BlueRev

Bio-based revitalisation
of local communities

Deliverable 4.4

A best practice guideline including the best practices coming from the 3 pilot regions

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0.3	28/01/25	APRE	Implementation of revisions
1.0	06/02/2025	APRE	Final document

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Table of Abbreviations and Acronyms

Abbreviation	Meaning
APRE	Agenzia per la Promozione della Ricerca Europea
CBI	Community-Based Innovation
CI	Collective Impact
DFBG	Distretto della Pesca e Crescita Blu
DMP	Data Management Plan
EMU	Estonian University of Life Sciences
ESG	Environmental, Social, Governance
FAIR	Findable Accessible Interoperable Accessible
FBCD	Food & Bio Cluster Denmark
LCA	Life Cycle Assessment
LL	Living Lab
LNG	Liquefied natural gas
FBCD	Food & Bio Cluster Denmark
LOBA	GLOBAZ, S.A.
NG	Negotiated Governance
NIBIO	Norsk Institutt for Biookonomi
PCP	Pre-Commercial Procurement
PPP	Public-Private partnership
R&D	Research and Development
RISE	Research Institutes of Sweden AB
STEM	Science, Technology, Engineering, and Mathematics
SBMC	Sustainable Business Model Canvas
SME	Small And Medium Enterprise
UiA	Universitetet I Agder
UNIPA	University of Palermo
WP	Work Package

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1 Executive Summary

Coastal communities are grappling with challenges from the climate crisis, rural depopulation, and economic pressures. The BlueRev initiative addresses these issues by empowering coastal communities, reimagining policy frameworks and fostering adaptable governance structures.

BlueRev aims to drive social and environmental impact within local communities across pilot regions (Denmark/Greenland, Italy, Estonia) by establishing sustainable and socially responsible business models in the blue bio-based sector. This report highlights best practices from pilot regions in fish by-products valorisation, showcasing innovative business models in Greenland, Denmark, Estonia, and Sicily.

- **Greenland:** Transforming fish processing waste into dog food.
- **Denmark:** Developing an Omega-3 enriched functional beverage.
- **Estonia:** Utilizing red algae for nutraceutical and cosmetic applications.
- **Sicily:** Promoting the sustainable valorisation of by-catch, specifically *The Ritunnu*.

The guidelines developed in this report will serve as a foundation for scaling these practices within the blue bioeconomy and beyond. They provide practical, actionable steps for implementing sustainable business models and are intended to support future efforts to expand the adoption of circular economy principles in the blue bio-based sector.

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2 Introduction

In today's competitive global marketplace, sustainability and innovation are crucial and indispensable for creating new value propositions in the blue bioeconomy. The blue bioeconomy refers to the sustainable utilization of marine and aquatic biological resources to produce innovative goods and services that drive economic growth and support sustainable development. Focusing on minimizing environmental impact while maximizing the economic potential of marine resources, the blue bioeconomy encourages businesses to utilize blue bio-based materials. This approach contributes to climate neutrality, promotes sustainable resource management, and reduces reliance on fossil-based materials. Blue bio-based products offer a range of significant sustainability benefits. They provide low-carbon alternatives to traditional products, helping to address global challenges such as greenhouse gas emissions and climate change. These products also support the preservation of marine ecosystems by encouraging responsible harvesting practices and alleviating pressure on overexploited resources. They are increasingly utilized in biofuels, biodegradable plastics, pharmaceuticals, cosmetics, and food: for example, algae-derived bioplastics offer a promising alternative to conventional plastics, combining functionality with environmental responsibility. At the core of this vision are circular economy principles, which emphasize resource regeneration and the extension of product lifecycles. By relying on renewable marine resources, the blue bioeconomy ensures continuous replenishment and supports the transition away from finite, unsustainable resources.

In the BlueRev project, developing and scaling the best sustainable business models is achieved by incorporating effective social and governance practices, ensuring stakeholders understand their value and potential. This understanding fosters trust among consumers and supports the widespread adoption of environmentally and economically sustainable innovations.

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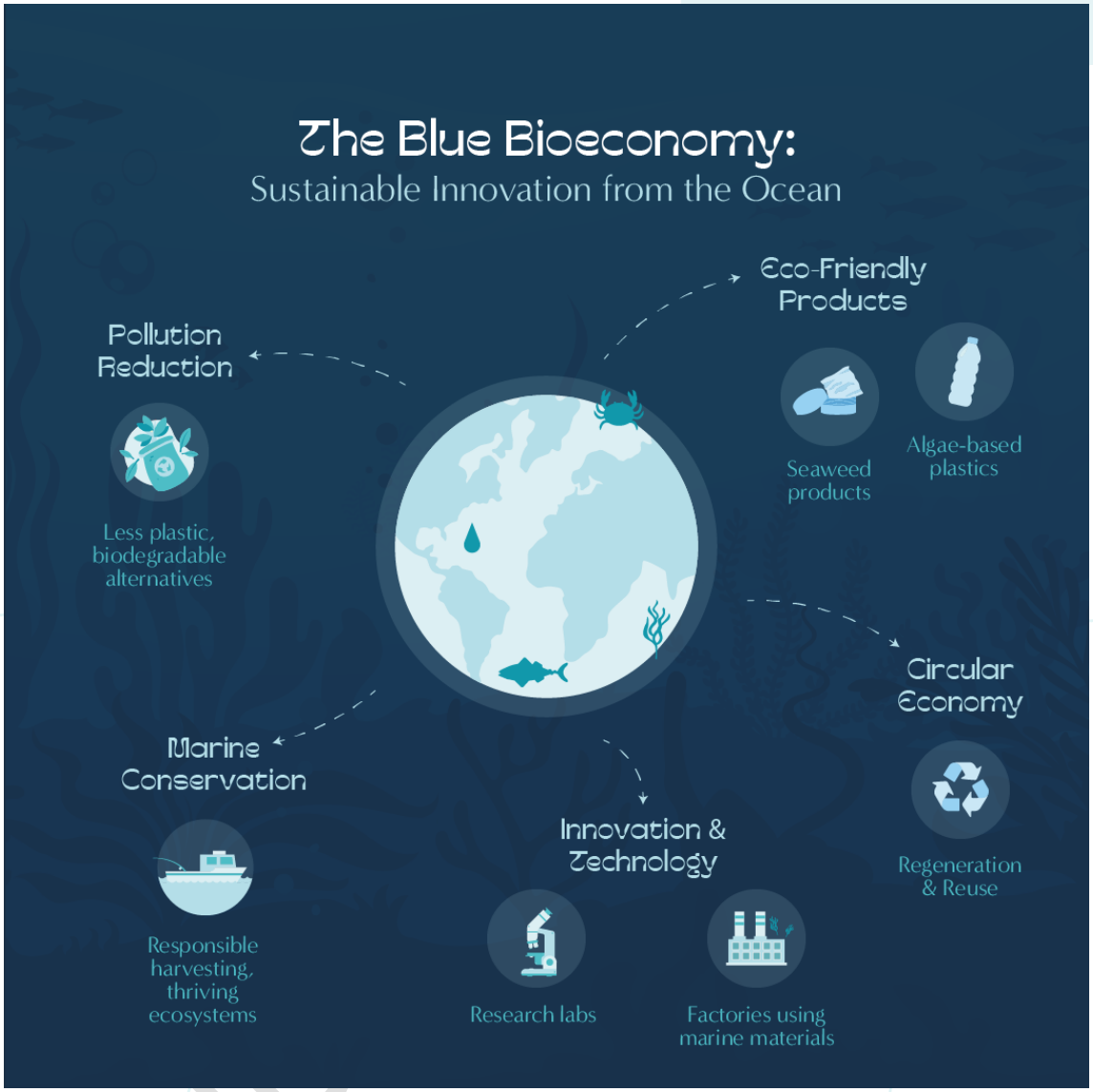

