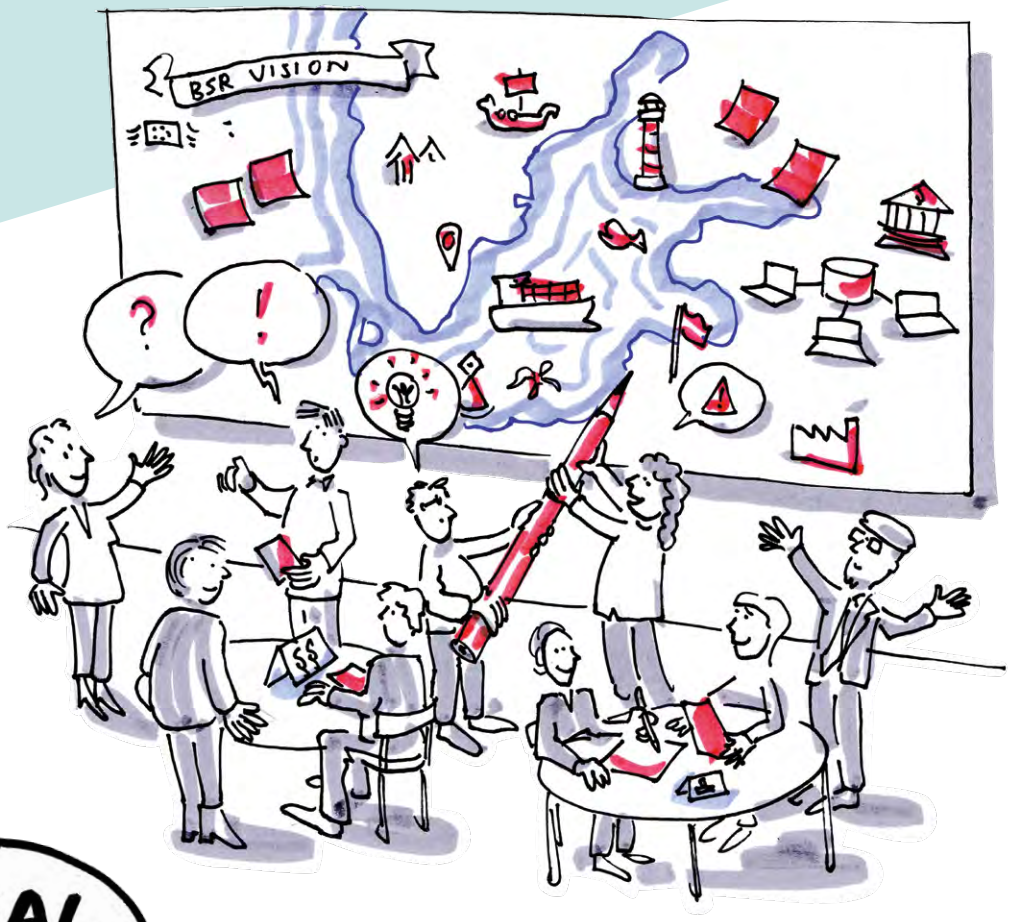
European Commission

TOWARDS AN **IMPLEMENTATION STRATEGY** FOR THE **SUSTAINABLE BLUE GROWTH AGENDA** FOR THE **BALTIC SEA REGION**



FINAL REPORT

s.Pro sustainable projects

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Maritime Affairs

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EXECUTIVE SUMMARY

The Sustainable Blue Growth Agenda for the Baltic Sea Region, adopted by the European Commission in 2014, highlights the extraordinary potential for developing the maritime economy in the Baltic Sea Region (BSR).

This report, "Towards an implementation strategy for the Sustainable Blue Growth Agenda for the Baltic Sea Region," presents the results of a systematic stakeholder dialogue in the region. Initiated by the European Commission in September 2016, the aim of the dialogue was to identify and discuss in greater depth the processes necessary to realise the Baltic Blue Growth Agenda in the coming years. This dialogue focused on the following mix of high-potential and emerging thematic areas[1]:

- ***Shipping;***
- ***Blue bioeconomy (incl. aquaculture);***
- ***Coastal and maritime tourism;***
- ***Environmental and monitoring technology.***

The process for the systematic stakeholder dialogue had six steps and included various engagement and outreach formats. 275 blue growth stakeholders participated in the survey, 50 interviews with pivotal stakeholders were carried out and around 120 stakeholders took active part in the workshops.

The report bundles and collates the broad feedback of the BSR blue growth stakeholders' process.

This summary lays out the strategic transformation maps suggested for each of the four thematic areas. They identify the main drivers and challenges for each area, sketch a desirable vision for 2030, point to the necessary strategic fields and recommended strategic actions targeting relevant stakeholders in the BSR.

The report identifies strategic action fields, potential actors and bricks to build on for implementing the Sustainable Blue Growth Agenda for the Baltic Sea Region, which could help public and private decision-making bodies to ensure that appropriate mechanisms and programmes are put in place in the coming years to enable actors to take the steps described under the various strategic action fields.

And last but not least, the report aims to inspire actors in the BSR to take a lead and/or get involved in those strategic action fields where they have most competence and capacity based on their existing innovation eco-systems, strategies and investment plans.

[1]The selection does not mean that other thematic areas are considered less important (e.g. ocean energy or fisheries). They may be taken up in future steps.

SHIPPING

The Baltic Blue Growth Agenda showed that out of all maritime sectors, shipping is still by far the greatest generator of gross value added in the region. Core drivers and challenges for the development of the BSR's shipping are

- Digitalisation and high tech: maritime clouds, computer power, smart sensors, big data and automation systems;
- Up-scaling of vessels sizes and cargo volumes per port;
- Governmental actions in favour of autonomous shipping;
- Environmental regulations;
- Oil price developments.

// Possible Demonstration Projects include: //

- Establishing a joint test bed for autonomous vessels at the BSR level (including their interaction also with conventional vessels);
- Develop a joint port-community system for small and some medium ports, which speeds up logistics and connects the different transport modes in the port and in its hinterland;
- Install high voltage onshore power supply infrastructure in test ports.

Vision for 2030

Digitalisation and green shipping has changed the whole shipping sector across the entire value chain.

Skilled labour is available at all levels due to adapted education.

The majority of ships in the Baltic Sea are e-navigation compatible and have some automated functions.

Shipping and port operations are environmentally sound. CO2, SOx and NOx ship emissions are lower.

A harmonised infrastructure network exists for alternative fuel bunkering and shore-sided electric power supply.

Shipbuilding remains at the current level of economic importance.

Shipyards have completed the retrofitting of existing vessels.

The maritime industry continues to produce high-end, specialised vessels and maritime equipment.

Potential actors include port authorities and port associations, maritime universities and research institutions, ship owners, transport operators and shipyards. The EU Strategy for the Baltic Sea Region (EUSBSR) Policy Area Coordinators (PACs) Ship and Safe, the Helsinki Commission's Maritime Working Group as well as the Baltic Ports Association are central networks of actors to build on for overall coordination. Other starting points include the results and networks of the Sea Traffic Management Validation project and the Maritime Cloud of the EfficienSea2 project.

Strategic action fields

Strengthen e-navigation and pave the way for autonomous shipping:
Join forces and align efforts to create improved internet connectivity and organise concerted action for appropriate regulation at the global level.

Share data across the entire supply chain:
Create a joint system for the collection and sharing of data on cargo from different transport modes.

Develop green solutions:
Develop onshore power supply infrastructure and fuel supply networks (e.g. for liquid natural gas). Assess the suitability of alternative fuels projects targeting the whole transport system.

Create framework conditions for a successful shipbuilding industry:
Support pre-competitive research (e.g. in the field of automation / robotics or the harmonisation of data formats).

Ensure skilled labour:
Develop education and training in new technologies and processes (e.g. digitalisation, new propulsion and logistics systems).

Secure operation of small and medium ports:
Improve conditions for the survival of small and medium ports (e.g. joint port-community system or hinterland transport connection).

The blue bioeconomy sector (incl. aquaculture) offers significant growth potential in the BSR for producing a variety of marine biobased products and services, maintaining and improving the ecosystem. Fishery is not included in this report. Core drivers and challenges for the development of the BSR's blue bioeconomy are

- Political strategies promoting the blue bioeconomy on various levels;
- The obligation to achieve Good Environmental Status[1] and ongoing challenges caused by eutrophication and pollutants as a driver for innovative measures and technologies;
- Inconsistent and unclear regulatory framework regarding specific blue bioeconomy activities;
- Strong research and development (R&D) capacities and high innovation potential of BSR R&D institutions and small and medium-sized enterprises (SMEs);
- Lack of dedicated and efficient blue bioeconomy business support structures;
- Presence of blue bioeconomy-related BSR-wide networks and platforms;
- Technical advances such as increased efficiency due to marine robotics and modelling techniques.

Potential actors include the EUSBSR PACs Bioeconomy, Nutri and INNO including its umbrella flagship SUBMARINER Network. Current projects, such as the Baltic Blue Biotechnology Alliance and InnoAquaTech are developing new forms of business development support structures.

Vision for 2030

A clear, consistent and harmonised regulatory framework is in place throughout the BSR.

A growing number of marine biobased products and services are available to end-consumer markets.

The BSR is a global knowledge hub for blue biorefinery and circular economy approaches.

Wild biomass (e.g. algae or reed) along the coastline is removed to remediate "eutrophication hotspots" and used in biogas production or as a food or feed ingredient.

Mussel farms provide environmental services such as increased water transparency and nutrient uptake, and supply high-value feed products for agri- and aquaculture.

Commercial macroalgae cultivation is in place in the Baltic Sea for a range of algae-based products produced according to the biorefinery concept.

Blue biotechnology works as an enabler through the whole value chain.

Considerable upscaling of blue biotechnology as an enabling technology for a thriving industry has taken place.

Land-based recirculating aquaculture systems (RAS) have enabled a steep increase in production of farmed fish and other high-value seafood.

Consumers have a positive attitude towards sustainably produced, regional high-quality fish and seafood products.

Strategic action fields

Regulation:
Establish an inter-ministerial, BSR wide working group, which initiates procedures to streamline regulations and ecosystem service payments.

Communication, networks and marketing:
Develop and implement a large-scale professional image, marketing and branding campaign for Baltic Sea blue bioeconomy products and services.

Technology:
Support technology transfer and development for blue biomass harvesting, preservation, cultivation and storage. Provide BSR wide access to a coordinated network of research and up-scaling infrastructures.

Finance and funding:
Provide ongoing public funding to support cross-disciplinary business development advice for blue bioeconomy start-ups. Develop novel public-private partnership financing instruments with long-term commitments.

// Possible Demonstration Projects include: //

- Novel aquaculture cultivation techniques (e.g. closed containment systems) are tested and adapted to Baltic Sea conditions;
- Systematic business development support: Set up a permanent BSR-wide business support infrastructure supporting blue bioeconomy start-ups and SMEs;
- Piloting ecosystem service payments: Economic measures are tested in pioneer regions.

[1]The main goal of the Marine Strategy Framework Directive (MSFD) is to achieve Good Environmental Status of EU marine waters by 2020.

