Navigating Challenges and Opportunities:

An Inventory Analysis of Barriers and Solutions in the Blue Bioeconomy Across Pilot Regions

Deliverable 6.3

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Abstract	This study assesses regional policies and programmes related to the blue bioeconomy, focusing on climate, social and economic aspects. It evaluates existing support structures and funding opportunities, identifies best practices, and identifies barriers and gaps in marine education and technical skills. The study examines regional needs and supply-demand dynamics, providing insights to support governments to set relevant local or international support programmes for actors in the blue bioeconomy. It also examines regulatory barriers to entry into the sector for small businesses.
Keywords	BlueBioClusters, barriers, solutions, blue visions, CoPs, blue bioeconomy

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Acronyms

BBC	BlueBioClusters
CoP	Community of Practice
GDP	Gross Domestic Product
EU	European Union
IPR	Intellectual Property Rights
NGO	Non-governmental Organisation
R&D	Research and Development
SME	Small and Medium-sized Enterprises
UN	United Nations

Executive Summary

Identifying barriers to the development of the blue bioeconomy provides an opportunity for policymakers and stakeholders to make decisions regarding policy formulation and investment strategies. This study covers nine selected pilot regions: Flanders (Belgium), Saaremaa (Estonia), Brittany (France), Iceland, Klaipėda Region (Lithuania), Møre&Romsdal (Norway), Peniche (Portugal), Scotland (United Kingdom), Västra Götaland (Sweden) (Figure 1).

First, a survey questionnaire was developed. Project partners responded to questions regarding the regulation, financing, and educational situation of the blue bioeconomy in their countries and regions. Through this survey, it was possible to identify barriers to the development of the blue bioeconomy. On the other hand, each region set up a Communities of Practice (CoPs); their aim is to identify barriers and opportunities to develop blue visions. The insights of these two actions provided relevant data to identify barriers and solutions for the development of the blue bioeconomy. The data obtained has been analysed, summarised and is presented in this report.

Figure 1. The regions of BlueBioClusters project.

1 Flanders, Belgium

Regulation

Belgium is a federal state composed of communities and regions. The power to make decisions is no longer the exclusive domain of the federal government and parliament. Flanders, one of Belgium's regions, now enjoys greater economic autonomy and has effectively conveyed its interests. The Belgian part of the North Sea is under federal control, though, which can be a barrier for Flemish companies as they sometimes must juggle between two regulations, possibly creating a conflict of interest between the national government and the regional government.

Figure 2. The region of Flanders.

Food safety is regulated at the national level, and there are some constraints on the stringency of specific food safety regulations for local production. In the case of macro- and microalgae, there are also restrictions on toxicity levels based on wild-harvested that do not apply for land-based micro- and macroalgae.

The Flanders region faces the following regulatory barriers within the blue bioeconomy:

- ✓ Lack of supportive policies and legislation. Need to support more local production and consumption of local products. Local products face the same (strict) regulations as the imported products.
- ✓ Lack of sufficient surface area in the Belgian North Sea as well as space on land (high competition, high land prices, specific permits).
- ✓ Not enough local biomass to supply the Flemish bioeconomy.
- ✓ Low economic feasibility (too much competition with imports, which have lower costs; production at sea will have higher costs as the designated zones for production are far from the coast, making logistics very expensive).
- ✓ Lack of market demand for organic products and services.
- ✓ Lack of profitability of bioeconomy companies.
- ✓ Lack of general social acceptance.

For offshore extractive aquaculture, a stakeholder engagement process with various meetings was carried out, resulting in an official governmental Aquaculture Vision Document. This can then be used by the ministry to foresee (or not) specific areas for aquaculture in the Belgian part of the North Sea.

Financing

Not all blue bioeconomy sectors receive the same financial support. Fisheries and aquaculture can receive funding for investments. However, they have to meet certain standards and requirements, and the funding is usually only 25-50%.
The following aspects within those sectors should be taken into account to allocate financial support:

- ✓ sustainable fisheries.
- ✓ sustainable land-based aquaculture.
- ✓ sustainable offshore aquaculture.
- ✓ integration of blue bioproduction with side streams or activities of other industries.

This can be done with the support of investors, for example, by lowering tax on “blue” investments, reducing risk, and providing more financial support for startups or blue innovation projects.

Education

There are several scientific institutions relevant to the blue bioeconomy in Belgium and Flanders. The study programmes that have a link to the blue bioeconomy are:

- ✓ Master of Biology with Integrated Management of Aquatic Resources and Aquaculture (University Liege).
- ✓ Informative and specialised course on Aquaculture (Odisee University College).
- ✓ Master of Science in Aquaculture (University of Ghent).

It is important to distinguish that there is no specific engineering education concerning aquaculture.

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Blue Cluster was established at the end of 2017 as a partnership for developing and promoting economic activities linked to the sea. Over 180 enthusiastic companies and knowledge institutions have joined since then. Blue Cluster is an independent and neutral partner supporting Flemish companies in setting up partnerships with other companies, knowledge centres, and government agencies to develop and promote offshore economic activities.

BLUE CLUSTER

Figure 3. Blue Cluster in Belgium.

General remarks

The aim of the Flanders Blue Vision is to increase local production, reduce import dependency and position Flanders as a leader in the blue bioeconomy, focusing on collaborative efforts and regulatory adaptations to unlock long-term opportunities in

fisheries, aquaculture, and algae cultivation. To achieve this aim, the following barriers have been acknowledged:

- ✓ The Belgian part of the North Sea is under federal control, which can be a barrier for Flemish companies as they sometimes must manage two regulations, and potentially leading to a conflict of interest between the national government and regional government.
- ✓ The complexity around novel food regulations is slowing down potential exploitation in Flanders and possibly Europe.
- ✓ Imports are the main source of raw materials for the blue bioeconomy in Flanders, but import dependence is expected to decrease in the future. A possible solution to this problem is the transition to aquaculture.
- ✓ Establishing value chains for the blue bioeconomy is a significant challenge. A methodology is needed that would allow this to be done simply and objectively.
- ✓ There is a noticeable lack of specialised technical study programmes in the field of aquaculture.
- ✓ A big challenge for the successful development of the blue bioeconomy is the low economic viability and the low profitability of the companies engaged in such activities. Therefore, financing instruments should be available to all companies that meet the blue bioeconomy criteria.

Conversely, even if blue bio production is limited in Flanders as in other regions, it is challenging to have a unified vision on economic matters, which are typically managed at the regional level. Given the inevitable political differences between regions, it is difficult to align interests and visions across them.

2 Saaremaa, Estonia

Regulation

Goals for Estonian sustainable development have been agreed until 2030 in the framework of the National Strategy on Sustainable Development "Sustainable Estonia 21". Strategy "Estonia 2035" states that "more attention needs to be paid to environmental protection measures that also improve the state of the sea and promote economic activity in the use of the sea (e.g., algae and shellfish farming, reed processing). The valorisation of food resources roadmap states that necessary R&D activities should include "developing innovative food technologies in marine aquaculture, the use of the marine microbiome in the food sector value chains, solutions for the blue economy".[1]

Figure 4. The region of Saaremaa.

Agriculture and Fisheries Strategy 2030: the Estonian Agriculture and Fisheries Strategy 2030 (AFS 2030) aims to contribute to increasing the competitiveness of agriculture, fisheries, aquaculture, and food industry sectors (e.g. cross-sectoral cooperation in bioeconomy), good plant and animal health, improved soil conditions, food safety, sustainable rural and coastal development, and the maintenance of a clean environment and biodiversity. It tackles aquaculture and sees mussels and algae cultivation as a potential method to reduce eutrophication and marine aquaculture to create jobs in rural areas.

The Planning Act is the basis for maritime spatial planning. In Estonia, the regulation of sea-based activities involves several acts: the Water Act, which sets requirements on permits for special use of water and superficies licenses; the Building Code; the Environmental Impact Assessment and Environmental Management System Act. The traditional harvesting of red algae Furcellaria lumbricalis (source of agar-agar) from the sea is regulated by the Fishing Act. Thus, commercial fishing authorisation is needed for harvesting *Furcellaria lumbricalis*.

From the Saaremaa point of view, the Saare County Development Strategy 2022-2035 includes a chapter on the blue economy. Saaremaa is the biggest Estonian island that is regarded as a blue growth cluster in marine spatial planning. To better utilise the development potential of its island position, it will be crucial in the future to pay even greater and broader attention to the more skilful and interconnected utilisation of maritime-related resources, competencies, and areas of activity. The

[1] https://valitsus.ee/en/estonia-2035-development-strategy/strategy/strategic-goals. Accessed 28 July 2024.

maritime industry (incl. shipbuilding), valorisation of marine resources (incl. aquaculture) and renewable energy are chapters under the blue economy.

In general, developers must apply for a superficies license to start aquaculture activities in the sea, which is a lengthy process.

The governance of the blue bioeconomy is spread across multiple ministries and authorities, resulting in a fragmented and challenging environment for developers.