Figure 1: The blue bioeconomy: sustainable innovation from the ocean

2.1 Objectives of this deliverable

The primary purpose of this report is to develop best practice guidelines coming from the BlueRev project and based on insights gathered from co-creation sessions conducted across the pilot regions in Denmark, Greenland, Estonia, and Italy. These sessions, which included workshops, interviews, and focus groups with a diverse range of stakeholders—such as local businesses, government representatives, researchers, and environmental organizations—focused on leveraging local capacities and addressing region-specific challenges and opportunities.

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This document serves as the deliverable within Work Package 4 (WP4) of the BlueRev project, focusing on developing best practice guidelines for scaling sustainable business models within the blue bioeconomy. The objectives of D.4.4 are as follows:

- To present key findings from co-creation workshops across pilot regions in Denmark, Greenland, Estonia, and Italy.
- To provide a step-by-step guideline for establishing a sustainable and innovative business model using the SBMC framework.
- To share actionable recommendations and practical advice for scaling the identified best practices in the blue bioeconomy.

2.2 BlueRev in a nutshell

The BlueRev project is dedicated to revitalizing local communities across Europe by introducing innovative bio-based business models, governance frameworks, and social innovations within the blue bioeconomy sector. It also aims to raise awareness of the widespread benefits that the adoption of bio-based solutions can offer.

To achieve these objectives, the project analysed various value chains, including the use of fish by-products, marine bioactive compounds, and red algae biomass. This analysis focused on identifying both social and economic barriers and opportunities in three pilot regions: Denmark/Greenland, Italy, and Estonia. By leveraging advanced monitoring systems and indicators, the project assessed the effectiveness of these value chains. The insights derived were then used to propose improvements to governance frameworks and sustainable business models in these regions, with the overarching goal of revitalizing local communities and promoting environmentally responsible practices.

For additional information, please visit the homepage at https://www.bluerevproject.eu/

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3 Methodological Approach

Scaling sustainable business models in the blue bioeconomy requires understanding market trends, consumer behaviour, financial, social and governance barriers. In addition to that, it is crucial to understand psychological drivers like social norms, perceived risks, benefits, identity, and cultural values. Incorporating these insights into the model can refine feedback mechanisms, address resistance points, and enable targeted communication and educational strategies that encourage sustainable practices within specific communities, boosting local economies. Such an approach fosters engagement within specific communities, and it is essential to involve relevant stakeholders. To gather their opinions, feedback, and insights on the topic, to discuss **Challenges and Barriers, Opportunities and Incentives**, **Cultural and Social Dimensions, Communication and Education** several co-creation sessions were organized. Additionally, a list of important questions was developed and provided to conduct structured interviews, ensuring a comprehensive understanding of stakeholder perspectives. The structured interviews, combined with the co-creation sessions, created a platform for stakeholders to share their perspectives and contribute to shaping sustainable and inclusive strategies in the blue bioeconomy.

The work done has been following a step-by-step approach, each supporting the design, validation, and potential application of **social innovation, governance framework and business models** tailored to the blue biobased sector.

The activities described in the following phases have been implemented over time:

Phase 1: Stakeholder Analysis and Stakeholder Engagement

In this step, we have identified and engaged key stakeholders across each pilot region, including government officials, industry leaders, academic institutions, and local communities.

For additional information on this step, how to engage stakeholders, see D2.1, available on the project website.

Through workshops, seminars, one-to-one meetings/interviews and collaborative sessions stakeholders have co-designed practical models fostering social responsibility in sustainable practices.

For additional information on the questions used, and to take inspiration on the types of questions to ask stakeholders, see D3.1, available on the project website.

Phase 2: Profiling and Refining Social Innovation, Business and Governance Models

During this phase we profiled the initiatives within each pilot region, detailing the processes, enabling factors, barriers, and outcomes.

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For additional information on this step, see D3.2, D3.4, D3.5, D3.6 available in the project website.

Phase 3: Developing Frameworks for Responsible Behaviour

Building on the insights gained in Phase 2, this step developed frameworks integrating responsible behaviours into blue bioeconomy practices.

For additional information on this step, see D4.1, D4.2, D4.3 available on the project website.

3.1 Social Innovation

Social innovation models provide frameworks for implementing transformative changes in complex socio-ecological settings, especially when addressing intertwined economic, environmental, and social issues. Each BlueRev pilot region demonstrates unique social innovation models addressing specific regional challenges, such as regulatory constraints, workforce limitations, and economic and environmental sustainability.

The semi-structured interviews used included key indicators that capture the extent of local community participation, the role of marginalized groups in innovation processes, and the alignment of innovations with community needs. This engagement has been crucial for ensuring that social innovation models are aligned with local needs and preferences. By examining each model's contextual factors, we highlighted how different social innovation approaches can be adapted and replicated, the interaction with existing governance structures and the opportunities to embed sustainability principles across the value chain.

3.2 Governance

Governance structures play a crucial role in enabling or constraining business model innovation within the blue bioeconomy sector. The governance landscape, comprising multilevel interactions between public institutions, regulatory frameworks, and industry stakeholders, fundamentally shapes the environment in which new business models can emerge and scale. This integrated approach to governance support recognizes that business model innovation in the blue bioeconomy requires both structural enablers and dynamic capabilities to navigate complex sustainability transitions.

The analysis supported using the canvas (Table 1), investigated the three aspects: the past, present, and future contexts and critical conditions for the value chains/by-products/solutions related to the governance processes, to anchor the results regionally and locally and to priorities and provide depth new governance recommendations.

