity fits within the same tax interval as their fishing activity, provided that their annual revenue from *pescatourism* does not exceed EUR 32,000 and does not account for over 50% of their annual income. As a result, the development of *pescatourism* in France is a matter of diversifying fishing activity and not of reconversion of profession.

In **Spain**, initial experiences and pilot projects of *pescatourism* were formed with the aim of promoting economic activities complementary to fishery to deal with problems derived from the reduction of the fishery resources and to show the complexity of fishing to the society. Fishing and seafaring tourism are regulated by National Maritime Fisheries Law (33/2014), which introduced the diversification of the fishing through tourism. Modifications to the national law with reference to *pescatourism* was also informed by the SAGITAL Project. In Roses (Girona), the project Roses Vila Mariner is considered as an example of good practice that brought together different activities related to fishing where two different activities of *pescatourism* have taken place first one on board a trawler during a full fishing day and the other on board a craft of minor gear, trammel and longline, In Cambrils (Tarragona) and in Palamós (Girona) pesctourism trips are offered to tourist and recent regulations on *pescatourism* is expected to lead to its development and advancement in other areas.

In **Portugal**, tourism related to fisheries has been partially regulated since 2007 and it has been practically limited to the autonomous region of the Azores (Molina García 2013). The Regional Legislative Decree No. 36/2008 established the legal framework for *pescatourism* in the Azores and in the Portuguese Exclusive Economic Zone. Decree No. 36/2008 defined aspects of the *pescatourism* operation such as identification of the maritime-tour operator, the boat to be used, allowable area of operation, insurance policy, identification of the point of embarkation, fishing gear and group of species with authorized catch. The number of tourists on a single boat should not exceed 12 people and children under 16 must be accompanied by parents or legal guardians. Although *pescatourism* is not regulated in Portugal mainland MUSES interviews identified this activity around the main ports of the Algarve: Sagres, Portimão, Albufeira, Vilamoura, Faro, Olhão, Tavira and Vila Real de Santo Antonio as well as in along Ria Formosa and Costa Vicentina.

In **Greece**, *pescatourism* is practiced under Law No. 4070/2012 entitled "Arrangements on electronic communications, transport, public works and other provisions" referring to Fishing Tourism and the Common Ministerial Decision (CMD) nr 414/2354-2015 describing conditions, terms and procedures for practicing fishing tourism by professional fishers. Also, there is a mention of such MU practice in other legal frameworks and strategies about tourism and environmental protection. Since the adoption of the law, more than 60 *pescatourism* licenses have been issued. Two major initiatives from fishers launched in Corfu Island, and in Astro Kinourias-Peloponnese Peninsula. Both initiatives are supported by an electronic platform for booking online fishing trips in Greece<sup>34</sup> with several Facebook pages which gives information on *pescatourism* in various locations in Greece (e.g., Corfu, Skiathos, Paros, Naxos and Crete).

Current regulations in **Belgium, Germany, Denmark, Ireland, the Netherlands, Poland, and Slovenia** do not allow tourists on board of active fisheries vessels during their operation (Anonymous 2013a). In these countries, FLAGs and other concerned fisheries organizations exert pressure on the

<sup>34</sup> Platform available at: <http://www.fishingtrips.gr/en/>



authorities to allow *pescatourism*. **Bulgaria, Estonia, Finland, Lithuania, Latvia, Romania, and the UK** have not excluded the possibility of *pescatourism*. However, their national regulations, have not been specifically tailored for this type of activity. Consequently, before a vessel can be used for this MU it would need to meet strict safety, accommodation, and sanitary standards for both fisheries and passenger vessels at the same time. This could be very costly and would render the whole activity and MU unprofitable.

### *Pescatourism (or fisheries/tourism) occurring within Environmental Protection areas*

Pescatourism or (fisheries/tourism as single sectors) in some cases occur in **environmental protection area**. These environmental protection areas sometimes form a MU on their own based on various human activities, such as fisheries and tourism, permitted within zoned areas especially MPA's and Biosphere Reserve (see the Iroise Marine Nature Park and the "Vama Veche Marine Reserve"<sup>35</sup> example). Biosphere Reserves for example goes through a revision process every year to keep its status and this assess uses in the various zones while MPA regulation sometimes differ across MS and the monitoring approach applied is dependent on international or national process which can inform their effectiveness in encouraging MUs. Although, fishery and tourism as single uses compete for the same maritime/coastal space and resources, certain principles of multiple used protected areas<sup>36</sup> including the following foster synergies between uses:

- Consideration of maritime uses internal and external to the marine protected area to enhance connectivity of ecosystem services and uses;
- Promotion of local traditional and social values uses such fisheries through management plans, legislation and practices of the MPA/Biosphere reserve;
- Zoning plans are used as management tool to order the location of uses. E.g. Biosphere Reserves enhance coexistence of activities of sustainable use by establishing interrelated zones, known as the core area, the buffer zone, and a transition zone or 'area of cooperation';
- Preliminary research, education, training and survey about sustainable uses and areas for protection;
- Stakeholder participation and coordination between actors.

In **France**, the tourism and fishing including pescatourism have taken advantage of national MPA's designations, such as the Iroise Marine Nature Park and MPA along the coasts of Marennes and Oléron Island, to ensure that human activities are compatible with conservation measures in the MPA. **The Iroise Marine Nature Park** case presents how MPAs are created from the onset to protect the marine environment in combination with other uses including sustainable fisheries, tourism and UCH. The marine park is designed for multiple uses and synergies with environmental protection. It largely applies the multi used protected area and zoning principles in a small area where regulations look at creating sustainable livelihoods and economy through stakeholder engagement and local governance. Key factors about the Iroise Marine Nature Park in MU development include:

<sup>35</sup> See further at: <http://www.rmri.ro/VV2M/index.html>

<sup>36</sup> See further at: <https://portals.iucn.org/library/sites/library/files/documents/MRN-008.pdf>





- The MPA is large enough to take certain ecosystems and uses into account in its entirety with neighbouring areas, range of uses and local challenges strictly considered;
- The legal text governing the creation of a Marine Natural Park (created by the Act of 14 April 2006), does not contain any specific provision limiting or banning activities within that area;
- The management board have responsibility to propose new regulations and can restrict some activities in a collaborative process with stakeholders, State and public authorities and organisations involved in the management of the park;
- The management board also have the competencies to grant permission for development projects and licenses that may have an impact on environmental conservation objectives of the park.

A similar situation can be realised in **Spain** where pescatourism activities are popular in the marine sanctuaries such as Isla Graciosa, Isla de Tabarca, Isla de la Palma, and La Restinga in the Atlantic. Fishing tourism has also been developed in areas of Portugal including (Vilanova de Milfontes, Aveiro (regeneration of traditional fisheries), Sesimbra, Viana do Castelo and Peniche). In **Italy** 43 pilot sites exploring eco-tourism activities and traditional coastal activities such as fishery/aquaculture have been identified in areas such as Northern Adriatic Sea. Some of the FLAGs in Italy have also been formed around existing MPAs (e.g. the FLAG of Costa dei Trabocchi that works along the Gargano National Park and the MPA of Tremiti Island in Foggia, Italy) and help artisanal fishers to diversify into complementary activities, such as pescatourism, improve their marketing activities and engage in direct sales.

In the **Black sea**, due to various marine environmental problems including eutrophication, pollution from industrial and agricultural sources, biodiversity loss, coastal degradation, there exist many MPAs and around 50% of the Black sea coast and part of the marine waters of Bulgaria and Romania are Natura 2000 sites. Environmental protection is therefore a political priority and there is a high level of ecological awareness of the local societies. This provides economic and policy incentives for developing recreational and tourist activities that are in line with the environmental protection goals in these sites. Soft uses such as sustainable tourism in MPAs can be seen as desired direction of blue growth. Coastal and Maritime tourism is also a key sector for these MUs generating a GVA of EUR 0.77 billion and the highest maritime employer. This provides both economic and policy incentives for MU combination as shown by environmental protection found in most MU combinations, identified in Bulgaria and Romania. These environmental protection sites with rich and pristine marine environment attracts number of visitors.

The MU combination in the Black Sea exist in **Bulgaria**, near cape Kaliakra and in **Romania**, in the Danube Delta Biosphere Reserve and the "Vama Veche - May 2" MPA. For instance, the Bulgarian marine protected area "Complex Kaliakra" (consists of three Natura 2000 sites north of Varna, south to the Romanian border) offers various tourist attractions e.g. visits to archaeological sites, caves, golf and spa clubs, holiday resorts, etc. Fishing is permitted, but only with boats without engines. The preserved natural environment and historical heritage within the reserve areas in the Kaliakra are an attraction for tourists, while the option for recreational fishing with the use of non-mechanised boats and the high-water quality attracts artisan fishermen.



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The **Marine Reserve “Vama Veche – 2 Mai”** is located in the southern part of the Romanian Black sea waters, right next to the border with Bulgaria. The Vama Veche as a Natura 2000 site of Community importance (SCI). It covers an area of 12, 311 ha close to the southern border of Romania with Bulgaria. The reserve aims at the conservation of critical habitats and endangered species; protection of habitats and species of interest for tourists; increasing fishery productivity; deepening the knowledge of marine ecosystem; promotion of cross-border cooperation and cooperation with civil society on sustainable coastal development. The National Institute for Marine Development Research "Grigore Antipa" took over the custody of "Vama Veche - 2 Mai" in 2004.