Financing

Different financial instruments support different business sector activities, including the creation of startups, business development, product development and innovation, trade development, and attracting foreign talent. These are not necessarily specific to the blue bioeconomy business sector because these financial support instruments are mostly open for applying to all entrepreneurs/businesses in Estonia from (almost) all sectors.

Regional organisations that coordinate different funding opportunities for businesses in Saaremaa:
Saarte Kalandus MTÜ (NGO)—Saarte Kalandus's purpose is to develop fishing and related activities and secure the vitality of coastal villages. The NGO cooperates with the European Maritime and Fisheries Fund, within the framework of which grants are distributed for implementing the European Union's common fisheries management policy.
Saarte Koostöökogu MTÜ (NGO) – the implementer of LEADER measure in Saaremaa. CLLD (Community Led Local Development), i.e. community-led local development, hereafter (community method), is an innovation of the LEADER method that has been in operation for 26 years, where, in addition to the European Agricultural Fund and the Fisheries Fund, the community method is also applied when using funds from the European Regional Development and Social Fund. LEADER increases the initiative of communities in finding solutions to their problems and favours cooperation and innovation. Among the projects, investment subsidies for the development of rural entrepreneurship are in first place.

National financial instruments:
Agricultural Registers and Information Board of the Republic of Estonia (ARIB) (Government and EU funding)—ARIB is responsible for organising the granting of national subsidies, European Union agricultural and rural development subsidies, European Maritime and Fisheries Fund subsidies, and market management subsidies. It is also responsible for maintaining national registers and other databases related to agriculture.
The areas of public subsidies cover fields and forestry, animals and fishing, entrepreneurship development, market organisation, and rural school curricula.
Enterprise Estonia (EAS) (Government agency) introduces opportunities to bring companies to a new level through business model innovation. It shares expert know-how and connects companies with the right partners for business development. Enterprise Estonia supports ambitious ideas and assists in finding international funding opportunities.

The State Shared Service Center (Government Agency under the administration of the Ministry of Finance) – provides various support services to the central government agencies that have entered into an agreement on the provision of support services and performs the function of managing and paying authority for the European Union structural funds and cross-border programs. The Liaison Office for Financial Mechanisms in Norway and the European Economic Area; and, where specified by law, the tasks of the implementing entity. Grant for starting an enterprise is up to 15,000 €.
Estonian Unemployment Insurance Fund (Governmental funding) – business start-up support and other services for employers. Support for starting a business is up to 6,000 €.
Accelerate Estonia (Governmental funding) is looking for ideas that:

- ✓ provide a game-changing solution to a problem in Estonia that can be scaled globally.
- ✓ develop a significant economic opportunity for Estonia.
- ✓ create or catalyse systemic change in Estonia through the public sector.

It offers up to 90,000 € in research and development funding to support designing, building, executing, and learning from experiments run with the programme. Supports business development, product development and innovation, trade development, raising foreign direct investments, attracting foreign talent, and developing tourism. The size of the different measures ranges from 6,000€ (innovation voucher) to 500,000 € (product development).

Education

On a national level, there are scientific institutions involved in the blue bioeconomy: the University of Tartu, the Estonian Marine Institute, the Estonian University of Life Sciences, the Tallinn University of Technology, and the Center of Food and Fermentation Technologies. Kuressaare College (part of Tallinn University of Technology) at Saaremaa contributes to Saaremaa-specific sectors of the blue economy by providing engineering and entrepreneurship education and R&D services. Nevertheless, there is a noticeable lack of specialists/teachers/lecturers in the blue bioeconomy.

Higher education offers three study programmes: applied higher education studies in Marine Engineering, bachelor's studies in Sustainable Technologies in Blue Economy and master's studies in Marine Engineering (Tallinn University of Technology).

The Estonian Marine Institute (University of Tartu) contributes to research in several marine fields and is supported by our various chemical and biological laboratories throughout Estonia, as well as marine field stations where researchers can conduct scientific research and innovative experiments. It has involved PhD students in its work, and staff occasionally gives lectures on blue bioeconomy topics at the University of Tartu.

Kuressaare Adult Gymnasium offers an elective course in "Maritime Basics," which prepares students to take the sailor's exam.

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Universities regularly cooperate with the business sector – for example, Tartu University is cooperating with Redstorm, which cultivates mussels next to a fish farm. "Development of a technological solution for the extraction of phycoerythrin from red algae of the Baltic Sea" (2018-2019) was the first large-scale study of the competence centre Plantvalor established at the Polli Horticultural Research Center of the Estonian University of Life Sciences in cooperation with Tallinn University and two companies whose research object was algae. The goal of the project was to find an effective technology that could be used to produce red colour pigment on an industrial scale. Companies Vetik and Est-Agar were partners in the project.

The Marine Resources Laboratory at Saaremaa: Saaremaa municipality and Tallinn University of Technology (Kuressaare College) signed a cooperation agreement to promote refining marine raw materials in Saaremaa in 2019. With the agreement, the university undertook creating a study module on the processing of marine raw materials and preparing the opening of a teaching and research development laboratory. The Marine Resources Laboratory aims to boost local business competitiveness and advance regional research and education through sustainable use and enhancement of marine resources. In the laboratory, various food products can be processed—grinding, mixing, and heating—and their moisture and dry matter content analysed. Additionally, it's equipped to measure organic matter (via loss on heating) and ash content (residue on heating). The lab also features a pH meter for acidity testing and a Soxhlet extractor for fat separation from various substances.

General remarks

VISION 2035, as agreed by the Estonian Community of Practice, is to create a sustainable blue bioeconomy that supports communities, promotes a circular economy, ecosystem benefits, carbon neutrality, nature conservation, and tourism while encouraging knowledge transfer, education, innovation, and local purchasing power. The implementation of this vision is hindered by:

- ✓ legislation (time-consuming and costly),
- ✓ lack of specialists and know-how, and product valorisation,
- ✓ lack of awareness of the blue bioeconomy as a concept in society,
- ✓ lack of a common vision for the blue bioeconomy,
- ✓ lack of effective cooperation between the government, researchers and other stakeholders,
- ✓ limited ability to develop and bring niche products to export markets.

In terms of economic and social aspects, scaling-up strategies and the promotion of competitiveness and self-sufficiency, especially for small enterprises and disadvantaged areas, are fundamental. These objectives can be facilitated by various means, including government financial support, the provision of satisfactory working conditions, especially in rural areas, and the introduction of competitive wages. Maintaining a balanced market structure, avoiding monopoly or dominant positions, ensuring equal treatment of all individuals and organisations regardless of their background, and developing insurance solutions for aquaculture are also key to a robust blue bioeconomy.

3 Brittany, France

Regulation

In Brittany, the main documents governing sustainable development on the regional territory are as follows:

- ✓ Stratégie régionale des transitions économique et sociale (SRTES). One of the objectives of this strategy is to strengthen Brittany's maritime dimension. "The sea is the area in which a sustainable development rationale must be deployed".
- ✓ Breizh CoP – Le Schéma Régional d'Aménagement, de Développement Durable et d'égalité des Territoires (SRADDET). The blue bioeconomy theme is not explicitly mentioned, but several objectives are linked to it. In the SRADDET in particular, several objectives are worth noting:

Figure 5. The region of Britanny.

Objective 8: Make the sea a lever for sustainable development of the regional economy and employment. Accelerate the sustainable development of the fishing and marine biotechnology industries. Simultaneously ensure the preservation of marine and coastal ecosystems, the sustainable development of maritime activities and free access to the sea for all by implementing spatial planning for the coastal zone. Consolidate and develop the industrial port economy by resolutely orienting Brittany's major ports as hubs serving the various industries.

Objective 29:

- ✓ Preserve and recover biodiversity by making it a priority in development and planning projects.
- ✓ Preserve and restore Breton's natural environments, in particular moors, grasslands, peat bogs, natural coastal and marine environments, and ecological connections between land and sea.

Other main strategic documents and legislation relevant to the blue bioeconomy in France are:

- ✓ A bioeconomy strategy for France – Action Plan 2018/2020.
- ✓ A bioeconomy strategy for France – Challenges and visions 2020.

<u>Feuille de route stratégique ODD 2030</u>

Since September 20, 2019, France has had a Roadmap for the 2030 Agenda. This Roadmap, drawn up in a concerted manner, sets the course for an enterprising, united and ecological France around six priorities. In this roadmap, two challenges can be identified as having a direct link with the blue bioeconomy:

- ✓ CHALLENGE 2. Transforming social models by reducing carbon emissions and saving natural resources to act on the climate, the planet and its biodiversity, with the aim of 32% of protected maritime areas.

- ✓ CHALLENGE 4. Promote the health and well-being of all, in particular through healthy and sustainable food and agriculture.

Loi n° 2021-1104 du 22 août 2021: Climate and Resilience Act
This law from 2021 was established to combat climate change and strengthen resilience to its effects. In this law, there are some articles devoted to the protection of ecosystems and biological diversity (Articles 45 to 81).

