Version 1.1

MUSES PROJECT

CASE STUDY 4: MULTI-USE FOR LOCAL DEVELOPMENT FOCUSED ON ENERGY PRODUCTION, TOURISM AND ENVIRONMENT IN SWEDISH WATERS (ISLAND OF GOTLAND - BALTIC SEA)

MUSES DELIVERABLE:
D3.3 - CASE STUDY IMPLEMENTATION - ANNEX 7

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1 GEOGRAPHIC DESCRIPTION AND GEOGRAPHICAL SCOPE OF THE ANALYSIS

The study area is located in the southern part of Gotland, which is the largest of the islands in the Baltic Sea. The case study is situated near a relatively large shallow Bay "Burgsviken" that has changed from an oligotrophic to a eutrophic stage since the 1970 until today. This change has resulted in a loss of ecosystem services from the Bay and the Bay no longer provides good fishing, swimming or yachting. In the Bay, large stands of reed (Phragmites australis) are covering the inner portions and in the mouth and centre of the bay the sandy beaches are covered with organic matter from floating opportunistic filamentous red algae. Since 2012, local stakeholders around Burgsviken have decided to create the "project Burgsviken", which is a local initiative to save the Bay and restore the ecosystem services of Burgsviken. The project is further explained in following chapters.

The permanent population in Burgvik is about 350 people. During summer, there are several more occasional residents. In the southern parts of the Bay (see map Figure 1), the village Burgsvik is situated on a harbour, originally established in the 1870's mainly for shipping of grindstones. Today this area is also used for tourism. For example, there is a camping close to the harbour. West of the harbour, the offshore wind park Bockstigen is located about 4 km from the coast. This was the first offshore wind park in Sweden, established in 1998 and one of the first in Europe. This site has several advantages, such as low water depth in relatively large distances from land and suitable soil conditions for drilling and monopile foundation. An extension of the park has been discussed but is not currently in reach to be realized.

The geographical scope of the multi-use combinations in this study refers mainly to the marine area where the Bockstigen wind park is situated, since offshore wind combinations have the most potential in the area. However, the entire Bay will be included in the overall analysis since related projects are conducted and on-going closer to the coast.

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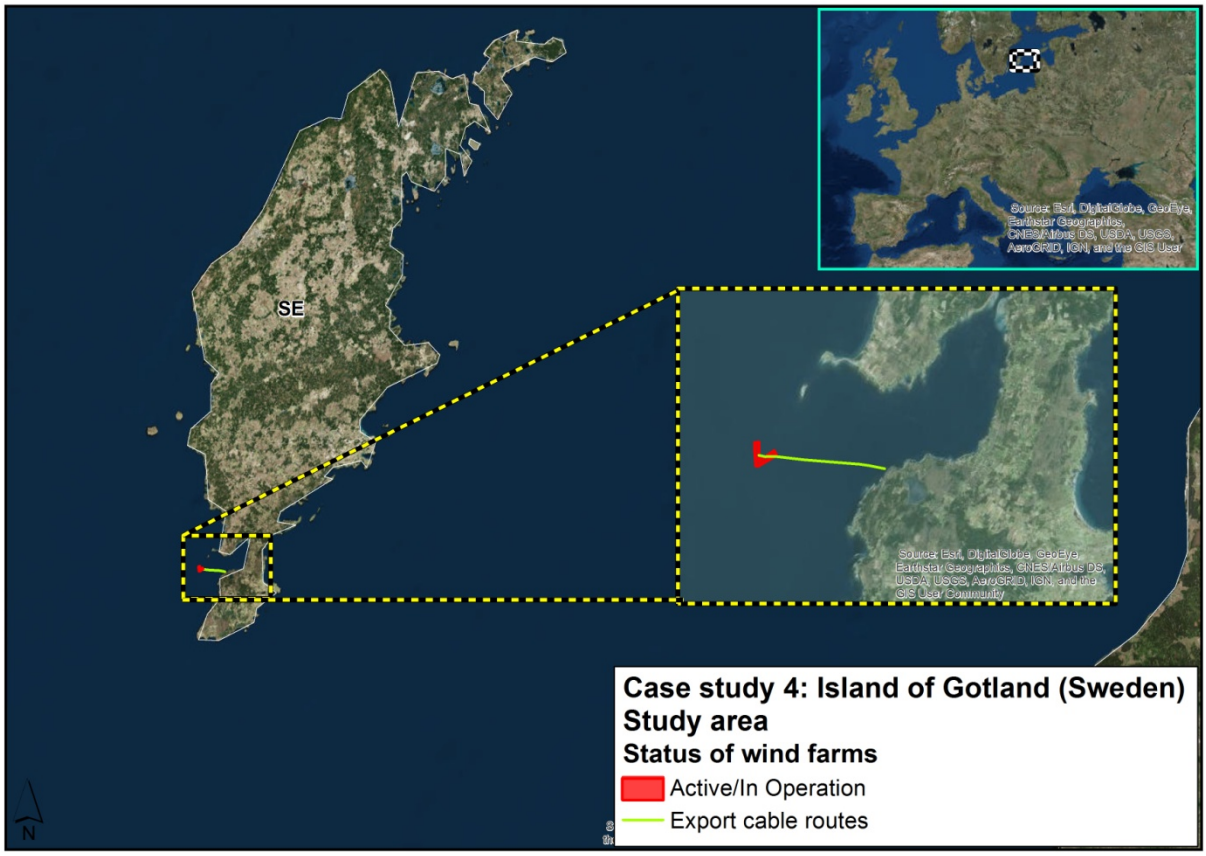

Figure 1 Geographical scope of the analysis. The area of Burgsvik Bay and the Bockstigen wind park

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2 CURRENT CHARACTERISTICS AND TRENDS IN THE USE OF THE SEA

In this chapter, we present some of the on-going activities and uses of the sea near Burgsvik and Gotland Island related to relevant MU combinations. This starts with a brief introduction of the local initiated measures related to the project "Save Burgsvik" (Rädda Burgsvik) and Forum Östersjön (Forum Baltic Sea) which involved measures to enhance water quality and reduce eutrophication impacts. However, these initiatives are linked to many different uses and activities in the area, and are also an important precondition for multi-use in the area. These projects indicate a strong local driving force and cooperation among different actors, and resulted in strong collaborative and innovative environment in the area. We will then present wind power, tourism and aquaculture that are related to the MU potential in the area.

2.1 Projects and measures to reduce nutrient levels

Since 2012, local stakeholders around Burgsviken have decided to create the "Save Burgsvik" initiative, managed by the non-profit association "Forum Östersjön" (Forum Baltic Sea). This is a local initiative to save the Bay and restore the ecosystem services of Burgsviken. In the project, more than 50 local actors including the municipality, local companies and landowners are involved, as well as universities. The overall research question pertains to whether the extensive biomass of reed and algae in the bay caused by eutrophication may be harvested or collected and used for feed or bioenergy (biogas). The problem is thus turned into an opportunity and may help the bay to recover and in the meantime create new socio-economic values around the bay.

The project has conducted several measures to reduce nutrient loads and increase the water quality and coastal environmental in Burgsvik. These are some examples of measures conducted:

- cleaning beaches by harvesting biomass such as reed and algae
- Phosphor traps in the agricultural land to reduce nutrient leakage into the bay
- restoring fishing grounds and spawning
- cooperation with a local elementary school for knowledge development and involvement of a younger generation

Among all measures conducted, the project has created a collaborative and innovative environment, which is a crucial precondition for multi-use of the marine areas outside Burgsvik. The project is still on-going, trying to develop activities for the area to be a forerunner for the "Blue economy" by turning the struggle to improve the local environment to an opportunity for local business. Relevant projects for MU in the area will be further elaborated in chapter 3.

2.2 Wind power

The driving economic sector in Gotland is wind energy production. Gotland is well suited for wind power production, and there are several wind parks on the island and one offshore wind park – Bockstigen, situated in our case study area. Wind power has been put to use on Gotland for many years and at one time there were over 500 traditional windmills provided milling power for the island's communities. Gotland has already witnessed significant development in wind power, both

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onshore and offshore, in such an extent that the power production has now reach its maximum ceiling. In May 2017, the agency responsible for ensuring the transmission system for electricity in Sweden Svenska kraftnät decided to stop the plans on connecting the transmission system at Gotland to the system at the main land of Sweden. This refers to the plans on further development of onshore and offshore wind power at Gotland, since no further production of energy will get permission provided this situation.

2.3 Tourism

Gotland is one of Sweden's most noted tourist destinations. Since 2010, the island has become a more versatile vacation spot visited by people from all over the world. In 2012, the ferries between Gotland and mainland Sweden had 1,590,271 passengers. The main port of call on Gotland is Visby and is visited by around 70 cruise ships every year. There is also the Round Gotland Race sailing event ("ÅF Offshore Race"), starting at Stockholm, around the island of Gotland and back.Fish that are most commonly fished around the island are pike (all year) and sea trout (October - May). A fishing license is not required for fishing taking place in state waters.

Burgsvik is situated about 80 km from Visby ferry terminal, and is close to one of the most popular tourism attractions (the road passes the Burgvik village), the Hoburgsgubben (a geological weathering phenomenon that has created a rock that looks like a human being). Burgsvik has also a camping area, a local smokehouse (for fish) and a pension that has been famous due to a popular TV show recorded here. The renovated beach in Burgsviken bay is now a popular, and visited by many tourists and occasional residents.

2.4 Aquaculture

In Sweden, mussels are cultivated on the west coast for consumption while they get too small in the Baltic Sea (due to low salinity) to be used as food. Small mussels can instead be used as feed for poultry and fish. Experiments are also in progress to cultivate ascidians for biogas and fertilizer. Fish and crayfish are cultured both for consumption and for stocking and conservation purposes. There are no aquaculture activities/businesses in Burgviken Bay today. Earlier attempts to grow mussels near Gotland coast have shown cautiously positive results, however, as expected, mussels grow slowly and do not become as big as on the Swedish west coast. There are plans to establish fish farms on land in Burgvik village. This could remove or reduce problems with nutrient leakage from fish farms, which is usually an argument for not having fish farms in the sea.

Whereas studies on the Swedish west coast have shown that people in general are positive towards aquaculture (except fish farms) (see Thomas et al. 2017), our local stakeholders in Gotland indicated that there might also be problems with public acceptance for mussel farms, despite their possibility of taking up nutrients and reducing eutrophication impacts. However, due to the urgency in reducing nutrient leakage and also reducing nutrient levels in the bay in Burgvik, and the large local interest in measures which could fulfill these needs – aquaculture related to mussels or algae is an interesting topic in the case study area. Thus, aquaculture will be able to abate nutrients and the products can be used as fodder (poultry or fish farms) or for biogas production.

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3 MU OVERVIEW

In this chapter we present the governance frames (legislation, policies, and institutional arrangements) related to relevant MU combinations in the case study area. Based on the initial desk analysis and initial interviews, we describe how relevant MU combinations were decided upon. This also includes a brief presentation of related MU approaches elsewhere in Sweden. Finally, we put forward the two MU combinations which demonstrate the most potential in the case study area, and the reasons for this.