Maritime & coastal TOURISM

Coastal and maritime tourism is a mature and well-developed blue growth area in the BSR. The Baltic Blue Growth Agenda regards coastal tourism as economically very important. Core drivers and challenges for the development of the BSR's coastal and maritime tourism are

- Seasonality of demand calls for diversification of products and services;
- Concentration of tourism in a few centres (e.g. cruise ports or seaside resorts) necessitates better development of (and connections to) hinterland destinations and new attractions away from city centers;
- Demographic change and new demand patterns require new specific touristic products;
- Digitalisation opens new possibilities for selling and creating touristic products;
- Local stakeholders need to benefit from coastal tourism and not suffer from it;
- Awareness of sustainability and the quality of the experience are becoming more important;
- The BSR is a safe and secure place.

Potential actors include tourism professionals (both public and private), local stakeholders and IT companies. Starting points include the flagship projects of the EUSBSR PAC Tourism.

Vision for 2030

A broader range of visitors (including from non - EU countries) and offers increase business in non-summer months.

Capacity limits of destinations are respected.

Marinas offer an attractive environment year-round.

The tourism sector closely cooperates with local residents.

Remote areas of the BSR are better accessible.

New cross-cutting products and services exist for specific target groups.

A pan-Baltic data portal on maritime tourism with common indicators exists.

Nature tourism offers many package deals in combination with other tourism sectors.

Cruise tourism is the gateway for many international tourists coming to the BSR.

More European senior citizens travel to the BSR.

Local businesses, citizens and authorities drive maritime tourism.

Both the tourism industry as well as the visitors highly value sustainability.

The Good Environmental Status status of the Baltic Sea is an indispensable prerequisite for tourism.

Strategic action fields

Product and service innovation:
Invest in digitalising offers and products. Identify new business models. Improve accessibility. Analyse data.

Coordinating the cooperation of actors and destinations:
Organise the destination management, and engagement and empowerment of local stakeholders. Enhance horizontal cooperation across the BSR. Facilitate cooperation across sectors and value chains.

Marketing and promotion:
Develop innovative marketing concepts (e.g. "clean air tourism campaigns" for non-EU markets). Apply a multitude of promotion tools. Increase visibility. Create common quality standards.

// Possible Demonstration Projects include: //

- Development of new luxury offers: Quality products other than traditional material luxury such as nature (glamping) or authentic maritime heritage experience (becoming a lighthouse keeper for a week);
- An 'UBER' for boats: Facilitate the hiring of private boats to tourists in order to increase accessibility of remote natural areas;
- Heritage Access Card: Up-scaling the Finnish Museum Card to other countries and regions in the BSR.

ENVIRONMENTAL & MONITORING TECHNOLOGY

Environmental and monitoring technology (EMT) is as a lynch pin for obtaining sustainable growth within other maritime functions. Core drivers and challenges for the development of the BSR's EMT are

- EU directives and regulations such as the Marine Strategy Framework Directive, Water Framework Directive, and Maritime Spatial Planning Directive;
- New and combined uses of ocean space and platforms;
- Growth in other maritime economic areas and their environmental and operational monitoring needs;
- Pressure to achieve cost efficiencies, especially regarding public funding;
- Complex knowledge-driven innovation and technologies.

// Possible Demonstration Projects include: //

- Optimal platform design for monitoring technology: Determine requirements for robust and cost-effective equipment (lifecycle cost);
- Develop a Marine Robotics Incubator for the BSR: Science meets industries to develop next generation of marine autonomy;
- Technology demonstrations of regional excellence for supporting the MSFD implementation.

Vision for 2030

EMT is an economically relevant blue growth sector itself.

An integrated knowledge platform for EMT in the BSR supports a sustainable maritime economy exists.

Affordable, robust, standardized technologies and systems enable long-term operations for the user and economies of scales for the producer.

Easy exchange of transnational and sectoral data through standards and agreed communication pathways.

Infrastructure is in place to deal with the demands of big data analytics.

A virtual Baltic Data Centre exists with public and private data available through a flexible open data policy.

Environmental monitoring is carried out on a transnational level by local, private companies in cooperation with public research institutions.

Operational monitoring provides on-demand services according to the different sectoral needs and based on a functioning business model.

The BSR is globally recognized for its monitoring technology expertise (also in harsh environments).

A "BSR Cluster" is setting the technological standards for (parts of) monitoring technology.

Strategic action fields

Make environmental and operational monitoring technologies and services more effective:
Establish a Technology Exchange Platform. Identify sectoral needs and relevant markets. Pilot market analysis.

Foster efficient monitoring technologies and services:
Develop necessary common standards and protocols. Boost adaptive monitoring to complement existing monitoring. Establish test facilities.

Develop export market for BSR environmental and operational monitoring technologies and services:
Invest in technology to be used in harsh environments. Promote "first use" of novel techology. Develop joint export promotion services (e.g. market research). Launch projects in developing countries to open up new markets.

Develop efficient public-private partnerships:
Investigate different models for partnerships. Increase knowledge exchange between young scientists, engineers and SMEs.

Potential actors include technology and system providers as well as research institutes and (transnational) networks. Starting points are a.o. the HELCOM-VASAB MSP Data Group, German Association for Marine Technology, European Marine Observation and Data Network Checkpoint and the Baltic Operational Oceanographic System.

FINDINGS AND THE WAY FORWARD

This stakeholder dialogue process has raised attention and interest in the Baltic Blue Growth Agenda among many stakeholders throughout the BSR. The process has created four positive and realistic visions for where the BSR could be in 13 years time in each of the four selected thematic areas.

Whereas the above four transformation maps show the specific visions and strategic action fields for each thematic area, there are some noteworthy commonalities between them:

- Making cooperation fit for purpose: Develop and conduct tailor-made dialogue formats with the private sector;
- Exporting blue solutions, products and services: What has worked in the BSR is potentially interesting for countries / regions not only within Europe, but also world-wide;
- Market research and marketing: Market intelligence does not exist in many instances and thus market development efforts are needed throughout all thematic areas;
- Financing: Lack of finance is less of an issue than the availability of specific types of financing and related support for unlocking it.

There are also common drivers for all four thematic areas:

- Digitalisation / IT Solutions: Technology solutions are in most cases already there, but throughout the blue economy there is still an insufficient understanding of how to make the best use of these solutions;
- Environmental Challenges: The search for finding adequate solutions represents a major driver for innovation and thus a driver for economic growth itself.

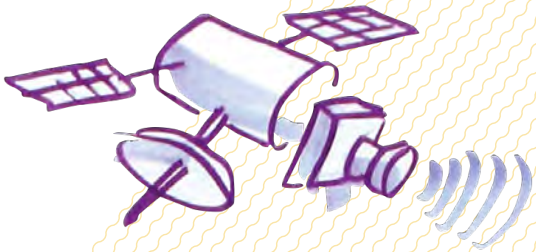
Many stakeholders would like to continue this interactive process as it has been very helpful for them to get to know the overall picture and to see where their role might be in this puzzle.

Suggestions for next steps:

- Disseminate and communicate the results of this process widely among the BSR stakeholders with the aim to ensure that actions are picked up at all levels (from local to EU);
- Make use of innovative communication tools and methods that facilitate the interaction and involvement of stakeholders (e.g. make transformation maps interactive; strategy roadshow);
- Consider the identified actions for the next generation of funding programmes and adjust the funding approach (ensure also longterm strategic network and cluster support in addition to time-limited projects);
- Provide support for developing bankable investment projects out of the identified demonstration projects;
- Work towards alignment and coherence of a multitude of strategies and policies in the field of blue growth under the umbrella of the EUSBSR. Provide resources for target-oriented coordination as well as more focused actions.

The strategic action fields, potential actors and bricks to build on as identified in this report could contribute to frame this process further.

INTRODUCTION



The Sustainable Blue Growth Agenda for the Baltic Sea Region, adopted by the European Commission in 2014, highlights the extraordinary potential for developing the maritime economy in the Baltic Sea Region (BSR). Not only is it a hotbed for innovation and competitiveness, the BSR also stands out due to its strong tradition of transnational cooperation on working with and for a healthy Baltic Sea.

This report "Towards an implementation strategy for the Sustainable Blue Growth Agenda for the Baltic Sea Region" presents the results of a systematic stakeholder dialogue in the region that the European Commission initiated in September 2016. The aim of the dialogue was to identify and discuss in greater depth the processes necessary to realise the Baltic Blue Growth Agenda in the coming years. This dialogue has focused on the following mix of high-potential and emerging thematic areas:

- Shipping
- Blue bioeconomy (incl. aquaculture)
- Coastal and maritime tourism
- Environmental and monitoring technology

The selection does not mean that other thematic areas are considered less important (e.g. ocean energy or fisheries). They may be taken up in future steps.

The process for the systematic stakeholder dialogue followed a step-by-step approach and included various formats of involving and reaching out to stakeholders. It was built on existing work within the framework of the BSR cooperation and was closely coordinated with the relevant governance structures of the European Union Strategy for the Baltic Sea Region (EUSBSR).

Desk research provided an initial overview of existing actors, projects and initiatives and helped to identify the most important development trends, industry challenges and entrepreneurial opportunities and action gaps in each of the chosen thematic areas.

A BSR-wide open **online survey**, covering all four thematic areas was launched in October 2016 and closed in December 2016. 275 blue growth stakeholders responded to the questionnaire, out of which 44 were excluded during data filtering due to incomplete replies. The survey results helped to verify and complement the desk research. It also strengthened the outreach to stakeholders, inviting them to play an active role – also in the subsequent implementation of the stakeholder dialogue.

In the third step, more than 50 **targeted interviews** with pivotal stakeholders were carried out to gain a deepened insight on the stakeholders' priorities and possible actors in each thematic area. The stakeholders interviewed were a balanced reflection in terms of thematic areas, geographic coverage as well as stakeholder groups (public, private, research).

The results of these three steps were captured in **scoping papers** that identified the most important development fields within each thematic area.

In February and March 2017, a series of four **interactive expert workshops** were organised, one per thematic area. These workshops brought together around 120 stakeholders from all across the BSR. They formed the peer group for the review of this report.

The workshops aimed to verify the results presented in the scoping papers, to formulate together a common vision for 2030 for each of the thematic areas and subsequently agree on concrete actions. These form the starting point for new projects, commitments and investments necessary to achieve this vision. Wherever possible, these proposed actions build on the expected outcomes of already running initiatives and pinpoint already active stakeholder groups.

The results of these different steps of the stakeholder dialogue all feed into this report, which bundles and collates the broad feedback of the BSR blue growth stakeholders in the four initial thematic areas.

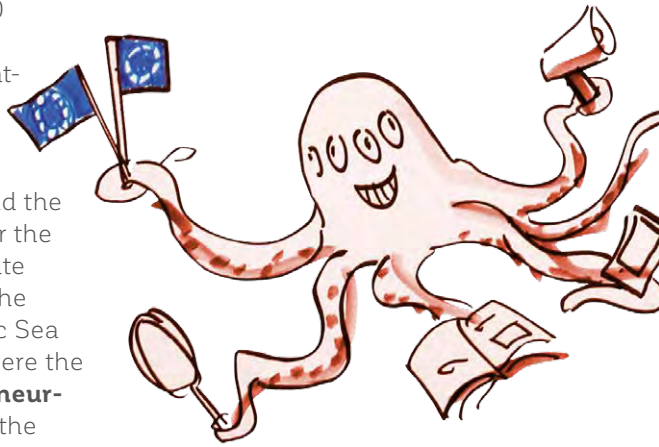
It provides orientations and ideas for reinforcing strategic cooperation on Blue Growth in the BSR, between public and private decision-making bodies and other actors as to ensure appropriate mechanisms and programmes are put in place in the coming years to facilitate actors to take the steps described under the various strategic action fields. It further aims to inspire actors to get involved in those strategic action fields where they have most competence, while showing the interlinkages with other actions necessary to harvest the full blue growth potential while also ensuring a sustainable, equitable approach.

