

Spurring blue bio-industrial symbiosis in Skive, Denmark

This brief is a part of the Blue-Green Bio Lab Tool Kit, that represents the findings in the Blue Green Bio Lab project. The project targets the urgent challenges of reducing nutrients to waters of the Baltic Sea Region, limiting greenhouse gas emissions, and enhancing European self-supply with food, feed, and energy. Together, aquaculture, agriculture and industry can provide solutions to these challenges through industrial symbiosis based on the sustainable exploitation of local blue and green biomasses initially grown and/or harvested with the objective to produce positive ecosystem services. The Blue-Green Bio Lab project is co-financed by Inter-Reg Baltic Sea Region with partners in Denmark, Latvia, and Sweden.

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This brief focuses on developing conducive policy environments and policy practices to spur bio-industrial symbioses in the area around Skive, Denmark. The activities discussed in the brief build upon challenges and opportunities for bio-industrial symbiosis identified earlier in the Blue Green Bio Lab project via workshops and discussions with local stakeholders.

Table of contents

- Choice of biomass
- Co-creative workshop
- Challenges and opportunities
- Next steps
- Reflections and learning
- Relevant sources

Choice of biomass

The inner part of the Limfjord is heavily polluted due to nutrient run-off from current and former agricultural activities and deposition of sewage from a now closed slaughterhouse. Eutrophication has been a repeated challenge in the area, reaching the most expansive and serious occurrence in the fall of 2023. These serious challenges with eutrophication have also affected marine life, as evident in the latest Key Fish Report in the fall of 2023, showing drastic decreases in the local fish population.

The Danish partners in the Blue Green Bio Lab project have focused on the possibility of increasing production of blue mussels to help with climate and environmental goals, particularly around Skive Fjord, Risgårde Bredning and Lovns Bredning (see Figure 1). It is anticipated that the filtration capacity of mussels will contribute to improved water quality enabling over time production of other blue biomasses for bio-industrial symbiosis such as seaweed and eel grass. Skive Municipality and the Climate Foundation Skive see opportunities for the development of new products using blue mussels.



Figure 1 – Map of the Inner Limfjord

Co-creative workshop

On November 27th the Climate Foundation and Skive Municipality together with Food and Bio Cluster Denmark held a second Blue Green Bio Lab workshop.

The workshop was organized based on results from the first project workshop in April 2023, where a prioritization of important next steps among participants revealed that they primarily wanted to meet again and share perspectives. To the partners' surprise, it turned out to be the first time that such a diverse group of stakeholders had gathered in the same room. Another important result was the desire to focus on "not what the fjord can do for us, but what we can do for the fjord." These prioritized wishes became the starting point for the second workshop.

The workshop was crafted around a collaborative question: What is needed to achieve a cleaner fjord, and what can each of us contribute to support this? The participants from the first workshop were invited and those who couldn't attend the first workshop but wanted to stay informed. Members of the Coastal Water Council and the Green Council in Skive Municipality were invited to involve more local NGO interests and politicians. Several researchers / universities were also invited to ensure knowledge about the latest research was present at the workshop.

The workshop was designed in a co-creative format using the Open Space Technology method, allowing participants to discuss what matters to them and engage with like-minded individuals. This method was chosen with the purpose of creating an idea catalog that could be used in a potential future project on the restoration of the Inner Limfjord. The participants produced 9 topics for the idea catalog on improving the Inner Limfjord:

- Mussels as an additional method to reach the goals for the EU Water Framework Directive
- How to reduce nitrogen discharge in the fjord
- Thyborøn canal development
- Re-establishment of the seabed- No scraping, fewer nets
- Limfjord Council's (Limfjordsrådet) further narrative
- Restoration of the fjord's natural state – crab removal
- Retrieval of eelgrass from the beach for building materials
- Reduce nutrient loading from livestock farming
- Preserve coastal stone reefs by halting dredging from shipping lanes

During the workshop, we also opened up the possibility of continuing these dialogue-based workshops, and many participants expressed their interest in doing so.

