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OCEAN MULTI-USE ACTION PLAN

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OCEAN MULTI-USE ACTION PLAN

Project: MUSES (Multi-Use in European Seas)

Title: Ocean Multi-Use Action Plan

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MUSES Multi-Use in European Seas

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LIST OF ACRONYMS

MUSES	Multi Use 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 Council 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
SDM	Survey, Deploy, Monitor
SMEs	Small and Medium Enterprises
SPA	Special Protected Area
SSE	Shore Side Electricity
TCT	Tidal Current Turbine
TRL	Technology Readiness Level
UCH	Underwater Cultural Heritage
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UKCS	United Kingdom Continental Shelf
WP	Work Package

EU COUNTRIES' ABBREVIATIONS

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

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ABOUT THE ACTION PLAN

DEAR READER,

Combining maritime uses, either through joint operations or joint installations, can reduce spatial pressures on European Seas and create new opportunities for socio-economic development, along with potential environmental benefits.

'Multi-use' implies a radical change from the concept of exclusive resource rights to an inclusive sharing of resources by one or more users. Thus multi-use often does not come naturally, but shall be motivated by clear drivers and added-values. This also implies that 'multi-use' solutions are not exclusively better than 'single-use' options. It is important to carefully consider local conditions when making a decision on whether to favour single – or multi-use in a given location.

Further development of multi-use requires actions mainly from the users themselves, but also backed by research and legislation at all levels.

Based on two years of systematic research, combined with extensive stakeholder involvement, within the framework of the Horizon 2020 funded MUSES project, the Action Plan details what actions are required and by whom in the coming years to turn the concept of Multi-Use in European sea basins into real life implementation.

The Action Plan consists of following parts:

- The **EXECUTIVE SUMMARY** offers a brief overview of the overall Action Plan.
- **PART 1** introduces the multi-use concept, its policy background and the MUSES methodology. It summarises its stage of development, possible benefits of and opportunities for multi-use, as well as what kind of support the multi-use concept receives across Europe.
- **PART 2** specifies the actions required for each of the nine multi-use combinations across Europe deemed "most important" by the MUSES Project. It commences with tourism-related multi-uses which are largely based on operational synergies, before going on to discuss energy-related multi-uses which often entail a higher level of physical integration. For each combination, we explain what the multi-use entails and its current state of development, and summarise its associated positive drivers/benefits as well as negative barriers/impacts. Most significantly, we then conclude with the key recommendations which need to be considered to advance each MU. Where possible, we indicate where the action is needed, who should be responsible for implementing it and whether it should be pursued at local, national, sea-basin or wider European level.
- **PART 3** presents the overarching conclusions and recommendations across all multi-use combinations. This is particularly advantageous as some actions are not specific to one combination only and require action by the same specific actors and regulators.

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All the chapters in Part 2 have been designed so that they can be read as standalone. Thus, readers are welcome to read only the chapters in which they have an interest.

Most importantly, we hope to inspire as many stakeholders as possible to pro-actively consider and take forward the actions specified. As such, the Action Plan should also be understood as a 'living document'.

Even though the MUSES project will have come to a close by October 2018, all MUSES partners are committed to further develop and fine-tune actions in conjunction with the relevant actors indicated in the Action Plan.

Please don't hesitate to get in touch with any of us to further discuss any of the actions in the Action Plan.

THIS PICTURE TAKEN DURING THE SECOND MUSES PROJECT STEERING GROUP MEETING IN EDINBURGH, SCOTLAND (APRIL, 2017).

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EXECUTIVE SUMMARY

WHAT IS MULTI-USE OF THE SEA?

Multi-use (MU), as defined within the MUSES project, is an **intentional joint use of resources in close geographic proximity**. It represents a radical change from the concept of exclusive resource rights to the inclusive sharing of resources by one or more uses [1].

The Action Plan focuses on the following **nine MU combinations**, which were found to be of highest relevance across Europe:

1) Tourism, fisheries & environmental protection
2) Tourism, underwater cultural heritage & environmental protection
3) Tourism and aquaculture
4) Offshore wind farm and tourism
5) Offshore wind farm and fisheries
6) Offshore wind farm and aquaculture
7) Oil and Gas and Decommissioning – Repurposing
8) Offshore wave energy and aquaculture
9) Offshore wind and marine renewable energy

The **degree of connectivity** between different maritime uses **can vary** with respect to **spatial, temporal, provisioning and functional dimensions** [2] – ranging from two uses merely sharing the 'same' maritime space to shared platforms and other infrastructure. In the definition provided by the MUSES project, MUs are therefore not limited to **joint use of installations**, but also encompasses **joint activities**.

Ideally the joint use of two maritime activities is planned as part of the same process (**joint development**). In some cases, however, it is also possible to develop MU by integrating a second use with an already existing use (**staggered development**) [1]. The higher the level of connectivity, the higher the need is for the two or more maritime activities to coordinate right from the beginning.

A related issue concerns whether a **primary user** exists (e.g. a user who has been given primary rights to a certain maritime zone, has an existing permit or whose use is already fully developed). In such cases, the **secondary user**[1] needs a legislated claim for using the primary user's priority areas, and only if their use has been proven not to be detrimental. This leads to a **power imbalance** between the primary and secondary users. However, even when the two uses are developed and operated by the same entity, existing **legislation often hampers** MU as the two regimes established for each single use often contradict each other.

1 A secondary user refers to a user that intends to establish itself in a maritime zone in which a primary user already has a permit, or is developed already.

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WHY MULTI-USE?

Demand for and pressure on ocean space and the environment is continuously increasing. Global megatrends such as population growth, climate change and environmental degradation require new blue solutions. Sustainable development of the ocean can no longer rely on single-sector management, but requires a more holistic, integrated approach. At the same time innovation and resulting new knowledge also provides new opportunities. MU solutions can lead to substantial benefits including:

- more **efficient use of ocean space** and resources by concentrating uses in one area and leaving other **areas free for future** generations;
- provide economic benefits to marine users from synergetic use, **maximising the economic benefit from a certain area**;
- **enable certain uses to develop** in maritime areas, where this would otherwise not be possible due to the dominance of other maritime uses;
- **reduce the environmental impact** of a given use by merging it with another activity;
- provide **additional socio-economic benefits** to the coastal region.

WHY AN ACTION PLAN?

Since 2007, the European Union (EU)'s overarching **Integrated Maritime Policy** [3] seeks to provide for **increased coordination** between different policy areas and cooperation of maritime players across sectors and borders. This has led to important initiatives in the areas of **Blue Growth,** environmental protection, marine data and knowledge, marine research and sea basin wide programmes and strategies.

The **Maritime Spatial Planning Directive** [4] requires all EU Member States (MS) to develop Maritime Spatial Plans up to 2021 and thus to strategically consider the best location and conditions for each use. In doing so, MS are asked to seek not only best available data and broad public participation, but also opportunities for co-location of maritime activities.

However, even where MU solutions may produce significant benefits, **multiple barriers** are stalling the transfer of MU from concept to implementation. Whereas earlier projects have mainly dealt with technological development, major barriers exist relating to regulatory, financing, liability and insurance issues; environmental concerns; stakeholder perceptions; and lack of appropriate skills.

Even though action ultimately has to be undertaken by the users themselves, results of the MUSES project show that **MU needs to be proactively facilitated and incentivised** through public regulatory bodies and respective support programmes, going well beyond mere spatial planning solutions.

The aim of this **Action Plan is to provide orientation and recommendations** of what should be done, by whom and where in order to further develop the MU concept. In doing so the report puts less emphasis on detailed technological requirements, rather focusing on aspects related to stakeholder coordination, research, planning, regulation, legislation, skills development and financing.

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DEVELOPMENT OF THE ACTION PLAN

The Action Plan is based on 22 months of systematic research undertaken by a European wide consortium, coupled with an extensive stakeholder engagement process involving more than 200 different actors throughout Europe. The following steps were applied to develop the Action Plan:

Development of the **analytical framework and common definition of MU**, to be employed in all the steps of MUSES research;
Desk research of past and ongoing MU related projects, policy documents and reports to provide an **overview of MU initiatives and potential at sea basin, national and case study levels** for 11 MU combinations. This was followed by:

- **Identification of MU Drivers, Added values, Barriers, and negative Impacts (DABI)** for each selected MU combination;
- **Interviews with stakeholders, three workshops and additional desk research** to fill identified research gaps. Analysis of stakeholder profiles was conducted in parallel to advise ongoing engagement processes at national and case study level;
- **Analysis of MU potential and evaluation of overall MU effects** were conducted as separate, but complementary, processes at national and case study levels;
- **Analysis of Focus Areas**: Case studies were further analysed through key questions including addressing MU development potential, boosting the blue maritime economy and improving environmental compatibility.

Results of country-based analyses were documented and subsequently analysed at Sea Basin level to provide an overview of the **profile and state of development of MU practices** across the sea basin, including intra-country and trans-boundary aspects;
The final step comprised the **integrative analysis of findings** at the sea basin, national and case study levels which generated a large number of recommendations and actions. Additional consultations with stakeholders (via interviews and workshops), as well as their review of the draft action plan, allowed for the finalization of the project's final output.

195
INTERVIEWS
+
2 WORKSHOPS
IN **5** EU SEA BASINS
+
1 WORKSHOP
IN THE NORTH SEA

117
INTERVIEWS
+
1 FOCUS GROUP
+
1 WORKSHOP
IN **10** MUSES CASE STUDY LOCATIONS

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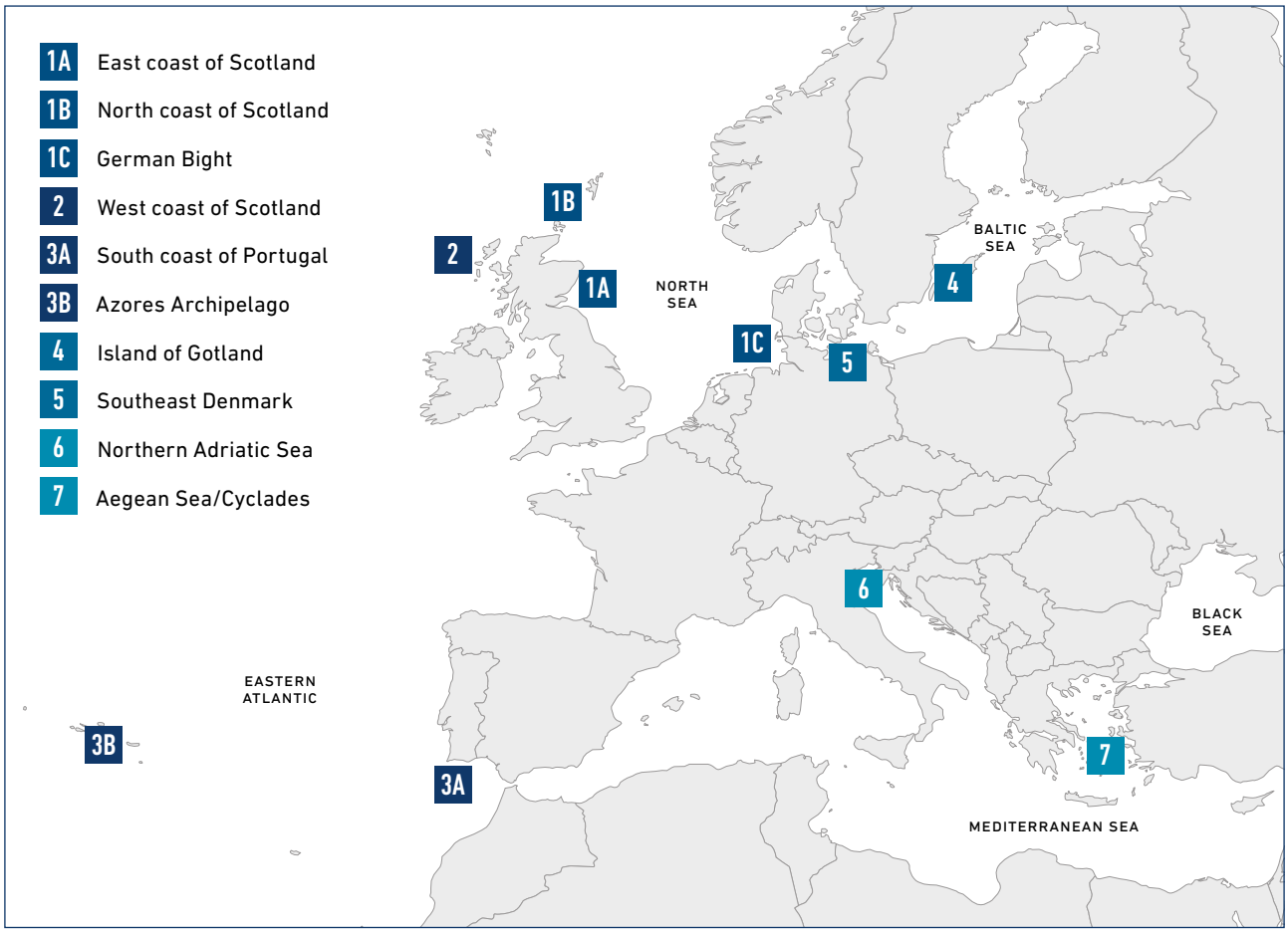
GEOGRAPHICAL LOCATION OF MUSES CASE STUDIES.



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ACTIONS REQUIRED TO ADVANCE MULTI-USE

TOURISM, FISHERIES & ENVIRONMENTAL PROTECTION

This MU involves professional fishers (mostly small scale) hosting tourists on a fishing vessel to discover fishing traditions. This MU predominantly involves the combination of fisheries and tourism otherwise known as pescatourism.

Existing Cases / Future Potential: Pescatourism [5] is well developed throughout southern Europe with many successful, existing examples. The Fisheries Area Network (FARNET) [6], financed via the European Maritime and Fisheries Fund, has been instrumental in promoting pescatourism through its Fisheries Local Action Groups (FLAGs) [6].

Drivers / Benefits: This form of MU provides fishers with an additional, **complementary income source** and **diversifies the tourism activities of a region**. It can c**ontribute to environmental protection** as it can reduce fishing impacts and provides tourists with an insight into the world of fishing and how this can be done sustainably. It therefore also **improves the image of the profession** and makes it more attractive for young people, as well as raising the profile of the given region.

Challenges / Barriers: Fishers who would like to engage in pescatourism often face the following barriers and challenges: 1) **safety requirements** for the vessel, 2) **different tax regimes** for fishing and tourism derived income, 3) limits on how many tourists can be hosted on board, and 4) **lack of experience and skills** of fishermen on how to work with tourists.

SUGGESTED ACTIONS:

1) **Build on existing good practices**
   - → foster knowledge exchange and transfer throughout Europe
   - → promote this MU by showcasing existing projects and benefits derived from them

2) **Train fishers on skills and knowledge necessary for pescatourism**, especially those related to safety and service-oriented businesses
   - → develop comprehensive and bespoke training guidelines for fishermen
   - → allocate funding towards such capacity building

3) **Create local and regional networks** to foster interaction between fisheries communities and tourism stakeholders and to increase marketing efforts

4) **Support the creation of clear legislation** for pescatourism by:
   - → developing guidance for national authorities which builds on existing best practices
   - → promoting comprehensive assessments at national level
   - → creating sectoral working groups

5) **Operationalise the MU** by integrating and mainstreaming it into various EU policies
   - → e.g. by **including pescatourism into sea-basin programmes** and strategies

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6) **Undertake further studies** to better understand the economic and environmental benefits

TOURISM & AQUACULTURE

This MU combination involves the diversification of tourism services to include aquaculture related activities such as visits to aquaculture sites, diving/ snorkelling in proximity or even within the aquaculture installation and sport fishing/ angling next to the aquaculture installation.

Existing Cases / Future Potential: This MU has so far been **implemented on a small (recreational) scale** in the Mediterranean and Atlantic Seas. Most projects involve tourist visits to aquaculture site; however, the most prominent cases are in Malta and South Portugal, where diving is organised within open bluefin tuna farming cages.

Drivers / Benefits: Most importantly, this MU may **resolve the potential conflict** for space among tourism and aquaculture, by opening up the aquaculture site for tourism activities. Moreover, such MUs provide an **alternative income source** for aquaculture operators and **increase acceptance, awareness and value** of the locally produced fish products. The creation of such MUs aiming to diversify the aquaculture sector are already incentivised by the EMFF and also FLAGs which promote the diversification into tourism across Europe.

Challenges / Barriers: Aquaculture operators face similar barriers and challenges to fishermen branching into pescatourism in relation to **legislation regarding hosting tourists on board** their vessels; regulations related to insurance against accidents; **lack of standards and guidelines** for aquaculture operators; and limited entrepreneurial and customer service **skills**.

SUGGESTED ACTIONS:

Actions are largely similar to pescatourism. However, contrary to pescatourism, there are very few existing cases on which to build on. Actions therefore include:

1) **Create local and regional networks and clusters** to foster interaction between aquaculture operators, tourism stakeholders and local operators in the field of food supply to enhance collaborative efforts and subsequent joint marketing efforts.

2) Explore possibilities to develop **new forms of multi-functional sites** when planning new aquaculture plants, where small touristic infrastructures can be put in place.

3) **Provide training and capacity building to aquaculture operators** to improve their service skills. Educational opportunities to visit aquaculture farms should also be organised to increase the number of young people looking to take a job in aquaculture.

4) **Identify the most suitable type of boat** for both the aquaculture plant operations and hosting tourists/ students.

5) **Support the creation of clear legislation and guidelines/ standards** for tourism activities within aquaculture farms.

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TOURISM, UNDERWATER CULTURAL HERITAGE & ENVIRONMENTAL PROTECTION

Within the context of the MUSES project, this MU has been defined as the combination of touristic or recreational activities with the protection of underwater archaeology and its adjacent marine ecosystems. This can take the form of 'dry footed access', with land-based museums to display the richness of local UCH or use of glass bottom boats to UCH locations. It can also involve n situ access to scuba divers for viewing UCH sites. Moreover, where relevant, this MU involves conscious efforts to link environmental and UCH protection measures.

Existing Cases / Future Potential: Examples of both forms of this MU exist in the Baltic and Eastern Atlantic. Also, the Black Sea's HERAS project is promoting such MUs. It has also has very good potential for development in the Mediterranean Sea in view of its rich UCH sites, warm temperatures and clear waters.

Drivers / Benefits: Conscious management of tourism activities involving UCH can lead to win-win situations for both tourism and UCH protection as it **raises public awareness** and appreciation of the value of UCH sites while providing an **income** stream for **better management of UCH sites**.

Challenges / Barriers: The main reasons for the lack of existing UCH-related MUs are strict protection measures and resistance from UCH authorities regarding tourist access to UCH sites due to **risk of damage and theft** of UCH artefacts. Moreover, scuba diving attracts a **limited number of tourists** and 'dry access' solutions are costly. This, coupled with generally **limited funding and skills** of UCH authorities or museums to engage in MU initiatives, has limited its development.

SUGGESTED ACTIONS:

1) **All EU MS** need to ratify the Convention for the Protection of UCH and further **strengthen the national legal frameworks on UCH protection**.

2) MSP and other area-based management approaches should be used as an opportunity to gather **better information about respective UCH sites** and have a **systematic approach to UCH management** regarding which sites can be opened to tourists and which should be strictly prohibited.

3) **Enhance cooperation** between UCH authorities, diving centres, regional authorities, tourism operators and business investors in order to
   - → **co-design approaches**, guidelines and training for divers to access UCH sites without damaging them;
   - → **co-create 'dry' UCH tourism activities** which showcase the 'culture of the sea'.

4) **Support research and technological development** to improve the identification and analysis of UCH sites, while also improving 'dry access' to tourists; e.g. use of underwater technologies to provide tourists with real time experience of underwater wrecks.

5) **Explore innovative financing methods** for UCH management and value development such as charged and controlled public visits; development of UCH related retail activities; and investments into UCH research, museums, underwater technology, etc.

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OFFSHORE WIND FARM & TOURISM

This MU encompasses shared use of sea space, and joint on/ offshore infrastructure and operational activities. Activities can entail OWF sightseeing boat tours; shared onshore facilities such as OWF related information centres and museums; and even specially designed offshore platforms around the turbines, which serve as a resting ground for seals, facilities for divers or restaurants. The unique wind farm layout may also serve as an attraction and landmark for tourists visiting the region.

Existing Cases / Future potential: Examples of this MU already exist in all countries where OWFs have already been installed (North & Baltic Sea). Combining OWF development with tourism activities from the outset may also be of prime interest for all countries/ regions which plan to develop major OWF developments in the future. Its potential to prevent conflicts arising from OWF installations with coastal communities is therefore of high relevance to the Atlantic and Mediterranean.

Drivers / Benefits: One of the main drivers for this MU is the fact that it can potentially **overcome issues of OWF project acceptance** by **offering socio-economic benefits to local communities** in the form of additional jobs and income from the OWF operation, transforming the potentially negative OWF image into a positive tourism experience. The MU may therefore also **reduce negative costs to OWF operators**, associated with planning delays and conflict resolution, as well as contributing to the positive image of OWF by increasing knowledge about the importance of green energy. Furthermore, if the OWF has a unique design and layout, it can become a symbol for the local region, building a **sense of pride among locals** [7] [8] and stimulating regional development in remote areas.

Challenges / Barriers: There are more barriers associated with developing the MU within the OWF zone compared to outside. Complicated licensing, **high insurance premiums** and uncertainties over **who should cover these costs** (OWF or tourism operators) are among the main regulatory barriers affecting its economic viability. Natural barriers relate to **distance from shore, weather and tide conditions and seasonality**. Moreover, despite the existence of good practices, it is not common practice to consider this MU from the outset of an OWF planning process.

SUGGESTED ACTIONS:

1) **Facilitate transfer of good practices** from existing cases across MS/ sea basins and to countries/ regions where OWF is still in pre-planning stage.
2) **Involve the local tourism sector and regional development agencies early in MSP** and specific OWF planning processes to facilitate cooperation and seek suitable solutions from the outset.
3) **Support the development of viable business models**, potentially by promoting cooperative ownership involving local communities (Danish/ Belgian examples).
4) **Prepare guidance on how agreements can be established** between OWF and tourism operators as part of broader project development guidance for OWF developers (esp. with regards to consultation and mitigation processes).
5) **Mainstream such MU solutions into local development and cohesion policies.**

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OFFSHORE WIND FARM & AQUACULTURE

In general, the MU concept of offshore wind and aquaculture can entail:

- **direct attachment of installations (i.e. fish cages or mussel/ seaweed long-lines) to offshore wind turbine foundations or development of a new infrastructural solutions (i.e. in the form of fully integrated multi-purpose platforms);**
- **the co-location of aquaculture installations within the security zone of the OWF farm. For instance, seabed cultivation of mussels within the vicinity of the OWF.**

Existing practice / Future Potential: Despite multiple research projects, there is still a very limited number of pilots in the real environment. Most have considered operations in Belgium, the Netherlands, Germany and the UK within the North Sea. Projects in the Baltic have concentrated on mussel or seaweed cultivation due to restrictions on fish aquaculture. This MU may provide an interesting option for new OWF developments in the Mediterranean, esp. France. Moreover, there is high interest and drive for MUs related to offshore aquaculture from large industrial actors in Norway – not necessarily with OWF, but also with the Oil & Gas industry.

Drivers / Benefits: The main driver behind this MU is the lack of suitable space in inshore sheltered areas to reach the **targets given for increase of aquaculture production** (60% for finfish and 25% for shellfish by 2020). The MU may provide an opportunity to move aquaculture offshore to further exposed sites and create **costs saving** through joint development and shared operations and maintenance. Moreover, using energy from the OWF for aquaculture operations could potentially ensure **green credentials** and allow aquaculture products to be marketed at a premium.

Challenges / Barriers: Drivers and opportunities do not match perfectly: **Extractive aquaculture** (seaweed and shellfish) is relatively low maintenance and therefore favoured by OWF developers since it involves less frequent visits to and smaller-scale operations taking place within the OWF. However, the financial benefits of a seaweed farm are small compared to any projected risks. Moreover, solutions do not yet exist to ensure timely harvesting and distribution of aquaculture products further offshore. **Fed aquaculture** (fish), while offering good financial return, **has high maintenance requirements** thereby increasing traffic at the site, while **impacts on the environment and the OWF installation** itself are still unknown.

Despite valid drivers, the MU faces substantial challenges related to:

- **Insufficient technology readiness level**, especially for harsh conditions in offshore areas, and compatibility of technologies used for different types of aquaculture (e.g. cage vs line) and OWF (e.g. floating vs jacket vs monopile);
- **Unknown cumulative effects**: especially with regards to combinations with fish aquaculture;
- **Unassessed risk and unclear permitting processes/ insurance implications,** as well as a lack of planning and financial incentives, needed to enhance commercial drive for such MUs.
- It is difficult to further develop this MU by adding aquaculture installations to an already operational (or even only licensed OWF) in places where OWF operators are able to veto any kind of development deemed detrimental to their activities.

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SUGGESTED ACTIONS:

1) **Address the power imbalance between the two sectors** through facilitation policy and regulation, especially within the currently ongoing MSP processes
   → **identify suitable areas for test pilot projects** which can then provide results necessary for future development.

2) **Synthesise knowledge from existing pilots and increase awareness** of the opportunities and benefits among all relevant actors.

3) **Support the development of full-scale pilot projects by**
   → **encouraging the involvement of established businesses** to address low investment capacity of the (small-scale) aquaculture sector;
   → **providing regulatory and financial incentives** to retailers, established aquaculture companies and utilities.

4) **Ensure the strategic research agenda corresponds to the needs** of the current decision-making system and supports continuous improvement.

OFFSHORE WIND FARM & FISHERIES

→ This MU entails OWF and fisheries sharing the same space, so that fisheries are not excluded from either the OWF development area (which can include a maximum 500m safety zone during OWF operation) or along the offshore export power cable corridor. It may also include access to the same staff pool, equipment (vessels) or infrastructure (port facilities). Moreover, monitoring may be conducted by fishermen as a service, with both users adhering to the same emergency system.

Existing practice/ Future potential: This MU is relevant for all countries with OWF development but **practice across MS varies substantially**. Fishermen using mobile gear are generally not suitable for OWF areas. Where law does not require connecting **cables to be buried, bottom-contact gears cannot be used** as they might cause damage to cables and to the fishing gear [9]. In Denmark and the UK, fishery is allowed, to a certain extent, within the OWF area during operation. In the Netherlands, legislation regarding safety zones has recently changed so that fishery is now possible within 500m of the OWF. In Belgium and Germany, fishing is currently not allowed within the OWF safety zones, but there are some research pilots in Belgium.

Drivers / Benefits: The main benefit of including a fishery within OWF areas is the potential **resolution of conflict** between these two uses, facilitating public acceptance of the OWF. Small-scale fishermen may especially experience loss of income by moving fishing grounds. Moreover, studies indicate that OWF foundations are particularly **valuable fishing grounds** as they serve as artificial reefs.

Challenges / Barriers: **Environmental impacts** and **safety risks** of fishing within the wind farms are **perceived differently** by involved actors (authorities, developers, fishers) across countries, resulting in different regulatory frameworks. Moreover, there is a **lack of strategic support** facilitating the transfer to other types of fishery (changing fishing gear, replacement of fishing quotas).

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SUGGESTED ACTIONS:

1) **Highlight and exchange knowledge on existing practices across countries** to create mutual understanding of the associated risks and ways to mitigate them.
2) **Ensure better cooperation** among the two sectors, following the lead of groups such as 'FLOWW'.
3) **Establish a collaborative and co-ordinated research and innovation** programme at national or EU wide level to ensure suitable **data collection** and monitoring; technology innovations (e.g. for cable installation, protection methods or gear modifications); management strategies to minimise risks; and further testing of these at real sites.
4) **Use MSP as a tool to identify and drive synergies between the two sectors**
   - → **adopting clear regulatory and technical guidelines and policies** that promote the co-existence of OWF and fishery at the pre-planning stage;
   - → **ensuring better involvement of the fishing sector in the OWF planning process** to identify the most suitable short and long-term options;
   - → **ensuring that the OWF developer and/or government provide mitigation measures** in case exclusion of fishery is inevitable.
5) **Provide financial support** towards the transition to an innovative fishery fleet.
6) **Undertake research on possible effects of floating wind farms on fishery.**

OIL & GAS DECOMMISSIONING – REPURPOSING

→ **This MU looks into how decommissioned offshore platforms can take on a new life without being completely removed. Decks, jackets and pipelines can be reused according to their original design (possibly elsewhere) or the structures and wells can be repurposed for alternative uses. Such new uses can span from artificial reefs ('rigs to reefs') to supporting LNG docking stations, aquaculture installations or renewable energy devices.**

Current practice / Future potential: There are no examples of repurposed O&G structures in the EU. However, a multitude of O&G structures in the North Sea (UK, NL, DK), as well as the Northern Adriatic Sea (Italy), are set to be decommissioned in the coming years and respective authorities are currently developing plans and guidelines for decommissioning and reuse.

Drivers / Benefits: Reuse of O&G platforms could potentially lead to **cost saving, both for companies and tax payers,** as complete removal of the structures is extremely expensive. Although O&G companies should have pre-emptively factored the costs of removal into the overall business calculation; it should be noted that in some countries these costs are up to 75% tax deductible, meaning that more than half of the costs are to be borne by the tax payer [10]. Costs savings may also be achieved for the new use as it makes use of the O&G platform installations and may therefore enable fish aquaculture to move further offshore. Moreover, efficient and **sustainable use of sea space** (more space left free from use and available for future generations) is achieved

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by **reusing an area which has already been in industrial use for many years,** rather than installing new infrastructure in another pristine marine area.

