Version 1.1

MUSES PROJECT

CASE STUDY 5: OFFSHORE WIND AND MARICULTURE: POTENTIALS FOR MULTI-USE AND NUTRIENT REMEDIATION IN RØDSAND 2 (SOUTH COAST OF LOLLAND-FALSTER - DENMARK - BALTIC SEA)

MUSES DELIVERABLE:
D3.3 - CASE STUDY IMPLEMENTATION - ANNEX 8

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1 GEOGRAPHIC DESCRIPTION AND GEOGRAPHICAL SCOPE OF THE ANALYSIS

This case is based around the offshore wind park of Rødsand 2, which is located in the Danish Baltic Sea, off the southern coast of the island of Lolland. There is 600km of coastline with sandy shores of gentle gradient, low salinity and shallow waters. There are no tides in the Baltic Sea, but the brackish sea water exchanges and merges with the numerous fresh water rivers and streams feeding into the sea basin and the saltier passage through the Kattegat to the North Sea according to the prevailing winds. In the shallow waters off the south coast of Lolland the water varies in salinity between approx. 8 and 13 PSU (Christensen et al. 2009).

Figure 1 Map of Lolland-Falster showing the areas designated to Natura 2000 (red diagonal lines) and the Wind Parks of Nysted (on the right) and Rødsand 2 (circled) to the left of Nysted Wind Park

The surrounding area is largely designated an EPA/Natura2000 area and there are wildlife reserves lining most of the coastline of this part of Lolland. Together with the Water Framework Directive, the Natura2000 areas limit the possibility to establish fish farms at the present time.

Rødsand Wildlife Reservation was established in order to protect the Harbour/Spotted seal colony and comprises 450 hectares of the fairway around the western part of Rødsand shelf. This part of the reservation consists of a small bare strip of land that is flooded regularly according to the weather conditions.

The Rødsand 2 offshore wind park covers an area of 34 km2 and comprises of 90 Siemens wind turbines. The closest shoreline is 1,7km away and it is 3,1km from Nysted Wind Farm. The depth of the water here varies between 5,5 and 12 metres.

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2 CURRENT CHARACTERISTICS AND TRENDS IN THE USE OF THE SEA

Shipping and transport

The main driving economic sectors concerning the water surrounding the islands of Lolland-Falster are maritime transport (trade and ferry lines), wind energy and tourism. The waters off the southern coast of the islands in south-east Denmark have always been part of complex and busy transport axes; east-west (long-haul maritime transport between the North Sea, the Baltic and Russia) and north-south (ferry and maritime leisure activities between Denmark and Germany).

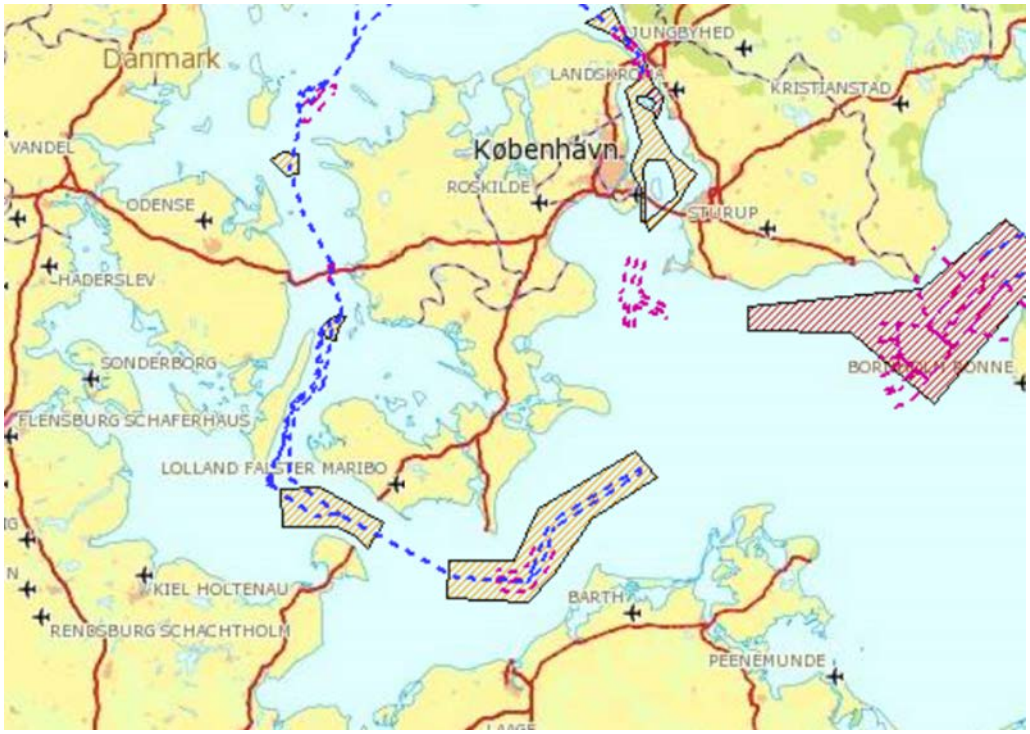

Figure 2 Showing trade fairways (dotted lines) and HELCOM Accident Risk Areas (blocked areas) around Lolland-Falster, excluding ferry lines. Source: EfficienSea (http://maps.efficiensea.org)

Offshore Wind

The world's first offshore wind park was established on the northern coast of Lolland, at Vindeby in 1985 and since 1999 the wind turbine industry has had a major influence on the industrial port town of Nakskov on Lolland, replacing many of the jobs that were lost when Nakskov Shipyard closed in the mid-nineties (S. Magnoni, A. Bassi, 2009). Between 2003 and 2007, two major offshore wind parks, Nysted Wind Park and Rødsand 2 were established 10 km off the south coast of Lolland; Nysted Wind Park, established in 2003, owned by DONG Energy (80%) and E.ON Sweden (20%) and Rødsand 2, established in 2007 and owned by SEAS-NVE (80%) and E.ON (20%). Together they have the capacity to produce 380,6 MW of electricity (about 3% of total Danish electricity needs).

Tourism

Tourism is one of the largest land-based economic sectors on Lolland, with popular beach resorts and sea-based activities accounting for most of this. Lolland's 600km of coastline, gentle gradient of sandy shores, low salinity and shallow and warm waters in the summer have contributed to an in-

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creasingly important income from, amongst others, water-based tourism, a trend which is expected to increase considerably in the future. Lolland Municipality together with Business Lolland-Falster is currently making a "Plan of Potentials 2030" for tourism development on the south coast of Lolland, including the increase of coastal tourism as part of its strategy. (http://www.businesslf.dk/turisme) (http://www.southbaltic-offshore.eu/reports-studies/img/OFFSHORE_WIND_FARMS_AND_TOURISM.pdf)

The new, high-speed rail transport between Copenhagen and Rødby on Lolland in connection with the planned Fehmarn Belt construction is expected to increase the number of tourists to Lolland as well as attracting commuters to purchase property in the area. (http://lolland.viewer.dkplan.niras.dk/media/224939/Plan-og-udviklingsstrategi-2016-2030-Det-nye-Lolland.pdf) The two wind parks, Nysted Wind Farm and Rødsand 2 can clearly be seen from the quaint village of Nysted (Lolland) and the ferry terminal towns of Rødby (Lolland) and Gedser (Falster). Fishing tourism has been identified as a growing sector and active holidays including sea-kayaking, sailing, kite-surfing and wind-surfing are increasingly popular in this area of Denmark (http://www.visitlolland-falster.dk).

Lolland Municipality has branded itself on its focus on renewable energy since 2009 when it published an ambitious Climate Strategy on the basis of the report "Green Energy Lolland-Falster" (http://klimabyggeri.dk/lolland.php) One of the spin-offs is a reasonably well established clean-tech tourism, which also involves the possibility of visiting the offshore wind parks by boat from Nysted.

Environmental Protection

There are large protected Natura2000 areas across most of Lolland, administered by the Ministry of Environment, due to the presence of rare biological species, including the white-tailed sea eagle. The largest colony of harbour and grey seals in the Baltic can be found at Redsand Wildlife Park (www.visitlolland-falster.dk/nysted-saelsafari-gdk1080793) Due to the ecological fragility of the Baltic Sea, small trawlers and leisure fishing are currently the only forms of aquaculture permitted in this geographical area.

Aquaculture and compensatory marine biomass cultivation

The Ministry of Environment and Food is keen to support marine based protein production and in June 2017 the Danish Law LBK #966 of 23/6/2017 was presented, making it possible for the Ministry to define new regulations concerning the establishment of marine compensatory instruments when applying for approval of open-water fish farms. https://www.retsinformation.dk/forms/r0710.aspx?id=192058.

Farming mussels or/and seaweed is known to contribute to the sequestration of nutrients, as recommended in the recently published EU report, "Towards an implementation strategy for the Baltic Blue Growth Agenda for the Baltic Sea Region" (https://ec.europa.eu) and therefore it is expected that the approval of the new law will be in place by Spring 2018 with effect from July 2018. At present, the Ministry has been asked to document the effects, regarding the environmental impact of mussel and seaweed farming in combination with fish farming.

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3 MU OVERVIEW

3.1 General background

No examples of multi-use with offshore wind can be found today in Denmark. Although there have been numerous studies and pilot sites concerning MU and with various recommendations as outputs of these (see list below), the desk analysis for this case study concluded that none of the recommendations have been implemented. The reason for this is unknown but can be due to a variety of factors; legislative barriers, complex administrative procedures, lack of cross-sectorial collaboration, lack of financial incentives or any combination of the above.

Due to the heavy weighting of environmental impacts on the sensitive Baltic Sea ecosystem, any proposal of establishing a new open cage fish farm is currently out of the question in the case study area, although the establishment of other marine biomasses, such as Baltic mussels and seaweed, has appeared on the list of nutrient remediation instruments in the "Catalogue of Environmental Instruments" since 2014 and are a focus of the newly proposed national legislation permitting the establishment of compensatory aquaculture in certain areas of the Danish sea, which is expected to be approved by Summer 2018. (http://dnmark.org/wp-content/uploads/2015/01/Virkemiddelkatalog.pdf)

In the case of Rødsand 2, an existing offshore wind park, the legislative requirements to expand the use marine space in order to establish a seaweed or mussel production off the coast of Lolland are determined by the distance to coast as well as the type of production:

- More than 1 nautical mile from land = Danish Environmental Protection Agency
- Less than 1 nautical mile from land = Local municipality
- Seaweed production = placement permit from Danish Coastal Authority
- Mussel production = placement permit from the Danish Agriculture and Fisheries Agency (earlier: NaturErhvervsstyrelsen)

Due to the proximity to shore and infrastructural span of Rødsand 2, it could be imagined that more than one scenario of the above permits could be required when considering a placement of mussel/seaweed biomass farms, or indeed if these were to be placed outside (e.g. downstream) the offshore wind park.

Some of the projects, publications and reports reviewed in the desk research in this case study include: "Nysted Windmølle Park" (Christensen et al. 2009) DTU-Aqua, "Combined-Uses"(Christensen, Pia B. et al. 2013), "Project MARIBE", "Den blå biomasse – potentialet I danske farvande"(Bruhn A., Rasmussen, M.B & Bech, K.S. 2010) Danmarks Miljøundersøgelser, Aarhus Universitet, "Seaweed perspectives in the Central Denmark Region" AlgaeCenter Denmark 2013, "Offshore wind farms and their potential for shellfish aquaculture and restocking," ICES CM (Stenberg, Claus, et al. 2010). "Blå vækstområder i Guldborgsund Kommune" (Orbicon A/S, Dolmer, P. 2017), "Strategy for sustainable development of the aquaculture sector in Denmark", Min. Food, Agriculture and Fisheries 2015, and "Marine Virkemidler" (Timmermann et al. 2016) Aarhus University, DCE.

3.2 Street interviews

In order to gain a wide impression of the state of awareness regarding MU in Denmark, "street interviews" were made on the basis of a short questionnaire when the opportunity for outreach pre-

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sented itself at the annual popular political Danish Folkemødet on Bornholm in June 2017 (https://folkemoedet.dk/) (90.000 visitors) (http://tidende.dk/?Id=80541).