3.1 Swedish governance related to the potential MU's

The governance of marine and water management in Sweden is divided into several agencies over different levels in society. On a national level, the most important agency for marine management is the Swedish Authorities for Marine and Water Management (SwAM) that was established in 2011 due to the implementation of the Marine Strategy Framework Directive (MSFD). From 2015, the SwAM has been responsible for implementing the MSP (Maritime Spatial Planning) directive. In 2015 marine/maritime spatial planning (MSP) was established and incorporated into Swedish law in the Swedish Environmental Code1. This states that the SwAM are responsible for creating MSP for Swedish marine resources, which are divided in three regions: the Skagerrak and Kattegatt (West coast), the Baltic, and the Bothnia Bay. Gotland is situated in the Baltic area. The legislation on MSP does not mention multi-use explicitly, but promotes co-existence of different uses of the sea, and also emphasizes that "business, social targets and environmental targets should be combined".2

In Sweden, municipalities (local level) are crucial actors in planning, which have sometimes been describes as a "planning monopoly" and is stated by the Plan and Building Act3. Municipalities have an important role in marine planning and in this context particularly for permitting offshore wind parks, since they have a veto on establishments inside the territorial sea boundary. The County environmental courts decide on permission, but the municipalities must accept this4. A big difference between the offshore and land based wind application process is that, for any operation in waters to be permitted, an analysis needs to be conducted that shows that the benefits are greater than the costs5. This is at the moment putting a stop to new offshore wind park establishments since the business sector is struggling financially6. However, MU combining offshore wind with environmental benefits (such as nutrient uptake by algae or mussels) might have the potential to increase the benefits. However, due to the lack of practice in these cases in Sweden today, this is not yet certain. The interviewees gave disparate meanings related to this: one interviewee suggested that permissions for new offshore wind parks would gain from the advent of

[1] *Havsmiljöförordningen 2015:400*
[2] *Havsmiljöförordningen 2015:400*
[3] *Plan and Building Act 2010:900*
[4] http://www.vindlov.se/sv/steg-for-steg/svenskt-vatten/provningsprocessen/tillstand-for-vattenverksamhet/.
[5] Environmental Code (11 chapter 6 §)
[6] http://www.foyen.se/orimlig-nyttobedomning-hindrar-havsbaserad-vindkraft/

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MU, and the other interviewee thought permission processes would only be more complicated by involving MU from the start.

Gotland Island has different administrative solutions on the ordinarily three separate institutional levels, which are municipality, County Board and "landsting"7. The "Region Gotland" is the municipality for the island, but has extensive responsibilities compared to other municipalities in Sweden. For instance, they manage all "landsting" responsibilities, and also some responsibilities usually managed by the County Board. However, there is also a County Board in Gotland. For example, Region Gotland is responsible for the regional/local development of Gotland, which can be relevant for this study. Whereas the County Boards in Sweden are regulators (supervision of activities in their region), municipalities in Sweden are a local administrative unit, with local autonomy and publicly elected politicians. Legally, this should not affect processes of facilitating MU combinations around Gotland. However, this compacted institutional solution might decrease some of the administrative barriers or at least help to find the right personal contacts when presenting local innovation projects related to MU combinations.

Many water activities or projects (ditching, piling, some aquaculture etc.) which can potentially affect environmental values have to go through the Environmental courts which decide on "vattendomar" (water judgement). These are normally related to time-consuming processes and administrative barriers, hindering measures related to environmental benefits (such as wetlands in the agricultural areas). Some aquaculture activities such as fish farms require this type permission, however, mussel farm projects do not normally need this permission. This can be important in our case where aquaculture is involved in several of the original MU combinations, and one of the MU combinations that was chosen as relevant for the case study area.

3.2 Current development of multi-use in Sweden and in the case study area

The initial desk analysis and interviews indicated a low level of maturity of MU development in Sweden, and a general lack of knowledge also at national agency level (related to marine planning). The following MU combinations were considered in the initial phase of the study.

1. Offshore wind and Environmental protection
2. Offshore wind and Tourism
3. Offshore wind and Aquaculture
4. Aquaculture and Tourism/environmental protection
5. UCH (Underwater cultural heritage) and tourism and environmental protection

Initial interviews and the desk analysis indicated that there are some MU activities taking place at existing wind parks in Sweden. At both Utgrundet and Lillgrunden offshore windparks (none in our case study area), boat trips have been arranged to show and present the wind parks to tourists or local residents close to the parks. In one of the case, it was arranged especially in early phase of

[7] This is usually at the same geographical scale as County Board, but have separate repsonsilitities such as healthcare and public transports.

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development, as a way to inform interested and concerned actors and public about the wind park.[8] In the other case it is an annual event, which, according to an interviewee, always attracted many people. It is the energy company owning the park which arrange the trips. Also, in Sweden, there are not particular prohibitions for visiting the wind park areas, which could, for example, facilitate the development of tourism in these areas.

Offshore wind and aquaculture as a MU combination has so far not been established in Sweden. But initial interviews with energy sector representatives indicated that MU is feasible if the energy company shows an interest in these type of synergies. If so, there is a potential in shared infrastructure, possibly sharing boats when visiting the piles.

For the combination of offshore wind and nature conservation, interviewees suggested that, to some extent, there could be some positive effects from the trawling ban in the offshore wind parks. However, this is not an actual MU combination according to the definition of the MUSES project. Furthermore, the establishment of nature conservation in wind parks such as marine reserves, could result in implications for the energy companies owning the parks, for example, by providing for future restrictions for the nature reserve which could affect the possibilities of getting to the piles of the wind park with larger ships than before.

The combination of aquaculture and tourism has been discussed for a mussel farm located at the Swedish west coast. The company running the mussel farm has struggled with negative local opinions in early stages of their mussel farms, however, local acceptance has generally increased. The company has plans to develop their business, for example with boat trips, to show tourists their mussel farms, and offer them to partake in the harvesting of the mussels.[9] The company sometimes also sells mussels to locals or tourists, even if it does not imply increased profitability for the company, but it may create an interest in their business.[10]

Multi-use as a combination of underwater cultural heritage (UCH) and tourism has been tested at some places in the Swedish Baltic coast. Sweden is particularly rich in underwater heritage with a unique ecosystem and majestic wrecks. The archipelago, located southeast of Stockholm, contains many well-preserved shipwrecks from the 17th and 18th century. Access to protected wrecks is controlled to avoid damage and licensed guides accompany divers. An interviewee described several difficulties with UCH and diving outside an island in the southern parts of the archipelago. For instance, divers became a risk for activities, people and themselves in the harbour. Diving here has therefore been cancelled for now.

In our case study area, none of the considered MU combinations are currently present. However, in Burgsvik there are several local entrepreneurs interested in developing tourism and innovative solutions on environmental measures, particularly linked to better water quality in the Burgsvik bay.

[8] Planering och kommunikation kring vindkraft i havet – En studie av lokala förankringsprocesser. Naturvårdsverket rapport 6350. April 2010.

[9] http://www.jordbruksverket.se/amnesomraden/landsbygdfiske/branscherochforetagande/vattenbruk/musselodling.4.44bedb3513533e95e618000614.html

[10] https://www.naturskyddsforeningen.se/sveriges-natur/2013-3/levande-reningsverk

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For example a current project under development is a “sea pool” which will oxygenate the water, and at the same time be an attractive swimming pool for tourists, with sea water free from harmful algae blooms and slightly warmer than the surrounding water.

3.3 Relevant MU for the case study area

Based on the initial study, and the local precondition that will be further elaborated on in this section, the following potential MU combinations were selected for steps 2, 3, 4 and 5 for the case study:

1. Offshore wind and Tourism
2. Offshore wind and Aquaculture

Rationale for selected MU combinations for case study analysis

The two most relevant combinations of multi-use in the case study area Burgsviken are to use the existing wind park Bockstigen for MU with either tourism or aquaculture. A first and dominant precondition in the case study area is the established wind park in use, and the fact that the representatives from the wind park ae positive and interested in MU in the area. Due to the limitation of power production at Gotland, the wind park owners cannot continue their plans of a possible extension of the park. This may be a reason for their interest in developing the existing park instead.

The initial study indicated that offshore wind and tourism to some extent already has been conducted in Sweden, however not focused on tourism as business, but rather for dissemination of wind power benefits and increasing public acceptance. Offshore wind and nature conservation did not turn out to be as interesting for the energy sector, which might complicate the establishment of this MU. The combination of offshore wind and aquaculture has not been established yet in Sweden. However, based on the large interest in the case study area on measures to reduce nutrient levels in the bay as well as a focus on harvesting biomasses, the cultivation of mussels or algae is of high interest for some of the local stakeholders engaged (see chapter 2, the project “Save Burgsvik”). A combination with aquaculture and tourism could also be interesting, however this was removed since it currently does not exist in any plans on mussel farming in Burgsviken bay.

In this section we present first some general aspects of offshore wind production and aquaculture. Then we present the current status and potential of multi-use in a case study perspective involving the two combinations.

3.3.1 Offshore wind and aquaculture

The idea of the combination offshore wind and aquaculture is basically to use the existing piles (sharing physical resources and infrastructure) in the wind park to attach aquaculture equipment. Most promising are longlines for mussel farms. However, as indicated above, mussels cultivated in the Baltic Sea do not become big enough for human consumption but may be used for fodder for poultry of fish farms. Algae cultivation might also be interesting for the site, and results from the Swedish west coast shows a great uptake of nutrient from algae. However, research and

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development is still needed to discern what kind of algae's would be suitable for cultivation in Baltic Sea conditions. Fish farms using the infrastructure of the wind park might also be feasible, but not interesting from an environmental point of view because they add nutrients to the sea, and not a nutrient uptake that both mussels and algae provide. In the case study area, there are examples of harvesting and using biomasses from the sea. This current knowledge and possibly also infrastructure could facilitate the realization of offshore wind and aquaculture.

3.3.2 Offshore wind and tourism

Offshore wind and tourism is basically a multi-use of shared geographical space, and also potentially the piles of the wind power (physical resource/infrastructure). It is also thought there might be an interest for tourists to go sightseeing in the offshore wind park. The tourism around and in the wind park might be developed in several ways. For example, there is a possibility to build and create an artificial ground for seals, which would enable sightseeing both offering information of the wind park itself and the potential for watching seals. Other options would be to make art at the monopiles, potentially in combination with light and/or water shows. Fishing tours around the piles could also work, since the piles often create a "reef effect" and can be a potentially good fishing spot. However, studies on the Swedish west coast have also shown that larger fishes are disrupted by the noise and therefore avoid the piles. So the alternative of starting recreational fishing boat tours to the wind park would probably require test fishing or research.

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

In this section, the results from the validated set of MU drivers, barriers, added values, and negative impacts (DABI) are presented for the two MU combinations of offshore wind + aquaculture, and offshore wind + tourism. Some factors were removed in comparison to the more general and initial desk analysis on DABI factors, since the stakeholders engaged did not perceived them as important or significant. On the other hand some factors were added, which are likely to be a result of the specific local case study application. Individual views of the stakeholders that were engaged resulted in the addition, removal, and scoring of DABI factors. Stakeholders engaged both on a national level (energy sector) and on a local level (different themes/sectors) did not perceive a lack of existing network or collaboration between different actors as a barrier. All factors added by stakeholders are included, which means that some of the factors in the catalogues were only claimed to be important by one or two stakeholders.

For both combinations there are many factors linked to the economic category. This appropriately reflects the discussions during the workshop held in the case study area (see section 7.1 for details), and the fact that many stakeholders engaged also represents local entrepreneurs or businesses in a rural area, where profitability is always a relevant topic and reality for rural communities. Both combinations include offshore wind power, however there are differences depending on the other activity/use combined with it. Some of the most important differences between the two combinations are that there are more environmental added values in the combination including aquaculture, since mussel or algae cultivation can imply a net uptake of nutrients. In the case of offshore wind and tourism, factors related to the public acceptance of offshore wind received greater emphasis, for example the promotion of offshore wind benefits, and potentially increased acceptance for offshore wind parks. However, there were also more factors reflecting the stakeholders' uncertainty of how tourism and offshore wind could be attractive for visitors.