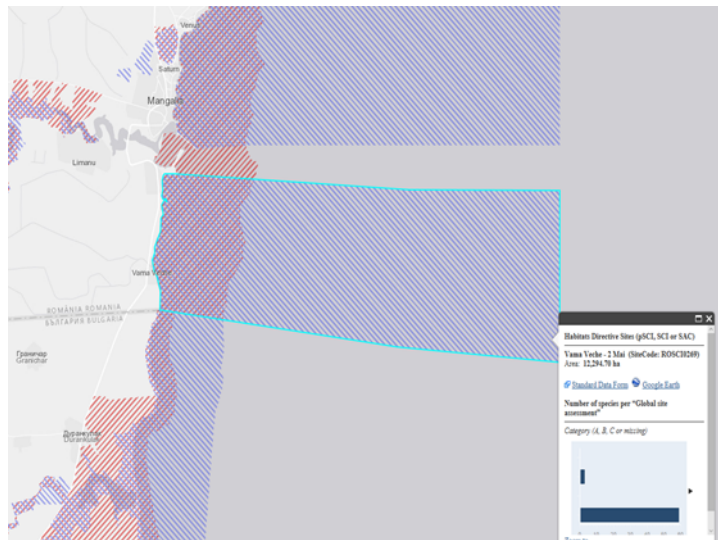


Figure 7: Map of Marine Reserve “Vama Veche – 2 Mai” (Source: EEA)

There are two zones in “Vama Veche – 2 Mai” Reserve, Zone A: Special Protection Area and Zone B: Buffer area. Only lifeguard services, scientific research and monitoring and access of the Custodian, Coast Guards and Navy Ships and rescue ships on missions are permitted in Zone A. Slightly more activities such as artisanal fisheries and tourism with the use of non-mechanised boats are allowed in the Buffer Zone, also known as “sustainable management area”.

The combination of artisan fishing with nature conservation seems beneficial for both users (e.g. less competition from large scale fishery). Resources for management and development of “Vama Veche – 2 Mai” are provided for in the Management Plan of the Marine Reserve. Advantages of the MPA that has supported MU include raising public awareness through educational courses on environmental protection in schools and public awareness in nearby villages. Again, there has been the cooperation between stakeholders was improved including support in the management and monitoring of the reserve

In the **Danube Delta Biosphere Reserve (DDBR)** mild economic activities are allowed in the Economic zone which is the area that lays outside the Core and Buffer zone. These activities are strictly regulated and authorised by the DDBR authority. Tourists are subject to an access permit and an entrance fee and limited to the use of small capacity boats with electric propulsion. However, this setting allows for flourishing touristic activities including amongst other, residence in eco-friendly floating hotels, rowing trips in the reserve and hikes along the coastal dunes. Moreover, sport and recreational fishing activities are allowed in designated locations within the reserve. The main reason for tourist attraction in this case is the natural landscape as preserved within the DDBR.



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## Actors, Drivers and Barriers of MU

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Relevant actors to drive this MU are the various departments/ministries and regulators responsible for these sectors. Their role is important in setting up a clear legal and regulatory framework especially for *pescatourism*. Analysis from the MU cases across the sea basins shows that the role of the FLAGS in relation to the European Maritime Fisheries Fund is also critical as they support investments contributing to the diversification of the income of fishermen, with special attention of tourism opportunities. However, the creation of clear legal framework especially for *pescatourism* is important for the work of the FLAGS to promote and develop this MU. For example, since 1999 Italian fishermen involved in *pescatourism* have received less restriction and more appropriate regulations which has enhanced the security and hospitality of tourists on board. Social and economic drivers also include the increasing interest and demand for consuming local fish products and for an experience-based tourism, which are both offered by *pescatourism* activity.

Another major driver for this MU is the institution of a management plan for environmental protection sites, which support combination of uses, and the economic gains related with single uses. (E.g. tourism growth, diversification of fisheries and reducing pressure of industrial fisheries). Management plans for Iroise Marine Nature Park in France and the Danube reserve serve as a major driver for this MU. There are also funding at the national and local level in France to support such management plans and MU.

Main barriers for the development of this MU include vague legal framework and administrative procedures such as licensing, security of passengers and the resistance of small fishing communities to diversification which was realised in case study in Italy (Northern Adriatic) and the Azores (Portugal)<sup>37</sup>. There are also restrictions about the number of passengers that can be taken on a vessel which makes this combination unattractive for mass tourism. For example, the Italian and Portuguese law specifies that only a maximum of 12 people can be taken on board a single vessel. In some countries, such as Portugal, main land there is no legal context defined for the MU. Other barriers pointed out by MUSES analysis (at the level of case study or sea-basin) include: fragmentation of fishery operators, lack of skills enabling fisherman to properly interact with tourists and lack of entrepreneurship. Lack of knowledge about possibilities and benefits of MU still exist. A specific barrier to the development of this MU in Bulgaria is the long-lasting problems with the strict regulation of local estates (ownership of private property) and the lack of initiative of local government to solve this problem.

Again, knowledge and technology to develop this MU are generally available but not used extensively which allow new users to be involved based on results of MUSES case studies in Portugal and in Northern Adriatic.<sup>38</sup> MUSES case study in the Northern Adriatic also pointed out that linking *pescatourism* activity at sea with the offer of food on land (e.g. through *itti-tourism*) could help promote this combination. Other virtuous links can be created between *pescatourism* and other land-based activities involving fishermen, as principally commercialisation of local fish products (0 nautical miles products) or involvement of fishermen as guides for visits to museums of the sea and navigation.

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<sup>37</sup> See Case Study 3 and 6 reports at <https://muses-project.eu/downloads/>



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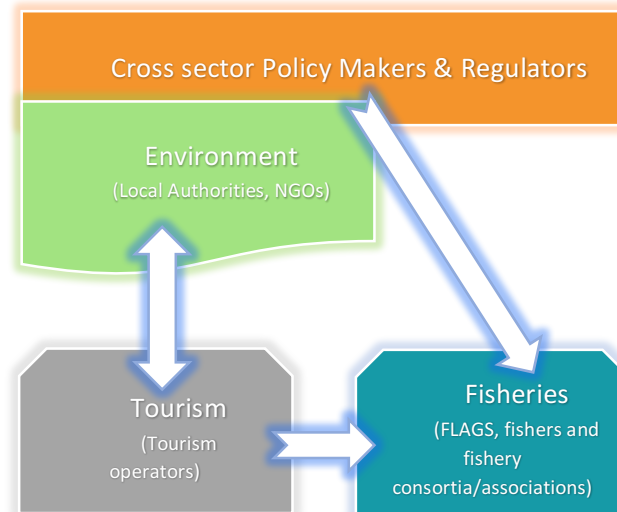
## Main Actors, Drivers and Barriers of Environmental Protection, Fisheries and Tourism MU

### National Level

- ✓ Fragmented and vague legal and permitting framework
- ✓ Diversification of Tourism
- ✗ MU not feasible for mass-tourism

### Local/Case Study Level

- ✗ Case study indicates lack of support and resources for tourist infrastructures e.g. nautical facilities to reduce conflict and collision



### EU/Sea Basin Level

- ✗ Strict EU regulation and technical requirement concerning security of passengers on the vessel

### Local Level

- ✓ Opportunity for maintaining their culture, and public awareness about the fishery sector

- ✗ Limited financial incentives for the implementation (adaptation of boats)

### EU/Sea Basin Level

- ✓ EU/Sea basin level funding through EMFF, INTERREG, LIFE funding, FARNET Network, FLAG Support

### National/Local Level

- ✓ Driver towards the diversification of the fisheries and tourism sectors
- ✓ Legal framework, policies and management plans at national/local level support this MU
- ✓ MU can support the recovery of fish stocks and increase acceptance for fish restrictions due to alternative revenue schemes
- ✗ Possible conflicts and environmental impact as there is less

The economic drive to indulge in tourism and environment sectors are driving this MU. The socio-economic drive to indulge in tourism (diversification of tourism offer) by fishers and the legal and management approach provided by environmental protection are the main factors driving this MU. Cross sector policymakers and regulators are the main actors to drive this MU. More fishers and tourist operators would indulge in this MU if they were able to acquire the necessary permits, skills and requisite facilities.



## General Conclusions

- The tradition, history, knowledge, use of similar resources and coastal space by the fishery and tourism sector provide the necessary technical and socio-cultural preconditions for the implementation of this MU;
- Diversification of tourism offer is important especially in the Mediterranean to increase competitiveness on the global market and promote sustainable tourism. However, the lack of capacity of small case fishery communities and in some case their resistance to change might limit the development of this MU as was realised in case studies in Portugal and Northern Adriatic. Synergies and acceptance by fishers can be enhanced through training and entrepreneurship capacity-building for fishers;
- Fragmented and vague regulatory framework mostly on *pescatourism* activities is a major barrier for this MU. There is fragmentation and variations in the legal framework for *pescatourism* across European countries for example while its considered as a professional activity in Italy, it is classified as an occasional activity for fishers in France. Some form of harmonisation of national and regional legislation, policies and management plans that integrates *pescatourism* and guidelines on its implementation are important in advancing the MU;
- There is a knowledge gap and lack of understanding of the actual demand and value of eco-tourism oriented MU potentials and business cases that showcases *pescatourism*. Existing knowledge and technology to develop this MU are also not used extensively. Efforts to understand and develop the value chain of *pescatourism* should be supported to advance the MU;
- Linking *pescatourism* activity at sea with the offer of food on land (e.g. through itti-tourism) could help promote this combination as has been exemplified in Sardinia (Italy);
- Active and early engagement of the FLAGs during the designation, design and implementation of area based approaches and integrated local development strategies is crucial for this MU.