The result of these short interviews indicated that the level of awareness of the general public concerning an organized multi-use of the sea around Denmark is almost non-existent; that most people believe that there are sufficient technology readiness (TR) levels, and that they have no power to influence decisions concerning MU. The public generally wish to eat more marine products and agree that optimizing resources (spatial, geographical, human and infrastructural) is something that should be developed and supported.

3.3 Individual interviews

The next level of interviews concerned selected stakeholders who represent different interests and aspects in relation to MU with the Rødsand 2 wind park. A list of Drivers, Added Values, Barriers and Negative Impacts (DABI) identified by the MUSES project partners, preparatory information for discussion as well as a list of interview questions regarding the DABI and other aspects of potential MU combinations were forwarded to the stakeholders. On the basis of the desk analysis and the street interviews, the most relevant MU combinations for the case study at Rødsand 2 and surrounding area that were identified for discussion were:

1) offshore wind and aquaculture (for remediation) and

2) offshore wind, environmental protection and tourism

3.4 Combination 1: Offshore wind and aquaculture

This specific combination envisages and considers the potentials of intentional joint multi-use of the geographical, physical and human resources between the owners of the existing offshore wind park and farmers of mussels and seaweed for remediation and biomass production.

Assuming that 25% of the maritime space in Rødsand 2 is available for other maritime uses, without hindering the operation and maintenance of the wind park (Christensen, Pia B. et al. 2013), the MU combination allows the possibility of farming naturally occurring brown seaweeds such as bladder wrack (fucus vesiculosus) and toothed wrack (fucus serratus), both removing 40 kg N and 2,4 kg P from the surrounding sea environment per ton (dry weight) of seaweed (Bruhn A., Rasmussen M.B, & Beck K.S. 2010) and producing a marine biomass for high value compounds and energy. Similarly, production of mussels (Mytilus edulis) for non-consumption e.g. mussel meal for feed (Dolmer, P. 2017) is possible in the low salinity waters.

Using the physical infrastructure of an offshore wind park is not an option in the Rødsand 2 case, where the wind turbine foundations have not been constructed for multi-use, but other physical resource multi-uses could be e.g. transport of personnel, sharing of equipment used for establishment of the biomass farms, harvesting of biomass, seasonal collection and storage of equipment, access to power and surveillance or sensor systems and data collection. Human resources such as personnel could also be considered in this MU combination, in surveillance situations, data collection and IT, harvest operations, etc.

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3.5 Combination 2: Offshore wind, environmental protection and tourism

This specific combination envisages and considers the potential of intentional joint multi-use of the geographical, physical and human resources between the owners of the existing offshore wind park, environment and nature organisations and tourist activity services.

Biodiversity is very limited in the Baltic Sea due to its brackish waters (Ojaveer, Henn, et al. 2010: "Status of biodiversity in the Baltic Sea.") and this MU combination would see the establishment of artificial reefs within the Rødsand 2 wind park, recreating marine environments that have otherwise been eliminated in the process of stone dredging over the past centuries and encouraging new settlements of various marine species and increased biodiversity. The shared physical resources could be regarding transport, sharing of equipment for establishment of the artificial reefs, a floating dock, surveillance systems and data collection.

The sheltering effect of the wind park and the new underwater environment would provide a completely new form of water tourism, allowing for the establishment of e.g. diving and marine nature education and study. Joint use of human resources could involve e.g. surveillance and data collection and dissemination of information as part of a tour.

With these two combinations as a basis for discussion, the MU catalogue of drivers, added values, barriers and negative impacts (DABI) concerning co-location was further developed, addressing e.g. lack of tradition of cooperation between the different sectors; conflict of interests; motivation for collaboration; conditions for the establishment of remediation sites vs wind sites; legal licensing, permits and insurance; positive environmental added value; potentials for a local blue bio-economy and relevant business cases for stakeholder involvement, etc.

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4 CATALOGUE OF MU DRIVERS, BARRIERS, ADDED VALUE, IMPACTS (DABI)

4.1 Combination 1: Offshore Wind & Aquaculture

The DABI catalogue illustrated in Table 1, Parts 1 & 2 is the final version of Drivers, Added Values, Barriers and Negative Impacts for the MU combination "Offshore Wind & Aquaculture" and is the result of discussions with stakeholders representing an appropriate distribution of relevance and professional backgrounds in considering Rødsand 2 wind park. Each of the stakeholders was interviewed for approximately 45-60 mins, after having received the preparatory documentation and general DABI a week or so previously. The stakeholder interviews were done by telephone and most were complemented by physical meetings in other relevant fora (e.g. workshops, conferences), where there were opportunities to discuss further. Nearly all interviewees were happy to be quoted and attributed with only a couple wishing a high level of anonymity. All agreed that this MU combination is relevant for development at Rødsand 2.

General feedback to the DABI:

Regarding the discussed DABI, all interviewees agreed that the identification of whether a factor was a driver or a barrier was subjective to the sector from which the interviewees came. One example of this is the limiting restrictions on fish farming in Danish waters – whether this is considered a driver for compensatory cultivation measures and ecosystem services or a barrier for MU with fish aquaculture is debatable. It was also commented that specifically the negative impact factors in the general DABI could be regrouped to cover the various descriptions of leakage or contamination, as many of these resembled each other closely and appeared to physically "outweigh" the other clustered factors in the table.

Most importantly, all interviewees expressed that "new business opportunities" as an economic driver and that "proof of concept" as an economic barrier that should be added for this MU combination.

None of the interviewees actually felt that competition for marine space at this specific location was a driver, but that under all circumstances, multi-use of resources and cultivation of marine biomass as an eco-system service should be encouraged. Some of the background information in the preparatory information was not specifically relevant for the waters around Rødsand 2, due to the ecological limitations and climatic conditions at this geographic situation. This became apparent when discussing the practicalities of establishing an aquaculture infrastructure of any kind (fish, mussels, seaweed).

For example, although the theoretical suggestion of a MU with offshore wind can be very well presented, if there is no ecological/biological validity regarding availability of nutrients to support the cultivation of biomass in that area, the theory will be disproved or invalid.

All interviewees concurred that the lack of dialogue between the involved sectors and the mismatch between the types and financial status of relevant stakeholders made the dynamics of approaching MU very difficult. All of them felt that political trends should be backed by some form of motivation to find a "reason to go" and that none of them had any power to influence the decision-makers alone.

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TABLE 1 - EXAMPLE OF CATALOGUE OF FACTORS (DABI). PART 1: DRIVERS AND BARRIERS.

MU COMBINATION OFFSHORE WIND + AQUACULTURE (SEAWEED/MUSSELS)

DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
Category D.1 – policy drivers Factor D.1.1 Strong national policies on environmental remediation (CO2/N/P) Factor D.1.2 Strong national policies on bio-economy and blue growth Factor D.1.3 New national laws on compensatory aquaculture for nutrient sequestration	***Category B.1 – legal barriers*** Factor B.1.1 Lack of regulatory support or incentives to promote co-localization between sectors Factor B.1.2 Different regulations apply regarding establishment of different types of aquaculture
Category D.2 – interactions with other uses Factor D.2.1 Rødsand 2 already in operation; improve green image/CSR Factor D.2.2 Effective use of maritime space	***Category B.2 – administrative barriers*** Factor B.2.1 Complicated procedure to obtain environmental permits for establishment of aquaculture administered by different authorities Factor B.2.2 Lack of high level political focus on MU Factor B.2.3 Lack of involvement of regulators and push from their side in form of MSP and other policies that could provide guidance and know how/best practices regarding the EIA, risk assessment, etc.
Category D.3 – economic drivers Factor D.3.1 Global increase in demand for marine protein Factor D.3.2 New market opportunities for blue biomass Factor D.3.3 Shared human resources	***Category B.3 – financial barriers / risks*** Factor B.3.1 Lack of proof of concept/large scale pilots Factor B.3.2 Lack of business cases, documentation regarding production efficiency, quality and quantity Factor B.3.3 Lack of risk capital/funding for scaling up Factor B.3.4 Existing compensation for loss of fishing areas within OWF discourages new aquaculture establishment incentives
Category D.4 – societal drivers Factor D.4.1 Involvement/interest of local fishermen, Nysted wind park visitors centre Factor D.4.2 Potential new jobs in a peripheral area Factor D.4.3 Development of specialised courses tailored to include both aquaculture and offshore wind aspects	***Category B.4 – barriers related to technical capacity*** Factor B.4.1 TRLs vary according to the sector (OW/AQ) Factor B.4.2 Lack of accurately documented study regarding the applied technologies in a MU situation
	Category B.5 – barriers related to social factors Factor B.5.1 Stakeholder profiles are not aligned (i.e. giant international energy companies with self-employed, niche production, small scale companies) Factor B.5.2 Lack of tradition for cooperation between different sectors, Factor B.5.3 Possible conflict of interest between sectors Factor B.5.4 Lack of dialogue between sectors and society – no tradition of considering MU at sea Factor B.5.5 Lack of local public and political awareness regarding the positive effects of mussel and seaweed cultivation – aquaculture is associated with negative effects Factor B.5.6. Lack of consumer awareness and market demand for energy and aquaculture products coming specifically from combined and spatially efficient sites

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DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
	Category B.6 – barriers related to environmental factors Factor B.6.1 Ecology is unstable (steep salinity gradients, water temperature flux, nutrient availability, direction of currents and water flow) Factor B.6.2 Lack of EIA for MU on local biodiversity – concerns regarding negative environmental impacts Factor B.6.3 Lack of documentation of EI of large scale mussel/seaweed cultivation in general

TABLE 1 - EXAMPLE OF CATALOGUE OF FACTORS (DABI) PART 2: ADDED VALUES AND IMPACTS.

MU COMBINATION OFFSHORE WIND + AQUACULTURE (SEAWEED/MUSSELS)

ADDED VALUES = positive effects of MU	**IMPACTS** = negative effects of MU
Category V.1 – economic added value Factor V.1.1 Sharing of equipment and personnel for specific tasks (management/establishment/surveillance) suggested shared costs/reduction of costs Factor V.1.2 Increase in production from the same marine space Factor V.1.3 Sheltering effect of OWF can have positive effect of number of working days possible at sea with aquaculture	***Category I.1 – economic impacts*** Factor I.1.1 Repair costs: damage to mussel/seaweed lines from e.g. ice falling from the turbines in winter, or collision with maintenance vehicles Factor I.1.2 Loss of income: fouling of biomass production due to spillage from OW maintenance equipment, lubrication, paint and other chemicals Factor I.1.3 Lack of financial or other incentives to stimulate such combined development Factor I.1.4. Unaligned investment needs - for new development that would consider expansion of both OW and AQ it is difficult to find joint investors for both OW and AQ, as OW investors rely on slow steady return in a long run, while the aquaculture needs to reach profitability much faster to keep operating. (aquaculture expert - MUSHOLM) Factor I.1.5. Large development/undertaking requiring large investments for aquaculture that is a single small investor normally and no venture capital or other forms of investment or financial mechanisms normally being used (aquaculture expert - MUSHOLM) Factor I. 1.6. Aquaculture operation and maintenance might for some reason compromise the immediate access that OW operation personal might need in case of urgent need for repair (the costs for OW investor if the turbine is not operating even only one day are immense) - someone might need to compromise so who takes on that loss. (DONG) Factor I.1.7 Low productive hours - Long working hours for aquaculture personnel, incl. Non-productive time required to come to the turbine and go back to shore - increasing the costs of human resources Factor I.1.8 Insurance costs increase due to higher (unknown) risks (DONG)

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ADDED VALUES = positive effects of MU	**IMPACTS** = negative effects of MU
Category V.2 – societal added value Factor V.2.1 Introduction of broader local skill sets/specialised job creation Factor V.2.2 Basis for educative/training courses at local level Factor V.2.3 No near-shore visual pollution regarding aquaculture	***Category I.2 – societal impacts*** Factor I.2.1 Possible limitation or exclusion of local leisure and fishing activities Factor I.2.2 Development of new skillsets and courses for personnel that needs to know both, about aquaculture operations and OW operations/maintenance
Category V.3 – environmental added value Factor V.3.1 Good potential for nutrient sequestration Factor V.3.2 Good potential for increased marine biodiversity Factor V.3.3 Sheltering effect of the OW can increase capacity for biodiversity (settling effect) Factor V.3.4 Establishment of seagrass and mussels can prevent sand erosion on the sea bed	***Category I.3 – environmental impacts*** Factor I.3.1 Limited information regarding EIA of MU Factor I.3.2 Introduction of habitats supporting invasive species. Factor I.3.3 Possible bio-fouling due to aquaculture Factor I.3.4 Increase of bacteria present due to increased bird population and excreta
Category V.4 – better insurance policies and risk management Factor V.4.1 Broader understanding of each other's work and risks involved	***Category I.4 - technical impacts*** Factor I.4.1 Unclear technical risks and insurance implications
Category V.5 - technical added values	

4.2 Combination 2: Offshore Wind, Environmental Protection & Tourism

General Feedback to the DABI

As the interviewees were the same as for MU combination 1, the general comments regarding the DABI for MU combination 2 also applied where the DABI were the same e.g. all interviewees agreed that the identification of whether a factor was a driver or a barrier was subjective to the sector from which the interviewees came. It was again commented that specifically the negative impact factors in the general DABI could be regrouped to cover the various descriptions of leakage or contamination, as many of these resembled each other closely and appeared to physically "outweigh" the other clustered factors in the table. Again and most importantly, all interviewees expressed that "new business opportunities" as an economic driver and that "proof of concept" as an economic barrier that should be added for this MU combination concerning tourism development.