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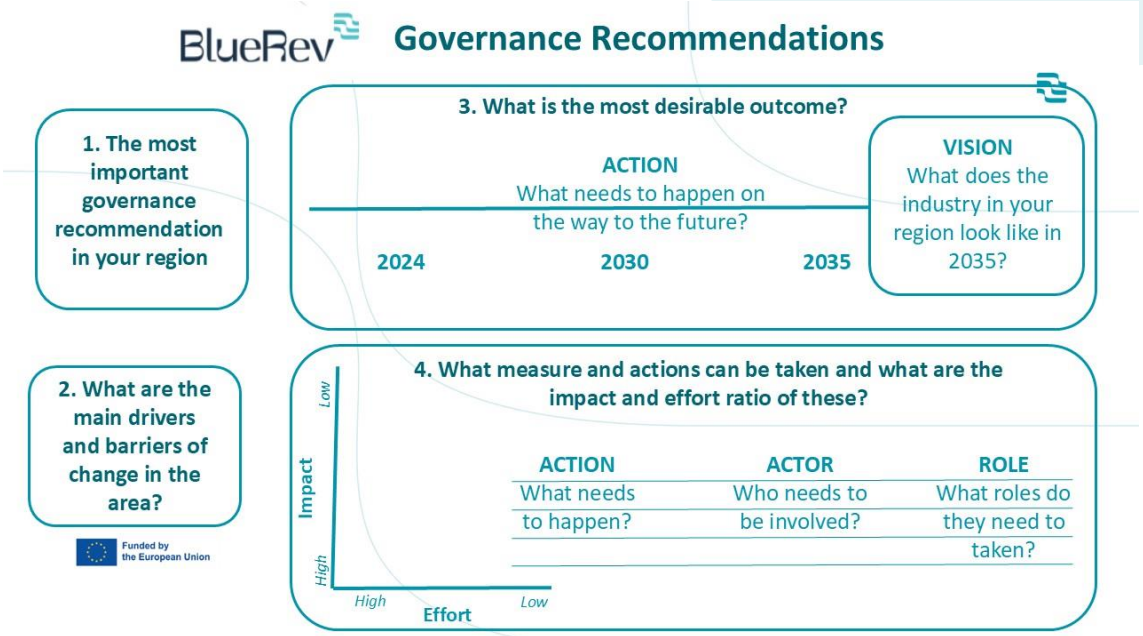

Table 1: Canvas for development of governance recommendations

3.3 Business

A Sustainable Business Model should integrate governance and social innovation to ensure a cohesive and supportive framework while assessing the potential for replicating successful business models across different European regions with similar resources and challenges. For this purpose, the specific structured template of the BlueRev SBMC, (Table 2) was used. This template aims to embed sustainability directly into the business's core, making it a fundamental aspect of strategic planning rather than a mere add-on. The SBMC provides a structured framework that visually maps essential elements, offering a clear overview of a company's value proposition, customer interactions, cost and revenue structures, and other critical components. While it incorporates features from social innovation and governance recommendations, the SBMC does not solely focus on these aspects but rather integrates them into the broader picture. Additional details are provided below.

- **Customer Segments**: Defines the target customers for whom the organization is creating value, identifying primary and secondary customers or any niche audiences.

Guidelines to follow: Identify your **target customers** and their characteristics. Think about the different groups of people or organizations your business aims to serve. Ask: Who are your most important customers? What are their needs, preferences, and behaviours?

- **Value Proposition**: Articulates the unique value the business provides, addressing customer needs or solving specific problems through tailored solutions.

Guidelines to follow: Define what makes your product or service **unique** and valuable. Specify the **problem you're solving** or the **need you're fulfilling** for your customers.

Assess competitors offering and position in the market. Ask: Why would customers choose your solution over others?

- **Channels**: Outlines the mediums through which value is delivered to the customer, focusing on efficient, cost-effective, and integrated methods for reaching target segments.

Guidelines to follow: Determine how you will deliver your product or service to your customers. Include both physical and digital distribution methods (e.g., retail, e-commerce, social media, etc.). Evaluate the costs and benefits of different communications and channels. Ask: How do your customers want to be reached?

- **Customer Relationships**: Details the nature of the relationships established with each customer segment, considering retention strategies, acquisition costs, and customer engagement methods.

Guideline to follow: Decide how you will engage and maintain relationships with your customers. Consider how you will **attract**, **retain**, and **grow** your customer base. Ask: What type of relationship does each customer segment expect?

- **Revenue Streams**: Identifies how and where the business generates revenue, exploring customer payment preferences, pricing strategies, and the contribution of each revenue stream to overall profitability.

Guideline to follow: Identify how your business will **earn money**. Consider different pricing models (e.g., subscription, one-time sales, licensing). Ask: What are customers willing to pay for? How will they pay?

- **Key Resources**: Specifies the essential resources, including physical, intellectual, human, and financial assets, required to deliver the value proposition effectively.

Guideline to follow: List the **assets** required to deliver your value proposition. Include physical, intellectual, human, and financial resources. Ask: What do you need to operate effectively?

- **Key Activities**: Highlights the critical activities that must be undertaken to produce, deliver, and sustain the value proposition and ensure seamless customer interactions.

Guideline to follow: Define the most important **actions** your business must take to succeed. Include activities like production, problem-solving, platform/network management. Ask: What does your value proposition require?

- **Key Partners**: Identifies essential partners, suppliers, and networks that support core operations, providing access to resources and enhancing efficiency.

Guideline to follow: Identify the **partners** and **suppliers** you'll need to rely on. Think about strategic alliances, joint ventures, or external suppliers. Ask: Who can help you achieve your goals more efficiently?

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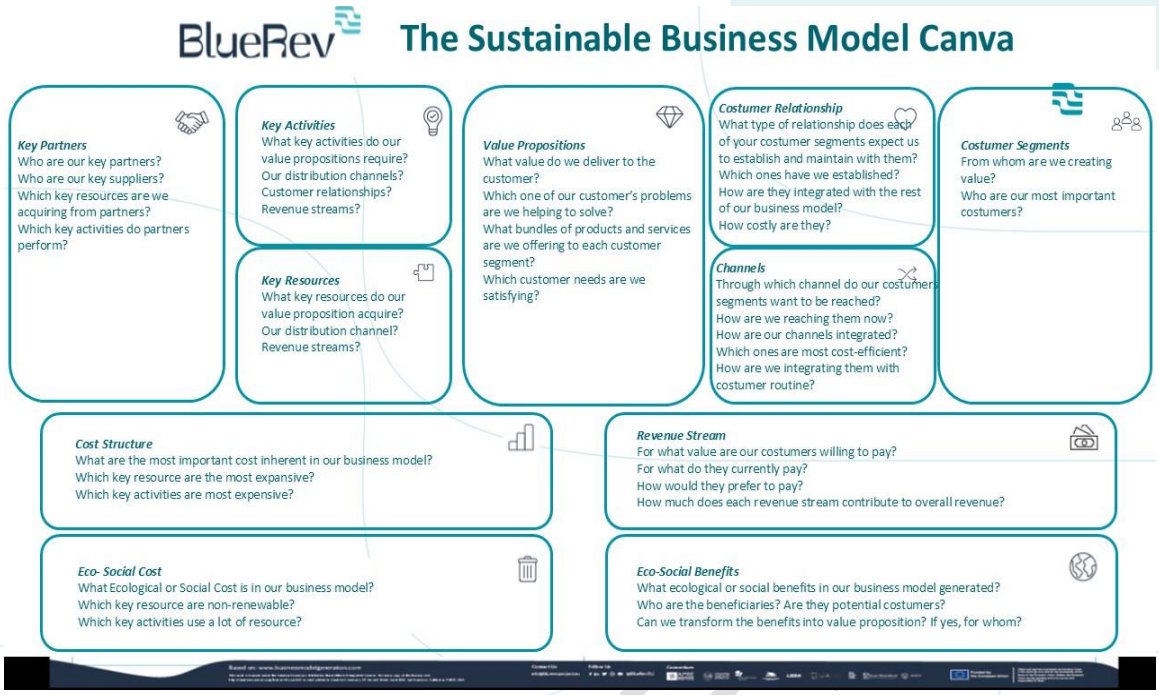

Table 2: The BlueRev Sustainable Business Model Canvas visual tool

- **Cost Structure**: Breaks down costs integral to the business model, identifying the most significant expenditures linked to resources and activities.