Structure of this report

The main parts of this report are the following four chapters that lay out strategic transformation maps for each of the four thematic areas. They identify the vision for 2030, the necessary strategic action fields and highlight priority actions targeting relevant stakeholders in the BSR (e.g. industry, regions, research, municipalities, EUSBSR).

The four thematic chapters

Each chapter starts with the 'big picture' of the vision 2030 and the various transformative steps, which were elaborated jointly at the workshops.



Key challenges and drivers

After defining the meaning and the scope of the thematic area for the purpose of this report, the state of play is sketched, showing the baseline from which the Baltic Sea Region starts off as of now. Here the **key challenges** and **entrepreneurial opportunities** throughout the region are identified and drivers for sustainable blue growth are named.

Where do we want to be in 2030?

In the next sub-section, the stakeholders' positive but realistic **vision for 2030** *is developed as a desired future scenario.*

What needs to be done? By whom?

The final sub-section is dedicated to the strategic action fields that have been identified in order to realise the vision for 2030. These strategic action fields go beyond mere short-term actions that might also be steered by priorities set under current funding programmes. At the same time, this sub-section presents ideas for **demonstration projects** that are understood as "pre-commercial or commercial pilot projects that ensure a full-scale demonstration of a new solution with a high potential to be marketed on an international scale. The new solution can be a new technology, process, service or new application of an existing solution."

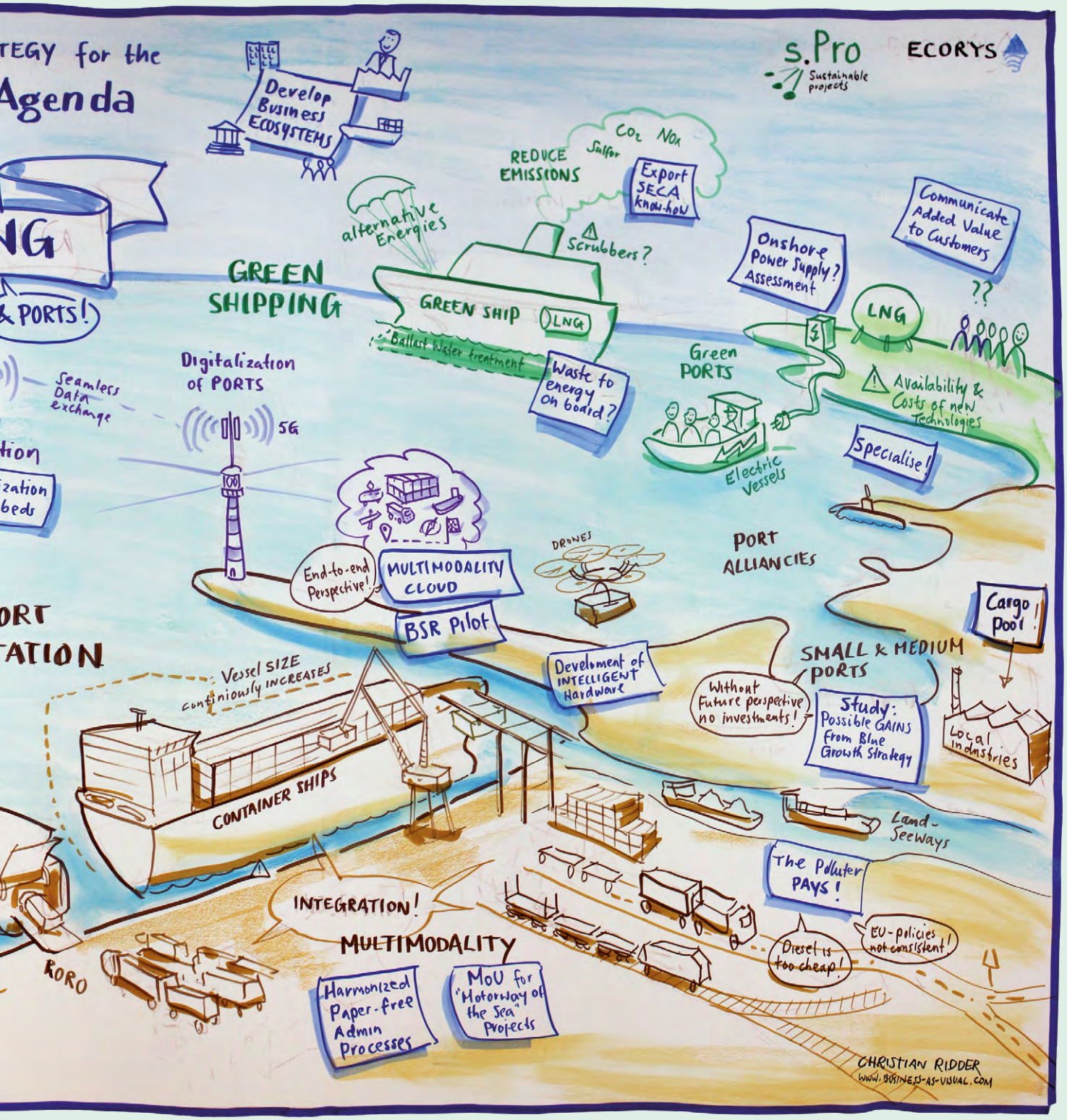
Each chapter also points towards interesting on-going (or recently completed) initiatives and upcoming events in the respective areas that could be valuable starting-points for identifying key stakeholders and potential future actions ("**bricks to build on**").

Concluding chapter

These four strategic transformation maps show the specific visions and strategic action fields for the four selected thematic areas. Also some noteworthy commonalities between the four thematic areas have been detected during the entire process of the stakeholder dialogue. The last chapter points at these commonalities, cross-linkages and synergies between the four thematic areas, which can be a good starting point for a more strategic transregional collaboration and orientation of implementing the Baltic Blue Growth Agenda.

And it points to a number of next steps that are recommended to translate the identified actions into project work. While the stakeholder process has paved the way to identifying what needs to be done over the next 13 years in the BSR, a couple of questions (who, how and when?) still need to be answered before the vision for 2030 can become reality.


European Commission
Stakeholder driven!
Developing an IMPLEMENTATION STRA
Sustainable Blue Growth
for the BALTIC SEA REGION
"PORT CLOUD"
SERVICES
artificial Intelligence
Spearhead Technology for EUROPE
Don't wait for Regulation!
harmonized Standards
SHIPPIN
Learn from other transport modes
INTERNET CONNECTIVITY
Shared DATA
Gain TRUST from participating STAKEHOLDERS
Things move fast!
Sensors & onboard MONITORING
SMART CONNECTED
Legal uncertainty
Safety
CONTROL CENTER
Captain
Technician
Many Hats
AUTONOMOUS SHIP
DIGITALIZATION
E-Naviga
Harmon
of Test-
Define Enhanced Job profiles
START with Concrete BUSINESS CASES
Increase EFFICIENCY along the value chain
ECONOMIC & ENVIRONMENTAL BENEFITS
BSR as a autonomous Shipping Pilot area?
Skilled IT Staff needed
Train Marine Staff
Bottom-up!
Different USECASES
Different SOLUTIONS
social Dilemma: will people become REDUNDANT?
First come first serve!
Collect good alternative practices
P
ADAPT
SERVICES!
Supplier Industry
Retrofitting
Recycling
CONSTRUCTION
OFF-shore
ATTRACT SKILLED LABOUR
Interdisciplinairy Research Projects
RESEARCH INSTITUTES
Practice Driven!
AUTOMATION & DIGITILIZATION
PASSENGER TRANSPORTATION
& TOURISM
PORT EXPANSION


TEGY for the
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Develop Business Ecosystems
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Export SECA know-how
alternative Energies
Scrubbers?
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GREEN SHIP
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Ballast Water treatment
Waste to energy on board?
Onshore Power Supply? Assessment
Communicate Added Value to Customers
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Electric Vessels
Seamless Data exchange
Digitalization of PORTS
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DRONES
End-to-end Perspective!
MULTIMODALITY CLOUD
BSR Pilot
PORT ALLIANCIES
Cargo Pool!
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Vessel SIZE continiously INCREASES
CONTAINER SHIPS
Development of INTELLIGENT Hardware
SMALL & MEDIUM PORTS
Without Future perspective no investments!
Study: Possible GAINS from Blue Growth Strategy
Local Industries
Land-Seeways
The Polluter PAYS!
INTEGRATION!
MULTIMODALITY
Diesel is too cheap!
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SHIPPING

DEFINITION AND SCOPE OF THE THEMATIC AREA "SHIPPING"

During the stakeholder involvement process leading to this report, the following four development fields were identified as important for the thematic area "Shipping":

Digitalisation:
Three main aspects of digitalisation are considered in this paper. The first is *e-navigation*, which is "the harmonised collection, integration, exchange, presentation and analysis of marine information on-board and ashore by electronic means to enhance berth to berth navigation and related services" (1). Secondly, *autonomous shipping*, "where advanced decision support systems on board [can] undertake all the operational decisions independently without intervention of a human operator" (2). And thirdly, *the digitalisation of ports* includes real-time information sharing across the logistics chain as well as electronic administrative procedures and hydro-meteo data integration.

Port and hinterland adaptation to changing shipping and traffic patterns:
Ports as well as their hinterland infrastructure connections have to adapt to two major trends:

1) *increasing size of vessels, especially cellular container vessels, and*
2) *demand for a high-performing, multimodal infrastructure with new connections for road, rail, inland water and sea transportation.*

Green shipping:
Green shipping comprises ship and port operations in the Baltic Sea Region (BSR) with minimised emissions to air and sea.

Shipbuilding:
For shipbuilding, the whole value chain is considered, i.e. research and development, system engineering, purchase and supply of components, design and construction, repair and maintenance as well as the provision of related services.

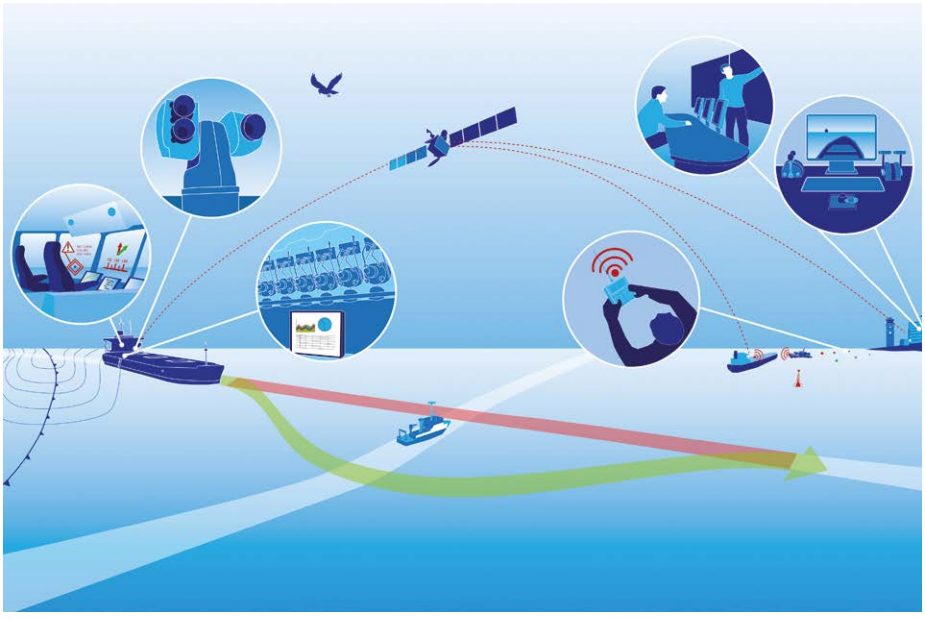

Figure 1: E-navigation of the future according to the MUNIN project
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STATE OF PLAY

According to the International Maritime Organization (IMO), 90 % of trade is accomplished by transporting goods over the seas (3). This trend is expected to intensify, as the increase in cargo transport by ships (42 % between 2004 and 2013) continues (4). Also, the global fleet is expected to increase at a rate of 50 % by 2020 compared to the capacity as of 2010 (4). The size of vessels has also increased substantially, in particular that of cellular container vessels, to enable more efficient and cost-saving freight transport, as well as the environmental benefits of fewer emissions per unit of cargo transported.