All interviewees agreed that the drivers in this combination mentioning Environmental Protection actually had a lot to do with economy and not so much to do with environment or nature issues. Some of the background information was again not so relevant for this combination of MU – but all agreed that this MU might give fewer interruptions to the OWF operation and maintenance in the longer term. One of the biggest barriers identified for this MU was the actual cost of establishing an artificial reef and marine nature park. All agreed that funding for this would have to come from an anthropological fund (such as Baltic2020), a wildlife fund (WWF) or a national financing mechanism, as there is no business model applicable, even though the establishment of the artificial reefs would result in a spin-off effect such as a good basis for a new type of tourism, or a food-chain improvement, resulting in a larger wild stock of fish. The lack of documentation and EIA concerning

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the establishment of artificial reefs is also considered a barrier and questions were also raised regarding the safety and insurance issues of allowing public access to the wind park area.

TABLE 1a - EXAMPLE OF CATALOGUE OF FACTORS (DABI). PART 1: DRIVERS AND BARRIERS.

MU COMBINATION OFFSHORE WIND, ENVIRONMENTAL PROTECTION & TOURISM

DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
Category D.1 – policy drivers Factor D.1.1 Strong national policies on environmental remediation (CO2/N/P) Factor D.1.2 New national laws on compensatory aquaculture for nutrient sequestration Factor D.1.3 New national focus on biodiversity Factor D.1.4 Adjacent to Natura200/wildlife parks	***Category B.1 – legal barriers*** Factor B.1.1 Lack of regulatory support or incentives to promote co-localization between sectors Factor B.1.2 Safety regulation restrictions regarding public access to industrial areas Factor B.1.3 Restrictions concerning use of a marine nature park may conflict with tourist activities
Category D.2 – interactions with other uses Factor D.2.1 Rødsand 2 already in operation; improve green image/CSR Factor D.2.2 Better use of maritime space Factor D.2.3 Strong and innovative tourism sector – diversification Factor D.2.4 New leisure opportunities/diving/training Factor D.2.5 Strengthened Marine Nature Park	***Category B.2 – administrative barriers*** Factor B.2.1 Complicated procedure to obtain environmental permits for establishment of aquaculture administered by different authorities Factor B.2.2 Lack of high level political focus on MU Factor B.2.3 Coordination of tour timetable may conflict with use of equipment for other fishing purposes
Category D.3 – economic drivers Factor D.3.1 New and increased business opportunities for tourism	***Category B.3 – financial barriers / risks*** Factor B.3.1 Lack of proof of concept/profitability Factor B.3.2 Lack of business cases Factor B.3.3 Expensive leisure activity – limited target group Factor B.3.4 Increased risk of collision due to increased use of area by various actors Factor B.3.5 Funding the cost of designing and installing artificial reefs Factor B.3.6 Unclear who should fund the establishment of the reefs
Category D.4 – societal drivers Factor D.4.1 Involvement/interest of local fishermen, Nysted wind park visitors center Factor D.4.2 Potential new jobs in a peripheral area of Denmark Factor D.4.3 Basis for a Marine Nature School	***Category B.4 – barriers related to technical capacity*** Factor B.4.1 New types of tourist vessels/docking platforms required for water leisure activities within the OW Factor B.4.2 Design of artificial reefs need to be tailored to the local habitat
Category D.5 – Environmental drivers Factor D.5.1 Artificial reef creates basis for increased biodiversity Factor D.5.2 New marine nature awareness Factor D.5.3 Increased nutrient sequestration Factor D.5.4 Clearer waters for leisure activities	***Category B.5 – barriers related to social factors*** Factor B.5.1 Stakeholder profiles are not aligned (i.e. giant international energy companies with self-employed, niche production, small scale companies) Factor B.5.2 Lack of tradition for cooperation between different sectors Factor B.5.3 Possible conflict of interest between sectors Factor B.5.4 Lack of dialogue between sectors and society – no tradition of considering MU at sea Factor B.5.5 Physical location of the leisure activity – local

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DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
	ownership may be weak Factor B.5.6 Lack of competent/trained personnel
	Category B.6 – barriers related to environmental factors Factor B.6.1 Lack of EIA for MU on local biodiversity – concerns regarding negative environmental impacts Factor B.6.2 Possible introduction of habitats favourable to invasive species Factor B.6.3 Weather conditions can mean a high risk of last minute cancellation Factor B.6.4 Lack of documentation regarding whether OWF meets MPA requirement

TABLE 1a - EXAMPLE OF CATALOGUE OF FACTORS (DABI) PART 2: ADDED VALUES AND IMPACTS.

MU COMBINATION OFFSHORE WIND, ENVIRONMENTAL PROTECTION & TOURISM

ADDED VALUES = positive effects of MU	**IMPACTS** = negative effects of MU
Category V.1 – economic added value Factor V.1.1 New economic activity in an otherwise unused sea bed area Factor V.1.2 Sheltering effect of OWF can increase the number of days suitable for leisure activities Factor V.1.3 Improved CSR for OW owner Factor V.1.4 Increased diversity in the food chain leading to increase in wild fish stocks Factor V.1.5 Low interference in OW running and operations	***Category I.1 – economic impacts*** Factor I.1.1 Damage to e.g. docking platforms from falling ice from the turbines in winter, or collision with maintenance vehicles Factor I.1.2 Fouling of area due to spillage from OW maintenance equipment, lubrication, paint and other chemicals Factor I.1.3 Insurance costs increase due to higher risks (e.g. collision to other vessels, etc.) (DONG) Factor I.1.5 Disrupted immediate access to the broken turbine can impose an immense cost to the OW investor
Category V.2 – societal added value Factor V.2.1 Introduction of broader local skill sets/specialised job creation Factor V.2.2 Basis for educative/training courses at local level - tourists and schools learning about clean energy and marine environment Factor V.2.3 No near-shore visual or acoustic pollution regarding tourism Factor V.2.4 New tourist attraction with a new value chain, new accessible activity	***Category I.2 – societal impacts*** Factor I.2.1 Increased risk of accidents (underwater activities and water transport collisions) Factor I.2.2 More space and options for recreational activities increasing the overall wellbeing in the area Factor I.2.3 Increased local interest for innovation and tourism related entrepreneurship
Category V.3 – environmental added value Factor V.3.1 Good potential for nutrient sequestration Factor V.3.2 Good potential for increased marine biodiversity Factor V.3.3 Sheltering effect of the OW can increase capacity for biodiversity (settling effect) Factor V.3.4 Establishment of seagrass and mussels can prevent sea bed erosion Factor V.3.5 Refuge areas for important species and ecological systems	***Category I.3 – environmental impacts*** Factor I.3.1 Limited information regarding EIA of MU Factor I.3.2 Introduction of habitats possibly supporting invasive species. Factor I.3.3 Possible bio-fouling Factor I.3.4 Increase of bacteria levels in the water due to increased bird and tourist population and excreta Factor I.3.5 Fouling of the area due to spillage from transport vehicles, OW maintenance equipment, lubrication, paint and other chemicals

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ADDED VALUES = positive effects of MU	**IMPACTS** = negative effects of MU
Category V.4 – better insurance policies and risk management Factor V.4.1 Broader understanding of each other's work and risks involved	***Category I.4 - technical impacts*** Factor I.4.1 Unknown impacts regarding the effect of the artificial reefs and settling wildlife on the turbine construction

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5 RESULTS OF DABI SCORING: ANALYSIS OF MU POTENTIAL AND MU EFFECT

5.1 MU combination 1: Offshore wind & aquaculture

NOTE: The stakeholders interviewed felt that the scoring system was too laborious and therefore we agreed to score according to the verbal feedback given during the interviews. I have therefore applied the scoring on the background of the interviews and on behalf of the stakeholders.

Having completed the interviews with the selected stakeholders and by applying the scoring system, we can see the average stakeholder scores of each MU Driver and Barrier and MU Added Value and Impact in Table 2, which represent the mean value of the individual stakeholder scores, with the factors presented in order of highest absolute value for each category.

MU potential

The calculated potential for developing MU with offshore wind and aquaculture at Rødsand 2 wind park is -0,70, perhaps not surprisingly reflecting the fact that there are currently more barriers than drivers when considering MU between existing offshore wind parks and aquaculture in the Danish Baltic Sea, albeit for remediation purposes. The score can also be interpreted as a lack of incentive and involvement by the regulators to encourage the employment of MU in Denmark with the OWF owners, who by the nature of their own renewable production, already feel that their businesses are contributing to the green economy in Denmark.

MU effect

The overall effect projected for MU development with offshore wind and aquaculture at Rødsand 2 shows very slightly positive, scoring 0,02 on average – indicating that the added value of MU is seen to be something that can contribute specifically to developing society at the local level, with jobs and new skills and just outweighs the negative impacts perceived.

Average score of categories (TABLE 3)

Looking closer at the average score of the DABI categories, it can be seen that the Policy, Economy and Societal drivers are equally weighted, whereas the category “Relation with other uses” is the least prioritised driver – perhaps an expression for the lack of open dialogue between the sectors and lack of insight into each other’s business potentials.

The factors that are seen to be hindering the development (barriers) of MU in this case study are indicated to be led by the issues regarding technical capacity, but in fact also are fairly spread out across the social, administrative, environmental, economic categories, with the legal barriers actually being the least. The weighting regarding the positive effects of MU is very much towards the environmental benefits of MU with offshore wind and aquaculture (for remediation), closely followed by the social benefits rather than the economic added value. Finally, the negative effects appear to be mostly associated with social and environmental impacts.

The “close to zero” results of this scoring could also be indicative of the fact that the 8 stakeholders interviewed represented a broad section of relevant actors that would be affected by, or interested in, MU development off the coast of Lolland-Falster and the results of the scoring take account of this. As expressed during their interviews, most stated that the drivers and barriers, added values and impacts could be and were perceived very differently according to their professional interests and views. Not all categories were relevant for all stakeholders.