Stratégie nationale Bas carbone
The National Low-Carbon Strategy (SNBC) describes France's roadmap for its climate change climate change mitigation policy. It provides guidelines for implementing a transition to a low-carbon economy in all sectors of activity.

Paris Agreement
The Paris Agreement is a legally binding international treaty on climate change. France, like the other signatory countries, is implementing regulations in line with the text.

Stratégie pour la mer et le littoral
The document that governs the sea and coastal strategy.

Other national entities can provide documents, studies and reports useful for the development of the blue bioeconomy: Ministry of Ecological Transition, General Secretariat for the Sea, The French Biodiversity Agency (OFB), Directorate General of Maritime Affairs, Fisheries and Aquaculture.

For all the strategies in France, the government has a well-defined structure for the development of the blue economy and the laws. Usually, there is consistency between the different levels, national and regional. However, the regional level has a low engagement; it just follows the national framework/ strategies.

Moreover, in the field of blue bioeconomy policy in Brittany region are the Consultation Bodies. They have been set up in the regions. In Brittany they are known as the Regional Conference on the Sea and Coastline. The aim of these bodies is to establish a dialogue between all those involved in the maritime sector. In Brittany, they are led by three presidents: the regional prefect, the maritime prefect and the president of the regional council.

Financing

In Brittany, some business areas receive financial support, such as fishing and aquaculture, renewable energy, coastal tourism, maritime transport, biotechnologies, and port activities. Blue biotechnologies, emerging bioresources (microalgae, marine bacteria), emerging markets (macroalgae), new aquaculture systems, such as Integrated Multitrophic Aquaculture, renewable energy (different alternatives not only one) and maritime decarbonisation technologies.
These financial instruments could be a decisive factor for the development of blue bioeconomy business in the region: public funds (European, national, regional, local, etc., co-financing, public/private partnerships, private capital). Business support can

be in different kinds of financial aids, as subsidies, tax incentives, loans for innovations, guaranteed loans, start-up funds, grants, etc. These finance tools are set up by local authorities or private organisations, for example, The French Agency for Ecological Transition, French National Research Agency, Bpifrance, the Defense Ministry, cities and department authorities.

Education

Current cooperation between policy-making and policy-implementing institutions in the field of the blue bioeconomy appears to be effective. Indeed, this cooperation is illustrated by the fact that there are numerous public research institutes and other public bodies linked to this field.

There are many universities offering courses related to the blue bioeconomy, as well as many laboratories in this sector (CNRS - National Research Centres and Sorbonne Universities) in France. In Brittany, many universities offer courses related to the blue bioeconomy, as well as many laboratories (Roscoff Biological Station, Concarneau Marine Biology Station, etc.) and research centres (Ifremer, etc.).

There are study programs related to blue bioeconomy in France:

- ✓ Master's degree in biology and bio-marine resources – Sorbonne Paris
- ✓ Master's degree in marine biology and ecology – Aix/Marseille University
- ✓ Master's degree in marine biomolecules and biodiversity - Toulon University
- ✓ Master's degree in marine biology and bioresources – Pierre-et-Marie-Curie University
- ✓ Master's degree in mechanisms and finalization of marine bioproduction – Le Mans University.

The study/training programmes in scientific institutions that have a link to the blue bioeconomy in Brittany: Blue Train, initial and continuing training for the development of the blue bio-economy, Roscoff biological station, Brittany; Sea-Education Summer University of the European University Institute of the Sea; LabexMER and in collaboration with UBO and Océanopolis; Master's degree in Marine and Coastal Sciences – IUEM, Brest; The environmental challenges of blue growth – University of Western Brittany (UBO); Master's degree in Environmental, Energy and Transport Economics (EEET): Economics applied to agriculture, the sea and the environment (E2AME) – University of western Brittany (UBO); Professional Licence – Aquaculture production and biotechnology (University of western Brittany) (UBO).

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Several clusters promote the collaboration between industries and research centres : CEVA (Centre of Studies and Valorisation of Algae), GEPEA (Génie des Procédés Environnement – Agroalimentaire), L'Institut Agro Rennes-Angers, MNHN (National Museum of Natural History) – Station de Biologie Marine de Concarneau, Station Biologique de Roscoff, IRD (The French institute for research & development) – Délégation Régionale Ouest, Océanopolis, OFB – Office Français de la Biodiversité.

IFREMER is the French research institute dedicated entirely to knowledge of the ocean. Through its scientific and technological research, innovations and expertise, Ifremer contributes to protecting and restoring the ocean, sustainably managing marine resources and environments, and sharing marine data and information.
SHOM produces reference maritime and coastal geographic information. As a public operator, its mission is to understand and describe the physical marine environment in its relations with the atmosphere, the seabed and coastal areas, forecast its evolution, and ensure the dissemination of the corresponding information. It is a public administrative establishment (EPA) under the authority of the Ministry of the Armed Forces, and they have the world's first official hydrographic service.
National Museum of Natural History: The Museum is a true centre of scientific excellence, studying Earth and Life. Some 2,500 staff - researchers, caretakers, librarians, taxidermists, curators, engineers, veterinarians, museologists, etc. - work tirelessly within its walls and in the field.
The French Biodiversity Office (OFB) is a public body dedicated to protecting and restoring biodiversity in mainland France and the French overseas territories under the supervision of the Ministries of Ecology and Agriculture.
Centre National de la Recherche Scientifique (CNRS) – universities in sciences.
Pôles de compétitivité: Régional clusters, professional organisations, regional development institutions. For instance, Pôle Mer Bretagne Atlantique (PMBA) is one of the competitiveness clusters with a Strategic Action Area (SAA) dedicated to marine biological resources. The PMBA is a maritime innovation cluster created in 2005, and it manages a network of more than 430 organisations on a triple helix approach in which industries (SMEs, start-ups, major companies), research centres and academia work together to develop innovative projects around maritime innovation. The PMBA cluster aims to enhance the capacity of companies to innovate, stimulate growth and increase employment in promising markets.
It has a specific expertise in supporting innovation within the fisheries, aquaculture and the upstream seafood sector, but also in environmental and maritime innovation. PMBA's transnational experience is based on 2 pillars: support for internationalisation mainly provided through the organisation of overseas visits in targeted countries and transnational cooperation through participation in European projects.

Figure 6. Pôle Mer Bretagne Atlantique.

Many of the projects approved by the Pôle Mer Bretagne Atlantique reflect the cooperation between companies in the bioeconomy and public institutions:
Marbiotech – Production of marine worms for human health applications.
OCEACTIF – Algae production and bio-inspired extraction for the development of innovative cosmetics use.
HOLOFARM – Development of new and innovative aquaculture, holothuriculture
VIPP-Bioactive marine molecules from sardines for "anti-stress" health solutions.

General remarks

In summary, in France, the government has a well-defined structure for the development of the blue bioeconomy and related legislation. There is usually consistency between the different government levels, national and regional. Regional

blue bioeconomy policy is quite clear as the various components of the bioeconomy are generally dealt with separately in the various framework documents involving the regions, sometimes with ambitious development targets and development objectives with challenging timelines. There is still a lot of progress to make to include 100% of the blue bioeconomy in the regional strategic plans, we highlight that the implementation of the regional tools of the European Maritime, Fisheries and Aquaculture Fund (EMFAF**)** and the European Agricultural Fund for Rural Development (EAFRD**)** are not included in the Stratégie Régionale d'Innovation – Spécialisation Intelligente (SRI-SI) framework. Only the SRI-SI for the Brittany region specifies the need for coordination with the EMFAF. This may reflect the regions' low level of involvement and strategic approach to the blue bioeconomy, with the exception of Brittany.

The operational objectives identified during the CoPs meeting to promote Brittany's blue bioeconomy include improving infrastructure and pilot platforms for mastering the life cycles and domestication of marine species, technological innovation to limit environmental impacts, supporting research, developing sustainable aquaculture systems, promoting digitalisation of the seafood sector, preparing a strategic document for European recognition and promoting industry-academia collaboration.

4 Iceland

Regulation

Iceland primarily follows EU guidelines, and this includes for regulating sustainable development and likewise refers to the UN Sustainable Development Goals and fulfilment of the Paris Agreement on climate change and has strategic guidelines and development plans at the national level. All EU legislation is used, and national sustainable development guidelines are provided by the ministry and by key authorities. Iceland also has a national strategy for sustainable development but also uses the Agenda 2030 as an umbrella for key national strategies linked to sustainable development. These do not single out the blue bioeconomy. There is currently not a strong or clear national blue bioeconomy policy– there are clear regulations about established uses of the ocean – including fisheries and aquaculture and particularly as they relate to food but not about wider blue bioeconomy and blue economic growth.

Figure 7. The region of Iceland.

Regulatory barriers exist for the establishment of new blue bioeconomy sectors. For example, the cultivation of seaweed has no legal framework yet, which must be created to grow the sector. Regulatory barriers often include lack of documentation and know-how to build the regulation on – there are still data gaps around the oceans of Iceland for example which make building regulation complicated. The regulatory barriers to the blue bioeconomy at the regional level are know-how, lack of collaboration across sectors and across the supply chain and lack of communication between policy makers and blue bioeconomy industrial actors. Since there is no formal policy for blue bioeconomy in Iceland, the initial link in the chain is missing since policymaking is a limiting factor. Much activity in blue bioeconomy is being driven by the private sector and by research and development by government institutions.