Guideline to follow: Understand **costs** associated with running your business. Distinguish between fixed costs (e.g., rent) and variable costs (e.g., production expenses). Ask: What are the most significant expenses, and how can they be optimized?

- **Eco-Social Cost**: This component evaluates the **ecological** and **social costs** associated with business activities, examining non-renewable resource dependency, environmental impacts, and potential social drawbacks of the business model.

Guideline to follow: Identify the environmental resources your business relies on and assess the sustainability of their use. Evaluate pollutants or by-products from your operations and determine ways to minimize or neutralize them; Investigate if your activities could negatively affect the health, safety, or livelihoods of any stakeholders.

- **Eco-Social Benefit**: This element assesses the **ecological** and **social benefits** generated by the business model, identifying specific beneficiaries and examining if these benefits could be leveraged as part of the value proposition.

Guideline to follow: Outline how does your business promotes environmental sustainability. Describe how your business improves community well-being or social equity. Highlight initiatives in place to educate stakeholders on eco-social issues.

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4 The BlueRev Case Studies – Best Practices per Pilot Region

This section provides an overview of the best practices identified in the pilot regions, beginning with the context and challenges, including key barriers such as regulatory complexity, logistics, and market constraints. It then outlines the social and environmental impacts resulting from the application of these best practices, alongside the potential and actual economic benefits and sustainability improvements. A step-by-step approach for adopting the model is provided, detailing the practical actions required by businesses, policymakers, and investors. Finally, practical tips for scaling and replicability are suggested.

Figure 2: Business idea from the Pilot Regions

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The participatory sessions were structured using iterative and collaborative process which allowed stakeholders to explore innovative solutions, refine their ideas, and ensure that the co-created models were both practical and aligned with local needs. The sessions involved defining value propositions, identifying target customer segments, and addressing key operational and ecological components, such as resource utilization, eco-costs, and eco-benefits. This comprehensive approach ensured that the resulting business models were economically viable while also being environmentally and socially sustainable.

4.1 Denmark and Greenland: Fish By-Products Valorisation Business Models

4.1.1 Context and Challenges

In **Greenland**, efforts are centred on valorising fish by-products to create new revenue streams and reduce environmental impact. Co-creation workshops brought together vessel owners, processing companies, food producers, policymakers and support organisations to ideate and refine business models that aligned with global circular economy objectives. Stakeholders identified three innovative applications for fish by-products, which were producing nutritional supplements e.g. fish-based oils or powders, production of cheeky cod (cheek meat from cod), which is a delicacy product and a business concept where fresh fish (by-catch), shellfish and seaweed are consolidated in a receiver station in Nuuk, near the new international airport for export and the local market. This commercially sustainable model for nutritional supplements leverages advanced extraction technologies to convert waste materials into high-value compounds, including Omega-3 oils and bioactive extracts, supporting sustainable fisheries, fostering local job creation, and enhancing community well-being.

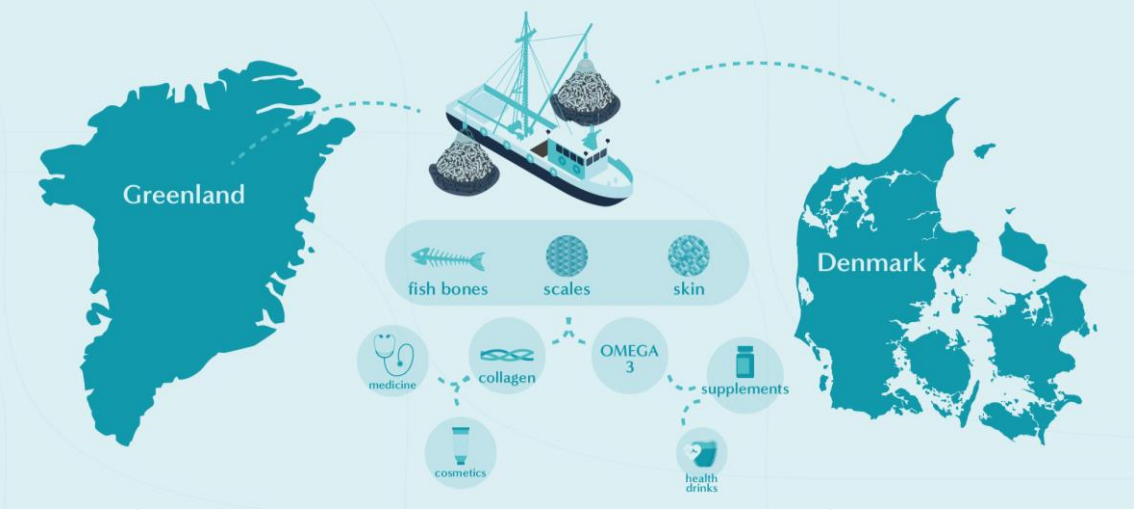

Figure 3: Fishery by-products in Greenland and Denmark

In **Denmark**, initiatives also focused on valorising fish by-products, integrating circular practices and wastewater management in the fish processing industry. Transforming cod by-products into nutraceuticals and advancing automated wastewater treatment systems

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to recover nutrients exemplified the alignment of technological innovation with sustainability goals. The Co-creation workshop facilitated iterative prototyping of nutrient recovery technologies, ensuring their feasibility and compatibility with existing operations. While these innovations underscored Denmark's strength in technological and circular economy integration, challenges such as high costs and logistical barriers highlighted the importance of scalable solutions.

4.1.2 Best Practice Identified

Below the full explanation of the best cases identified

Specific case I: Omega-3 functional beverage in Denmark.

The concept of maximizing the use of fish by-products has emerged as one of the key focuses for advancing sustainability and innovation in the blue bioeconomy within the pilot regions. Among the various ideas explored, the standout solution as the best practice is an innovative proposal to develop an Omega-3 nutrition drink targeted at the rapidly growing Chinese market. Industry partners highlighted how the dairy industry has significantly advanced compared to the fishing industry, diversifying dairy products extensively (e.g., multiple yogurt flavours, healthy dairy sports drinks with various flavours). The following section provides a step-by-step description of the proposed best practice based on the Omega-3 nutrition drink concept.

Social and Environmental Impact

The proposed Omega-3 nutrition drink exemplifies a best-practice model for aligning sustainability principles with market opportunities. It presents the potential to effectively leverage the resources and capabilities within the pilot regions and can be supported by social innovation and corporate governance recommendations (D4.1 and D4.3). The concept combines health-focused innovation with a circular approach by transforming fish processing waste into high-value, consumer-friendly products.

- **Environmental Benefits:** Utilization of waste materials to support circular economy principles.
- **Social Benefits:** Creation of local jobs, particularly in fish processing and sustainable production. Health Impact: Improved health outcomes from increased Omega-3 consumption, particularly among children, the elderly, and health-conscious professionals. Cultural Relevance: Alignment with local dietary habits and traditional medicine, ensuring greater consumer acceptance.