The limitation is that some factors that might be important as drivers, barriers or added values and negative impacts were dismissed due to difficulties in finding and getting in touch with the "correct" informants. Also, some factors under the economic category seem to be very influential for the contacted stakeholders, suggesting that they may outweigh other factors which could play an important role. For most stakeholders the concept of multi-use was new to them. This means that, despite their knowledge of local conditions for the uses/users separately, the thought of combining the activities/uses of the sea partly was new. This means that they may perceive legislation as a barrier for multi-use, when it does not necessarily represent a real barrier.

4.1 MU combination offshore wind and aquaculture

The wind park Bockstigen is situated approximately 4 km outside Burgsvik. This was the first wind park in Sweden (1998) and one of the first in Europe. Today, the park consists of five wind piles. The owner of the Bockstigen wind park has planned an extension and renovation of the park, replacing the five old piles with twelve new ones. However, the island of Gotland produces so much energy already that this would require a new cable for energy transportation to the main land in Sweden. The process of getting a new cable in place has not been approved. This implies a barrier itself for

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future offshore wind power extension at the case study area and potentially also for multi-use in a more advanced way. The current potential of MU between offshore wind and aquaculture implies the use of the existing five piles. Hence, this combination addresses the sharing of physical resource (infrastructure) in cultivating mussels or potentially algae on long lines placed attached and placed between the piles. Fish farms were also discussed with stakeholders, but this would involve negative impacts to the marine environment in relation with mussels or algae's. Therefore, this was not discussed in detail. The combination of offshore wind and aquaculture in Burgsvik also entails shared geographical marine resource and could potentially also imply shared human resources. The latter is highly hypothetical, but the offshore wind park managers or technical support staff could for example share boat traffic to and from the piles, and thus also personnel for the boating.

Table 1a Catalogue of factors (DABI) for MU combination offshore wind + aquaculture (Part 1, drivers and barriers)

DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
Category D.1 – policy drivers	***Category B.1 – legal barriers***
Factor D.1.1 Political will. If the politicians on a local and/or national level would be interested in developing multi-use in marine areas, that will also entail support for this development (such as economic compensation, pilot projects etc.) National or local/regional level.	**Factor B.1.1 Legislations and permissions**. According to the Environmental Act[11] some water activities need permission called "*vattendom*"[12], (water judgement) in an Environmental court. This MU may also imply the need of a water judgement. National level.
Category D.2 – interactions with other uses	***Category B.2 – administrative barriers***
Factor D.2.1 Energy sector's CSR. Combining offshore wind with activities which can reduce nutrient loads in the Baltic Sea might be a way of for the energy sector to increase or emphasize their CSR. This factor also reflects the will of the energy sector entrepreneur to invest in MU with aquaculture, which might depend on the individuals involved in each wind park. In the case of Bockstigen, wind park management is highly interested in this combination. National and/or local level.	**Factor B.2.1 Conflicting interests in legislation/rules**. This can for example be a risk resulting from attaching long lines for mussels between the piles, creating a potential risk for transports to the piles (technical staff for the wind park), or the other way around. National level. **Factor B.2.2 More difficult permission for ow if combining with aquaculture.** Potential conflicting legislations might complicate the process of getting permission for the extension of offshore wind parks. National level. **Factor B.2.3 Risk of future restrictions in the area for both users.** There might be future restrictions in the area based on aquaculture, which might decrease the possibilities for

[11] Environmental Act (in Swedish Miljöbalking 1998:808)

[12] Activities and uses of Swedish waters are govern in the Environmental Act, chapter 11 (1998:808) where some activities need to seek permission for activities in an Environmental court to get a 'water judgement' (*vattendom* in Swedish). This process is usually related to as a time consuming process, hindering or slowing down activities with a positive effect on water quality, for example constructing wetlands in the agricultural areas to reduce nutrient leakge. Musselfarming does usually not need a 'water judgement'.

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DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
	offshore wind (transports – how often, which type of ships etc). This can also be the other way around, i.e. restrictions related to safety in the wind park that may affect aquaculture. National and or regional level.
Category D.3 – economic drivers	***Category B.3 – financial barriers / risks***
Factor D.3.1 Potential economic profitability for activities/business. Offshore wind companies might get income through taking out a rent from aquaculture activities using the piles. Aquaculture might reduce its costs by using the existing piles for longlines for example. **Factor D.3.2 Investments in wind power (piles) already made.**	**Factor B.3.1 No subsidies in place.** For this particular MU, or for aquaculture (mussels/algae) regarding their uptake of nutrients, in comparison with agricultural measures that reduce nutrient leakage. **Factor B.3.2 Low profitability**. Both offshore wind and aquaculture are businesses/activities with low profitability. **Factor B.3.3. Financial barriers for developing a pilot case.** Beyond the long-term risk related to low profitability, there are financial barriers due to a lack of investment in the MU combination.
Category D.4 – societal drivers	***Category B.4 – barriers related to technical capacity***
Factor D.4.1 Technical development of mussel farming. Investing in MU combining offshore wind and aquaculture in the area would require and create the development of mussel farming and potentially also algae cultivation which might be interesting both locally and for research on a more general level. **Factor D.4.2 Promoting related research/pilot studies.** Beyond development of mussel farming itself, this site might be interesting for research as a pilot study for combining offshore wind and aquaculture. **Factor D.4.3 Local community's willingness/interest.** There is already an innovative environment in the case study area, for example, combining tourism and environmental measures at the coast.	**Factor B.4.1 Lack of knowledge on technology for aquaculture and offshore wind.** There are many technical solutions that need to be solved in order to facilitate and realize this combination. Some knowledge exist at the county board administration, but it needs to be further discussed, tested and adapted to local conditions. **Factor B.4.2 Limitations of existing technologies in regard to wind and weather conditions for aquaculture.** Typically, mussel farms are located in areas of calm water in order to avoid the effects of waves and wind. Placing aquaculture in a wind park might require special techniques to avoid such risks. **Factor B.4.3. Timing in processes of different activities/users.** The activities of harvesting and maintenance of the longlines or other installed equipment for aquaculture might have to be agreed upon and coordinated with the activities needed for maintenance and/or technical support for the offshore wind park.
	Category B.5 – barriers related to social factors
	Category B.6 – barriers related to environmental factors

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Table 1b Catalogue of factors (DABI) for MU combination offshore wind + aquaculture (Part 2, added values and negative impacts)

ADDED VALUES = positive effects of MU	**IMPACTS** = negative effects of MU
Category V.1 – economic added value	***Category I.1 – economic impacts***
Factor V.1.1 Additional income for offshore wind and/or reduced costs for aquaculture. This could also be seen as a driver, but offshore wind could potentially take a rent from aquaculture, whom might lower costs due to the infrastructure in place. **Factor V.1.2 Local jobs**. This multi-use could create local jobs, both in terms of the activities and additional jobs as spin-off effects of increased activity in the harbour for example.	**Factor I.1.1 Economic risk**. Due to lack of knowledge and profitability in these "new" combinations of activities
Category V.2 – societal added value	***Category I.2 – societal impacts***
Factor V.2.1 Innovative local environment and local development. **Factor V.2.2 Increased acceptance**. Both offshore wind and aquaculture experience some problems with local public acceptance. Combining marine space for these activities might increase this acceptance.	**Factor I.2.1 Reduced/limited boat traffic**. There might be restrictions in the area affecting tourist and occasional visitors **Factor I.2.2 Acceptance by the local community.** Both permanent and summer/occasional residents might feel negatively towards more activity in the area.
Category V.3 – environmental added value **Factor V.3.1 Increased nutrient uptake.** Mussel farms or cultivation of algea can increase nutrient uptake and reduce eutrophication impacts **Factor V.3.2 Environmental friendly fodder.** Mussels can be a good basis for fodder for fish farms, poultry etc.	***Category I.3 – environmental impacts*** **Factor I.3.1 Noise impacts.** Due to more traffic in the area, both at sea and on land. **Factor I.3.2 Potential negative impact of fish farms**
Category V.4 – better insurance policies and risk management	***Category I.4 - technical impacts***
Category V.5 - technical added values	

4.2 MU COMBINATION Offshore wind + tourism

The wind park at Bockstigen is situated fairly close to the Burgvik society and the harbour. This makes it a possible site for sightseeing and boat trips for tourists visiting the area. There are other offshore wind parks in Sweden that occasionally (some days in a year) are doing boat trips to the wind parks which are attractive according to interviewee 2. However, the stakeholders involved in

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this study think that the wind park trip has to be combined with something else. The potential combinations discussed were to create an artificial seal ground at the piles, so sightseeing around the area could be combined with the chance to watch seals. Also, art installations potentially with light and water shows were also discussed. Another potential tourism use is recreational fishing in the wind park area. However, it is not known today if there are species of fish which are attractive for recreational fishing in the wind park area. Noise implications might disturb them, so further studies would be required, such as test fishing. This combination implies **shared geographical space**, and potentially also shared **physical resource** (is using the piles to construct seal ground).

A prerequisite in place at Burgsvik area, for combining offshore wind with tourism, is the existence of local entrepreneurs that are positive to innovative tourism, and collaboration between them and the offshore wind representatives.

Table 1c Catalogue of factors (DABI) for MU combination offshore wind + tourism (Part 1, drivers and barriers)

DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
Category D.1 – policy drivers	***Category B.1 – legal barriers***
Factor D.1.1 Political will and support. If there is political will and awareness of the benefits of MU, this may entail economic support for example.	**Factor B.1.1 Legislations and permissions.** Permissions might be needed to both change the piles (seal ground) and for boating with tourists in the area.
Category D.2 – interactions with other uses	***Category B.2 – administrative barrier***
Factor D.2.1 Energy sector CSR.	**Factor B.2.1 Permissions and administrative difficulties**. Potentially difficult rules and permissions for offshore wind + tourism due to the pilot character of the activities.
Category D.3 – economic drivers	***Category B.3 – financial barriers / risks***
Factor D.3.1 Potential economic compensation. There may be possibility of compensation through funds for innovation in tourism or ow. **Factor D.3.2 Development of local industry/activities.** In coastal rural areas people are struggling with profitability and some entrepreneurs are positive towards further development. **Factor D.3.3 Increased profitability of activities.**	**Factor B.3.1 Low profitability and high economic risk** **Factor B.3.2 Lack of market for ow + tourism**
Category D.4 – societal drivers	***Category B.4 – barriers related to technical capacity***
Factor D.4.1 Local innovation/entrepreneurship **Factor D.4.2 Increased public acceptance for offshore wind.** This may entail an increased interest by boats trips for example.	**Factor B.4.1 Limitation in energy production/transport.** There is a limitation in energy production due to lack of further transportation of energy to the main land of Sweden.