Financing

A wide range of activities in the Blue Bioeconomy business sector are financially supported, from research and development to the scale-up of Blue Bioeconomy products and services – these are funded both by national funding bodies such as Rannis (The Icelandic Centre for Research), as well as by EU and international funding and private investment. These funding schemes primarily support fisheries, aquaculture, microalgae and blue biotech.

Further development of the sectors already supported and those that facilitate international cross-pollination in the blue bioeconomy between different countries. More early-stage and sector-specific venture capital and more public grants and equity focused on scaling-up viable blue bioeconomy ideas are needed.

Education

While there are several education and research centres, there are none dedicated to the blue bioeconomy, and, as a small country, the number of experts to develop them is still limited - making international cooperation key. There is a lack of specific blue bioeconomy education and research institutes.

Hólar University College Iceland offers programs in aquaculture and aquatic biodiversity. University of Iceland department of food science offers programs linked to food production and food safety. The Icelandic College of Fisheries, fish processing, fish quality and aquaculture at the vocational level. University of Akureyi – Fisheries Science – BSc. Icelandic students wanting to pursue education in the blue bioeconomy will often study overseas – most commonly in Denmark, United States, and United Kingdom. Those studying aquaculture also often study in Norway accessing educational opportunities in other regions.

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

The Iceland Ocean Cluster is a world leader in supporting, connecting, incubating, investing, and growing startups that create value from material formerly considered waste. For over a decade, the Cluster has been a driving force in connecting the dots between the blue economy and entrepreneurs with great ideas on utilising sustainable wild catch and farmed seafood further – pushing them to do more with less. The Ocean Cluster in Reykjavik is a community of over 70 companies and entrepreneurs in the blue economy. It includes companies in aquaculture, fish sales, marine technology, software, design, biotechnology, cosmetics, and more.

Figure 8. Iceland Ocean Cluster.

General remarks

Iceland's blue vision is to drive its economy forward through the sustainable growth of its fisheries sector and the emerging blue economy and bioeconomy, leveraging both technologies, along with innovative uses of seafood resources across traditional and emerging value chains to create high-value products and foster collaboration, thereby transforming the industry towards full sustainability, and significantly increased economic value. The realisation of this vision can be hindered by a lack of established policy and legal frameworks, a lack of expertise in fields outside of fisheries science, and challenges in developing businesses and business cases at scale in more remote locations. It is necessary to subsidise training possibilities abroad for future local blue-bioeconomy actors.

5 Klaipėda Region, Lithuania

Regulation

In Lithuania, sustainable development as a direction of the country's development was established earlier than the UN approved the Agenda 2030, namely in the National Strategy for Sustainable Development adopted in 2003 and other strategic planning documents. The necessity of sustainable development is also mentioned in the Spatial Planning Law, which is relied upon in the General Plan of the Territory of the Republic of Lithuania and in the White Paper on Lithuania's Regional Policy for Sustainable and Balanced Development for 2017-2030. With the adoption of the Agenda 2030, the existing strategic documents remained unchanged during the evaluation period, so although they are related to the goal of sustainable development, the objectives set in the documents are not directly linked to the Sustainable Development Goals (SDGs) and their tasks. In a resolution adopted by the Seimas (Parliament) in 2018, it was encouraged to integrate the goals of sustainable development and corresponding tasks into the long-term and medium-term (up to 2030) strategic documents of public policy under preparation.

Figure 9. Klaipėda Region.

Blue bioeconomy is not indicated as a priority development direction in the strategic documents of regional municipalities. There is a lack of clear understanding among regional actors of what is encompassed by the blue bioeconomy.
Lithuania does not have a clear and consistent document on national blue bioeconomy policy. Some issues are discussed in these documents:

- ✓ Action Program for the Lithuanian Fisheries Sector 2021–2027.
- ✓ Lithuanian aquaculture sector development plan for 2021-2030.
- ✓ Prospects of Bioeconomic Development in Europe and Lithuania (2020).

The promotion of the development of a sustainable blue economy in coastal areas is highlighted in the Action Programme for the Lithuanian Fisheries Sector as one of Lithuania's challenges. Lithuania expects to set up 10 to 12 Local Action Groups with a focus on business development in blue economy sectors, including blue biotechnology, renewable energy, supporting tourism and other services to diversify income sources from fisheries and aquaculture and thus overcome the above-mentioned challenge.

The Local Action Groups described in the The Lithuanian EMFAF programme are territorial units. Fisheries regions are designated in two types of territories: 1) coastal areas – municipalities bordering the Baltic Sea coast or the Curonian Lagoon, where communities engaged in the fishing business dominate, featuring very small-scale fishing enterprises and the necessary infrastructure for unloading fishing products; 2) inland areas – municipalities with significant recreational potential in natural water

resources or a developed aquaculture sector. Based on different levels of economic development, the territory of Lithuania is divided into two regions with varying levels of economic development: the "Capital Region", consisting of Vilnius County, and the "Central and Western Lithuania Region", consisting of the remaining 9 counties. These regions face social exclusion, inequality, and other social and economic challenges.

Depending on the specific challenges and opportunities of the Fisheries region, the Fisheries Local Action Group (FLAG) should develop and, upon approval, implement a unique Local Development Strategy (LDS) tailored to that Fisheries region. Based on the individual needs and opportunities of the Fisheries region, it should be aimed to 1) create conditions for sustainable blue economy growth and 2) promote the development of fishing and aquaculture communities, encourage activities that complement fisheries (niche tourism is an increasingly popular type of tourism that can provide fishermen and aquaculture producers with opportunities to diversify their activities by offering tourism services related to their fishing and/or aquaculture product production (e.g., providing fishing tourism, catering, accommodation services, conducting educational and/or cultural activities related to fishing and/or aquaculture), support blue economy projects aimed at developing blue biotechnologies and related services, utilising renewable energy sources, as well as solutions for the use of low-value, invasive, but more abundant fish species.

The Local Action Groups are responsible for the development of the Local (territorial) Development Strategy. As the Local Action Groups are usually established by the fishermen community, there is a concern about whether they include in the Local Development Strategy actions dedicated to the development of blue biotechnology, which is foreseen in The Lithuanian EMFAF programme.

Klaipeda Region Specialization Strategy 2030 (hereinafter - KRSS2030) is a strategic development document of Klaipeda Region. Bioeconomy is one of the main strategic directions indicated in KRSS2030, and it also includes blue bioeconomy. There are plans to establish a Regional Board of Bioeconomy aiming at strategic governance of the implementation of the targeted aims of KRSS2030 Bioeconomy direction, but currently, such a Board is not established, and specific regulations are not defined as well. Yet, there is a need to build a proper ecosystem of blue bioeconomy in the region.

Financing

Business financing includes various stages – from the generation of a business idea to the development of markets. Companies can receive funding under the 2021-2027 EU Fund Investment Program Priority "Advanced Lithuania" – InoStartas, InoPažanga, InoBranda, direct INVEGA loans "Perspektyva", InoConnect, InoKlaster, TUI IL, TUI Invest, Co-investment fund/VENTURE DEBT Venture capital lending/Acceleration fund 3, EcoInnovations, direct INVEGA loans "Change" (activity "Transformation"), Green Experiment, Expo cluster, Expo opportunities, Expo opportunities for advanced, Smart skills, Skills for SMEs, etc. Although these measures are not focused only on the blue bioeconomy sector, companies belonging to it can also receive financing. The main economic directions of the Lithuanian fisheries sector are fishing, aquaculture, fish processing. Funding is provided for: 1) promotion of sustainable fishing and restoration and preservation of aquatic biological

resources; 2) for the promotion of sustainable aquaculture activities and the processing and trade of fishing and aquaculture products, thus contributing to the security of food supply in the EU; creating conditions for a sustainable blue economy in coastal, island and inland areas and promoting the development of fishing and aquaculture communities; for strengthening international ocean governance and ensuring that seas and oceans are safe, protected, clean and sustainably managed.

The Lithuanian fisheries sector programme for 2021-2027 (hereinafter - the Programme) aims to focus on possible actions for which support from the European Maritime, Fisheries and Aquaculture Fund (hereinafter - EMFAF) is being planned. Total allocation – EUR 87 405 110.

The Lithuanian EMFAF programme implements all EMFAF Priorities (1, 2, 3 and 4):

1. Fostering sustainable fisheries and the restoration and conservation of aquatic biological resources.
2. Fostering sustainable aquaculture activities, and processing and marketing of fisheries and aquaculture products, thus contributing to food security in the Union.
3. Enabling a sustainable blue economy in coastal, island and inland areas, and fostering the development of fishing and aquaculture communities.
4. Strengthening international ocean governance and enabling seas and oceans to be safe, secure, clean and sustainably managed.