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TABLE 2 - SCORED DABI TABLE

MU COMBINATION OFFSHORE WIND + AQUACULTURE (SEAWEED/MUSSELS)

DRIVERS = factors promoting MU			**BARRIERS** = factors hindering MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
D.1.2 Strong national policies on blue growth/bio-economy	D1	1,9	B1.1 Lack of regulatory support or incentives to promote co-localization between sectors	B1	-1,8
D.1.3 New national laws on compensatory aquaculture	D1	1,6	B1.2 Different regulations apply regarding establishment of different types of aquaculture	B1	-1,7
D1.1 Strong national policies on environmental remediation	D1	1,4	B2.3 Lack of involvement of regulators and push from their side in form of MSP and other policies that could provide guidance and know how/best practices regarding the EIA, risk assessment, etc.	B2	-3
D2.2 Effective use of maritime space	D2	1,2	B2.2 Lack of high level political focus on MU	B2	-2,2
D2.1 Rødsand 2 already in operation: improve CSR	D2	0,3	B2.1 Complicated procedure and points of contact for obtaining permits for aquaculture administered by different authorities	B2	-1,8
D3.1 Global increase in demand for marine protein	D3	2,2	B3.2 Lack of business cases, documentation regarding production efficiency, quality and quantity	B3	-2,4
D3.2 New market opportunities for blue biomass	D3	1,9	B3.1 Lack of proof of concept/large scale pilots	B3	-2,2
D3.3 Shared human resources	D3	0,8	B3.3 Lack of risk capital for scaling up	B3	-2,1
D4.2 Potential creation of new jobs in a peripheral area	D4	2,2	B3.4 Existing compensatory measure for loss of fishing areas within OWF discourages new aquaculture establishment incentives	B3	-0,9
D4.3 Development of specialised courses	D4	1,9	B4.2 Lack of accurately documented study regarding the applied technologies in a MU situation	B4	-2,8
D4.1 Interest of local fishermen, visitors to the Nysted Wind Park	D4	0,8	B4.1 TRLs vary according to the sector (OW/AQ)	B4	-2,6
			B5.2 Lack of tradition for co-	B5	-3

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DRIVERS = factors promoting MU			**BARRIERS** = factors hindering MU		
			operation between different sectors		
			B5.4 Lack of dialogue between sectors and society - no tradition of considering MU at sea	B5	-3
			B5.6 Lack of consumer awareness and market demand for energy and aquaculture products from MU sites	B5	-2,6
			B5.5 Lack of local public and political awareness regarding the positive effects of mussel and seaweed cultivation - aquaculture is associated with negative effects	B5	-2,4
			B5.1 Co-locating stakeholder profiles are very different (e.g. giant international energy companies and small/self-employed, niche production companies)	B5	-1,9
			B5.3 Possible conflict of interests between sectors	B5	-1,3
			B6.3 Lack of documentation of EI of mussel/seaweed cultivation on large scale	B6	-2,2
			B6.2 Lack of EIA for MU on local biodiversity - concerns regarding negative impacts on the environment	B6	-2,1
			B6.1 Ecology is unstable (e.g. steep salinity gradients, water temperature flux, nutrient availability, direction of currents and water flow)	B6	-1,7
DRIVERS average score		**1,47**	**BARRIERS average score**		**-2,17**
		MU POTENTIAL	**-0,70**		

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ADDED VALUES = positive effects of MU			**IMPACTS** = negative effects of MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
V1.2 Increase in production from the same marine area	V1	2,1	I1.3 Lack of financial or other incentives to stimulate such combined development	I1	-2,8
V1.1 Sharing of equipment and personnel for specific tasks (e.g. infrastructural management, surveillance) suggests shared costs /reduction of costs	V1	1,4	I1.4 Unaligned investment needs - for new development that would consider expansion of both OW and AQ	I1	-2,1
V1.3 Sheltering effect of OWF can have positive effect of number of working days possible at sea with aquaculture	V1	1,2	I1.5 Large development /undertaking requiring large investments for aquaculture that is a single small investor normally	I1	-1,9
V2.2 Basis for educative/training courses at local level	V2	2,2	I1.2 Loss of income: fouling of biomass production due to spillage from OW maintenance equipment, lubrication, paint and other chemicals	I1	-1,8
V2.3 No near-shore visual pollution regarding aquaculture	V2	1,9	I1.1 Loss of income: fouling of biomass production due to spillage from OW maintenance equipment, lubrication, paint and other chemicals	I1	-1,4
V2.1 Introduction of broader local skill sets/specialised job creation	V2	1,6	I1.7 Low productive hours - Long working hours for aquaculture personnel, incl. Non-productive time	I1	-1,3
V3.1 Good potential for nutrient sequestration	V3	2,6	I1.6 Aquaculture operation and maintenance might for some reason compromise the immediate access that OW	I1	-0,8
			I1.8 Insurance costs increase due to higher (unknown) risk	I1	-1,0
V3.2 Good potential for increased marine biodiversity	V3	2,6	I2.2 Possible limitation or exclusion of local leisure and fishing activities	I2	-2,7
V3.4 Establishment of seagrass and mussels can prevent sand ero-	V3	2,2	I2.1 Development of new skillsets and courses for OW/AQ personnel	I2	-2,0

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ADDED VALUES = positive effects of MU			IMPACTS = negative effects of MU		
sion on the sea bed					
V3.3 Sheltering effect of the OW can increase capacity for biodiversity (settling effect)	V3	1,4	I3.3 Possible bio-fouling due to aquaculture	I3	-2,6
V4.1 Broader understanding of each other's work and risks involved	V4	1,9	I3.4 Increase of bacteria present due to increased bird population and excreta	I3	-2,4
			I3.1 Limited information of MU regarding EI	I3	-2,3
			I3.2 Introduction of habitats supporting invasive species	I3	-1,2
			I4.1 Unclear technical risks and insurance implications	I4	-1,1
ADDED VALUES average score		**1,9**	**IMPACTS average score**		**-1,88**
MU OVERALL EFFECT			**0,02**		

TABLE 3 - SCORED DABI TABLE

MU COMBINATION OFFSHORE WIND + AQUACULTURE (SEAWEED/MUSSELS)

DRIVERS = factors promoting MU		BARRIERS = factors hindering MU	
Category	**Average score**	**Category**	**Average score**
D1 – Policy drivers	1,6	B4 – Technical capacity	-2,7
D3 – Economic drivers	1,6	B5 – Social factors	-2,4
D3 – Societal drivers	1,6	B2 – Administrative barriers	-2,3
D2 – Relation with other uses	0,8	B6 - Environment	-2,0
		B3 – Economic availability/risk	-1,9
		B1 – Legal barriers	-1,7
ADDED VALUES = positive effects of MU		**IMPACTS** = negative effects of MU	
Category	**Average score**	**Category**	**Average score**
V3 - Environmental	2,2	I2 – Social	-2,4
V2 - Societal	1,9	I3 - Environment	-2,1
V4 – Better insurance policy/risk management	1,9	I1 - Economic	-1,9
V1 - Economic	1,6	I4 - Technical	-1,1

5.2 MU combination 2: Offshore wind, Environmental Protection & Tourism

NOTE: As in the case of MU combination 1, the stakeholders interviewed felt that the scoring system was too laborious and therefore we agreed to score according to the verbal feedback given

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during the interviews. I have therefore applied the scoring using information from the interviews and on behalf of the stakeholders.

Having completed the interviews with the selected stakeholders and by applying the scoring system, we can see the average stakeholder scores of each MU Driver and Barrier and MU Added Value and Impact in Table 2a, which represents the mean value of the individual stakeholder scores, with the factors presented in order of highest absolute value for each category.

MU potential:

The calculated potential for developing MU of offshore wind, environmental protection and tourism at Rødsand 2 is 0,01. This suggests that the uncertainty concerning the logistics, technology and economy surrounding the establishment of a marine nature park in a new tourism context equalises the political, environmental and economical drivers of such a new and innovative vision for tourism.

The score can also indicate that the traditional lack of communication between the various stakeholder sectors is as a limiting factor, creating perceived barriers and negative impacts due to the lack of insight into the MU sectors.

Again, the score can also be interpreted as a lack of incentive and involvement by the regulators to encourage the employment of MU in Denmark with the OWF owners to contribute further to the green transition and blue growth in Denmark.

MU effect:

The overall effect of potentially developing MU of offshore wind, environmental protection and tourism at Rødsand 2 shows slightly positive, scoring 0,10 on average – indicating that the added value of MU is seen to be something that can contribute specifically to improving environmental challenges as well as developing society at the local level, with jobs and new skills and a new innovative type of tourism to build upon.

Average score of categories (TABLE 3a)

Looking closer at the average score of the DABI categories for this MU combination, it can be seen that the Policy and Environmental drivers are weighted as the most import, with Economic drivers following closely behind. This corresponds nicely with the discussions concerning economic barriers and the question of by whom or how an environmental investment such as a Marine Nature Park should be financed.

The category “Relation with other uses” has been indicated as the least important driver – again, perhaps an expression for the lack of open dialogue between the sectors and lack of insight into each other’s business potentials.

The factors that are seen to be hindering the development of MU (barriers) in this case study suggest that the economic and social risks connected with this type of MU are of most concern, closely followed by legal and technical barriers, whereas the environmental and administrative factors are of the least concern. The weighting regarding the positive effects of MU is very much towards the risk management environmental benefits of MU with offshore wind, environmental protection and tourism, closely followed by the social benefits rather than the economic category, which is of least importance. Finally, the negative effects appear to be mostly associated with economic and environmental impacts, rather than the technical and social categories.

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The 7 stakeholders interviewed represented a broad section of relevant actors that would be affected by or interested in MU development of this type off the southern coast of Lolland-Falster and the results of the scoring take account of this. As expressed during their interviews, most stated that the drivers and barriers, added values and impacts could be and were perceived very differently according to their professional interests and views. Not all categories were relevant for all stakeholders.

TABLE 2a - SCORED DABI TABLE

MU COMBINATION OFFSHORE WIND, ENVIRONMENTAL PROTECTION + TOURISM

DRIVERS = factors promoting MU			**BARRIERS** = factors hindering MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
D.1.3 New national focus on biodiversity	D1	2,3	B1.1 Lack of regulatory support or incentives to promote co-localization between sectors	B1	-2,0
D.1.1 Strong national policies on environmental remediation (CO2/N/P)	D1	2,0	B1.2 Safety regulation restrictions regarding public access to industrial areas	B1	-1,7
D.1.3 New national laws on compensatory aquaculture (mussels/seaweed) for nutrient sequestration	D1	1,8	B1.3 Restrictions concerning use of a marine nature park may conflict with tourist activities	B1	-1,6
D.1.4 Adjacent to Natura2000/wildlife parks	D1	1,3	B2.2 Lack of high level political focus on MU	B2	-1,7
D.2.3 Strong and innovative tourism sector – diversification	D2	1,6	B2.1 Complicated procedure and points of contact for obtaining permits	B2	-1,3
D.2.5 Strengthened Marine Nature Park	D2	1,4	B2.3 Coordination of tour timetable may conflict with use of equipment	B2	-0,7
D.2.4 New diving opportunities/training areas	D2	0,9	B3.2 Lack of business cases	B3	-2,7
D.2.2 Better use of MSP	D2	0,9	B3.5 Funding the cost of designing and installing artificial reefs	B3	-2,7
D.2.1 Rødsand 2 already in operation: improved CSR	D2	0,3	B3.6 Unclear who should fund the establishment of the reefs	B3	-2,7
D.3.1 New and increased business opportunities for tourism	D3	1,8	B.3.1 Lack of proof of concept/profitability	B3	-2,2
D.4.2 Potential creation of new jobs in a peripheral area	D4	2,0	B3.4 Increased risk of collision proportional with increased use of area	B3	-1,7

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DRIVERS = factors promoting MU			**BARRIERS** = factors hindering MU		
D.4.1 Interest of local fishermen, visitors to the Nysted Wind Park visitors centre	D4	1,9	B.4.1 New types of tourist vessels/docking platforms required for water leisure activities within the OWF	B4	-1,9
D.5.2 New marine nature awareness	D5	2,4	B.4.2 Design of artificial reefs need to be tailored to the local habitat	B4	-1,2
D.5.4 Clearer waters	D5	2,1	B.5.2 Lack of tradition for cooperation between different sectors	B5	-3,0
D.5.3 Increased nutrient sequestration	D5	1,7	B.5.4 Lack of dialogue between sectors and society - no tradition of considering MU at sea	B5	-2,3
D.5.1 Artificial reef creates basis for increased biodiversity	D5	1,6	B.5.1 Co-locating stakeholder profiles are very different (e.g. giant international energy companies and small/self-employed, niche production companies)	B5	-1,8
			B.5.5 Physical location of the leisure activity - local ownership may be weak	B5	-1,6
			B.5.6 Lack of competent/trained personnel	B5	-1,4
			B.5.3 Possible conflict of interests between sectors	B5	-1,1
			B.6.1 Lack of EIA on local biodiversity - concerns regarding negative impacts on the environment	B6	-2,2
			B.6.2 Possible introduction of habitats favourable to invasive species	B6	-1,8
			B.6.4 Lack of documentation regarding whether OWF meets MPA requirements	B6	-1,1
			B.6.3 Weather conditions can mean a high risk of last minute cancellation	B6	-0,7
DRIVERS average score		**1,64**	**BARRIERS average score**		**-1,63**
MU POTENTIAL			**0,01**		