## 5.2 Tourism and Aquaculture

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### MU Overview

### SEA BASINS & CASE STUDY

**Tourism and Aquaculture** MU combination comes about through the diversification of tourism offer through the involvement of tourist in aquaculture activities. The provision of fresh (and local) farmed fish and mussels through aquaculture is an important asset for tourism, and a contribution to the national self-sufficiency in food production. The MU combination also contributes to tourism development through diversification of the touristic offer. The first form of this MU combination is similar to *pescatourism* but it is slightly different in its operation as it involves the boarding of people on aquaculture vessels to visit plants and learn about aquaculture techniques and tradition. The second form involves diving/snorkelling tourism, which could be practiced next to aquaculture farms, where a rich fauna can be observed. When sport fishing tourism (mainly angling), is practiced next to mussel aquaculture plants in marine spaces which normally function as attractive areas for a number of fish, the third form of the MU combination is also formed.

### Existing cases and good practices

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This MU combination has been identified in **Greece, France, Portugal, Slovenia, Italy and Malta** through the MUSES project. These types of MU combination were specifically identified through the MUSES a case study in Northern Adriatic (Castellani, C. et al., 2017), including Veneto and Emilia Romagna (Italy). In Emilia Romagna, the regional law (LR 22/2014) goes beyond *pescatourism*. It also provides a clear definition and specifies the term “*Acquiturismo*”, meaning aquaculture-related tourism which refers to the hosting of tourist for recreational, educative and cultural activities aimed at ensuring water quality and sustainable aquaculture activities. An active experience of this combination is located in the Cavallino-Jesolo mussel plant (northern area of Veneto region in Italy), where sport-recreational fisheries and guided tours, are occurring within the area used for aquaculture. In Slovenia, touristic and educative activities are offered by aquaculture farmers in the Piran bay. The same site in Piran bay is also an example of this MU since the site is located in a protected fishing area and natural park. The farmers also participate in research projects concerning several environmental and biological issues.

In Greece, this MU has happened in the past at Rodos Island where an aquaculture developer was accepting tourists for educational purposes and perhaps for fishing from the cages. This MU is quite specific in areas of the French Atlantic including Charente-Maritime, Arcachon and Sea of Iroise, the Gulf of Morbihan and the Bay of Brest. In the Spanish Atlantic, specifically in the Ria de Arousa (Galicia) mussel aquaculture companies interact with tourism companies by contracting tourist vessels for various operations related to aquaculture activities. Aquaculture tourism and seafaring tourism in Spain are regulated by Law 33/2014, modifying Law 3/2001 de National Maritime Fisheries, which introduced the concepts of diversification of aquaculture and the fishing activity through tourism in the national law.

In Malta, there is an activity called Tuna Dive that includes organized diving in open sea Tuna Farming Cages that are located 1 mile offshore and hold large numbers of Giant Blue Fin tuna. With



this activity, the divers get the chance to get in the floating net - organized diving in an open sea Tuna Farming Cage<sup>39</sup>.

The main challenges from the planners' side are the fact that there are no case studies, business models in the Med and that there is absence of adequate regulations related to insurance against accidents. Additionally, this is a niche market and the interest from the tourism industry to take this further appears to be low.

### Actors, Barriers and Drivers

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The barriers and drivers for these MU combinations are in general similar to *pescatourism* (see section 6.1). Some of the main drivers include availability of funds (EMFF) to diversify the aquaculture sector, the role of FLAG in promoting this diversification and the high demand for an experience-based tourism. Other barriers are related to technical (e.g. lack of skills to properly interact with tourists) and business (fragmentation of operators and lack of entrepreneurship) capacity.

#### General Conclusions

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- These developments are so far implemented on a small (recreational) scale and their further development should be carefully estimated on case by case basis as the hanging reefs do not necessarily imply environmental benefits;
- The possibility of developing multi-functional sites (including tourism and environmental protection) in connection with aquaculture plants is an interesting and promising idea for the potential development of MU between aquaculture and tourism. In that sense, equipped areas for diving, snorkeling and/or sport fishing could be associated to aquaculture plants, where small touristic infrastructures can be put in place.

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<sup>39</sup> More information available at: <http://www.isletourismalta.com/swimming-with-tuna/>  
<http://www.scubadivingmalta.com/recreational-diving/?scuba-info=tuna-dive>

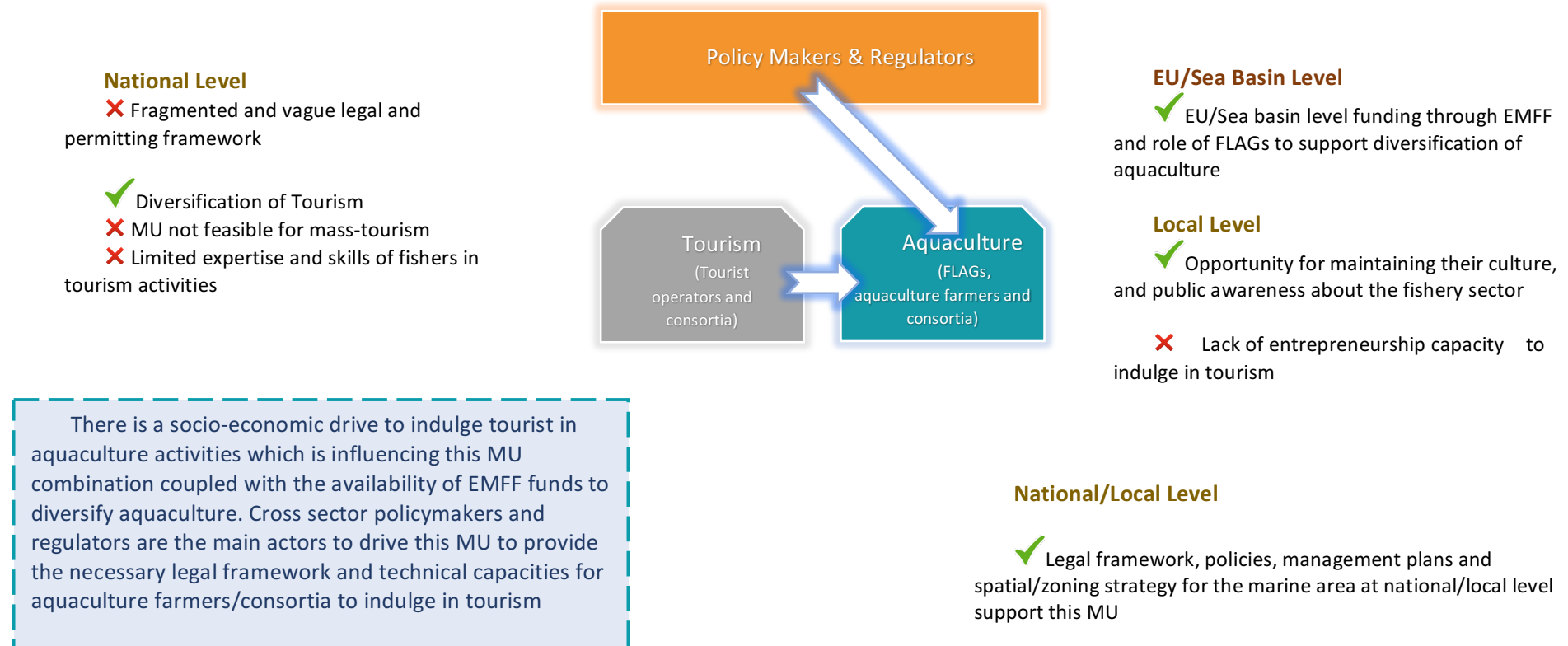




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## Main Actors, Drivers and Barriers of the Tourism and Aquaculture MU







## 5.3 Aquaculture and Environmental Protection

### MU Overview

### SEA BASINS

**Aquaculture** including seaweed, shellfish, finfish or multi-trophic aquaculture in some cases co-exist with **environmental protection** areas especially at the local scale. Environment protection areas and measures for this MU are normally through legal designation given to the areas such as MPAs and Natura 2000 sites. Over 5% of Natura 2000 sites have been reported to host aquaculture activities at the time of their designation.<sup>40</sup> Both sectors need and aim to maintain a good water quality of the site and this is considered as an important environmental driver which can promote co-location of aquaculture in environment protection areas.

There are interesting examples of win-win coexistence between aquaculture and Natura 2000 sites especially in cases where the aquaculture installations like ponds have served as suitable habitats for important marine species. Aquaculture is also considered to have acted as an instrument in nature management and conservation, thereby invoking positive effects on maintenance goals (Smaal et al, 2010). In many of these sites, aquaculture has been practiced traditionally and is considered compatible or has adapted its operation to the conservation needs of the sites.