The regional development challenges in rural areas, as highlighted in Priority 3, will be addressed through investments from the Cohesion Policy Funds and the European Agricultural Fund for Rural Development (EAFRD). In contrast, specific economic, social, and environmental challenges in Fisheries regions, including rural areas, will be tackled with investments from the European Maritime and Fisheries Fund (EMFF).

Education

The study programmes that have a link to the blue bioeconomy in Lithuania are the following:

- ✓ *Bachelor's degree*: Biology and Marine Biotechnology, Physical Geography and Oceanography (Klaipeda University, Marine Research Institute), Biotechnology, Sustainable Biobusiness Management (Vytautas Magnus University), Molecular Biotechnology (Vilnius University), Bioengineering (Vilnius Gediminas Technical University).
- ✓ *Master's degree*: Sustainable Management of Aquatic Ecosystems (Klaipeda University, Marine Research Institute), Bioengineering, Water Engineering (Vilnius Gediminas Technical University), Biodiversity (Vilnius University).

The mentioned study programmes are only partially related to the blue bioeconomy. The major breakthrough occurred a few years ago when Klaipėda University introduced a new training program – the Blue Growth Leaders Academy (BGA). This programme is designed for business leaders and any professionals interested or already working in the blue economy or adjacent sectors. This international program offers an opportunity to meet top experts from all across Europe (Denmark, Sweden, UK, Norway) and become a part of a networking platform dedicated to the blue economy. BGA aims to provide the insights and tools to bridge that difficult gap

between the traditional development of a strategy based on continuous improvement and innovative approaches for emerging blue economies. The content of the programme consists of thematic areas related to the following blue economy industries: port and shipping, blue biotechnology, sea and coastal tourism, innovation management & business strategy.

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Business and scientific organisations are pooling their efforts to develop the maritime innovation ecosystem in the country – for this purpose, the Lithuanian Maritime Cluster was established in Klaipeda in 2020. Its mission is to promote the creation of high value-added products and services by bringing together the necessary competencies, human resources, and infrastructure.

LIETUVOS JŪRINIS KLASTERIS

Figure 10. Lithuanian Maritime Cluster.

Business sector and scientific partnerships are seen in various fields:

- ✓ Partnership in EU funded projects (AquaVIP – aquaculture virtual career development platform for the South Baltic region; AquaLoop - aquaculture expert floor for circular economy practice).
- ✓ Joint research (experimental studies for RAS development (fish and shrimp aquaculture), expert knowledge).
- ✓ Contract R&D services (Floating Islands, Fish Feed testing).
- ✓ Industrial PhD topics (utilization of blue bioeconomy resources).
- ✓ Studies support (Expert knowledge, lectures, scholarships, internships).

General remarks

The Klaipėda region's strength in the blue bioeconomy field is R&D.
The main outcomes of the CoP meetings are summarised below:
1. There is a lack of understanding among relevant regional actors regarding the scope of the blue bioeconomy.
2. The fishery sector is facing numerous restrictions.
3. Although some organisations and companies may be attributable to the blue bioeconomy sector, they may not identify themselves as such, causing them to miss out on potential opportunities. This highlights the need for further education on the topic.

6 Møre & Romsdal, Norway

Regulation

Norway has a raw material profile and a potential that differs from most European countries. In regards to regulatory harmonisation, it is important to highlight that Norway has identified regulatory barriers that stand in the way of the high-quality utilisation of raw materials. The industry has also pointed out that EU rules are interpreted differently in some countries. It would be recommended to review such barriers in close dialogue with industry stakeholders, preparing for national rule changes, working towards EU processes and, where necessary, reviewing interpretation.

Figure 11. The region of Møre & Romsdal.

The regulatory and political landscape is undergoing major change and, to a large extent, driven forward by EU processes and the development of new standards. Examples of different interpretations of certain regulatory requirements have emerged. In order to ensure the right framework conditions for the Norwegian bioindustry, uncertainties should be uncovered and clarified. It should also be mapped which planned changes in the future may have an impact on Norwegian raw material flows, as well as existing and future bio-producers.

An inspiring know-how example in the field of blue bioeconomy policy in this region is “Land meets Ocean”.
It is a cross-sector collaboration between the national clusters NCE Heidner Biocluster, NCE Seafood Innovation, NCE Blue Legasea and Biotech North. These are leading clusters in agriculture, aquaculture, fisheries and biotechnology, and with its more than 250 members, represent a significant part of the bio-based industries and the strongest R&D environments in Norway.

Financing

It is recommended that support is given to clusters, industrial parks or county municipalities to carry out various pilots related to documentation and trade in bio-raw materials.
Møre and Romsdal County has launched a call called Skaparkraft that aims to support in particular projects that contribute in green transition and where blue bioeconomy projects fits well. Also, Innovation Norway and the Norwegian Research Council, as well as Regionalt Forskningsfond (Om RFF Møre og Romsdal (regionaleforskningsfond.no)), are funding projects in the region on blue bioeconomy topics.

Education

Norwegian Institute of Bioeconomy Research (NIBIO) aims to contribute to food security and safety, sustainable resource management, innovation and value creation

through research and knowledge production within food, forestry and other biobased industries.

Norwegian University of Life Sciences' mission is to contribute to the well-being of the planet. The interdisciplinary research and study programmes generate innovations in food, health, environmental protection, climate and sustainable use of natural resources.

Norwegian University of Science and Technology (NTNU) – bachelor`s degree programme "Blue Innovation". Education in innovative thinking is relevant for all kinds of employment, both within new and established businesses. The programme is suited for those interested in marine biology combined with business development and management.
Overall, there is quite a strong presence of scientific institutions, but a lot of expertise and attention is associated with the aquaculture/salmon industry.

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Forskningsforum Møre: a forum for research institutions, academia and clusters representing industry, initiated and organised by the local representative of the Norwegian Research Council. "Blue" topics are on the agenda, including blue bioeconomy.
Land meets Ocean is a cross-sector collaboration between the national clusters NCE Heidner Biocluster, NCE Seafood Innovation, NCE Blue Legasea and Biotech North.

Figure 12. Land Meets Ocean.

These are leading clusters in agriculture, aquaculture, fisheries and biotechnology. Its more than 250 members represent a significant part of the bio-based industries and the strongest R&D environments in Norway. The project is a driver for conversion from linear to circular value chains. The aim is to contribute to sustainable innovation and industrial development across the blue and green sectors. This will in turn contribute to increased circularity, lower emissions, a better degree of self-sufficiency and strengthening of natural diversity. The collaboration has existed since 2018; Elise Sæle Dahle has been employed as a project developer since December 2021.

General remarks

There is currently an enormous rate of innovation related to technologies, business models, bioprospecting, and product development related to raw bio materials and circular bio value chain development. This development lays the foundation for potentially valuable IPR with export potential and early market positions in emerging

markets. In order for Norway to become a world leader, it is important to ensure significant investment in innovation and research activity, particularly related to raw materials, which are important to the Norwegian economy. Both financial incentives and a proactive attitude from the authorities are recommended.

7 Peniche, Portugal

Regulation

Blue bioeconomy has been a minor sector for years, contributing only 5% of Portuguese GDP and relying mainly on traditional activities and the exploitation of traditional bioresources. While there were incentives for R&D activities, they were not particularly effective in fostering innovation. A consistent approach and strategy to the local regions and innovative blue bioeconomy activities are needed to contribute to the high-value activities, services, and products that can be developed with the potential and dimensions of this natural blue bioresource in Portugal. Now, with the implementation of the MAR20-30 strategies (https://mar2030.pt/) and the introduction of innovative solutions from R&D, the sector is transitioning towards a more sustainable blue bioeconomy. Additionally, increased co-creation efforts between stakeholders and policymakers are being undertaken to support this transformation.

Figure 13. The region of Peniche.

The public framework is not well-aligned with the R&D and emerging needs of novel market services, products, and solutions, possibly due to the bureaucratic nature of public systems and organisations. The lack of deep expertise among policymakers results in complex licensing and regulation, inadequate funding for blue bioeconomy initiatives, difficult rules for accessing biomass, and an absence of a legal framework for new and innovative services, products, and technologies.

It is a challenge for policymakers to define strategies adapted to local circumstances. Nowadays, a more regional vision has emerged with the creation of 7 Blue Hubs across the country. This strategy allows local policy-implementing institutions to act more effectively within their regions. It comes from a collaboration started with relevant stakeholders in the field of blue bioeconomy, such as R&D centres, professional networks, incubators, companies (SMEs, large companies and startups), NGOs, experts and municipalities.