Challenges / Barriers: The main barrier to reuse of O&G installations is the lack of clear regulation and guidance that specifies the **ownership rules** and **liability during reuse period**, as well as responsibility for its final dismantling and monitoring activities. Combined with the above described tax regime and negative public perceptions, O&G companies are not sufficient incentivised to investigate this MU further. It must also be noted that a multitude of first generation O&G platforms have reached end of life.

SUGGESTED ACTIONS:

1) **Adopt a comprehensive legal framework that clarifies liability rules** between current and future O&G platform users.

2) **Develop general suitability criteria** (detailing which sites and types of platforms, including their technological characteristics, are suitable for which type of reuse) to aid the decision-making process on which O&G sites to focus on.

3) **Undertake pilot assessments** of selected O&G platforms that considers
   - → **social and environmental impact assessments;**
   - → **reuse options;**
   - → **recommendations for investment mechanisms**, including business plans based on the valorisation of the whole value chain.

4) **Establish a North/ Adriatic Sea networking platform** for information exchange and networking on O&G reuse options including an online platform which acts as a repository of practice, procedures and guidelines, as well as active networking and knowledge exchange activities.

5) **Raise awareness of reuse options and establish suitable conditions** (transparency, trust, sharing of knowledge and practices) for joint identification of viable options; co-design processes; evaluating the social sustainability of projects under development; and promoting a faster permitting process.

6) **Provide funding for research to advise risk assessment frameworks and de-risking methods**; licensing procedures for MU; EIA requirements considering the substantial and long-term liabilities involved; and public awareness and buy-in.

OFFSHORE WIND & MARINE RENEWABLE ENERGY GENERATION

→ **This MU involves the combined deployment of offshore wind energy and marine renewable energy (MRE) sources, chiefly wave and tide, as part of the same physical platform, or as an indirect connection via the same cable array.**

Existing practice / Future potential: The **North Sea** offers particularly good conditions for this MU combination and a pilot test hybrid (wind and wave) is already being planned in Scotland (Caithness). We understand that the developers aspiration is that this technology could enter construction and be operational and delivering power by 2022. The long-term goal is to develop a commercial scale project in staged development steps.

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A feasibility study was also conducted in the Eastern Atlantic (**Spain, Cantabria)** associated with the MERMAID project. In the Baltic Sea, tests have been carried out on wave energy generation devices, but rather for export markets due to unsuitable physical conditions in the Baltic.

Drivers / Benefits: The main driver for this MU is its ability to generate **maximal energy per square nautical mile,** with the additional benefits of **reducing operational, maintenance and investment cost**. It also **mitigates potential conflict** by allowing space for other maritime uses.

Challenges / Barriers: The challenges hindering the development of this MU are less technical – more related to the **separate permitting and regulatory processes**, different tariff rates and lack of incentive schemes which limits the competitiveness of this MU.

SUGGESTED ACTIONS:

1) **Disseminate the benefits** and viability of existing initiatives, as well as wider interest from the industry side for such solutions, to increase chances for receiving the policy and regulatory support.
2) **Conduct comparative case study analysis** to identify suitable conditions for commercial deployment and upscaling.
3) **Enable exchange of information between different developers** on environmental impacts in an open process that can advise future **EIA requirements**.
4) **Design and support planning and financial incentive** schemes that cater for this type of MU where multiple energy resources are combined. This will involve working closely with industry and regulators to ensure appropriate support which considers existing regulations, the marine environment and capacities of the private sector.

WAVE ENERGY & AQUACULTURE

This MU involves the combination of aquaculture farms and wave energy, either physically connected or co-located side by side, enabling the use of wave energy generated directly for the purpose of aquaculture operations (especially in remote areas). The generated electricity can also be connected to onshore enterprises and national grids.

Current practice / Future Potential: Commercial scale MU of existing finfish aquaculture and wave energy generation has been developed in Mingary Bay (Scotland) mainly due to the developer's interest in receiving *green credentials* due to use of renewable energy as an alternative to diesel. In general, smaller scale devices that are designed to operate in less energetic conditions might be more suitable for fish farm applications.

In many EU MS, both wave and aquaculture rely on small-scale developers with limited financial capacity. Therefore, such technologically and financially intensive solutions are especially suitable for northern countries where the salmon industry is well developed and could benefit from moving to a further exposed site. Such solutions may also be of interest for the tuna farming industry in the Mediterranean.

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Drivers / Benefits: The main driver for this MU is the potential reduction in initial investment requirements for both developers due to shared operational and maintenance (O&M) costs throughout the lifetime of the MU.

Challenges / Barriers: This MU has not been widely applied or commercialised mainly due to low technology readiness; limited knowledge of safety, technical, environmental and financial risks and implications on insurance; and operational difficulties caused by unknown consequences of the interaction between the two uses

SUGGESTED ACTIONS:

1) **Identify suitable sites** for the development of this MU i.e. through the MSP/ORE planning process.

2) **Disseminate information** about suitable sites and life cycles of the two developments to increase awareness about potential opportunities.

3) **Define suitable means of support**, including:
   - **how this MU could be incentivised** (e.g. through preferential access to public funds or public infrastructure, tax breaks, subsidies, price regulation or preferential access to the national grid);
   - **consenting procedures** specifically for combined installations (e.g. 'auxiliary aquaculture infrastructure' vs 'renewable energy device').

4) **Create networking opportunities** for the various actors involved:
   - **Support business pitches for future pilots and associated innovative activities** and products along the value chain (e.g. low carbon footprint certification for aquaculture) and sharing of experiences at maritime events (development of local development strategies, action plans);
   - **Ensure involvement of a wide range of supporting actors/ advisors**, such as **business experts** to develop suitable business models, **insurance companies**, **consenting lawyers**, etc. to ensure identification of additional opportunities along the value chain and development of feasible solutions.

OTHER MULTI-USE COMBINATIONS

Application of the MU concept should not be limited to the sectors and uses indicated in this report. A broader approach to synergies, MU and co-location allows for a much wider spectrum of opportunities and benefits. Additional MUs, explored only in certain locations, but whose application could potentially be widened in scope, are briefly discussed with associated recommendations. These MUs include:

- Shipping terminal and green energy generation;
- Tidal energy generation and environmental protection (and monitoring);
- Marine renewable energy and desalination/ hydrogen.

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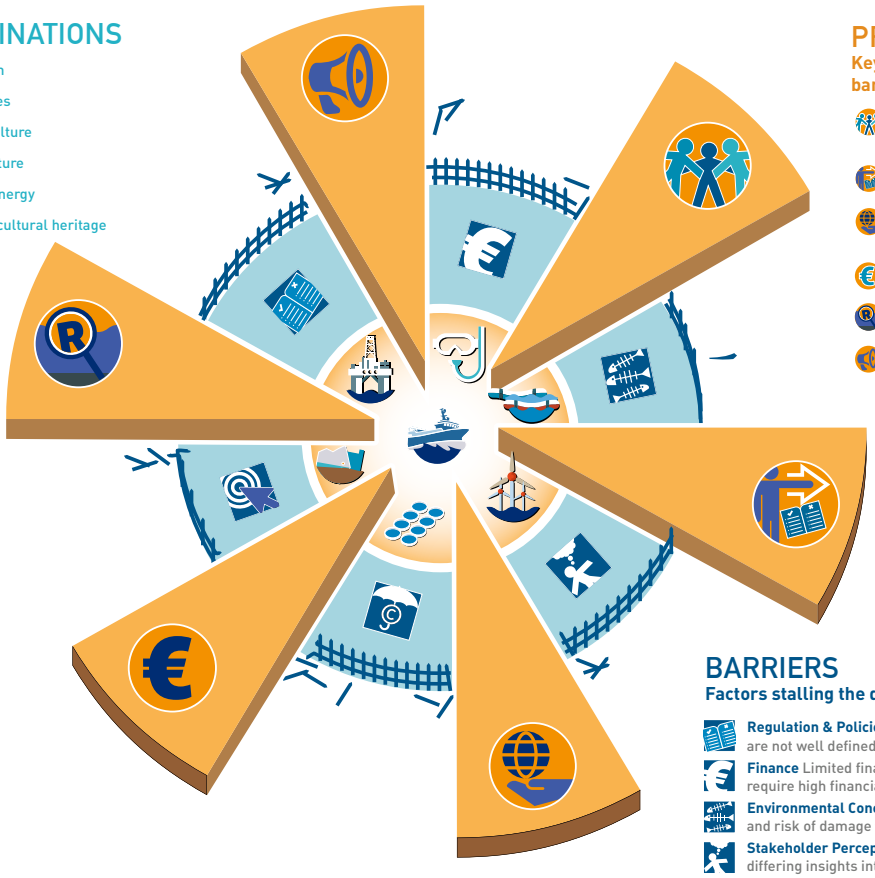
CROSS-CUTTING ISSUES AND ACTIONS

The MU combinations analysed differ widely in terms of their state of development, stakeholders involved, investment and technology required. However, the MUSES project has uncovered a number of issues and recommendations which reappear, interconnected across various MUs and addressed to similar actors.

BREAKING THROUGH THE BARRIERS FOR SUCCESSFUL MULTI-USE (MU)

MULTI-USE COMBINATIONS

- Offshore wind & tourism
- Offshore wind & fisheries
- Offshore wind & aquaculture
- Wave energy & aquaculture
- Offshore wind & wave energy
- Tourism & underwater cultural heritage
- Tourism & fisheries
- Tourism & aquaculture
- Oil & gas decommissioning - repurposing



PRIORITY LINES

Key thematic recommendations for addressing barriers to multi-use implementation

- **Integration & Coordination** between different sectoral structures, institutions and actors through cross-sectoral platforms
- **Policy & Regulation** which creates a strong framework for MUs at national level, with clear EU guidance
- **Capacity Building & Training**, especially for fishers and aquaculture farmers, including knowledge exchange between stakeholders
- **Funding & investment** for innovative and technological solutions to advance MU development
- **Research & pilot** studies to inform business models and improve understanding of MU value chains
- **Marketing & Dissemination** of good practices and information through integrated MU platforms which consider local needs

BARRIERS

Factors stalling the development of multi-use opportunities

- **Regulation & Policies** Unclear licensing processes for MUs as key terms are not well defined
- **Finance** Limited financial incentives and funding targeting MUs which can require high financial investment and risk
- **Environmental Concerns** about the impact of MUs on the environment and risk of damage to valuable sites
- **Stakeholder Perceptions** of weak representation of their interests and differing insights into MU impacts and risks
- **Technological Aspects** Low technology readiness especially regarding harsh environmental conditions in offshore areas and compatibility of technologies
- **Liability & Insurance** High cost of insurance due to safety risks and limited understanding of liability in case of accidents

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INTEGRATION & COORDINATION

MU as a concept is still novel for **government authorities, sectoral bodies and policy makers.** These actors must adjust policy, planning, consenting and management reform in order to advance synergies between maritime uses that are usually managed under different sectoral institutions and owners. Integration and coordination at **vertical (across levels of governance) and horizontal levels (across sectors and policy topics)** is needed. This may be achieved by setting up cross-sectoral platforms to guide the development of MU, involving continuous stakeholder engagement, exchange of knowledge and integration of new MU actors.

MARITIME SPATIAL PLANNING

MSP supports an integrated approach to and efficient use of maritime space. Current MSP processes offer an opportunity for **planning authorities,** together with stakeholders, to identify **suitable areas** and **comprehensive policies promoting MU, especially for new joint developments**. Moreover, data generated throughout the process should be shared with stakeholders to promote possible opportunities for MU development.

POLICY & REGULATION

MU development may flourish under clear direction and comprehensive **national legal frameworks** which specify safety, insurance and permitting process standards. Clear direction and **guidelines from the EU** and the responsible directorates are needed for integrating operational issues about MU into EU and national policies. For example pescatourism will need a clear definition on which activities are involved, which taxation regime can be applied and indication of how Member States can adapt thier institutions and regulations for its implementation.

CAPACITY BUILDING

MU actors involved in developing MUs at the project and operational level such as ocean users, investors and businesses have different capacity building needs such as know-how, training, finance, logistics and public awareness that needs to be addressed to ensure the success of a MU venture. **Responsible sub-national and national authorities** should support these actors through comprehensive training, providing financial support and encouraging professional and personal networks between stakeholders at regional, national and international levels.

PROMOTION & DISSEMINATION

Promoting good practices and disseminating information about the economic and societal benefits of MUs through **existing regional and sea basin forums and networks** is necessary to facilitate its replication and encourage investment. Such promotional support should consider the needs of actors at the local level to ensure that their issues and values are addressed. MU projects and business cases should put more focus on developing marketing strategies to increase the awareness and value of thier products and services.

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FUNDING

The success of MU implementation mainly depends on an in-depth understanding of its appeal to stakeholders and its readiness for the target market. Targeted **incentives for MU** are needed to advance its implementation, while existing funding schemes directed towards single sectors should be adapted to consider MU. Funding should also **support those small scale or local MU solutions** that may not have a high contribution to the national GDP, but may render important socio-economic and cultural benefits for the local communities, as well as wider environmental benefits. However, for the long term financial viability of MU, there is a need for development of **new financial instruments, business models** and for **monetisation of possible services and products along the full value chain** of the MU.

RESEARCH PRIORITIES

Research for MU is needed, not only for technological development, but to understand the economic, social, and environmental impacts of MU, along with related legal aspects such as liability and insurance issues. Identifying research areas and undertaking pilots in the real environment led by **research centres** would allow the development of full scale business models; enhance understanding of the MU value chain and the opportunities that it presents; and generate recommendations for advancing MU.

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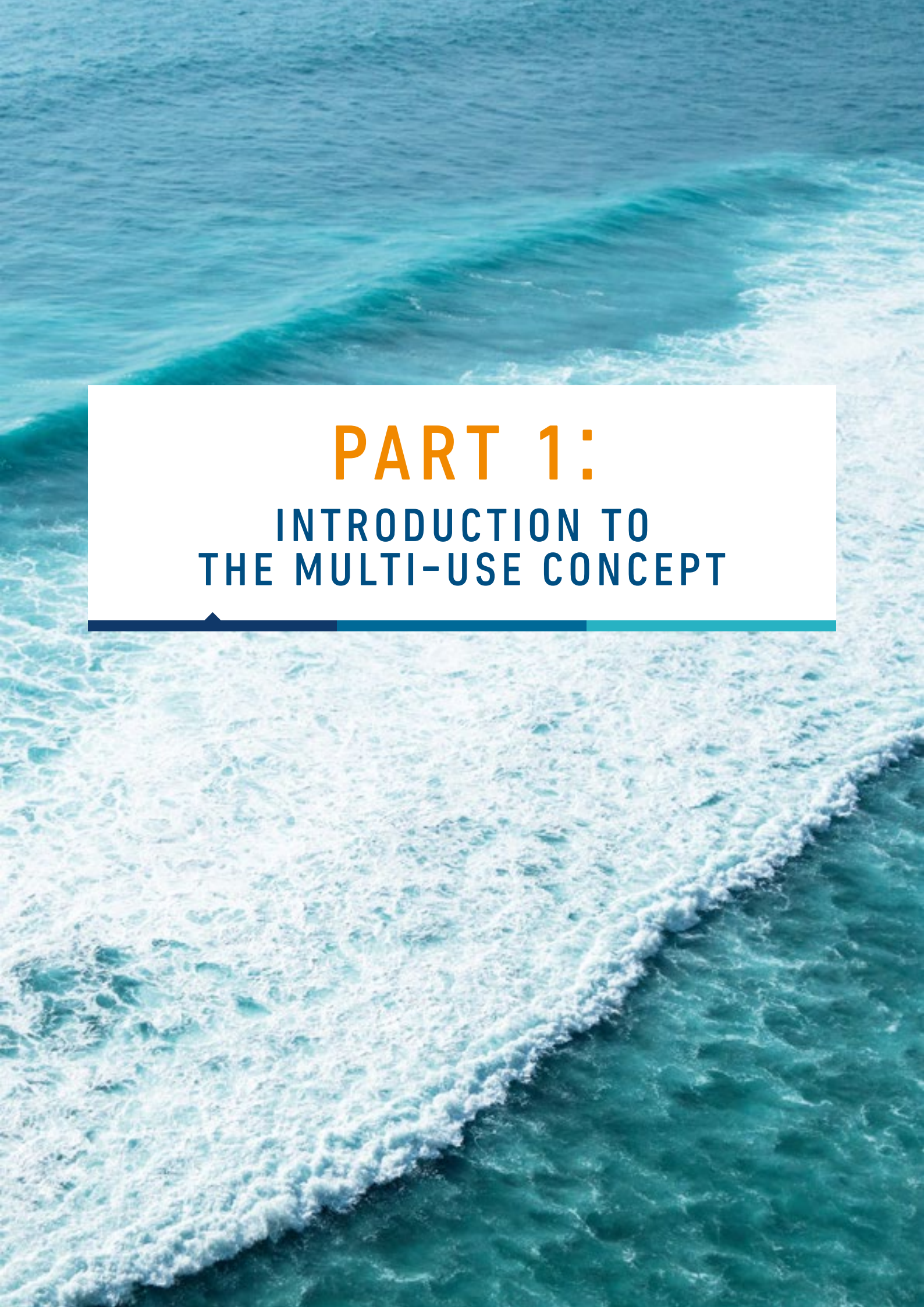

PART 1:

INTRODUCTION TO THE MULTI-USE CONCEPT

INTRODUCTION

Coastal and maritime activities are expanding rapidly due to advancements in technology, increasing global population, economic growth, trade and rising income levels. Moreover, climate change and other environmental pressures call for new types of maritime uses, such as the development of offshore renewable energies and sustainable aquaculture. However, further expansion of maritime activities **drives demand for ocean space which increases pressure on ocean resources and intensifies conflicts between maritime users.**

Sustainable development of the ocean cannot be managed exclusively by disparate single sectors, but requires a more holistic, integrated management approach.

The EU, its Member States (MS) and regions are increasingly introducing strategic policy frameworks to support the transition from single sector to a more integrated management approach. Although Integrated Maritime Policy [3] and the EU Blue Growth Strategy [11] have already sought a more coherent approach to maritime issues; it is mainly through the implementation of the Maritime Spatial Planning (MSP) Directive 2014/89/EU, that the concept of co-existence, co-location and multi-use (MU) has gained recent policy momentum through the European Union (EU).

The maritime business community is also becoming more receptive to novel and sustainable concepts that foster synergies between sectors, and improve operational and spatial efficiency. The OECD report on Blue Economy [12] calls for spatial co-existence, synergies from collaboration among different ocean industries and interdependencies and interactions among maritime activities.

While the need for a more holistic approach to maritime development is widely recognised, its practical application still faces multiple challenges. MUSES project research commenced in November 2016 with the following aims:

- **explore the real opportunities for MU in European Seas**, including the scope for innovation and Blue Growth potential;
- **identify regulatory, operational, environmental, health & safety, societal and legal barriers** that are stalling the application of the MU concept; and
- **explore practical solutions to overcome existing barriers and minimise risks associated with MU development whilst maximising local benefits.**

This EU wide Multi-Use Action Plan aims to provide orientations recommendations and actions for further development of the MU concept, highlighting the need to deliver and optimise the full blue growth potential within a sustainable and equitable approach. It builds on past research, existing MU experiences and extensive research and discussion with stakeholders at sea basin and local level to ensure that suggested actions are relevant, timely, and realistic.

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MULTI-USE BENEFITS

- contributes to more efficient use of ocean space and resources by concentrating uses and leaving areas free for future generations;
- provides economic benefits to marine users from synergetic use, while maximising the economic benefit of a certain area;
- enables the development of certain uses in maritime areas where this would otherwise be impossible (e.g. development of aquaculture farms offshore combined with offshore wind farming);
- provides an alternative source of revenue for declining or restricted sectors;
- diversifies sectors to ease environmental pressures and provide alternative sources of recreation and well-being.

However, it should be noted that MU isn't necessarily appropriate in every situation and might not always be preferable to having dedicated space for single-uses.

MULTI-USE BARRIERS

Even in cases where MU could bring significant benefits, multiple **barriers** continue to stall the transfer of MU from concept to real life implementation. Key barriers noted are:

- technological aspects;
- regulation;
- financing;
- liability and insurance issues;
- environmental concerns;
- stakeholder perceptions.

The actions recommended in this Action Plan are addressed chiefly to public and private decision-making bodies at local, national, sea basin and EU levels. For each MU combination discussed, the Action Plan identifies the actors responsible for taking suggested actions forward and, where relevant, indicates the governance level (local, national, sea basin or international) at which the action should take place.

This action plan focuses on **nine MU combinations** found to be of high relevance across the EU sea basins:

1. Tourism, fisheries and environmental protection
2. Tourism and aquaculture
3. Tourism, underwater cultural heritage and environmental protection
4. Offshore wind farm (OWF) and tourism
5. OWF and aquaculture
6. OWF and fisheries
7. Oil & Gas Decommissioning – Repurposing
8. Offshore wind and marine renewable energy
9. Offshore wave energy and aquaculture

A key conclusion of the MUSES project is that increased involvement of public regulatory bodies, including both sectoral and cross-sectoral regulators and policy makers, is essential for driving MU development. This should involve the development of a facilitation policy to promote MU, at both strategic and project levels. So far, support for MU has mainly taken the form of recommendation but has had limited impact on further development.

The concept of multi-use (MU) can take various forms and involve a wide range of maritime sectors and sub-sectors.

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MULTI-USE CONCEPT

Sustainable and efficient use of maritime space can be achieved through the combination of different maritime uses in the same area. Combining uses, either through joint installations (e.g. multiple uses on the same platform) or by establishing synergies in close proximity (e.g. through shared operations), can reduce spatial pressures and derive potentially significant socio-economic and environmental benefits.

There is no one globally accepted definition of MU, but their connotations are often similar. The following definition, developed within the scope of the MUSES project, is based on expert understanding, previous definitions used in other MU projects and initiatives (including Mermaid, MARIBE, ORECCA, TROPOS, H2Ocean and SUBMARINER), and stakeholder input at the first MUSES stakeholder workshop in Poole [13].

Multi-use (MU) – *"joint intentional 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."* [14].

The level of connectivity between maritime users can vary with respect to spatial, temporal, provisioning and functional dimensions [2]. Examples of users ordered by decreasing degree of connectivity are provided in table 1.

Another MU typology refers to stages of its development. Namely, MU can be developed jointly where the two uses are designed, planned and **developed as part of the same process**. Another option is so called **staggered development** [14], where one use is already in place and the second one is additionally integrated. The staggered development is in general more feasible for the MU designs that entail the lower degree of connectivity between the two uses.

Analogues to ocean MU can be found in various terrestrial land-use planning and zoning approaches focusing on saving space through the intensification and combination of uses. These include *Multifunctional Land Use* [15], *New Urbanism* and *Smart Growth* [16], the *Compact City Concept* [17] [18] and *Urban Nexus* [19].

Type	Dimensions				Description	Examples
	Spatial	Temporal	Provisioning	Functional		
Type 1	✓	✓	✓	✓	Takes place in the exact same place and time, with shared services and core infrastructure	German FINO Platforms, PLOCAN, Scottish Floating Power Plant (FPP)
Type 2	✓	✓	✓		Peripheral infrastructure or services on sea or land are shared	Proposed aquaculture in OWF in the Germany and Scotland
Type 3	✓	✓			Takes place in the same ocean space at the same time	Fisheries in Offshore Windfarms in the UK
Type 4	✓				Takes place in the same ocean space but at a subsequent time	Repurposing of offshore structures for new uses like recreational fishing, tourism, aquaculture or environmental conservation (US, Italy)

TABLE 1: TYPOLOGY OF MARINE MU WITH REGARDS TO ITS SPATIAL, TEMPORAL, PROVISIONING AND FUNCTIONAL DIMENSIONS [2] CONNECTIVITY IN ANY GIVEN DIMENSION IS SYMBOLISED BY "✓".

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RESEARCH AND POLICY CONTEXT

In an effort to ensure more sustainable and efficient use of maritime space and resources, many countries are moving from traditional single-sector management of marine activities towards **more holistic and integrated approaches.**

The European Union (EU) MSP Directive 2014/89/EU requires EU Member States to develop and implement MSP, advocating for co-location of maritime activities and more efficient and sustainable use of maritime resources.

A more strategic outlook for the entire European maritime economy, including funding streams and environmental actions, has already been facilitated through Integrated Maritime Policy (IMP) [11], covering aspects such as marine data and knowledge, and the EU Blue Growth Strategy [3] which provides support to key maritime sectors.

Macro-regional EU programmes and projects which aim to drive the "blue economy", also serve as an instrument to promote MU. For example, the **EU Action Plan for the Atlantic Strategy** [20] and the **EU Strategy for the Adriatic and Ionian Region** [21] promote combination of aquaculture and fisheries with other activities (tourism, environmental protection). The **Strategic Research and Innovation Agenda (SRIA) of the BlueMed Initiative** [22] advocates for the development of MU platforms in support of environmental monitoring, safety and security, and renewable energy development.

Furthermore, a number of **national strategic and legal documents** support the concept of MU (table 2). Multiple national and sub-national maritime planning processes also promote co-location and aim to foster synergies across sectors.

EXAMPLE

According to the Scottish National Marine Plan (SNMP) [23], development proposals which enable coexistence with other maritime 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.

	Eastern Atlantic – EA	North Sea –NS	Baltic Sea – BSR	Mediterranean Sea – MED	Black Sea – BS
MU in national legislation	UK	NL, BE, UK, DE, DK	DE, DK	IT, SI, GR[3], MT[3], CY[3]	None
MU at an individual administrative decision level	UK	BE, UK	DK, SE, DE[6]	IT, GR[3], MT[3], CY[3]	None
Economic incentives for MU	UK[1], PT[1], ES[1], RI[1]	BE [5], UK[1], FR[2]		FR, IT, SI, HR, GR[3], MT[3], CY[3]	None

NOTES:

1 not direct to MU but available from general and sectoral policies
2 available for research and development (R&D) projects and initiatives
3 concept of co-location and co-existence appear in strategic documents
4 specific sector regulation mention possibility of combination
5 not explicit policy-driven incentive; companies are active in driving Multi-use in BE North Sea. The Colruyt group sees it as an opportunity for branding OW and producing local aquaculture
6 Applicable only to the State of Mecklenburg-West Pomerania, in the Baltic Sea

TABLE 2: OVERVIEW OF MU EXISTENCE IN NATIONAL STRATEGIC AND LEGAL DOCUMENTS [9]

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Funding support for EU wide research projects has been provided by the **EU research funding 2007–2013 7th framework programme and an ongoing Horizon 2020 research and innovation programme** (e.g. the latest Blue Growth call "BG 05–2019: Multi-use of the marine space, offshore and near-shore: pilot demonstrators") which made reference to "reconversion/reuse of decommissioned platforms". Funding for MU and related projects involving fisheries, aquaculture and tourism have been provided primarily through the **European Maritime and Fisheries Fund** (EMFF) and focus on making fisheries and aquaculture more sustainable and profitable, as well as diversifying local economies. Although use and allocation of these funds varies across European Member States, some funds are allocated for specific MUs such as pescatourism, especially in Southern Europe. Projects such as Pescatourism 83 (Var, France) have been funded by the EMFF in order to establish the conditions necessary to establish pescatourism locally. Additional opportunities exist aimed at funding research and innovation for sea basin/macro-regional scale projects (e.g. Interreg). National funding bodies and research institutions, together with industry actors and private foundations have also shown strong interest and support for further development of the MU concept through numerous test pilots and studies.

A number of large-scale collaborative projects have provided promising designs, technological solutions and models for combining activities, in terms of economic potential and environmental impact. The **TROPOS project** designed a modular MU platform concept for use in deep waters, focusing on the Mediterranean, tropical and sub-tropical regions [24]. The **MERMAID project** examined different design concepts, such as the combination of structures or different uses at representative sites under different conditions [25] [26]. **H2Ocean** instead focused specifically on the combination of wind and wave power for hydrogen generation, supporting multiple energy users. Following FP7, the **Horizon 2020 research and innovation program** aims to further promote economic growth and sustainable development in Europe. Most recently, the **MARIBE project** focussed on analysing and developing business cases for a selection of most promising MU combinations.

MULTI-USE IN EUROPEAN SEA BASINS

The resources and capacity, and therefore potential, for specific MU concepts differ across the five EU Sea Basins [27]. **Physical conditions, availability of space and ecological richness are important factors influencing the development of specific MU combinations. MU might not always be the best option for all sectors or areas of the sea. It is important to carefully consider local conditions when deciding whether to favour single – or multi-use in a given location.**

In southern Europe, MUs generally evolve around tourism as this is one of the most important, economic sectors for many countries, having exhibited continuous growth over the past two decades. Tourism-driven MUs usually involve co-location of uses where existing infrastructure or installation is used without major modifications (e.g. tourism and fishing). These exist already on a small scale in coastal areas where tourism activities take place.

MUs involving aquaculture, fisheries and environmental protection appear relevant across all sea basins but MU with environmental protection are of particular significance in the Black and Baltic seas.

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MUs that involve the energy sector and the use of fixed (or floating but stationary) offshore installations (e.g. OWF and aquaculture) **are relevant largely in the northern part of Europe** (north-eastern Atlantic, North Sea and the south-west Baltic Sea), given the advanced development of and need for offshore energy in these regions. Combining multiple offshore energy generation technologies can ensure the maximal energy yield from a given space. While these sea basins already host a large number of installed wind farms, application of the MU concept can ensure space for the development of other relevant Blue Growth sectors such as tourism, fishing and aquaculture. Combination of wave energy generation and aquaculture, explored in the North Sea and the Mediterranean, can potentially advance wave Technology Readiness Level (TRL) and support offshore aquaculture operations.

The large number of **Oil and Gas (O&G) installations in the Northern Adriatic and the North Sea** set to be decommissioned in the coming decades as well as the need to lower the costs and environmental impacts of such activities, has led to interest in their reuse (e.g. for carbon capture and storage, aquaculture or tourism).

