

Spurring blue bio-industrial symbiosis on land in Lysekil, Sweden

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 focusses on developing conducive policy environments and policy practices to spur bio-industrial symbioses in the area around Lysekil, Sweden. 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.

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Resumé

Lysekil is as many places around the world facing major challenges in terms of energy and food supply as well as the impact of climate change on people and society. Based on local conditions the municipality aims to increase access to locally produced food, electricity and energy – while at the same time acting climate-smart. Thus, the municipality, LEVA in Lysekil and the PREEM refinery are working jointly on a feasibility study: developing an area near Brofjorden into a climate-positive and circular industrial park for companies with high sustainability ambitions.

The planned circular industrial park has via Preem unlimited access to residual heat and is located about 1000 meters from the seaside with the possibility to have salty water on land. In the feasibility study we are trying to do the utmost with the uniqueness of the site. The chosen biomasses to work with in the project are therefore all tropical marine species, the red algae *Aperagopsis*, giant shrimp *Vannamei* and Kingfish/catfish.

Co-creative meetings

In Lysekil two co-creative meetings in the format of roundtable discussions were conducted. The first one was on October 6, 2023, and the second on November 22, 2023. The first meeting focused on societal engagement and how to communicate with different stakeholders in transforming society. The planning of the workshop was in cooperation with Linköpings University, focusing on Preem in Lysekil Municipality, LKAB a mining company in Luleå Municipality and Cementa a cement company in Slite Municipality in the transformation to sustainable societies. These companies are the top 3 emitters of carbon dioxide in Sweden. The main topic discussed by participants, echoed the challenge identified earlier in the Blue Green Bio Lab project related to communication and trust.



Figure 1 Happy participants at workshop in October 2023

Twelve participants represented a broad range of stakeholders. Fossil Free Sweden (a governmental initiative), Swedish Climate Policy Council, LO – Swedish Trade Union Confederation, Tenant Alliance for Fair Climate Change, Stockholm University, Linköping University, the 3 municipalities in transition as well as the study organization (see Figure 1). Worth mentioning is also that the municipal representatives came from very different development sectors: Lysekil – business, Slite – cultural and Luleå – social. Before the event all the participants received a brief and the below 3 themes/questions to reflect upon. At the meeting the 3 questions were presented, one at a time, to the municipalities who shared reflections. After each question all participants were invited to comment, followed by a joint discussion.

1. Does climate change need to be fair and if so, what does that mean from your perspective?
2. How do we make a fair transition in practice? What is required for a policy of rapid and extensive emission reduction (and societal change) to be anchored in a wider population?
3. What future society do you hope for? What needs to be changed to get there?



Figure 2. Main points from discussions, October. 6, 2023.

The second roundtable discussion had a more “hands-on” approach to the environmental policy topic – how do we create a land-based aquaculture system in harmony with environmental regulations? Besides Lysekils municipality, LEVA in Lysekil (municipal electricity and wastewater company), Smögenlax (aquaculture company), Rena Hav (wastewater and biogas plant) and IVL (Swedish environmental institute) participated. LEVA and Lysekils municipality planned the meeting together. Smögenlax and Rena Hav participated at the previous Blue Green Bio Lab workshop, and this meeting was a continuation of the workshop held in spring. The meeting had the following agenda:

- Conceptual design circular industry park (LEVA)
- Learnings in Sotenäs – Smögenlax & Rena Hav (Rena Hav)
- Environmental status in Brofjorden water body (IVL)
- Possibilities and challenges (All)
- Summary and next steps (Lysekil municipality)

Challenges and opportunities

Communication with society and among businesses

The challenges addressed in October were mainly about how to achieve a societal understanding and acceptance to the rather new set up of a circular bio-industrial symbiosis industry. From Lysekil's perspective – a tool for achieving a fair societal transformation to a sustainable future. The need for change is urgent, and we must be able to focus on the right questions. But, as many people are reluctant to change, we have at the same time a need to spend time to inform and act transparently in order to build trust.

As we learned from the report How can municipalities support the development of industrial symbiosis (Baltic Industrial Symbiosis) one of the key findings for seeding, developing and expanding industrial symbiosis is the importance of creating an entrepreneurial and collaborative culture of trust and innovation.

Not only is there a need for trust and acceptance in the society towards a symbiosis industry park. Even more important is the need for trust and understanding between the companies involved in the symbiosis setting. If the foundation is not solid and transparent and the businesses do not or will not rely on each other, there is simply no possibility to create a symbiotic relationship or enhance business opportunities in this way.