The Baltic Sea is no exception to this trend. It is already one of the areas where traffic is heaviest, accounting for up to 15 % of global cargo transportation. Shipping is therefore an important sector in the Baltic Sea Region. According to the **Baltic Blue Growth Agenda of the European Commission**, shipping is by far the greatest generator of gross value added (GVA) in the region.

In 2013, when considering shipbuilding, short sea shipping and passenger ferry services in the Baltic Sea, the GVA of those three sectors reached € 9.7 billion, providing 116,000 jobs (5).

The value of shipping for the BSR is also reflected in the European Strategy for the Baltic Sea Region (EUSBSR). The policy areas PA Ship and PA Safe are specifically dedicated to clean shipping and maritime safety and security. Both policy areas are coordinated by the Danish Maritime Authority (DMA).

The DMA and the Finnish Transport Safety Agency are acting jointly as Policy Area Coordinators for PA Safe.

The shipping sector and its stakeholders show a high level of diversity across the value chain as across BSR countries. This analysis has therefore been conducted along four development fields (see section 2.1) and national specificities will be mentioned where applicable.

Table 1: Core drivers and challenges for the development of shipping in the BSR

New technologies: increasing global high-speed internet coverage, computer power, smart sensors, sophisticated automation systems, Big Data business solutions
Up-scaling of vessels sizes and cargo volumes per port
Governmental and international actions in favour of autonomous shipping, e.g. in Finland
Environmental regulations
External factor: potential rise of the oil price and resulting fuel price developments

DIGITALISATION

The digitalisation of shipping is still in its infancy but will evolve rapidly. An unprecedented boost in communication capabilities has already revolutionised the shipping sector in less than 10 years. New tools and systems are being developed to collect and share data between ships on the one hand and between ships and shore on the other hand.

// STM Validation project (Trans-European Network for Transport TEN-T) //

- Follow-up project of Mona Lisa 1 & 2;
- Led by the Swedish Maritime Authority;
- Tests the concept of Sea Traffic Management (STM);
- 2015-2018.

// Maritime Cloud //

- Part of the EfficienSea2 project ;
- Led by the Danish Maritime Authority with project partners across Europe;
- Intends to build a digital infrastructure for the whole maritime domain.

Worldwide, numerous pilot projects dealing with ship connectivity and data sharing are ongoing and Baltic Sea is at the forefront in this respect. Defining common standards for the digitalisation of shipping is currently one of the main challenges. First initiatives are being carried out in order to standardise e-navigation tools and services. A standardised guideline potentially covering all technical e-navigation services was agreed in April 2017 by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). The guideline will now be shared with other international organisations with the objective of achieving an international agreement on e-navigation services description (6).

Digitalisation is a market-driven development as it increases the efficiency of operations, the safety and the environmental performance of shipping.

// MUNIN (European Union 7th Framework Programme – EU FP7) //

- Led by Fraunhofer-Center für Maritime Logistik (CML);
- Developed a technical concept for the operation of an unmanned merchant ship, assessed the technical, economic and legal feasibility;
- Focussed on deep-sea voyage;
- 2012-2015.

The welfare and entertainment provided for crews and passengers thanks to digitalisation is also considered a business opportunity for suppliers of soft- and hardware.

Research on autonomous seagoing vessels has been carried out for about 10 years. However, fully autonomous shipping has not yet become a reality, neither in the Baltic Sea nor anywhere else. Technological challenges are only partly the reason. So far, the necessary transformative steps in the organisation of traffic at sea (including

// Rolls-Royce Marine remote operations projects //

- Advanced Autonomous Waterborne Applications Initiative: specification and preliminary designs for berth to berth remote operations;
- Developing concepts for onshore control centres together with Technical Research Centre of Finland Ltd.

legal adaptations and development of business cases) have not been undertaken. Still, the Baltic Sea is at the forefront of research into autonomous vessels as several pilot projects have been developed and tested there. Governments, especially in the Scandinavian countries, are also taking measures in order to promote the development of such autonomous ships. Finland, for instance, is planning to open a testbed dedicated to the testing of autonomous ships by 2025 off the coast of Eurajoki in Western Finland.

For ports, the state of digitalisation depends on the country and more importantly on the size of the harbour.

Several tools are already in place at large scale in most of the bigger BSR Ports:

- For administrative procedures before / when arriving at port: National Single Windows to make available at a single place all data required by local government agencies;

- Ports community systems in bigger ports: speed up logistics and connect different transport modes.

But ports also need to adapt in order to meet the needs of e-navigation users. They have to:

- Provide accurate, accessible, up-to-date information in a common data format to enable ship and port to share the information necessary in order to facilitate safe access and berthing, to plan loading / unloading and to allocate resources efficiently;

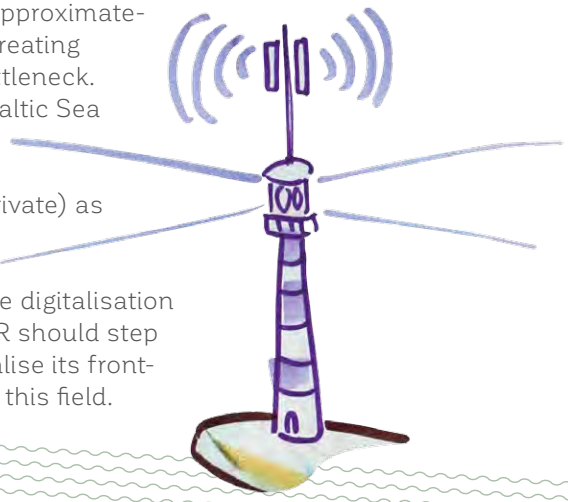
- Implement systems and equipment to receive and disseminate such information to all relevant users;

- Train and hire people according to those new digitalisation needs.

At the same time, core ports are carrying out development projects (e.g. in the fields of expansion or relocation) in order to secure competitiveness and keep their role as import and export hubs for the regional industries and as employment providers in coastal and peripheral regions. Such projects often offer an opportunity for ports to carry out digital improvements.

In many smaller ports, however, the process of digitalisation is not well developed. In fact, for such ports the traffic volume and number of users are generally too low to make the investment in digital infrastructure profitable. Digitalisation in ports is therefore seen as a factor contributing to the increase of discrepancy between small and big ports. The current challenge for all ports is to define their respective future roles in the transport business. This would, for instance, imply a search for anchor customers and the optimisation of door-to-door opportunities.

For digitalisation in general, a number of legal and technical challenges need to be overcome. Questions on cyber security, governance, data protection, data harmonisation, liability and intellectual property rights remain to be solved. Furthermore, the capacity of the current communication equipment is insufficient for shipping operations. With the process of digitalisation, the volume of data produced and exchanged is soaring, but vessels' broadband capacity remains approximately the same, thus creating a technological bottleneck. Nevertheless the Baltic Sea Region is home to very active players (both public and private) as well as promising initiatives for pushing forward the digitalisation endeavour. The BSR should step up efforts to capitalise its frontrunners position in this field.



GREEN SHIPPING

For green shipping, the main drivers in the BSR are regulations at sea-basin or global level. Shipowners and ports are generally sensitive to the introduction of new regulations, because of the increased costs that come with their implementation. This is especially the case if the regulations target the shipping sector, but not other modes of transport are only valid for a particular geographic area. As Table 2 shows, limits have been set on sewage and ballast water discharge as well as sulphur and nitrogen oxide emissions during ship operations. However, emissions of carbon dioxide and exhaust gas at berths are not yet regulated.

// Platform for sustainable shipping under HELCOM MARITIME //

- Led by Finland and Sweden;
- Aim is to enhance the cooperation between the public and private stakeholders in promoting development and use of green technology and alternative fuels.

// Scandlines hybrid ferries) //

- Two ferries running on Diesel and electricity;
- between Gedser / Rostock and Rødby / Puttgarden;
- 15 % CO_2 emission savings.

Alternative fuels (Liquefied Natural Gas (LNG), methanol, hydrogen) or electrical propulsion systems are an important mitigation strategy for exhaust gases. Their deployment in the Baltic Sea to date plays a minor role. Only about 2 % of vessels are fuelled with LNG (7). A single vessel, the Stena Germanica, uses methanol. Reasons for this lack of development are the comparatively low costs for conventional fuel, high installation costs and insufficient bunkering supply offers and facilities.

On the shore side, many ‘green’ measures have been taken by Baltic Sea ports, whose environmental performance exceeds the European average. Many have environmental management systems in place and are certified based on European or international standards (7).

To prepare for the ban of sewage release from passenger vessels, reception facilities have been upgraded, especially in major ports. However, some ports still impose restrictions on the quality of the sewage they accept as well as the quantity that is included in the port dues. Two topics currently on the agenda (but so far insufficiently implemented) are environmentally differentiated port dues and shore-side power supply (so called ‘cold-ironing’). The latter requires compatibility with the local onshore power generation capacity and grid.

Green shipping will enable cleaner oceans, cleaner air and help to combat global warming. It will also provide business opportunities for suppliers of environmental technologies and services, which may partly offset additional economic burdens for the national economies.

// CompMON (Connecting Europe Facility) //

- Led by the Finnish Transport Safety Agency;
- Compliance monitoring pilot for Marpol Annex VI;
- 2014-2016.

Table 2: Environmental pollutants from ships, relevant regulations in place and mitigation

	Regulations limiting emissions / discharge of polluting substances	Regulations supporting implementation		Measures for mitigation
SOx	0.1 % sulphur limit in the Baltic Sea as of 2015	**Directive 2014/94/EU:** Deployment of Alternative Fuel Infrastructures; obligation to establish LNG terminals and OPS in major seaports by 2025		• Low-sulphur fuel • Heavy fuel oil + scrubber, • Alternative fuels • Electricity
NOx	NOx emission in the Baltic Sea according to tier III standard for vessels built 2021 or later			• Low-sulphur fuel + SCR • Alternative fuels • Electricity
CO_2			**MARPOL Chapter IV amendment:** EEDI for new ships and SEEMP for all ships	• Alternative fuels and electricity - • Improved routing • Improved ship design
Exhaust gas emissions at berth				• Onshore power systems
Sewage	**MARPOL Annex V:** Prevention of Pollution by Garbage from Ships **Directive 2000/59/EC:** Improve the availability and use of port reception facilities for ship-generated waste and cargo residues **MARPOL Annex IV:** Baltic Sea as a special area, release of sewage by passenger ships banned as of 2019/2021/2023	**Directive 2005/35/EC:** Better enforcement of prohibition of discharging polluting substance into the sea		• Treatment systems • Discharge into reception facilities in ports
Ballast water	Ballast Water convention: Release of untreated ballast water prohibited as of 09/2017			• Ballast water treatment systems

SHIPBUILDING

Shipbuilding has lost importance in the last five decades, but the sector is still considered important in Finland, Germany, Poland, Estonia and Lithuania (8). Indeed, the sector contributes to national economies as an employment provider in coastal and peripheral regions.