DEVELOPMENT OF THE ACTION PLAN

The Ocean Multi-Use Action Plan is the result of the 22 month period of research and systematic stakeholder involvement, initiated by the MUSES project in November 2016. The research built upon past MU related EU wide and national projects, including MARIBE, TROPOS, MERMAID, H2Ocean and ORRECCA. The systematic stakeholder dialogue included various formats to involve and reach out to stakeholders.

Initial step was the development of an **Analytical Framework** [14]**, Case Study Methodology** [28] **and common definition used by MUSES partners** on what is meant by 'multi-use'.

Overview of MU initiatives in five European sea basins (the Eastern Atlantic, the North Sea, the Baltic Sea, the Mediterranean Sea and the Black Sea) was conducted at national (23 EU Member States) and case study levels (10 case studies of subnational scale).

In order to understand the **key opportunities and challenges** involved at these different levels, national and local stakeholders were engaged in scoring exercises to determine the **Drivers, Added Values, Barriers and Negative Impacts (DABI)** of selected MUs. From this, the MU potential was calculated as the average of drivers and barriers, while the MU effect was estimated as the average of added values and negative impacts.

DRIVERS

factors promoting / supporting / facilitating / strengthening MU development

BARRIERS

factors hindering / preventing / negatively affecting MU

ADDED VALUES

the benefits or positive effects/impacts of establishing or strengthening MU

IMPACTS

(NEGATIVE IMPACTS) = the consequences or negative effects/ impacts of establishing or strengthening MU

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In parallel, **MUSES EU wide analysis of over 600 stakeholders** (including a large number of MUSES interviewees and attendees from the MUSES four stakeholder workshops and one focus group meeting) was undertaken to advise the ongoing engagement processes on the national and case study levels and the preparation of the Action Plan. The analysis was documented as Stakeholder Profiles report [29].

MUSES project has conducted 195 interviews as part of the sea basin analysis and 117 interviews as part of the case study implementation.

Apart from DABI analysis, case studies were further analysed through key questions defined for each of the following topics (focus areas):

1. Addressing MU development potential
2. Boosting Blue Maritime Economy
3. Improving environmental compatibility

Results of case study analyses were compiled and published as **Case Study Reports** [30] **and Case Study Comparative Analysis** [30].

	Eastern Atlantic			North Sea			Baltic Sea		Mediterranean Sea	
Case number on the map	1	2	3	4	5	6	7	8	9	10
Case study area	Northern Atlantic Sea	South coast of mainland Portugal	Azores Archipelago	East coast of Scotland	North coast of Scotland	North Sea of Germany	Island of Gotland – Sweden	Southern Denmark	Northern Adriatic Sea	Aegean Sea
OWF & Fisheries					✓	✓				
OWF & Aquaculture						✓	✓	✓		
OWF & Tourism							✓			
OWF & Environmental Protection & Tourism								✓		
Wave energy & Aquaculture	✓									
Tidal energy & Environmental Protection				✓						
Tidal energy & Environmental Monitoring				✓						
Tourism & Fisheries		✓	✓						✓	✓
Tourism & Aquaculture		✓							✓	
Tourism & Environmental Protection		✓	✓						✓	
Tourism & UCH									✓	
Tourism, UCH & Environmental Protection			✓							
Oil & Gas & Tourism & Aquaculture									✓	
Oil & Gas & Renewable Energy									✓	
Renewable Energy & Desalinisation										✓
Shipping terminal & Green Energy Generation	✓									

FIGURE 1: MU COMBINATIONS EXPLORED ACROSS THE TEN CASE STUDIES

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Results of country-based analyses were documented as country fiches and subsequently analysed at Sea Basin level. The **Sea Basin Final Report** presents an overview of the profile and state of development of MU practices across the sea basin, including intra-country and trans-boundary aspects. Detailed results from case studies analyses were not included at this stage. Comparative analysis of Sea Basin potential and barriers was also conducted and presented in **the Sea Basin Comparative Report** [9].

The final step comprised the integrative analysis of findings at the sea basin, national and case study levels for eleven MU combinations. In this step, knowledge **gaps for the development of the action plan were also identified and filled through additional desk research and consultations with stakeholders**. Detailed results of the analysis were published in the **Multi-Use Analysis** report, while the **Sea Basin Fiches report** summarises the main conclusions and recommendations per for sea basin. The analysis itself generated a large number of recommendations and actions which were fed in to this action plan. Additional consultations with stakeholders (via interviews and workshops), as well as their review of the draft action plan, allowed for the finalization of the project's final output.

A more detailed description of analysis on specific MU combinations, sea basins and case studies can be found in the corresponding reports developed by the MUSES consortium, all of which are further detailed in Annex 1 – an overview of the MUSES project [31].

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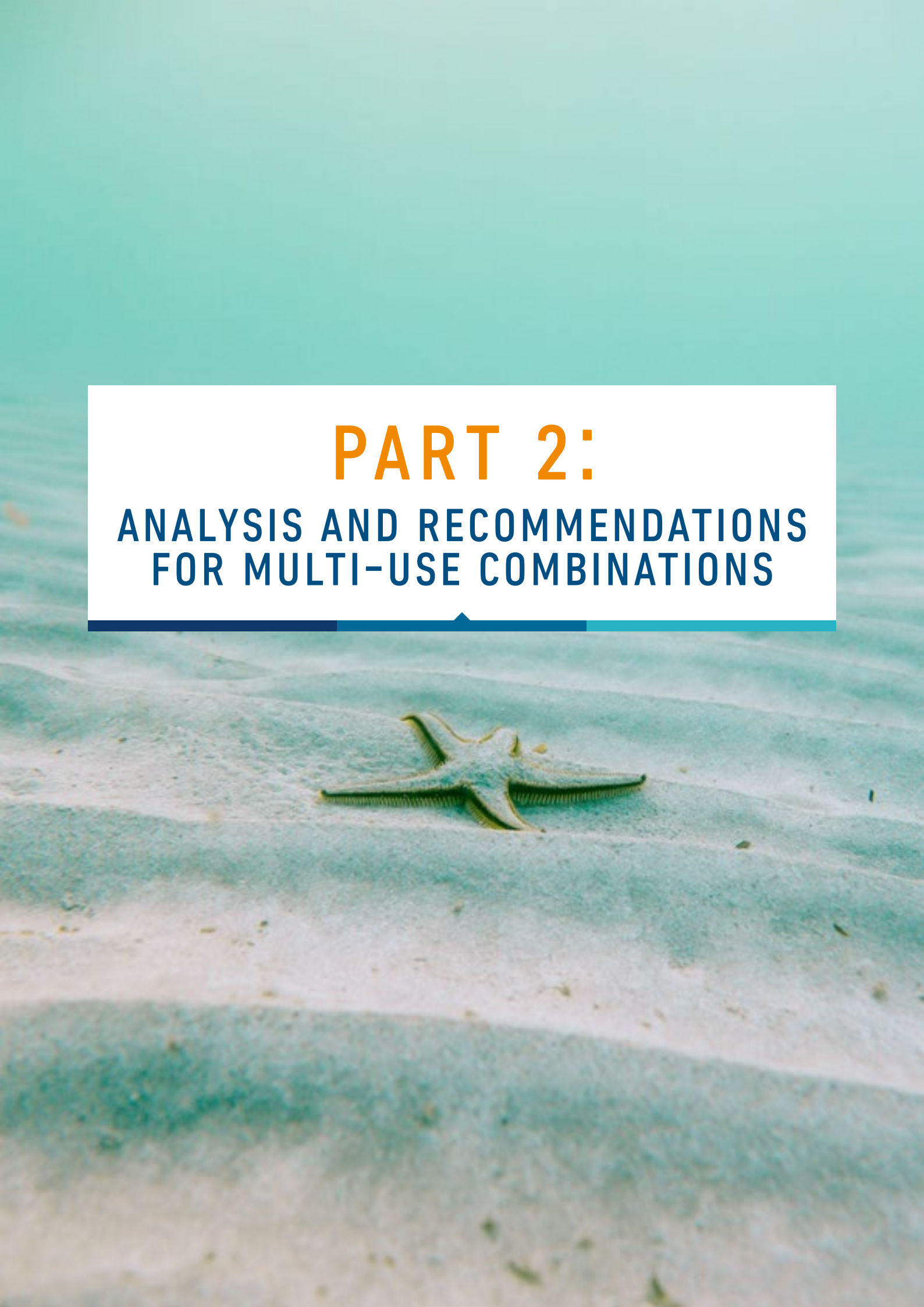
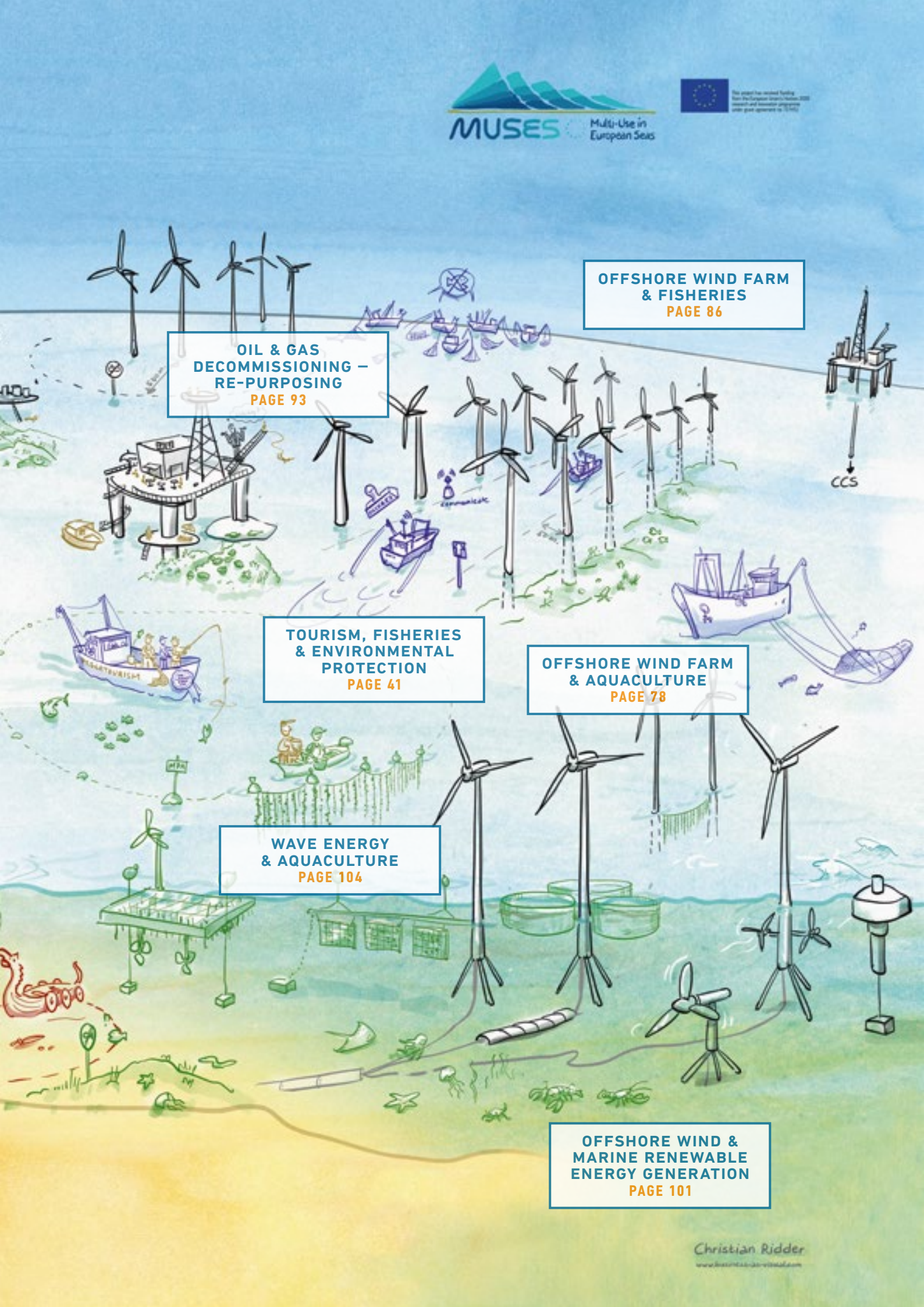
PART 2:

ANALYSIS AND RECOMMENDATIONS FOR MULTI-USE COMBINATIONS



Embracing Opportunities – Ocean Multi-Use Action Plan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MU	Eastern Atlantic	North Sea	Baltic Sea	Mediterranean Sea	Black Sea
OWF & Fisheries		✓			
OWF & Aquaculture		✓	✓	✓	
OWF & Tourism		✓	✓		
OWF & Wave energy		✓			
Wave energy & Aquaculture	✓	✓		✓	
Tourism & Aquaculture	✓			✓	
Tourism & Fisheries	✓			✓	✓
Tourism & UCH & Environmental protection	✓		✓	✓	✓
Re-use of O&G decommissioned installations		✓		✓	

FIGURE 2: MU COMBINATIONS REVIEWED ACROSS THE FIVE EU SEA BASINS

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TOURISM, FISHERIES & ENVIRONMENTAL PROTECTION

DEFINITION AND SCOPE

This MU involves professional fishers (mostly small scale) hosting tourists on a fishing vessel to discover fishing traditions. This MU predominantly involves the combination of fisheries and tourism otherwise known as pescatourism (and henceforth referred to as such). However, often some form of environmental protection including conservation, education and sustainability measures are applied during pescatourism activities.

Overexploitation of fishery resources to meet growing demand for seafood has led to pressure on the marine ecosystem, decline in fish stock and has resulted in declining incomes for small scale fishers, especially in Southern Europe.

The high **demand for goods and services created by tourism** in Southern Europe provides an opportunity for fishers to diversify their income with complementary activities. Hence growing interest in pescatourism has developed in Southern Europe since its initiation in Italy in the 1980s [32] [33].Fishers engage tourists in light fishing and other traditional fishing techniques [34] [35]including:

- Boat excursions, watching and participating in fishing activities;
- Learning about fishing methods, observation of professional fishing techniques and activities
- Preparation of lunch/dinner on board;
- Exploring the coastal and marine environment and its biodiversity.

Pescatourism can be a complementary activity to a fisherman's regular activity or a commercial tourist activity in its own right conducted as a parallel activity to fishing. The fishers/consortia are required to have a valid fishing license, registered fishing vessel, and permission to operate within the coastal fisheries zone. Vessels hosting tourists must meet certain safety standards and be properly equipped. Pescatourism activities primary involves small-scale fisheries and consider sustainable approaches to fishing and fishing gears are predominantly static (e.g., gill nets or trammel nets), long lines, hand lines and harpoons which don't impact the seabed [33].

This MU combination is different to fisheries tourism, recreational fishing and angling which may involve non-fishing vessels and other fishery activities which are neither traditional fishing nor commercial fisheries.

STATE OF DEVELOPMENT

This MU has developed predominantly in Southern Europe and been identified (including pilots) in seven out of eight Mediterranean countries. **Socio-economic benefits and demand for tourism** in the Mediterranean have been a major boost for pescatourism [32]. In **ITALY**, it is recognised as a professional activity and a legislative framework was developed in 1999 to regulate the security and hosting of tourists on board. The activity is for example well developed in Eastern Sardinia, Orbetello (Tuscany) and the Egadi Islands (Sicily). An different form of tourism involving fisherman is ittitourism

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(itti-turismo) which has been for example developed in Italy where tourists have the option of spending a day or more in the house of a fisher, and having traditional and local meals with his family and may participate in everyday routines of the fisher [33]. In **FRANCE**, pescatourism is only an occasional activity for fishers. Valorisation of their profession has been an influential reason for its advancement and tourist participation. Various pilot projects including Equal/DEFIS, PRESPO, Pescatourisme 83 and PescAtlantique, along with the efforts of the FARNET, have led to its development in France. In **SPAIN**, trips are offered to tourists in Cambrils (Tarragona) and Palamós (Girona) with recent efforts to develop a legislative framework expected to drive its advancement in other areas. In **PORTUGAL**, although pescatourism is not regulated on the mainland, MUSES interviews identified this activity around the main ports of the Algarve: Sagres, Portimão, Albufeira, Vilamoura, Faro, Olhão, Tavira, Vila Real de Santo Antonio, Ria Formosa and Costa Vicentina. In the Azores (a Portuguese autonomous region), however, pescatourism has been increasingly implemented on different islands and regional legislation created by the Regional Government. In **GREECE**, pescatourism occurs in many coastal areas and islands, such as Corfu Kefalonia, Crete, the Cyclades, in the Peloponnese and Chalkidiki Peninsulas, as well as in Attika and the Astro Kinourias-Peloponnese Peninsula.

Within coastal areas, tourism and fishing activities can take **advantage of MPA designations to develop eco-tourism activities,** further advancing pescatourism. This has been identified in the French Iroise Marine Nature Park and MPA along the coasts of Marennes and Oléron Island. A similar situation exists in **SPAIN** where pescatourism activities are popular in marine sanctuaries such as Isla Graciosa, Isla de Tabarca, Isla de la Palma, and La Restinga in the Atlantic. It has also been developed in areas of **PORTUGAL** including Vilanova de Milfontes, Aveiro, Sesimbra, Viana do Castelo and Peniche. In **Italy,** 43 FLAGs [6] were identified as exploring eco-tourism activities and some of these FLAGs have been formed around existing MPAs including for example the FLAG of Costa dei Trabocchi which supports artisanal fishers to engage in pescatourism, improve their marketing activities and engage in direct sales.

Tourism, fisheries and environmental protection have already been developed in various forms across the EU Member States in the Mediterranean, Eastern Atlantic and the Black Sea.

In the Black Sea, pescatourism occurs near Cape Kaliakra in **BULGARIA**, around the Danube Delta Biosphere Reserve and the "Vama Veche " MPA in **ROMANIA** although, in this case, there is a strong focus on environmental protection. During the fishing tour, tourists are educated about issues which pose threats to environmental sustainability.

EXAMPLE

In-depth analysis of pescatourism was undertaken by the MUSES project for case study 3 in the Eastern Atlantic (South Coast of Mainland Portugal (Algarve) and the Azores Archipelago), case study 6 in the Northern Adriatic Sea (Italian coast from Emilia Romagna to Veneto) and case study 7 in the South Aegean Sea (Mykonos Island-Greece). The results of these studies are presented in individual case study reports [65] [106] [13] [66]

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DRIVERS AND ADDED VALUE

The **tradition, history, knowledge and use of similar resources and coastal space** by both fishery and tourism activities provide the necessary synergetic technical and socio-cultural preconditions for this MU. The value chain[2] for pescatourism is varied and can include fishing and tourism activities, production of local fish products, education and promotion. These present various opportunities and added value for the fishers, tour operators, regulators, hospitality providers, local communities, and related and supporting institutions.

MAIN BENEFITS OF THE TOURISM, FISHERIES AND ENVIRONMENTAL PROTECTION MU

1 Extra income for fishers and suppliers
Stable and guaranteed income

2 Improves livelihood of fishers
Reduced physical risk for fishers, less hours on board

3 Contributes to sustainability
Reduced fishing effort and impacts on the environment

4 Improves the image of the profession
Maintaining and attracting young people

5 External benefits and added value
These include marketing the products and culture of local fisheries, environmental and gastronomic education

PESCATOURISM VALUE CHAIN

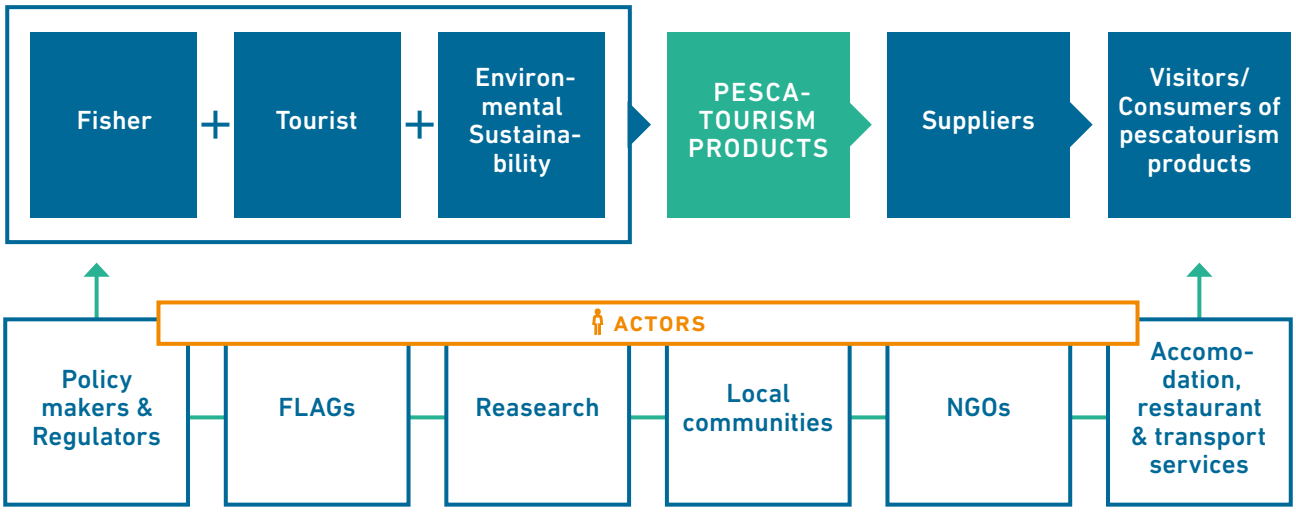

FIGURE 3: PESCATOURISM VALUE CHAIN

2 The term value chain is used to describe "the full range of activities required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use" (Kaplinsky and Morris, 2000)

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At the European level, **the European Maritime and Fisheries Fund (EMFF)** has been a major economic driver for pescatourism. Through the Fisheries Area Network (FARNET)[3], FLAGs strategies have been developed (initiated by the EMFF) which focus on diversifying local economies for sustainable development. **FLAGs** are local partnerships or groups involving key actors in a given fisheries area that develop and implement strategies at the local level, aiming to strengthen the role of fisheries communities in local development.

In many MS, such funding has promoted pescatourism as a means of sustainable diversification for fisheries communities. In the Mediterranean Sea, about 85% fish stock are fished at biologically unsustainable levels and small scale fisheries account for 80% of the total number of vessels [36]. Pescatourism is therefore a **realistic option for diversifying fishing activity** with other secondary benefits such as the reduction in fishing effort and addressing the declining trend of fish stocks.

Analysis from MUSES case studies 3 and 6 highlights the importance of **FLAGs and the European Maritime Fisheries Fund in promoting pescatourism**.

Other important social and economic drivers include increasing interest and demand for local fish products and experience-based tourism, both of which are offered by pescatourism activities.

The main driver for pescatourism in the EU has been the diversification of fishing communities and fishers into tourism activities for new income sources due to decline in fish stock.

BARRIERS AND NEGATIVE IMPACTS

Fishers who would like to engage in pescatourism, however, are facing key barriers and challenges in diversifying their fishing vessels and activities (see figure 4). Legislation on pescatourism currently only exists in Italy, Portugal (in the autonomous region of the Azores), France and Greece, while Spain, Cyprus and Malta have initiated efforts to have appropriate legislation in place.

Those with legislative frameworks to allow this activity are sometimes **limited to particular aspects of pescatourism**. The Pescatourism 83 [5] project identified that France applies a specific tax regime for fishers and it is unclear whether fishers would be eligible for the same tax regime if carrying out tourist activities. Italian legislation does not specify the income levels accepted for such an activity, nor gear restrictions or safety measures. There are also national and regional differences (e.g. in Portugal, legislation covers only the Azores region, not the mainland). In most cases, these small scale fishers are discouraged from undertaking pescatourism due to conflicting requirements of two different tax systems and different income levels as well as the high cost of refitting fishing vessels to conform to tourism requirements. Due to safety regulations in Portugal, for instance, a limited number of tourists (less than 12) are allowed on fishing vessels. This can reduce profits and increase the cost that fishers incur from participation in this MU. Although, pescatourism in general is **unsuitable for mass tourism** as it occurs on a small-scale with relatively short trips.

Fishers often **lack experience and skills** regarding safety issues, entrepreneurship, permits and customer care, and language skills needed to work with tourists, amongst other challenges of marketing and managing this type of business opportunity. Comprehensive training standards and guidelines that cover these aspects are yet to be developed. The lack of such skills tends to discourage fishers, especially after negative feedback from dissatisfied customers. Results from MUSES case studies in Portugal

3 FARNET is the community of people implementing Community-Led Local Development (CLLD) under the European Maritime and Fisheries Fund (EMFF). This network brings together Fisheries Local Action Groups (FLAGs), managing authorities, citizens and experts from across the EU.

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and in the Northern Adriatic [31] demonstrate that the **knowledge and technology** to develop this MU are generally available, but not used extensively. There is therefore a need for exchange of information on best practices to encourage more fishers to initiate pescatourism activities.

Negative socio-economic impacts related to this MU include **possible competition and conflict with other conventional touristic services**. Again, there is the possibility that non-professional fishers will begin to engage in pescatourism activities (e.g. through commercial boat tours offering fishing experiences) contradicting the definition and added value of this specific MU which is focused on small scale fishers and has a strong cultural heritage dimension. The only environmental impact identified for this MU is the possibility of overexploitation of fish stocks, which could occur only if pescatourism activities are not well managed [31]. However, necessary in-depth assessment and studies on the socio-economic benefits, value chain and environmental impacts of this MU are lacking.

BARRIERS AND NEGATIVE IMPACTS OF THE TOURISM, FISHERIES AND ENVIRONMENTAL PROTECTION MU

CAUSES OF PROBLEMS

- Sector specific regulatory framework
- Novelty of concept for some regions
- Inconsistent legislation

CORE PROBLEMS

- **Restrictive legislation on pescatourism**
- **Low capacity and skills of fishers in service oriented business**
- **Lack of knowledge about its demand and benefits**

EFFECTS OF PROBLEMS

- Negative feedback
- Dissatisfied customers
- Low motivation for fishers to participate
- Increase in the cost of licensing and modification
- Unemployment of fishers
- Less tourists can partake

OBJECTIVES FOR DEVELOPING PESCATOURISM

1) Build a knowledge base on the benefits and value chain of pescatourism through research;
2) Equip fishers with skills and knowledge necessary for pescatourism activities, especially those related to safety and service-oriented businesses;
3) Promote the MU, its products and benefits by using successful projects as examples;
4) Support the creation of clear and comprehensive legislation for pescatourism using best practices from other countries;
5) Operationalise the MU by integrating and mainstreaming it into various EU policies.

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ACTIONS AND RECOMMENDATIONS

RESEARCH AND STUDIES ON THE MU'S VALUE CHAIN AND PRODUCTS

There is a need for in-depth analysis of several different components of the pesca-tourism value chain including fisheries and tourism activities, education, promotion of quality local products, use for local cuisine, and promotion of the cultural value of traditional activities. This analysis should result in:

- better understanding of social and economic benefits associated with this MU;
- recommendations on how to maintain traditional activities, cultural heritage, and identity within the value chain;
- how to further promote this MU as a worthwhile activity for fishers.

- **Develop methods for Life Cycle Analysis (LCA)**[4] to understand the impacts and benefits of the MU's value chain. The value chain can be used to emphasise the good quality of products and their sustainability [37].

  ICES, research institutions as well as national and local actors such as tourism operators, fisheries associations and NGOs

- **Develop harmonised guidelines for undertaking Product Environmental Footprint** (PEF) assessments (multi-criteria analysis of the environmental performance of a good or service throughout its life cycle [38]. Identifying environmental carrying capacity, optimal vessel fuel consumption and emissions, spatial regulations, time limits, and fishing gears defined at local or national level for sustainable fishing enables definition of strategies for the management and planning of this MU.

  Policy makers, regulators, EC (EEA), sectoral ministries, regional sea authorities (HELCOM, UNEP-MAP), IUCN and research centres such as JRC-IES (e.g. ISPRA)

- **Develop more robust and MU relevant indicators** for socio-environmental assessment of the bioeconomy value chain. This enables definition of risks to key assets, communities, and to the values deemed significant to communities and tourists.

  Policy makers, regulators, EC (EEA), sectoral ministries, regional sea authorities (HELCOM, UNEP-MAP), IUCN and research centres such as JRC-IES (e.g. ISPRA)

- **Perform pilot studies to understand the socio-economic benefits** (direct and indirect) of this MU via cost-benefit analyses at local and national level to inform policy recommendations at the European level.

  DG Mare and DFGM, research organisations and universities

- **Further studies** on sustainable practices which can be used, sustainable quotas, tourists perceptions and preferences and the cultural/traditional impact of this MU would serve to advance this MU.

4 The Life Cycle Analysis (LCA) is a methodology used to quantify environmental impacts along the bioeconomy value chain and includes all processes from the extraction of resources to end-of-life or "from cradle to grave" within the boundaries of the study area. ISO 14040:2006

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INTEGRATION AND COORDINATION

Sectoral structures and policies involved in *pescatourism* are mostly managed and led by different sector-specific ministries and departments. This is problematic for coordination in licensing, management and administrative processes. Pescatourism involves both socio-economic and environmental components and therefore a platform for coordinating actions and activities is vital.

- **Establish and/or use inter-ministerial and sectoral working groups** on fisheries and tourism as decision-making bodies to provide guidance and direction for the MU. This is especially important in relation to the proactive establishment of marketing platforms, revenues distribution (of which a portion should be allocated to MPAs and conservation schemes), funding and financing small scale business, and downscaling value chain organisation.

  Potential members for such working groups or committees include FLAGs, Fisheries Advisory Councils, Coastal and Marine tourism associations, Ministries/Departments responsible for fisheries, tourism and environmental protection, MPA Networks (e.g. MedPAN, AdriaPAN), fishery cooperatives, and sectoral clusters.

EXAMPLE

The French Department of Fishing and Aquaculture hosts a national working group on pescatourism providing guidance on relevant safety and fiscal legislation – the result of the Pescatourisme 83 project recommendation.