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DRIVERS = factors promoting MU	**BARRIERS** = factors hindering MU
Factor D.4.3 Dissemination of information about ow. Easier dissemination of information about offshore wind and improved knowledge of wider public about the benefits of the offshore wind.	
	Category B.5 – barriers related to social factors
	Factor B.5.1 Conflicting interests. Potentially between permanent residents (positive development of the area) and occasional summer house owners or visitors (might be negative towards further development). **Factor B.5.2 Low interest in ow + tourism in combination.** This factor refers to if there is enough public or local visitor interest for developing offshore wind + tourism. **Factor B.5.3 Aesthetic aspects.** If the wind park is further developed, for example by art, or if a potential development of the wind park would be realized.
	Category B.6 – barriers related to environmental factors

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Table 1d Catalogue of factors (DABI) for MU combination offshore wind + tourism (Part 2, added values and negative impacts)

ADDED VALUES = positive effects of MU	**IMPACTS** = negative effects of MU
Category V.1 – economic added value	***Category I.1 – economic impacts***
Factor V.1.1 Potentially increased profitability. Mostly valid for local business related to tourism **(Factor V.1.2 More energy production)** **Factor V.1.3 Increase in local jobs.** Partly related to increased activity in the area and the harbour. **Factor V.1.4 Spin-off effects.** Such as more activity in the area, which could entail better profitability of existing business but also the possibly new ones.	
Category V.2 – societal added value	***Category I.2 – societal impacts***
Factor V.2.1 More visitors. **Factor V.2.2 Increased acceptance.** Mainly for offshore wind. **Factor V.2.3 Increased knowledge/knowledge generation** **Factor V.2.4. Increased/improved cooperation**	**Factor I.2.1 Social disturbance.** Lowered acceptance, disturbed "views" for example **Factor I.2.2 Conflict of interests.**
Category V.3 – environmental added value	***Category I.3 – environmental impacts***
Factor V.3.1 Environmental benefits	**Factor I.3.1 Environmental impacts due to more traffic (boats, etc)** **Factor I.3.2 Noise for aquatic fauna**
Category V.4 – better insurance policies and risk management	***Category I.4 - technical impacts***
	Factor I.4.1 Need of additional services such as parking, waste disposal etc.
Category V.5 - technical added values	

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

5.1 How results were obtained for MU potentials and MU effects

The result from the MU potentials and effects were obtained through telephone interviews, a questionnaire and a workshop in the case study area. An extensive description of stakeholder engagement is outlined in section 7.1 in this document. However, in general they are fairly consistent with the desk analysis. The results are extracted from the Appendix 1 sheet.

5.2 MU combination offshore wind and aquaculture – potential and effects

The factors are further elaborated in the "catalogue of factors", in this section they are only briefly explained (see numbers of factors).

Table 2a MU COMBINATION Offshore wind + aquaculture (Part 1 MU potential and effect)

DRIVERS = factors promoting MU			**BARRIERS** = factors hindering MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
D.5.1 Environmental benefits (nutrient uptake)	D.5	1.3	B.3.2 Low profitability	B.3	-2.1
D.3.1 Profitability for business	D.3	0.7	B.4.1 Lack of knowledge on MU	B.4	-1.4
D.3.2 Investment in ow (piles) already made	D.3	0.7	B.3.3. Financial barrier for investing in MU pilot case	B.3	-1.3
D.4.2 Promoting research	D.4	0.6	B.1.1. Legislation	B.1	-1.1
D.4.1. Technical development of mussel farms	D.4	0.4	B.2.1 Conflict of interest	B.2	-0.4
D.1.1. Political willingness	D.1	0.3	B.3.1 No subsidies in place	B.3	-0.4
D.2.1 Good will entrepreneur	D.2	0.3	B.2.2 Permissions are complicated	B.2	-0.3
D.4.3 Local communities willingness	D.4	0.1	B.2.3 Risk of future conflicting restrictions	B.2	-0.3
			B.4.2 Limitations due to wind/weather	B.4	-0.3
DRIVERS average score		**0.6**	**BARRIERS average score**		**-0.8**
		MU POTENTIAL	**-0.2**		

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ADDED VALUES = positive effects of MU			**IMPACTS** = negative effects of MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
V.3.1 Nutrient uptake	V.3	1.9	I.3.1 Noise impact (transports)	I.3	-0.6
V.1.1 Additional income for ow and/or reduced costs for aquaculture	V.1	1.3	I.3.2 Potential negative impact if/of fish farms	I.3	-0.6
V.2.1 Local innovation	V.2	0.6	I.1.1 Economic risk	I.1	-0.4
V.3.2 Fodder production (fish farms or poultry)	V.3	0.3	I.2.1 Limitation in boat traffic	I.2	-0.1
V.1.2 Job creation	V.1	0.3	I.2.2 Acceptance of local community	I.2	-0.1
V.2.2. Increased acceptance for activities	V.2	0.3			
ADDED VALUES average score		**0.8**	**IMPACTS average score**		**-0.4**
MU OVERALL EFFECT			**0.4**		

The MU estimated potential for the combination offshore wind and aquaculture was slightly negative (-0.2). As seen in table 2a, stakeholders ranked different economic factors and lack of knowledge of MU as the most important barriers. For drivers, the environmental factors were most important followed by the possibilities that MU could imply an increase in profitability for each activity/business combined. Stakeholders have also ranked and scored “legislation” as an important barrier. Since the combination of offshore wind and aquaculture has not been realized elsewhere in Sweden, we do not know by now what potential further barriers in terms of legislation would be, i.e. there is no legal practice in place. Also if also considering the MU overall effect which is positive (0.4) – this combination might have a potential in the area.

In the case of impact, the potential negative impacts of fish farms were ranked, since the combination did not state what type of aquaculture that would be suitable. If removing this factor, the overall effect increases to 0.5. However, as emphasized by stakeholders, the lack of knowledge on the technology of combining offshore wind and aquaculture could be a barrier for its realization. A lot of knowledge and practical issues are still to be sorted out before aquaculture can be financially viable. During the workshop (see section 6. Focus areas) stakeholders discussed this technology, and according to the County Board specialist in aquaculture, the technology already exists. What is important is to investigate what type of aquaculture would be best suitable for this setting, particularly concerning the wind/weather conditions including the risk of icing in winters. The stakeholders also ranked the opportunity for research in the area as a driver. In this area, the existing offshore wind park could be suitable for pilot projects of offshore wind and mussel farms for example, since the representatives for the owner of the park are positive towards such development.

The representatives from commercial business linked to aquaculture (harvesting biomass) and water activities suggested that there are no drivers for scaling up aquaculture as harvesting of costal algae

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is already made locally and the demand is met. For them to participate in a MU project with aquaculture they need third party financing and someone else to take the risk. They initially suggested research financed pilot studies. Some are positive about being an implementing party and contributing with resources like boats, infrastructure and their experience from previous similar projects, since it can create job opportunities and local activity. They were also informed that mussels can be used as poultry or fish feed which increased their interest.

Table 3a MU categories for offshore wind + aquaculture - average score per category

DRIVERS = factors promoting MU		**BARRIERS** = factors hindering MU	
Category	**Average score**	**Category**	**Average score**
D.5 Environmental	1.3	B.3 Barriers related with economic availability/risk	-1.3
D.3 Economic drivers	0.7	B.1 Legal barriers	-1.1
D.4 Societal drivers	0.4	B.4 Barriers related with technical capacity	-0.7
D.1 Policy drivers	0.3	B.2 Administrative barriers	-0.4
D.2 Relations to other uses	0.3		
ADDED VALUES = positive effects of MU		**IMPACTS** = negative effects of MU	
Category	**Average score**	**Category**	**Average score**
V.3 Environmental added values	1.1	I.3 Environmental impact	-0.6
V.1 Economic added values	0.8	I.1 Economic impact	-0.4
V.2 Societal added values	0.4	I.2 Social impact	-0.1

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5.3 MU combination offshore wind and tourism – potential and effects

The factors are further elaborated in the "catalogue of factors", in this section they are only briefly explained (see numbers of factors).

Table 2b MU combination offshore wind + tourism (part 1 – potential and effect)

DRIVERS = factors promoting MU			**BARRIERS** = factors hindering MU		
Factor	**Category**	**Average score**	**Factor**	**Category**	**Average score**
D.4.2. Increased acceptance	D.4	1.0	B.3.1 Low profitability	B.3	-1.7
D.2.1. CSR for ow entrepreneurs	D.2	0.7	B.2.1 Permissions/rules	B.2	-0.9
D. 3.3. Increased profitability	D.3	0.6	B.4.1 Lack cable for energy transport to main land	B.4	-0.9
D.3.2 Local development	D.3	0.4	B.3.2 Lack of market	B.3	-0.7
D.4.1. Local innovation	D.4	0.3	B.1.1 Legislation	B.1	-0.4
D.3.1. Economic compensation/start-up subsidies	D.3	0.1	B.5.1 Conflicting interests	B.5	-0.3
D.4.3 Dissemination/information on ow	D.4	0.1	B.5.2 Low interest for the MU combination	B.5	-0.3
D.1.1.Political willingness	D.1	0.1	B.5.3 Aesthetic aspects	B.5	-0.3
DRIVERS average score		**0.4**	**BARRIERS average score**		**-0.7**
		MU POTENTIAL	**-0.3**		

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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 Increased profitability	V.1	1.0	I.3.1 Environmental impact (boat traffic)	I.3	-0.7
V.2.2 Increased acceptance	V.2	0.6	I.2.1. Social disturbance	I.2	-0.6
V.1.2 More energy production	V.1	0.4	I.2.2 Conflict of interest	I.2	-0.1
V.2.4 Increased cooperation	V.2	0.4	I.3.2 Noise for aquatic fauna	I.3	-0.1
V.5.1 Innovative environment	V.5	0.4	I.4.1 Need of additional services parking, waste	I.4	-0.1
V.2.3 Increased knowledge	V.2	0.3			
V.1.3 Local jobs	V.1	0.3			
V.1.4 Spin-off effects locally	V.1	0.3			
V.2.1 More visitors	V.2	0.0			
ADDED VALUES average score		**0.4**	**IMPACTS average score**		**-0.3**
MU OVERALL EFFECT			**0.1**		

The estimated potential for the combination of offshore wind and tourism was also slightly negative (-0.3). The stakeholders ranked low profitability and difficult permissions (administrative barriers) as important. They expressed some concern about administrative barriers e.g. since boats for transporting people need to be handicap accessible and hence commercial fishing boats have to be altered before they can be used for tourism. In comparison with the MU combination with aquaculture, this combination does not automatically have any clear environmental benefits. This also makes the average drivers' score lower than the first MU combination. Stakeholders were also clearly sceptical whether tourists would be interested in the offshore wind park, i.e. if there is a market for this type of tourism. Some kind of sightseeing tourism with boats seems more practical and requires less alteration in the operation of offshore wind production for the energy companies in comparison with aquaculture. The representative from the energy sector said that there are no restrictions regarding visiting offshore wind park areas, and said an interest seems to exist for visiting off shore wind parks. As discussed in more detail in sections 4 and 6, stakeholders came up with several ideas on how to make tourism and offshore wind combination more appealing.

Also, with potentially more tourists or visitors, there are also more risks of negative impacts of noise and traffic, which the scoring reflects. The local NGO's thought that it can be good for local business and with the increased number of tourists in the area as other local services like restaurants and gas stations can get an upswing in business and be able to remain in the area. Which would give the community benefits in terms of local job opportunities and social activities. They see some possible

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negative impacts for local residents from e.g. increased littering, noise, more competition for parking and boat trips and more. Most residents will probably see increased tourism as a good change while others will feel disturbed. Also, sound effects from windmills have created noise disturbance for local residents, which is why further development of offshore wind might meet some opposition. This combination also put forward more social and societal categories as important for both drivers/barriers and values/impact. This is basically because it may imply more people being involved and affected (visitors which also affect summer house owners, and permanent residents). Still, barriers related to economic availability or risk were ranked as most important when categories were summed.