Implementation Guidelines

- **Co-creation with local stakeholders:** Collaborate with local fishing communities to gather raw materials from pilot regions. Engage with academic institutions to develop extraction technology production protocols and with financial institutions to invest in extraction technology
- **Product innovation and branding:** Diversification of nutrition drink; Campaigns focused on health benefits and sustainability

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- **Sustainability measures:** Use recyclable, biodegradable, or reusable materials tailored for long-distance shipping while minimizing carbon footprint. Leverage innovative packaging solutions such as algae-based bioplastics
- **Market access and distribution:** Engage Chinese government agencies, NGOs, and industry associations in the export strategy. Co-create solutions for aligning the business model with Chinese environmental regulations and consumer expectations.

Key To-Dos for Stakeholders

- **Fishing Cooperatives and Processing facilities**: Develop efficient collection and processing systems for fish by-products. Ensure the Omega-3 oil meets food-grade standards for refinement and encapsulation. Collaborate to optimize the supply chain for consistent raw material availability.
- **Product Development and Innovation:** Develop flavours appealing to Chinese consumers, focusing on popular tastes like lychee, green tea, and plum. Design eco-friendly, innovative packaging solutions using sustainable materials (e.g., algae-based bioplastics).
- **Regulation Bodies and Certification Organizations**: Ensure compliance with Chinese food safety and health regulations (e.g., CFDA standards). Obtain necessary certifications for sustainability and health, such as MSC and HACCP, to build consumer trust.
- **Distribution and Logistics:** Establish partnerships with online platforms. Develop carbon-neutral transportation solutions for product export, aligning with sustainability goals.

Scaling and replicability

The Chinese market offers a unique combination of opportunities for an Omega-3 nutrition drink, driven by its vast and diverse consumer base, growing health consciousness, and cultural acceptance of functional foods offered in flavours to suite Chinese's tastes such as goji berry and matcha. With an increasing emphasis on preventative healthcare and nutritional well-being among Chinese consumers, demand for health-focused products is surging, supported by a robust e-commerce infrastructure that enables efficient market penetration and scalability. An additional key factor in the market's appeal is the positive reputation and perception of food products originating from Europe. European products, particularly those from Scandinavia, are often associated with high quality, sustainability, and innovation, creating a favourable image that can

Figure 4: Omega-3 drink

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enhance consumer trust. The "***country of origin effect***" plays a significant role in the Chinese market, where European food products are perceived as premium and reliable. Scandinavian countries, known for their focus on sustainability, environmental consciousness, and high standards in food safety, further reinforce this positive perception. By tapping into these factors, the business can effectively position itself to meet the increasing demand for health-focused, sustainable products in this dynamic and lucrative market.

Possible expansion of the market:

- *Explore opportunities to integrate algae cultivation (i.e., Estonia) into the production pipeline as an additional resource for the Asian market.*
- *Develop dual-purpose products, such as Omega-3 oils and algae-based bioplastics, for export.*

Figure 5: Chinese market for omega-3 nutrition drink

Specific case II: Dog food from fish processing waste in Greenland.

Inspired by successful models from the Faroe Islands, where Marine Biotech, partnered with European firms to turn fish waste into valuable ingredients like peptides, collagen, oil, and proteins, small producers were encouraged to convert fish waste into high-value products. *Qalut*, a small business based in the South of Greenland used waste from fisheries to create an innovative dog food line. This approach not only generates local economic value but also aligns with Greenland's circular economy aspirations, ensuring sustainable growth rooted in community engagement and resource efficiency.

Social and Environmental Impact

- **Social impact:** empowers local communities to adopt sustainable practices by transforming part of the 45,000 tons of unprocessed fish waste—such as bones, skins, and innards—into valuable products like dog food, while respecting traditional lifestyles.
- **Environmental impact:** reduce waste production supporting circular economy.

Implementation Guidelines

- **Co-creation with local stakeholders:** Collaborate with local fishing communities to collect fish waste.
- **Product innovation and branding:** Position the pet food as high-quality product with eco-friendly credentials.
- **Sustainability measures:** Implement sustainable packaging and marketing strategies that align with circular economy principles.
- **Market access and distribution:** Online and local shops. Work with policymakers to overcome regulatory hurdles, if any, and obtain certifications.

Key To-Dos for Stakeholders

- **Local Fishing Communities**: Establish waste collection systems at fishing sites, train staff in proper waste segregation and storage and maintain quality standards for waste handling.
- **Processing Companies**: Develop standard operating procedures for waste processing. Invest in appropriate processing equipment. Create quality control systems and obtain necessary certifications and permits.
- **Local Government**: Create a supportive regulatory framework. Offer financial incentives or grants. Monitor environmental compliance.

Scaling and replicability

The scaling and replication of this fish waste valorisation model begins with a thorough assessment of local conditions, mapping waste volumes and evaluating infrastructure needs. This initial groundwork leads to a carefully managed pilot program where small-scale processing allows for testing and refinement of product formulations while

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gathering crucial market feedback. As the model proves successful, expansion follows naturally through increased processing capacity and broader collection networks, potentially incorporating new product lines. Throughout this growth, knowledge transfer remains essential – proper documentation, training programs, and mentorship ensure that successful practices can be effectively replicated in other communities, creating a sustainable cycle of implementation and improvement.

4.2 Estonia: Algae-Based Business Models

4.2.1 Context and Challenges

In Estonia, the focus was on leveraging algae resources, particularly red algae (*Furcellaria lumbricalis*), to develop sustainable business models for applications in cosmetics, nutraceuticals, bioplastics, and other value-added products. Co-creation workshops engaged academic researchers, SMEs, and environmental organizations, emphasizing empathy-driven ideation to address challenges such as the Baltic Sea's low salinity and lengthy permit processes for algae cultivation, and technical solutions for growing different macroalgae species and exploring the product development options. One notable innovation opportunity involved integrating macroalgae cultivation with offshore wind farms to maximize marine spatial efficiency and support nutrient management. Additional innovation opportunities lie in the exploration of integrated multitrophic aquaculture with the cultivation of green algae Ulva intestinalis and mussels in fish farms.

Figure 6: Algae-based business models in Estonia

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4.2.2 Best Practice Identified

Specific case: Nutraceuticals and cosmetic applications of red algae.

Since the 1960s, red algae from the shallows near Saaremaa has been used to produce furcellaran, a gelling agent widely utilized in the food industry. Harvesting this resource involves both trawling and beach collection, with current environmental permits allowing up to 2,000 tons of red algae trawling annually, although actual trawling volumes have yet to reach this limit. In addition to furcellaran, red algae are a potential source of microcellulose, highlighting an opportunity to repurpose processing by-products. Furcellaran production has traditionally focused on the food industry, but transforming furcellaran into powder opens new applications within cosmetics. This development is being explored to create a high-value ingredient, expanding beyond the conventional production of flaky furcellaran.

The challenges are:

- **Technical Operational and Logistical challenges and ecological limitations** in scaling macroalgae production in the Baltic Sea.
- The need for **Regulatory and Governance Frameworks** to incentivize sustainable practices and foster collaboration among stakeholders.
- **Market Acceptance and Consumer Perception** due to limited examples of nutrient trading, limited awareness and access to global intermediaries.
- **Access to Investments** is limited, as local financial institutions have very limited understanding of the specific sector and regard this field as a very high-risk activity.