EXAMPLE

The Spanish General Secretariat of Fisheries, through the General Directorate of Fisheries Management, has created the Technical Working Group for Fisheries and Aquaculture Diversification (DIVERPES), gathering representatives of the Autonomous Coastal Communities. The working group has produced the first National Strategic Plan DIVERPES 2013–2020 which addresses SWOT analysis issues, strategic priorities and objectives, monitoring and evolution indicators, financing, promoters, and applicable regulations.

- **Increase local level engagement** so that fishery stakeholders are involved at all stages of tourism development planning, implementation of area-based approaches and integrated local development strategies.

  Tourism representatives should be part of the FLAGs decision making bodies, working together to identify projects and possible funding sources.

  Local and regional authorities, FLAGs, fisheries associations, local tourism offices and local communities

- **Adopt alternative and innovative ways of engaging fishers** by demonstrating the benefits of pescatourism as well as results of previous/ongoing projects and how they could apply to local context.

  FLAGs and fisheries associations

- **Support twinning, partnerships and interregional cooperation** among pilot projects to further develop or aggregate into a regional bioeconomy value chain.

  FLAGs and fisheries associations

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- **Create mechanisms (e.g. networks, clusters) that can further support stakeholder interaction,** upstream (process initiation) and downstream (end user/process output) of the value chain, and promote knowledge transfer and communication.

  FLAGs, FARNET and fisheries associations

- **Strengthening the role of fisheries communities through co-management of resources, co-creation of projects, and co-ownership** of local development, facilitating their engagement with pescatourism and environmental conservation.

  FLAGs, local communities and fishers

The success of the Pescatourisme 83 project in the Var, France was due to its inclusive working method and its steering by a non-partisan third party and project coordinator (Marco Polo Echanger Autrement). Fishing professionals, public authorities, environmental actors and tourist agencies were brought together by Marco Polo Echanger Autrement to seek a solution that reduces captures and guarantees fishermen a decent wage, while protecting the environment and adding value to local heritage.

LEGISLATION

Inconsistencies in legal and regulatory frameworks on pescatourism are a key barrier to the its development in MSs (discussed under barriers and negative impacts, above). At the European level, there are significant differences in legislation in relation to its definition, taxation regimes, licensing procedures, obligations for qualifications, etc. Therefore, creating and aligning legislation and regulations as well as defining pescatourism is a key priority in establishing a level playing field to ensure that fishers are motivated to engage in pescatourism. Recommended Actions include:

- **Create and align legislative and regulatory frameworks on pescatourism** by undertaking comprehensive assessment of existing legal frameworks for all relevant sectors. This assessment should identify the real and perceived regulatory barriers and opportunities (at national and regional level) in addressing them. Such legislative framework should facilitate licensing for joint activities, specify processes for risk assessment and ensure environmental sustainability of fishing.

  Public institutions or authorities, DG Mare, FARNET and FLAGs

EXAMPLE

Good practice in Italian Legislation for pescatourism includes a precise definition of pescatourism including related activities such as educational scope and dissemination of knowledge, culture and fisheries tradition. The framework and provisions also cover national and sub national levels.

EXAMPLE

The Greek legal framework on pescatourism provides a comprehensive definition which includes income limits and the integration of pescatourism with ittitourism.

- **Develop guidance for legal frameworks** at national and regional levels which sets out how fishers can be the core of the MU. Such guidance should define which activities pescatourism involves and indicate how MS can downscale organisation and regulation of MU.

  Public institutions or authorities, DG Mare, FARNET, FLAGs, national, regional/local authorities, research institutes (planning and FLAGs fishing), universities, fishing cooperatives and clusters

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MARKETING AND DISSEMINATION

Promotional activities play an important role in making pescatourism more visible and patronised. Marketing platforms which accommodate potential demand for products at popular seaside resorts and unspoilt rural, coastal and island destinations must be developed. The promotion of pescatourism products through regional tourism marketing initiatives is considered effective and can further benefit the image of fishing and boost seafood sales.

- **Include actions for pescatourism within Sea Basin/macro-regional Strategies and Action Plans** (like in the Atlantic Action Plan, EUSAIR Action Plan) to give it a more prominent role in Blue Growth, integrating it into environmental strategies. Sea Basin clusters and networks, and Action Plan stakeholder forums
- **Strengthen links to local agro-food sectors** (land and sea products) by promoting innovative fishery products/processing, creating networks with local tourism, and organising fish festivals, education programs (children and adults), local gastronomy experiences and environmental protection associations/NGOs.

  
  National, regional and local tourism operators, restaurant owners and chefs, fisheries associations, local authorities and NGOs

- **Valorisation and dissemination of sustainable fishery activities and products** within the tourism sector through regional /programmes and pilot projects in association with the fishers. regional and local tourism operators, restaurant owners and chefs, fisheries associations, local authorities, and NGOs

- **Better promotion of benefits and the added value chain generated among local/ regional stakeholders, SMEs, decision-makers**. This can be achieved through better dissemination of pilot/demonstrator results and communication of funding opportunities, stimulating MU through the value chain and ensuring involvement of actors upstream (e.g. fishers) and downstream (e.g. tourists).

  
  Regional and local tourism operators, fisheries associations, local authorities and NGOs

- **Promote pilot activities and demonstrators that can support the upscaling of MU** related activities into a value chain in terms of infrastructure, equipment, actors, labour force, etc.

  
  Regional and local tourism operators, fisheries associations and SMEs

- **Exchange knowledge on value chains among existing pilot examples** to facilitate adaption to regional contexts.

  
  Regional and local tourism operators, fisheries associations and SMEs

- **Develop dedicated bioeconomy standards and ecolabelling schemes for MU related products to promote the MU**. Such schemes will enforce certain standards (sustainability/ ecological endorsement) in return for certification of pescatourism products.

  
  National, regional and local authorities, sanitary services, food certification bodies and NGOs such as WWF

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EXAMPLE

The Belgian FLAG initiated the "A l'Ostendaise" project, linking 20 restaurants with local fishermen. Every month, participating restaurants use a new fish species and promote this to their consumers. The idea was to immerse chefs into the world of fishermen, serving stories with their dishes.

They also introduced the Foodpairing "Fish" project. Foodpairing is a scientifically informed method of identifying which foods go well together and the project enables the creation of new fish-based dishes.

CAPACITY BUILDING

Some national and subnational legislation requires fishers to undertake specific training courses before being granted a certificate of competence for commencing the pesca-tourism activity. However, these training courses are sometimes limited and don't cover skills necessary for adaptation to the service orientated trade of tourism.

EXAMPLE

MarGalaica brings together the fisheries sector and other key maritime stakeholders to create an integrated tourism package along the Galician coast, promoting local fisheries products and heritage while offering an authentic taste of the region's fishing communities. Its comprehensive website was launched in the FLAG area with 57 fisheries companies offering 97 different tourism products and was subsequently extended to the whole Galician coast. The first stage of the project was to identify and convince fishery related businesses to offer tourist services and products ranging from fisheries related activities, to fish restaurants and accommodation. A series of training courses were then organised to provide fishermen and other actors with the skills necessary to work with visitors, and a quality charter known as the "Fisterra Standard" was developed. The final stage of the project involved working with tourist operators to promote the area's pescatourism activities through an annual "sea gastronomy" campaign, printed promotional material and a website (www.margalaica.net) offering an online directory of coastal fisheries resources, complete with reservation system.

EXAMPLE

The creation of the Pescatourism and Maritime Club *"Club de Producto de Turismo Pesquero o Marinero"* by the Secretary of State of Fisheries and Tourism (June 2013) in Spain has proven to be a successful means of promoting pescatourism after completion of the MarGalaica project.

Membership of the Club includes access to a number of supporting activities to increase potential markets through the marketing and promotion of the actual pescatourism model. Also, the Club's label means the formal recognition of a given site as a touristic destiny of pescatourism. The Club also enhances operational cooperation among its members and monitors the quality of the services provided by those belonging to the Club.

EXAMPLE

A good promotional example of pescatourism in Greece, is the fishingtrip.eu platform, acting as an intermediary between tourists and fishers. Organisers of fishing trips register the fishing packages they offer on the website, including location and cost information. Customers book and pay online and the fisher is informed immediately about the reservation by email and SMS.

→ **Develop comprehensive and bespoke training guidelines for fishers** (and other local actors) on both safety standards, communication skills (e.g. in foreign languages) and business skills to improve the quality of services offered to tourists. This should be developed with reference to national/ international tourism and navigation safety standards such as SOLAS.

FLAGs, fishing associations, regional authorities and local communities

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- **Allocate specific funding schemes to train fishers**. Although FLAGs can lead action, a pescatourism specific funding scheme should be put in place, as well as guidelines for capacity building. DG Mare can provide funding schemes to be disseminated by FLAGs and fishers' associations or other relevant NGOs, regional authorities, local communities and development agencies.

EXAMPLE

After members of the PanCyprian Association of Professional Fishermen highlighted their interest in pescatourism training, and the legal and technical requirements to engage in direct sales related to these activities, a training programme was developed and implemented by the Educational Center of Larnaca to train 35 fishers. It included two separate sessions, amounting to a total of 180 hours. These sessions were specifically aimed at professional fishermen and included an educational trip. The main topics addressed through training were:

- marketing
- new technologies and computers
- logistics
- legislation (including health and safety)
- an educational trip to Crete (Greece)

On completion of the training, one of the fishermen launched a pescatourism activity, while four others increased their income through the development of direct sales activities. In addition to these immediate results, the training was also considered highly beneficial by other participants, who appreciated that the FLAG was taking their specific needs and expectations into account.

EXAMPLE

The following bespoke course content was developed for fishermen by the FLAG in Sodankylä, Finland, complemented by visits to businesses and tourism exhibitions. Four of the twenty local fishermen who attended the course went on to develop successful tourist packages.

- Licence to carry passengers/ safety at work certification
- First aid
- Training in safety procedures/ consumer safety (legislation)
- Product development (collective and individual)
- Development of fishing tourism as a product
- Training in English terminology specific to fishing tourism/ Russian culture and language
- Public grants available for the promotion of tourism
- Introduction to social media
- Rescue activities on and around water
- Greeting and guiding customers
- Specifications and quality charter
- Running the excursion ("story telling")

FUNDING AND SUPPORTING SOCIO ECONOMIC DIVERSIFICATION

Fishers need particular infrastructure, incentives, logistics, and platforms such as fishing vessels, marinas and microcredit facilities to be able to diversify their activities to include tourism and market their products. Funding and initiatives to create a pesca-tourism-enabling environment are critical. It is also important that coastal community infrastructure addresses tourism needs such as on-land transport, accommodation and other facilities to attract customers.

It is important to explore which sources of funding, including the EMFF, can be utilised for particular elements of pescatourism, such as fishers for monitoring, grants for boat refitting and cultural fishing activities, among others.

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- **Coordinate with tourism operators to raise funds and provide shared resources necessary to diversify tourism activities**.

  FLAGs, fishers' associations and regional/local authorities

- **Explore other existing sources of funding, such as European Economic Area (EEA) grants to support traditional activities**, including purchase of new suitable boats, boat recovery and maintenance for fishers.

  FLAGs and fishers' associations

- **Explore funding for cultural fisheries and maritime cultural heritage under the European Maritime and Fisheries Fund (EMFF)** for the programming period 2014–2020. This covers tourism-related projects such as ecotourism, pescatourism and fishing tourism, local gastronomy (fish and seafood restaurants), accommodation and tourist trails.

  The EMFF and donor States of EEA grants, FLAGs and fishers' associations

- **Provide alternative solutions to support fishers** by providing incentives and micro credit to small scale fishers, especially in cases where micro credit funding cannot be accessed from the EMFF.

  Public institutions or authorities and FLAGs

EXAMPLE

The Azorean Regional Government, in 2017, provided an incentive mechanism to fishers who were registering to undertake pescatourism for the first time were exempted from paying the annual pescatourism license.

EXAMPLE

At the national level in Italy, the General Directorate for Marine Fisheries and Aquaculture (DGPE-MAC) of MiPAAF represents the most important financial entity, funding more than 70% of national research projects in the last ten years within the three-years Fisheries and Aquaculture National Plans [36]. The Ministry for University and Research is also providing funds supporting research and innovation in this field and could specifically promote MU-related projects.

EXAMPLE

Microcredit for small-scale fishermen is reported by the East Sardinia FLAG as a good practice which is transferable to other coastal areas where access to credit is limited. The FLAG established a microcredit fund in response to fishermen's financial needs and to support initiatives related to the fisheries sector, made available by a private credit company which was also member of the East Sardinia FLAG.

A financial intermediary who is willing to work with minimal third-party guarantees and who has sufficient financial means is crucial. This is likely to be a public authority or an institution seeking to support small enterprises.

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MAINSTREAMING PESCATOURISM INTO EU POLICIES

In the long term, it is important that the above actions are well-coordinated and operational issues of pescatourism are integrated into various EU policies, including the Cohesion Regional Policy, policies on "populating" rural areas, gender balance and the role of women in sustainable societies, jobs for young people, cultural identity and tradition. Effective implementation of such an approach would ensure that this MU has a positive influence on rural coastal areas and islands suffering from unemployment and depopulation.

DG Mare, DG Environment, the Ministries and Departments of associated sectors, regional/local authorities, regional sea authorities (e.g. FAO-GFCM who work closely with DG Mare), and IUCN

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TOURISM & AQUACULTURE

DEFINITION AND SCOPE

The Tourism and Aquaculture MU combination involves the diversification of tourism services to include aquaculture related activities. This MU takes three main forms:

- **The first form** is similar to pescatourism but differs in its operation, instead involving hosting customers on vessels to visit aquaculture sites and learn about aquaculture techniques and tradition.
- **The second form** involves diving/snorkelling or other active recreational activities which are practiced in proximity to, or within, aquaculture installations to observe the resident fauna.
- **The third form** includes sport fishing tourism (mainly angling) practiced next to aquaculture installations in marine spaces which normally function as attractive areas for a number of fish species.

STATE OF DEVELOPMENT

Thus far, this MU has been **implemented on a small (recreational) scale** in the Mediterranean and Atlantic Seas.

In **ITALY**, this MU was identified in the Veneto and Emilia Romagna regions. The regional law (LR 22/2014) of Emilia Romagna goes beyond pescatourism and provides a clear definition for this MU as aquaculture-tourism ("*Acquiturismo*") [29]. Active experience of this combination was identified at the Cavallino-Jesolo mussel plant in the northern Veneto region where sport-recreational fishing and guided tours take place within the aquaculture site. In **SLOVENIA**, touristic and educative activities are offered by aquaculture farmers in Piran Bay, a triplet MU combination (tourism, aquaculture and environmental protection), located in a protected fishing area and natural park. The farmers also participate in research projects concerning several environmental and biological issues. The combination of Aquaculture and Tourism has also been identified in areas of the **French Atlantic** including Charente-Maritime, Arcachon, the Sea of Iroise, the Gulf of Morbihan and the Bay of Brest. In the **Spanish Atlantic**, specifically the Ria de Arousa (Galicia), mussel aquaculture companies interact with tourism companies, contracting tourist vessels for various operations related to aquaculture activities. In **PORTUGAL**, at least two different forms of this MU have been implemented: both the **first form** where tourists are taken onboard to view aquaculture activities (especially mussel aquaculture) and the **second form** whereby diving takes place next to the tuna farming installations set offshore. In **MALTA**, another form of this MU exists involving organised diving in open sea Blue fin tuna farming cages located 1 mile offshore [39]. In **GREECE**, this MU was previously operational in Rodos Island where an aquaculture developer accepted tourists into the site for educational purposes and potentially fishing from the cages. In **the Baltic Sea**, this MU has only been envisioned within the SmartSea project [40] in Finland and has been considered in the MSP process for the Gulf of Bothnia region.

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MUSES REPORT

In-depth analysis of this MU combination was undertaken by the MUSES project for case study 3 in the Eastern Atlantic (South Coast of Mainland Portugal (Algarve) and the Azores Archipelago) and case study 6 in the Northern Adriatic Sea (Italian coast from Emilia Romagna to Veneto).The results of these studies are presented in individual case study reports [65] [106] [29].

DRIVERS AND ADDED VALUE

The Aquaculture and Tourism MU activities provide various socio-economic and environmental opportunities and benefits. Similar to pescatourism, the MU value chain is formed by different components which need to be further explored. Some opportunities provided by this MU include:

MAIN BENEFITS OF TOURISM AND AQUACULTURE MU

1

Integrative and alternative source of income and employment for aquaculture operators

During high tourism seasons and periods of instability in the aquaculture business

2

Raise public awareness of sustainable aquaculture practices and increase acceptance by the public

Tourists benefit from engaging in aquaculture activities

3

Increase commercialisation of local fish products

Aquaculture products gain added value and acceptance as they are better recognised by consumers and local residents

4

Promotes the wellbeing of rural and coastal communities

Provides a reliable supply of high-quality seafood

The drivers for this MU appear to be homogenous across all EU sea basins where development is possible. The main driver is related to the **economic benefits of combining both sectors**. A further driver is the availability of funds (EMFF) to diversify the aquaculture sector and the **role of FLAGs** in promoting this diversification into tourism across Europe. Increasing sustainable fish consumption also drives this MU, along with **growing interest in sustainable and locally-based tourism**. However, MU analysis in the Portugal and the North Adriatic case studies shows that existence of relevant know-how has not been a key precondition for its development there.

BARRIERS AND NEGATIVE IMPACTS

MUSES case studies in Portugal and the Northern Adriatic [31] identified various challenges and issues associated with this MU. **Restrictions in legislation or in its interpretation**, which regulate the possibility of hosting tourists on board aquaculture vessels, was identified as a major barrier**.** Only regional legislation in Emilia Romagna, Italy referred to and defined this MU. There is absence of adequate regulations related to insurance against accidents. The development of the combination is also hampered by the fact that existing vessels used for aquaculture are not often suitable for touristic use.

The main challenge for planners is the **lack of case studies and business models** for this MU. Limited standards and guidelines to train fishers and aquaculture operators, coupled with their limited experience and skill in management, customer services and entrepreneurial skills also hinders this MU. **Poor entrepreneurship and investment**

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capacity of aquaculture operators is a key challenge which is informed by their spatial fragmentation.

A common concern in promoting this MU is the possible increase in touristic pressure in already overcrowded areas, with possible increases in coastal cumulative impacts. Certain environmental concerns also arise with the involvement of recreational fishing activity next to aquaculture plants. There is the possibility of fish stock overexploitation if MU activities involving fishing are not well monitored.

BARRIERS AND NEGATIVE IMPACTS OF TOURISM AND AQUACULTURE MU

CAUSES OF PROBLEMS

- Sector specific regulatory framework
- Novelty of concept for some regions
- Niche market

CORE PROBLEMS

- **Restrictions in legislation and interpretation**
- **Few case studies and business models**
- **Low capacity and skills of aquaculture farmers in service business**
- **Poor entrepreneurial and investment capacity**

EFFECTS OF PROBLEMS

- Negative feedback
- Dissatisfied customers
- Low interest from tourist operators
- Increase in the cost of licensing and modification
- Less tourists can partake

OBJECTIVES

1) Build a knowledge base on the benefits and value chain of aquaculture and tourism through research
2) Train aquaculture operators in required skills, including entrepreneurial skills
3) Promote this MU in existing legislation, policies, strategies and plans
4) Allocation of specific funding to support real case development

ACTIONS AND RECOMMENDATIONS

POLICY, STRATEGIES AND PLANNING

Ensuring the development of this MU is especially important in coastal areas where there is competition for space. MSP and other area-based approaches and policies are important in ensuring this is successful. Recommended actions include:

- **Promote the MSP process** and enhance coexistence in provision of space for aquaculture.

  MSP authorities, sectoral agencies and planning authorities.

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- **Undertake an assessment of sectoral policies** to identify cross-sector needs and opportunities and take necessary measures to address barriers to MU.

  Regulators and planners.

- **Explore the possibility of developing multi-functional sites** (including tourism and environmental protection) in connection with aquaculture plants. Areas equipped for diving, snorkelling and/or sport fishing could be added to aquaculture plants.

  MSP authorities and sectoral agencies

- **Macroregional strategies, such as Sea Basin Strategies, can stimulate MU** development as some of these are already refer to MU and co-existence. This should be reflected in action plans accompanying such strategies with dedicated funding.

- **Recognise in legislation aquaculture-related tourism as a business activity.**

EXAMPLE

The experience of Piran Bay in the Slovenian marine area can be considered a good example of a multifunctional site. It is a fish farm (sea bass and mussel production) located in the southernmost part of the Slovenian Sea, in a preserved fishing area and Natural Park. The fish farm has become a refuge for numerous fish and other marine organisms, performing a function similar to artificial underwater reefs or wrecks. In this environmental context, touristic and educative activities are offered by Piran Bay aquaculture farmers. This experience is also an example of a triplet MU combination (Aquaculture, Tourism and Environmental Protection). Farmers of Piran Bay participate in national and European research projects concerning environmental, biological and supply chain traceability issues of economically significant fish species in the Portorož fishing preserve. These research projects are financed by the Slovenian Research Agency and the Ministry of Agriculture, Forestry and Food (national project) and by the European Commission through the Information and Communication Technologies Policy Support Program (ICT-PSP, Farm to Fork project).

RESEARCH AND STUDIES ON THE MU'S VALUE CHAIN

- *Please refer to the Tourism, Fisheries and Environmental Protection "Research and Studies on the MU's value chain and products" priority line and associated actions which are also applicable in this case.*

INTEGRATION AND COOPERATION

Integration between actors involved in this MU is necessary in creating a positive and productive climate for its development.

Integration between government and sectoral agencies, business operators and fishers should be enhanced.

- **Create clusters of business operators to develop and implement MU, including networks with local food supply operators**.

  FLAGs, Fisheries Advisory Councils, coastal and marine tourism associations, Ministries/Departments responsible for aquaculture, tourism and environmental protection.

- **Enhance dialogue and create mechanisms for stakeholders** to get together and participate in decision-making.

- **Create joint working groups between institutions and commercial sectors to perform an analysis of MU opportunities in the area and identify resources to be valorised through MU.** Working groups should include government authorities, investors and the private sector to develop project ideas to pilot/ implement

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MU through already available opportunities**.** Potential members for such working groups or committees should include FLAGs, Fisheries Advisory Councils, coastal and marine tourism associations, Ministries/Departments responsible for fisheries and tourism, fishery cooperatives, and sectoral clusters.

TECHNICAL IMPROVEMENTS & INNOVATION

- **Identify the best type of boats for developing this MU** considering local meteorological and marine conditions, and which adhere to requirements for commercial sectors (aquaculture) and for hosting tourists.

EXAMPLE

Experience in the Algarve region Portugal demonstrates the recovery of an abandoned traditional activity using modern technology and innovation. The "tuna catch" in the Algarve has its origin in the ancient Arab "almadrava" technique. This activity was recovered in the 1990s with a system of trapping ponds to catch Bluefin tuna 2.5 nautical miles offshore. Tunipex, one of the companies which invested know-how and technology in the recovery of tuna traps, also conducted the farming, catching and processing of fish. Tuniplex adopted an innovative approach by offering the possibility to visit and dive in its installations. For this purpose, the subsidiary company "Tuna Dive Tours" was created in 2014. Tuna Dive Tours offers the opportunity to observe large tuna shoals and other fish within Tunipex aquaculture ponds. The company has an equipped diving centre and facilities adapted to the company's aquaculture activities.

MARKETING AND DISSEMINATION

- *Please refer to the Tourism, Fisheries and Environmental Protection "Marketing and Dissemination" priority line and associated actions which are also applicable in this case.*

EDUCATION & TRAINING

- **Create educational opportunities for aquaculture operators** to train members of the public to boost and sustain this MU operation.

EXAMPLE

Bassin d´Arcachon bay is popular area for Tourism and Aquaculture MU. Over a period of 45 years, the Bassin d´Arcachon FLAG lost around 700 oyster farms. This had negative socio economic and environmental effects due to the importance of oysters in maintaining water quality. In response, the Regional Shellfish Farming Committee partnered with a local maritime college and careers office to promote oyster farming as an attractive career to students. Oyster farmers visited 13 schools to talk about their work and excursions were organised outside school hours for pupils to visit the area's oyster farms. Boats specially equipped for aquaculture tourism gave pupils an immersive experience of the activity, followed by an opportunity to taste the oysters. Around 10 youngsters a year are now starting up as oyster farmers in the area and the FLAG has further plans to promote the local fishing activity and the availability of local seafood in school canteens.

- *Please refer to the Tourism, Fisheries and Environmental Protection "Capacity Building" priority line and associated actions which are also applicable in this case.*

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FUNDING

- **Create targeted opportunities for integrating this MU into the frameworks of regional European funds,** and also opportunities for acquiring suitable boats**.**
- *Please refer to the Tourism, Fisheries and Environmental Protection "Funding and supporting socio-economic diversification" priority line and associated actions which are also applicable in this case.*

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TOURISM, UNDERWATER CULTURAL HERITAGE & ENVIRONMENTAL PROTECTION

DEFINITION AND SCOPE

UCH, Tourism & Environmental Protection MU, within the context of the MUSES project and this Action Plan, has been defined as the combination of touristic or recreational activities with the protection of underwater archaeology and its adjacent marine ecosystems.

UCH sites (for example wrecks) often act as artificial reefs and become a refuge for several marine organisms. Environmental protection initiatives can therefore be compatible with UCH conservation initiatives and tourists can benefit from the MU's environmental and cultural values. The conservation and protection of UCH has become a growing priority over the past decade, especially with the adoption of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (CPUCH) in 2001, designed to support countries better protect UCH through the application of specific principles and rules on cooperation, research and management. The Convention defines UCH as "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" [41] or shorter periods, based on a number of criteria to prove that they are worth being preserved and protected. The Convention has been **ratified by 10 European Member States**, while Denmark, Poland and Germany are making efforts to ratify. Ratifying State Parties are required to take necessary measures to preserve UCH sites.

The designation of an UCH site in most cases assures environmental protection of this MU and, in addition, national management plans set different levels of protection for UCH. In some cases, depending on the nature of the UCH site, the general public are permitted access for touristic activities. Two types of touristic activities are typically involved in this MU: **Dry footed access** with land-based museums to display the richness of local UCH or use of glass bottom boats to UCH locations for the non-diving public. Another type is **diving tourism** where in situ access is given to scuba divers to view UCH sites. The popularity of this MU can be limited due to the sporadic location of UCH sites which are, in some cases, too far from the coast to be suitable for diving.

STATE OF DEVELOPMENT

This MU is most popular in **the Baltic** (Estonia, Finland, Germany, Poland and Denmark) and **Eastern Atlantic Seas** (Spain, Portugal and France). It has good potential in **the Black Sea** following the HERAS project [42], jointly implemented by Romanian and Bulgarian research institutes and historical museums, to explore shipwrecks and other UCH with opportunities for diving. A follow up project known as Western Black Sea Cultural Heritage (NIRD) is also exploring innovative ways to define and launch new tourist packages for scuba diving tourists. This MU also has strong, potential in many

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countries of **the Mediterranean Sea** due to rich UCH sites, and warm, clear waters with great visibility.

The Baltic Sea hosts around 100,000 shipwrecks on its seabed according to historical data. [43] Its brackish nature, low temperatures and oxygen content, with an absence of aggressive marine borders in the northern and eastern parts[5] have resulted in slow decomposition of organic materials in this sea basin. Past and present UCH objects can be preserved in exceptional conditions compared with other European sea basins (with the exception of the Black Sea). These natural conditions, in addition to an abundance of historical artefacts, have served as favourable conditions driving this MU. Moreover, due to post-glacial rebound, the land mass south of the Ringkøbing–Fyn High (RFH) is gradually sinking, resulting in inundated Mesolithic and early Neolithic settlement sites in Denmark and Germany (e.g. Tybring Vig). One popular Tourism, UCH and Environmental Protection MU in the Baltic is the Nordic Blue Parks[6] project which testing the concept of introducing sustainable blue trails to local UCH sites and formulating criteria and guidelines for further sites in **DENMARK, FINLAND AND SWEDEN** (Dalarö Blue Park). In **DENMARK**, the *Vikingeskibsmuseet* (Viking Ship Museum) has made authentic reconstructions of Viking ships discovered at Skuldelev (near Roskilde) and offers sailing trips to museum visitors. In Denmark, the Højklint site underwater trail offers safe and easy dives in good visibility to a maximum depth of three meters.

FINLAND is particularly advanced, with concrete cases in Kymenlaakso, Helsinki underwater park (UNESCO World Heritage site), Jussarö ship trap, Kvarken archipelago, Perämeri Underwater Nature Trail, and The Story of Vrouw Maria and St. Michael at the Maritime Museum of Finland in Kotka. The Kronprins Gustav Adolf underwater park, the first maritime historical underwater park in Finland and Baltic Sea region, hosts the Swedish ship of Kronprins Gustav Adolf. The sites allow access with no special permission needed for diving.

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 rising rapidly for several years. The Interreg project BalticRIM is explicitly analysing and leading the way for new local opportunities in the blue economy sector in the Baltic Sea. As part of the project, **GERMANY** and **DENMARK** have started a pilot management case project in Flensburg Fjord to find synergies between nature protection, tourism and the traditional maritime community, including maritime traditions such as the operation of historical ships and traditional usage of waterways.[7]

In **the Eastern Atlantic** this combination exists along the Atlantic coast of France, Portugal, Spain and the UK. Existing MUs include the marine park of Iroise in France, the Islas Cíes (Galicia) and Bahia de Santander (Cantabria) in Spain. The Roman Bou Ferrer shipwreck (Villajoyosa, Spain), a large sailing ship from the 1st century AD with a cargo of hundreds of amphorae with fish sauce (garum) from Cadiz, was discovered in 2000. In Portugal, UCH sites have been identified around the Azores archipelago. Thousands of wrecks exist along the UK coastline, mainly left from the two World Wars, including the remains of the German High Seas Fleet, scuttled in Scapa Flow (Orkney) at the end of World War I. Scotland has eight designated wrecks with a 'visitor licence' granted by Historic Scotland. In England, increasing numbers of visitor licenses have

5 In the western part, UCH sites are usually only protected if covered under a sediment layer (wrecks usually survive beneath a pile of ballast stones).