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ADDED VALUES = positive effects of MU			IMPACTS = negative effects of MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
V.1.1 New economic activity in an otherwise unused sea bed area	V1	2,4	I.1.2 Loss of income: fouling of the area due to spillage from OW maintenance equipment, lubrication, paint and other chemicals	I1	-3,0
V.1.4 Increased diversity in the food chain leading to increase in wild fish stocks	V1	2,4	I.1.3 Insurance costs increase due to higher risks (e.g. collision to other vessels, etc.	I1	-2,6
V.1.5 Low interference in OW running and operations	V1	1,2	I.1.1 Repair costs: damage to e.g. docking platforms from falling ice from the turbines in winter, or collision with maintenance vehicles	I1	-2,0
V.1.2 Sheltering effect of the OWF can increase the number of days suitable for leisure activities	V1	1,1	I.1.5 Disrupted immediate access to the broken turbine can impose an immense cost to the OW investor	I1	-1,9
V.1.3 Improved CSR for OW owner	V1	1,1	I.2.1 Increased risk of accidents (underwater activities and water transport collisions)	I2	-2,0
V.2.2 Basis for educative/training courses at local level - tourists and schools learning about clean energy and marine environment - increased public awareness	V2	2,3	I.2.3 Increased local interest for innovation and tourism related entrepreneurship	I2	-0,2
V.2.1 Introduction of broader local skill sets/specialised job creation	V2	2,0	I.3.1 Limited information of MU regarding EI	I3	-2,7
V.2.4 New tourist attraction with a new value chain, new accessible activity	V2	1,7	I.3.3 Possible bio-fouling	I3	-2,6
V.2.3 No near-shore visual or acoustic pollution regarding tourism	V2	1,4	I.3.5 Fouling of the area due to spillage from transport vehicles, OW maintenance equipment, lubrication, paint and other	I3	-2,6

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ADDED VALUES = positive effects of MU			IMPACTS = negative effects of MU		
			chemicals		
V.3.2 Good potential for increased marine biodiversity	V3	2,3	I.3.2 Introduction of habitats possibly supporting invasive species	I3	-2,2
V.3.1 Good potential for nutrient sequestration	V3	2,2	I3.4 Increase of bacteria levels in the water due to increased bird and tourist population and excreta	I3	-2,1
V.3.3 Sheltering effect of the OW can increase capacity for biodiversity	V3	1,9	I.4.1 Unknown impacts regarding the effect of the artificial reefs and settling wildlife on the turbine construction	I4	-1,8
V.3.4 Establishment of seagrass, reefs, etc. can prevent sea bed erosion	V3	1,9			
V.3.5 Refuge areas for important species and ecological systems	V3	1,9			
V.4.1 Broader understanding of each other's work and risks involved	V4	2,1			
ADDED VALUES average score		**1,93**	**IMPACTS average score**		**-1,83**
MU OVERALL EFFECT			**0.10**		

TABLE 3a - SCORED DABI TABLE

MU COMBINATION OFFSHORE WIND, ENVIRONMENTAL PROTECTION + TOURISM

DRIVERS = factors promoting MU		**BARRIERS** = factors hindering MU	
Category	**Average score**	**Category**	**Average score**
D1 – Policy drivers	1,9	B3 – Economic availability/risk	-2,0
D5 – Environmental drivers	1,9	B5 – Social factors	-1,9
D3 – Economic	1,8	B1 – Legal barriers	-1,7
D4 – Societal drivers	1,6	B4 – Technical capacity	-1,6
D2 – Relation with other uses	1,0	B6 – Environmental factors	-1,4
		B2 – Administrative barriers	-1,2
ADDED VALUES = positive effects of MU		**IMPACTS** = negative effects of MU	
Category	**Average score**	**Category**	**Average score**
V4 – Risk Management	2,1	I1 – Economic	-2,4
V3 – Environmental	2,0	I3 - Environmental	-2,4
V2 – Societal	1,9	I4 - Technical	-1,8
V1 – Economic	1,7	I2 - Social	-0,7

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6 FOCUS AREAS ANALYSIS

The three focus areas were discussed between the Danish case study group members in a working group and then later in various relevant fora, where the various stakeholders and case study group members were present and where there was the opportunity to discuss the focus topics in the context of the actual events as well as on a less formal level. (Dansk Bioøkonomi Konference, Better Off Blue Conference)

The 2nd Danish Bio-economy Conference, organised by Guldborgsund Municipality on the 11th October 2017, was one such opportunity, where the vast majority of case study stakeholders were present and where the topics were a natural part of the parallel sessions concerning the blue bio-economy and blue growth. It gave a very useful picture and overarching perspective of the stakeholders involved in MU and helped to provide more in-depth understanding of which factors were perceived, which were actual and by whom.

As experienced in the individual interviews, the consensus of the discussions within the working session was that although there is a goodwill and wish to develop aquaculture sites for remediation and therewith new biomass resources for new bio-products, there is real need for proof-of-concept – on the economic, environmental and legislative levels. They felt that the business case for mussel and seaweed aquaculture needs to be addressed before adding in the complexity of an already existing and successfully functioning wind park. It was important to the group that the commercial activity of one part of the MU combination should not be economically compromised by the second or third activity.

Environmental issues are high on the agenda in the case study area and the visionary idea of the basis for new biodiversity in the form of a Marine Nature Park also providing a basis for educative and underwater tourism experiences was very positively received. However, the financial requirements concerning the establishment of the artificial reefs within the wind park that would form the basis for such an MU combination was considered the biggest barrier, as obviously there is no business case on the environmental protection part of the combination. A business case can only be based upon using the area to develop and support tourism, education and awareness raising and the question is whether this is economically sustainable.

The following Focus-Area questions are answered based on the experiences of and discussions between the case study group and relevant stakeholders.

6.1 KEQs for Focus-Area-1 "Addressing Multi-Use"

1. *Is it possible to establish / widen / strengthen MU in the case study area?* Yes, potentially there could be interest from local stakeholders, but there is a need for awareness raising in general about MU and also some specific proof of concept/business cases (perhaps a full scale demonstration/pilot) in order to seal the interest and attract investors.

   For which MU combination in particular? Offshore wind power, environmental protection and tourism (Marine Nature Park). An aquaculture combination with mussels and algae would also be an option, but is still not a confirmed possibility at the present time, due to legislation.

   What needs would MU satisfy? It could contribute to Lolland Municipality's tourism development plan for the south coast of Lolland, building on the existing coastal leisure facilities

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e.g. boat tours and create the basis for new activities such as diving and underwater nature tours as well as raising marine awareness and new educational courses, etc. The artificial reefs would attract mussels, algae and many other species which will help towards reducing the eutrophication and biodiversity challenges of the Baltic Sea.

2. *Is space availability an issue for MU development / strengthening in the case study area at present?* Not really, although there is a lot of traffic, this is not in competition with the existing offshore wind park around which this case is built.

   Will space availability become an issue for your area in the future? No, not likely.
   For what elements could space availability become an issue? Only if the Ramsar/Natura2000 areas were to be compromised.

3. *Are there MUs combinations and potentials that will share the same resources but in different times (e.g. reuse of an infrastructure after the end of its first life and original scope)?* Possibly. *What are they?* Lolland has only just decommissioned the historic offshore wind park at Vindeby. The turbine foundations and sea-to-shore electricity cables and infrastructure is being investigated for its suitability for offshore solar panels. The turbine foundations of Rødsand 2 and Nysted Wind Park could hypothetically speaking be re-used as a form of aquaculture anchorage. But this is very unlikely due to the demand for renewables.

4. *What would be the most important resources to be shared between uses (infrastructures, services, personnel, etc)?* Harbour, maintenance and surveillance.

5. *Are potential MUs taken into account within the existing or under development Maritime Spatial Plans)?* No, although there have been various recommendations from earlier projects concerning this, these have not been adopted in any MSP documents.

6. *How are MUs connected or related to land-based activities?* Local tourist development bodies are experienced in using Lolland's nature and natural resources in tourist activities.

7. *Is the needed knowledge and technology for MU development in the case study area already available?* Yes, for all three (offshore wind, environmental protection and tourism) but not with the creation of artificial reefs.
   What is the level of maturity of available knowledge? Plenty regarding OW and tourism, but uncertain regarding artificial reefs / marine nature parks
   What is the level of readiness of available technology? High for OW and tourism, unknown for artificial reefs / marine nature parks
   Are there still research needs? Yes!

8. *What action(s) would you recommend to develop / widen / strengthen MUs in the case study area?* Raise awareness – open the cross-sectorial dialogue between relevant stakeholders, research the funding possibilities for establishment of a marine nature park.

   Which actor(s) do you see as particularly important to develop / widen / strengthen MU in the case study area? National/governmental actors, energy companies (DONG, E.ON, SEAS-NVE) and local tourism and business entrepreneurs.

6.2 KEQs for Focus-Area-2 "Boosting Blue Economy"

1. *Do you see added values for society and the economy at large and/or for local communities of developing / widening / strengthening MU in the case study area?* Yes

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What are the most important ones? Although the most obvious or straight forward choice would be the MU combination between Offshore wind and Aquaculture under normal circumstances (e.g. if there were no problems obtaining permits), the MU combination between Offshore wind, Environmental Protection and Tourism is more likely to succeed in this geographical area, increasing biodiversity and increasing the demand for support services (accommodation, transport, leisure) on Lolland and Falster and thereby increasing local job opportunities.

2. *Is it possible to quantify the socio-economic benefits related to MUs and how they (could) contribute to the sea economy at local and regional/national scale?* Yes, we believe so. *What tools, knowledge, experiences are available?* Knowledge and experiences from local stakeholders from comparable land based and coastal studies (synergies and symbioses) could indicate key points to address regarding local marine economy of potential MU with OW.
3. *Would MU development / strengthening be an opportunity for job creation and / or job requalification in your area?* Yes, in the long term – but the initial work would concern existing actors and the establishment of completely new competences.
4. *Do you see possible elements of attractiveness for investors in developing / widening / strengthening MU in the case study area?* Only on the environmental/anthropological level. *What are these elements?* Encouraging biodiversity in the local sea waters.
5. *What are possible investors interested in developing / widening / strengthening MU in the case study area?* Proof of concept and business cases are required showing the feasibility and effects of both MU combinations before investors can be approached.
6. *Is there sufficient dialogue between the stakeholder sectors for developing / widening / strengthening MU?* No
   Would dialogue facilitation be an asset? Yes, but awareness for MU needs to be in place first.
7. *In order to promote MU development / strengthening in MU in the case study area,*
   - would the availability of a vision/strategy (e.g. at national or sub-regional level) be helpful? Yes, a vision/strategy of blue growth would definitely be helpful
   - would a feasibility study including evaluation of alternative scenarios be helpful? Yes
   - would detailed projects on already identified simulations be useful? Yes
   - do you see other enablers? Funding mechanisms for eco-system services are very important for both MU combinations. Currently the regulators are not pushing for MSP and the establishment of a "one-stop-shop" for MU (as in the case for OW establishment) would ease the confusion and bureaucracy that is perceived as a barrier today. The pull from the market together with the level of consciousness regarding the existing and potential uses for seaweed and mussel biomass needs to be promoted on a broader level (nationally and macro-regionally) in order to ensure a gradual increase of products available. The establishment of a Marine Nature Park could be taken up as a showcase for renewable energy, biodiversity /nature care and sustainable educative tourism, working together with the municipalities' strategic business and tourism body as well as national tourism partners for marketing strategies to increase awareness of this MU.