// Important to improve cost efficiency //

83 % of survey respondents see a need for improved cost efficiency in shipbuilding

As can be seen in Table 3 the construction of specialised vessels has been the survival strategy of the industry. Additionally, recent phenomena observed in BSR shipyards have been the outsourcing of the design step and the purchasing of larger system packages, including engineering tasks. Concentration processes and changes in ownership of shipyards could also be observed.

Regarding the upstream value chain actors, the following supply industries and businesses based in the wider area around the BSR (including e.g. Norway, North-West Germany and the Netherlands) are most competitive. More specific, providers of:

- Ship design (in Germany, Finland, Sweden and the Netherlands);
- Electronics, navigation and automation systems;
- Propulsion and power packages and devices (including medium speed diesel engines, propellers, nozzles, etc.);
- Heating, Ventilation and Air Conditioning (HVAC), accommodation and insulation (with locational advantage, as installation is necessary);
- Electrical systems;
- Outfitting and components (e.g. winches, piping, valves, sensors, measuring devices sometimes with locational advantage, as installation is necessary);
- Environmental technology, especially scrubbers (e.g. Finland) and ballast water treatment systems.

// Small Craft Competence Centre //

- Specialised research institution of Tallinn University of Technology;
- Research and development services in the fields of boat design, model testing, material technologies and test production of marine electronic systems.

Shipbuilding and component manufacturing are integral parts of the shipping value chain. However, shipyards and suppliers buy and sell globally. Therefore, these two sub-sectors are largely independent of each other and even more so of the actual transportation activities in the Baltic Sea.

// Conversion of two HH ferries (Innovation and Networks Executive Agency) //

- Battery power retrofitting;
- Launched in 2016.

Only component producers with significant installation services may have a slight advantage when supplying local shipyards.

Where ships that operate mainly or only in the BSR are concerned, ship repair and maintenance services are more pertinently subject to regional rather than international competition.

R&D projects are important facilitators of the transition from the current state of play to a more advanced future, both for engineering and production technologies as well as for advanced competitive ship designs.

// Stena Germanica RoPax Ferry //

- Piloting the conversion of a ferry to run on methanol as a primary fuel;
- Co-financed by TEN-T;
- Launched in 2015.

Most BSR states still maintain (varyingly extensive) state funded R&D programmes to support and stimulate their shipbuilding industry. Many companies (in particular the larger yards and suppliers) also have their own, largely privately financed, R&D strategy.

Table 3: Vessels types and installations constructed in BSR shipyards

Type of vessel / installation	Main location of clients
Offshore service vessels	Northern Europe
Offshore platforms	Northern Europe
Icebreakers	Northern Europe
Cruise ships	USA and European operators, now also increasingly Asian (e.g. Genting Group)
Passenger ferries and Ro-Ros	Northern Europe (including BSR) and Mediterranean
Yachts and other small crafts	US, Asian, Middle Eastern and European clients (including Russia)

SHIPPING: VISION 2030

In 2030, maritime transport operations in the Baltic Sea have increased. Stakeholders along the value chain benefit from this development. For the shipbuilding segment, maintaining the level of economic importance comparable to that in 2017 is feasible, assuming peace and a moderate, but steady growth of the global economy as well as a certain reasonable consolidation in Asian shipbuilding countries such as Japan, Korea and China. The shipping industry has successfully adapted to changing conditions, such as digitalisation and increasing expectations in terms of environmental performance, and has therefore been able to fulfil its overall economic potential. Finally, an increasing amount of data is shared as open data enabling the businesses to use and to link the data in various fields of shipping and thereby creating a whole new set of automated services.

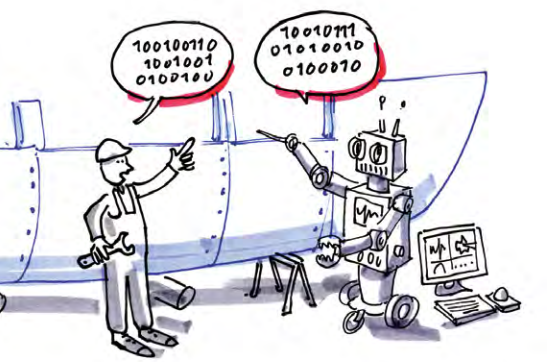
Digitalisation has changed the whole shipping sector significantly across the whole value chain. In 2030, all commercial and government-owned ships in the Baltic Sea are e-navigation compatible (i.e. able to share their route and ship particulars, like certificate data, in a standard format and have the possibility to use other e-navigation services available in the BSR). This is possible due to increase in the internet access for ships, the high automation of ships allowed by the multiplication of sensors and software on-board and by secure, seamless exchange of data. In contrast to global data centres, the Baltic Sea Region works with regional data centres, which use a common model in order to exchange data smoothly. In addition, Baltic countries have the same policies (legislation) on data exchange.

The first commercial solutions for **highly automated ships** (enabling vessels to sail autonomously but still requiring human intervention) have been available since 2020. The first test operations with fully autonomous vessels also started around that time. In 2030, a smaller number of fully autonomous vessels operates on special routes in the BSR (feeder, barge, ferries) while the majority of vessels is still operated conventionally or partly autonomously. A solution to the question of interaction between autonomous vessels and those operated by people is available. The gradual appearance of autonomous vessels necessitates numerous adaptations of the established system. For instance, 'traditional' shipping operations such as stowage, transhipment or bunkering as well as the port infrastructure need to be adapted.

The trend of digitalisation has had an impact not only on the vessels themselves, but also revolutionised the entire **door-to-door transportation process**. A **"Maritime Logistics Cloud"**, accessible for all commercial and administrative stakeholders, is now in place. The information system is comprised of several subclouds, sharing information between vessels, ship operators, ports, freight forwarders, and authorities in order to smoothen the transportation process. The Maritime Cloud developed by the Danish Maritime Authority could serve as an example to develop such a Cloud.

Ports are embracing the role of **information hubs**, connecting operators of a diversified multi-modal infrastructure and cargo owners. This increase of multimodality, especially in core and medium ports, is a reality by 2030 with the support of national and EU policy (9). Short sea shipping, especially, is the main element of multimodality in the Baltic Sea Region. Delivery and pick-up of cargo function "just in time" is in place. This avoids congestion and emissions as well as saving fuel due to slow steaming. The load capacity of ships is better

used thanks to a digital logistics chain and port optimisation processes and ships no longer sail half empty. Cargo handling and passenger transportation in ports is highly autonomous, especially in core ports. In the context of information sharing, the widespread application of blockchain technology is especially promising, since it offers more data security than overly centralised systems.



Digitalisation has also changed the shipbuilding industry. The value chain is digitally interlinked and production processes are highly automated. The problem of attracting skilled labour for the maritime industry, in competition with other attractive industries, is gradually being solved, as a smaller workforce is needed and more IT-based and robotic applications make the work places more attractive and productive.

The new digital maritime economy, requires a highly-qualified workforce. The **need for skilled labour**, fit for the requirements resulting from digitalisation along the entire shipping value chain, has been recognised sufficiently early. Education and training programmes have been adapted to equip seafarers as well as candidates and employees of supporting industries, shipyards and component suppliers with the necessary skills.

Shipping and port operations are **environmentally sound** and the regulations specified in Figure 2 (see above) have been implemented and enforced. In addition, obligatory international targets for cutting the carbon dioxide (CO_2) emission of the shipping sector have been set up. As an effect, CO_2, sulphur oxides (SOx) and nitrogen oxides (NOx) emissions by ships have substantially decreased (see Figure 4), as vessels employ alternative fuel and exhaust gas-cleaning technology, i.e. low sulphur fuel, conventional fuel with scrubbers as well as LNG. Methanol and hydrogen propulsion play a lesser role. Electricity-propelled ferries are employed for short distances, especially in Denmark. Hybrid-electric propulsion complements fossil as well as alternative fuel propulsion systems in many cases. In BSR ports, reception facilities for sediments, untreated ballast water and sewage are comprehensively available. A wide network of bunkering infrastructure for alternative fuels, shore-sided power facilities and charging infrastructure for electric vessels is in place. To this end, ports have cooperated on procedures and technical interfaces. A common, differentiated port fee system is applied across the Baltic Sea, rewarding environmentally friendly vessels.

Table 4: Projected emission savings in the Baltic Sea 2011 and 2030 (10)

A concentration process has taken place among **Baltic Sea ports**. **Alliances** have been formed in order to reduce the burden of investment costs for infrastructure. Especially medium and small ports, which continue to be the majority of ports in the Baltic Sea, thereby secure their survival.

Shipyards are also impacted by environmental regulations. Until 2025, repair and conversion shipyards were occupied with the retrofitting of technology to meet new environmental standards (e.g. ballast water treatment systems, LNG, scrubbers, Selective catalytic reduction (SCR) systems). In 2030, retrofitting of existing vessels has been largely completed. Shipyards continue to successfully produce high-end, specialised vessels and structures. The vessels produced use e-navigation equipment and feature an enhanced environmental performance. Even though demand for ship types is highly volatile, sound research and development capacities enable BSR shipyards to adapt to the market. In comparison to the state of play in 2017, the portfolio of BSR shipyards is more diversified and embraces traditional ship types (see Table 3 above e.g. short sea vessels, special tankers and bulk carriers, dredgers, workboats) as well as innovative vessels and installations (e.g. deep sea mining vessels and respective floating structures, wave energy devices, heavy lift and ocean construction vessels and platforms). Most sustainable growth is achieved in segments such as cruise shipbuilding, where important clients place more trust in European (including BSR) yards and suppliers than in their global competitors elsewhere.

STRATEGIC ACTION FIELDS

Taking into account the four shipping development fields presented in the second part of this paper (2.1 Definition and scope of the thematic area "Shipping"), we have defined six cross-cutting strategic action fields:

- Strengthening e-navigation and paving the way for autonomous shipping;
- Sharing machine readable data across the entire supply chain;
- Securing operation of small and medium ports;
- Developing green solutions;
- Creating framework conditions for a successful shipbuilding industry;
- Adapting education and training.

It should be stressed that shipping is a global operation. For regulatory issues in particular, international agreement must be reached at IMO level. However, the suggested actions below focus on the BSR as an action field.

STRENGTHENING E-NAVIGATION AND PAVING THE WAY FOR AUTONOMOUS SHIPPING

// Steering Committee of PA Safe as e-navigation working group //

This Committee should discuss the implications of e-navigation for the BSR by following e-navigation initiatives, regulatory developments and research on this topic. The working group should facilitate exchange and sharing of results between e-navigation projects, especially of those with BSR participation.