### Selection of existing cases and good practices

There are many well-known Natura 2000 areas in Europe where aquaculture activities are currently taking place sustainably, such as the Wadden Sea in the Netherlands (see example below on Mussels seed collection system), Arcachon in France, the Sado Estuary in Portugal, Doñana in Spain, shellfish culture in England and Wales and several Lochs in Scotland.

In 2009 a policy was developed for **seed mussel collection systems in Natura 2000 sites in the Netherlands**. The mussel fishery sector, government and nature organisations have agreed to phase out traditional methods and make room for the alternative collection systems. The Government has initiated an open plan process together with all parties concerned (fishery and recreational sectors, nature organisations, provincial authorities) to draw up policy for 2010-2013. This involved selecting suitable locations for seed mussel collection systems. Some 890 hectares in Natura 2000-sites Waddenzee, Oosterschelde and Voordelta were designated as potential locations. Apart from nature, other interests relating to recreation, safety and archaeology were also weighed in the selection process. The Government carried out an appropriate assessment of the potential locations. The assessments were based on a worst-case scenario. The ecological effects of the seed mussel collection systems on the seabed, birds and seals were studied.

In **Denmark**, sea-gardens are projects are making it possible for people to develop small-scale aquaculture production of shellfish and seaweed to provide locally produced marine products in their 'back yard'. So far MUSES project has identified only two existing examples of the aquaculture – sea gardens in the Natura 2000 areas, both in Denmark:

- ✓ Horsens Fjord, Ebeltøft Vig (established in 2013, more than 80 members).

<sup>40</sup> See further at <https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/guidance-aquaculture-natura2000.pdf>



- ✓ The Limfjord – Alborg, Løgstør, Nykøbing Mors and Lemvig harbours (sea gardens in the Limfjord are being established through the cooperation between Limfjords Council, Orbicon A/S, and the Danish Shellfish Centre)

These high quality environmentally friendly seafood products can be consumed by the co-op members, or can be used as the basis for development and sale of locally produced marine products. Hence, the sea-garden project is set up to provide a basic platform for small-scale personal or small-business aquaculture production. At present, this is most often in the form of long-line aquaculture structures, well known from production of mussels and seaweed in rope cultures. Each member of a sea-garden co-op are allowed to use a pre-determined length of the long-line for their own production. Sea-garden activities are financed by the members of the association and supported by funding from local authorities. In regard to **sea gardens** – recreational and association-based production of shellfish and seaweed in coastal waters and fjords, applications for permits must be forwarded to both, the Danish Coastal Authority and the Danish Agrifish Agency. However, there is very low commercial activity when it comes to sea gardens. According to Andersen, P. et al. (2015) possible future developments in relation to sea gardens as marine shelters and artificial reefs are:

1. Establishment of floating shelters/platforms in the sea-garden for:

- Camping;
- Attachment of production units;
- Visitors/observation/snorkelling/fishing.

2. Establishment of an artificial reef on the sea-floor:

- Increase local biodiversity;
- "Sea ranching" of e.g. black lobster;
- Recreational diving.

According to the Danish Maritime Authority (2017), the advantage of collocating sea farms/aquaculture and environmental protection is its potential to remove nutrients. Studies show that mussel and seaweed farms may include functions such as "hanging" reefs, serving as a protection and hiding area as well as a food base for fish and birds. This could be areas where a high degree of biodiversity is generated. Negative impact of seaweed in the form of shadow of natural vegetation might be examined in detail in connection with the new test seaweed culture at Northern Djursland. However, its actual impact is highly related to the specific conditions at the given space and should be assessed on a case by case basis.

Annual EIAs are conducted for each Natura 2000 site and in the Limfjorden before fishery on wild beds of mussels or oysters can be initiated. The Danish mussel and oyster fishery is managed by several regulations both implemented by government institutions as well as internal regulations within fisheries associations. The overall framework was implemented in 2012 as "The mussel policy", which states that the fishery should be sustainable and in accordance with the EU Habitat Directive. Furthermore, four key ecosystem components (eelgrass, blue mussels, macro algae and benthos) are designated in the Mussel Policy. For blue mussels, macro algae and benthos 15% cumulative area impacted by fishery is accepted, whereas for eelgrass it is 0 %.



DTU Aqua performs annual surveys determining blue mussel and flat oyster abundance and biomass, regular surveys of eelgrass and macroalgae in all relevant Natura 2000 areas. Data are used for impact assessment of fishery and contain sustainable quotas of either mussel or oysters, protected areas for eelgrass and an assessment of the effects of fishery on the species included in the Natura 2000 plan. Furthermore, the cumulative area affected by fishery is calculated by analysing black box data. The black box data shows where fisheries have taken place and how large areas that has been affected by logging the position of the vessels every 10 seconds and register any activity by the winch (starting or ending of fishing time)<sup>41</sup>.

**The Sado estuary, Portugal** is a Natura 2000 site that has no management plan at the moment but still host traditional human activities on the estuary (salt and rice production) and has several areas designated for molluscs' production. Arcachon Bay is the 6th largest Natural Marine Park in France and a genuine inland sea which offers an original way for tourists to discover oyster farming or sea-fishing and the traditional skills of the Bay where 14 oyster producers have diversified their activity into tourism.

In **Spain**, the Natural Park of Bahia de Cadiz, host several aquaculture installations within the environmental protected areas. In Galicia, Fisheries Protected Zones, especially in Rias Baixas host aquaculture sites with a specific focus on bivalves. The regional government have elaborated policy on the sector, which foresees compatibility with environmental protection and other uses. The autonomous government of Galicia has elaborated several policy documents on aquaculture to guide this important regional economic activity, being the first region in Europe to create a strategic plan for the aquaculture sector. The Master Plan for Coastal Aquaculture (Plan Director de Acuicultura Litoral in Spanish or PDAL) guides this activity planning and management till 2030. The Master Plan sets criteria for compatibility of aquaculture installations with the environmental, natural and landscape characteristics, besides areas for environmental protection. Other specific objectives of the Master Plan are establishing criteria to make aquaculture compatible with other coastal traditional activities such as fisheries and tourism; and the inclusion of the needed environmental conditions to make the activity sustainable, including the development of renewable energy, among others<sup>42</sup> (Xunta de Galicia, 2018).

### Actors, Drivers and Barriers

Drivers of **aquaculture and environmental protection MU** include the need to maintain a good water quality of the site and this is considered as an important environmental driver which can promote co-location of aquaculture in protected areas. Policy and economic drivers are similarly relevant, such as the development of environment protection areas and spatial/zoning strategy for the marine area which combines different uses in the same space and the existence of economic incentives in selling eco/green labelled products. Major barriers are related to possible cases of incompatibility of aquaculture with the existing regulations of marine protected areas which impose the exclusion of MU by law in specific zones of MPAs.

<sup>41</sup> See further at: [http://orbit.dtu.dk/en/projects/environmental-impact-assessments-of-mussel-and-oyster-fishery-in-natura-2000-sites-39241\(26a9d03b-038c-42f8-8c59-ca9654cdf1c7\).html](http://orbit.dtu.dk/en/projects/environmental-impact-assessments-of-mussel-and-oyster-fishery-in-natura-2000-sites-39241(26a9d03b-038c-42f8-8c59-ca9654cdf1c7).html)

<sup>42</sup> Xunta de Galicia. 2018.



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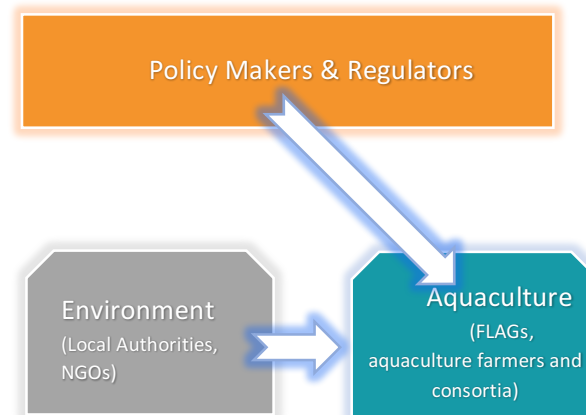


## Main Actors, Drivers and Barriers of the Aquaculture and Environmental Protection MU

### EU/Sea Basin Level

#### National/Local Level

- ✓ Need to maintain a good water quality of the site
- ✓ Legal framework, policies, management plans and spatial/zoning strategy for the marine area at national/local level support this MU
- ✓ MU can support the recovery of fish stocks and increase acceptance for fish restrictions due to alternative revenue schemes
- ✗ Possible conflicts and environmental impact of aquaculture activities



### EU/Sea Basin Level

- ✓ EU/Sea basin level funding through EMFF and role of FLAGS to support diversification of aquaculture

#### Local Level

- ✓ Opportunity for maintaining their culture, and public awareness about the fishery sector
- ✗ Lack of entrepreneurship capacity to indulge in tourism
- ✗ Competition with other coastal maritime activities

There is an environmental drive to combine aquaculture activities and environmental protection. Designation of environmental protection areas serves as a driver to combine this MU as when the two uses have been found to be using the same space. Aquaculture is considered as an instrument in nature management and conservation where both uses jointly ensure good water quality. Cross sector policymakers and regulators are the main actors to drive this MU.