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6.3 KEQs for Focus-Area-3 "Improving environmental compatibility"

1. *What are / would be the environmental added values of developing / widening / strengthening MU in the case study area?* In both MU scenarios nutrient sequestration would reduce the levels of eutrophication in the Baltic sea. In the 2nd MU combination the aim would be to increase the biodiversity of this area of the Baltic, an important step in the food chain and sustenance of the marine environment.
2. *Which tools (conceptual, operational) are used or should be further developed and used to better estimate environmental impacts and benefits of MU?* Monitoring the impacts and benefits of MU on the environment would be an activity that both Aarhus University, Syddansk University (SDU) and DTU-Aqua/DCE are well equipped and organised to undertake.
3. *Is saving free sea space for nature conservation a driver for MU in the case study area?* No, although the nearby coastal areas are already designated – so this topic could have a strengthening effect on the existing nature conservation in the area
   Are there evidences about the present and future benefits of reserving free sea space? No
4. *What practical actions would you undertake to link MU development / widening / strengthening to improved environmental compatibility of maritime activities?* This could only be relevant for the MU combination with tourism – but the MU would also increase the frequency of water transport, so whether the creation of a Marine Nature Park can outweigh this increase as well as existing activities?
5. *Are there win-win solutions triggering both socio-economic development and environmental protection already available for the case study area that MU should take up?* No
   What are they?
6. *Is the environmentally friendly knowledge / technology for MU development/strengthening in the case study area available?* Not really – perhaps yes for the knowledge – but not the technology regarding the MU / Marine Nature Park
   Which is the level of readiness of available solutions? Others in Denmark have addressed the artificial reef construction – would need to be researched further
   Are there still research needs on blue/green technologies for MU? Yes
7. *Would it be possible to promote MU through SEA/EIA procedures?* Yes
   What modifications would you suggest at your national / local level to promote MU through SEA/EIA procedures? When applying to establish a new wind park or other marine infrastructure, it should be strongly encouraged or give positive points if the applicant has made an EIA including a MU combination as part of their application.

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7 STAKEHOLDER ENGAGEMENT AND LOCAL STAKEHOLDER PROFILES

7.1 Activities carried out to engage stakeholders

As described in section 3, the case study group made an initial survey to test the levels of public awareness in Denmark regarding MU by conducting street interviews in June 2017 at the annual popular Danish political "Folkemødet" on Bornholm (https://folkemoedet.dk/) (90.000 visitors) (http://tidende.dk/?Id=80541).

Case study stakeholder interviews

After identifying the most relevant stakeholders for the case study of MU at Rødsand 2, these were contacted in late August and September with information about the MUSES project (see list below), giving the definition of Multi-Use (MU) within the frame of the project and asking for their consent to contact them with a view to interviewing. The initial interviews set the agenda for the narrowing of the MU combinations to two and DABI were adjusted accordingly for the following interviews.

Stakeholder (Name of organization)	Type	Contact
Orbicon A/S	Consultant Aquaculture	Interview 8/9 & group discussion 11/10
DONG (new name Orsted)	Offshore Wind – Energy provider	Interview – IL
Guldborgsund Municipality	Local government	Interview 7/9 & group discussion 11/10
Danish Aquaculture	National Fish and aquaculture branch organisation	Interview 24/10 & group discussions 28/9 & 11/10
Business Lolland-Falster	Business and tourism	Interview 23/10 & 11/10
Region Zealand/LA21 office	Regional government	Interview 11/9
Danish Nature Preservation – Lolland	Environment and Nature	Interview 23/10
SEAS-NVE	Electricity provider	Emailed
Lolland Municipality	Local government	Emailed
E.On Wind Services	Offshore Wind	Time issues
Danish Energy Agency	National regulator	Emailed – IL
Organic Seaweed	Seaweed farmer	Time issues
AquaCircle	Aquaculture network	Group discussion 28/9
Technical Gymnasium Lolland-Falster	Education	Group discussion 11/10
Danish Agriculture South	Agriculture	Group discussion 11/10

Discussions

The stakeholders were contacted for informal discussions at two relevant events: at the "Better Off Blue" SUBMARINER conference in Berlin on the 27-28th September 2017: https://www.submariner-network.eu/network/better-off-blue and the 2nd Danish Bio-Economy Conference, 11th October 2017, where many more of the case study relevant stakeholders were present and where there was the concrete opportunity to discuss MU during the blue biomass afternoon working session: http://www.bioguldborgsund.dk/?page_id=9

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7.2 Local stakeholder profiles

The case study stakeholder profiles relevant for both MU combinations are shown in the table below, indicating the sector and organisational category to which they belong.

Stakeholder organisation	Sector	Category
Orbicon A/S	Aquaculture	Business support - consultancy
DONG (new name Orsted)	Offshore Wind – Energy provider	Commercial Business
Guldborgsund Municipality	Local government	Regulator, local policy maker
Danish Aquaculture	Fish and aquaculture	National business support
Business Lolland-Falster	Business and tourism	Business support
Region Zealand/LA21 office	Regional government	Regulator, regional policy maker
Danish Nature Preservation – Lolland	Environment and Nature	NGO
Danish Energy Agency	National regulator	Regulator, national
AquaCircle	Aquaculture network	Business support
Technical Gymnasium Lolland-Falster	Education	Educational
Danish Agriculture South	Agriculture	Business support

On the basis of the information collected during the interviews and discussions, the stakeholders' interest in the specific case combinations have been attributed according to their overall feedback, interest and attitude towards the specific combination, the geographical scale at which they have the power to operate, their category of organisation, level of power and type of power to influence development of MU.

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MU Combination 1: Offshore Wind and Aquaculture (mussels and seaweed)

	Attribute 1 - Overall interest in MU	Attribute 2 - Overall attitude towards MU	Attribute 3 - Geographical scale at which certain stakeholder has the power	Attribute 4 - Organisation of stakeholders	Attribute 5 - type of power	Attribute 6 - Level of Power
Category						
Commercial Business	dormant	Neutral/undecided	national	strong clustering	Power to influence indirectly	high
Business support – consultancies	reactive	Neutral/undecided	Local-regional	a couple of individual organisations	Power to influence indirectly	medium
Educational	Not known	neutral/undecided	local	couple of individual organisations	No power to influence	low
Regulators	dormant	neutral/undecided	local-regional	couple of individual organisations	power to control and make decisions	strong
Policy makers	dormant	neutral/undecided	Local-regional	couple of individual organisations	power to control and make decisions	strong
NGO	reactive	positive - driving forces	national	Nation organization with local sections	Power to influence indirectly	medium

MU Combination 2: Offshore Wind, Environmental Protection and Tourism

	Attribute 1 - Overall interest in MU	Attribute 2 - Overall attitude towards MU	Attribute 3 - Geographical scale at which certain stakeholder has the power	Attribute 4 - Organisation of stakeholders	Attribute 5 - type of power	Attribute 6 - Level of Power
Category						
Commercial Business	reactive	neutral/undecided	local-regional	A lot of individual organisations	Power to influence indirectly	medium
Business support	reactive	positive - driving forces	Local-regional	a couple of individual organisations	Power to influence indirectly	medium
Educational	Not known	neutral/undecided	local	couple of individual organisations	Power to influence indirectly	low
Regulators	dormant	neutral/undecided	Local-regional	couple of individual organisations	power to control and make decisions	strong
Policy makers	dormant	neutral/undecided	Local-regional	couple of individual organisations	power to control and make decisions	strong
NGO	reactive	positive - driving forces	national	National with local organisations	Power to influence indirectly	medium

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8 CONCLUSIONS AND RECOMMENDATION FROM THE CASE STUDY TO THE ACTION PLAN

The current non-existent development of MU in the case study area reflects the national level of awareness regarding MU combination concepts and indicates that there is further awareness raising work to be done at local level as well as at the regulatory level, if a bottom-up development is to strengthen national policy making.

Due to the environmental concerns regarding the Baltic Sea and the current constraints on fish aquaculture, the MU combinations that are most likely to succeed in the case study area (and the rest of Denmark) will be those concerning mussel and seaweed cultivation or environmental nurturing, e.g. in the form of a Marine Nature Park together with already established marine infrastructures and tourism.

Stakeholders requested in-depth assessment of the impacts of the MU combinations and proof-of-concept and business models in order to encourage financial and investment interest. Both combinations would be feasible for further development on the condition that clear economic, commercial benefits exist for all sectors involved and that the environment and local society is not compromised.

Parallel to these risk assessments the regulatory organisations need to address the MU concept and include it in MSP and local maritime and coastal development plans, assisting the identification of areas suitable for establishing such MU combinations. The importance therefore of cross sectorial multi-stakeholder dialogue and physical opportunities for further discussion should be emphasised and the creation of a national task force to determine the strategy and conditions surrounding the development of MU in Denmark prioritised.

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APPENDIX 1: SCORED DABI SHEETS

MU Combination 1: Offshore wind & Aquaculture

	Gudhorgsund Municipality	Region Zealand	Orbicon A/S	Business Lolland-Falster	Denmarks Naturpreservation Lolland	Danish Aquaculture	DONG Energy	MUSHOLM	Bornholm Folk		
Combination: Offshore Wind and Aquaculture	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Factor average for all stakeholders**	**Category average (average of all factors averaged for all stakeholders)**
DRIVERS											
Category D.1 - Policy drivers											
Factor D.1.1 Strong national policies on environmental remediation (CO2/N/P)	2,0	1,0	3,0	0,0	3,0	0,0	0,0	3,0	1,0	1,4	
Factor D.1.2 Strong national policies on blue growth/bio-economy	3,0	2,0	2,0	3,0	0,0	2,0	1,0	3,0	1,0	1,9	
Factor D.1.3 New national laws on compensatory aquaculture (mussels/seaweed) for nutrient sequestration	2,0	1,0	3,0	1,0	2,0	1,0	0,0	3,0	1,0	1,6	
Average	**2,3**	**1,3**	**2,7**	**1,3**	1,7	1,0	0,3	3,0	1,0		1,6
Category D.2 - Relation with other uses											
Factor D.2.1 Rødsand 2 already in operation: improve green image/corporate social responsibility (perceived driver!)	0,0	0,0	1,0	1,0	0,0	0,0	0,0	0,0	1,0	0,3	
Factor D.2.2 Effective use of maritime space	1,0	0,0	2,0	1,0	2,0	2,0	1,0	0,0	2,0	1,2	
Average	**0,5**	**0,0**	**1,5**	**1,0**	1,0	1,0	0,5	0,0	1,5		0,8
Category D.3 - Economic drivers											
Factor D.3.1 Global increase in demand for marine protein	3,0	3,0	3,0	3,0	1,0	3,0	0,0	3,0	1,0	2,2	
Factor D.3.2 New market opportunities for blue biomass	2,0	2,0	3,0	2,0	1,0	3,0	0,0	3,0	1,0	1,9	
Factor D.3.3 Shared human resources	0,0	0,0	1,0	1,0	0,0	1,0	0,0	3,0	1,0	0,8	
Average	**1,7**	**1,7**	**2,3**	**2,0**	0,7	2,3	0,0	3,0	1,0		1,6
Category D.4 - Societal drivers											
Factor D.4.1 Interest of local fishermen, visitors to the Nysted Wind Park visitors centre	2,0	0,0	0,0	2,0	1,0	1,0	1,0	0,0	0,0	0,8	
Factor D.4.2 Potential creation of new jobs in a peripheral area	3,0	3,0	1,0	3,0	1,0	2,0	1,0	3,0	3,0	2,2	
Factor D.4.3 Development of specialised courses tailored to include both aquaculture and offshore wind aspects	3,0	3,0	2,0	2,0	0,0	2,0	1,0	2,0	2,0	1,9	
Average	**2,7**	**2,0**	**1,0**	**2,3**	0,7	1,7	1,0	1,7	1,7		1,6