At the current stage, it is important to join forces and align efforts to create a favourable environment for the development of e-navigation and autonomous shipping. Not all issues can be influenced at sea-basin level. Solving regulatory questions is a fundamental and indispensable condition for further development – especially for partly or fully autonomous shipping – but they need to be solved on the global level. Implementation should be prepared through pilot projects that do not start from scratch, but rather build on previous project outcomes.

Recommended strategic actions are:

- **Develop cooperation between e-navigation initiatives at BSR level.** *Potential actors* include the HELCOM Maritime, the EUSBSR and IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities);
- Assess the potential benefits of autonomous shipping including the consideration of higher inspection and maintenance cost, the higher crew cost for better IT-qualified seafarers onboard and ashore. *Potential actors* are industry stakeholders and research institutions;
- **Join forces to promote the development of a regulatory framework** for fully or partly autonomous shipping mode (remote-controlled, unmanned and autonomous). This includes classification and survey, rules, regulations and procedures at both BSR and IMO level. *Potential actors* are BSR governments, HELCOM Maritime, supported by industry stakeholders and research institutions / universities;
- Join forces to promote the development of procedures for the interaction between autonomous and conventional ships as well as the interaction with shore-based facilities (e.g. Synthetic Aperture Radar (SAR), Vessel Traffic Service (VTS), piloting, ports, etc.). *Potential actors* include BSR governments (national emergency response bodies maritime administrations, coast guards, etc.), HELCOM Maritime, IALA, IMO, supported by industry stakeholders and research institutions / universities;
- Develop a decision support system for assisting crews in efficient ship operation, showcasing savings made through improved efficiency. *Potential actors*: IT solutions company - companies, ship operators, universities and R&D organisations, the showcasing can roled out through a project or industry network;
- Study the economic impact of the present “first come, first served” arrival principle, compared to smart, digitally supported alternatives. Collect good practices for berth allocation and discuss with stakeholders how they could be implemented. *Potential actors* include Åbo Akademi, Tallinn University of Technology and STM Validation project;

- Transfer experience from developing autonomous solutions in other transport modes to shipping. *Potential actors* include research institutions / universities, the private sector as well as EUSBSR PA Ship and PA Transport;

- Assess e-navigation projects and processes through Formal Safety Assessment as well as in terms of efficiency gains. *Potential actors* include HELCOM Maritime and institutions / universities;

- Address the implications of autonomous ships for ports. *Potential actors* include port authorities and associations;

- **Continue to invest in internet connectivity** (e.g. by implementing 5G) as a condition for e-navigation and autonomous shipping. *Potential actors* include BSR governments and internet providers;

- Exchange experience on best practices and support measures for digitalisation. *Potential actors* include EUSBSR, BSR governments, maritime administrations, port authorities, ESPO (European Sea Ports Organisation) and ship owners;

- Establish a joint test bed for autonomous vessels at the BSR level. *Potential actors* include IALA, HELCOM Maritime, EUSBSR, maritime, shipping and industry associations, national maritime administrations and authorities;

- Develop and employ digitalised solutions for multimodal cargo handling. *Potential actors* include port authorities, digital solutions producers and operators of other transport modes.

// Establishing a joint test bed for autonomous vessels at the BSR level. //

This test bed should be run by a consortium of project partners. Autonomous ships should be tested there as well as their interaction with each other and with conventional vessels. Different projects should use the testbed, which would improve inter-project co-operation. As a first step, a simulator could be implemented in order to create a management framework for the test bed and test this framework virtually before implementing it.

The Maritime Cloud, which is currently being developed by the Danish Maritime Authority, could be used to share data in the test bed. Lessons learned from the live test beds implemented under the STM Validation project should also be used.

Potential actors: IMO, IALA and HELCOM should provide a recommendation on the legal framework of the test bed. BSR countries (Finland is preparing the opening of a testbed for autonomous vessels by 2025) should then establish and take part in the test bed and its forum. Universities should provide maritime and Information and Communication Technologies (ICT) education as well as training development especially for the virtual testbed.

PA Safe of the EUSBSR might be the coordinating body, gathering the interest groups and facilitating the projects in the test bed.

// Cooperation and exchange of information between STM Validation project, Maritime Cloud (DMA) and the Korean Smart Navigation projects. //

// Autonomous shipping test beds //

In Norway, the Trondheimsfjord was designated as an official test bed for autonomous shipping by the Norwegian Coastal Authority.

// Establish autonomous feeder services from core ports with frequent connections to smaller ports //

Potential actors: Public-private consortium including ship owners and authorities as well as R&D organisations and universities to provide sufficient implementation into education and training.

SHARING DATA ACROSS THE ENTIRE SUPPLY CHAIN

Digitalisation involves sharing of data along the supply chain, including ports, ships, other transport modes, cargo owners as well as shipyards and suppliers. Currently, a lot of initiatives are developing in parallel. A one-stop-shop for data sharing, including all branches of the supply chain, does not seem feasible at this point. However, integrative efforts for a smoother supply process is already taking place and should be reinforced.

// Industrial Data Space Initiative in Germany (developed by Fraunhofer CML) //

// Pilot project on developing intelligent hardware for multimodality purposes in the port //

for example to load and unload cargo from one ship directly to another ship without storing it in the port, e.g. "container drones" that steer the loading / unloading process.

Potential actors: Port authority and private sector, EUSBSR PA Transport, R&D organisations and universities.

Recommended strategic actions are:

- Establish a future common European Maritime Single Window environment including links with the National Single Windows (NSWs) already established through Directive 2010/65/EU on reporting formalities. *Potential actors* include EUSBSR, Baltic Ports authorities and Baltic Ports Organisation (BPO) in order to develop a concept at the Baltic Sea level. In a second step, a European Single Window concept could be developped;

// eManifest project //

- harmonise the cargo information that is needed for both maritime and customs purposes and test its submission in a European Maritime Single Window (EMSW) prototype
- fully-fledged testing in Spring 2017.
- EC to fit the harmonised European reporting solution developed in the project into legislation.

- International data standards for ports. This action should be initiated by the transport chain actors and approved by national authorities such as maritime administrations;

- Improve network and links between customers and suppliers along the value and supply chain, follow up and possibly regionalise the STM Validation project (see above). *Potential actors* include representatives of the entire supply chain;

- Screen on-going data space initiatives for application in BSR projects, assess their applicability for maritime cloud purposes as well as possible gaps and provide proposals for common standards and good practices on system architecture, security rules, data access rules, etc. This action should be linked to and learn from on-going practices, not necessarily from the maritime field. *Potential actors* include research institutions and universities, maritime networks, ports and ship owner associations, national maritime authorities and private sector companies;

- Conduct a study on the benefits and risks of data sharing (not only within the maritime domain), including how the risks can be addressed, and widely promote the results among all stakeholders along the supply chain. *Potential actors* include institutions and universities, maritime networks, ports and ship owner associations, national maritime authorities and private sector companies;

- **Gathering and sharing of data between different transport modes for cargo and passengers.** *Potential actors* include EUSBSR PA Transport, research institutions, ship owners, port authorities and freight forwarders, governmental authorities.

// Creation of a new platform, integrating different platforms for passenger transportation //

(e.g. ferry schedules, train schedules, bus schedules and Google maps) and allowing people to book tickets, compare travel options and see transport connections.

Potential actor: Baltic Ports Organisation

// Pilot project in a limited area on forming a joint system for the collection and sharing of data on cargo from different transport modes. //

Potential actors: RISE Viktoria with public authority, EUSBSR PA Transport, Abo Akademi, Baltic Ports Organisation.

SECURING OPERATION OF SMALL AND MEDIUM PORTS

Small and medium ports constitute the majority of Baltic ports and continue to be very important as they guarantee access to remote areas, especially in Scandinavian countries such as Finland and Sweden. However, globalisation leads to the concentration of trade flows and thus investments in core ports. This in turn increases the discrepancy between small & medium ports and core ports. As small and medium ports are regarded as important employment providers and facilitators of import and export for regional industries, the conditions for their survival should be created.

Recommended strategic actions are:

- Conduct a study on the role of small and medium-sized ports and show what opportunities for them arise from the Blue Growth Strategy and the Baltic Blue Growth Agenda. *Potential actors* include Baltic Ports Organisation, port associations and port authorities;
- **Make sure that small and medium ports are sufficiently accessible** through dredging and hinterland connection projects. *Potential actors* include the European Commission through the TEN-T programme, national administrations and governments and port authorities;
- Include small ports in digitalisation (of value chain) projects. *Potential actors* include EUSBSR PA Transport and port authorities;
- Include ports (especially small and medium ones) in regional smart specialisation strategies. *Potential actors* include regional and local authorities, clusters and port authorities.

// Develop a joint port-community system for smaller and some medium ports at BSR level. //

This tool is meant to speed up the logistics and connect the different transport modes in the ports and their hinterlands. Bigger ports already have ports community systems for administration and logistical purposes but smaller ports (and some medium ports) do not have the required number of users to develop such a system and make it profitable.

Potential actors: Some small ports in Finland, Sweden, Estonia, Latvia or Lithuania, Baltic Ports Organisation.

DEVELOPING GREEN SOLUTIONS

For truly green transport solutions, the whole transport system must be targeted. In light of tightening environmental regulations for shipping, it is important that political actions are taken at EU level to create fair conditions for shipping as an environmentally friendly transport mode.

Recommended strategic actions in this field are:

- A master plan coordinated at European level for integrated transportation policy, rewarding environmentally friendly transportation. *Potential actors:* EU Member States in consultation with the transport sector and environmental non-governmental organisations;
- Cost-benefit analysis of modernising inland waterways in the BSR, taking into account environmental benefits. *Potential actors* include regional authorities, Member States and universities / R&D institutions;
- Assess the suitability of alternative fuels by type of ship. *Potential actors* include research institutions, ship owners and associations;

// Install high voltage onshore power supply infrastructure in test ports. //

The project should take into account findings from the collaboration within the Memorandum of Understanding on onshore power supply.
Potential actors: Baltic Ports Organisation, ports.

// Memorandum of Understanding on on-shore power supply //

Collaboration between the ports of Helsinki, Turku, Tallinn and Stockholm in the field of high-voltage onshore power supply to identify a common approach.

// GOLNG (Baltic Sea Region Programme) //

- Led by Klaipeda Science and Technology Park;
- Addresses the LNG value chain to strengthen demand and increase competitiveness of LNG;
- Establishes an LNG Competence Center and an LNG Business Partnership;
- 2016-2019.

// EnviSuM (Baltic Sea Region Programme) //

- Led by University of Turku;
- Provides the shipping sector with guidance to support future investment decisions for compliance with environmental regulations;
- 2016-2019.

// Port dues discounts based on environmental performance in ports of Stockholm, Gothenburg, Rostock and Riga. //

- Elaboration of a cost-benefit analysis of onshore power supply for electric vessels (including shoreside investments needed to supply the necessary capacity) at the BSR level. This cost-benefit analysis should focus on specific areas and ports in the Baltic Sea (e.g. TEN-T ports), as well as special types of vessels. *Potential actors* include research institutions, universities, ports and port associations;

- Assess feasibility of financial support mechanisms for ship owners and ports to promote the installation of green technology. *Potential actors* include research institutions, universities, port authorities, port associations and ship owners;

- **Invest in a fuel supply network** (e.g. LNG infrastructure). *Potential actors* include the private sector, possibly supported through public funding (see above);

- Explore possibilities of creating a green label that includes the transportation footprint, as well as the associated certification process with cargo owners. *Potential actors* include cargo owners, ship owners, operators of other transport modes, flag states, HELCOM Maritime, the European Commission;

- Draft a roadmap preparing for the ban on sewage discharge, including information exchange between ports and cruise lines (on pumping capacity, quality of the sewage, itineraries), assessment of demand for sewage reception and a best practice guide for onboard handling of sewage. *Potential actors* include HELCOM Maritime and cruise operators;

- To facilitate the reporting of inadequate Port Reception Facilities (PRF), also berth specific, improve the EU PRF Directive. *Potential actors* include HELCOM Maritime at BSR level and the European Commission at European level;

- Based on existing experience, elaborate a system for environmentally differentiated port dues that can be adopted Baltic Sea wide. *Potential actors* include Baltic Ports Organization, port authorities and HELCOM Maritime.