## General Conclusions

- The fact that establishment of the recreational aquaculture reefs is possible in the Natura 2000 in Danish North Sea tells that this combination might be interesting for further examination in some other countries. However, the impacts are highly dependent on the conditions at the specific place. The location and siting of aquaculture is probably the single most important factor in determining its environmental impact. The ecological characteristics, e.g., biodiversity, ecosystem structure, dynamics and interrelationships of living communities may be distinct in different sites. Also, the conservation objectives are specific to each Natura 2000 site;
- The observed impacts of aquaculture on a given site are generally not directly transferable to another site, even under similar farming and environmental conditions since a number of parameters generate considerable variability in the observed effects.

## 5.4 Tourism, Underwater Cultural Heritage (UCH) and Environmental Protection

### MU Overview

### SEA BASINS & CASE STUDIES

Within the context of the MUSES project, the “UCH & Tourism & Environmental Protection” MU is defined as touristic and recreational activity combined with the protection of underwater archaeology and adjacent marine ecosystems. According to the UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001), this type of heritage includes all traces of human existence having a cultural, historical or archaeological character, which have been partially or totally under water, periodically or continuously, for over 100 years (UNESCO, 2011) or shorter periods, and based on a number of criteria proving that they are worth to be preserved and protected. The Convention has been ratified by 10<sup>43</sup> European MSs, while Denmark and Germany are planning to ratify in autumn 2018. At the same time, environmental protection refers to spatial or other conservation measures, set with the objective to balance ecological constraints and economic activity to assure continuous delivery of goods and services<sup>44</sup>.

When designating and establishing MPAs, the possible underwater archaeological components must be taken into account and their value must be considered when deciding the protection status of the area (according to the EU Habitat Directive 92/43/EEC<sup>45</sup> and national legislation). In some countries, like Denmark, similar requirements are applicable when designating/establishing UCH protected areas/sites. Here, the value of the habitats and species must be considered when deciding the UCH protection status of the area/site. Environmental protection is assured right from the designation of the UCH site. In all countries management plans foresee specific levels of protection

<sup>43</sup> See further at: <http://www.unesco.org/eri/la/convention.asp?KO=13520&language=E&order=alpha>

<sup>44</sup> (EEA, 2015a; EEA, 2015b; Smith et al., 2009)

<sup>45</sup> Directive available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31992L0043&from=EN>



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(according to the six IUCN categories for MPAs) and can allow touristic uses or prohibit them related to the value of the UCH or ecosystem. This approach is under permanent construction and can be handled flexible within the legal framework. The touristic activities, that UCH & Tourism & Environmental Protection MU involves, ranges from visiting the area by diving or with the use of glass bottom boats to museums on land showing the richness of cultural heritage in the near sea.

UCH benefits in most cases<sup>46</sup> from the conservation measures of environmental protection areas while tourism benefits economically from both sectors. The UCH sites provide shelter for fishes from fishing or other activities that can impact the sensitive seabed habitats. Tourists get access to UCH sites, which serve as a source of revenue for the economy. It is important to note that this type of MU is very much site specific and the physical and natural condition of the marine space. This can limit the popularity of this MU, as the random location of UCH may not always coincide with ecologically valuable areas. However, the level of entry into this MU is not high as initial costs are relatively low while it offers both, ecological and economic benefits.

### Selection of existing cases and good practices

The MU is most prominent and popular in the **Baltic (Estonia, Finland and Denmark) and Eastern Atlantic Seas (Spain, Portugal and France)**. The combination also has a good potential in the **Black Sea** after the HERAS project<sup>47</sup> was set up and jointly implemented by **Romanian and Bulgarian** research institutes and historical museums to explore shipwrecks and other underwater remains near their seacoast, and the opportunities for diving activities.

It has a strong and imminent potential in many countries of the **Mediterranean Sea** due to rich UCH sites, good temperatures and clear waters with great visibility. For instance, in **Greece** there are more than 20,000 shipwrecks (from one dating back 2.200 years BC to more recent warships of the 2nd World War), airplane wrecks, but also sunk ancient ports, temples, cities etc. Diving to see such wrecks is in place for example in **Cyprus, Greece and Spain**. Furthermore, the competent authorities of **Greece** have announced plans for the creation of 26 selected and organised UCH parks/museums to be combined with tourism activities and environmental assets. More precisely, there are three case specific Common Ministerial Decisions (CMD)<sup>48</sup> for the establishment of marine/ underwater archaeological sites or museums at specific locations open for visitors i.e. at Laurio and Makronissos, at the Sporades Islands (coinciding with the National Marine Park of Alonissos and Sporades) and at Pylos and Methoni (in the Aegean). However, these underwater museums are not operational yet<sup>49</sup>.

<sup>46</sup> In some cases, the strict protection of wetland results in the total coverage of Viking sites by reed in Denmark and Germany. Here, a compromise between the different agencies has to be found to ensure the protection of the environment and the preservation of the cultural heritage. The archaeological open-air museum in Groß Raden (Germany) with Slavic ringwall and village uses buffer zones to avoid conflicts with nearby settlements and nature conservation sites.

<sup>47</sup> See further at: [http://www.herasprojectcbc.eu/project\\_description.html](http://www.herasprojectcbc.eu/project_description.html)

<sup>48</sup> Greek CMD (ΥΠΠΟΑ/ΓΔΑΠΚ/ΔΙΠΚΑ/ΤΠΚΑΧΜΑΕ/Φ17/344762/203211/16908/4712) for the "Establishment of Underwater Archaeological Sites of Lavreotiki – Makronissos open for visitors", Greek CMD (ΥΠΠΟΑ/ΓΔΑΠΚ/ΔΙΠΚΑ/ΤΠΚΑΧΜΑΕ/Φ53/12387/6960/772/240) for the "Establishment of Underwater Archaeological Sites of Pagasitikos North Sporades open for visitors", Greek CMD (ΥΠΠΟΑ/ΓΔΑΠΚ/ΔΙΠΚΑ/ΤΑΧ/Φ41/176862/94489/11963/5535)- "Establishment of Underwater Archaeological Sites of Pylos and Methoni open for visitors"

<sup>49</sup> See further at: <http://tridentstar.gr/portfolio/%CE%BD%CE%BF%CE%BC%CE%BF%CE%B8%CE%B5%CF%83%CE%AF%CE%B1-2/>



One reason for that is that having civil servants as guides and guards to escort the divers individually as required by the CMDs, is economically not viable if the numbers of divers are low. New approaches to solve this issue have to be found. For Cyprus it was not possible to clarify whether this MU officially exists or is planned. The only well-known example is the high demand for diving to the wreck “Zenovia” (Cyprus, close to Larnaca) which is an indication of the interest from the tourist sector for such MU.

Because of its rich maritime history, **Malta** has a number of authentic wrecks that are highly regarded among the international diving community. Currently, these important historic shipwrecks are protected by the Maltese Cultural Heritage Act (2003) and the UNESCO Convention (2001)<sup>50</sup>. They are also „protected“ because they lie at depths not easy accessible to recreational divers. Furthermore, in Malta,<sup>51</sup> there are plans to pass a law that will enable the creation of a network of underwater archaeological sites, open for visitors. Such law will describe specific restrictions and requirements for the smooth operation of the network.

**In Italy**, the UCH sector witnessed a renewed interest in the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage and its ratification in 2010<sup>52</sup>. The MU demonstrated increasing potentials, mainly through the development of novel underwater video surveillance systems for research, education and promotion of the national archeological heritage (especially Northern Adriatic Sea). Examples of MU opportunities were identified in the Northern Adriatic like the ancient city of Nora (Southern Sardinia), a partially submerged Pre-roman settlement, where recreational diving takes place<sup>53</sup>.

The importance of this MU in the Mediterranean is also highlighted by the recent Interreg Mediterranean project “Bluemed” that promotes activities of planning, testing and coordinating underwater museums, diving parks and knowledge awareness centres in order to support sustainable and responsible tourism development and promote blue growth in coastal areas and islands of the Mediterranean.<sup>54</sup>

In the **Baltic Sea**, based on historical data, it is assumed that there are around 100,000 shipwrecks on the Baltic seabed. Specific physical conditions, including low temperatures, low oxygen content, brackish character with an absence of aggressive marine borders results in slow decomposition of organic materials in this sea basin<sup>55</sup>. In consequence, past and present UCH objects can be preserved in exceptional conditions as compared to other sea basins. The Baltic Sea has more MPAs than the EU average and the existence of many MPAs is an important factor enabling this MU combination, while tourism plays a proactive role as a component in the combination of this MU. In **Estonia**, there is

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<sup>50</sup> See further at:

<https://www.um.edu.mt/library/oar/bitstream/handle/123456789/9916/14BT0U020.pdf?sequence=1&isAllowed=y>

<sup>51</sup> See further at: <https://www.timesofmalta.com/articles/view/20171006/local/maltas-underwater-cultural-heritage-gets-some-government-tlc.659733>

<sup>52</sup> Secci M., 2017. Survey and Recording Technologies in Italian Underwater Cultural Heritage: Research and Public Access Within the Framework of the 2001 UNESCO Convention. *Journal of Maritime Archaeology* August 2017, Volume 12, Issue 2, pp 109–123

<sup>53</sup> <https://www.telegraph.co.uk/travel/destinations/europe/italy/sardinia/articles/Diving-in-Nora-Sardinia-the-sunken-road-to-Roman-ruins/>

<sup>54</sup> See further at: <https://www.researchitaly.it/en/projects/underwater-archaeology-the-activities-of-the-blued-med-project-begin/>

<sup>55</sup> However, in the Southern part of the Baltic Sea, higher salinity causing strong invasion of the shipworm, is a severe threat to those UCH not covered by sedimentation.