6 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 to formulate criteria and guidelines for sustainable blue trails and set up trails to test the concept.

7 For example, a revived historical regatta like the Kongelig Classic 1855.

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been issued for protected sites, the most popular being the Coronation wreck which attracted approximately 1,000 licensed visitors in its first year of operation.

The Mediterranean boasts rich UCH sites, including the Zinovia relict or Nemesis III in Cyprus. In France, along the French Riviera, several underwater cultural heritage sites exist such as the Le Dramont in the Cote D'Azur. In **GREECE**, there are more than 20,000 shipwrecks (from one dating back to 200 BC to more recent warships of the World War II), airplane wrecks, and also submerged ancient ports, temples, cities etc. There are three joint ministerial decisions about the creation of underwater museums in Attica, Peloponnese and Sporades Islands. Diving to see such wrecks occurs in **CYPRUS, GREECE AND SPAIN**. In **ITALY**, other submerged diving sites are being explored. An example is the Natura 2000 site "Paguro", a gas platform wreck which collapsed in 1965, located 12 miles off the coast of the Emilia Romagna Region in the Northern Adriatic and used for tourist diving.

MUSES REPORT

In-depth analysis of this MU combination was undertaken by the MUSES project for case study 3 in the Eastern Atlantic (South Coast of Mainland Portugal (Algarve) and the Azores Archipelago) and case study 6 in the Northern Adriatic Sea (Italian coast from Emilia Romagna to Veneto).The results of these studies are presented in individual case study reports [65] [106] [29].

DRIVERS AND ADDED VALUE

The main driver for this MU combination is public **demand for alternative tourism** activities. The MU therefore makes UCH sites accessible to the public, encouraging their protection and appreciation of their value and significance. This brings about possible mutual opportunities and advantages amongst UCH authorities, diving centre and tour operators, touristic service providers, fishery institutions and associations (e.g. NGOs) involved in marine protection. The MU offers both ecological and economic benefits and opportunities.

MAIN BENEFITS OF TOURISM, UCH AND ENVIRONMENTAL PROTECTION MU

1. **Public access increases appreciation of the value of UCH** and understanding of its significance
2. **UCH sites provide shelter for fish from human activities** that can impact sensitive seabed habitats
3. **Tourist access to UCH sites** serves as a source of revenue for the management of UCH
4. **UCH sites benefit, in most cases[8], from the conservation measures** of environmental protection
5. **Shapes cultural identity** and fosters interaction between the community and their history
6. **Provides options for co-monitoring, surveillance and co-management** of UCH sites

8 In certain cases, the strict protection of wetland resulted in the total coverage of Viking sites by reeds in Denkmark and Germany. Here, a compromise between the different agencies must be found to ensure the protection of the environment and the preservation of the cultural heritage. The archaeological open-air museum in Gros Raden (Germany) with Slavic ringwall and village uses buffer zones to avoid conflicts with nearby settlements and nature conservation sites.

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Clear linkages between policy and legislation on preservation of UCH within environmental protection areas as well as socio-economic policies have been a driver for most UCH cases. For example, MPA and MSP processes in the Iroise Nature Marine Park in France and Finland respectively have been backed by such legislation. UNESCO's CPUCH, a perceived driver, indicates and promotes this MU, especially in Romania and Bulgaria who have ratified the Convention and are jointly discovering UCH sites. In the Eastern Atlantic (France and Portugal) marine biodiversity aspects, UCH resources exploration and legislation such as the ratified UNESCO Convention have driven this MU. According to stakeholders, in Greece, Malta and Cyprus, the most important drivers are environmental issues and policy goals of achieving 10% MPA[9] while exploring multiple synergies between UCH and environmental protection.

Other driving factors 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 as well as improved regulation and funding in place for UCH.

BARRIERS AND NEGATIVE IMPACT

The key barriers to the development of this MU is the **limited public access** to UCH sites, mainly **due to strict protection measures** which are in most cases **necessary for the protection of the UCH site and resources** (see figure 6). In Romania, there are strict laws on shipwreck protection with sanctions making touristic activities a low access priority. The Maritime Museum of Finland in Kotka (Vrouw Maria) is located in the Natura 2000 area, restricting activities around the wreck site. Access must be granted by Finnish nature agencies with strict conditions including prohibition of diving apparatus.

In the Mediterranean Sea, where the risk of theft is very high, archaeological authorities are often reluctant to provide information about and facilitate access to UCH sites. In general, the number of tourists that can engage in this MU is limited to the **ones having specialised skills** and certification (e.g. ISO, PADI, CMAS, SSI, NAUI).

In some cases, limited public access is due to resistance from UCH authorities based on the **risk of damage to and theft of UCH artefacts**.

This can limit the number and diversity of people who can engage in this MU. Human resources and technologies for designing new equipment (e.g. vessels to observe the sea floor) are limited across sea basins.

Statistics from PADI (Professional Association of Diving Instructors) show that 80% of qualified open water divers have a college education and can be defined as members of higher income groups with the means to spend more money than the average tourist on their travels [44].

Funding schemes for environmental protection, UCH and tourism, in most Member States and at EU level, are normally separated which restricts funding for joint initiatives. **Limited funds of** UCH authorities or museums for starting MU initiatives have been indicated most prominently in the Baltic and the Mediterranean Sea basins, but this generally an issue across all EU sea basins**.** Existing experiences and results from UCH projects and relevant initiatives have not been well shared. The combination of these key challenges and problems have, in some cases, led to concentration of this MU activity to only a few UCH sites which limit the number of visitors.

9 It was agreed under both the Strategic Plan for Biodiversity (2011–2020) and Sustainable Development Goal 14.

MUSES Multi-Use in European Seas

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 727451

BARRIERS AND NEGATIVE IMPACTS OF TOURISM, UCH AND ENVIRONMENTAL PROTECTION MU

CAUSES OF PROBLEMS

- Strict regulations on the protection of UCH sites
- Limited knowledge about possible UCH sites
- Resistance of UCH authorities and NGO's due to risk of theft or damage to artefacts
- Heterogenous actors and fragmented nature of UCH interests

CORE PROBLEMS

- **Limited public access to UCH sites**
- **Limited specialised skills restricts accessibility**
- **Limited, fragmented funding for tourism and environmental**

EFFECTS OF PROBLEMS

- Congested diving sites
- Dissatisfied tourists
- Lack of collective mentality and action between actors
- Limited numbers of tourists can partake

OBJECTIVES FOR DEVELOPING TOURISM, UCH AND ENVIRONMENTAL PROTECTION MU

1) Enhancing cooperation between research centres, diving centres, UCH authorities and business investors
2) Improving access to UCH by adhering to conservation measures
3) Supporting technological innovation to facilitate accessibility
4) Exploring innovative financing for UCH management and value development

ACTIONS AND RECOMMENDATIONS

LEGISLATION

Public access to UCH sites is facilitated by legislation which defines the preconditions under which access can be granted. National legal frameworks should be used to clarify and agree on which areas can be accessed by tourists and which should be strictly protected. It is essential that the UNESCO CPUCH, as well as the processes leading to its agreement and ratification, is used to consider in-situ protection and approaches for opening sites to the public. Legislative and institutional frameworks should promote the integration of different institutions and authorities involved with this MU.

- **Convince as many States as possible to agree and ratify the CPUCH and those who are yet to accede to apply its principles** especially with regards to areas beyond territorial waters.

  International organisations such as International Council on Monuments and Sites (ICOMOS) and Regional Sea Conventions such as HELCOM, OSPAR and UNESCO.

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EXAMPLE

Romania and Bulgaria are two of the 10 EU MS that have ratified the UNESCO CPUCH and are identifying and promoting joint UCH sites. Through the HERAS project, the two States have also developed a Cross Border Management Plan for Underwater Heritage tourism.

- **Develop a code of conduct to regulate tourist and diver activities at UCH sites**. Potential rules within such a code of conduct include not touching UCH objects, keeping within a certain distance from the site, and refraining from deliberately disturbing sediment.

  National Authorities for UCH and diving centres.

- **Create or improve sub-national regulations and sectoral policies focused on removing barriers to MU, targeting cross-border sector needs and opportunities**.

- **Make use of other existing legal frameworks and policies such as MSP and other area-based management approaches to regulate and promote UCH management**.

  National Authorities for UCH, Competent Authorities for MSP and local authorities.

COORDINATION AND INTEGRATION

Early and continuous engagement between actors is important to encourage collective mentality and action to advance MU implementation. Cooperation platforms between actors are also relevant for considering new and innovative ways to provide public access to UCH, control site access and encourage information exchange between actors.

- **Create working groups/ intersectoral committees to discover UCH sites and innovative ways of accessing and promoting UCH**.

  Government authorities, NGOs, management bodies of MPAs, the scientific community and scuba diving clubs.

- **Develop relations between different countries and national authorities to address issues in relation to UCH theft and controlling imports of artefacts obtained from waters**.

  Customs services, the police and naval authorities.

- **Explore approaches to include professional divers and diving clubs in controlled access and monitoring activities and co-management to ensure UCH are well managed and preserved.** This can be initiated by organising workshops with these diving clubs illustrating the characteristics of the sites and discussions on how to request diving permissions.

  Diving centres and local authorities.

EXAMPLE

In Sweden, the Dalarö Model has been used to foster cooperation in advancing access to UCH sites. The model is based on the idea of controlled access to protected shipwreck sites. Divers get permission to dive to the wrecks when accompanied by a licensed underwater guide. The guide has relevant competence and training to educate the divers on the cultural heritage of the area. Non-divers enjoy the underwater cultural heritage via real-time experience onboard charter boats equipped with ROVs. In addition, digitally enhanced movies and animated reconstructions of ships

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can be made for display on widescreen television and movie screens. The Dalarö model is a method for simultaneously preserving, using and enriching UCH for both divers and the non-diving public.

EXAMPLE

In Estonia, cooperation between diving clubs and the National Heritage Board have advanced this MU. Diving clubs participated in the development of regulations and also participated in joint projects with National Heritage Board, e.g. Central Baltic project Baltic History Beneath Surface: Underwater Heritage Trails In Situ and Online (which aimed to demonstrate the significant tourism potential of Baltic Sea UCH by developing easy and convenient ways for visiting the unique and well preserved underwater sites in situ. The project indicates the existence of several new tourist attractions in the Baltic Sea that are supplied with buoys, underwater information boards and dive trails.

EXAMPLE

The Adopt a Wreck Scheme [107] was a successful joint initiative between the Nautical Archaeology Society (NAS) and the Maritime and Coastguard Agency in UK to encourage groups and individuals (mainly dive clubs) to take a close interest in a particular maritime site and adopt a minimum level of stewardship. This is a means of encouraging the public to actively record the sites that they are visiting and monitor how the site changes over time. Its success was cut short only by the limited availability of long-term funding options. The scheme corresponds to the underlying aims of the Faro Convention, enabling the public to become directly involved in curating their UCH, offering avenues for "layman research". This fills a gap, particularly for the monitoring of early modern sites from the two World Wars which archaeologists typically don't take a great scientific interest in, but are nevertheless protected sites in most countries.

In Denmark, the "Adopt a Wreck" approach has been introduced to involve divers in monitoring activities at the Kings Bight in Daneborg.

EXAMPLE

In the state of Mecklenburg-Vorpommern, Germany, there are two diving clubs dedicated to UCH (i.e. "Gesellschaft für Schiffsarchäologie Rostock e.V." and "Regionalverein für Unterwasserarchäologie Vorpommern e.V."). The divers assist state archaeologists as volunteers and thus do not require a professional diving brevet as scientific diver.

It is planned, as part of the BalticRIM Project (Schleswig-Holstein, Germany), for National UCH authorities to establish contacts with the scuba diving community in order to receive reports and other information useful for site-monitoring, whilst also enhancing awareness on the legal basis, licensing procedures and possibilities for cooperation.

PROMOTION AND DISSEMINATION

Information campaigns geared towards tourists, and other associated marketing and informational activities such as tourism promotional websites, brochures and leaflets and special offers for tourists, are required for developing new business opportunities in the region. This kind of communication outreach can also help in financing scientific work. Promotion and Dissemination of information can be achieved by the following;

- **Inform and develop public awareness campaigns regarding UCH** by cooperating with other tourism operators and activities on offer. This should include greater attention on tour and exhibition opportunities as well as films and publication in planning archaeological excavations.
- **Promote submerged sites and providing responsible access to the public**, selecting some UCH sites to open for visitors while leaving others closed (within or outside MPAs). Also, creating replica sites to steer tourists away from the original can help in safeguarding particularly valuable UCH.

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- **Develop a national and sea basin database of UCH,** identifying sites suitable for regulated touristic use and sites where access is to be prohibited and share this information with the public.
- **Offer heritage-focused dive courses as part of 'normal' dive training activities** by dive clubs or specialised NGOs.
- **Promote cultures of the sea**, **by linking UCH sites to coastal sites, museums** and local cultural values, including seamanship traditions, expertise, professions, historical marine routes, etc.

EXAMPLE

The Finish Heritage Agency shares data with the public and other agencies, as well as a registry showing locations where UCH diving is permitted. This has fostered better relationships and coordination between UCH authorities, MSP authorities and diver clubs to promote Tourism, UCH and Environmental Protection MU and divers feel a sense of pride and duty in monitoring and conserving these sites.

EXAMPLE

An example of a replica site is located in France. Around 250 amphorae, recovered in the 1950s, after being carefully studied were re- submerged in 2010 at the mouth of the Niolon cove off the coast of Marseille, in a location with appropriate conditions to allow access for divers of different levels. The amphorae were secured in place with a steel cable to prevent looting and the dive centre keeps close guard on the site.

EXAMPLE

Spain hosts the Atlantic Museum 15 metres under the sea in Lanzarote (Gran Canaria), where 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 30 m-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 with the figures helping to form part of an artificial reef, which will act as a breeding site for local species of fish and plants.

EXAMPLE

In Italy, the Relitto della piattaforma Paguro is a good example of this MU, including tourist diving to a submerged platform wreck with environmental protection (SIC IT4070026). The NGO "Associazione Paguro" is in charge for diving authorisation and managing recreational activities. The NGO acts to promote the site's cultural and natural heritage and is connected with several diving schools and organises educational events (e.g. diving days to the site). It is also connected with the National Museum of Underwater Activities in Marina di Ravenna, where historical, cultural and educational activities are carried out.

The NGO website reports, among the others, the average number of registered diving visits (after the agreement in 1997 was around 2,000 on yearly basis and the trend shows an increase toward 3,000).

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RESEARCH AND TECHNOLOGY

- **Projects to identify and discover UCH sites and potential for access are important in advancing this MU**. The development of new technologies could help develop the sector and, in turn, could open a specific market niche for remote monitoring of UCH sites, as well as the possibility of implementing state-of-the-art means of virtual exploration. Dedicated boats, ROVs and technology which support real time experience of the UCH would be required for this.

The following are necessary actions to improve research and technology in relation to UCH:

- **Undertake pre-evaluation to understand which UCH sites need strict protection and which have potential for tourism activities and development**, as well as whether access to UCH sites would be needed for a community's cultural development. This would help to prioritise activities for limited research budgets.

  UCH authorities, research centres and archaeological teams.

- **Exploration projects and knowledge of existing UCH site locations their suitability for touristic purposes, and legal, technical and financial prerequisites, are required to initiate this MU.** Researching and documenting human stories connected to the underwater sites can support this MU.

  UCH authorities, research centres and archaeological teams.

- **Explore the UCH site using underwater technologies in order to provide tourists with visual access and real time experience of underwater ruins/wrecks**. These include virtual visits to UCH sites in 3D, 360-degree filming, dedicated boats, ROVs and other like technology.

  Research centres

- **Develop guidelines on how to establish underwater parks or trails**.

EXAMPLE

in France, the Virtual Dive project provides virtual access to the Lune wreck, once Louis XIV's flagship in Toulon, via DRASSM and Dassault 3D. A mermaid-like divebot called Ocean One has also been used at this site which gives a virtual sense of touch according to what the robot is doing.

EXAMPLE

The Vrouw Maria interactive in Finland, a real-time 3D virtual reality simulation gives visitors a feeling of "being there" at the actual site and allows them to navigate and experience the wreck and underwater landscape and sound scape.

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FUNDING

In order to advance this MU, fundraising and financing activities should be encouraged for development projects and the protection of submerged sites. The main funding opportunities are related to the tourism sector by forming alliances and collaboration between countries (regional or micro-regional), as well as shared interests between ministries responsible for culture and tourism during application of UCH projects. Joint interests can result in receipt of a bigger budget at the national level and increase chances of obtaining international (EU, UN) funds, such as INTERREG programs targeting diversification of tourism activities, sustainable tourism initiatives and innovation in the tourism sector e.g the "Kongelig Classic [45]" regatta.

- **Align sources of funding at international (example of UNESCO), national , departmental and local levels, and between sectors**.

  Sector ministries and national agencies dealing with environmental protection, archaeology, UCH and tourism

- **Enhance collaboration between actors to fund research protecting underwater cultural heritage.** Cooperation between dive centres and authorities can ensure that funds are raised with permission to access the sites, provided they agree on how to control site integrity and monitor it regularly under the guidance of a certified underwater archaeologist.

  Dive centres, UCH authorities and underwater archaeologists

- **Organise charged and controlled public visits to UCH** where divers can watch sites during the process of project and research work.

  UCH owners and operators in cooperation with tourism operators

- **Encourage retail activities, as well as gift sales of appropriate and varied merchandise**, which can be an important part of the visitor experience and an important revenue source promoting local culture and identity.

  UCH authorities in cooperation with tourism operators

EXAMPLE

The INTERREG "Maritime Heritage Assets and Nautical Routes as Sustainable Cultural Tourism Attractions" project aims to exploit synergies and capitalise on relevant knowledge and results, introducing innovations and supporting policies for preserving and valorising UCH, and working towards sustainable cultural tourism development and promotion.

EASME-EMFF calls for proposals (deadline was in March 2017) aimed to support the development of transnational thematic tourism products promoting nautical and water sports tourism.

EXAMPLE

The *Natière* shipwreck in Brittany, France, provides a good example of charged and controlled public visits to archaeological sites during the process of research. While working on this site, researchers could study two naval structures sunk at the same site and more than 3,000 artefacts were brought to the surface to preserve the site. It has since been used as a site that host archeologist to promote research into maritime archaeology both in France and internationally.

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CAPACITY BUILDING

- **Promote training schemes and courses, which also increase awareness and appropriate conduct of recreational divers.** Training and diving courses such as the Nautical Archaeology Society (NAS) International Education Programme[10] delivers courses in nautical archaeology and diving which build skills and experience by allowing participants to take part in projects and fieldwork around the world. Similar training courses are offered by the German Federation of Sport Divers (VDST), which teaches scuba-divers about the sensitivity of archaeological sites and provides a code of conduct, legal basis and basic surveying skills. Such courses and training should be supported and promoted elsewhere and also include information about the circumstances and materials of the wrecks (and the UCH sites in general) to ensure that divers understand their value.

10 The NAS International Education Programme has been adopted in several other countries outside the UK including Germany and France.

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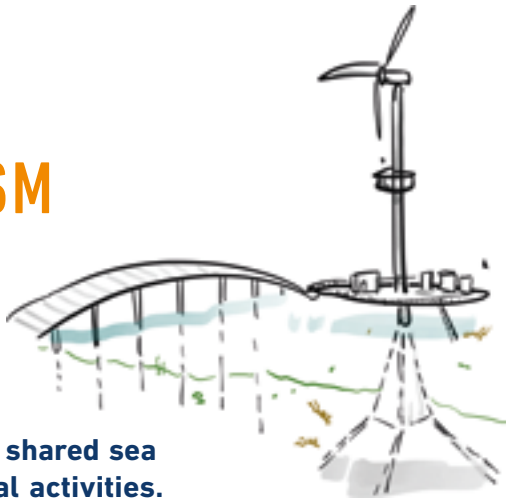
OFFSHORE WIND FARM & TOURISM



DEFINITION AND SCOPE

MU of tourism and offshore wind farms (OWF) results from shared sea space, joint on and offshore infrastructure and operational activities. These include OWF sightseeing boat tours and shared onshore facilities such as OWF related information centres and museums.

Synergies between OWF and tourism can be developed in several ways [46], including:

- sightseeing boat tours, sometimes combined with angling;
- specially designed platforms around the turbines serving as a resting ground for seals, designated facilities for divers and offshore restaurants in the vicinity of OWF;
- unique wind farm design and layout can serve as a tourist attraction and regional landmark;
- on land visits to OWF information centres and museums, and platforms for observing the farms with telescopes;
- boat tour operators can be engaged in OWF related monitoring activities;
- helicopter flights around OWF.

STATE OF DEVELOPMENT

There is already a lot of experience with this MU across the EU Member State-swhere offshore wind farms are already developed.

Most existing examples of this MU are situated in the **Baltic and North seas**. In the coastal areas of **DENMARK, BELGIUM, SWEDEN, GERMANY AND THE UK**, OWFs are already being consciously integrated into regional tourism activities.

In **BELGIUM**, there are boat tours to the first national OWF, Thorntonbank (owned by C-Power), situated 30 km from the coastline. For business groups, the tour operator collaborates with the visitor centre of C-Power in Ostend, where a delegate from the wind farm operator gives a presentation about the OWF. The tour boat does not cross the 500 m safety zone yet, despite the distance, visitors are able to experience good views of the wind farm.

In **GERMANY** (North Sea), in addition to boat tours (outside the 500 m safety zone) [11]to one of the OWFs, there is also an on-land observation platform in Bremerhaven with an information board and multimedia terminal.

In **THE UK**, the safety distance is usually only 50 m, allowing vessels in close proximity to the turbines [47]. Some examples can be found in Brighton, East Sussex in Southern England (visits to Rampion OWF); Ramsgate, Kent (visits to Thanet OWF) [48] and Great Yarmouth, Norfolk (visits to Scroby Sands OWF) in Eastern England; Llandudno, Wales in Irish Sea (visits to the Gwynt Y Mor OWF).

In Middelgrunden OWF in **DENMARK**, tourists can even climb the 60 m tower of one of the turbines and open the nacelle (if the weather conditions are suitable) [49]. This OWF also provides a good example of an attractive OWF layout and the benefits of early

11 In its first year, the Helgoline tour was accompanied by an OWF company employee who answered questions and provided information to tour guests. In the following years, the OWF operator instead created a video with information about the construction and operation of the OWF.

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engagement of local community in a co-design process. The wind farm layout follows a single curved line, continuing the Copenhagen city structure which has the shape of a super-ellipse, characterised by the old defence system west of Copenhagen [50].

This MU is also initiated on a temporary basis, usually as part of the OWF developer's corporate social responsibility (CSR) local outreach campaigns [51]. These are undertaken especially during the pre-planning stage when local acceptance needs to be secured for the OWF project to continue.

MUSES REPORT

In-depth analysis of this MU combination was undertaken by the MUSES project for case study 5 in the Baltic Sea (south coast of Lolland-Falster, Denmark) [52].

DRIVERS AND ADDED VALUE

Tourism and offshore wind energy sectors often compete for the same space: shallow waters which are close to shore. Visual impact of OWFs on the natural landscape can negatively affect the acceptance of OWF project in the coastal areas. One of the main drivers for this MU is that it could potentially **overcome issues related to OWF project acceptance and the "NIMBY" phenomenon** (Not In My BackYard).

It increases local knowledge about the importance of green energy and provides an opportunity to derive **long-term benefits for local communities** by promoting **innovation, entrepreneurship and job growth**. Moreover, if the OWF has a unique design and layout, it can become a symbol for the local region and create a **sense of pride among locals** [7] [8].

EXAMPLE

In the Netherlands, the **Art on Windmills project** attracted many artists to apply for the opportunity to have their art displayed large scale on turbine towers [53]. In addition, the innovative **Windlicht (wind light) project**, an installation that connects a row of wind turbines with a neon green laser, transforms the wind farm into a mesmerising light show in strong winds [54].

Presence of an OWF can potentially **add value to existing boat tours and make them more attractive.** It also gives tour operators an opportunity to offer additional promotional products, or OWF related **educational content**.

More direct long-term benefits from OWF for the local communities can be derived by applying MU principles.

MAIN BENEFITS OF OWF AND TOURISM MU

1
Mitigation of potential conflict
and increased acceptance of the OWF project

2
Financial benefits to boat tour operators
and other tourism actors, attracting more tourists, boosting innovation and the local economy

3
Promotes sustainability and education of tourists
about the green energy transition

4
Financial benefits
to the OWF sector through outsourcing some operational activities (e.g. environmental monitoring, surveillance and data collection)

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BARRIERS AND NEGATIVE IMPACTS

Licensing procedures are often complicated for boat tours within the OWF zone and entail **high insurance premiums** due to safety risks. At present, there is very little information about overall interaction between the two activities and associated risks within the zone that could advise the insurance premiums. Moreover, the question remains on who is to cover the insurance premium and who will be **liable in case of any accidents** within the zone.

Development of this MU is somewhat easier if the tourism activity is kept outside of the OWF zone. However, it is still limited by **lack of awareness and interest of local boat operators** and artisanal fishers (angling) about the opportunity, as well as low individual financial power and overall capacity from local tourism businesses to initiate and sustain such tourism opportunities. An additional barrier is **distance to shore**, which increases fuel consumption, working hours of personnel onboard and efforts to keep tourists entertained. Experience from the UK shows that 3–4 hrs is the maximum duration of a trip in order to keep it profitable. Moreover, the **interest for such activities is seasonal** (seasonal character of coastal tourism making MU not economically viable all year round) and dependant on **weather and tide conditions** (mainly relevant in the North Sea). Moreover, it appears that in some regions the **overall interest** for such boat tours or other tourism developments in relation to OWF is not high enough to sustain the MU.

BARRIERS AND NEGATIVE IMPACTS OF THE OWF AND TOURISM MU

CAUSES OF PROBLEMS

- Unclear regulations and insurance implications
- Lack of communication between the two sectors
- Lack of information about the business models and operational interactions
- Heterogenous nature of tourism sector

CORE PROBLEMS

- **Limited financial and technical capacity of tourism operators**
- **Lack of awareness about business opportunities**
- **Lack of interest from both sectors**

EFFECTS OF PROBLEMS

- Lack of long term local benefits from the OWF project
- Low and/or short term profitability
- Lack of collective action between actors and low presence of the tourism sector in OWF project development discussions
- Possible cross-sectoral conflicts

OBJECTIVES FOR DEVELOPING OWF AND TOURISM MU

1) Improving involvement of the local tourism sector early in MSP and planning processes of a specific OWF (consider involvement of local clusters and tourism sector representatives);
2) Facilitate transfer of good practices across Member States/sea basins, generated from existing MUs;
3) Support the development of viable business models and capacity building for local tourism operators;

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4) Mainstream such solutions in local development policies, cohesion policies, and as part of broader project development guidance for OWF developers (esp. with regards to consultation and mitigation processes).

ACTIONS AND RECOMMENDATIONS

POLICY AND REGULATION

- **Ensure substantive involvement of tourism boards and other tourism industry representatives in MSP and OWF planning consultation processes**. Given the heterogeneity of the tourism sector and relatively small size of individual tourism businesses, consider encouraging their inclusion in the local maritime industry clusters or other cooperation platforms to ensure their increased involvement in relevant policy and planning processes.
- Policy makers and responsible authorities should consider this MU an opportunity from two perspectives:
  - In crowded areas as an opportunity to disperse tourism activities and reduce pressure on tourism hot spots (this would be especially useful as criteria for siting the OWF).
  - in remote (or declining population/slow economy) areas **as a means to boost the local economy**. As well as providing direct job opportunities, increased number of tourists would also benefit from related local services, such as restaurants and gas stations.

National policy developers, MSP authorities, local (municipal and regional) authorities involved in development strategies and clusters

FUNDING

- **Promote cooperative ownership** that enables earlier and more effective involvement of local communities, and therefore facilitates easier agreement about suitable design of the OWF, establishment of associated tourism and recreational activities and ensures that profit from the establishment of the OWF stays local [55].

EXAMPLE

Diverse funding sources and ownership structures for OWF and MU can be noted, ranging from partial private ownership and reinvestments to initiatives resulting from private and public partnerships and community (incl. tourism and recreation activities) benefit funds from the OWF developer.

Local **intermediaries and clusters** such as tourist boards and local councils, can have a strong role in initiating and supporting the long-term functioning of this MU, mainly by identifying opportunities, facilitating cooperation and promoting MU concepts. Tourism associations can empower the sector by gathering relevant tourism stakeholders and maintaining a **network of local tour operators.**

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EXAMPLE

Two examples of cooperative ownership and the development of related recreational tourism activities are **Middelgrunden and Hvidovre OWFs in Denmark, situated off the coast of Copenhagen** [56]**.**

- **Middelgrunden**: ten of the turbines belong to OWF company Orsted and the other 10 to the Middelgrunden Wind Turbine Cooperative.
- **Hvidovre OWF:** the cooperative was organised as a typical NGO organisation with considerable participation from the local county, including representatives from established local companies and other similar NGOs sharing knowhow from related projects. The cooperative was responsible for local engagement and for selling 10,700 shares financing one of the turbines while the organisations also collaborated for the public hearing related to the EIA.