// Dialogue platform for good practices on Port Reception facilities under HELCOM Maritime //

Involves ports, shipping industry, national administration and waste water treatment plants.

CREATING FRAMEWORK CONDITIONS FOR A SUCCESSFUL SHIPBUILDING INDUSTRY

To foster the development of the BSR shipbuilding industry, actions should be taken to create favourable market conditions. Pre-competitive research is an important lever. The listed actions describe what kind of research should be carried out by universities and research institutes. Strengthening local and regional value chains and access to finance should also be addressed.

Recommended strategic actions are:

- **Researchers should concentrate on methods** (rather than very specific topics) to be able to adapt to the quickly changing research demands of the industry. *Potential actors* include research institutions and universities, in interaction with the industry as sound board;

- Knowledge transfer across disciplines should be encouraged, e.g. between aviation and navigation. *Potential actors* include research institutions, universities, private sector R&D and end users of different disciplines;

- Research projects should be interdisciplinary, involve the end user and should focus on concrete problems in a holistic manner. *Potential actors* include research institutions, universities, private sector R&D and end users;

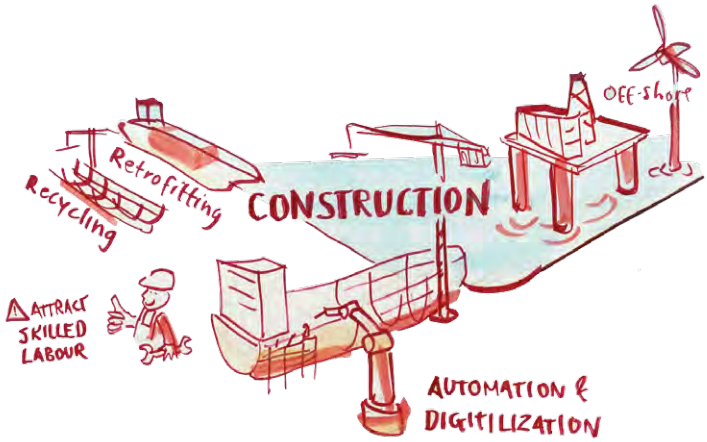
- R&D projects in the following fields should be supported:
  - Automation / robotics;
  - Harmonisation of data formats;
  - Green ship technology involving ship designers, equipment manufacturers and shipyards;
  - More durable and eco-friendly materials.

  Potential actors include research institutions, universities, private sector R&D and end users;

- Strengthen local supply chains and the role of shipyards as system responsibles. *Potential actors* include Baltic shipyards, component producers and maritime networks;

- Assess how the European Investment Bank (EIB) could provide interim financing or refund guarantees for banks / insurance companies. *Potential actors* include the EIB, research institutions and universities;

- Improve access to finance for the shipbuilding industry through national programmes, where such financing is not provided by the market. *Potential actors* include banks, insurances and the EIB;



// Zero Vision Tool //

- Collaboration method, project platform and interdisciplinary network for green shipping;
- Involves main stakeholders;
- Pilot projects testing different technologies.

// (De-) installation services //

Develop the market of (de-) installation services, recycling or retrofitting of offshore wind farm constructions (wind turbines, substations, foundations).
Possible activities:

- Assess costs of individual steps for (de-) installation;
- Create an inventory of companies engaged in the field;
- Assess the regulatory framework and promote an alignment of legal standards across the BSR;
- Assess market potential for components to be recycled.

Potential actors include Gdansk Shipyard Group, other shipyards, offshore wind farm owners and logistics & installation operators.

ADAPTING EDUCATION AND TRAINING

New technologies and processes being implemented in the shipping and shipbuilding industry (digitalisation, new propulsion systems for vessels and infrastructures, new logistics systems, etc.) are directly affecting the required skills and competence profile of the workforce. Employees of the maritime sector need to be trained accordingly. The education system also has to respond to the new requirements. The expert group on skills and career development in the blue economy as well as the EU platform on maritime technologies as part of the blue print on skills cooperation (11) could play a vital role in the actions below.

Recommended strategic actions are:

- Facilitate close co-operation between universities, R&D institutions, public as well as private sector. Coherent cooperation is aiming to offer innovative and labour market based maritime education and training integrated with R&D;
- In the shipping and shipbuilding industry, analyse demand for skilled workforce and assess qualification possibilities;
- **Invest in competitive, transboundary maritime education and training,** supporting the labour market needs in seafaring, ship engineering, ICT, port and shipping management etc. It is not only employees who need to be trained differently. The entire education process needs to be adapted, including the training of trainers and lecturers;
- Train staff to be able to meet requirements arising from digitalisation and automation. This concerns both educational institutions and the shipping and shipbuilding industry (ports, shipyards, shipping operators, digitalisation projects coordinators, etc.);

- Practitioners from the shipbuilding sector should visit (and teach at) schools and universities to attract young people to the industry;
- Facilitate close cooperation between universities and the shipping and shipbuilding industry. This cooperation may take the form of study visits, provision of guest lecturers and dialogue on curricula.

// Potential Actors in this strategic action field //

Potential actors include the IMO, the International Association of Maritime Universities, other allied universities and vocational colleges, maritime clusters, chambers of commerce and associations representing the private sector, training institutions and the EUSBSR (PA Safe, PA Education, PA Secure).

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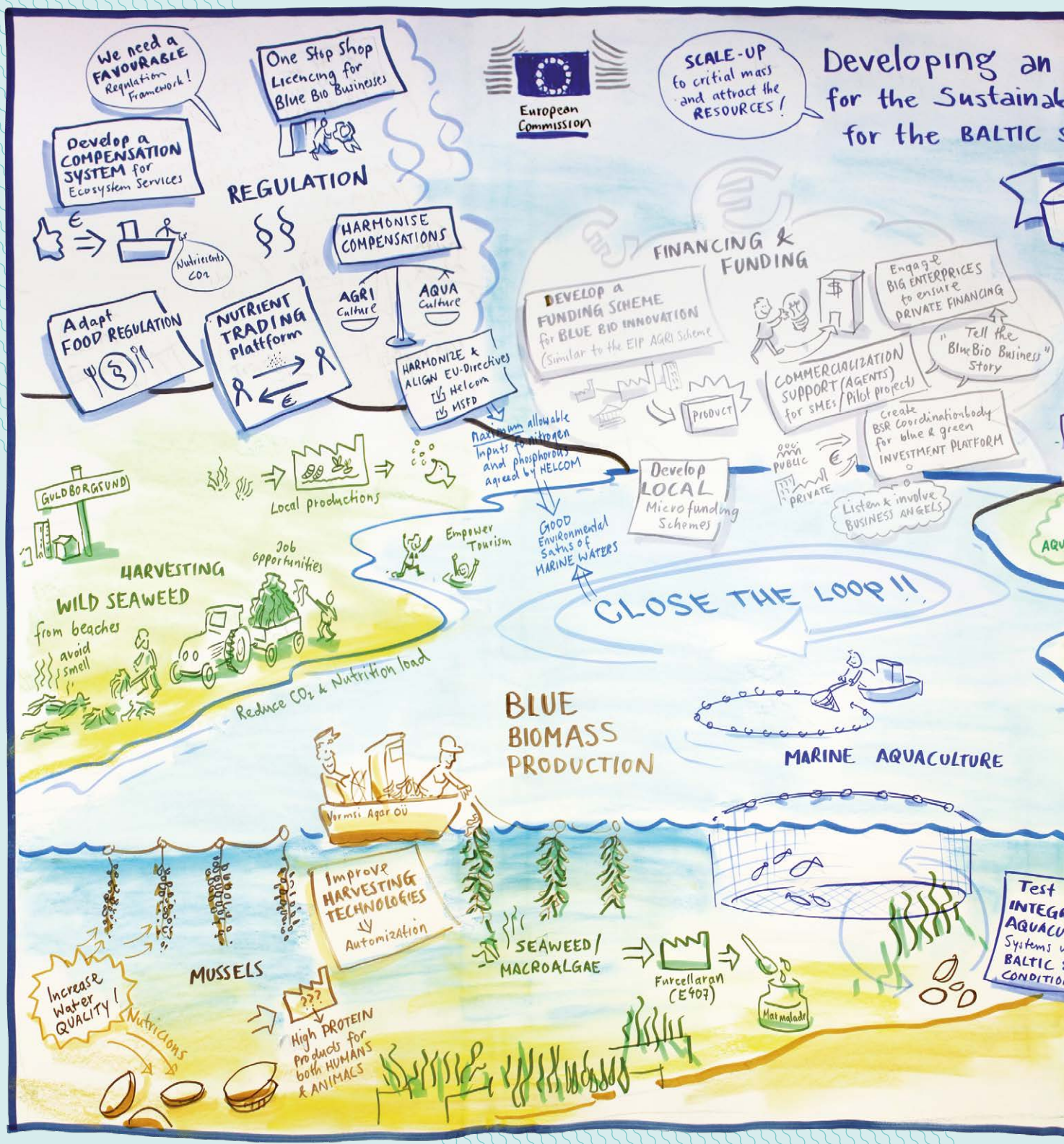
We need a FAVOURABLE Regulation Framework!
One Stop Shop Licencing for Blue Bio Businesses
European Commission
SCALE-UP to critial mass and attract the RESOURCES!
Developing an
for the Sustainab
for the BALTIC
Develop a COMPENSATION SYSTEM for Ecosystem Services
REGULATION
HARMONISE COMPENSATIONS
AGRI Culture
AQUA Culture
Nutrients CO2
Adapt FOOD REGULATION
NUTRIENT TRADING Platform
HARMONIZE & ALIGN EU-Directives
HELCOM
MSFD
FINANCING & FUNDING
DEVELOP a FUNDING SCHEME for BLUE BIO INNOVATION (Similar to the EIP AGRI Scheme
Engage BIG ENTERPRICES to ensure PRIVATE FINANCING
COMMERCIALIZATION SUPPORT (AGENTS) for SMEs/Pilot projects
"Tell the BlueBio Business" Story
PRODUCT
Create BSR Coordinationbody for blue & green INVESTMENT PLATFORM
Listen & involve BUSINESS ANGELS
PUBLIC
PRIVATE
Maximum allowable Inputs of nitrogen and phosphorous agreed by HELCOM
Develop LOCAL Micro funding Schemes
GULDBORGSUND
Local productions
Empower Tourism
GOOD Environmental Status of MARINE WATERS
Job opportunities
HARVESTING WILD SEAWEED
from beaches
avoid smell
CLOSE THE LOOP!!
Reduce CO2 & Nutrition load
BLUE BIOMASS PRODUCTION
MARINE AQUACULTURE
Vormsi Agar OÜ
Improve HARVESTING TECHNOLOGIES
Automization
MUSSELS
SEAWEED/ MACROALGAE
Furcellaran (E407)
Matmaladr
Increase Water QUALITY!
Nutrients
High PROTEIN Products for both HUMANS & ANIMALS
Test INTEGR AQUACU Systems BALTIC CONDITIO