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cooperation between tourism sector (diving clubs) and National Heritage Board in development of regulation and developing easy and convenient ways for visiting unique and well-preserved underwater sites.

The Nordic Blue Parks<sup>56</sup> project being undertaken by Nordic countries including **Denmark, Finland and Sweden** also promotes this MU. For instance, in **Sweden**, the project uses existing underwater nature and cultural trails as examples in Sweden's Dalarö Blue Park (well-preserved shipwrecks from the 17<sup>th</sup>/18th century located Southeast of Stockholm). It serves as demonstrating example for other sites under development like Karlskrona World heritage site, the Dykpark Vättern dive park and a potential dive park in the Kalmar strait area. Access to protected wrecks is prohibited or controlled to avoid damage and licensed guides accompany divers. It is prohibited to dive to some specific, especially valuable wrecks.<sup>57</sup> Non-divers can access the UCH on-board of boats equipped with remotely operated vehicles (ROV) or on land through exhibitions organised by the local tourist office and the local historic community association. The similar Axmar Blue Park is more "web based" and the shipwrecks are not prohibited.<sup>58</sup>

In **Denmark**, the *Vikingskibsmuseet* (Viking Ship Museum) has made authentic reconstructions of the Viking ships discovered at Skuldelev (near Roskilde) and offers sailing trips for museum visitors in English and Danish. The new reconstructions are built in publically accessible workshop areas, so every step of the building process can be observed. "Adopt a Wreck" approach has been taken to include divers into monitoring activities at the Kings Bight at Daneborg. However, it is not implemented consequently like in the UK.

In collaboration with **Germany**, Denmark started a project in Flensburg Fjord to find synergies between nature protection, tourism and the traditional maritime community. This would set a precedent by including the intangible cultural heritage (cf. 2003 UNESCO Convention) in terms of a living maritime tradition, i.e. the operation of historical ships and their traditional usage of waterways.<sup>59</sup> **Finland** is particularly advanced with concrete cases of this MU combination especially in Kymenlaakso, Helsinki underwater park (UNESCO World Heritage site), Jussarö ship trap, and Kvarken archipelago. The Kymenlaakso regional MSP applied the MSP process and principles to promote sustainable nature and recreational tourism (Kymenlaakson liitto 2013) in combination with environmental protection and UCH. In **Poland**, there is a special system established by maritime administration that opens some wrecks for diving, and the number of trips to the wrecks from Polish ports has been growing at a fast rate for several years.

In the **Eastern Atlantic**, this combination exists along the Atlantic coast of **France and Spain and in Portugal** who all have ratified the UNESCO Convention on the Protection of UCH. The marine park of Iroise in **France** celebrated the MU combination as happening. Existing MUs in the **Atlantic Spain**

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<sup>56</sup> This is a joint initiative to protect their heritage and ensure public access to the wrecks. The project is led by the Finish Metsähallitus (a state company) and aims at formulating criteria and guidelines for sustainable blue trails and setting up trails to test the concept

<sup>57</sup> Wrecks older than 100 years can only be accessed with a single-use license provided by the relevant authority.

<sup>58</sup> The park includes an exhibition room telling the story of the cultural heritage underwater, accompanied by an information folder for divers and canoeists about the wreck sites. Additionally, 8 places in the area are marked with floating buoys with an information sign.

<sup>59</sup> For example, a revived historical regatta like the Kongelig Classic 1855.





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include the Islas Cíes (Galicia) and Bahía de Santander (Cantabria). The Roman Bou Ferrer shipwreck (Villajoyosa, Spain), a large sailing ship from the 1st century AD with a cargo of hundreds of amphora with fish sauce (garum) from Cadiz, was discovered in 2000. The team responsible for the diving tourists is composed of archaeologists who are working on the wreck. The regional government of Valencia initiated an in situ protective area to prevent pillaging. The level of protection, however, allows public access to involve sport divers and local communities in the protection of the shipwreck.<sup>60</sup> In Portugal, UCH sites have been identified around the Azores archipelago.<sup>61 62</sup>

### Actors, Drivers and Barriers of MU

The main actors with the power to develop an integrative policy for the development of the MU are the national authorities in charge of UCH and the other uses and their respective ministries and directorates. However, tourism clusters and businesses may be the main private actors to push for this combination being enhanced as was realised in Spain.

Different governance regimes, specificity of UCH sites and legal frameworks contribute to differences in drivers and barriers across countries and sea basins. However, policy and environmental factors including the discovery, recovery and protection of UCH sites, and increasing tourists' awareness towards environmental protection and UCH are mostly driving this MU combination. For example, in the Eastern Atlantic (**France and Portugal**) marine biodiversity aspects, UCH resources exploration and legislation such as the ratified UNESCO Convention on the Protection of the Underwater Cultural Heritage have driven this MU. In the Baltic Sea, **Finland** can be seen as a main driver for the regional planning process as it set goals to develop sustainable recreational and touristic use of Kymenlaakso sea area. Other driving factors promoting this MU include the provision of new jobs, due to new marine museums and information stands on land and the increase of local revenues related to tourist services and the better control in place regarding UCH. The Interreg project BalticRIM is explicitly analysing and preparing the way for new opportunities in the blue economy sector on local level, focusing on this MU.

In the Mediterranean Sea, where the risk of looting is very high, archaeological authorities are often reluctant to provide information and facilitate access to UCH sites. The main driver is tourism, since it seeks alternative activities and detects quickly attractive assets of these sites. Such interest, if accompanied by appropriate investments, could act as an incentive mobilising also UCH and environmental stakeholders (both preferring initially a protective approach for their field of responsibility). In contrary, in **Greece**, according to stakeholders, the most important driver are environmental issues. The multiple synergies between UCH and environmental protection and the need to achieve the 10% MPA target<sup>63</sup>, contribute to minimal destruction of submerged archaeological sites and to this MU. Other important drivers are socio-economic aspects like the increasing demand for eco- and heritage tourism and the increasing interest by local communities. On the other hand, the

<sup>60</sup> See further at: <http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/partners/diving-community/diver-access/>

<sup>61</sup> These include "Angra Bay" (Terceira Island) in 2005, "Dori" (São Miguel Island) in 2012, "Caroline" (Pico-Faial Channel) in 2014, and "Slavonia" (Flores Island) and "Canarias" (Santa Maria Island) in 2015.

<sup>62</sup> Stakeholders also identified some areas in Portugal mainland including the coastal areas between Sagres and Portimão and Ria Formosa and the Ocean Revival.

<sup>63</sup> It was agreed under both, the Strategic Plan for Biodiversity (2011-2020) and Sustainable Development Goal 14.



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most important barriers in Greece are legally: tourism is not allowed in underwater archaeological areas and those yet to be designated. Economic and social barriers include the lack of funds to start such initiatives like UCH centres and the lack of collective agreement and action that is required for the coordination of such MU due to numerous heterogeneous stakeholders. Other important social barriers are the fact that the success of this MU is restricted/dependent on weather conditions and the need of specialized skills (e.g. diving certification).

Human resources and technologies to design new equipment (e.g. vessels to observe the sea floor) are limited across sea basins. A good example of innovation for UCH has been indicated in the MUSES Northern Adriatic case study. Here, in Relitto della piattaforma Paguro (Paguro gas platform's wreck – SIC IT4070026) technologies such as vessels were used to observe the sea floor. The site, which is a wreck of an old gas platform is located in an MPA and attracts about 3000 scuba divers yearly. Similar drivers and barriers apply also for **Malta**. For **Cyprus**, most important drivers are the need for better control and protection (pollution incidents, marine litter), which is a high priority at national level.

Generally, there is no need for a mechanism to move tourism away from the original valuable UCH. However, in some specific cases where looting and / or destruction of UCH is a frequent fact, the selection of some UCH sites to open for visitors while leaving others closed (within or outside MPAs) is a way for improvement. Also, the approach to copy an UCH or create something new to steer tourists away from the original can help safeguarding especially valuable UCH.

Stakeholders from **Spain** highlighted the example of the Atlantic Museum. 15 metres under the sea in Lanzarote (Gran Canaria) 12 installations draw attention to global issues such as climate change, conservation and migration. One of the new installations, "Crossing the Rubicon", features 35 figures walking towards a gateway in a 30m-long, 100-tonne wall. The work is illustrative of the effects of climate change, and humankind's tendency to ignore responsibility towards it. The project, which has taken three years to complete, aims to create a visual dialogue between art and nature – the figures helping to form part of an artificial reef, which will act as a breeding site for local species of fish and plants.