Furthermore, developing acceptance for producing different species (mainly discussed in the November meeting) highlights the need for transparency. The breeding and farming will take place in fully controlled processes in a RAS setting (recirculating aquaculture systems). Nevertheless, as there will be access to tropical conditions the species farmed will likely be non-native and if not communicated in a planned and transparent way – there might be a communication failure – giving room for rumors that could delay and in worst cases stop this development, for example with misunderstandings ending in thoughts like 'They are going to farm invasive species that will ruin the whole ecosystem!'

National regulations perceived as barriers for circular bio-industrial symbiosis

In the November meeting LEVAS concept work around wastewater was in focus (Figure 3). The main question addressed was designing a land-based circular aquaculture industrial park to meet the requirements in national environmental regulations.

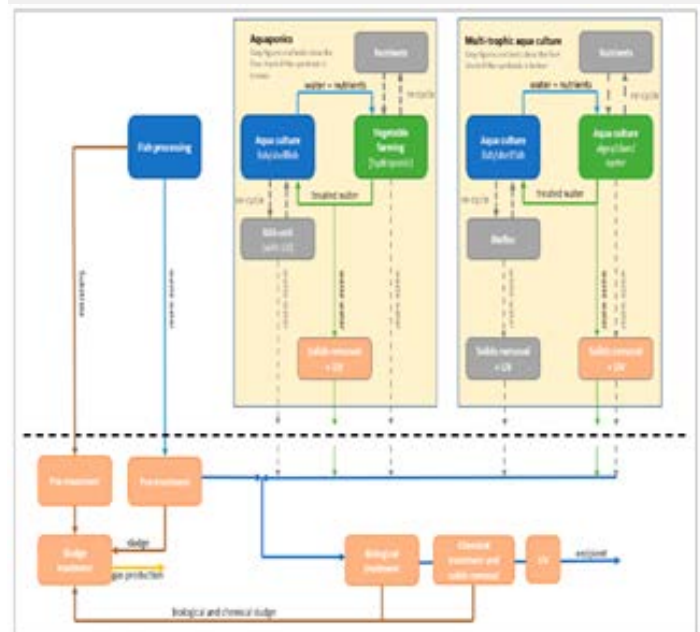


Figure 3. Levas concept design

National environmental water regulations in short- In Sweden, the EU Water Framework Directive is largely implemented in the Environmental Code, the Water Management Ordinance, and the county administrative boards' instructions. Five water authorities are responsible for water management in their respective districts. The Swedish Agency for Marine and Water Management supports the water authorities through guidance and issues binding rules, regulations, for how work is to be carried out.

The environmental quality standards are a legal instrument for authorities and municipalities when applying laws and regulations in the environmental area and the norms also govern the physical planning in the municipalities. Water organizations, such as water councils, are important in their role as associations of stakeholders with regional or local support.

WISS (Water Information System Sweden) is a database developed by the Swedish Water Districts, the County Administrative Boards and the Swedish Agency for Marine and Water Management. All lakes, rivers, groundwater, and coastal waters are classified and given an ecological, quantitative and chemical status. The data fed into WISS is used to report the Swedish work within the EU Water Framework Directive.

In WISS, the waterbodies are fairly small compared to other countries. For example, are there two just outside the refinery and one on the inside (Figure 4). The ecological status for all three waterbodies are “moderate” and the chemical status are “poor”. When designing the bio- industrial park’s wastewater system and locating a possible emission point at sea, the carrying capacity of the waterbody is crucial and directly affects the permit process. This could in turn directly affect the type of biomasses/businesses valid for the circular bio-industrial park and how the symbiosis should be planned.



Figure 4. Waterbodies around the refinery from WISS

Next steps

Closing the roundtable conversation some activities were planned to continue these discussions:

- As there is still much to learn from Rena Hav, a follow up meeting will take place between Lysekil Municipality, Leva and Rena Hav
- A critical question found during the discussions was about energy and electricity supply. Some years ago, energy and electricity were nearly an unlimited source in Sweden and available at relatively unexpensive rates. This situation has changed, and as energy and electricity supply is central in the circular setup, we aim to further address the question.
- The environmental quality standards in the waterbodies outside the refinery will also be further examined to determine a feasible emission point fulfilling the EU Water Framework Directive.
- The communication aspects will be further investigated and addressed in 2024 as there is much more to do here. One of the most critical aspects of the continuing work is developing commitment and acceptance to the needed sustainability transition.

Reflections and learning

The outcomes of both meetings were very positive, but in different ways. The best thing about the first meeting was without question the broad representation of stakeholders. Starting the meeting we did not really know what to expect and what value it would give. The take-home message is don't be afraid to mix perspectives! It added so much dynamism to the conversation and is an approach worth doing again.

The second meeting had in a way the same setup for the conversation, but with a much more practical approach in trying to solve a problem. The conversations added much value to the wastewater treatment concept development and was perhaps also a starting point for a much closer collaboration between the businesses.

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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