The Danish model for cooperative ownership [56] **can be replicated across EU:**

- one vote per person, independent of number of shares;
- approximately 3–5 shares are sold per person which covers electricity consumption in a standard household;
- most of the shareholders are individuals (with about 20% living in the county where the turbines are established) or unions buying shares to equalise electricity consumption on their premises;
- the feasibility of the project for individuals with the actual tariff for wind energy is showing 11% return for the investment the first 7 years. For a period of 25 years the return is 6.7% and the payback time is 11 years.

- **Develop general business models from existing examples to support financial viability of future developments in other areas. Such models should include guidance for cost-benefit analysis.**

  The wind industry associations, and **public-private clusters and partnerships** (e.g. State of Green in Denmark) are found to be in support of this MU and are likely to be important for future efforts to identify concrete opportunities and raise awareness of individual actors

- **Consider other options, including on-land information centres, or virtual tours, where MU such as boat tours are not economically feasible.**

For example, one of the parameters for cost-benefit analysis could be distance to shore. This MU is preferably developed at a distance < 10 nm (18 km) from the coast. With increasing distance, more tour content will need to be provided to attract tourists and justify the high price (due to gasoline consumption and long working hours). In the case that the OWF is too far offshore, or environmental conditions are unsuitable, other options can be considered (figure 8).

EXAMPLE

On land experiences that include virtual reality are increasingly gaining interest. For example, at the OWF exhibition centre at Klimahaus Bremerhaven, Germany, visitors can experience a "virtual helicopter ride" around an OWF.

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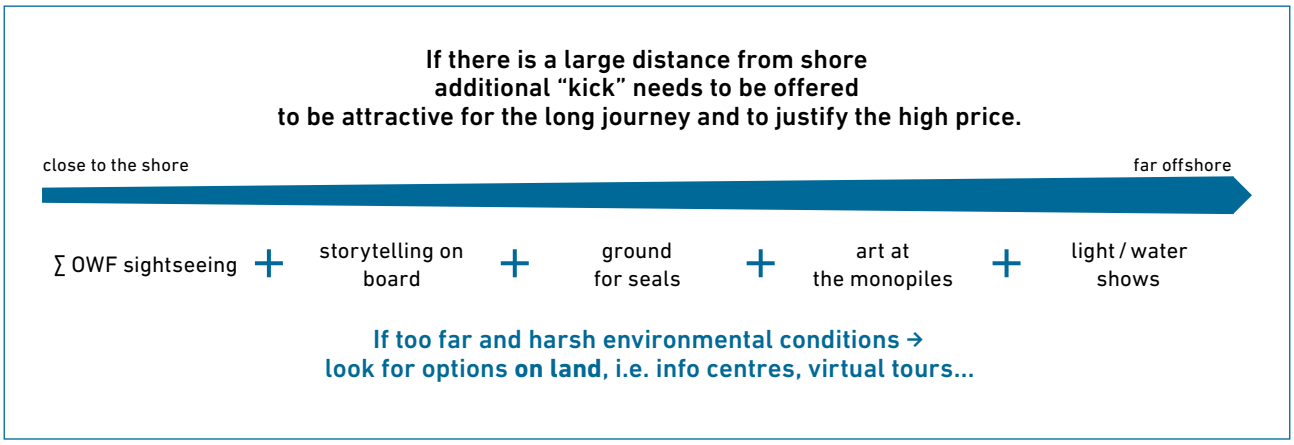

FIGURE 4: LONGER DISTANCES FROM SHORE REQUIRE SUPPLEMENTARY TOURISM ACTIVITIES

EXAMPLE

FRANLIS BUSINESS CASE (Belgium): Currently, there are approximately **10,000 people per year** taking the boat tour to the local OWF. The tour is mildly profitable, with the **turnover** of the OWF tour being **5% of the company's total turnover**. Without the wind farm, boat tours would still be possible, but the OWF provides important added value[12]. Typical customers include **active seniors, schools and groups**, while a teambuilding tour for companies presents a potential opportunity for expansion of this business. **A strong marketing campaign** is very important for such tours. In this case, the **special reputation** and value of Thorntonbank as the largest wind farm in Belgium, played an important role.

CAPACITY BUILDING

→ **Ensure collection and exchange of information about what type of agreements should be made between the two sectors and how the operations and communication within the turbines should be organised**, including the use of VHR[13], scheduling of maintenance, etc. This is required to advise licensing and insurance practices and stimulate developers to consider what type of arrangements could be made on the project level.

Sea basin/macro-regional projects that involve the business community can help the exchange of good practices across Member States.

Intermediaries such as tourism and energy associations which have an important role in sharing such information.

MARKETING AND DISSEMINATION

→ **Facilitate the dissemination of MU viability and success stories**.

→ **Encourage early engagement of local communities** in discussions about the most suitable site, layout, design, funding and ownership of an OWF. This can contribute not only to better acceptance of the future project but also to identification of suitable tourism activities related to the OWF and establishment of necessary agreements between the two users.

12 From interview with Michel Seeger, CEO Franlis.

13 Very High Frequency (VHF) marine-band radios used for "simplex" transmission, where communication can only take place in one direction at a time.

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RECOMMENDATIONS FOR THE OTHER LOCATIONS

Existing OWFs close to the Irish Sea coast could also consider this MU in the future.

Existing MU practices from the southern Baltic, North Sea and the Eastern Atlantic will serve as important examples for MS planning to develop their OW resources and integrate them in a sustainable manner within existing local context. **Mediterranean countries are increasingly considering OWF developments**[14] and, given the strong tourism sector in this sea basin, such MU combinations could be very successful. Northern and central Baltic countries are also committed to developing OWF. For example, Poland is dependent on OWF to fulfil its EU renewable energy obligations and the nine binding concessions already given for OWF. These concessions are close to important tourist destinations and an ongoing MSP process, including engagement and discussion with the maritime business community, is supporting the MU concept. This MU approach can also be proposed for the new Portuguese OWF project WindFloat Atlantic. This will be a floating OWF that is expected to bring technological novelty in a region where the diversification of tourism activity needs to be further enhanced. The main drawback is the distance to the coast (15 km).

14 The Greek Regulatory Authority for Energy (RAE) has awarded seven wind projects with a total capacity of 171 megawatts (MW) in the country's first onshore wind auction. It noted that the auction was oversubscribed, with 14 wind projects with a total capacity of 308 MW placing bids. Of the winning bids, four projects are in Northern Greece, two central and one on the island of Andros. More information available at: https://www.aa.com.tr/en/energy/wind/greece-awards-7-onshore-wind-projects-totaling-171-mw-/20767.

MUSES Multi-Use in European Seas

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 727451

OFFSHORE WIND FARM & AQUACULTURE

DEFINITION AND SCOPE

The MU concept of offshore wind and aquaculture generally entails:

- **direct attachment of installations i.e. fish cages or mussel/seaweed long-lines to offshore wind turbine foundations or development of new infrastructural solutions, for instance in the form of fully integrated multi-purpose platforms;**
- **the co-location of aquaculture installations within the security zone of the OWF farm, for instance, seabed cultivation of mussels within the vicinity of the OWF.**

Aquaculture is a very diverse industry [57]**. The infrastructural**, maintenance requirements and environmental impacts of aquaculture depend on the type of organisms farmed. These requirements, as well as the public perception about its environmental impact shapes MU potential. As a general rule, **extractive aquaculture** (seaweed and bivalves) is relatively low maintenance, as it requires less daily intervention than **fed aquaculture** (fish). OWF developers consider combination with extractive aquaculture more favourably compared to fed aquaculture, as it entails less frequent visits to and smaller-scale operations taking place within the OWF.

FISH – A 4% annual growth trend is anticipated for marine fish aquaculture [58]. While the North Sea generally supports combinations with all types of aquaculture, combinations with fish aquaculture are found unsuitable for the Baltic Sea, given strong environmental concerns.

SEAWEED – Production of seaweeds is relatively new to Europe, but is expected to grow in importance, especially as part of Integrated Multi-Trophic Aquaculture. The combination of OWF with seaweed cultivation has been primarily considered in the North Sea and the Eastern Atlantic.

SHELLFISH – Shellfish producer in the EU are predicted to increase their output by 30% by 2030, while the current annual growth rate is just 1.3% [58]. In most of the MSs,[15] **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 Eastern Atlantic (UK, Irish Sea) are the most advanced in examining different technological options for this combination.

15 Out of all countries in the EU where this MU was examined.

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EXAMPLE

Ability of extractive aquaculture (mussels and seaweed) to take up nutrients

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 through this activity, potentially contributing to the lower levels of eutrophication in the Baltic Sea [59].

EXAMPLE

To highlight the potential of mussel farming in the Baltic Sea, a pan-Baltic map on viable regions for mussel growth has been developed by the **Baltic Blue Growth (BBG)** [60] project. The nitrogen and phosphorus removal layer together with many other related environmental variables can be viewed on the dedicated portal under the section of "plan your farm".

STATE OF DEVELOPMENT

Multiple research projects ranging from conceptualisation studies to pilots in the real environment, mostly in North and Baltic seas, have played a major role in conceptualising this MU. These projects have analysed different technological solutions (TROPOS and MERMAID projects), assessed environmental and economic feasibility (ongoing EDULIS project), examined interaction between the two activities in terms of operations and maintenance (Coastal Futures project), and identified the most suitable type of aquaculture for the given site (Offshore Aquaculture project).

In the **North Sea** (NL, UK, BE, and DE) existing cooperation between research institutes and relevant commercial actors plays an important role in developing this MU. For example, SOMOS, an ongoing project in **THE NETHERLANDS**, funded by the Lloyd's Register Foundation and led by the Wageningen University & Research, is investigating the potential for wind energy production in combination with seaweed cultivation. In conjunction with relevant authorities, certifiers and operators, the project aims to develop a methodology for assessing risks associated with this MU in terms of food safety, food quality, food security, employee health risks and environmental pollution.

Seaweed can be cultivated for food, animal feed, bio-chemicals, energy and other valuable products.

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 [61]. 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, western England and western Scotland.

EDULIS, an ongoing pilot project in **BELGIUM**, was initiated by the consortia of research institutes and private companies. It studies the feasibility of mussel cultivation within two wind farms; C-Power (27 km from the coast), and Belwind (46 km from the coast). The focus of the research is to measure the pressure that mussel farm installation 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 **GERMANY**, multiple projects were initiated by the research institute. These are summarised in figure 9.

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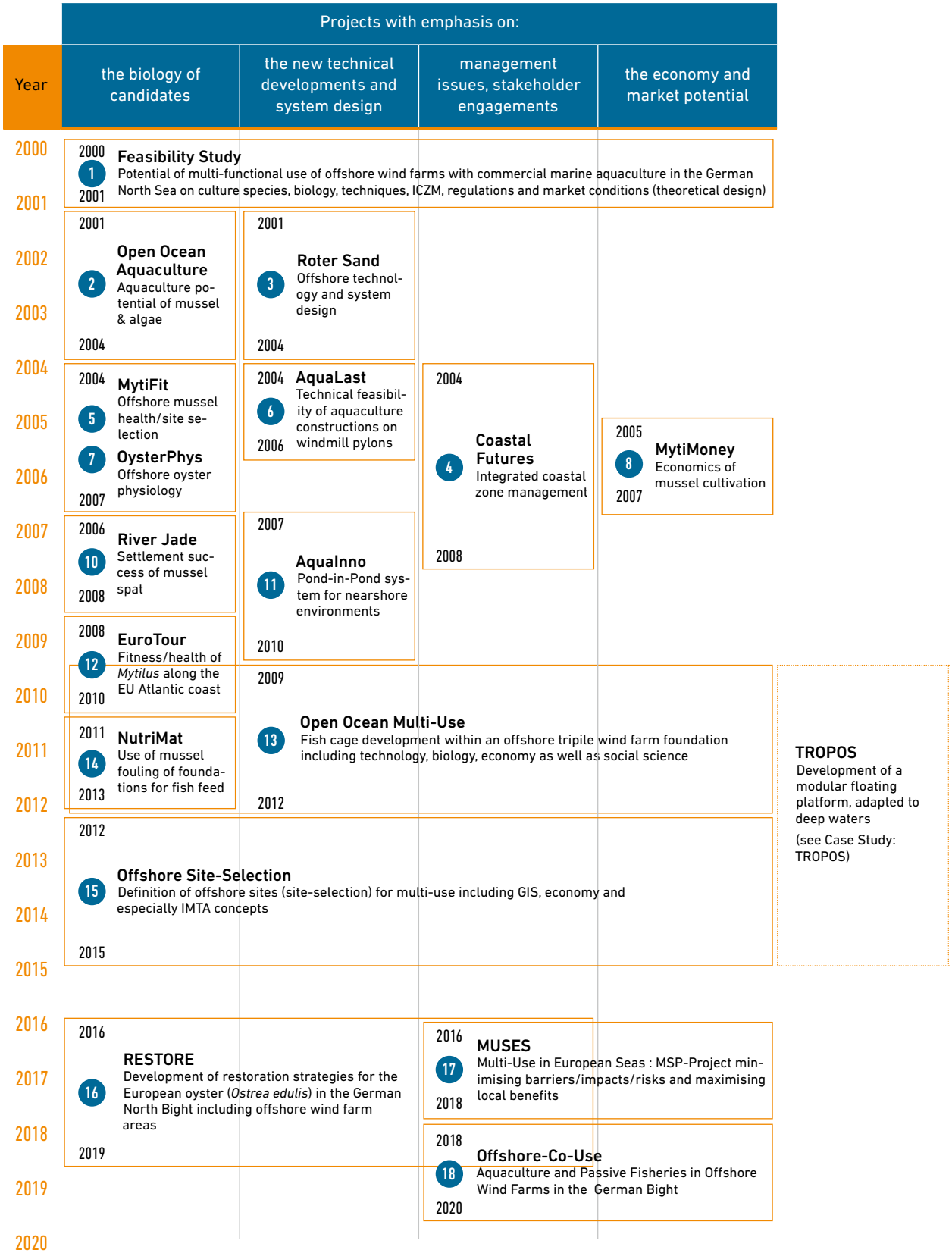

FIGURE 5: MULTI USE PROJECTS CONDUCTED IN THE GERMAN BIGHT FROM EARLY 2000 ONGOING – AS ADAPTED FROM [62]

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In **the Baltic Sea**, theoretical concepts were developed in Kriegers Flak, southern SWEDEN, within the scope of the MERMAID project [20] while tests in the real environment were conducted in the Rødsand 2 offshore wind farm off the south coast of Lolland, DENMARK as part of the SUBMARINER project [63].

MUSES REPORT

For a more detailed overview and further analysis of past and ongoing MU projects please see MUSES Overview of MU Analysis [30].

However, such MU has also been considered as a viable concept in **the Mediterranean**: in FRANCE**,** for combination with future offshore wind farms [64] and in CYPRUS, as a feed management system powered by a stand-alone renewable energy system [65].

MUSES REPORT

The MUSES project has undertaken a series of in-depth case study analyses:

Case Study 1c: Multi-use of off-shore wind farms with marine aquaculture and fisheries (German North Sea EEZ) [66].

Case Study 4: Multi-Use for local development focused on energy production, tourism and environment in Swedish waters (Island of Gotland – Baltic Sea) [67]

Cast Study 5: Offshore wind and mariculture: potentials for multi-use and nutrient remediation in Rødsand 2 (South Coast of Lolland-Falster – Denmark – Baltic Sea) [52]

DRIVERS AND ADDED VALUE

The combination of OWF and aquaculture has mainly been driven by the **need to increase the aquaculture production,** a key component of the Common Fishery Policy, Blue Growth Strategy and national policies.

The combined objectives from Multiannual National Aquaculture Plans are to increase marine aquaculture production (compared to the baseline levels) of:
→ finfish for 60% by 2020
→ shellfish for 25% by 2020.

The main challenge to enhancing production of aquaculture is the **lack of available space in inshore sheltered areas** [67] [62] **and** visual and environmental impacts. Moving aquaculture activities further offshore can potentially reduce negative impacts (water quality and visual impacts) in coastal areas. For example in UK, further expansion of finfish aquaculture raises environmental concerns and, therefore, this MU is seen as an **opportunity for moving aquaculture to *'further exposed sites'*** [68].

Given the large fixed costs associated with development and operation of aquaculture in offshore areas [69], aquaculture developers consider the combination with OWF as an opportunity to make this move feasible and profitable. **Cost saving** can potentially be derived through shared operations and maintenance (O&M) between the two sectors. Moreover, use of renewable energy instead of diesel for aquaculture operations **could potentially ensure green credentials** and allow aquaculture produced seafood to be marketed as a premium product.

In some cases, this MU is also seen as an **opportunity for improving Corporate Social Responsibility (CSR), ensuring public support** and local community approval for the OWF developments.

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MAIN BENEFITS OF OWF AND AQUACULTURE MU

1	2	3	4
More space available for scaling up aquaculture to reach national targets	O&M cost-sharing can potentially benefit both actors	Operational support for developing aquaculture in offshore sites	Possibly improved CSR for OWF and green credentials for aquaculture

BARRIERS AND NEGATIVE IMPACTS

Wider application of this MU still faces many **challenges**, including:

- **Technology readiness level**, especially with regards to harsh environmental conditions in offshore areas, and compatibility of technologies used for different types of aquaculture (e.g. cage vs line) and OWF (e.g. floating vs jacket vs monopile);
- **Unknown cumulative effects**: there is particular concern with regards to combination with fish aquaculture (and bivalve farming to a certain extent);
- **Unassessed risk, unclear permitting processes and insurance implications**, and a lack of planning and financial incentives targeting specifically this MU. These are needed to enhance commercial drive for such concepts.

Although many past projects have analysed this MU, **information is not readily available due to protection of intellectual property, or is scattered across different sources,** with uncertain future availability (i.e. when the hosting license of project websites expires).

Although some national policy and regulatory documents support this MU, the **power imbalance between the two sectors has been insufficiently addressed to date**. As a general rule, OWF operators of the already licensed or operational OWFs, have priority over other maritime users (aquaculture, fisheries). Project finance and **maritime permits and licences given for specific technical proposals**, are acquired at a certain estimated risk level and generally cannot be amended past the project planning stage [62]. For example, the German Federal Marine Facilities Ordinance (SeeAnlV), allows for the development of aquaculture at already existing wind power installations, as long as the aquaculture site does not become an obstacle for general maintenance. This gives the OWF operators a de-facto veto right against any development deemed hindering or detrimental to their activities in the area.

The **interest of investors** to actually invest in the development of this MU seem to be limited to a few examples in the UK and Belgium. Apart from the UK, existing aquaculture farms in EU are operating on a very small scale, or in the pilot stage. This implies very **limited investment and technical capacity of individual aquaculture developers** whereas such MU developments would require considerable investments for the advanced technological solutions. Therefore, funding is more likely to come from joint ventures.

For investors, proof of the concept is needed before engaging more actively. Challenges in combination with seaweed include low financial capacity of the sector and low added financial benefit given the underdeveloped market and industry in Europe. On the other hand, fish aquaculture has high maintenance requirements, increasing traffic around the site, while the impacts on the OWF installation (i.e. fouling) are still unknown. This also further increases **high insurance premiums** required by the OWF insurance companies, and the question remains how these costs are to be shared between the two developers.

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Additional factors shaping the feasibility of this MU are:

- **Distance to shore:** for example, shellfish (mussels, oysters, scallops) usually require a 2-day window for distribution to the next step of the supply-chain; the distributor. For far offshore locations it is difficult to predict when harvesting and subsequent distribution can take place.
- **Security of tenure**: most OW is licensed for around 25 years, after which all infrastructure has to be completely removed. If the aquaculture farm is successful, this requires consideration of what will happen when OWF are to be decommissioned.

BARRIERS AND NEGATIVE IMPACTS OF OWF AND AQUACULTURE MU

CAUSES OF PROBLEMS

- Unclear regulations and insurance implications
- Lack of communication between the two sectors
- Lack of information about possible risks, cost benefit assessment and business models
- Aquaculture developers lack awareness of business opportunities as well as the f technical and financial capacity to initiate such projects

CORE PROBLEMS

- **Potentially high investment requirements and high financial risks**
- **Low technology readiness level**
- **Lack of interest from OWF sector**

EFFECTS OF PROBLEMS

- Lack of long term local benefits from the OWF project
- Low and/or short term profitability
- Possible cross-sectoral conflicts

OBJECTIVES FOR DEVELOPING OWF AND AQUACULTURE MU

1) Increase awareness of all relevant actors about MU opportunities and benefits realised to date from existing ventures;
2) Ensure the strategic research agenda corresponds to the needs of current decision-making systems and supports continuous improvement;
3) Support the development of full-scale pilot projects and encourage the involvement of established businesses to address low investment capacity of the small-scale aquaculture sector;
4) Address the power imbalance between the two sectors through facilitation policy and regulation.

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ACTIONS AND RECOMMENDATIONS

RESEARCH

- **Design a research agenda that is iterative and dynamic to provide the required evidence base for current decision-making processes.**
  - **Identify suitable sites** where such concepts could take place to advise regulatory changes (e.g. zonation system, EIA requirements) and provide assurance for future MU developments.

EXAMPLE

For example, in Estonia a "study on mapping of areas most suitable for expanding aquaculture, developing relevant infrastructure and applicability of innovative technologies" has been carried out, and three possible sites for the MU of OWF and aquaculture have been identified. Similar studies have been conducted in Belgium and the Netherlands.

  - **Support development of pilot projects and proofs of concept (**functioning full-scale pilot with Technology Readiness Level (TRL)[16]8**)** in order to assess the technological, safety, and financial risks and cumulative environmental impacts of this MU, and advise the development of a general assessment framework.
  - **Analyse the optimal operational interactions between the two sectors at the project level** e.g. type of vessel to be shared, means of communication, timetables for maintenance, training requirements and procedures for minimising risks at the site.

EXAMPLE

In 2013, Wageningen University published the research paper 'A Triple P review of the feasibility of sustainable offshore seaweed production in the North Sea' [40]. 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 to become feasible in a MU context, the business case needs to be further developed, considering an economically viable value chain and further products that could be derived from seaweed[17], as well as potential risks.

Similarly, in the Baltic, only a few areas provide suitable salinity levels for growing mussels for human consumption e.g. in Småland Sea, north of Lolland, Denmark and in the area around Kiel, Germany. Combination of mussel aquaculture with OWFs could also take place in other areas. However, for this, further studies are needed to define the profitability of low quality mussels used as food for poultry and fish farms on land.

FINANCIAL VIABILITY

- **Support the development of business cases and ensure their effective dissemination.** The implementation of aquaculture concepts and related technological solutions depends highly on policy support and regulatory regimes in the given MS, acting as a 'supply push', as well as the market and investors willingness to invest

16 The TRL scale is used for measuring or indicating the maturity of a given technology. The TRL spans over nine levels is presented in: https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018–2020/annexes/h2020-wp1820-annex-g-trl_en.pdf

17 The seaweed is harvested for use in a variety of ways, primarily including alginate (i.e. thickening agent), soil fertilisers, cosmetics and nutraceuticals (dietary supplements), especially for livestock foods. Seaweed is also being harvested as biofuel.

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in such projects, the 'market pull'. While the technology might be viable (high technology readiness level), its application depends on the Commercial Readiness Level of such solutions. This implies that a deep understanding of the target application and market is needed, including

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

- **Support involvement of established businesses to address low investment capacity of small-scale aquaculture sector.**
  - Making such business cases visible and attracting other commercial actors and investors, such as retail, utilities, and established aquaculture businesses, is an important step to increase the commercial readiness level of such combinations in the future.
  - Regulatory and financial incentives from high-level policy support are pre-requisites for these endeavours. Such frameworks have so far been established in Belgium and the UK, attracting financiers to investigate the potential for commercialisation of such MU solutions.

For countries where aquaculture is more developed (e.g. UK), **aquaculture industry groups** (e.g. UK: Shellfish Association of Great Britain), and **individual farmers** (especially mussel and fish farmers), have 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 specialised consultancies were the main driving forces in countries where aquaculture is not yet a strong sector.

REGULATION AND POLICY

Develop a facilitation policy to drive this MU at a strategic and project level. The role of regulators in driving MSP is to identify suitable areas for testing pilot projects that can advise future planning policies, and provide guidance regarding EIA, risk assessment, certification and insurance premiums.

Offshore wind developers have shown high levels of openness towards this concept, especially during the initial stages of the project planning and as an argument for easier licensing process.

Support for this MU combination **mainly in the form of recommendations**, can be found in key policy documents such as Multiannual Aquaculture Plans, integrated maritime strategies and plans, and other strategic documents.

EXAMPLE

In Belgium, this MU is supported by the zoning system which identifies specific zones where aquaculture can take place within OWF, but under strict environmental conditions. Moreover, in Estonia this MU was examined/initiated by the Ministry of Finance for national MSP, while also under consideration in the current Polish MSP process.

National sectoral and MSP authorities (policy and regulation), research institutes

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OFFSHORE WIND FARM & FISHERIES

DEFINITION AND SCOPE

This MU entails OWF and fisheries sharing the same space, so that fisheries are not excluded from either the OWF development area (which can include a maximum 500 m safety zone during OWF operation) or along the offshore export power cable corridor.

Other than sharing the same space, synergies and 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 [70].

This MU is mainly of relevance in the North Sea, southern Baltic Sea and Eastern Atlantic, given that offshore wind energy potential is most utilised in these sea basins. Fishery is a diverse sector and presence of this MU also depends on the type of fishery traditionally taking place in the given area. Given the potential safety risks and fishing gear impacts on inter-array cables, fishermen using mobile gear (i.e. towed and drift) are generally unsuitable for this MU and usually prohibited from fishing within OWF development areas [71]. Similarly, export power cables may restrict access in case of wilful or negligent damage from fishing gears.

Operational synergies are often established through fisheries mitigation measures, either as a short or even a long-term solution.

Different regulations across EU Member States apply to the safety zones around OWF, as well as different cable laying laws and practices (including burial and other protection measures) directly affecting certain types of fishing. In some Member States (NL, DE, BE), fisheries are displaced from the **500 m safety zone** not only during the OWF development, but also during operation. Where law does not require connecting **cables to be buried, bottom-contact gears (a large proportion of the total commercial fishery activity) cannot be used** as they might cause damage to cables and to the fishing gear (e.g. the Netherlands and Germany) [9].

Different regulations to the safety zones around OWF and different cable laying laws and practices.

STATE OF DEVELOPMENT

Regulatory implications differ across countries and therefore stages of integration are also different. While in some countries (e.g. UK), MU of sea space is already taking place and discussions are on-going in relation to innovative means of integration; in other countries (e.g. Germany) unknown effects and regulatory aspects are still a major barrier. This MU is, to a certain extent, ongoing in Member States where the safety zone of 500 m does not apply (or is not common practice) during the operation of an OWF (DK, UK, NL and PT). In other places, certain mitigation practices can be regarded as MU. Maritime policy framework for most Member States bordering the North Sea rarely support co-existence in the context of sharing space between these two activities. In **THE UK**, fishers are excluded from OWF areas only during construction and maintenance and the reinstatement of fishing activity during regular operation of an OWF is encouraged. In **THE NETHERLANDS**, legislation regarding the safety zones around

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offshore windfarms recently changed for three windfarms to allow fisheries closer. In **BELGIUM**, exceptions to regulations have been made to facilitate several experimental research projects for this MU to gain more knowledge about environmental implications. On the other hand, in **GERMANY**, MSP grants fisheries special considerations, but not rights, inside the priority areas of other uses.

DRIVERS AND ADDED VALUES

Both offshore wind farms (OWF) and commercial fisheries rely on sea space with similar characteristics: shallow areas with certain types of substrates, in proximity to the coast. This leads them to compete for the same space. OWF development areas constrain the crossing or circumnavigation of fishing vessels during construction and operation phases and, in some cases, implies total exclusion of fisheries from the area. This spatial conflict often leads to either fisheries being excluded from the OWF area or OWF not receiving necessary approvals for development. Consideration of MU, where possible, is relevant in **directly solving spatial conflict** or identifying other possible **synergies as mitigation measures** that can provide a long-term solution for both uses. Moreover, studies indicate that OWF foundations can act as an artificial reef, attracting more fish and potentially creating **valuable fishing grounds.**

Exclusion of fisheries due to an OWF development is **particularly challenging for smaller vessels which normally operate close to the coast** and do not always have the capability to move to fishing grounds further offshore, nor to switch to other fishing methods. Impeded by availability of capital, licences and quota, **fishers whose profit depends on areas** designated for potential offshore wind farm development, may not be able to operate profitably during and after construction of an OWF [72].

Added values to local economies and society-at-large include better use of marine space, positive contribution towards food security, promotion of longevity of the fishing industry, support to fisheries management, building of trust with local fishermen, innovation in fishing methods as well as in offshore wind foundations, and improved image of the OWF industry. etc.

MUSES REPORT

For more information about this MU in Scotland, please see MUSES Case Study 1a Multi-use space between commercial fisheries and offshore wind farms in Scotland (East Coast of Scotland – North Sea) [73].

MAIN BENEFITS OF OWF AND FISHERIES MU

1	2	3
Reduction of conflicts and enhancement of possible synergies between the two	Longevity of the fishing industry and better image of the OWF developer	Added values to local economies and society at large

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BARRIERS AND NEGATIVE IMPACTS

Environmental impacts and safety risks of fishing within OWF are perceived differently by involved actors (authorities, developers, fishers) across countries, serving as the major argument for setting different regulatory frameworks. Fishers using mobile gear (i.e. towed and drift) can potentially snag subsea cable causing severe danger to fishers (snagging can cause a vessel to tip over or capsize) [74]. Fishing gears that have snagged may have to be cut free and discarded, resulting in financial losses for fishers.