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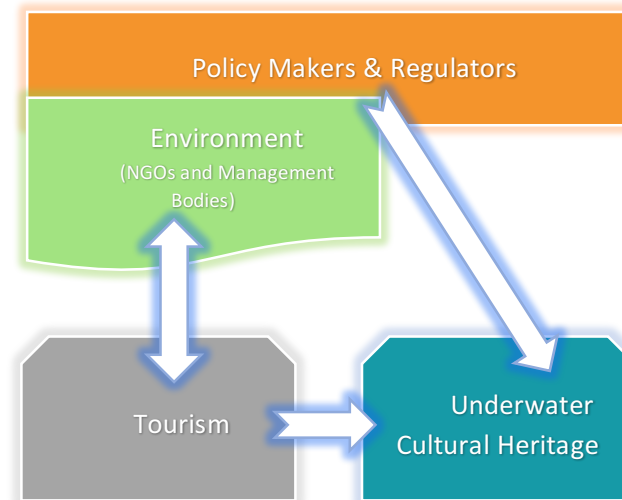
## Main Actors, Drivers and Barriers of Tourism, Underwater Cultural Heritage and Environmental Protection

### National Level

- ✓ Demand for alternative tourism activities
- ✗ Lack of specialized skills (e.g. diving certification), or the design of new equipment (e.g. vessels to observe the sea floor)
- ✗ Having civil servants as guides and guards to escort the divers is not viable
- ✗ Lack of collective mentality and action that is required for the coordination of such MU since it involves numerous heterogeneous stakeholders

### Local/Case Study Level

- ✓ In Finland, the regional MSP process has goals to develop recreational and touristic use of Kymenlaakso sea areas
- ✗ Potential damage caused by tourists to the fragile environment or to UCH
- ✗ Risk of looting/stealing of the underwater archaeological sites
- ✗ Risk of congested diving sites that may decrease tourist levels of satisfactions



### International level

- ✓ UNESCO Convention on the Protection of the Underwater Cultural Heritage being ratified by Member States

### EU/Sea Basin Level

- ✗ Separated EU funding sources for tourism and environmental protection
- ✓ Opportunity for public awareness about the UCH

### National/Local Level

- ✓ Provision of new jobs, due to new

### EU/Sea Basin Level

- ✓ Discovery, recovery and maintenance of cultural and natural heritage, preventing the destruction of submerged archaeological sites, increase tourists' awareness towards environmental protection

Results from the sea basin and country fiches analysis shows that tourism and environmental protection sectors are driving this MU. The economic drive to indulge in tourism with the advantage of seeing UCH sites and the conservation/regulation provided by environmental protection sites to undertake touristic activities drive this MU. Government authorities responsible for these sectors are the main actors to drive this MU. Clear regulation on the access to UCH sites, while ensuring their protection at the same time, through diving and requisite facilities will promote this MU.



## General Conclusions

- The existence of a clear linkage between policy and legislation on protection/preservation of underwater cultural heritage with natural protection and socio-economic policies is an important facilitator for this MU combination. For example, MPA and MSP processes were important to promote this MU combination e.g. the cases of the Iroise Nature Marine Park and the regional MSP processes in Finland respectively;
- The major driver for this MU is tourism, however, more awareness on the possible benefits of such MU synergies could increase openness of UCH and environmental stakeholders;
- Exploration projects and knowledge of existing UCH site locations, their suitability for touristic purposes as well as the legal/technical/financial prerequisites to this end are needed to start up this MU;
- Approaches to foster the inclusion of divers for monitoring activities like “Adopt a Wreck” have proven to be successful. Also, the Swedish system to enhance divers’ control of each other and to support their attitude towards specific locations to keep the ship in good shape is progressive. It may also overcome partly the general problem to keep knowledge and interest in UCH alive;
- Coordination between actors – especially government authorities, NGO’s, management bodies of Marine Protected Areas and scientific communities for these sectors – and UCH is critical as was realised in Estonia and the Nordic Blue Parks. Initial collaboration between the scientific community and scuba diving clubs in exploring underwater cultural heritage promotes this MU;
- Limited specialised skills and human resources in fields such as diving and UCH is a major obstacle which limits the accessibility of UCH sites. There is the need for targeted training to form new competences and use of appropriate under water technologies (boats with a glass floor, cameras, specialized boats, Underwater Museums) could allow a much broader public to benefit from UCH. Nevertheless, there is also a problem of limited resources to employ civil servants to escort divers that needs to be addressed.
- Development of new technologies could help in developing the sector and in turn could open a specific market niche, considering the need of remote monitoring of UCH sites, as well as the possibility to implement some of the almost infinite state-of-the-art ways of virtual exploration;
- Resistance by the responsible UCH government authorities and NGO’s due to damage and destruction to UCH sites and stealing of UCH objects due to touristic activities is a major barrier;
- Continuous integration of local municipalities who can directly benefit from successful MU approaches by transparent communication schemes and campaigns.



## 6. GENERAL CONCLUSIONS AND NEXT STEPS TOWARDS THE ACTION PLAN

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This section summarises the main thematic issues that need to be addressed to advance MUs, based on the analysis in this report. It is important to note that some particular thematic areas are common to all the MUs, while some are quite specific to certain combination or a country. These priority lines also serve as indicators for developing an action plan for MUs.

### Integration and Coordination

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MU as a concept presents combinations between maritime uses and activities normally managed by different sectoral structures, institutions and actors and this presents a major challenge in licensing, management and administrative processes. To advance these MUs, horizontal and vertical integration and coordination between the sectors involved have to be enhanced through;

- **The setting up of Inter-ministerial/sectoral committees** in MSs with representatives of sectors such as tourism, renewable energies, fisheries and culture heritage at national level with a similar structure at regional level. This should ensure integration between regulators, policy makers and administrations. Where possible, existing inter sectoral groups could also be used as platform to discuss synergies and co existence between uses and discuss approaches for advancing specific MUs.
- **Engaging and involving new actors and users** which are developing due to MUs and necessitating new and specific policies. These policies should be backed by structures and institutions that support integration and coordinations between existing and new institutions. New actors of MUs should also be involved during consultations at an early stage during sectoral and MSP processes. For example, groups such as the FLAGs which deal with multiple uses, must be engaged in various decision-making processes.
- **Addressing integration at the horizontal level**, between different sectoral structures and policy topics e.g. cohesion, food security and other cross sectoral policy issues.
- **At a vertical level**, there is the need to consider integration between different levels of governance (EU, National and Local) and the various legislative instruments (policy, regulation, plans) to support the development of MU.

### Policy and Regulation

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- **Regulatory implications differ across countries, and therefore stages of integration are also different.** While in some countries (e.g. UK), multi-use of sea space is already taking place and discussions are on-going in relation to innovative ways for integration, in other countries (e.g. Germany) unknown effects and regulatory aspects are still a major barrier. In Belgium, exceptions to regulations have been made to facilitate several experimental



research projects for this MU to gain more knowledge about the implications to the environment;

- **Environmental impacts and safety risks are perceived differently by involved actors (authorities, developers, fishers) across countries**, serving as the major argument for setting different regulatory frameworks;
- **The power of individual sectoral businesses can be limited when acting individually**, and in some cases, they don't see clear financial benefits to initiate a MU. This act as a barrier to influence the necessary regulatory and policy changes and to advance the development of the MUs;
- **The MU with OWE, can potentially provide significant benefits to the aquaculture, tourism or fishery sector, and indirect benefits to offshore wind energy developer**. In case there is no direct economic benefit for each single sector, but the combination can provide wider societal benefits (sum of benefits per square kilometer is larger than that of single use in the same given area), then there is the need for government to intervene to drive the MU;
- **There is the need for harmonisation of legal and regulatory frameworks at national and regional level** (e.g. cases of regional complexity in legislation in Italy, and in relation to pescatourism and gaps in legislation at local/regional scale in Portugal and Greece). Moreover, certain level of consistency of legislation across EU Member States, would allow for easier replication of good practices and exchange of knowledge across countries. Initiatives from the European Commission or other intermediaries would be helpful to facilitate the preparation of these consistency guidelines;
- **It is also useful that MU concepts are integrated into the various EU and national policies** (i.e. cohesion policy, food security). This should make them more operational for job creation and enforcing traditions related to the sectors especially in coastal and rural areas which are faced the challenge of unemployment;
- Those MUs related to MRE have received major policy driver through the Renewable Energy Directive where MS are obliged to attain certain targets. Similar policy backing for the sustainable tourism related policies will go a long way to support their effectiveness in supporting the blue growth agenda and ensure more sustainable development of tourism sector;
- **Difficulties during consultation process between sectors** (e.g. offshore wind energy developers with fishers) appears to be a major factor stalling the advancement of this MU. In some cases, stakeholder perception was that most of the consultation exercises are undertaken only because it is a legal requirement to do so, timing and frequency is varying, and it was perceived that in some cases there may be no sincere drive to reach any kind of mutually beneficial agreement at meetings. This, coupled with often weak representation of fishing and aquaculture interests, power imbalances between the sectors and overall cautious attitudes has caused many discussions of MU to be derailed.