Social and Environmental Impact

The macroalgae industry can balance ecological preservation with social and economic benefits implementing the transformation of algae into high value products for nutraceuticals and cosmetics. By addressing the challenges of scaling production, integrating sustainable practices, and fostering collaboration among stakeholders' possible impacts could be:

Environmental:

- **Waste Reduction Through Full Resource Utilization:** The processing creates multiple valuable products (furcellaran, microcellulose). This circular economy approach maximizes the value of harvested biomass with a **Low Environmental Impact Production**, since Red algae doesn't require **agricultural land, irrigation or fertilizers.** The red seaweed processing residue is utilized as biofertilizer.

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- The harvesting and collection of red seaweed contribute to the **nutrient removal** from the Baltic Sea, which is particularly relevant given the environmental condition of the Baltic Sea.

Social:

- **Economic Opportunities**: Furcellaran production supports local economies, by creating jobs in harvesting, processing, and product innovation. Expanding applications in cosmetics, food, biofertilizer and bioplastic production could further stimulate economic growth and diversification in coastal communities.
- **Community Engagement and Cultural Value**: Red algae harvesting has cultural significance in some coastal areas, contributing to local heritage and identity related to collection of beach cast. The cultural significance also lies in the historical uniqueness of furcellaran production and the utilization of very specific local resources. Ensuring sustainable practices respects these traditions while balancing economic growth.

Implementation Guidelines

- **Stakeholder Engagement**
  - Collaborate with local and international researcher to find **technical solutions** for scaling macroalgae production in the Baltic Sea and product development.
  - Organize meetings **regulatory and governance body** for developing **frameworks** to incentivize sustainable practices and fair access to resources and ease the regulatory bottle necks.
- **Market Development**
  - Increase awareness in consumers and local communities to foster acceptance and demand, access to markets.

Key To-Dos for Stakeholders

- **Industry and Private Sector** (Algae harvesters; Macroalgae processors; Biotechnology and innovation companies): Develop and implement sustainable harvesting techniques to minimize ecological impact; Invest in innovation to optimize macroalgae cultivation and processing and explore by-product applications and value chain development.
- **Governance and Regulatory Bodies** (Local and national governments; Environmental agencies; International regulatory organizations): Monitor compliance to environmental regulations. Support policies promoting nutrient trading and carbon-neutral operations. Assess regulatory processes, timelines and information dissemination to the industry.
- **Research and Innovation Community** (Universities and research institutions; Product developers in food, cosmetics, and bio-based industries): Tackle technical

challenges in scaling macroalgae cultivation and production and collaborate with industry to create innovative solutions for ecological and logistical challenges.

- **Educational Institutions** (Applied and Higher education institutions): develop and update study programs to support the production of highly skilled labour for the industry. Initiate industrial doctorates and joint programs with industry to build R&D capacity.
- **Civil Society and Consumers**: Raise awareness about the ecological and socio-economic benefits of sustainable algae-based products to improve consumer demand and support for sustainable harvesting practices.

Scaling and replicability

Collaborations among researchers, small businesses, and environmental organizations aimed to enhance resource efficiency and expand markets for algae-based products, such as cosmetics and nutraceuticals. Algae, particularly macroalgae, rich in bioactive compounds, is used in food, cosmetics, biofuels, and pharmaceuticals. For instance, algal oils can replace petroleum in biofuel production, while alginates from seaweed are applied in food processing and packaging.

4.3 Italy: Marine By-Product Transformation & Valorisation

4.3.1 Context and Challenges

Sicily has a long-standing tradition in the fishing sector, with a significant focus on fish processing that dominates the National production. with traditional species such as tuna, sardine, and anchovy.

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Figure 7: Marine by-product valorisation in Italy

Innovation plays a key role in increasing the competitiveness, sustainability and profitability of the local seafood supply chain, and for the development of value-added processed products, it is recommended to focus on underutilized fish species Another challenge for the processing sector is to extend and guaranteeing the shelf-life UNIPA has setup innovative technologies on traditional processing and new species, thus proposing new product categories, allowing to decrease pressure on endangered species and added value to the products.

The processing sector gives another area of exploitation, related to by-product production, utilization and valorisation, to reduce waste and create high-value products shifting the added values towards the producers and reducing the length of the value-chains in line with the sustainability principles. Despite these traditions, the region faces several challenges, including:

- **The diversification of the fish processing** sector that is based on a limited number of species and products.
- **Fragmented value chains,** where traditional processing methods lack modern scaling approaches.
- **Regulatory barriers,** making it difficult for small-scale fisheries to commercialize their products.
- **Market competition,** where traditional products struggle to find their place in an increasingly competitive market.

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4.3.2 Best practice identified

Specific case: Ritunnu – Sustainable valorisation of by-catch The Ritunnu Case Study in Sicily

A successful social innovation in Sicily is the revival and commercialization of *ritunnu salatu,* a traditional fish product made from **menola**, *Spicara smaris*, a Mediterranean fish species traditionally considered of low commercial value. Historically, menola has been undervalued despite its abundance in the local fishery. The **Ritunnu case**, spearheaded by local fisherman Natale Amoroso in partnership with the University of Palermo (UNIPA), has created a sustainable, marketable and high-value product, thanks to transfer of innovative technologies from lab to enterprise, which has made it possible to standardise the process and quality of the product, making it a controlled supply chain product of renowned commercial value.

The traditional *ritunnu salatu* process involves salting and drying the fish, which is then preserved dry or in oil or grated as a condiment, similar to bottarga. This practice, once considered a "poor man's bottarga", has now gained market traction, with prices reaching up to **200 euros per kilogram**, positioning it as a premium gourmet product.

Figure 8: Ritunno salatu

Social and environmental impact

- **Social Benefits**: Empowering local fishers, preserving cultural heritage, and creating new job opportunities in the region.
- **Environmental Benefits**: Reducing food waste and promoting the sustainable utilization of marine resources by moving consumers' attention on non-target, not endangered fish species, according to SDG 12.

Implementation Guidelines

- **Co-creation with local stakeholders:** Collaborate with local fishing communities to preserve and scale traditional knowledge. Engage academic institutions to develop formal production protocols.

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- **Product innovation and branding:** Position *ritunnu* as an artisanal, high-quality product with eco-friendly credentials and create brands like "eco-bottarga," which uses the entire fish rather than just the roe.
- **Sustainability measures:** Focus on using by-catch that would otherwise be discarded. Implement sustainable packaging and marketing strategies that align with circular economy principles.
- **Market access and distribution:** Online shops and local restaurants to introduce *ritunnu* to wider markets. Work with policymakers to overcome regulatory hurdles and obtain certifications.

Key To-Dos for Stakeholders

- Fishing cooperatives: Scale production and maintain product authenticity
- Policymakers: Provide tailored regulations to support artisanal fish products
- Academic partners: Offer R&D support to improve product shelf-life and quality control
- Retailers and distributors: Explore export opportunities and niche gourmet markets

Scaling and replicability

The success of the *Ritunnu* case study demonstrates how traditional knowledge, when combined with scientific validation and modern business strategies, can be replicated in other coastal regions across Europe. In Greenland there is a similar product called *ammassak* (Figure 9), and the local fishermen could benefit from these guidelines. In general, this model can serve as a benchmark for small-scale fisheries looking to enhance their sustainability and economic resilience.