In Peniche, an inspiring example of know-how in blue bioeconomy policy is the Hub Azul investment – Smart Ocean (https://smartoceanpeniche.com/), part of the Infrastructure Network for the Blue Economy, under Component C10-Mar, integrated within the Climate Transition dimension. With 87 million euros allocated among 7 Hubs, the funding aims to build a more competitive, cohesive, and inclusive maritime economy. This initiative also strives for a more decarbonised and sustainable future, enhancing the capacity to seize opportunities from climate and digital transition and constitute a true ecosystem of networked infrastructures and skills for the blue economy. The Hub has investments in national centres of coastal infrastructure (new and existing) with access to water, laboratories and test areas, places for prototyping, pre- and industrial scale-up and space for incubation and leverage of companies creating a virtual and physical platform, networks to boost the blue bioeconomy and

other emerging areas of the economy of the sea in Portugal and Europe. Hub Azul will include not only the land and sea infrastructures but also a close connection to national universities, with a particular focus on higher education in marine-related subjects and professional training centres specialising in maritime studies. These measures aim to promote the interconnection between the training of highly qualified human resources for sea activities and the market needs of the economy of the sea and trends towards new economic models that are more digitised and friendly to the planet.

Portugal has NGOs, foundations, clusters and many companies/startups and projects from R&D centres collaborating with public institutions in the field. For example, Blue Bio Alliance, representing the blue biotech network in Portugal, joined forces with governmental and public institutions to support policy-making and strategy planning in the sector. Other private institutions and foundations such as Oceano Azul Foundation, Cluster for Blue Economy **–** Fórum Oceano, Colabs and R&D centres have joined forces too in the name of blue economy development.

Financing

Through public finance mechanisms, a variety of projects and companies receive funds to evolve their solutions. The main sectors and activities are related to fisheries and aquaculture, valorisation of marine bioresources, harvesting, tourism and exploitation and monitoring of marine bioresources. As a result, support is being provided for emerging sectors related to biodiversity and bioprospecting, innovation, and differentiation for added-value products. There is also a significant focus on the digitalisation of the sector.
More financial support should be given to high-value products from biomass extraction and ancillary activities that could support the circular utilisation of the sector's by-products.
A recommendation to support the business sector in the field of blue bioeconomy could be the reinforcement of dedicated public instruments for R&D, which are non-refundable.
MAR2030 is an initiative aimed at transforming and promoting the sustainable development of Portugal's maritime economy. It focuses on integrating and supporting various stakeholders to enhance the blue bioeconomy, contributing to climate and digital transitions through innovation and investment. Currently running the Blue Bioeconomy Pact (https://inovamar.pt/en/blue-bioeconomy-pact) with an investment of 133 million euros up to 2025 – of which 94 million is provided in the form of incentives. Bringing together the most varied industrial interests in Portugal, it plans to develop new products, processes and services resulting from the total or partial incorporation of goods from the blue bioeconomy in new or existing value chains, with a real impact on the environment due to their responsible and sustainable nature, on the life of their consumers, and the country's exports.

Education

There are several scientific institutions (universities) relevant to the blue bioeconomy in Portugal and the Peniche region. Local public and private universities offer a range of programmes and training courses, such as:

- ✓ University Porto **–** School of Medicine and Biomedical Sciences.
- ✓ University of Porto **–** Sciences Faculty.

- ✓ University of Lisbon – Instituto Superior Técnico.
- ✓ University of Lisbon - Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa
- ✓ University do Algarve – School of Science and Technology.
- ✓ University of Açores – Faculty of Science and Technology.
- ✓ University de Aveiro.
- ✓ University da Beira Interior.
- ✓ University of Minho.
- ✓ University de Évora - School of Science and Technology.
- ✓ University of Madeira.
- ✓ University Nova of Lisbon.
- ✓ University of Católica.
- ✓ University of Trás-os-Montes e Alto Douro – School of life and environmental Sciences.
- ✓ Institute Polytechnic de Coimbra.
- ✓ Institute Polytechnic de Leiria.
- ✓ Institute Polytechnic of Setúbal.
- ✓ Institute Polytechnic do Porto

The study programs available at these institutions cover a range of fields in blue Science, Technology, Engineering, and Mathematics. These include Bioengineering, Biochemistry, Aquatic Science, Marine Biodiversity, Biology, Marine Biology, Biotechnology, Maritime and Coastal Management, Marine Science, Ecology and Environment, Marine and Oceanic Engineering, and Environmental Sciences.

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Cross-collaboration between scientific institutions and companies is being developed in order to promote the valorisation of marine bioresources, sustainability of industrial processes and circular economy. Currently, in Peniche, cooperation in canned fisheries and fish processing industries is being established for the circularity of the processes and valorisation of byproducts. Byproduct valorisation encourages collaboration between different sectors, including agriculture, pharma, cosmetics, plastic, food and beverages. Algae harvesting and production also encourage cross-sector collaboration in the Peniche region thanks to the work of Instituto Politécnico de Leiria and MARE - Marine and Environmental Sciences Centre.

General remarks

An initial blue vision for Peniche was formulated during the CoPs meeting.
Envision a sustainable and innovative maritime economy deeply rooted in its historical bond with the sea, transitioning towards sustainable practices across key value chains like fish and macroalgae and fostering collaborative growth. Through community collaboration, workshops, and innovative projects, it seeks to protect marine resources while boosting local prosperity.
The following barriers can be highlighted:

- ✓ Licensing and regulation.
- ✓ Several Legal/IP constraints to innovate and develop new products.

- ✓ Intellectual property issues.
- ✓ Complex design of certification schemes.
- ✓ Lack of financial sector's knowledge on the Blue Bioeconomy aspects.
- ✓ Complex international or regional regulatory issues.
- ✓ Funding and cost of operations challenges.
- ✓ Complex mechanisms to receive funding.
- ✓ If the product is unable to meet the desired price per unit, it cannot be competitive in the market or match customer price expectations.
- ✓ Need of support in attracting or securing funding.
- ✓ There is no market demand for innovative added-value products.
- ✓ Difficulty in determining real market needs.
- ✓ Support needed in defining and developing a business model.
- ✓ Access to bioresources/biobanks is complicated or not clear.
- ✓ Difficulty in accessing pilot scale units.
- ✓ Difficulty in finding national cooperation partners.
- ✓ Difficulty in accessing local manufacturing facilities.
- ✓ Inappropriate political focus or strategy.
- ✓ Difficulty in penetrating existing value chains.
- ✓ Difficulty in hiring specialised human resources.
- ✓ Difficulty in getting sustainable and reproducible batch supply (adequate culture/harvest, adequate manufacturing technologies, adequate volumes yield).

8 Scotland, United Kingdom

Regulation

For Scotland, the main policy links the overarching "Economy Strategy". This covers everything related to the economy and links with the Environmental Strategy, the National Planning Framework, the National Transport Strategy, and the Fairer Scotland Action Plan. Included in the Economic Strategy is Scotland's overarching Blue Economy Vision: "Scotland's Blue Economy Vision". By 2045, Scotland's shared stewardship of the marine environment will support ecosystem health, improved livelihoods, economic prosperity, social inclusion, and wellbeing. Within the strategy, it is clearly specified that environmental, social and economic aims are inextricably interlinked, with a healthy marine environment underpinning Scotland's blue economy.

Figure 14. The region of Scotland.

Environment—Scotland's marine and interlinked freshwater and coastal environments are restored, adapted, and resilient to climate change and sustainably managed to achieve good environmental status.

Social—The blue economy is managed to ensure fairer, healthier, happier communities across Scotland, with equal access to the benefits of marine resources. All of Scotland's population is aware of and engaged with its fantastic marine and freshwater resources, and they value the part they play in their lives. Scotland has improved governance, transparency, and shared stewardship of the blue economy.

Economic—A healthy marine environment is enabling innovative blue sectors. Blue sectors are resource efficient, internationally competitive, and operating to meet net zero and nature-positive commitments. They are supported by a skilled workforce that is inclusive, diverse, and fair, reflecting our commitment to equality and human rights.

This further links to the UK Marine Policy statement for "A marine environment, which is clean, healthy, safe, productive and biologically diverse, managed to meet the long-term needs of nature and people", and recognises that Scotland's economy and society are embedded in nature.

Other main strategic documents and legislation relevant to the blue bioeconomy are:

- ✓ Scotland's National Marine Plan (2015), currently being updated.
- ✓ Future Fisheries Management Strategy 2020 to 2030.
- ✓ Environmental Strategy.
- ✓ National Island Plan: Annual Report 2023.
- ✓ The National Plan for Scotland's Islands (2019).
- ✓ Island's Strategy 2020.
- ✓ Scotland's National Strategy for Economic Transformation (2022)
- ✓ Scotland's National Planning Framework 4 (2023)

The documents listed above are very high-level and cover all the industries that work in the marine environment. One challenge with the blue bioeconomy is that it encompasses both marine and land activities, from biomass production to processing.

So, for example, fisheries in terms of reducing waste from the industry sits within the Scottish Government's Zero Waste Scotland 2015 policy document. It is complicated to navigate the relevant policy documents and how they relate to the blue bioeconomy. In a way, it is more acceptable in Scotland because of the well-established industrial biotechnology/bioeconomy sector sitting within the IBioIC Innovation Centre (https://www.ibioic.com/IBioIC – a networking and support organisation that connects industry, academia and government).