Table 3b MU categories for offshore wind and tourism – average score per category

DRIVERS = factors promoting MU		**BARRIERS** = factors hindering MU	
Category	**Average score**	**Category**	**Average score**
D.2 Relations to other uses	0.7	B.3 Barriers related with economic availability/risk	-1.2
D.4 Societal drivers	0.5	B.2 Administrative barriers	-0.9
D.3 Economic drivers	0.4	B.4 Barriers related with technical capacity	-0.9
D.1 Policy drivers	0.1	B.1 Legal barriers	-0.4
		B.5 Barriers related with social factors	-0.3
ADDED VALUES = positive effects of MU		**IMPACTS** = negative effects of MU	
Category	**Average score**	**Category**	**Average score**
V.1 Economic added values	0.5	I.2 Social impacts	-0.4
V.5 Technical added values	0.4	I. 3 Environmental impacts	-0.4
V.3 Environmental added values	0.3	I.4 Technical impacts	-0.1
V.2 Societal added values	0.3		

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6 FOCUS AREAS ANALYSIS

The questions related to the three focus areas were examined by the case study research team at first, and then discussed with local stakeholders at the workshop (see section 7 for stakeholder engagement). One could argue that in the case study area, the need of addressing multi-use (focus area 1) is closely related to the profitability for local business for creating vital rural areas. Competition of space is far less important. However, in order to address and realized multi-use in practice, economic compensation for pilot projects is required. Also more research on aquaculture activities suitable for offshore wind parks would be needed. The questions of MU at sea would also gain from being related to the coastal or/and land-based activities. The need of financing of pilot projects of MU in the case study area (or in other places in Sweden) and the important role of MU emphasized by the case study in increasing profitability for the users, also relates to the second focus area ("Boosting blue economy"). The third focus area addresses the improvement of environmental compatibility. In the case study area, the environmental aspects related to the combination that includes mussel or algae cultivation/farms were important to stakeholders, rather than spatial efficiency. The stakeholders engaged in the case study were all interested and knowledgeable of environmental issues, particularly related to eutrophication. There are already several projects conducted in the area working to realize measures to reduce nutrient leakage and to reduce nutrients in the bay of Burgvik (Forum Östersjönd and "Save the Burgsvik bay"). This is also reflected in the results of this case study report, both in the scoring of the DABI's and the focus area analysis.

6.1 "Addressing Multi-Use"

1. *Is it possible to establish / widen / strengthen MU in the case study area?* Yes, potentially. Local stakeholders are clearly interested, but research in the area and economic compensation for a pilot project would strengthen their potential to realize multi-use.

   For which MU combination in particular? Offshore wind power and tourism (recreational fishing/animal sightseeing) and offshore wind power and aquaculture (mussels/algae)

   What needs would MU satisfy? There is a need for local entrepreneurs (e.g. fishing and agriculture) to diversify and utilize their resources, e.g. boats and machines, to a maximum so that they can increase their profitability and continue with their regular business. If the MU can attract more people to the area there will also be an increase in the demand for services like gas stations and restaurants. A combination with extractive aquaculture that retain nutrients, like mussels or algae, will help reduce the extensive problems of eutrophication in the Baltic Sea.

2. *Is space availability an issue for MU development / strengthening in the case study area at present?* No, in the sea around Gotland there is no shortage of space. That problem is more eminent in the coastal area.

   Will space availability become an issue for your area in the future? Not in the near future.

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For what elements could space availability become an issue? If the need for more extensive defence operations located at Gotland becomes a reality there may be greater competition for maritime and air space, which will hinder both wind power and aquaculture/boat tourism since defence is of national interest and has priority.

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)?* Hypothetically, yes. *What are they?* Boats will be needed for both tourism and aquaculture and could be used for different MU combinations. Potentially the foundations of the windmills could be left behind and used for aquaculture even after their commercial lifetime, creating the opportunity for MUs other than with wind power, e.g. marine protected areas.
4. *What would be the most important resources to be shared between uses (infrastructures, services, personnel, etc)?* Harbour, boats and the foundations of the windmills. It is not likely that wind power personnel possess the knowledge needed for aquaculture and vice versa.
5. *Are existing and/or potential MUs taken into account within the existing or under development Maritime Spatial Plans)?* No. The Swedish MSPs are under development but in the draft each focus area (e.g. fishing/energy/nature conservation) is discussed separately. Some potential synergies and conflicts with other topics are commented on for each focus area, however the expression multi-use is not used in the MSP.
6. *How are MUs connected or related to land-based activities?* Local entrepreneurs have experience from land-based and coastal projects focused on sharing resources and combining activities to increase benefits. This experience will be useful for maritime
7. *Is the needed knowledge and technology for MU development/strengthening in the case study area already available?* For wind power and tourism yes, but not with aquaculture.
   What is the level of maturity of available knowledge? Aquaculture (mussels/algae) in the Baltic Sea has so far mostly been performed as research studies. More research needs to be done on how aquaculture is affected by wind and waves out at sea.
   What is the level of readiness of available technology? How to attach aquaculture on windmill foundations, what materials to use, at what depths to put lines, how to cope with ice formation etc. are issues that need to be figured out locally before existing aquaculture technology can undergo the necessary adaptations for MU.
   Are there still research needs? Yes
8. *What action(s) would you recommend to develop / widen / strengthen MUs in the case study area?* Start a dialogue between different stakeholders to increase the interest for these kinds of projects in the study area and map existing knowledge and find financial possibilities (research, funds etc.)

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What actor(s) do you see particularly important to develop / widen / strengthen MU in the case study area? Governmental agencies, energy companies, research institutes, local entrepreneurs and local non-profit associations.

6.2 "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
   What are the most important ones? As mentioned in 6.1-1, new tourism can increase the demand for services in the area around Burgsviken and increase job opportunity locally. Tourism has however an obvious downside due to littering, noise and other annoyances for local residents.
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
   What tools, knowledge, experiences are available? Experiences from other land based and coastal projects of shared resources in the study area and how they have contributed to the local economy can indicate the potential of maritime MUs.
3. *Would MU development / strengthening be an opportunity for job creation and / or job requalification in your area?* Yes, mainly by increasing the stability of existing local entrepreneurs in the case of wind power-tourism. MU with aquaculture could create a demand for new knowledge and bring expertise to the area.
4. *Do you see possible elements of attractiveness for investors in developing / widening / strengthening MU in the case study area?* No
   What are these elements?
5. *What are possible investors interested in developing / widening / strengthening MU in the case study area?* For MU with aquaculture and wind power, research institutes might want to perform pilot projects of large-scale mussel cultivation to measure growth size, uptake of nutrients, how they are affected by the windmills etc., while the energy company can see an opportunity to increase revenue by “renting out” their wind parks.
6. *Is there sufficient dialogue between the stakeholder sectors for developing / widening / strengthening MU?* No, but there is a good foundation of existing collaboration in the area related to other projects.
   Would dialogue facilitation be an asset? Yes, to some extent.
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
   - would a feasibility study including evaluation of alternative scenarios be helpful? Yes
   - would detailed projects on already identified simulations be useful? Yes, since the wind and waves in the area around Bockstigen are so strong, unpredictable and changing, testing of different lines and attachments for aquaculture would be needed before going full scale.

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- *do you see other enablers?* Third party financing and environmental payments are important for aquaculture at this time. Local entrepreneurs can't see profitability in cultivating algae and mussels since there is no obvious buyers of the products. For tourism, some help from the municipality for marketing strategies and advertising to increase the awareness of Burgsviken would be needed. Today most publicly financed advertising on Gotland is directed at Visby.

6.3 "Improving environmental compatibility"

1. *What are / would be the environmental added values of developing / widening / strengthening MU in the case study area?* Nutrient recovery that reduces eutrophication of the Baltic sea. By creating by-products from aquaculture like fodder or biogas the use of non-renewable resources and emissions can be decreased.
2. *Which tools (conceptual, operational) are used or should be further developed and used to better estimate environmental impacts and benefits of MU?* The National Centre for Knowledge on Aquaculture (Nationellt Kompetenscentrum för Vattenbruk, NKfV) being run by the University of Gothenburg (GU) and the Swedish University of Agriculture (SLU) gathers all relevant research on the topics of e.g. cultivation, nutrient recovery and biproducts of aquaculture. On the homepage there are links to reports on new research[13]
3. *Is saving free sea space for nature conservation a driver for MU in the case study area?* No
   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 question is not relevant. For this MU combination with tourism, there are mostly negative environmental impacts from fuel emissions and littering, and with aquaculture the main purpose is an improved environment.
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?* Yes
   What are they? In Burgsviken, local actors have joined to build a sea pool that filtrates and oxygenates water to create great bathing conditions. This is an innovative project that tests a new filtration technique and is expected to decrease the number of algae in the bay and at the same time attract bathing tourists, thereby boosting the local economy.
6. *Is the environmentally friendly knowledge / technology for MU development/strengthening in the case study area available?* No
   Which is the level of readiness of available solutions? See 6.1-7, 6.2-5 and 6.2-7 for information.
   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

[13] http://www.nkfv.se/index.php?option=com_content&view=article&id=118&Itemid=192

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What modifications would you suggest at your national / local level to promote MU through SEA/EIA procedures? To make it a requirement to analyse possibilities and consequences of MUs in all EIAs done as part of the legal permission process for water activities.

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7 STAKEHOLDER ENGAGEMENT AND LOCAL STAKEHOLDER PROFILES

7.1 Activities carried out to engage stakeholders and rationale for activities

7.1.1 Initial interviews

The first step in the stakeholder involvement included interviews. During August and September 2017, mapping of stakeholders was conducted covering representation from the initial and wider set of MU combinations, in order to better define the focus of the case study, and supplement the county fiche. The general and national DABIs for five initial combinations resulting from the desk research were used as a base for the interviews. Stakeholders were contacted by e-mail and informed about the activities of the MUSES project in Sweden and relevant MU combinations. Table 4 shows the stakeholders contacted in this stage. It was difficult to draw stakeholders to be interviewed, mostly due to lack of their time but also in some cases, because stakeholders did not think their knowledge about the topic would be enough for a valid discussion. Out of nine specific requests, four telephone interviews were conducted.

Table 4 Stakeholders engaged in initial step of the project

Stake-holder	Representing	Comment
1.	Aquaculture, municipality (local regulator)	Contacted for interview, referred to stakeholder no. 2.
2.	Aquaculture, municipality (local regulator)	Time constraints
3.	SwaM – Swedish Agency for Marine and Water Management (national authority - regulator)	Interviewed on the 5th of September 2017
4.	SwaM – Swedish Agency for Marine and Water Management (national authority - regulator)	Email request sent. Outstanding
5.	Energy sector, national level (business)	Interviewed the 7th of September 2017
6.	EU Flagship project (UCH – local entrepreneur)	Interviewed the 11th of September 2017
7.	Coordinator wind power Sweden south east regions (Energy, national/regional regulator)	Contacted, could not participate in interview or workshop. Some contributions given via email.
8.	Innovation and tourism (private business)	No answer.
9.	Lawyer/EIA expert (offshore wind/energy)	Interviewed on the 4th of September 2017

7.1.2 Local stakeholder engagement: Questionnaires, interviews and workshop

As a second step, the case study analysis also used two different questionnaires and focus group meeting. A focus group was felt to be more appropriate for interaction with local and regional stakeholders for purposes of the case study. Also, a focus group was a suitable method for discussing questions for the three focus areas. Thus, stakeholder mapping, based on authors' knowledge about

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the area, desk research of important actors and organisations, and interviews with some of the stakeholders in the area led to a list of 15 stakeholders potentially interesting to involve in the focus group. Some of the local stakeholders were seen as crucial for a focus group at Gotland regarding the potential MU combinations (for example offshore wind power manager, representatives from the project Save Burgsvik, and a local tourism entrepreneur). These stakeholders were therefore contacted via telephone beforehand. This way, we received further confirmation on the potential of the MU combinations for the area, including their attitude towards MU.

Invitations to all 15 stakeholders were sent out via email together with a short questionnaire (Appendix 2) that covered:

- short info of the informants' affiliations ("theme" and "category" in MUSES),
- their attitude towards MU,
- which MU combinations they thought were most promising for the case study area,
- what are the benefit of MU to their organisation.

Of the invited stakeholders, seven participated in the workshop at Gotland on the 6th of November. The workshop involved both discussions in the entire group and individual work with a questionnaire (questionnaire 2 in Appendix 3) based on the interview form to fill in and score the DABI tables for the two MU combinations they have stated to be the most promising: offshore wind + tourism and offshore wind + aquaculture. The participants discussed the individual DABI scoring in a group setting, and also discussed the key questions for the three focus areas. Additional matters were discussed related to land-based activities relevant to these two MU combinations, MUSES methodology, the definition of MU, and if some current activities in the area could be seen as MU. The minutes from the workshop were sent out for comments to the participants together with a presentation of MUSES and the case study (Appendix 3).