Figure 9: Ammassak (Mallotus villosus)

Picture from: https://www.royalgreenland.gl/da-gl/fisk-skaldyr/Naturfisk/ammassak/

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4.4 BlueRev Recommendations for Governance, Social and Business Innovation

Through the BlueRev project activities and with extensive input from stakeholders, researchers, practitioners, and industry experts, governance and social innovation recommendations and key policy recommendations for supporting sustainable business models have been developed. Across various territories, several common barriers have been identified that hinder the development of sustainable blue bio-based economies.

Policy Support is crucial to overcome financial and regulatory barriers, enabling regions to adapt these social innovation models to their unique socio-economic and environmental contexts. Policymakers should consider implementing specific regulatory incentives, grants, or tax benefits that encourage sustainable practices and reduce the financial burden on businesses and communities engaged in the blue bioeconomy. Flexible policies and incentives can facilitate access to resources, attract skilled labour, and encourage sustainable practices, particularly in emerging or resource-dependent regions.

One significant challenge is **regulatory complexity**, with fragmented regulations across regions and a lack of harmonization in policies. Lengthy and cumbersome permit processes further discourage innovation, making it difficult for businesses to navigate the regulatory landscape effectively.

Financial constraints also present a major obstacle. Limited funding is available for high-risk projects in emerging blue bioeconomy sectors, and small-scale actors often struggle to access financing or sustain long-term investments, hampering growth and innovation in the sector.

Another challenge is the **lack of collaboration** between stakeholders, particularly between industry and academia. Insufficient interaction and weak regional cooperation limit the transfer of knowledge, resources, and best practices, slowing down progress.

Consumer awareness and acceptance is another critical barrier. There is a low public understanding of the ecological and economic value of blue bio-based products and resistance to adopting innovative products persists due to perceived risks or unfamiliarity.

Finally, there are significant **technical challenges**. Scaling sustainable practices remain difficult due to ecological and operational limitations. Furthermore, there is a pressing need for advanced technologies to repurpose side-streams efficiently and cost-effectively.

To overcome these barriers, several critical success factors have been identified:

Simplified regulatory processes are essential. This includes implementing regulatory sandboxes and one-stop shops to reduce bureaucratic hurdles and streamline permit procedures. Better coordination among agencies to ensure clear guidelines and faster decision-making is also critical.

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Access to financing and entrepreneurial support can play a transformative role. Innovative financing models, such as blue bonds, accelerators, and impact investments, should be developed. Additionally, mentorship programs, funding opportunities, and tax incentives are needed to support small and medium enterprises (SMEs) and startups.

Collaboration and networking must be strengthened through the establishment of councils, regional cooperation networks, and public-private partnerships (PPPs). Promoting knowledge sharing between industry, academia, and local communities can further drive innovation and cohesion.

Market development and public engagement are crucial for increasing consumer awareness. Raising awareness of the benefits of blue bio-based products through targeted marketing campaigns and public forums can help incentivize sustainable practices and drive demand.

Finally, **technological innovation and scalability** are vital for addressing technical challenges. Investment in research and development is necessary to improve side-stream utilization and enhance resource efficiency. Leveraging new technologies can also enable scaling sustainable practices in aquaculture and algae production.

4.4.1 Key Recommendations for Supporting Sustainable Business Models

1. Promoting Policy Flexibility and Responsive Governance

Policymakers should develop adaptable regulatory frameworks that can quickly respond to industry changes and market demands. This may include fast-tracking permits for foreign labour to meet workforce demands or creating policy incentives for companies to adopt sustainable practices. Policy flexibility can reduce bureaucratic barriers, facilitate business operations, and attract a diverse talent pool, all of which are essential for scaling up the blue bioeconomy.

To achieve this, government agencies should align their efforts and simplify processes, such as permit applications. Current fragmented mandates lead to decision-making delays. A unified approach, designating a single oversight agency or adopting a one-stop policy, can resolve jurisdictional overlaps. Detailed mapping of roles and collaborative discussions will clarify responsibilities, ensure accountability, and enhance governance efficiency. (Figure 10)

The negotiated governance model in Denmark and Greenland (see B., par 4.2.2) illustrates the importance of flexible and responsive policies.

2. Encouraging Sustainable Business Models Through Financial Incentives

Financial incentives, such as grants or tax breaks, can drive businesses to adopt sustainable practices and innovative models that prioritize circularity and local economic development. By reducing financial risks, these measures support the transition to a sustainable and inclusive blue bioeconomy.

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The blue bioeconomy, especially macroalgae research, is in its early stages, facing high costs, scaling challenges, and limited infrastructure. Increased funding is crucial for commercialization and scaling innovations. Market growth can benefit from innovative procurement methods like Pre-Commercial Procurement (PCP) and collaboration between finance ministries and agencies to develop tailored frameworks. Strengthened university-business partnerships, such as industrial doctorates and applied research, can enhance knowledge exchange, innovation, and technical expertise, supported by funding mechanisms that encourage collaboration. (Figure 10)

The valorisation of fish side-streams in Denmark, Italy, and Greenland (par. 4) demonstrates the economic potential of by-products within the blue bioeconomy.

3. Strengthening Cross-Sectoral Partnerships

Establishing formal collaboration frameworks between government agencies, private sector players, and non-profit organizations can streamline regulatory processes and attract investments. These partnerships also create a supportive environment for sustainable practices, fostering economic growth while addressing environmental concerns. (Figure 10)

Collective Impact models, as seen in Denmark and Italy (A. and D., par. 4.2.2), offer a proven pathway to align government policies with industry needs and community interests.

4. Building Community Ownership and Engagement

Empowering local communities to take ownership of bioeconomic initiatives is critical for sustained impact. Community-based workshops and locally led business development programs should be encouraged to foster a sense of ownership and accountability. This approach not only builds community resilience but also ensures that the benefits, such as job creation and environmental conservation, are linked directly to the community. (Figure 10)

Agency mobilization model in Greenland and the community-driven approaches in Italy (see E. and D., par 4.2.2) highlight the benefits of community-based innovation, especially in regions with limited infrastructure.

5. Enhancing Capacity Through Localized Training Programs

Building a skilled workforce is essential for scaling sustainable practices in the blue bioeconomy. Collaboration between educational institutions and industry partners can create tailored curricula on blue bioresource valorisation, equipping local talent with the necessary skills to support a circular bioeconomy.

Addressing the industry's workforce gaps requires attracting talent and upskilling workers. Promoting the sector’s benefits, such as regional development and job creation, can improve public perception and spark interest. Increased funding is needed to expand

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training programs, cover high equipment costs, and develop local expertise. Communication campaigns and success stories can further raise awareness, foster community acceptance, and encourage investment. (Figure 10)

Estonia and Italian Living Lab (see C., par 4.2.2) exemplify how training programs should be adapted to build technical capacity for bioeconomic processes.

6. Leveraging Digital Platforms for Knowledge Sharing and Collaboration

Digital platforms can play a pivotal role in scaling up social innovation by enabling knowledge sharing and fostering collaboration across regions. By creating an online network of stakeholders involved in blue bioeconomy projects, regions can exchange insights, share best practices, and coordinate efforts. Digital platforms also offer training resources and support virtual collaboration, enhancing the ability of remote communities to access the expertise needed for sustainable blue bioeconomic growth. (Figure 10)

Hub's experiences (par. 4) can inspire other regions with limited infrastructure.