Vessels also risk colliding with the wind turbines, especially in bad weather and sea conditions, and low visibility. For these reasons, in countries where a 500 m safety zone is not enforced by law, developers are considering applying for the establishment of such a safety zone as to avoid possible risks [75]. Given the risk of collision and gear entanglement, even without enforcement, areas in the immediate vicinity of OWF in some countries (e.g. UK) are likely to be avoided by fishers using certain incompatible gear types (e.g. pair trawling, Danish and Scottish seine netting) [76] while other gears (creels) may continue, subject to the local perceived risk by fishermen.

Safety and financial risks issues are yet to be resolved.

Challenges depend on the level of development, perceptions and regulations in the given country. For example, in Germany, the main issue is lack of a clear regulatory framework to allow fisheries in OWFs. On the other hand, in Scotland, a regulatory framework exists but in some cases safety concerns of fisherman are still present.

There are also difficulties during the OWF project consultation process. In some cases, stakeholder perception was that fishing interests are under-represented and there may be no sincere drive to reach any realistic, mutually beneficial agreement.

BARRIERS AND NEGATIVE IMPACTS OF OWF AND FISHERIES MU

CAUSES OF PROBLEMS

- Unassessed safety and environmental risks
- Low representation of the fishery sector and lack of sincere communication between the two sectors
- Lack of strategic support for fishers to uptake other types of fishery (changing fishing gear, replacement of fishing quota, etc.)
- Lack of awareness about long term options (current focus is on short term mitigation strategies)
- Lack of pilots and exchange of information regarding assessed risks and technical lessons learnt (cable burial, suitable OWF layout, communications within the OWF)

CORE PROBLEMS

- **Potentially high insurance costs and high financial risks**
- **Fishers reluctant to fish within OWFs**
- **No regulatory framework**

EFFECTS OF PROBLEMS

- Lack of long term local benefits from the OWF project
- Loss of fishing grounds and long term local income from fisheries
- High fishery displacement mitigation costs
- Possible cross-sectoral conflicts, low acceptance of the OWF project

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OBJECTIVES FOR DEVELOPING OWF AND FISHERIES MU

1) **Establish a collaborative and co-ordinated research programme** to develop test pilots and highlight existing areas of good practice (especially with regards to insurance and safety aspects) to increase confidence of regulators and stakeholders
2) **Ensure better involvement of fishing sector in the planning process** to identify the most suitable long and short term options
3) **Consider MSP as a tool to identify and drive synergies, but also enforcements where appropriate**

ACTIONS AND RECOMMENDATIONS

COOPERATION

→ **Ensure that effective cooperation mechanisms are in place** between representatives for the two sectors. These can include specific topical working groups, MSP stakeholder forums, or sectoral planning channels. Involvement of not only fishing associations, but also individual fishers, is important given their knowledge of the value of different local fishing grounds. A prerequisite for fishers attendance is adequate timing and promotion of such events.

Marine spatial planners, local authorities in charge of local development strategies and development clusters

EXAMPLE

In order to jointly develop **best practices for co-existence and mitigation,** the renewables industry is involved in several working groups between the various sectors. For example, the **Fishing Liaison with Offshore Wind and Wet Renewables Group** (FLOWW), was set up in 2002 to foster good relations between the fishing and offshore renewable energy sectors, and has developed associated Offshore Renewables and Fisheries Liaison Guidance.

RESEARCH

→ **Design a collaborative and coordinated research programme**
  → **The programme should include data collection and strategic or project level monitoring to identify issues and provide new social, economic and environmental evidence.**
  → Through **adaptive management practices**, this new evidence can then be incorporated into decision-making, guidance on EIAs, and iterations of policy and MSP.
  → A **transparent feedback loop is crucial to ensure that the lessons are adopted** in revisions of future MSP, including periodic updates of SEAs.

Consider coordinated approach to research programme design – at the EU, sea basin and national level, while involving industry throughout.

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EXAMPLE

The Scottish Offshore Renewables Research Framework [77] provides a collaborative and co-ordinated research programme that informs future marine planning and decision making for OWF developments. A coordinated national, regional and project specific environmental monitoring strategy would also be of value to **identify potential opportunities for enhancement and recovery of fish stocks** in the exclusion zones around OWF sites.

The following studies and research activities would help promote this MU combination:

- innovation studies (e.g. moorings, cable installation method, fishing- friendly cable protection measures, gear modifications);
- studies to develop management strategies and technologies to minimise risks;
- empirical studies exploring the compatibility between offshore wind farms and commercial fisheries;
- studies to fill research gaps for better mapping of navigational hazards and surveys to illuminate sites of current/ potential over-trawling;
- data sharing agreements and protocols to demonstrate that fishing can take place safely within wind farms.

MUSES REPORT

For more information about the actions recommended for Scotland and Germany please see the results of the following MUSES case studies:

Case Study 1a: Multi-use space between commercial fisheries and offshore wind farms in Scotland (East Coast of Scotland – North Sea) [73]

Case Study 1c: Multi-use of offshore wind farms with marine aquaculture and fisheries (German North Sea EEZ – North Sea) [70]

- **Pilots in the real environment are needed (with respect to areas where fishing is prohibited), as well as the exchange of lessons learned from existing cases, to build the confidence of actors relevant for enabling this development.**
  - Pilot examples should include gear modifications to minimise seabed penetration of gears and demonstrate compatibility; cable installation and protection methods with guaranteed burial depths; minimal sediment suspension and post-installation obstructions; real-time monitoring of installed cables for detection of exposed sections; and studies that demonstrate the artificial reef effects of OWF by engineering turbine foundations or cable rock armouring to provide cryptic spaces that would benefit crustacean fisheries.

  Insurance companies, authorities responsible for licensing fishing vessels, as well as planners and regulators responsible for defining safety zones and related regulatory frameworks

  - Such pilots would also **improve the confidence of the fishing sector**, who were found to be reluctant to fish within the OWF due to safety and financial risks, even in countries where such practices are not restricted by a 500 m safety zone.

EXAMPLE

In Scotland, the National Marine Plan provides examples of **voluntary collaborative arrangements** that have been put in place to resolve potential competition for space between OWF and fisheries. During the planning process, technical solutions are discussed with the industries with an aim to identify the potential for co-location and enhance synergies between the two sectors. Furthermore, **good practice guidance for community benefit** [76] for OWF development should be followed by developers, where appropriate.

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EXAMPLE

A study [78] conducted in Belgium to investigate the feasibility of fishery in and near OWFs recommended a licensing system for fishing activities within a wind farm. To receive the licence, vessels must be equipped with a tracking system, and comply with imposed requirements regarding size, supplementary installed fenders etc. This is a prerequisite to guarantee safety within the wind farms and allows verification of use.

EXAMPLE

For the **Netherlands,** legislation regarding the safety zones around offshore windfarms recently changed for three windfarms (since May 1st 2018). Previously, it was prohibited for any ship to enter the 500 m zone around the windfarms. With the new legislation, ships smaller than 24 m are allowed into the Offshore Windpark Egmond aan Zee, Prinses Amalia Windpark, and Luchterduinen. This measure, described in the National Water Plan 2016–2021, is specifically aimed at facilitating efficient use of space and MU.

There are strict requirements to this new legislation, including:

- It is obligatory to have an operational AIS transponder on and to listen to VHF channel 16.
- The parks are only accessible during the day (after sunrise and before sunset).
- The windfarms are only accessible for ships up to 24 m in length.
- A minimum distance of 50 m to the wind turbines and 500 m to the transformer station should be taken into account.
- Fishers must not employ methods which make contact with the bottom of the sea, such as dropping anchor or trawl fishing. Fishing with rods is allowed.
- Other fishing gear should be secured so that it is not ready for immediate use and visible on deck. Activities that could lead to dangerous situations in the OWF are prohibited, including scuba diving, kite surfing and reckless boating [79].

PLANNING AND REGULATION

- **Adopt clear regulatory guidelines and policy that promotes coexistence and mutual benefit.**
  - **Environmental assessment procedures could be updated in order to consider MU a key element**. For example, a co-existence plan and mitigation strategy to be required prior to the submission of a licence application.
  - Where exclusion of fishery is inevitable, **required mitigation measures** can include the OWF developer and government 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).

National regulators, policy makers, politicians and other strategic actors including those involved in sea basin level governance, research institutes and businesses

EXAMPLE

Favouring synergies and co-existence: Scotland Marine Plan's policy favours OWF project proposals which enable co-existence with fisheries, if these are compatible or synergistic in one location, to make good use of space, taking into account temporal and spatial issues. To identify potentials for coexistence, the plan advised use of appropriate mechanisms such as **interactions matrices**.

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EXAMPLE

The UK Marine Policy Statement, adopted in 2011, commits marine planning authorities to consider the potential social and economic impacts of OWF developments on fishing and to encourage opportunities for co-existence between fishing and other activities.

- **Provide technical guidance at the project pre-planning stages in order to facilitate maximal synergetic effect.**
  OWF developers can contribute to synergies through:
  - careful **siting of offshore wind farms (layout)**,
  - careful **timing of construction work**,
  - **configuration of turbines** to allow navigation and fishing in between,
  - adequate **cable burial**, and monitoring, communication and contingency response to any emergent cable exposures,
  - appropriate marking and **lighting of developments**,
  - adequate **early consultation** with the fishing industry [71].

These actions need to be implemented at the national and sub-national level and must consider local specificities..

There is considerable interest in the value of turbine bases and scour protection material, serving as artificial reefs for attracting commercially valuable marine species [80]. There may be opportunities to maximise fisheries value through the use of specific base designs or through the use of greater quantities or specific designs of scour material [81].

EXAMPLE

The Department for Business Enterprise and Regulatory Reform "Fishing Liaison with Offshore Wind and Wet Renewables Group" (FLOWW) has developed RECOMMENDATIONS FOR FISHERIES LIAISON which contains best practice guidance for offshore renewables developers.

- **Support transition to a new and innovative fleet which is compatible with increasing numbers of wind farms and reduced space for fishery**

This action needs to be spearheaded by the EU, based on the complexity of the issue and the need to consider other EU related policies (relating to regulation of markets, fish quotas, development and cohesion, research, etc.)

Despite the regulatory changes made so far to allow fishing boats within OWF, these usually refer to vessels up to 24 meters (e.g. in the Netherlands). This has had limited benefits for the sector since most of the vessels are over 24 meters. Any transition would require not only the smaller vessels but also changing fishing gear (passive vs mobile) which raises questions over fish quotas, CFP, etc. There needs to be support for establishment of alternative fishing practices targeting new species within OWFs. Furthermore, developers can subsidise marketing costs to support these niche markets. In addition to national regulatory changes, a clear EU level policy must pave the way by mainstreaming such concepts in all relevant policies.

FUTURE AREAS OF DEVELOPMENT

Floating wind turbines are of interest to many countries for future development of renewable energy potential (e.g. Scotland, Portugal and France). One difference in relation to fixed foundations versus floating technologies, is the potential for **Electro-Magnetic Fields** (EMF) to be generated from cables within the water column. While conventional (fixed) OWF developments bury export cables, **floating foundations cables are usually deployed within the water column, also posing risks for the entanglement of fishing gear**. A better understanding of the potential for these cables to produce EMF fields and evidence to assess potential **impacts upon electro-sensitive species** and the consequential impact on fisheries in the area may be required in the future. Moreover, floating offshore wind turbines can be deployed at much greater depths (up to 200 m), which opens opportunities for using sea areas that were not previously accessible. The floating technologies and associated MU combinations are particularly suitable for the Mediterranean, where the depth gradient is steep, even in proximity to the coast [82].

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OIL & GAS DECOMMISSIONING – REPURPOSING

DEFINITION AND SCOPE

This MU looks into how decommissioned offshore platforms can take on a new life without being completely removed. Namely, decks, jackets and pipelines can be reused according to their original design (possibly elsewhere) or these structures and wells can be repurposed for alternative uses.

More specifically, this MU can include:

- retrofitting infrastructure (pipelines) to accommodate carbon storage (CCS);
- transformer locations for wind farms;
- offshore wind power to gas;
- LNG docking stations;
- Supporting recreational activities such as scuba diving stations [83], recreational fishing, environmental education, marinas, gastronomic experiences);
- supporting monitoring, observation and research activities;
- function as structural and/or logistical support for aquaculture installations;
- supporting renewable energy devices: wave energy devices, wind energy, solar panels;
- being converted convert into artificial reefs, as a so called 'rigs to reefs' concept [84] [85], promoting environmental conservation and biodiversity and allowing new tourism and recreational uses.

A wide variety of options have been considered in theory although experiences in the real environment are still very limited.

After several decades of operation, Oil and Gas (O&G) installations are decommissioned and cleaned [86]. Installations are then either dismantled and removed completely, left in place, or removed partially, depending on legal requirements. However, there is poor understanding and little empirical data on the associated environmental and sustainability impacts and implications, even before considering repurposing options.

Proximity to the shore and water depth is relevant for the type of repurposing possible. Since the Adriatic O&G fields are closer to shore than in the North Sea, there is a different focus in terms of which solutions can be implemented. For example, tourism and aquaculture is more suitable for the Adriatic. Given the harsh environment and distance to shore, the structures and rigs in the North Sea, are better suited to accommodate CCS or 'rigs to reefs' concepts.

An important element to be considered regarding potential reuses is related to the **technical characteristics** (e.g. monotubular, cluster, reticular, etc.) of the platforms to be decommissioned. Namely, the different types of O&G platforms, their age (structural integrity) and weight, all influence the type of repurposing that can be operated. According to stakeholders, an eight-legged O&G platform in the Northern Adriatic has the stability for developing tourism and aquaculture related activities. A pilot research project also indicates its suitability for the installation of a wind turbine on top of it.

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The use of decommissioned jackets to create new artificial reefs, valuable for environmental and biodiversity protection and for tourism (e.g., diving, recreational fisheries), could be potentially viable for any decommissioned platform type (mono-tubular, bi-tubular, reticular, cluster), provided that careful selection (i.e. ecosystem evaluations, navigation safety, proximity to ports and marinas, other uses affected) of reefing sites is carried out.

The type of repurposing possible for a particular O&G installation is based on factors such as proximity to the shore, water depth and technical characteristics of the installation.

STATE OF DEVELOPMENT

There are currently no examples of repurposed O&G structures in the EU, with the exception of the rigs-to-reef site "Paguro" in the Northern Adriatic Sea.

In **the Northern Adriatic Sea** alone, 21 platforms will be decommissioned by 2021–2022 [87] – 8 within the MUSES Case Study area "Northern Adriatic". The Emilia-Romagna Region of **ITALY** located along the Northern Adriatic Sea represents a special test and operative case, as the sea area with the highest density of offshore O&G in Italy, and the Mediterranean as a whole. More specifically, in Ravenna, reuses are potentially favoured due to the proximity to shore, the industrial port and O&G base of Ravenna, and well-developed coastal and maritime tourism and aquaculture sector.

The North Sea has more than 300 O&G fields with infrastructure of more than 5,000 wells and over 10,000 km of pipelines [88]. This adds up to **more than 550 platforms and undersea production facilities**, virtually all of which are set **to be decommissioned in the next 30 years** [89], mostly in the UK, Netherlands and Denmark. Currently, it supports more than 1350 installations (including more than 545 fixed steel platforms that are among the largest in the world) with more than 3500 wind turbines total, which will also have to be decommissioned in the future.

Table 6 shows total estimated future decommissioning costs in different countries, with an expected peak between years 2025 and 2035.

A large number of O&G installations will have to be decommissioned in the next 30 years.

	UK	NOR	NL	DK	IT
Wells [nr.]	4.000	2.400	700	500	49
Platforms [nr.]	323	199	156	62	26
Pipelines [km]	20.000	10.000	3.500	1.800	203
Total estimated cost [€ Bln]	67,0	25,0	5,0	5,5	0,5

TABLE 3: TOTAL ESTIMATED FUTURE DECOMMISSIONING COSTS IN EUROPEAN COUNTRIES [10] [90]

In **THE UK**, some **40 decommissioning programmes** have been submitted to the Department for Business, Energy and Industrial Strategy (BEIS) – the government body that regulates the decommissioning of offshore O&G installations and pipelines [91]. For example, Shell U.K. Limited is preparing to decommission four of its giant Brent oil rigs in the North Sea, located about 136 km east of the Shetland Islands. Shell have proposed not to remove the entire platform but leave most manmade structures in

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the North Sea. The company is seeking an exemption from removing all infrastructure, 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 concrete bases beneath three of the platforms.

THE NETHERLANDS **Masterplan for Decommissioning and Re-use** aims to develop a clear view of decommissioning activities and potential for reuse through a National Database of decommissioning demand. One of the objectives for this database is to identify opportunities for reuse and repurpose. "Mid-term objectives" include to stimulate innovative decommissioning, i.e. new ways of repurposing structures, which could significantly reduce both waste and cost (e.g., CCS, power to gas, artificial reef construction) [84].

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 ongoing discussion through a **"Forum on the future of Platforms".**

MUSES REPORT

Some preliminary proposals on where and how to operate are presented in MUSES Case Study 6: *Coastal & Maritime Tourism and O&G Decommissioning as drivers for potential Multi-use in the Northern Adriatic Sea (Italy – Mediterranean Sea)* [85]

DRIVERS AND ADDED VALUE

At the EU level, this MU is driven by the requirement of O&G structures to reduce their emissions under EU legislation, due to their designation in the Large Plant Directive. The reuse of decommissioned platforms could potentially also contribute to **cost saving, both for companies and tax payers, by avoiding complete removal of the structures**. Complete removal is argued to be extremely expensive, both to O&G companies and the taxpayer [92]. Although O&G companies should have pre-emptively factored the costs of removal into the overall business calculation; it should be noted that in some countries these costs are up to 75% tax deductible, meaning that more than half of the costs are actually to be borne by the tax payer [93]. This could mean that costs savings may be achieved for the given 'new' use as it makes use of the O&G platform installations, eliminating the need for complete removal and associated costs.

The total future cost for decommissioning in the **North Sea** is estimated to be around 86 billion euros [94]. The estimated bill for decommissioning on the UK Continental Shelf is £17.6 billion between 2016 and 2025, with a £2 billion price tag on decommissioning costs for 2017 alone.

The huge cost associated with decommissioning and complete removal of O&G installations, could potentially be reduced with their reuse and repurposing.

The total **cost of decommissioning** in the **Adriatic Sea** in the period 2021–2022 is estimated to be around 500 million euros [94]. This could support the case for potential MU combinations of decommissioned O&G platforms with renewable energies or tourism and aquaculture.

Moreover, efficient and **sustainable use of sea space** (more space left free from use and available for future generations) is achieved by **reusing an area which has already been in industrial use for many years,** rather than installing new infrastructure in another pristine marine area.

Obsolete oil rigs have great **potential as artificial reefs**, supporting fish larval production, and acting as homes for delicate plant and marine life. The Rigs-to-Reefs

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organisation estimates the cost of a single rig-to-reef conversion more than five times less expensive than dismantling and removing a rig entirely [83].

In the Northern Adriatic, such reuse solutions could **promote further development of aquaculture.** Emilia-Romagna has become the first producer of shellfish in Italy and there is unexploited potential for fish farming. Repurposing of O&G structures would enable **fish farming to move further offshore**, and **support the development of coastal tourism.** The use of decommissioned platforms located close to the coast and **"rigs to reefs"** solutions can potentially promote the **diversification of tourism offer**, including experience-based tourism, such as leisure boating and **geographical dispersion of tourism activities**.

Reuse and repurposing options can **stimulate research and innovation** towards new uses and technologies and are considered as an **opportunity to boost and renew the existing O&G sector**, capitalising on decades of well-established knowledge and expertise.

Moreover, potentially viable repurposing options for decommissioned O&G platforms, with potential returns to investors and wider society, include harvesting of pre-smoke-stack CO_2 (such as from a coal-fired power station) and using it as feedstock for oil-rich algae in solar membranes to produce oil for plastics and transport fuel (including aviation fuel), as well as nutritious stock-feed for farm animal production (e.g. Bio CCS Algal Synthesis). [95]

BENEFITS FROM O&G DECOMMISSIONING – REPURPOSING MU

1	2	3	4
Cost saving both for companies and tax payers, by avoiding complete removal of the structures	More efficient use of existing industrial space	Potential environmental benefits through the application of the rigs to reefs concept application	Additional sources of income and revenue through the development trough development of other economic activities

BARRIERS AND NEGATIVE IMPACT

The main barrier to reuse of O&G installations is the **lack of clear regulation and guidance** that specifies ownership rules and liability during the reuse period, as well as responsibility for its final dismantling and monitoring activities.

Current international and regional regulatory frameworks (i.e. Geneva Convention, 1958; Barcelona Convention, 1976; UNCLOS Convention, 1982; IMO Guidelines, 1989; OSPAR Convention, 1992) prefer the complete removal of offshore platforms, pipelines and other related infrastructure at the end of their productive life. In recent years, however, changes have been proposed, promoting reuse of offshore installations, where such options are socially, environmentally and economically viable.

The repurposing of decommissioned O&G installations in the North Sea is not currently possible due to OSPAR regulations adopted across all North Sea countries. **OSPAR regulation** (decision 98/3) in the North Sea **asks for the seabed to be left clean**, restraining MU application. However, there are options to seek exemption (or derogation) from current regulation. For this, the O&G operator must demonstrate significant reasons why an alternative (reuse) option is sought, while the country responsible has to consult with all countries which are signatories of OSPAR for approval. Consideration

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of exemptions has, until now, been rare and stringent (5 exemptions issued out of 124 installations decommissioned to date).

Repurpose options face issues of **economic and social sustainability**. An environment where there is clarity on the MU's business case and value proposition is required. Incentives, carefully crafted around commercially viable business cases, would also be beneficial, especially where wider social and economic benefits are foreseen.

Low **technological readiness level is** also one of the key barriers, especially for some of the technologically demanding reuse solutions where significant changes need to be made to the existing O&G installations (e.g. retrofitting infrastructure to accommodate CCS, or to fit innovative aquaculture technologies, or fit technologies to store or/and transport energy and fuels). In the North Sea, the **remote nature of rigs, deep and hostile waters**, together with the **unusual concrete construction and weight (over 300,000 tonne) of some rigs**, pose a unique challenge. Therefore, it is evident that only a few O&G platforms to be decommissioned may be suitable for reuse.

Finally, **environmental concerns** refer to:

- *solutions where the structures are repurposed for other activities*: there is concern that no one will take **responsibility for correct final dismantling**, or that this cost will be charged to the community as a whole, without compensation.
- *where parts of the platforms are used to build artificial reefs*: there is concern that **reefing sites are not properly selected**, environmental impacts are not properly estimated in the medium-long term, and that monitoring and management of the sites are underestimated. There is also the question of when in the life cycle of the oil rig can appropriate reuse and repurpose options be determined (e.g. as a "reef"). Past cases have been opposed by environmentalists, who argued reuse to be a mere cost-cutting exercise on the part of private investors who have already made considerable profits.

CCS technologies appear to be a topic of global relevance and interested parties include governments (e.g. the Netherlands [96], and global and international NGOs such as the IPCC. A key policy and investment enabler for CCS was the agreement at COP17 in Durban – enabling CCS projects to receive support through the Clean Development Mechanism [97]. CCS is considered to be potentially financially viable given the possible revenue from carbon credits [96]. Nevertheless, research is still required on technological viability, potential negative environmental effects and health and safety risks.

BARRIERS AND NEGATIVE IMPACTS OF O&G DECOMMISSIONING – REPURPOSING MU

CAUSES OF PROBLEMS

- Unassessed safety and environmental risks
- No funding mechanisms nor financial insurance
- Sectoral approach to planning for O&G, lack of integrated (circular-economy) solutions in the design stages
- Virtually no market apart from cost saving which is already largely tax deductible
- Lack of test pilots and exchange of information regarding assessed risks and technical lessons learnt from international examples.

CORE PROBLEMS

- **Potentially high insurance costs and high financial risks**
- **No regulatory framework clarifying liability and responsibility for reuse and final dismantling**
- **No viable business models**

EFFECTS OF PROBLEMS

- Expensive decommissioning remains a burden to society
- Existing industrial area unused (future developments built in new areas instead of using existing industrial areas)
- Large financial losses and no institution to take responsibility

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OBJECTIVES FOR DEVELOPING O&G DECOMMISSIONING – REPURPOSING MU

1) Support research and exchange of international practices on reuse options
2) Establish a regulatory framework which enables the development of suitable reuse options
3) Reduce the costs of decommissioning and derive additional benefits from reuse

ACTIONS AND RECOMMENDATIONS

POLICY AND REGULATION

→ **Adopt clearer legal frameworks and clarify liability rules (between current and future platform users)** to ensure that such MU solutions are guided by an appropriate regulatory framework, allowing for better management of expectations and predictability.

→ **Develop general suitability criteria on which sites and types of platforms, including their technological characteristics, are suitable for which type of reuse to aid the decision making process.**

While general regulatory framework and guidance is needed at the EU and sea basin level, the development of suitability criteria and business models need to be undertaken at the local level.

→ **Undertake an assessment of reuse options as a requirement for the O&G technical proposal.** Where possible, ensure that reuse options suitable for the region are **considered in the design stage of any given future O&G platforms** – taking into consideration circular economy principles and Life Cycle Assessment.

EXAMPLE

The decommissioning of offshore O&G installations and pipelines on the UK Continental Shelf is enforceable under the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) which provides **guidance on the regulatory requirements for decommissioning.** Consultation on updating this guidance has recently taken place which could serve as a potentially crucial entry point for MU.

Supranational organisations such as the OSPAR Commission and Decom North Sea, could create frameworks to guide national level implementation. National authorities would be responsible for integrating such concepts in their long term strategies, and advise the development of a strategic research agenda to support the future decision making process.

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FUNDING

- **Support the development of detailed business plans** including valorisation of the entire value chain and social benefits. This relates to, for example, indirect benefits associated with revitalisation of an industrial area or the development of new high-tech sectors. Extensive interaction with a wide range of stakeholders (including society at large) is also crucial for better understanding local values and potential benefits.

EXAMPLE

The UK has established "Decommissioning Relief Deeds" to provide tax incentives and certainty for the O&G decommissioning sector. This could be an entry point for introducing the reuse concept and related incentives. There is also a decommissioning challenge fund in Scotland that supports business cases and feasibility studies [98].

- **Undertake cost-benefit assessments, covering social and environmental impact assessments for a selected range of pilot O&G platforms** – considering different options including de-commissioning itself as well as retrofitting, reuse and repurposing.

- **Suggest suitable investment mechanisms that can be implemented for reuse projects.** In general, a developer expressing interest in directly reusing an O&G installation (e.g. aquaculture installation, diving station) would need to present, further to the project plan, a financial warranty corresponding to the costs of final removal, any foreseen environmental remediation costs, as well as liability costs proportional to the worst-case accident scenario hypothesised within the risk assessment. In addition, maintenance costs need to be considered covering the entire second-life period of the infrastructure. Given that large financial investments are needed, such an undertaking is more likely to be initiated by a joint venture rather than an individual investor.

Risk transfer mechanisms comprise a wide group of financial instruments used to transfer risks to another party, either in the form of borrowers defaulting on their debt (credit-linked securities) or the risk of catastrophe (insurance-linked securities). [99]

DISSEMINATION

- **Raise awareness on reuse options, potentials and limitations among all actors.** If not adequately informed and involved, civil society and stakeholders, might prefer simpler solutions (removal) in contrast with unclear benefits and possible future risks. This extends to operators from other sectors (MRE, tourism, aquaculture) who should be informed of the pros and cons of different options and, in particular, the benefits and potentialities of this type of MU.

- **Establish suitable conditions (transparency, trust, sharing of knowledge and practices) for joint identification of viable options, co-design processes**, and for evaluating the social sustainability of projects under development and promoting a faster permitting process. The **"Forum on the future of Platforms"**, activated by the Italian Ministry for Economic Development, is an example of such an initiative.

National policy makers (e.g. in the UK a suitable actor could be the Oil and Gas Authority (OGA), obliged to maximise the economic recovery of the country's petroleum resources).

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EXAMPLE

The Italian Ministry of Economic development, through stakeholder consultation associated with the National Forum "The Future of Platforms", details guidelines for O&G decommissioning. The list of platforms that are to be closed down is provided periodically by the owner of the mining concession and verified by the Ministry of Economic Development. Article 8 of the Legal Decree explicitly defines conditions (technical, financial, economic and organisational) for societies and other entities that express interest in repurposing a platform; Article 9 explicitly lists information to be included in the project proposal.

CAPACITY BUILDING

- **Establish a platform for information exchange and networking** on O&G reuse options. Consider developing an online platform acting as a "repository of practice" and a "one stop shop" for sharing best practices, procedures and guidelines, in line with International, and EU and Regional Policies and Conventions, and for forging closer relationships between Mediterranean and North Sea research initiatives.

  A coordinated network of national authorities on an International and EU level (e.g. EUOAG).

RESEARCH AND FUNDING

Ensure funding for research that will advise the risk assessment framework and de-risking methods; the licensing procedure for MU; EIA requirements considering the substantial and long-term liabilities involved; and public awareness and buy-in.

- Support demonstration projects which foster cooperation between operators, engineering companies, administrations, research institutes and universities across local, national and international levels.

EXAMPLE

Examples of pilot studies include the INSITE (Influence of Structures in The Ecosystem) Programme, which aims to provide stakeholders with independent scientific information to better inform future decision making process on man-made structures, including decommissioning and rigs-to-reef approaches; and the EBN project, developing an alternative to the decommissioning of three ENGIE Platforms, based on rigs-to-reef approach ("return to nature").

EXAMPLE

A study, commissioned by the Dutch Ministry of Economic Affairs and NOGEPA conducted a simulated wind and gas energy conversion pilot project in the North Sea. This involved an extensive calculation of virtual pilot investment in an offshore installation, capable of turning nearby offshore wind energy into gas via power-to-gas conversion. The gas would then be stored, transported and sold from the offshore platform. In the simulated pilot, an offshore oil or gas platform, due to be decommissioned, is used as a site for converting power from an adjacent offshore wind park into hydrogen, methane or syngases, with the help of an electrolyser and related equipment installed on the platform [100].