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	Guldborgsund Municipality	Region Zealand	Orbicon A/S	Business Lolland-Falster	Denmarks Naturpreservation Lolland	Danish Aquaculture	DONG Energy	MUSHOLM	Bornholm Folk		
Combination: Offshore Wind and Aquaculture	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Factor average for all stakeholders**	**Category average (average of all factors averaged for all stakeholders)**
ADDED VALUES											
Category V.1 - Economic added values											
Factor V.1.1 Sharing of equipment and personnel for specific tasks (e.g. infrastructural management, surveillance) suggests shared costs /reduction of costs	0,0	0,0	1,0	0,0	0,0	3,0	3,0	3,0	3,0	1,4	
Factor V.1.2 Increase in production from the same marine area	2,0	1,0	3,0	2,0	3,0	3,0	0,0	3,0	2,0	2,1	
Factor V.1.3 Sheltering effect of OWF can have positive effect of number of working days possible at sea with aquaculture	0,0	0,0	3,0	0,0	0,0	3,0	0,0	3,0	2,0	1,2	
Average	**0,7**	**0,3**	**2,3**	**0,7**	1,0	3,0	1,0	3,0	2,3		1,6
Category V.2 - Societal added values											
Factor V.2.1 Introduction of broader local skill sets/specialised job creation	3,0	3,0	1,0	2,0	0,0	3,0	0,0	3,0	2,0	1,9	
Factor V.2.2 Basis for educative/training courses at local level	3,0	3,0	2,0	2,0	0,0	3,0	1,0	3,0	3,0	2,2	
Factor V.2.3 No near-shore visual pollution regarding aquaculture	3,0	1,0	1,0	2,0	3,0	1,0	0,0	0,0	3,0	1,6	
Average	**3,0**	**2,3**	**1,3**	**2,0**	1,0	2,3	0,3	2,0	2,7		1,9
Category V.3 - Environmental added values											
Factor V.3.1 Good potential for nutrient sequestration	3,0	3,0	3,0	2,0	3,0	3,0	0,0	3,0	3,0	2,6	
Factor V.3.2 Good potential for increased marine biodiversity	3,0	3,0	3,0	2,0	3,0	3,0	0,0	3,0	3,0	2,6	
Factor V.3.3 Sheltering effect of the OW can increase capacity for biodiversity (settling effect)	0,0	0,0	2,0	0,0	3,0	3,0	0,0	2,0	3,0	1,4	
Factor V.3.4 Establishment of seagrass and mussels can prevent sand erosion on the sea bed	2,0	1,0	3,0	1,0	3,0	3,0	2,0	2,0	3,0	2,2	
Average	**2,0**	**1,8**	**2,8**	**1,3**	3,0	3,0	0,5	2,5	3,0		2,2
Category V.4 - Better ensurance policy and risk management											
Factor V.4.1 Broader understanding of each others work and risks involved	1,0	1,0	2,0	2,0	0,0	3,0	3,0	3,0	2,0	1,9	
Average	**1,0**	**1,0**	**2,0**	**2,0**	0,0	3,0	3,0	3,0	2,0		1,9

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	Guldborgsund Municipality	Region Zealand	Orbicon A/S	Business Lolland-Falster	Denmarks Naturpreservation Lolland	Danish Aquaculture	DONG Energy	MUSHOLM	Bornholm Folk		
Combination: Offshore Wind and Aquaculture	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Factor average for all stakeholders**	**Category average (average of all factors averaged for all stakeholders)**
NEGATIVE IMPACTS											
Category I.1 - Economic impacts											
Factor I.1.1 Repair costs: damage to mussel/seaweed lines from e.g. ice falling from the turbines in winter, or collision with maintenance vehicles	0,0	0,0	3,0	0,0	0,0	3,0	2,0	3,0	2,0	1,4	
Factor I.1.2 Loss of income: fouling of biomass production due to spillage from OW maintenance equipment, lubrication, paint and other chemicals	0,0	0,0	3,0	0,0	3,0	3,0	2,0	3,0	2,0	1,8	
Factor I.1.3 Lack of financial or other incentives to stimulate such combined development (DONG)	3,0	3,0	3,0	3,0	1,0	3,0	3,0	3,0	3,0	2,8	
Factor I.1.4. Unalligned investment needs - for new develoment that would consider expansion of both OW and aq it is difficult to find joint investors for both OW and aq, as OW investors rely on slow steady return in a long run, while the aquaculture needs to reach profitability much faster to keep operating. (aquaculture expert - MUSHOLM)	2,0	2,0	3,0	2,0	0,0	3,0	1,0	3,0	3,0	2,1	
Factor I.1.5. Large development/undertaking requiring large investments for aquaculture that is a single small investor normaly and no venture capital or other forms of investment or financial mechanisms normally being used (aquaculture expert - MUSHOLM)	2,0	1,0	3,0	2,0	0,0	3,0	0,0	3,0	3,0	1,9	
Factor I. 1.6. Aquaculture operation and maintainance might for some reason comromise the immidiate access that OW operation personal migh need in case of urgent need for repare (the costs for OW investor if the turbine is not opearting even only one day are immense) - someone might need to compromise so who takes on that loss.. (DONG)	0,0	0,0	2,0	1,0	0,0	1,0	3,0	0,0	0,0	0,8	
Factor I.1.7 Low productive hours - Long working hours for aquaculture personel, incl. Non productive time required to come to the turbine and go back to shore - incresing the costs of human resources	0,0	0,0	1,0	1,0	0,0	3,0	3,0	3,0	1,0	1,3	
Factor I.1.8 Insurance costs increase due to higher (unknown) risks (DONG)	0,0	0,0	1,0	0,0	0,0	2,0	3,0	3,0	0,0	1,0	
Average	**0,9**	**1,3**	**3,0**	**1,3**	1,0	3,0	2,0		2,5		1,9
Category I.2. - Social impacts											
Factor I.2.1 Possible limitation or exclusion of local leisure and fishing activities	3,0	2,0	1,0	3,0	3,0	1,0	1,0	1,0	3,0	2,0	
Factor I.2.2 Development of new skillsets and courses for personel that needs to know both, about aquaculture operations and OW perations/maintainance	3,0	3,0	3,0	3,0	0,0	3,0	3,0	3,0	3,0	2,7	
Average	**3,0**	**2,5**	**2,0**	**3,0**	1,5	2,0	2,0		3,0		2,4
Category I.3 - Environmental impacts											
Factor I.3.1 Limited information of MU regarding EI	3,0	1,0	3,0	2,0	3,0	3,0	0,0	3,0	3,0	2,3	
Factor I.3.2 Introduction of habitats supporting invasive species	1,0	1,0	1,0	1,0	3,0	1,0	0,0	1,0	2,0	1,2	
Factor I.3.3 Possible bio-fouling due to aquaculture	2,0	2,0	2,0	2,0	3,0	3,0	3,0	3,0	3,0	2,6	
Factor I.3.4 Increase of bacteria persent due to increased bird population and excretia	3,0	2,0	2,0	3,0	3,0	3,0	0,0	3,0	3,0	2,4	
Average	**2,3**	**1,5**	**2,0**	**2,0**	3,0	2,5	0,8		2,8		2,1
Category I.4 - Technical impacts											
Factor I.4.1 Unclear technical risks and insurance implications	0,0	0,0	3,0	0,0	0,0	3,0	3,0	3,0	0,0	1,3	
Average	**0,0**	**0,0**	**3,0**	**0,0**	0,0	3,0	3,0		0,0		1,1

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MU Combination 1: Offshore wind, Environmental Protection

	Guldborgsund Municipality	Region Zealand	Orbicon A/S	Business Lolland-Falster	Denmarks Naturpreservation Lolland	Danish Aquaculture	DONG Energy	MUSHOLM	Bornholm Folk		
Combination: Offshore Wind, Environmental Protection and Tourism	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Factor average for all stakeholders**	**Category average (average of all factors averaged for all stakeholders)**
DRIVERS											
Category D.1 - Policy drivers											
Factor D.1.1 Strong national policies on environmental remediation (CO2/N/P)	1,0	1,0	3,0	2,0	3,0	3,0	0,0	3,0	2,0	2,0	
Factor D.1.3 New national laws on compensatory aquaculture (mussels/seaweed) for nutrient sequestration	1,0	1,0	3,0	2,0	1,0	3,0	0,0	3,0	2,0	1,8	
Factor D.1.3 New national focus on biodiversity	3,0	2,0	3,0	3,0	3,0	1,0	0,0	3,0	3,0	2,3	
Factor D.1.4 Adjacent to Natura2000/wildlife parks	2,0	1,0	1,0	2,0	3,0	1,0	0,0	1,0	1,0	1,3	
Average	**1,8**	**1,3**	**2,5**	**2,3**	2,5	2,0	0,0	2,5	2,0		1,9
Category D.2 - Relation with other uses											
Factor D.2.1 Rødsand 2 already in operation: improve green image/corporate social responsibility	0,0	0,0	1,0	1,0	0,0	0,0	0,0	0,0	1,0	0,3	
Factor D.2.2 Better use of MSP	1,0	1,0	2,0	1,0	1,0	1,0	0,0	1,0	0,0	0,9	
Factor D.2.3 Strong and innovative tourism sector - diversification	2,0	2,0	1,0	3,0	1,0	1,0	0,0	1,0	3,0	1,6	
Factor D.2.4 New diving opportunities/training areas	1,0	1,0	0,0	3,0	0,0	0,0	0,0	0,0	3,0	0,9	
Factor D.2.5 Strengthened Marine Nature Park	2,0	2,0	0,0	3,0	3,0	0,0	0,0	0,0	3,0	1,4	
Average	**1,2**	**1,2**	**0,8**	**2,2**	1,0	0,4	0,0	0,4	2,0		1,0
Category D.3 - Economic drivers											
Factor D.3.1 New and increased business opportunities for tourism	3,0	3,0	1,0	3,0	1,0	1,0	0,0	1,0	3,0	1,8	
Average	**3,0**	**3,0**	**1,0**	**3,0**	1,0	1,0	0,0	1,0	3,0		1,8
Category D.4 - Societal drivers											
Factor D.4.1 Interest of local fishermen, visitors to the Nysted Wind Park visitors centre	1,0	1,0	0,0	3,0	0,0	2,0	0,0	1,0	0,0	0,9	
Factor D.4.2 Potential creation of new jobs in a peripheral area	3,0	3,0	0,0	3,0	0,0	3,0	0,0	3,0	3,0	2,0	
Factor D.4.3 Basis for a Marine Nature School	2,0	2,0	0,0	3,0	3,0	3,0	0,0	1,0	3,0	1,9	
Average	**2,0**	**2,0**	**0,0**	**3,0**	1,0	2,7	0,0	1,7	2,0		1,6
Category D.5 - Environmental drivers											
Factor D.5.1 Artificial reef creates basis for increased biodiversity	1,0	1,0	2,0	1,0	3,0	2,0	0,0	1,0	3,0	1,6	
Factor D.5.2 New marine nature awareness	2,0	2,0	3,0	3,0	3,0	3,0	0,0	3,0	3,0	2,4	
Factor D.5.3 Increased nutrient sequestration	1,0	1,0	3,0	0,0	3,0	3,0	0,0	3,0	1,0	1,7	
Factor D.5.4 Clearer waters	2,0	2,0	1,0	3,0	3,0	2,0	0,0	3,0	3,0	2,1	
Average	**1,5**	**1,5**	**2,3**	**1,8**	3,0	2,5	0,0	2,5	2,5		1,9