All stakeholders invited and/or who participated in interviews or/and workshop are incorporated in the tables under 7.2 Local stakeholder profiles.

7.2 Local stakeholder profiles

In this section, the categories of stakeholders for each theme that have been involved through interviews, surveys and/or the workshop will be described according to a couple of questions:

- Overall interest in MU
- Overall attitude towards MU
- Geographical scale at which stakeholder has the powers operate
- Organisation of stakeholders
- Level of Power
- Type of power to influence.

Some of the categories involves only one stakeholder/interviewee while others like commercial businesses involves many stakeholders, sometimes with very different opinions. For different reasons, this makes it difficult to give representative answers for certain categories. If only one stakeholder has been reactive it is hard to say if others in that category have the same opinions. The

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text accompanying the tables try to describe the situation better while the summary tables represent the opinion of the majority, or in cases with only one respondent, that person's opinion.

7.2.1 Aquaculture

Commercial business

The reactive local entrepreneurs are slightly negative towards aquaculture with mussel/algae because they a market for the products and hence there is no profitability. The stakeholders in this category are not individually powerful actors but as many other local actors, they have other roles. In this case, for example, they also represented the water council at Gotland. The water council do not per se have any power, but can possible affect local decisions about water management.

Business support

Local consultancy agents have knowledge of water activities in the case study area and can contribute to the legal application process that according to the Swedish Environmental Code requires an EIA and evidence that private and public benefits exceed costs. In this case the local agents are slightly negative towards MU because external conditions like strong winds and waves are very unpredictable and ever changing which makes it difficult to establish aquaculture at Bockstigen. The profitability is also a concern since the risk of damage to or loss of crops is high. The stakeholders in this category are individual organisations and have the power to indirectly influence through the type of practical work they perform. They can specify to research organisations what elements of aquaculture need to be further studied for it to work in combination with offshore wind.

Aquaculture - Research organisations

A lot of research has been done on the cultivation of algae and its environmental benefits at the Royal Institute of Technology in Stockholm (KTH). They are a partner to this report but no researcher has participated in any of the stakeholder engagement, which is why their overall attitude towards MU of aquaculture and offshore wind is still undecided. Research organisations have a strong power to influence decision-makers directly through their research since the results will indicate what type of aquaculture will be most (cost-) efficient and help reduce eutrophication in the Baltic sea.

Regulators

Representatives of the County Administrative Board of Gotland are positive overall towards the idea of MU because of the need of nutrient reduction. They are unsure if anyone would want to invest in aquaculture in the case study area, but don't see legal or administrative barriers for them to do so. They noted that previous mussel cultivation in the area have been unsuccessful but that experience and useful technological knowledge exists abroad and could probably be adapted for local conditions. As a regulator they have a strong power to control and make decisions regionally.

NGOs and other intermediaries

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Members of Forum Östersjön (Forum Baltic Sea) and Save Burgsviken have mainly shown a positive attitude towards MU since it can reduce eutrophication impacts and lead to a better the water quality. They would however prefer coastal projects where the link between the measure and the environment in Burgsviken is stronger. The dialogue between Forum Östersjön and regulators is extensive and they have collaborated in previous projects. This gives an opportunity to directly influence decision making in the case study area and also for upcoming projects.

Table 5a Stakeholder characteristics for aquaculture (MU combination offshore wind and aquaculture)

Theme:	**Aquaculture**					
MU:	**Aquaculture and offshore wind**					
	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	negative-but can positively influence barriers	local-regional	a lot of individual organisations	Power to influence indirectly via NGOs or regulators	low
Business support – consultancies	reactive	negative-but can positively influence barriers	local-regional	a lot of individual organisations	Power to influence indirectly via research organisations or regulators	low
Research organisations	dormant	neutral/undecided	national	couple of individual organisations	power to influence directly	strong
Regulators	reactive	positive - driving forces	local-regional	monopoly of one organisation	power to control and make decisions	strong
NGOs and other intermediaries	reactive	positive - driving forces	local-regional	strong clustering	power to influence directly	medium

7.2.2 Tourism

Commercial business

There are many local entrepreneurs that are trying to combine their main business with some sort of tourism and are positive about further expanding activities. There is disagreement among the

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stakeholders to what extent there would be any interest in visiting offshore windmills, but some had suggestions for increasing the attractiveness with water and light shows and/or platforms for seals and other animals and offer safaris. The stakeholders in this category are not individually powerful actors but can create or be part of local communities like Save Burgsviken and through them influence regulators to make decisions about local projects.

Regulators

The Swedish Agency for Marine and Water Management (Havs- och Vattenmyndigheten) which are responsible for producing the Swedish MSP have been contacted but haven't participated in the stakeholder engagements. They would have a strong power to make decisions about the use of MU in the Baltic Sea by requiring that MU is considered in all EIA of water activities at sea and mentioning it as an important strategy in the final version of the MSP. Their attitude towards MU is yet to be determined.

NGOs and cross-sectoral clusters

Representatives of Forum of the Baltic Sea have showed a positive attitude towards MU with tourism in combination with offshore wind. Through their clustering they have the direct power to influence decision making locally.

A member of a similar cluster organization on the island of Landsort in the archipelago of Stockholm that was interviewed brought up the importance of spreading activities over seasons. At Landsort they have an overflow of sailing and sunbathing tourists during summer but not enough tourists during the winter season. Combining energy production with some sort of sightseeing, creating a new type of tourism on the island, can mean that they attract tourists during a bigger part of the year, thereby spreading business over a longer time period.

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Table 5b Stakeholder characteristics for tourism (MU combination offshore wind and tourism)

Theme:	**Tourism**					
MU:	**Tourism and offshore wind**					
	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	positive - driving forces	local-regional	a lot of individual organisations	Power to influence indirectly via NGOs	low
Regulators	dormant	neutral/undecided	sea basin	monopoly of one organisation	power to control and make decisions	strong
Intermediaries	reactive	positive - driving forces	local-regional	strong clustering	power to influence directly	medium
NGOs	reactive	positive - driving forces	local-regional	strong clustering	power to influence directly	medium

7.2.3 Offshore wind

Commercial business

An interview was held with an employee at one of Sweden's energy companies (not the current owner of Bockstigen) that has previously worked with MU projects in other countries. The interviewee was generally skeptical towards MU in Sweden (combining offshore wind and other uses) currently, but did however like the idea of MU in general. The most important barrier for MU brought up was the lack of knowledge/interest/economic drivers for offshore wind companies to invest in MU at their parks. The interviewee also stressed that the infrastructure related to existing offshore wind (electricity, ships to and from wind parks) potentially could be shared by other users, and that the infrastructure enables other activities at sea, for example as they keep waters ice-free in the winter. Energy companies with offshore wind parks have the power to control and make decisions about how to utilize the wind turbine foundations and thereby their involvement is a prerequisite for MU.

Business support

The maintenance of Bockstigen is overseen by a local consultant that has been reactive to participating in surveys and the workshop and has been mostly positive towards MU. As a local

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actor, the stakeholder has like other entrepreneurs been interested in increasing business in the community through tourism and aquaculture, but also see benefits for the energy companies to increase revenue by "renting out" the foundations for aquaculture. By not having to make new rock attachments the profitability should increase also for aquaculture, creating the sought-after win-win solution of sharing resources. This actor has the power to potentially increase commercial business' interest in MU and thereby indirectly influence decisions about MU in the case study area.

Policy makers

Sweden has four regional coordinators for wind power representing the state government. The one operating in the southeast region is stationed on Gotland and has a personal interest and knowledge about offshore wind. The actor has been contacted and has showed interest in participating but it was not possible due to others engagements. The policy makers attitude towards MUs in combination with offshore wind is hence undecided but they would have the strongest power to control and make decisions.

Table 5c Stakeholder characteristics for offshore wind power (MU combination offshore wind and aquaculture, and offshore wind and tourism)

Theme:	**Offshore wind**					
MU:	**Tourism and offshore wind**	**Aquaculture and offshore wind**				
	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	national	couple of individual organisations	power to control and make decisions	medium
Business support – consultancies	reactive	positive - driving forces	local-regional	a lot of individual organisations	Power to influence indirectly via commercial business	low
Policy makers	dormant	neutral/ undecided	sea basin	monopoly of one organisation	power to control and make decisions	strong

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

8.1 Current stage of MU development

This study indicates that multi-use in Swedish waters is a relatively unknown concept, both from national authorities' viewpoint, and particularly in a local community perspective. Sweden has a long coastline and therefore, large marine areas. There are however some few examples of multi-use in Swedish waters that this study has come across, and there might be several more. Underwater cultural heritage and tourism, offshore wind and tourist boat trips, and eventually planned tourist trips to mussel farms are some of them. However, these combinations of activities might not be formulated as "multi-use" and often they are rather started due to a local need of innovations for profitability in rural coastal areas, then a need of sharing marine areas (i.e. competition of space, or space efficiency). This is also the case for case study area explored in more detail in this study, i.e. the island of Gotland, and Burgvik including Bockstigen offshore wind park.

8.2 Best potential MU combination(s) for the future in the area

In the case study area, the first offshore wind parks in Sweden, and one of the first in Europe is located – Bockstigen wind park. The unique circumstances here are that the management of the Bockstigen park is positive towards multi-use combining offshore wind and other uses. Also, in Sweden there are few restrictions of entering the marine space near the offshore wind parks, which facilitates potential MU development with offshore wind parks. However, as seen in the MU potential sheets, stakeholders emphasized the need of economic support and pilot studies/research to shape combination of activities that will actually last (also after potential project support are finished) and help sustain rural coastal communities. The result of this study indicates that the best MU potential is the combination of offshore wind and aquaculture. Some of the engaged stakeholder contacted the research team after the local focus group, and said they will continue with the idea of establishing the MU combination of offshore wind and mussel farming.

In the next section we elaborate some key solutions to prioritize in realizing MU in the area.

8.3 Key solutions and actors that can contribute to enhance MU in the area.

This case study points out economic factors (both as potential drivers, and as barriers), environmental and local community values, lack of knowledge as a great barrier and potential legislation/administrative difficulties as barriers – for the development of MU at the site. There is already a local innovative and a cooperative environment which improve the possibilities for MU realization. Also, key actors such as the offshore wind company are clearly interested. However, in order to facilitate further development and planning of MU at the site, the stakeholders DABI scoring and focus group discussion clearly emphasized factors that are important. Some recommendations may be activities that are possible to do already today (for example continued meetings discussing potential MU development in the area), while others are policy recommendations on a national level. Some short notes of actions that could facilitate MU in the case study area include:

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- A local/regional (Gotland island) meeting or workshop to further discuss the potential of the MU's explored in this study, and potentially others. Actors important to facilitate this: representatives from energy sector (manager of Bockstigen, national coordinator of wind power located at Gotland), local/regional officials and politicians (municipal level as well as county board), local communities ("Save the Burgvik" project, local entrepreneurs for example tourism innovation).
- Research on the possibilities of cultivating mussels and algae's in the Baltic and in combination with offshore wind power - engaging local stakeholders for effective dissemination of results and existing knowledge. Actors important for facilitate this: academia interested in marine planning, renewable energy production, mussel and algae production
- Pilot studies – economic compensation and research. Actors important for this: politicians (local and/or national level), agencies (SwAM responsible for MSP and County Board administration), research community.
- Clarifying potential legislation and rules when combining different uses in marine areas. Actors important: relevant regulator (County Boards, SwaM)

8.3.1 Research development and knowledge generation

The stakeholder clearly ranked the lack of knowledge as an important barrier for the development of MU in the area. Also, the response or the lack of response on the initial interviews for the desk analysis and general DABIs indicate that there is a lack of knowledge also on a more national level on MU potential, benefits and barriers. From a research perspective, multi-use in the seas can consist of so many different types of activities which implies that a transdisciplinary approach would be needed to gather information on MU as a topic. For the two multi-uses explored in detailed in our case study several disciplines are involved such as: knowledge on technical development of platforms and wind power piles; alternative techniques for aquaculture; mussel and algae ecology for Baltic sea conditions; economic studies including market demands for aquaculture products, policy tools (economic compensation and valuation studies); and potentially also studies on tourism demand on events around offshore wind parks. Much of this knowledge already exist, however, it is not combined as needed for the discussion and development of multi-use. Besides academia, a similar situation is true for policy and decision-makers, and practitioners (in topical MU activities/business).