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OFFSHORE WIND & MARINE RENEWABLE ENERGY GENERATION

DEFINITION AND SCOPE

Combined deployment of offshore wind energy and marine renewable energy sources, chiefly wave and tide, is possible as part of the same physical platform, or as a more indirect connection via the same cable array. Additional synergies can be established through joint operations, monitoring activities or shared monitoring software.

The **North Sea** offers particularly good conditions for all types of offshore and marine renewable energy (MRE) generation.

STATE OF DEVELOPMENT

There is already some experience of wave and tide energy combinations in the Northern part of **SCOTLAND**. Moreover, a pilot test hybrid wind and wave technology is to be applied in Caithness, Scotland, by 2020 [101]. In **the Northern Atlantic**, **north of SPAIN (Cantabria)**, the MERMAID project has also explored the feasibility of wave and wind MU. While testing of a wave energy generation device was conducted in **DENMARK**, this combination was never designed to be commercially employed in the Baltic Sea, rather tested for further employment elsewhere (Danish Wave Energy Test Centre). In the Baltic, major barriers include small waves, winter ice, and the lack of market and suitable technology to address such conditions.

DRIVERS AND ADDED VALUE

This combination is driven by maximal energy generation from all energy resources in a given sea space and potential **reduction of operational, maintenance and investment costs**. Developers are increasingly considering this MU in the UK. According to the MERMAID study, **small regions,** such as Cantabria, strongly benefit from such MU developments. In such regions, integration of foreign companies within the already existing industrial network and the **creation of new economic activity will reinforce job creation, specialisation, and competitiveness.**

BENEFITS FROM OWF AND MARINE ENERGY GENERATION MU

1	2	3	4
Maximal energy generation from all the energy resources in the given sea space	**Mitigation of potential conflict** between the two energy sectors	**More space left available for other developments or protection**	**Increasing technology readiness of various energy technologies**

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BARRIERS AND NEGATIVE IMPACTS

Lack of information about impacts and requirements for **separate environmental impact assessment processes for each of the (hybrid) technologies** present a major challenge. The permitting process is conducted separately for each of the technologies applied regardless of the fact that these are integrated technological solutions. A **lack of guidance on cumulative impact assessment for MU** is also an issue.

Countries have different regulatory and incentive regimes with regards to MRE. For example, UK waters have highly suitable conditions but the government **incentive scheme** applicable to England, Wales and Scotland, i.e. Contracts for Difference (CfD)[18], **does not currently support combined** renewable energy technologies. Under the feed-in tariff (FiT), accredited producers whose plants have a capacity of less than 5 MW can sell their electricity at fixed tariff rates established by the Gas and Electricity Market Authority (Ofgem). Under a FiT, 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, to enable a diversity of projects (wind, solar, etc.) to be developed while investors can obtain a reasonable return on renewable energy investments.

Unsuitability of existing renewable energy government incentive schemes for this MU can act as an eminent barrier.

There are five renewable and low-carbon technology types eligible for FiTs, each specifically addressing one source of energy, leading to the question of how MU would be categorised under the current framework.

BARRIERS AND NEGATIVE IMPACTS OF THE OFFSHORE WIND AND MARINE RENEWABLE ENERGY GENERATION MU

CAUSES OF PROBLEMS

- No guidance to lead cumulative impact assessment
- No financial insurance, given the novelty of the concept
- No suitable planning and financial incentives to support implementation
- Lack of test pilots and exchange of information regarding assessed risks and technical lessons learned

CORE PROBLEMS

- **No fully applicable financial incentive system**
- **Low technology readiness level**
- **Separate EIA procedure for each of the renewable energies in the MU solution**

EFFECTS OF PROBLEMS

- Low certainty and high initial costs making the solution unattractive to investors
- Unused existing industrial area. Limited energy yield derived from the given space.
- No viable businesses

18 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 UKmarket). 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.

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ACTIONS AND RECOMMENDATIONS

RESEARCH

→ **Conduct comparative case study analysis to identify suitable conditions for commercial employment and upscaling**

EXAMPLE

A study by the University of Ghent (Belgium) [102] has developed **a Search Group Algorithm** for wind and wave farm layout optimisation. The algorithm allows calculation of the optimal geometric layout of the devices within farms, in order to achieve optimal power output, while considering device interactions and respecting minimal distances between the devices (necessary for maintenance).

→ **Enable exchange of information between different developers on environmental impacts, in an open process that can advise future EIA requirements.**

POLICY

In countries with pre-commercial technologies such as floating offshore wind, or countries where offshore wind is just entering the market, market mechanisms may be more appropriate than legal enforcement.

→ **Design and support planning and financial incentive schemes** that cater for this type of MU where multiple energy resources are combined. Work closely with industry and regulators to ensure that support is appropriate with regards to existing regulations, marine environment and capacities of the private sector.

MARKETING

→ **Disseminate the benefits and viability of existing initiatives and wider interest from industry for such solutions, to increase for the likelihood of receiving policy and regulatory support.**

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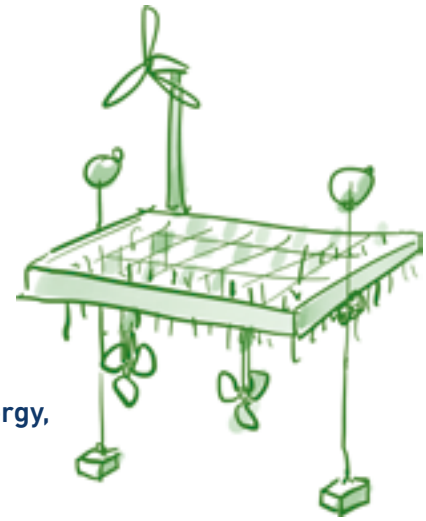
WAVE ENERGY & AQUACULTURE



DEFINITION AND SCOPE

This MU considers the combination of aquaculture farms and wave energy, either physically connected or co-located side by side.

This MU enables the use of wave energy generated directly for the purpose of aquaculture operations (especially in remote areas). In addition to supplying aquaculture, electricity could also be provided to onshore enterprises and national grids, especially in constrained grid environments with high power costs. As well as being connected through the export cable, the two users could share anchors and moorings, offshore transformer platforms, vessels, jetties, and human resources. There are a variety of wave energy technology types with different energy conversion concepts, however the majority are floating structures which are moored to the seabed.

STATE OF DEVELOPMENT

Commercial-scale MU of finfish aquaculture and wave energy generation was developed in Mingary Bay, **SCOTLAND**. The finfish aquaculture farm already existed and the addition of the wave energy harvesting device was intended to partially supply aquaculture farm operations. The aquaculture developer was also interested in receiving '*green credentials*' due to use of renewable energy as an alternative to diesel, particularly relevant in marketing *premium quality* Scottish salmon. Trial testing of relevant concepts is also planned in Clift Sound, Shetland Islands, Scotland.

MUSES REPORT

For more information about this MU in Scotland please see MUSES 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)' [103]

This combination was mainly considered in Scotland and Malta, given the long tradition of the aquaculture sector in these two countries and the recent need to move aquaculture activities further offshore.

Multiple past studies and projects (Aquatera, MARIBE) have reviewed the feasibility of combining wave energy with aquaculture. According to Aquatera Ltd. (2014), smaller scale devices, designed to operate in less harsh conditions, might be more suitable for fish farm applications. The combination of finfish and mollusc aquaculture (using scale nets and pods) with wave energy generation (multiple point absorbers), located side by side, was developed as a pilot concept in **MALTA** as part of the EU funded research project MARIBE. The concept included a large-scale aquaculture farm, with energy supplied by wave energy devices. The roadmap for commercialisation of the concept is provided in Table 3.

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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 4: MARIBE CASE COMMERCIALISATION ROADMAP [104]

DRIVERS AND ADDED VALUE

This MU can **reduce initial investment requirements for project development** for both developers and **lower operational and maintenance (O&M) costs** throughout the lifetime of the project, due to shared O&M processes, human resources, installations, and onshore infrastructures. Potential advantages for **aquaculture operators** include:

- **Renewable energy supply** potentially provides an opportunity for a premium to be attached to aquaculture products (should, however, be as economic as diesel);
- **reduction of aquaculture's environmental impact** due to the use of clean energy (and thus potential for premium pricing);
- the wave device can aid remote monitoring of the site and autonomous operations i.e. lowering seaweed when the conditions are rough or adapting feed according to site conditions. This situation could **facilitate the move of seaweed farms to offshore locations** (locations exposed to ocean waves) as space in coastal areas becomes a pressing issue;
- **reduction of aquaculture impact on coastal areas** due to use of offshore sites near wave energy generation;
- **sheltering effects** of the wave energy device if aquaculture is placed 'downwave' (leeward [105]).

Additional **benefits for wave developers** include:

- **guaranteed sale of electricity** to the aquaculture; and
- **low electrical losses and cabling costs** due to consumer proximity.
- Possibility of testing at different scales and the opportunity to develop new pilot technologies/ projects: proof-of-concept that has been widely sought by the wave energy industry.

BARRIERS AND NEGATIVE IMPACTS

This MU combination has not been widely applied, due to **low levels of commercialisation of wave energy conversion technology**. Interviews with key stakeholders indicated a general lack of data and knowledge about **safety, technical, environmental and financial risks, insurance implications and operational difficulties** caused by **interaction between the two uses**. Interaction between fish growth and wave energy devices is unknown and **increase of fouling is a possibility** due to nutrients from fish farming. Liability in case of accident is an essential element which needs to be agreed

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among developers. If an array were to break apart and release farmed fish into the wild this could generate large economic losses and tarnish reputation. Moreover, the procedure for obtaining a license for such MU is unclear and could complicate the existing licensing process for aquaculture. Licensing procedures for this MU depend on (i) the regulatory framework of the potential location and (ii) whether activities are **staggered or joint**. In the Scottish case-study, the aquaculture farm was pre-existing while the wave energy device was licensed as '**auxiliary aquaculture infrastructure**' which simplified acquirement of the licence. However, for a new proposal in Mingary Bay, the associated wave device was consented as a **'renewable energy device'.** In other locations (e.g. Ireland, Portugal) and for other projects, this situation will likely vary due to different consenting bodies and stakeholders and coordination with different agencies, which could be time-consuming.

The energy demand of offshore fish farm sites is closely correlated to the amount of biomass present and stage in the production cycle. Therefore, typical energy demand at any one site cycle over a 2–3 year time scale. These energy demand cycles are not necessarily in sync with the energy resource from the various renewable technologies. **The mismatch between the demand for and supply for energy**, along with the intermittency of renewable energy resources, necessitates an **energy storage system** when integrating renewables with offshore sites, as grid electricity is unable to manage peak and troughs of supply and demand.

Technological requirements go beyond mere integration of the two installations but also considerations such as energy storage, suitable vessels or temporary housing of workers offshore.

BARRIERS AND NEGATIVE IMPACTS OF WAVE ENERGY & AQUACULTURE MU

CAUSES OF PROBLEMS

- Lack of integrated life cycle assessment
- Lack of research into optimal O&M interactions and integration
- Lack of available information from existing cases regarding EIA, O&M and risk assessment
- The current cost of energy from small scale wave energy is likely to be higher than diesel

CORE PROBLEMS

- **Complicated consenting process**
- **Lack of information about suitable sites and life cycles of both businesses**
- **Lack of interest, technical and financial capacity of individual business operators**

EFFECTS OF PROBLEMS

- High initial investment , (including site selection, assessments, licensing and insurance) leaving developer unable to proceed
- Long pre-planning process demotivates developers
- Financial losses and risk to reputation

OBJECTIVES FOR DEVELOPING WAVE ENERGY AND AQUACULTURE MU

1) Increase awareness of, and interest in, wave and aquaculture MU opportunities
2) Support studies which increase the TRL, define suitable sites and provide recommendations for risk mitigation and joint EIA requirements
3) Create a policy and regulatory environment for improving the MU's economic viability and commercial readiness level

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ACTIONS AND RECOMMENDATIONS

POLICY AND REGULATION

- **Identify suitable sites (i.e. through the MSP process) to indicate locations** where this MU can be potentially developed and involve relevant actors in discussions on how to enable this
- **Define consenting procedures specifically for combined installations** (e.g. 'auxiliary aquaculture infrastructure' vs 'renewable energy device') and impose feasible licensing requirements.
- **Mainstream such MU concepts in all relevant policies** (e.g. cohesion policy identifying this MU as a promising solution for remote islands and rural areas in need of an economic boost and with little access to the national grid).

FUNDING

- **Define in which cases this type of MU should be incentivised and how** (e.g. through preferential access to public funds or public infrastructure, tax breaks, subsidies, price regulation or preferential access to the national grid).
- **Ensure a vibrant competitive system which rewards continuous improvement of technological output.** Whilst there is a need to 'ring-fence' certain MU technologies so they may develop for commercial use, a vibrant competitive system that rewards *continuous improvement in technological output* is needed. Otherwise, technology developers who receive funds may not be sufficiently motivated to continue technological advancement due to guaranteed revenues and lack of competition.

MARKETING

Identify factors which add value along the value chain

- **Disseminate information about suitable sites and life cycles of the two developments** which would increase awareness of potential opportunities;
- **Support business pitches and sharing of existing experiences** at local maritime events (development of local development strategies, action plans) and ensure involvement of a wide range of supporting actors and advisors, such as consultancies specialised in developing business models, insurance companies, and consenting lawyers, to assist in identification of additional opportunities along the value chain and development of feasible solutions.

EXAMPLE

Swedish Västra Götaland Regional Action Plan for Sustainable Maritime Sector has been developed in close cooperation with industry, academia, institutes, local and regional authorities. To enable implementation of the plan, a yearly budget is allocated for projects addressing sustainability and societal challenges. Project pitches are regularly held in order to give small businesses a voice and decide jointly which project should receive funding.

- **Develop a low carbon footprint certification for aquaculture,** linking this MU to the objectives of Green House Gasses (GHG) emission reductions, and explore opportunities to market it as a premium product;

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- **Consider branding *'energy from multi-use'* and providing a 'green certificate' to those who purchase MU generated energy to justify the initially high cost of such solutions.**

RESEARCH

- **Develop pilots to demonstrate technological and commercial readiness of such MU solutions.** Pilots should aim to provide clear recommendations for administrative and operational interactions between the two users, and mitigation strategies.
- **Conduct hydrodynamic modelling to assess the scale of wave farm required** to provide a measurable benefit to the aquaculture industry in terms of its sheltering effect (if aquaculture is placed in the lee) and hypothesised energy demand.
- **Consider conducting an integrated lifecycle assessment of both uses in the design phase of the project.** At this stage, there might be a need to develop scenarios considering different scaling up rates of individual businesses and evaluate the best options for accommodating the other user's growth.

Developers, research institutes, specialised consultancies and regulators (if life cycle assessment is required in the technical proposal).

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MAIN RECOMMENDATIONS FOR OTHER MULTI-USE COMBINATIONS

Application of the MU concept should not be limited only to sectors and uses indicated in this Action Plan. A broader approach to synergies, MU and co-location, similarly to procedures for land planning and process efficiency (e.g. nexus, economy of agglomeration), can allow for a much wider spectrum of opportunities and benefits. In this chapter, only a selection of additional MUs and associated recommendations have been presented. These have been explored only in certain locations, but their application could potentially be wider in scope.

SHIPPING TERMINAL AND GREEN ENERGY GENERATION

- 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 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. This case study was extensively explored in the MUSES project [103].
- 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 a regulatory framework which standardises conversion to Shore Side Electricity (SSE) and addresses the risk to 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 to be used for the pilot testing of SSE, including offshore marine renewables ('demo zones');
- The potential of this MU in other locations depend on existing links between ports with OWF; ownership status and governance of ports, ports specificities, and the 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 this end, the role of the EU is crucial in facilitating the development of this MU.

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TIDAL ENERGY GENERATION AND ENVIRONMENTAL PROTECTION (AND MONITORING)

- A degree of environmental monitoring is generally implemented throughout the lifecycle of various maritime activities, often conditional via regulatory requirements depending on national regulation and the scope and scale of given activity. Monitoring can be undertaken 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.
- In addition to 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 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. This was analysed as part of MUSES Case Study 1b1, 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 [108].
- To some extent, the tidal energy industry already practices MU with environmental monitoring through Survey, Deploy, Monitor (SDM) policy guidance, but environmental data gathering is not effectively subsidised by public funds;
- Early developers are bearing the costs of environmental characterisation for further development, undertaken by other 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 inform environmental management regimes throughout the Scottish marine environment;
- In order to expand the commercialisation 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 materialise on a considerable scale.

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MARINE RENEWABLE ENERGY AND DESALINATION/HYDROGEN

- The combination of MRE and desalination was explored as part of MUSES Case Study 7 (pilot conceptual/demonstrative phase) in the Mykonos Island, Cyclades region (Greece) [66]. 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 discharge from land-based desalination plants on the marine ecosystem. The advantages of this MU are the energy independence of the desalination unit, mobility of the (floating) installation, green energy provision and spatial conflict minimisation.
- The option of developing and installing a MU combining renewable energy and desalination at sea must be first compared with the option to install it on land. The main reason for installing it at sea is the better quality of winds offshore and the possibility for the floating "platform" to move, 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 this 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 this MU can be developed.

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PART 3:

CROSS-CUTTING RECOMMENDATIONS

The following priority lines have been gathered across all MU combinations studied in this Action Plan and are identified as significant for overcoming the key barriers to MU, detailed in Part 2.

INTEGRATION AND COORDINATION

MU as a concept presents combinations between maritime uses and activities normally managed by different sectoral structures, institutions and actors. This presents a major challenge in terms of licensing, management and administrative processes. To advance the application of MU concepts there is a need for better **integration**:

- **at the horizontal level** – between different sectoral structures and policy topics e.g. cohesion, food security and other cross-sectoral policy issues; and
- **at a vertical level** – between different levels of governance (EU, sea basin, national and local) and the various legislative instruments (policy, regulation, plans) to support the development of MU.

In this context, the following recommendations apply:

- **The setting up or promoting the use of existing inter-ministerial/sectoral committees** in MSs, with representatives from sectors such as tourism, renewable energies, fisheries and cultural heritage at national level, with a similar structure at regional level. Most MSs have set up inter-sectoral agencies and stakeholder groups for the implementation of MSP that can also be used as a discussion platform. This should ensure integration between regulators, policy makers and administrations.
- **Engaging and involving new MU actors and users** during consultations at an early stage during sectoral and MSP processes. For example, groups such as the FLAGs and maritime clusters which deal with multiple uses, must be engaged in various decision-making processes.
- **The exchange of knowledge via cross-industry forums** from researchers and industry representatives alike is important in creating well informed actors. There needs to be emphasis on communicating both risks and benefits, as well as solutions and future possibilities, to all involved.

MARITIME SPATIAL PLANNING

Depending on the planning approach of the given Member State, MU concepts can be promoted through identification of zones suitable for MUs, planning policies and guidelines on mitigation measures. **Maritime Spatial Plans** can directly support MU by assigning preference towards joint uses versus single uses and imposing certain conditions on the developer during the permitting process. However, for this, further country-specific studies are needed to advise decision makers. MSP is useful in identifying knowledge gaps and advising future research agendas (e.g. cumulative and in-combination impacts of the MU) as well as helping to clarify potential legislation and good practice for combining different uses in marine areas.

- **Conduct siting studies to identify MU suitable areas** where space could be preferentially allocated to MU development. As well as availability of resources and suitable environmental conditions, additional socio-economic criteria could be included in the model, such as distance to shore, scenarios involving different design options, and assessment of values and benefits to the local communities.

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- **Ensure appropriate representation of all relevant stakeholders** and involve them early in the planning process to advise suitable site selection, business opportunities and local benefits. Consider innovative methods of stakeholder involvement contributing to better communication among sectors and identification of cross-sectoral business opportunities. Local authorities should consider differences in capacities of different sectors and serve as a mediator in the process.
- **Throughout the joint intergovernmental process, conduct institutional mapping and mapping of related legal requirements** to identify the gaps, inconsistencies and opportunities for regulatory improvements. Use this information to provide guidance to developers throughout the permitting process. Where appropriate, consider introducing administrative and regulatory incentives (e.g. preferential access to space) for implementation of the MU concept.
- **Identify where lack of scientific evidence is restricting decision-making processes** in order to advise the strategic research agenda. MSP and sector planning authorities should aim to serve as the interface between science and policy, establishing a continuous feedback loop which ensures that the research contributes to better decision-making processes and informs regulatory changes. Links with the industry R&D activities should be established to ensure that the national strategic research agendas are also driven by and are in line with the industry needs and capabilities.
- **Use cross border consultation processes to exchange existing MU practices and lessons learnt**. This should also be used as a platform to discuss ways of improving the management of MUs, especially those of common interest such as UCH. Sea Basin wide policy actors and funding programmes should consider suggesting and supporting the process of marketing certain MU combinations as a sea basin wide offer (e.g. Baltic as a cultural heritage destination, wind energy tours across the North Sea, the Mediterranean Sea as a pescatourism haven etc.). MSP and local coastal zone management authorities should consider planning implications of such options.
- **Data resulting from the MSP process,** especially data pertaining to the location and key information of proposed MU developments, should be shared with stakeholders to enhance dialogue between sectors about possible MU joint venture. For example, data and registry information showing the location of UCH which were shared with the public in Finland has been influential in divers being able to access UCH sites.
- **The MSP process should also consider and identify areas of cultural importance** and cultural ecosystem services to support decision making areas as to where MU can be developed, especially MUs that combine with tourism and UCH. This should also ensure that local priorities are considered and support of communities gained before development of MU sites.

POLICY AND REGULATION

Significant funds have been devoted to MU research to date but, in many cases, there is still no solid legal and regulatory framework under which the MU concept could flourish. Clear direction from the EU is needed, indicating that **MU should be the norm where its application is appropriate and beneficial**.

- **Environmental impacts and safety risks are perceived differently by involved actors (e.g. authorities, OWF developers, fishers) across countries**, serving as the major argument for setting different regulatory frameworks.
- **There is a need for harmonisation of legal and regulatory frameworks at national and regional level** (e.g. cases of regional complexity of legislation in Italy, and gaps

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in legislation relating to pescatourism at national, regional and local scale in Portugal and Greece). Moreover, a 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 mainstreamed into the various EU and national policies** (i.e. cohesion policy, food security).
- **Difficulty of the consultation process between sectors** (e.g. offshore wind energy developers with fishers) appears to be important factor stalling the implementation of the MU. Good representation of less visible sectors (e.g. small scale fishery, aquaculture, UCH, environmental protection) and a transparent engagement process, with the timing and frequency of meetings agreed in advance, were found to be important factors influencing effective discussion about MU and synergies.

CAPACITY BUILDING

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 (including know-how, training, finance, logistics and public awareness) are provided for actors to boost and advance MU development. It is important to note that capacity building is a priority especially for fishery, aquaculture, UCH related MU. Fishers often lack capacity in service business and in providing tourism related activities. This is quite different for OFW MUs which require initial 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 tourism-driven MUs which are less recognised and happen at a local and community level. Such training and capacity building is an important to create employment in these coastal communities.
- **Continuous engagement between stakeholders from different sectors** to learn more about their different ways of thinking and to find common solutions at different levels is especially useful for UCH MU combinations. Pilot cases could foster such collaboration, with focus on the socio-economic benefits derived from heritage sites to show communities how to merge interests from different sectors.
- **Transboundary cooperation** and knowledge exchange between all levels and kinds of involved stakeholders is of utmost importance for further development of the MU concept. In order to keep this exchange free from Brexit-associated issues, there is a need to create professional and personal networks between stakeholders to foster communication and exchange of best practice examples in both directions between the UK and other countries.

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FUNDING AND COMMERCIAL READINESS

- Further development of 'hard' MU solutions requires the **demonstration of not only technological, but also commercial readiness.** While a technology might be viable (high technology readiness level), its **application depends on the Commercial Readiness Level** of such solutions. This implies that a deep understanding of the target application and market needs is required, as well as insurance and regulatory issues;
- Implementation depends highly on **policy support and regulatory regimes in the given MS acting as a 'supply push'**, as well as the **market and investors willingness to invest in such projects and the '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 benefit funds (linked to CSR) from the OWF developer.
- **Early developers are bearing the costs of environmental characterisation 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 (eg.) tidal energy developments, but the baseline data could also be gathered to inform environmental management regimes.

RESEARCH PRIORITIES

The results of the analysis presented in this Action Plan shows that research and innovation is key to advance such a novel concept. In addition to technological knowledge, socio-economic, policy-related and financial knowledge are important in addressing MU challenges. It is worth noting that research requirements for tourism-driven MU are about understanding the potential demand of products and associated value chain, while the energy-driven MU combinations are focused on development of new and advanced technologies for efficiency. While demand for energy-related uses already exists in current policies and regulatory commitments, this is not completely the case for tourism-related uses. Research for MU should consider:

- **Assessment of the site's cumulative economic, social and environmental impact, 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 usually have different components and aspects such as education, direct sales, promotion of local and quality products, eco-labelling, promotion of cultural values of traditional activities, etc. **Extensive analysis is needed to understand the MU value chain, its opportunities and how it can be promoted**. Guidance from the EU level is needed on how to better organise the value chain to inform national and regional policies and decision-making.

Germany and Belgium provide good practice models with regards to a well-funded research sector with strong ties to relevant stakeholders and an open and inclusive research and communication strategy for creating and transferring knowledge.

This also directly links with the following priority points under Marketing and Dissemination/Promotion.

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MARKETING AND DISSEMINATION/PROMOTION

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 in marketing and promoting MUs:

- **Transparent communication between local and regional stakeholders** to both demonstrate and promote understanding of the benefits of MU approaches, as well as support in adjusting their long-term strategies to provide planning security, e.g. for potential investors.
- Tourism-driven MU combinations are usually undertaken at a small scale and their visibility, promotion and **marketing platforms at the regional, national and sub-sea basin level are important**. Given that tourism related MUs are addressing niche markets, 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 campaigns.
- **Considering the needs of rural and island destinations and benefits** that certain types of MU can provide is relevant for marketing such solutions in local communities and to relevant actors that can support such developments.
- On the **local, municipal and micro-regional levels, development strategies and associated events and forums have an important role** in connecting relevant actors and giving small businesses (i.e. tour operators) a voice.

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CONCLUDING REMARKS

The research undertaken within the MUSES project throughout all European sea basins has revealed that **a much wider range of opportunities** for creating positive synergies among different maritime uses exist compared to what has been previously associated with the multi-use concept.

Even though we had to eventually focus our work on only some of these combinations, it should be kept in mind that the shift from a single sector to a multi-sector approach may unleash a wide scale of new opportunities both for socio-economic development as well as improvement of the environmental status of our oceans.

As shown in this Action Plan, **some of these multi-uses** – such as combinations of fishery with tourism or offshore wind farms – are **already a reality** today. Even though such combinations may not substantially impact general economic growth, they may provide other socio-cultural benefits for coastal communities and a **shift of perspective** on how different uses and users can work together rather than being separate.

A wider recognition and active promotion of **such small scale and local MU combinations** is needed to advance their function as tangible and beneficial multi-use. This can **build confidence in the MU concept** and **pave the way for future MU combinations**, which require joint planning and development efforts now to become a reality in the future.

Moreover, new technological solutions such as floating offshore wind farms, hydrogen energy storage or various wave energy generation technologies can tap into a wider range of socio-economic and environmental benefits if **multi-use solutions are considered in their designs right from the outset**, through the application of the life cycle assessment, systems design approach or circular economy principles. This would increase the **R&D competitiveness of the European market** as benefits can be derived from its recognition and promotion as an innovation hub for MU through technology and knowledge transfer to other parts of the world.

Nevertheless, **MU development is not possible everywhere**. Lack of suitable geo-morphological and environmental conditions, or high safety and environmental risks, that make the development of MUs unsuitable for certain areas. However, other **barriers such as stakeholder perceptions, lack of awareness, low capacity, as well as MU unfriendly policy and regulation, may be overcome** through sufficient stakeholder integration in planning and policy processes on all geographical and governance levels.

The **maritime spatial planning processes** currently undertaken in all EU coastal member states provide an opportunity to foster such interaction between the different maritime businesses as well as sector regulators, including those in charge of environmental protection – and thus foster the paradigm shift from a single sector perspective to an integrated view. **MSP is, however, only one out of many tools and actions, which need to be undertaken.** It is necessary, but not sufficient alone for enabling multi-use. Other sectoral planning and licensing processes including area-based management approaches such as multiuse MPA designation should be coordinated to ensure that MU development is realistic at the operational and project level to address the barriers noted above. Moreover, substantial efforts are needed in **capacity building, changes**

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in the underlying legal frameworks, funding structures as well as even **research** in itself – all of which are still not designed towards **multi-disciplinary** work and solutions.

The composition of the MUSES project team in itself was designed to reflect a multitude of different perspectives – not only bringing together researchers from across Europe, but also from a variety educational and professional backgrounds. Even in this closed group it took time and substantial discussions to develop a joint understanding. Moreover, our numerous interviews and discussions with a wide range of stakeholders across Europe showed that **'multi-use' is still a very young concept which has not yet reached common, mainstream thinking**, even among those who deal with maritime affairs on a day to day basis.

It should not be underestimated that – as pointed out in our definition of MU – advancing the development of MU implies a **radical change** and thus requires a **paradigm shift** that is backed by the **willingness of policy makers, governmental authorities, businesses, investors** and other actors involved in MU to take up the recommendations and actions proposed in this Action Plan. Building trust among stakeholders to initiate multi-use initiatives takes time, capacity building and funding.

With this Action Plan the MUSES project team hopes that the **understanding of the opportunities inherent in multi-use have been raised** and **MU actors will be inspired to take up these recommendations and actions** to advance the development of MU.

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