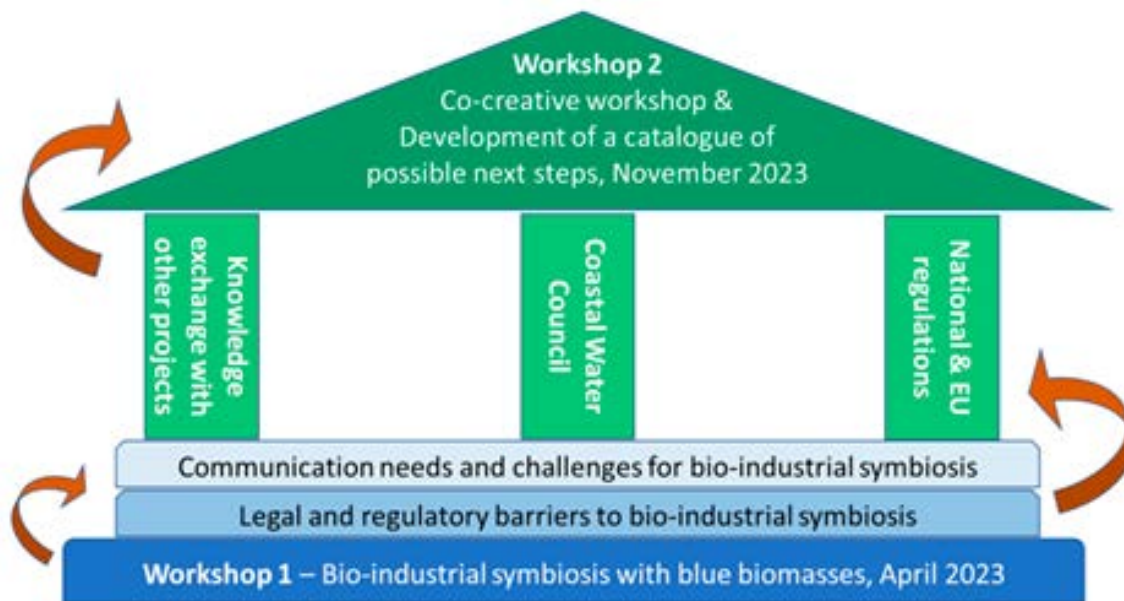


Figure 2. Activities in Denmark and discussed in this brief

Challenges and opportunities

The diagram in Figure 2. shows the activities of the Climate Foundation Skive and Skive Municipality prior to the co-creative workshop held on November 2023. Blue Green Bio Lab workshops in Sweden, Denmark and Latvia in spring 2023, the partners focused on the themes of communication and legal barriers to work with further.

Legal barriers - National and EU regulations

In Denmark the production of mussels and biorefining of mussel extracts for high-value products are subject to regulations from various areas of legislation primarily related to aquaculture, environmental protection, and water management. Below is a short summation of these regulations.

- Fisheries and marine environment legislation falls under the Danish Environmental Protection Agency, which regulates the protection of the Danish marine environment regarding permits for mussel farms, fishing methods, water quality and environmental protection.
 - The Danish Environmental Protection Agency also prepares the Water Area Plans in accordance with the EU Water Framework Directive, while municipalities have a role in ensuring that the goals and measures of the water area plans are incorporated into local administration.

- Food safety regulations fall under the auspices of the Danish Veterinary and Food Administration, which regulates safety, quality and hygiene with regard to mussels and high-value products derived from mussels.
- Cosmetics and pharmaceutical legislation: If mussel lactate is to be used in cosmetic products or pharmaceutical production, then the following EU legislation applies Novel Food Regulation, EU Regulations on Animal By-products, EU's Cosmetic Products Regulations, REACH requirements (chemical regulations), EU's Active Pharmaceutical Ingredients and Good Manufacturing Practice.

Mussel Committee

Skive Municipality represents several municipalities on the Mussel Committee, an advisory group to the Danish Fisheries Agency. The permitting process for new mussel farming has been on hold since July 2021, due to delays with the development of a new Danish Maritime Spatial Plan and uncertainties regarding how the plan will impact permitting for mussel farming. Over the years there has also been rising opposition to mussel farming, particularly regarding Smart Farms. During a meeting in September 2023 Skive Municipality discussed the permitting process with Mussel Committee members, specifically about improving transparency in the permitting process. Skive Municipality shared experiences with the Committee from



Figure 3. Example of a SmartFarm, photograph by Lars Skytt Nielsen

the Blue Green Bio Lab workshop held in April 2023. A key learning from this workshop was the need for greater communication between stakeholders and a better understanding about the mussel farming industry, how it operates and the positive environmental effects from mussel farming for water quality. Skive Municipality is continuing this dialogue with the Danish Fisheries Agency, which is preparing a new permitting process, after the adoption of a new Danish Maritime Spatial Plan, possibly in the fall of 2024.