As mentioned, a good prerequisite in the site at Gotland is an already established network and local cooperation between different sectors and between local community and policy makers. A first step for knowledge generation would therefore be a conference or a workshop where academia (representing the crucial scientific disciplines), policy makers, local business and local NGO's can discuss the potential in MU around Gotland.

Separately, further development in research needed includes:

- Mussel and algea species potential for cultivation in these conditions
- Platform/pile construction for aquaculture in Sweden

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- Musselfarm techniques at exposed sites such as Bockstigen (wind, waves, icing)
- Economic support/policy tools for mussel/algae farms/cultivation (nutrient uptake – ecosystem services)
- Demand for offshore wind tourism
- Economic and environmental values of MU (including values of ecosystem services)

8.3.2 Pilot projects

A pilot project of for example for offshore wind and aquaculture in the case study area could also be a great knowledge resource to the research on multi-use in Sweden in general. This requires economic support for starting up and for maintaining the activities long enough to gather valuable insights on the potential of MU. A pilot project could also imply new networks and cooperation that are important for developing MU at site, and elsewhere. A pilot project could also prove if and how MU can increase the profitability of local business when combining them. This can be an important way of enhancing the development of MU in Sweden, since many coastal areas are rural areas struggling with profitability of the local business and often season based incomes (such as tourism). A pilot project would be interesting from both a local/regional (Gotland island) perspective as well as a national perspective. Important actors to facilitate this would therefore be politicians and policy makers at Gotland, related national agencies (Swedish Energy Agency, Swedish Agency for Marine and Water management), and the research community.

8.3.3 Legislation and administration

It is difficult to determine for which MU's, legislation and policies can be conflicting, since there is a lack of practice in Sweden, and particularly in the site. Clearly, the stakeholders engaged had a lot of experience of conflicting policies regarding their business and/or activities today. The policies in Sweden regarding MSP do not mention multi-use explicitly, but mention spatial efficiency and coexistence of different activities at sea. The pressure on coastal areas is already high in certain areas in Sweden. A potential development towards more aquaculture (for example as a result of a potential economic support for ecosystem services such as nutrient uptake) would surely claim a lot of marine space, which is not always appreciated (see Thomas et al. 2017). Using offshore wind parks for this purpose would probably increase the acceptance for this development.

This topic of "legislation and administration" refers mainly to following tasks:

- Clarify if and how multi-use can involve conflicting legislation. In this way also preconceptions on how complex (both in terms of legal and administrative) MU processes must be, can potentially be contested.
- Clarifying rules and legislation regarding multi-use involving offshore wind (both on existing and planned offshore wind parks). For example: could environmental benefits such as nutrient uptake by mussel farms be used in the permission process?
- Knowledge empowerment regarding MU among related/relevant agencies
- Dissemination of multi-use at sea to potentially interested actors – who is responsible where interested actors should start etc.

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REFERENCES

SFS 1998:808. Miljöbalken. (In English: Swedish Code of Status 1998:808: the Environmental Code)

SFS 2010:900 Plan och bygglagen (In English: Swedish Code of Status 2010:900: Plan and Building Act)

SFS Havsmiljöförordningen 2015:400 (In English: Swedish Code of Status 2015:400: The marine environment regulation)

Pettersson, M. Ek, K., Söderholm K. & P. Pettersson, 2010. Wind power planning and permitting: Comparative perspectives from the Nordic countries. Renewable and Sustainable energy reviews. 14 (9): 3116-3123

Planering och kommunikation kring vindkraft i havet – En studie av lokala förankringsprocesser. Naturvårdsverket rapport 6350. April 2010. (In English: Planning and communication regarding offshore wind power – a study of processes for local acceptance. SEPA report 6350).

Thomas, J-B., Nordström, J., Risén, E., Malmström, M. & F. Gröndahl. 2017. The perception of aquaculture on the Swedish West Coast. AMBIO. p. 1-12

WEB SOURCES

http://www.vindlov.se/sv/steg-for-steg/svenskt-vatten/provningsprocessen/tillstand-for-vattenverksamhet/. (the 10th of September, 2017)

http://www.foyen.se/orimlig-nyttobedomning-hindrar-havsbaserad-vindkraft/ (the 10th of September, 2017)

http://cordis.europa.eu/result/rcn/183781_en.html (the 12th of September, 2017)

https://corporate.vattenfall.se/om-oss/var-verksamhet/var-elproduktion/vindkraft/pagaende-vindkraftprojekt/vindkraftprojekt-till-havs/kriegers-flak-vindkraftpark/ (the 2nd of September, 2017).

http://www.jordbruksverket.se/amnesomraden/landsbygdfiske/branscherochforetagande/vattenbruk/musselodling.4.44bedb3513533e95e618000614.html (the 12th of September, 2017)

https://www.naturskyddsforeningen.se/sveriges-natur/2013-3/levande-reningsverk (the 2nd of September, 2017).

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APPENDIX 1 - OVERALL DABI SCORING TABLES

Offshore wind and aquaculture - drivers

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination:	**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 Policital will/support	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,3	
Average	**0,0**	**0,0**	**0,0**	**0,0**	2,0	0,0	0,0		0,3
Category D.2 - Relation with other uses									
Factor D.2.1 Entrepreneurs' CSR	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,3	
Average	**0,0**	**0,0**	**0,0**	**0,0**	0,0	0,0	2,0		0,3
Category D.3 - Economic drivers									
Factor D.3.1 Economic profitability for business	0,0	2,0	1,0	2,0	0,0	0,0	0,0	0,7	
Factor D.3.2 Investment in wind power (infrastructure, piles) already made	0,0	3,0	0,0	0,0	2,0	0,0	0,0	0,7	
Average	**0,0**	**2,5**	**0,5**	**1,0**	1,0	0,0	0,0		0,7
Category D.4 - Societal drivers									
Factor D.4.1 Technical development of mussel farms	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	
Factor D.4.2 Promoting related reserarch/pilot studies	3,0	0,0	1,0	0,0	0,0	0,0	0,0	0,6	
Factor D.4.3 Local communities willingness	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,1	
Average	**2,0**	**0,0**	**0,3**	**0,0**	0,3	0,0	0,0		0,4
Category D.5 - Environmental									
Factor D.5.1 Environmental benefit (if mussels or algea)	2,0	2,0	2,0	3,0	0,0	0,0	0,0	1,3	
Average	**2,0**	**2,0**	**2,0**	**3,0**	0,0	0,0	0,0		1,3

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Offshore wind and aquaculture - barriers

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination:	**Score**	**Score**	**Score**	**Score**	**Score**	**Score**	**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 Legislation (water court matter)	-2,0	-1,0	-3,0	0,0	-2,0	0,0	0,0	-1,1	
Average	**-2,0**	**-1,0**	**-3,0**	**0,0**	-2,0	0,0	0,0		-1,1
Category B.2 - Administrative barriers									
Factor B.2.1 Conflicts of interest	**0,0**	-1,0	-2,0	0,0	0,0	0,0	0,0	-0,4	
Factor B.2.2 Permissions for ow is difficult in itself, so combining with other users might be more complicated	0,0	0,0	0,0	-1,0	0,0	0,0	-2,0	-0,4	
Factor B.2.3 Potential/risk of future restrictions in area, which could affect the users (for example aquaculture regulations could imply restrictions on shipping in the area for ow)	0,0	0,0	0,0	0,0	0,0	0,0	-2,0	-0,3	
Average	**0,0**	**-0,3**	**-0,7**	**-0,3**	0,0	0,0	-1,3		-0,4
Category B.3 - Barriers related with economic availability / risk									
Factor B.3.1 No subsidies in place (lack of knowledge, measures on environbmental benefits)	-2,0	0,0	0,0	0,0	-1,0	0,0	0,0	-0,4	
Factor B.3.2 Low profitability	-3,0	0,0	-3,0	-1,0	-3,0	-3,0	-2,0	-2,1	
Factor B.3.3 Financial barriers for pilot case of MU	-3,0	0,0	0,0	0,0	-3,0	-3,0	0,0	-1,3	
Average	**-2,7**	**0,0**	**-1,0**	**-0,3**	-2,3	-2,0	-0,7		-1,3
Category B.4 - Barriers related with technical capacity									
Factor B.4.1 Lack of knowledge on technology for aquaculture and offshore wind (what mussels, algea etc. is possible. How should they be cultivated)	-2,0	-1,0	-2,0	0,0	0,0	-3,0	-2,0	-1,4	
Factor B.4.2 Limitations due to wind and weather conditions	0,0	-1,0	0,0	0,0	-1,0	0,0	0,0	-0,3	
Factor B.4.3 Timing in processes of different activities/uses	0,0	0,0	0,0	0,0	0,0	0,0	-2,0	-0,3	
Average	**-0,7**	**-0,7**	**-0,7**	**0,0**	-0,3	-1,0	-1,3		-0,7
Category B.5 - Barriers related with social factors									

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Offshore wind and aquaculture – added values

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination:	**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 Additional income for offshore wind and/or reduced costs for aquaculture	1,0	3,0	1,0	1,0	2,0	1,0	0,0	1,3	
Factor V.1.2 Can create additional local jobs	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	
Average	**1,5**	**1,5**	**0,5**	**0,5**	1,0	0,5	0,0		0,8
Category V.2 - Societal added values									
Factor V.2.1 Innovative local environment and local development	0,0	1,0	2,0	0,0	0,0	1,0	0,0	0,6	
Factor V.2.2 Increased acceptance (for both activities)	0,0	0,0	0,0	0,0	0,0	1,0	1,0	0,3	
Average	**0,0**	**0,5**	**1,0**	**0,0**	0,0	1,0	0,5		0,4
Category V.3 - Environmental added values									
Factor C.3.1 Musselfarms or cultivation of algea can increase nutrient uptake (and reduce eutrophication impacts)	3,0	3,0	2,0	2,0	2,0	1,0	0,0	1,9	
Factor C.3.2 Mussels can created a basis for fodder (fish farms, poultry etc)	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	
Average	**2,5**	**1,5**	**1,0**	**1,0**	1,0	0,5	0,0		1,1
Category V.4 - Better ensurance policy and risk management									

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Offshore wind and aquaculture – negative impacts

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination:	**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 Can also imply economic risk (due to lack of knowledge and profitability in these "new" combinations of activities)	0,0	0,0	-3,0	0,0	0,0	0,0	0,0	-0,4	
Average	**0,0**	**0,0**	**-3,0**	**0,0**	0,0	0,0	0,0		-0,4
Category I.2. - Social impacts									
Factor I.2.1 Reduced/limited boat trafic in the offshore wind park area	-1,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	
Factor I.2.2 Acceptance of local community	0,0	0,0	0,0	-1,0	0,0	0,0	0,0	-0,1	
Average	**-0,5**	**0,0**	**0,0**	**-0,5**	0,0	0,0	0,0		-0,1
Category I.3 - Environmental impacts									
Factor I.3.1 Noise impacts	-1,0	0,0	-2,0	-1,0	0,0	0,0	0,0	-0,6	
Factor I.3.2 Potential negative impact of fish farms	0,0	0,0	0,0	-1,0	-2,0	-1,0	0,0	-0,6	
Average	**-0,5**	**0,0**	**-1,0**	**-1,0**	-1,0	-0,5	0,0		-0,6
Category I.4 - Technical impacts									