The planning system for aquaculture products is regional, so each county will have its own planning departments looking at the applications. However, the planning departments use the National Marine Plans and the National Planning Framework to inform the Local Development Plan. In other words, the regulatory planning challenges nationally filter down to be the same at a regional level. The added dimensions are the regionally relevant human elements of local politics, variable social license for operations, and the planning officers themselves.

The environmental regulations and enforcement sit at a national scale with Nature Scot, the Joint Nature Conservation Committee, the Scottish Environment Protection Agency, and the Marine Directorate through the Marine Directorate's Licensing and Operations Team. These agencies follow national policies but also have regional plans for contextual environmental/designation relevance. Some of the regions are not the same as the county regions. For example, there are 32 Scottish counties

(councils) and 11 Marine Regions. The coastal counties overlap in their statutory function with the marine regions but do not cover the same territory. Navigating this system can be a significant challenge to start-ups and SMEs.

Policy implementation often lags policymaking. In some cases, the funding instruments and the Scotland-UK Government relationship (and funding mechanism through the Barnett formula, which determines a significant portion of the UK government's funding to the Scottish Government) are also at the mercy of this lag.

Financing

Blue bioeconomy business is funded by regional and national grant organisations, including government research grants (Innovate UK, UKRI, Horizon Europe) and government business grants (Scottish Enterprise, Highlands and Islands Enterprise, Business Gateway). Scottish Enterprise offers limited funding through the following mechanisms: Scottish Venture Fund, Scottish Co-investment Fund, Energy Investment Fund, Workplace Innovation Fund, Food and Drink Collaborative Fund, NGO research grants, NGO business grants, private grants through trusts, etc. In a small number of cases, community organisations, community shares, and/or kick-starters are used to raise funds.

Securing public funding for the blue bioeconomy is a challenge in Scotland (national) and Argyll and Bute (regional). Funding is largely related to the wider socio-political climate in the UK and the current UK Government Budget (and the subsequent Barnett Consequentials—a block grant that funds many of the Scottish Government's services and funding streams). Currently, all innovation sectors are struggling with funding cuts as the UK Government focuses on issues it perceives to be relevant to the voting public.

Private funding is sporadic, opaque, and largely related to the interests of those who hold the funds. Assessing how much private funding has been made available or has been directed at the blue bioeconomy at a regional scale is hard, as this is not publicly available information.

Education

Scotland has a long history of scientific research in the blue bioeconomy. The study/training programs in scientific institutions that have a link to the blue bioeconomy within the Argyll and Bute Local Authority (region) are:

- ✓ EIT Food Algal Biotech Professional Development Course **–** Scottish Association for Marine Science **(**SAMS), Cambridge, Matis and Fraunhofer Institute for Interfacial Engineering and Biotechnology.
- ✓ MSc in Industrial Biotechnology University of Strathclyde contains a module on Blue Biotechnology.
- ✓ Algal Biotechnology and Bioeconomy Masters in Science (MSc) – University of the Highlands and Islands (UHI).

There are three scientific institutions relevant to the blue bioeconomy in this region: Scottish Association for Marine Science (SAMS), University of Stirling Marine Environmental Research Laboratory, Argyll College University of the Highlands and Islands (UHI).

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

The blue bioeconomy is firmly established in the region. The industrial biotechnology/bioeconomy sector is based within the IBioIC innovation Centre (IBioIC – a networking and support organisation that connects industry, academia and government). This has been in operation for 10 years and is now funded for a further 10 years. Its remit is to promote the bioeconomy within Scotland. This includes the blue bioeconomy. The IBioIC innovation centre plays a significant role in this, although the two are not always directly linked. Additionally, support may be available from Innovate UK and Interface. SAMS also enjoys excellent links with blue bio businesses in the region, both in terms of research and SAMS Enterprise.

SAMS Scottish Association for Marine Science

Figure 15. The Scottish Association for Marine Science.

European Marine Science Park

Figure 16. European Marine Science Park.

Cooperation between the business sector and public institutions in the blue bioeconomy is very strong in this region. First of all – European Marine Science Park (EMSP). Situated on Scotland's stunning West Coast, EMSP provides quality office and laboratory accommodation in an established location for marine science. It's a world-leading cluster of marine research and business expertise. Some initiatives include:

- ✓ ASTRAL – a European Union Horizon 2020 collaborative project that focuses on integrated multi-trophic aquaculture (IMTA) farming.
- ✓ BactMetBar – Environmental Deoxyribonucleic acid (DNA) metabarcoding as an alternative to macrobenthic assessments in fish-farm compliance assessment
- ✓ GENIALG – the Horizon 2020 Blue Growth project is the first industry-driven project bringing together pioneering companies in large-scale integrated European biorefineries and experts in seaweed cultivation, genetics and metabolomics to boost the seaweed industry.
- ✓ Blue Growth Farm – project aims at developing and demonstrating an automated, modular and environmentally friendly multi-functional platform for open sea farm installations of the Blue Growth Industry.
- ✓ IMPAQT – aims to develop and validate in-situ a multi-purpose, multi-sensing and multi-functional management platform for sustainable Integrated Multi-Trophic Aquaculture production.
- ✓ Macrofuels – aims to develop and validate in-situ a multi-purpose, multi-sensing and multi-functional management platform for sustainable Integrated Multi-Trophic Aquaculture production.

General remarks

The blue bioeconomy is not considered as a separate entity from the economy as a whole. It is seen to sit within both the Scottish Blue Economy and the Scottish Economy. The main barriers for both are having the correctly trained workforce, the

technology, social and political backing and how that is developing to meet the increasing demand for products from the bioeconomy and cost of production.

9 Västra Götaland, Sweden

Regulation

Figure 17. The region of Västra Götaland.

The Swedish Strategy for Sustainable Economic, Social and Environmental Development is a national strategy which addresses the three dimensions of sustainable development: economic, social and environmental. It builds on the 2002 World Summit on Sustainable Development held in Johannesburg, the EU strategy for sustainable development and the so-called Lisbon process. It sets out three overarching objectives: poverty reduction, promotion of sustainable consumption and production patterns and preservation of the natural resource base for economic and social development. Government efforts are based on eight core areas: the future environment; limitation of climate change; population and public health; social cohesion, welfare, and security; employment and learning in a knowledge society; sustainable economic growth and competitiveness; regional development and regional conditions; development of sustainable community planning.

Within this context, four issues of strategic importance to the future of sustainable development are identified: a) Environmentally driven growth and welfare; b) Good health; c) Coherent policies for sustainable community planning; d) Child and youth policies for an ageing society.

Regarding the blue bioeconomy, the Swedish Sea and Water Authority and the Swedish Agency for Agriculture have produced a joint strategy for Swedish fisheries and aquaculture (2021-2026). The government decided in 2022 to appoint an investigation that will produce proposals for a strategy for a sustainable, competitive, and growing Swedish bioeconomy that includes the blue bioeconomy.

The national food strategy, with a view to the year 2030, is the first Swedish food strategy to cover the entire food chain. Focus on an increased and sustainable production of food that can lead to more jobs and sustainable growth throughout the country. "Blue Food" is one area that has recently been gaining attention and is expected to be seen more clearly in the next "Livsmedelsstrategi 2.0" that is currently being drafted under 2023.

At the regional level, there is an approved Regional Development Strategy for Västra Götaland 2021-2030. The regional development strategy is an overall strategy for the regional growth and development work in Västra Götaland. The aim is to create an overall picture of the region's assets, opportunities and challenges and what is jointly prioritised to gather strength around. The strategy can cover several different areas such as business development, traffic and infrastructure, environment and participation. The regional development strategy forms the basis for other

programmes and strategies at local and regional level. The strategy is drawn up based on an analysis of the specific conditions for sustainable regional development in Västra Götaland. It is developed in collaboration with municipalities, municipal associations, business organisations, associations, the county administrative board and other relevant government authorities and actors working for Västra Götaland's development. The regional development strategy governs the Västra Götaland region's investments in regional development, together with the annual budget. The blue bioeconomy is one of the priority areas that has been determined to have a high potential for growth, competitiveness and sustainable development in the region. Strategic significance is placed on "Food, bio-based materials and renewable energy with a focus on production and further processing." ...from marine environments.

Regulatory aspects of the blue bioeconomy can also be found in other documents. The Environmental Code aims to promote sustainable development, which means that present and future generations will be assured of a healthy and good environment. Such a development is based on the realisation that nature has a protective value and that man's right to change and use nature is combined with a responsibility to manage nature well. The national strategy for circular economy points out the direction for the transition to circular production, consumption and business models as well as non-toxic and circular material cycles. The Swedish Agency for Marine and Water Management is the responsible Government agency tasked to protect, restore and ensure sustainable use of freshwater resources and seas, including fisheries management. The Swedish Board of Agriculture is the government agency responsible for the areas of agriculture, fishery and rural areas. Their responsibilities include topics related to aquaculture (cultivation). They have developed a Strategy for Swedish fishing and aquaculture 2021–2026 – healthy ecosystems and sustainable use. As well as an Action Plan for Swedish Aquaculture 2021-2026.