## Capacity Building

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The MU of marine resources as a concept is still relatively new to users, regulators, policy makers, investors and the various stakeholders involved. It is important that specific capacity needs (know how, training, finance, logistic and public awareness among others) are provided for actors, so that it serves as a repelling effect to boost and advance its development. It is important to note that capacity building is a priority especially for tourism and fishery related MU. For example, fishers lack capacity in aspects related to business strategies and also to indulge in tourism related activities. This is quite different for the OFW MUs which require an initial high level and advanced capacity. Capacity building for MU can be enhanced through:

- **Comprehensive training for fishers, tourist operators and aquaculture farmers** (and other local actors) to boost these soft MUs that are less recognised and rather happen at a local and community level. Such training and capacity building are important to create employment in these coastal communities;
- **Frequent engagement between stakeholders from different sectors** to learn more about the different ways of thinking and to find common solutions at different levels is especially useful for UCH MU combinations. Pilot cases could foster these kinds of collaboration and focus on socio-economic benefits derived from heritage sites to show communities how to merge interests from different sectors.

## Funding and commercial readiness

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- Further development of 'hard' MU solutions requires the **demonstration of not only technological, but also commercial readiness**. While the technology might be viable (referring to the high technology readiness level), its **application depends on Commercial Readiness Level** of such solutions. This implies that a deep understanding of the target application and market needs;
- Implementation depends highly on **policy support and regulatory regimes in the given MS acting as 'supply push'**, as well as the **market and investors willingness to invest in such projects, 'market pull'**;
- For 'hard' MU solutions, **diverse funding sources can be noted**, ranging from partial private ownership and reinvestments, to initiatives resulting from private and public partnerships, and community (incl. tourism) benefit funds (links to CSR) from the OFW developer;
- **Early developers are bearing the costs of environmental characterization for further developments of other potential companies to come to fruition in the near future**. If public subsidies were provided, the environmental data could be made public and possibly used not only for tidal energy developments, but the baseline data could also be gathered to such an extent as to inform environmental management regimes.





## Research priorities

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The results of the analysis presented in this report shows that research and innovation is key to advance such a novel concept. Apart from the technological knowledge, socio-economic, policy and financial knowledge are important in addressing some of the challenges MUs. It is worth noting that research needs for tourism related MU are more geared towards understanding the potential demand of products and value chain of these MU, while the hard MU combinations are focused on new and advanced technologies for efficiency. While the demand for such hard uses already exist through existing policies and regulatory commitments, this is not the case for soft uses. Research for MU will have to consider;

- **Assessment of the site related to cumulative economic, social and environmental impacts, including related legal and regulatory aspects.** Pilots in the real environment would allow development of a full business-model and better understanding of insurance implications and other aspects relevant for the interaction of given sectors. This would advise the development of suitable regulatory, policy and incentive regimes for MU development. While financial support is often available, regulatory and administrative support and coordination at the local level needs to be better delivered;
- MU combinations such as pescatourism and acquitourism have different components and aspects such as education, promotion of local and quality products, eco-label, fish use for local cuisine, promotion of cultural values of traditional activities, etc. **Extensive analysis is needed on value chain, its opportunities and how it can promote 'soft' MUs.** This will also involve guidance from the EU level, on how to better organize the value chain to inform national and regional policies and decision-making. This also directly links with the following priority points under Marketing and Dissemination/Promotion;

## Marketing and Dissemination/Promotion

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The promotion of existing good practices and understanding the full life cycle of MU in terms of economic and societal impacts, are necessary to boost its replication and financial investment. The following aspects are identified as important to market and promote MUs:

- **Transparent communication between local and regional stakeholders** to show and understand the benefits coming from MU approaches and supporting them in adjusting their long-term strategies to provide planning security, e.g. for potential investors.
- Soft MU combinations are usually undertaken at a small scale and their visibility, promotion and **marketing platforms at the sea basin or sub sea basin level are important.** Given that tourism related MUs are addressing niche market, coupling them under the same name as the same experience (as an exquisite experience in the given sea or sub-sea basin) can ensure higher impact of such campaign;



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- **Considering the needs of rural and island destinations and benefits** that certain type of MU can provide are relevant for marketing such solutions in local communities and to relevant actors that can support such developments.



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## ANNEX I

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### Case studies in the North Sea:

1. Case study 1A - Multi-use space between commercial fisheries and offshore wind farms in Scotland (East Coast of Scotland - North Sea)
2. Case study 1B - Tidal energy development and environmental protection and monitoring (North Coast of Scotland - Inner sound of the Pentland Firth - North Sea)
3. Case study 1C - Multi-use of off-shore wind farms with marine aquaculture and fisheries (German North Sea EEZ - North Sea)

### Case studies in the Atlantic:

4. Case study 2 - Marine Renewables & Aquaculture Multi-use including the use of marine renewable energy near the point of generation (West Coast of Scotland - Northern Atlantic Sea)
5. Case study 3A - Development of tourism and fishing in the Southern Atlantic Sea (South Coast of mainland Portugal - Algarve region - Atlantic Sea)
6. Case study 3B - Development of tourism and fishing in the Southern Atlantic Sea (Azores archipelago – Eastern Atlantic Sea)

### Case studies in the Baltic Sea:

7. Case study 4 - Multi-Use for local development focused on energy production, tourism and environment in Swedish waters (Island of Gotland - Baltic Sea)
8. Case study 5 - Offshore wind and mariculture: potentials for multi-use and nutrient remediation in Rødsand 2 (South Coast of Lolland-Falster - Denmark - Baltic Sea)

### Case studies in the Mediterranean:

9. Case study 6 - Coastal & Maritime Tourism and O&G Decommissioning as drivers for potential Multi-use in the Northern Adriatic Sea (Italy - Mediterranean Sea)
10. Case Study 7 - Marine Renewable Energy Sources & Desalination, Fishing & Tourism in the South Aegean: the case of Mykonos Island (Greece - Mediterranean Sea).



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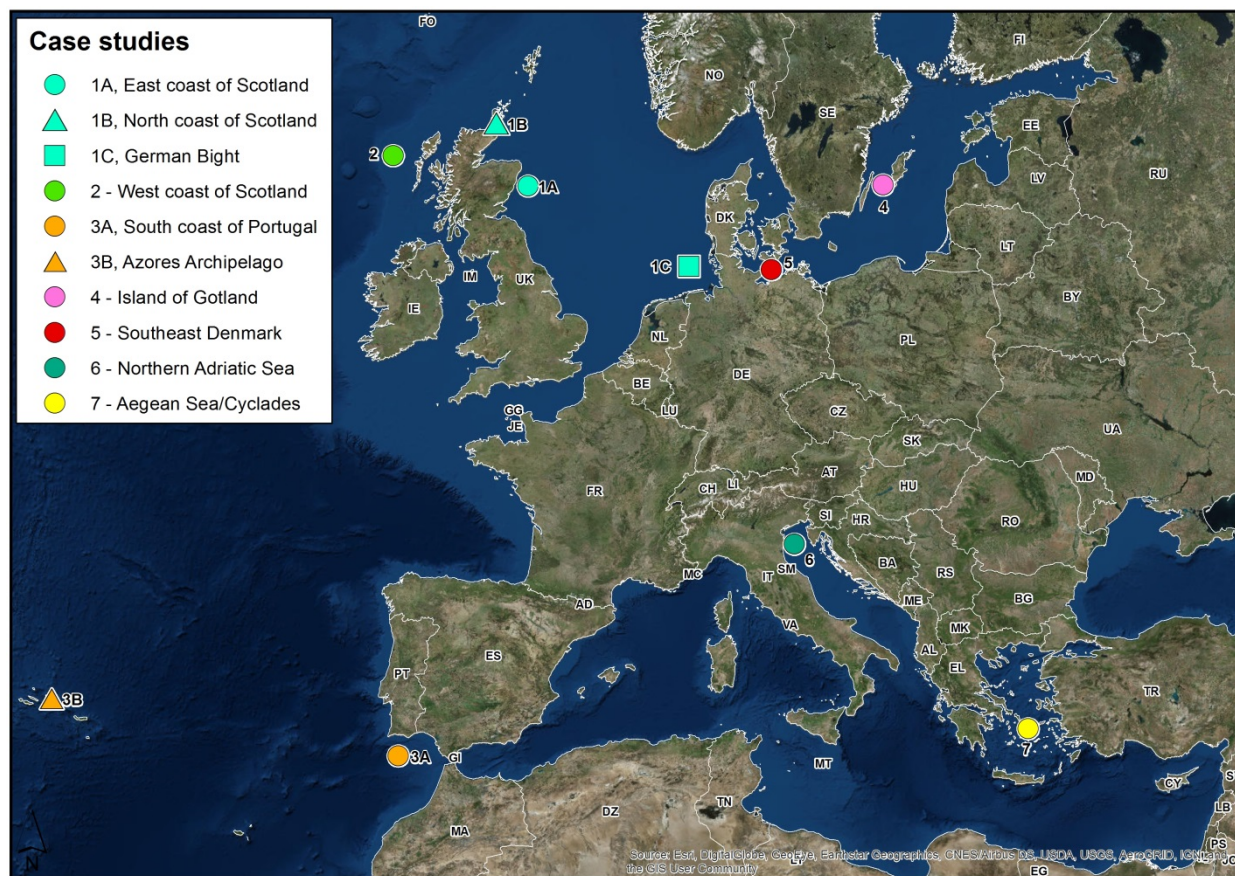


Figure 1 Geographical location of MUSES case studies<sup>64</sup>

<sup>64</sup> Martina Bocci, Chiara Castellani, Emiliano Ramieri et al. (2018). Case study comparative analysis, MUSES project. Edinburgh.