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Offshore wind and tourism – drivers

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination: Offshore wind & Tourism	**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 Political willingness	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	
Average	**1,0**	**0,0**	**0,0**	**0,0**	0,0	0,0	0,0		0,1
Category D.2 - Relation with other uses									
Factor D.2.1 Energy sector efficiency environmental benefits/"good will"	0,0	0,0	0,0	0,0	3,0	0,0	2,0	0,7	
Average	**0,0**	**0,0**	**0,0**	**0,0**	3,0	0,0	2,0		0,7
Category D.3 - Economic drivers									
Factor D.3.1 Potential "starting subsidies/economic compensation"	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	
Factor D.3.2 Development of local industry/activities	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,4	
Factor D.3.3 Increased profitability	0,0	1,0	0,0	3,0	0,0	0,0	0,0	0,6	
Average	**0,3**	**1,3**	**0,0**	**1,0**	0,0	0,0	0,0		0,4
Category D.4 - Societal drivers									
Factor D.4.1 Local innovation/entrepreneurship possibilities	0,0	0,0	0,0	0,0	1,0	1,0	0,0	0,3	
Factor D.4.2 Increased public acceptance for offshore wind	0,0	0,0	3,0	2,0	0,0	0,0	2,0	1,0	
Factor D.4.3 Information/dissemination about offshore wind	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,1	
Average	**0,0**	**0,0**	**1,0**	**1,0**	0,3	0,3	0,7		0,5

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Offshore wind and tourism – barriers

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination: Offshore wind & Tourism	**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 Political willingness	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	
Average	**1,0**	**0,0**	**0,0**	**0,0**	0,0	0,0	0,0		0,1
Category D.2 - Relation with other uses									
Factor D.2.1 Energy sector efficiency environmental benefits/"good will"	0,0	0,0	0,0	0,0	3,0	0,0	2,0	0,7	
Average	**0,0**	**0,0**	**0,0**	**0,0**	3,0	0,0	2,0		0,7
Category D.3 - Economic drivers									
Factor D.3.1 Potential "starting subsidies/economic compensation"	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	
Factor D.3.2 Development of local industry/activities	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,4	
Factor D.3.3 Increased profitability	0,0	1,0	0,0	3,0	0,0	0,0	0,0	0,6	
Average	**0,3**	**1,3**	**0,0**	**1,0**	0,0	0,0	0,0		0,4
Category D.4 - Societal drivers									
Factor D.4.1 Local innovation/entrepreneurship possibilities	0,0	0,0	0,0	0,0	1,0	1,0	0,0	0,3	
Factor D.4.2 Increased public acceptance for offshore wind	0,0	0,0	3,0	2,0	0,0	0,0	2,0	1,0	
Factor D.4.3 Information/dissemination about offshore wind	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,1	
Average	**0,0**	**0,0**	**1,0**	**1,0**	0,3	0,3	0,7		0,5

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Offshore wind and tourism – added values

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination: Offshore wind & Tourism	**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 Political willingness	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	
Average	**1,0**	**0,0**	**0,0**	**0,0**	0,0	0,0	0,0		0,1
Category D.2 - Relation with other uses									
Factor D.2.1 Energy sector efficiency environmental benefits/"good will"	0,0	0,0	0,0	0,0	3,0	0,0	2,0	0,7	
Average	**0,0**	**0,0**	**0,0**	**0,0**	3,0	0,0	2,0		0,7
Category D.3 - Economic drivers									
Factor D.3.1 Potential "starting subsidies/economic compensation"	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1	
Factor D.3.2 Development of local industry/activities	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,4	
Factor D.3.3 Increased profitability	0,0	1,0	0,0	3,0	0,0	0,0	0,0	0,6	
Average	**0,3**	**1,3**	**0,0**	**1,0**	0,0	0,0	0,0		0,4
Category D.4 - Societal drivers									
Factor D.4.1 Local innovation/entrepreneurship possibilities	0,0	0,0	0,0	0,0	1,0	1,0	0,0	0,3	
Factor D.4.2 Increased public acceptance for offshore wind	0,0	0,0	3,0	2,0	0,0	0,0	2,0	1,0	
Factor D.4.3 Information/dissemination about offshore wind	0,0	0,0	0,0	1,0	0,0	0,0	0,0	0,1	
Average	**0,0**	**0,0**	**1,0**	**1,0**	0,3	0,3	0,7		0,5

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Offshore wind and tourism – negative impacts

	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7		
Combination: Offshore wind & Tourism	**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									
Average	-	-	-	-	-	-	-		-
Category I.2. - Social impacts									
Factor I.2.1 Social acceptance "disturbed views" (if extension of offshore wind) and more noise	0,0	0,0	-3,0	-1,0	0,0	0,0	0,0	-0,6	
Factor I.2.2 Coflicts of interest	0,0	0,0	0,0	0,0	-1,0	0,0	0,0	-0,1	
Average	**0,0**	**0,0**	**-1,5**	**-0,5**	-0,5	0,0	0,0		-0,4
Category I.3 - Environmental impacts									
Factor I.3.1 Potentially environmental impacts due to more boat trafic etc	0,0	-2,0	-1,0	-1,0	0,0	-1,0	0,0	-0,7	
Factor I.3.2 Noise for aquatic fauna	0,0	0,0	0,0	-1,0	0,0	0,0	0,0	-0,1	
Average	**0,0**	**-1,0**	**-0,5**	**-1,0**	0,0	-0,5	0,0		-0,4
Category I.4 - Technical impacts									
Factor I.4.1 Need of additional services such as parking, waste disposal	-1,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	
Average	**-1,0**	**0,0**	**0,0**	**0,0**	0,0	0,0	0,0		-0,1

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APPENDIX 2 – QUESTIONNAIRE 1

QUESTIONNAIRE 1 (short web questionnaire sent to participants of the focus group)

1. Are you living in the case study area?
2. Do you visit the case study area? And how (work, recreation etc)?
3. Which organization/sectors are you representing?
4. What is your attitude to MU?
5. What type of MU do you think is the most potential for the case study area
6. Would your organization benefit from MU, if so how?

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APPENDIX 3 – NOTES FROM FOCUS GROUP INCLUDING QUESTIONNAIRE 2

Workshop Gotland the 6th of November 2017
Swedish case study MUSES, Burgsvik the Island of Gotland

Participants:

1. Farmer at Gotland Island, also represent the local water council. Runs own business with coastal zone activities: algae cultivation, renovation of sea bays.
2. Official at Gotland County Administration Board, focus on marine issues and particularly aquaculture.
3. Official at Gotland County Administration Board, focus on marine issues, particularly marine planning.
4. Entrepreneur active in case study area. Business focus is innovate tourism.
5. Representative from local association "Forum Baltic Sea", living in the case study area, active in different project focusing on improving water quality and reducing eutrophication impact in Burgsvik Bay.
6. Representative for offshore wind power, manager of the offshore wind park Bockstigen in the case study area. Also involved in local projects for improving water quality of Burgsvik bay.
7. Self-employed consultant in water and sewage related activities. Also representative for local water council.
8. Frida Franzén and Henrik Nordzell, analysts from Anthesis Enveco, and working with the case study in the MUSES project

AGENDA

A. Presentation of participants
B. Presentation of the MUSES project and the case study application
C. Drivers and barriers for multi-use 1 (offshore wind and tourism) and 2 (offshore wind and aquaculture)
    a. Participants fill in questionnaire and score drivers and barriers
    b. Discussion of drivers and barriers + discussion of focus areas
D. Added value and negative impacts of multi-use 1 and 2
    a. Participants fill in questionnaire and score drivers and barriers
    b. Discussion of drivers and barriers + discussion of focus areas
E. Final discussion of focus area. Needs, knowledge and values.

QUESTIONNAIRE 2

For each MU (offshore wind + aquaculture and offshore wind + tourism) tables with the DABI's were provided, where participants were asked to add DABI's, score DABI's, and fill in on which geographical scale and which actor that is important for each DABI factor.

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Discussions during the day

Using the piles of the wind park to build "seal ground" and use for sightseeing for seals (and the wind park). Decorating the piles (art) and use water shows or light shows to make it more attractive. The wind park in itself is not that fun, so it is not enough as it is. Fishing tourism would also be a possibility since there are much fish here. However, earlier studies shows that big fish avoid the piles due to the noise. Inconsistence in the groups whether this was true. Dissemination of information of wind power wound be possible, so to increase acceptance for offshore wind. Difficult in getting the activities attractive and low profitability for business. How big is the interest, really? Is there a market for this type of tourism? It can be difficult with rules regarding tourism boat trips, one have to make it disability customization. That is wrong, one should start the other way around: if it turn out to be attractive and many tourists want to visit the offshore wind parks, then the company should need to meet those requirements. Difficult to combine different activities and their rules. It can imply conflict of interest. Economic drivers are the most important for all type of MU according to all participants. It's a precondition for working with tourism. It could lead to increased acceptance for offshore wind, and also additional values are if there will be more activity in the harbor. This may imply more activity in the area and make it easier for existing local business (shops etc). However, it could also imply negative effects, with more traffic (boat traffic, traffic to the harbor etc) both for humans and for the environment. There might be conflicts among different groups locally. It can also lead to a more innovative local environment. The local tourism is well developed, and there area boats that could be used for sightseeing. By combining offshore wind and tourism it might lead to better profitability for tourism or other local entrepreneurs/business.

Wind park (piles) could also be used to attach mussel farms in long lines. How should the lines be attached? How are the harvested? County board representative explains that the technology already exist, in Canada they use special equipment's and can for example lower the longlines in the winter to avoid risks with icing. The technique exist, but it has to be imported and adapted to Swedish conditions. The aquaculture is needed in order to reduce nutrient loads in the Baltic Sea, and if the fundaments (piles) could be used to attach longlines the investment costs would decrease. This should be seen as an environmental measures, and be economically compensated. There is more data needed on which type of aquaculture that is appropriate for the local conditions, and also

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education to local entrepreneurs how is should be realized and developed. The profitability could be better for both offshore wind power producer and aquaculture, maybe the energy company could take a rent for the use of the piles, and the aquaculture could gain from using the existing piles. The environmental benefits from this activity are large. Other values are local knowledge generation, local innovation, use the mussels as environmental friendly fodder (for example to fish farms instead of fish based fodder). There is a need of research and pilot projects and stations for this combination. But this require economic support and start up compensation. Also academia has a great responsibility for research and pilot projects. Legislation, rules and permission could be difficult when combining the different uses. Logistic problems for aquaculture – from cultivation to customer. Eelgrass have been cultivated on the Swedish west coast. It has good potential of nutrient uptake. But what works in the Baltic, and Gotland conditions? It needs to be more research regarding algae cultivation. Future boat traffic to the piles, could create hinder for the aquaculture. There might be further restrictions. This might be a problem.

Both combinations would require marketing from the municipality/"Region of Gotland" (county level). There is another example at Gotland were the tourism guides used the name "Blue lagoon" for a water filled limestone quarry. It created a big interest and the lagoon was visited by many tourists. However, the natural lake beside is one of the best water quality at Gotland. But it is not marketed, so no one goes there.

Other related activities to MU is for example the "sea pool" that is planned in Burgsvik. It will combine tourism and environmental measures. It will provide oxygen to the bay, and attract tourism by warmer water and free from algae blooms (harmful, blue-green).

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