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Combination: Offshore Wind, Environmental Protection and Tourism	Guldborgsund Municipality Score	Region Zealand Score	Orsticon A/S Score	Business Lolland-Falster Score	Denmarks Naturpreservation Lolland Score	Danish Aquaculture Score	DONG Energy Score	MUSNOLM Score	Bornholm Folk Score	Factor average for all stakeholders	Category average (average of all factors averaged for all stakeholders)
BARRIERS											
Category B.1 - Legal barriers											
Factor B.1.1 Lack of regulatory support or incentives to promote co-localization between sectors	-2,0	-1,0	-1,0	-3,0	-3,0	-1,0	-3,0	-1,0	-3,0	-2,0	
Factor B.1.2 Safety regulation restrictions regarding public access to industrial areas	-1,0	-1,0	-2,0	-3,0	0,0	-1,0	-3,0	-1,0	-3,0	-1,7	
Factor B.1.3 Restrictions concerning use of a marine nature park may conflict with tourist activities	-3,0	-1,0	-1,0	-3,0	0,0	-2,0	0,0	-1,0	-3,0	-1,6	
Average	**-2,0**	**-1,0**	**-1,3**	**-3,0**	-1,0	-1,3	-2,0	-1,0	-3,0		-1,7
Category B.2 - Administrative barriers											
Factor B.2.1 Complicated procedure and points of contact for obtaining permits for aquaculture establishment - administered by different bodies	-1,0	0,0	-1,0	-1,0	-1,0	-2,0	0,0	-3,0	-3,0	-1,3	
Factor B.2.2 Lack of high level political focus on MU	-2,0	-2,0	-2,0	-2,0	-2,0	-1,0	0,0	-1,0	-3,0	-1,7	
Factor B.2.3 Coordination of tour timetable may conflict with use of equipment for other fishing purposes	0,0	0,0	-1,0	-2,0	0,0	-1,0	0,0	-2,0	0,0	-0,7	
Average	**-1,0**	**-0,7**	**-1,3**	**-1,7**	-1,0	-1,3	0,0	-2,0	-2,0		-1,2
Category B.3 - Barriers related with economic availability / risk											
Factor B.3.1 Lack of proof of concept/profitability	-3,0	-3,0	-1,0	-3,0	-1,0	-3,0	0,0	-3,0	-3,0	-2,2	
Factor B.3.2 Lack of business cases	-3,0	-3,0	-2,0	-3,0	-1,0	-3,0	-3,0	-3,0	-3,0	-2,7	
Factor B.3.3 Expensive leisure activity - limited target group	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Factor B.3.4 Increased risk of collision proportional with increase use of area	-1,0	-1,0	-1,0	-2,0	-1,0	-1,0	-3,0	-3,0	-2,0	-1,7	
Factor B.3.5 Funding the cost of designing and installing artificial reefs	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	0,0	-3,0	-2,7	
Factor B.3.6 Unclear who should fund the establishment of the reefs	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	0,0	-3,0	-2,7	
Average	**-2,2**	**-2,2**	**-1,7**	**-2,3**	-1,5	-2,2	-2,0	-1,5	-2,3		-2,0
Category B.4 - Barriers related with technical capacity											
Factor B.4.1 New types of tourist vessels/docking platforms required for water leisure activities within the OWF	-3,0	-1,0	-1,0	-3,0	-1,0	-1,0	-3,0	-1,0	-3,0	-1,9	
Factor B.4.2 Design of artificial reefs need to be tailored to the local habitat	-1,0	-1,0	-1,0	-1,0	-3,0	-1,0	0,0	0,0	-3,0	-1,2	
Average	**-2,0**	**-1,0**	**-1,0**	**-2,0**	-2,0	-1,0	-1,5	-0,5	-3,0		-1,6
Category B.5 - Barriers related with social factors											
Factor B.5.1 Co-locating stakeholder profiles are very different (e.g. giant international energy companies and small/self-employed, niche production companies)	-2,0	-2,0	-2,0	-2,0	0,0	-2,0	0,0	-3,0	-3,0	-1,8	
Factor B.5.2 Lack of tradition for cooperation between different sectors	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	
Factor B.5.3 Possible conflict of interests between sectors	-1,0	-1,0	-1,0	-1,0	0,0	-1,0	-2,0	-2,0	-1,0	-1,1	
Factor B.5.4 Lack of dialogue between sectors and society - no tradition of considering MU at sea	-3,0	-3,0	-3,0	-3,0	-1,0	-2,0	-2,0	-1,0	-3,0	-2,3	
Factor B.5.5 Physical location of the leisure activity - local ownership may be weak	-3,0	-3,0	-1,0	-3,0	0,0	-1,0	0,0	0,0	-3,0	-1,6	
Factor B.5.6 Lack of competent/trained personnel	-1,0	-1,0	-2,0	-2,0	0,0	-2,0	-2,0	-1,0	-2,0	-1,4	
Average	**-2,2**	**-2,2**	**-2,0**	**-2,3**	-0,7	-1,8	-1,5	-1,7	-2,5		-1,9
Category B.6 - Barriers related with environmental factors											
Factor B.6.1 Lack of EIA on local biodiversity - concerns regarding negative impacts on the environment	-3,0	-3,0	-1,0	-3,0	-3,0	-1,0	0,0	-3,0	-3,0	-2,2	
Factor B.6.2 Possible introduction of habitats favorable to invasive species	-3,0	-3,0	-1,0	-1,0	-3,0	-1,0	0,0	-1,0	-3,0	-1,8	
Factor B.6.3 Weather conditions can mean a high risk of last minute cancellation	-1,0	0,0	-1,0	-2,0	0,0	-1,0	0,0	0,0	-1,0	-0,7	
Factor B.6.4 Lack of documentation regarding whether OWF meets MPA requirements	-1,0	-1,0	-1,0	-1,0	-3,0	-1,0	0,0	-1,0	-1,0	-1,1	
Average	**-2,0**	**-1,8**	**-1,0**	**-1,8**	-2,3	-1,0	0,0	-1,3	-2,0		-1,4

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	Guldborgsund Municipality	Region Zealand	Orbicon A/S	Business Lolland-Falster	Denmarks Naturpreservation Lolland	Danish Aquaculture	DONG Energy	MUSHOLM	Bornholm Folk		
Combination: Offshore Wind, Environmental Protection and Tourism	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Factor average for all stakeholders**	**Category average (average of all factors averaged for all stakeholders)**
ADDED VALUES											
Category V.1 - Economic added values											
Factor V.1.1 New economic activity in an otherwise unused sea bed area	3,0	3,0	3,0	3,0	1,0	3,0	1,0	2,0	3,0	2,4	
Factor V.1.2 Sheltering effect of the OWF can increase the number of days suitable for leisure activities	1,0	1,0	0,0	3,0	1,0	1,0	0,0	0,0	3,0	1,1	
Factor V.1.3 Improved CSR for OW owner	2,0	2,0	1,0	1,0	1,0	1,0	0,0	1,0	1,0	1,1	
Factor V.1.4 Increased diversity in the food chain leading to increase in wild fish stocks	2,0	2,0	3,0	3,0	3,0	3,0	0,0	3,0	3,0	2,4	
Factor V.1.5 Low interference in OW running and operations	1,0	1,0	1,0	1,0	1,0	1,0	3,0	1,0	1,0	1,2	
Average	**1,8**	**1,8**	**1,6**	**2,2**	1,4	1,8	0,8	1,4	2,2		1,7
Category V.2 - Societal added values											
Factor V.2.1 Introduction of broader local skill sets/specialised job creation	3,0	3,0	2,0	3,0	0,0	2,0	1,0	1,0	3,0	2,0	
Factor V.2.2 Basis for educative/training courses at local level - tourists and schools learning about clean energy and marine environment - increased public awareness	3,0	3,0	1,0	3,0	3,0	3,0	1,0	1,0	3,0	2,3	
Factor V.2.3 No near-shore visual or acoustic pollution regarding tourism	2,0	1,0	1,0	3,0	0,0	2,0	0,0	1,0	3,0	1,4	
Factor V.2.4 New tourist attraction with a new value chain, new accessible activity	3,0	3,0	1,0	3,0	1,0	1,0	0,0	0,0	3,0	1,7	
Average	**2,8**	**2,5**	**1,3**	**3,0**	1,0	2,0	0,5	0,8	3,0		1,9
Category V.3 - Environmental added values											
Factor V.3.1 Good potential for nutrient sequestration	2,0	2,0	3,0	1,0	3,0	3,0	1,0	2,0	3,0	2,2	
Factor V.3.2 Good potential for increased marine biodiversity	2,0	2,0	3,0	2,0	3,0	3,0	1,0	2,0	3,0	2,3	
Factor V.3.3 Sheltering effect of the OW can increase capacity for biodiversity	1,0	1,0	3,0	2,0	3,0	2,0	1,0	1,0	3,0	1,9	
Factor V.3.4 Establishment of seagrass, reefs, etc. can prevent sea bed erosion	2,0	2,0	2,0	2,0	3,0	1,0	1,0	1,0	3,0	1,9	
Factor V.3.5 Refuge areas for important species and ecological systems	2,0	2,0	2,0	1,0	3,0	2,0	0,0	2,0	3,0	1,9	
Average	**1,8**	**1,8**	**2,6**	**1,6**	3,0	2,2	0,8	1,6	3,0		2,0
Category V.4 - Better ensurance policy and risk management											
Factor V.4.1 Broader understanding of each other's work and risks involved	2,0	2,0	2,0	2,0	2,0	2,0	3,0	2,0	2,0	2,1	
Average	**2,0**	**2,0**	**2,0**	**2,0**	2,0	2,0	3,0	2,0	2,0		2,1

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	Guldborgsund Municipality	Region Zealand	Orbicon A/S	Business Lolland-Falster	Denmarks Naturpreservation Lolland	Danish Aquaculture	DONG Energy	MUSHOLM	Bornholm Folk		
Combination: Offshore Wind, Environmental Protection and Tourism	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**Factor average for all stakeholders**	**Category average (average of all factors averaged for all stakeholders)**
NEGATIVE IMPACTS											
Category I.1 - Economic impacts											
Factor I.1.1 Repair costs: damage to e.g. docking platforms from falling ice from the turbines in winter, or collision with maintenance vehicles	-1,0	-1,0	-2,0	-3,0	-1,0	-2,0	-3,0	-2,0	-3,0	-2,0	
Factor I.1.2 Loss of income: fouling of the area due to spillage from OW maintenance equipment, lubrication, paint and other chemicals	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	
Factor I.1.3 Insurance costs increase due to higher risks (e.g. collision to other vessels, etc.) (DONG)	-2,0	-2,0	-3,0	-3,0	-1,0	-3,0	-3,0	-3,0	-3,0	-2,6	
Factor I.1.5 Disrupted immediate access to the broken turbine can impose an immense cost to the OW investor	-1,0	-1,0	-1,0	-3,0	-1,0	-3,0	-3,0	-3,0	-1,0	-1,9	
Average	**-1,8**	**-1,8**	**-2,3**	**-3,0**	-1,5	-2,8	-3,0	-2,8	-2,5		-2,4
Category I.2. - Social impacts											
Factor I.2.1 Increased risk of accidents (underwater actitivies and water transport collisions)	-2,0	-2,0	-1,0	-2,0	-1,0	-2,0	-3,0	-2,0	-3,0	-2,0	
Factor I.2.2 More space and options for recreational activities increasing the overall wellbeing in the area (Added Value?)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Factor I.2.3 Increased local interest for innovation and tourism related enterpreneurship (added Value?)	0,0	0,0	0,0	0,0	-1,0	0,0	0,0	0,0	-1,0	-0,2	
Average	**-0,7**	**-0,7**	**-0,3**	**-0,7**	-0,7	-0,7	-1,0	-0,7	-1,3		-0,7
Category I.3 - Environmental impacts											
Factor I.3.1 Limited information of MU regarding EI	-3,0	-3,0	-2,0	-3,0	-3,0	-3,0	-1,0	-3,0	-3,0	-2,7	
Factor I.3.2 Introduction of habitats possibly supporting invasive species	-3,0	-3,0	-2,0	-2,0	-3,0	-2,0	0,0	-2,0	-3,0	-2,2	
Factor I.3.3 Possible bio-fouling	-3,0	-3,0	-2,0	-2,0	-3,0	-3,0	-2,0	-2,0	-3,0	-2,6	
Factor I.3.4 Increase of bacteria levels in the water due to increased bird and tourist population and excretia	-3,0	-3,0	-2,0	-2,0	-3,0	-2,0	0,0	-1,0	-3,0	-2,1	
Factor I.3.5 Fouling of the area due to spillage from transport vehicles, OW maintenance equipment, lubrication, paint and other chemicals	-3,0	-3,0	-3,0	-3,0	-3,0	-3,0	-1,0	-1,0	-3,0	-2,6	
Average	**-3,0**	**-3,0**	**-2,2**	**-2,4**	-3,0	-2,6	-0,8	-1,8	-3,0		-2,4
Category I.4 - Technical impacts											
Factor I.4.1 Unknown impacts regarding the effect of the artificial reefs and settling wildlife on the turbine construction	-2,0	-2,0	-1,0	-2,0	-3,0	-1,0	-3,0	-1,0	-1,0	-1,8	
Average	**-2,0**	**-2,0**	**-1,0**	**-2,0**	-3,0	-1,0	-3,0	-1,0	-1,0		-1,8

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