Communication and engagement in various fora

The Danish partners have been deeply involved in Coastal Water Council's discussions at a local level, but have also reached out to projects with a similar focus to gain a better understanding of how to support improved communication.

Coastal Waters Council (Kystvandråd):

In spring 2023 a local Coastal Water Council was established with financing from the Danish Ministry of Environment. The Coastal Water Council brings together researchers, agricultural interests, mussel farmers, politicians, NGOs and representatives from 3 municipalities with catchment areas to the inner part of the Limfjord. The Coastal Water Council discusses ways to improve water quality to fulfill the EU Water Framework Directive, while considering the array of stakeholders in the area.

The Climate Foundation Skive and Skive Municipality are both involved in the work of the Coastal Water

Council and are supportive of the idea of new regulatory options for mussel farming including the possibility for 'mitigation mussels', whose primary function is to provide positive ecosystem services through filtering and removing nutrients that cause eutrophication. This type of mussel farming is currently not permitted in Denmark. Mitigation mussels are unlikely to be of high enough quality for human consumption, but have potential uses in new value chains. It should be noted however, that mussel farming cannot alone solve eutrophication challenges in the Inner Limfjord.

The concluding technical report from the Coastal Waters Council will be presented in early 2024 with recommendations from the Council to the Ministry of Environment. The Climate Foundation and Skive Municipality are continuing this dialogue with the policy level locally and nationally.

Knowledge exchange with other projects:

In the fall 2023 the Danish partners reached out to several organizations and projects to better understand communication issues and approaches about bio-industrial symbiosis.

- Submariner Network – Skive Municipality's met with SUBMARINER to gather best practices for communicating about blue economy development, which made clear the importance of mutual knowledge sharing with local society, particularly around mussel farming.
- Danish Bio-economy Conference – At this yearly conference the partners met with:

- TETRAS project- Discussions about the project's involvement of local students in the development of a demonstration facility for recirculatory aquaculture systems (RAS).
- Baltic Muppets project – Discussions about the project's testing of how to sink Smart-Farms fully underwater, which could improve public acceptance of increased mussel farming by reducing the impact of mussel farming in the seascape.
- Kalundborg Symbiosis – Discussions about network's structure for ensuring communication between symbiosis partners at strategic and practice levels.
- Blue Mission BANOS 1st Mission Arena- Workshops and discussions at the Ocean Arena gave the partners further insights into the basis for public views toward mussel farming and suggestions on addressing these sentiments through authentic stakeholder involvement, knowledge sharing (regulations and science) and developing trust.

Next steps

The partners anticipate the following next steps:

- Following up with participants to the workshop held on November 2023
- Working with the results from the Coastal Water Commission
- Continuing dialogue about a new mussel farm permitting system
- Continuing dialogue with companies interested in working with blue biomasses
- Securing funding to keep the dialogue going with a point of departure in our idea catalogue

Reflections and learning

After the first workshop in Skive focusing on bio-industrial symbiosis of blue biomasses, the partners took a step back and really looked at what the stakeholders wanted – more options for dialogue. We therefore put their needs and interests at the center of 2nd workshop. The result was constructive conversations between participants that before the workshop likely saw themselves as opponents. Some of these participants remained after the workshop or walked out together to keep the conversation going. Furthermore, the mixing of various entrepreneurs and business development people stimulated interesting discussions about innovation, which we are in acute need of to reach climate, environmental and business goals.

Using the Open Space Technology approach is not a typical way of doing things for the municipality, but trusting the participants created meaningful results that the partners can work with in the future, knowing that there is already support for these ideas.

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Project facts

The Blue-Green Biolab project is co-financed by Interreg Baltic Sea Region.

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Homepage: <https://interreg-baltic.eu/project/blue-green-bio-lab/>

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