Today, regulations and regulatory organisations are fragmented and considered a hinderance to the sector's development. A national strategy that specifically details the blue bioeconomy is needed. Today, the development strategy for this sector of the economy is not clear, and both regulations and their regulators/authorities are fragmented, resulting in barriers to growth in this sector.

Major barriers:

- ✓ The permit process: The permit process refers to the process by which activities that may affect the environment, including the water environment, are assessed and approved by authorities. It can be a complex and time-consuming process with the aim of ensuring that the operations meet the established environmental quality standards. For companies seeking aquaculture permits, various approvals are needed from several different authorities. This process is time-consuming and expensive and has been known to hinder the growth of the sector. The authorities are not coordinated in their review process, so a business has to navigate and pay fees for all the processes on its own. The need to streamline the regulatory process for permits and licenses has been noted already in 2009 and continues to be a major point of efforts to change. It is a major barrier.
- ✓ Strict environmental quality standards and the water directive: guidelines established to ensure a good ecological and chemical status for the aquatic environment. In Sweden, the Water Directive is referring to legislation within the EU that aims to achieve a good water status for all bodies of water, including lakes, streams and coastal waters. It establishes overall goals and requirements to protect

and improve water quality. In 2015, Sweden was found guilty of non-compliance with the EU water directive, and the ensuing consequences were the stricter and harder implementation of water quality standards in Sweden. The changes in the view of water management and quality that occurred around that time moved previous practices to stricter implementation of water quality requirements and standards to achieve and maintain good water status. The more stringent regulations have resulted in the non-issuance of offshore aquaculture permits over the past decade. These strict requirements for environment and water also affect the land-based fish aquaculture permit processes as well making it difficult for businesses to establish themselves and increasing the costs of establishing businesses along the West Coast.

For the last 20 years, municipalities in Sweden have formulated their own strategies, guidelines, and regulations tailored to the specific needs and resources of their area. They have jurisdiction over their own coastal waters from the shoreline and prepare their own plans based on regional considerations. In some cases, regional authorities have the power to make decisions and set regulations within their jurisdiction. In other cases, certain aspects may require the involvement of higher-level authorities, such as national or federal agencies, to ensure consistency and alignment with overarching policies. There is a challenge here as it requires that sufficient competence in the blue bioeconomy at the municipal level would be available to make good decisions. These plans, of course take into account environmental, social, and economic factors, as well as the potential impact on existing industries and local communities. After the municipality has prepared its plans, it is common for them to be sent to the County Board or similar regional governing bodies for review and approval. At this stage, the state's interests and objectives come into play. The state authorities will assess the plans in terms of their alignment with national policies, environmental regulations, and economic considerations. Once the plans are approved, there is a responsibility on the municipal level to ensure effective implementation and monitoring of operational activities related to the blue bioeconomy. This may involve establishing regulatory frameworks for licensing, permitting, and monitoring of activities such as aquaculture, marine biotechnology, renewable energy projects, or sustainable fisheries.

In the region of Västragötaland, there are currently no regional specific policies for the blue bioeconomy at the regional level but initiatives at the regional level are ongoing to gather and establish better cooperation between actors that represent the various stakeholders in the blue bioeconomy at the regional and local municipal levels. For example, there is a project financed by the region to establish a cooperative platform for innovation and support organisations to the blue biomarine industries. Innovatum Science Park has been designated as a "hub" for the blue bioeconomy from the regional government and many of the activities it does are to support the regional government to deploy the current regional strategy and also to gather input for a new strategy moving forward. The regional government has set an ambitious vision where the blue bioeconomy is highlighted as a strategic area for development along the coastline.

There are good examples of collaborations between authorities, but there are still many variations in the interpretations of what should be done. There is an initiative to develop a "One-stop-authority - shop", a sort of gateway to the authorities for those seeking permits where the authorities could meet to discuss different errands and coordinate more effectively. However, this is only in the early testing phases and has

not been deployed yet. The blue bioeconomy is complicated – it includes many different policies regarding aquaculture, animal and food-related, animal health, animal protection, and water quality as well as 8-10 different permit processes that are not connected. Implementation is definitely a challenge. As well, aquaculture in Sweden is quite a small industry in comparison with other more developed industries such as forestry or agriculture, so there have been more resources available and more competencies built over the years. There is a lack of available blue bioeconomy competence across the country; for aquaculture, there may only be one operation, and in others, 10 – so implementation is a challenge to cover all the needs in each county. There have been earlier attempts to try and centralise competencies in aquaculture, for example in fish health.

Financing

The Swedish Agricultural Agency has received a government mandate to, within the framework of the Food Strategy 2020–2025, further develop the promotion work of aquaculture and, through coordination of the Swedish aquaculture industry, create a long-term sustainable and competitive food chain. Further development must take into account refinement and innovation opportunities for the aquaculture industry, as well as promote regulatory simplification, technology development, and cooperation. The Swedish Agricultural Agency had to use 6 million kronor for the implementation of the measure in 2020. For 2021–2025, kronor 6 million is estimated annually. Universities, companies, and organisations can apply for financing for various projects and investments.
There are seed loan programs for innovative start-ups and SMEs, innovation checks to do third-party verification or testing or Intellectual Property analysis, and Research and Development checks for SMEs, but all of these are for a smaller amount and often require matching finance by the start-up or SME (50/50).

Education

The strong food research and academic institutions and marine biotechnology are growing. Much of the biotechnology in Sweden is dedicated to MedTech and health tech – there is a need to increase "blue tech". But also, the crossover between businesses and academics needs to be strengthened so that the scientific research being conducted really reflects the needs of the businesses and that, vice versa, the results of the research can be adopted into the businesses.
The Swedish western region has strong marine research and development institutions and organisations: Kristineberg Marine Research Center, Tjärnö Marine Laboratory, Gothenburg University—Department of Marine Sciences, Center for Sea and Society, and Chalmers—Department of Mechanics and Maritime Sciences (anti-fouling).

A good example of business sector cooperation with scientific institutions in the blue bioeconomy

Samverkansplattform för den biomarina näringar: Collaboration Platform for the biomarine industries. It is a regionally financed project that aims to bring together actors supporting startups and SMEs in the blue bio marine industries to better coordinate efforts of action and support in the region and engage companies in collective actions as a sector.

SVOS (Svensk vattenbruk och sjömat) – Swedish association for aquaculture and seafood – business members organisation that works to influence the direction and decisions that are the basis for the production and use of the sea's raw materials, mussels, oysters, barnacles and seaweed. The organisation and its members are active in supporting regional and national strategy work.

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General remarks

The barriers to the development of the blue bioeconomy in Västra Götaland:

- ✓ The current water quality directive and environmental standards present a challenge for the Swedish fishing industry. To overcome this, Sweden requires greater support to comply with these regulations. Otherwise, Sweden risks offsetting its environmental footprint to other countries, such as Norway, where they import more than 70% of the fish due to the lack of cultivation opportunities in their own water.
- ✓ Effective planning – aquaculture is not included in all municipal planning – where to place it.
- ✓ Access to concentrated competencies at the national level.
- ✓ Resources: a small industry will remain small – if it is competing for the same financial resources as other bioeconomy sectors that receive a lot of financing (forest, agriculture).

The process of giving permits is considered one of the greatest hindrances. Both regional and local authorities are involved, but the process is not very well coordinated. The company applying will have to navigate the various applications separately and on their own. Another hindrance is the planning processes at the regional and municipal levels that need to take into consideration the blue bioeconomy. Oftentimes, there are knowledge gaps here, and municipalities are not informed enough about the potential of the blue bioeconomy or the environmental/social/economic benefits to the municipality. The aforementioned aspects will be considered when formulating the blue bioeconomy vision in Västra Götaland.

Summary

This report analyses the current situation of the blue bioeconomy in nine pilot regions in terms of roadmaps, regulation, financing, and education. The analysis revealed that regions' progress in the context of blue bioeconomy regulation varies. Some regions already have quite clearly defined strategies for the partly regulated sector, while in other countries, only the first steps towards it are being taken.

It was noticed that blue bioeconomy at the regional level is usually only superficially mentioned in national strategies, so the primary aim should be to initiate as concrete inclusion of blue bioeconomy into regional strategies as possible, which could be facilitated by creating a blue bioeconomy strategy. Today, the development strategy for this sector of the economy is not clear, and both regulations and their regulators/authorities are fragmented, resulting in barriers to growth in this sector. On the other hand, the study revealed a shortage of blue bioeconomy experts and specialists in almost all countries, so regions should collaborate on this issue. This report presents some good examples of the crossover between business and academics, but it is believed that this should be continuously strengthened.

Blue bioeconomy is highly innovative, so special financing for startups should also be a priority direction. Representatives of all regions agree that an example of collaboration between the business sector and scientific institutions are clusters; their mission is indeed to foster the interactions between different kinds of stakeholders to boost innovation. Undoubtedly, they can be not only local but also international. A recommendation to support the business sector in the field of blue bioeconomy could be a reinforcement of dedicated public instruments for R&D.

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