Additional recommendations for supporting sustainable business models are listed below:

- **Map the lifecycle**: Analyse each stage of your product or service lifecycle (e.g., raw materials, production, distribution, usage, disposal) to be aware of the environmental impact of your product or service and the activities you could implement to reduce it.
- **Use metrics**: Quantify impacts where possible (e.g., carbon footprint, energy savings, number of lives improved).
- **Promote** responsible behaviour within the blue bioeconomy, to overcome social, economic, and cultural barriers to sustainable practices.
- **Communicate mitigation and innovation** highlighting actions taken to reduce costs and maximize benefits.

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Figure 10: BlueRev Recommendations

4.4.2 Successful Approaches

A. Collective Impact in Denmark's Blue Bioeconomy

In Denmark, the Collective Impact (CI) model has proven essential for aligning diverse stakeholders within the blue bioeconomy. By fostering cross-sectoral collaboration between government agencies, industry leaders, and community organizations, this model addresses the need for regulatory improvements, workforce development, and resource efficiency. Danish companies, for example, are leveraging side-stream fish products to create high-value items like fishmeal, cosmetics and pharmaceuticals. This model encourages partnerships that streamline regulatory processes, making it easier

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for companies to access skilled labour through initiatives like fast-tracking permits for foreign workers. By promoting a shared vision and coordinated action, CI fosters sustainable bioeconomic growth while addressing critical resource management and environmental challenges.

B. Negotiated Governance for Collaborative Policy-Making in Greenland and Denmark

The Negotiated Governance (NG) model, used in both Denmark and Greenland, demonstrates a successful approach for addressing regulatory challenges and creating policy changes tailored to the blue bioeconomy's needs. This model promotes active dialogue among stakeholders, including government bodies, businesses, and local communities, to create flexible and responsive policies that support sustainable practices. For example, the governance model has been used to fast-track permits for foreign labour in Greenland. This model enables stakeholders to negotiate solutions for regulatory barriers that hinder the development of circular bioeconomy practices, fostering a supportive policy environment for long-term sustainable growth.

C. The Living Lab Approach for Innovation and Capacity Building in Estonia and Italy

The Living Lab (LL) model in both Estonia and Italy exemplify a successful framework for fostering local innovation through community involvement. In Estonia's Saaremaa region, a specialized laboratory at Kuressaare College as well as been the opening of a new study program for sustainable technologies for the blue economy supports local businesses in the valorisation of macroalgae and other blue bioresources. Through continuous workshops and consultations with local bioresource processors, this Kuressaare College is developing into focal hub that serves as a testing ground for bioeconomic practices and business models, product development and its study programs and PhD students enhance local capacity. Similarly, in Sicily, Italy, the Living Lab approach facilitates collaboration between local fishermen, scientists, and industry experts in developing protocols for high-value transformation of traditionally low-value by-catch, such as menola (known locally as "*ritunnu salatu*"). This model supports innovation in waste valorisation, where community-driven research and development empower local stakeholders and promote sustainable economic practices. The community-informed approach in both regions ensures that solutions developed are adaptable and directly relevant to local socio-economic contexts.

D. Community-Based Innovation and Collective Impact in Italy's Blue Bioeconomy

In Sicily, the Collective Impact model combined with Community-Based Innovation (CBI) has successfully driven sustainable transformation in the local fishery sector. The University of Palermo collaborates closely with local cooperatives, industry leaders, and policymakers, forming a core group that leads initiatives for waste valorisation and product development in food sector, nutraceuticals and cosmetics, using by-products like menola (*ritunnu salatu*). This traditional fish product, previously undervalued, has been

elevated to a premium product fetching up to 200 euros per kilogram. Natale Amoroso, a local fisherman, revived the tradition of producing ritunnu salatu using eco-friendly methods and now markets it as “eco-bottarga.” These community-based initiatives empower local stakeholders, foster economic value through sustainable practices, and strengthen the local blue bioeconomy. The Collective Impact and Community-Based Innovation models effectively engage community ownership and resource stewardship, creating a resilient and self-sustaining industry rooted in local cultural heritage.

E. Agency Mobilization within Community-Based Innovation in Greenland

In Greenland, the Community-Based Innovation (CBI) Model mobilizes local stakeholders to address challenges unique to the region, such as high transportation costs, limited infrastructure, and labour shortages. The BlueRev project facilitates community-driven workshops and local training initiatives that foster a circular economy mindset, encouraging small producers to find innovative ways to use marine resources sustainably. A notable success is the transformation of fish processing waste into dog food products, exemplified by the small businesses Milak Productions ApS. This model empowers local businesses to adopt socially responsible practices, generate local economic value, and support Greenland’s circular economy, highlighting the importance of community agency in addressing regional challenges.

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5 Conclusion

Blue bio-based products represent a critical shift toward renewable, biodegradable, and climate-friendly materials. They are increasingly utilized in food, biofuels, biodegradable plastics, nutritious supplements, pharmaceuticals and cosmetics, providing a sustainable alternative to fossil-based industries. Those innovations can contribute to reducing waste accumulation and repurpose discarded resources in both marine and terrestrial environments while respecting traditions and enhancing local economies. However, challenges such as overfishing risks, environmental impacts of production, and equitable access for consumers remain critical. Addressing these barriers requires continued alignment between innovation, policy, and governance, alongside localized solutions that leverage regional strengths. Despite the potential, significant challenges persist, including risks related to overfishing, the environmental impacts of production processes, and ensuring equitable consumer access. Overcoming these barriers requires ongoing alignment between technological innovation, regulatory frameworks, and governance structures, alongside the development of localized solutions that harness regional strengths.

The BlueRev project has demonstrated the transformative potential of integrating social innovation, governance, and sustainable business models to foster growth in the blue bioeconomy. By addressing financial, regulatory, technical, and social barriers, the project has provided actionable frameworks and recommendations that are adaptable across diverse European regions. Through stakeholder engagement, co-creation, and structured interviews, critical insights were gathered to refine these models and ensure alignment with local socio-economic contexts.
Scaling sustainable practices in the blue bioeconomy requires a cohesive approach that combines policy flexibility, community engagement, and innovative business models. Simplified regulatory processes, targeted financial incentives, and strengthened collaboration between academia, industry, and local communities are key enablers for overcoming challenges and unlocking opportunities. Furthermore, initiatives such as localized training programs, the valorisation of by-products, and digital knowledge-sharing platforms play an essential role in building capacity and resilience.
The successful strategies implemented in Denmark, Greenland, Estonia, and Italy offer valuable lessons for replication and scaling. By leveraging these models and integrating them with adaptive governance and community-driven approaches, regions can achieve sustainable growth while addressing environmental concerns and fostering economic resilience. Policymakers, industry leaders, and local stakeholders must now build on these foundations to ensure the long-term success and inclusivity of the blue bioeconomy, setting a pathway for a more sustainable and prosperous future.

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6 Acknowledgements

We would like to conclude by expressing our heartfelt gratitude to all the participants whose valuable contributions have enriched this best practice report. The knowledge shared is free, and we sincerely hope this report will inspire positive transformations in the fishing industry. We hope some businesses will embrace the ideas presented and develop the products outlined. Knowledge is free; now we hope that businesses will act and help transform the industry for a sustainable future.

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