BLUE


IMPLEMENTATION STRATEGY
le Blue Growth Agenda
SEA REGION
BLUE BIOECONOMY
Policy Makers
Consumers
Investors
INCREASE VISABILITY
Media
SUBMARINER NETWORK
Start wit the existing PROJECT Networks!
NETWORKING between companies/ NGO's / Gov. Bodies
BLEV LOBBY Group
Marketing Campains
Consumers
Retail
COMMERCIALIZATION & MARKETING
Integrating Blue Bio Economy in ENVIRONMENTAL EDUCATION
TECHNOLOGY
TRAINING & KNOWLEDGE TRANSFER
for Practioners & producers
Attract CROSSBORDER INVESTMENTS
Learn from other Sectors
EFFICIENCY & SUSTAINABILITY
IMPROVE CONVENTIONAL SYSTEMS
SCALE INFRASTRUTURE
JOINT BSR TEST BEDS
Agriculture or ACULTURE?
GREENHOUSE PRODUCTION
MICROALGAE
3imiis Algae Omega3
Making MORE from LESS
Optimizing the BIOREFINERY
BLUE Bio-based PRODUCTS
High Value NUTRIENTS
FUEL
BIO GAZ
Commodity FEED
COSMETICS
Materials
speciality CHEMICALS
Fertilizers
PHARMCEUTICALS
FOOD Proteins
CONSUMERS
FISHFARMING
• New Industry (+7%/year since 1970)
• relatively ecological source of proteins
• but: not possible without any env. foodprint
⇒ "ENVIRONMENTAL ROOM"
FRESHWATER AQUACULTURE
TRADITIONAL
MODEL FISHFARM
HIGH RECIRCULATION AQUACULTURE SYSTEM (RAS)
Recirculate 80-95%
Improve EFFICIENCY of RAS-Systems through TRAINING & KNOWLEDGE TRANSFER & TECH. IMPROVEMENTS
Trans-disciplinarity
Bring BIOBASED products to the market!
1163 known COMPOUNDS
70 Products in Production/ on the Market
infrastructure to Scale-up!
Competition of fossil Products!
BLUE BIOTECHNOLOGY
GREEN processes
Reliable ANALYTICAL Methods
Non-destructive fractionation Methods
s.Pro
ECORYS
KTH
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BIOECONOMY

DEFINITION AND SCOPE OF THE THEMATIC AREA "BLUE BIOECONOMY"*

The blue bioeconomy is not a clearly defined sector. In our understanding, it encompasses economic activities that are based on the sustainable use of living aquatic resources and their conversion into a wide variety of products and services such as food, feed, bio-based materials and bioenergy.

During the stakeholder involvement process leading to this report, the following four development fields were identified as important for regional (and even global) economic opportunities for growth in the blue bioeconomy:

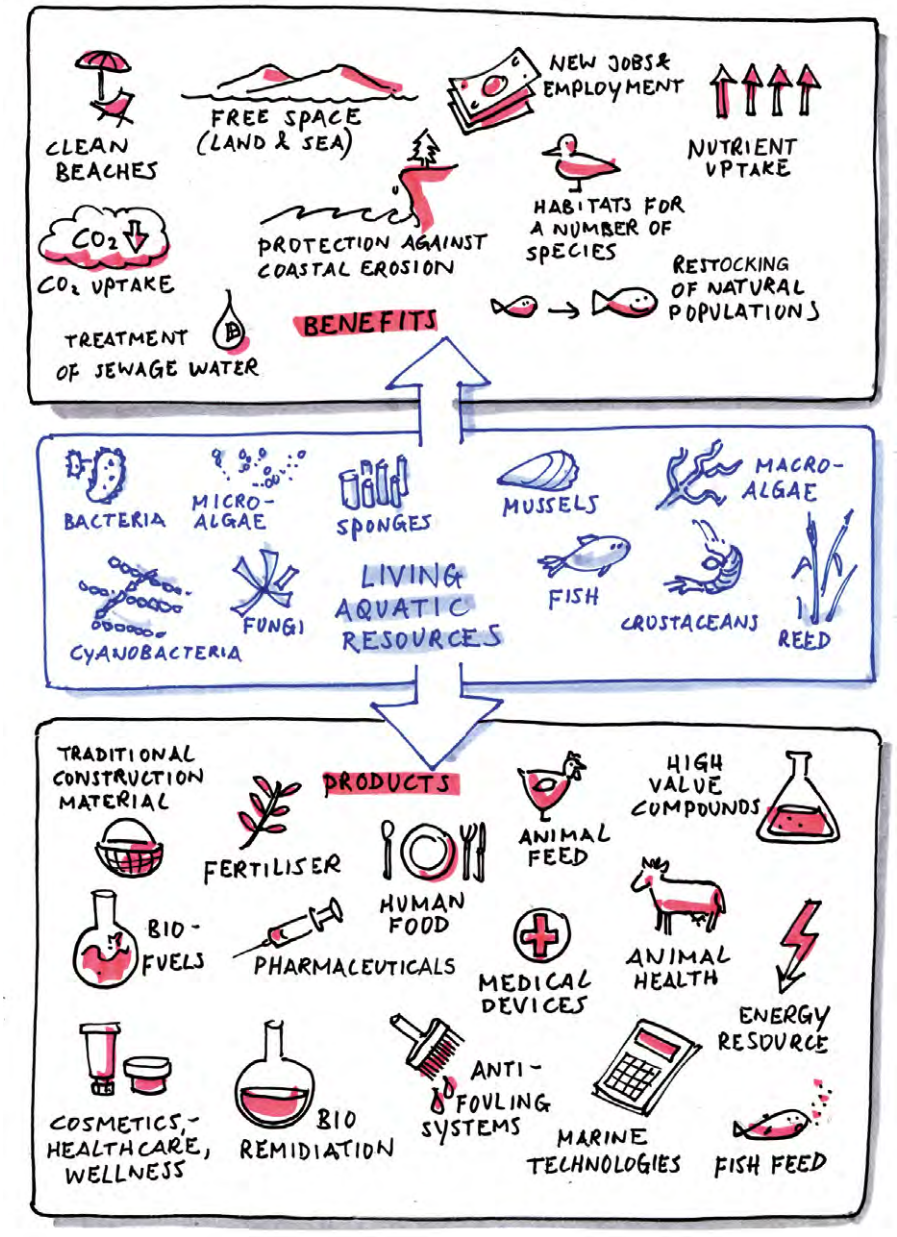


Figure 1: Summary of benefits and products that can be obtained from a sustainable use of living aquatic resources. Adapted from the SUBMARINER Roadmap (1)

Harvesting and new uses of wild aquatic biomass: this development field refers to the collection and / or harvesting of aquatic biomass such as algae or reed to clean beaches, improve water quality and to converting the biomass into a variety of products;

Blue biomass production: means the production of aquatic biomass with the purpose of converting it into a variety of biobased products and services. The current activities in the Baltic Sea Region (BSR) focus mostly on mussel and macroalgae cultivation in the sea. It also covers (commercial) microalgae cultivation activities taking place in the region. The latter, however, is land-based;

Blue biotechnology can be defined as the application of science and technology for the production of knowledge, goods and services from marine biological resources (adapted from OECD (2));

Sustainable fish aquaculture covers the farming of both marine and freshwater fish species in marine, inland freshwater and land-based cultivation systems with minimised environmental impacts and sustainable feed supply chains.

These development fields do not cover the whole range of the blue bioeconomy areas, but are considered as particularly important for triggering blue growth. Please note that for this reason, fisheries are not included in this report although in other contexts are often regarded as part of the blue bioeconomy.

*(incl. aquaculture)

STATE OF PLAY

Some parts of the blue bioeconomy, such as fish farming or algae collection, have a long tradition in many parts of the world and also in some European countries. However, the holistic notion of a blue biobased economy in which the sustainable use of living aquatic resources can replace fossil-based materials and deliver a variety of products and services is still a relatively young concept. In comparison to well-established bioeconomy sectors such as forestry or agriculture, it is obvious that many of the activities currently taking place in the field of blue bioeconomy are still at the research & development stage and yet need to be commercialised.

Interest in the blue bioeconomy has been increasing in BSR countries, with many new actors and initiatives becoming active in the field during recent years. A survey launched by the SUBMARINER Network in 2015 resulted in a list of as many as 139 currently on-going or recently finished initiatives and projects dealing with sustainable uses of marine resources in the BSR countries (3). Even though this survey was not fully comprehensive, the sheer number of activities and actors involved in them shows that the BSR is making progress in blue bioeconomy-related disciplines. The Nordic countries and Germany are clearly at the forefront, while actors from the Baltic countries and Poland are involved to a significantly lower degree in these initiatives and projects.

Due to their research excellence and innovation capacity, research institutions and SMEs are key actors in the field. However, coastal municipalities and regions are becoming increasingly active, taking advantage of the benefits of blue bioeconomy solutions for local and regional development in both environmental and socio-economic terms.

As eutrophication and a historically high level of pollutants continue to pose huge environmental challenges in the BSR, the development of its blue bioeconomy must also be seen in the context of the EU Member States' obligation to achieve Good Environmental Status (GES) of marine waters in accordance with the Marine Strategy Framework Directive (MFSD) and the HELCOM Baltic Sea Action Plan. Especially the maximum allowable inputs for nitrogen and phosphorous and resulting reduction needs recommended by HELCOM steer the development of any water-related economic activities. While this might be perceived as a barrier – in particular for marine fish aquaculture – the obligation to improve the Baltic Sea's poor water quality is also a driver of growth for many blue bioeconomy-related activities. For example, the collection of beach-cast seaweed or the cultivation of mussels in the eastern parts of the Baltic Sea were originally initiated for their potential to clean up beaches, locally improve water quality and combat eutrophication.

// Stakeholder involvement in survey //

The largest share of responses was received from Germany, Sweden and Denmark (18 % each), followed by Finland (16 %). The largest stakeholder group was made up of representatives of research and development organisations, making up 38 % of responses, while 25 % of respondents represented businesses or private interests.

STATE OF PLAY

Once smart ways of creating added value in the use and transformation of this blue biomass have been tested and respective value chains created, such activities are expected to simultaneously generate substantial blue growth. Apart from the on-going search for commercial applications, potentially interested investors face an unclear, inconsistent and uncertain regulatory framework, which has been identified as a major barrier to the blue bioeconomy's development.

The blue bioeconomy has also gained political tailwind through a number of initiatives and strategies that recognise its potential and put the topic high on the agenda, such as:

- the United Nations Sustainable Development Goals, in particular goal 14 ("Conserve and sustainably use the oceans, seas and marine resources");
- the European Commission's Blue Growth initiative;
- Bioeconomy strategies on the European as well as national levels;
- Aquaculture strategies on national and regional levels;
- the European Union Strategy for the Baltic Sea Region (EUSBSR), in particular its Policy Area "Bioeconomy";
- Bioeconomy policy as part of the Nordic cooperation within the Nordic Council of Ministers;
- Research and innovation strategies for smart specialisation (RIS3) of several sub-regions of the BSR;
- The Marine Biotechnology Strategic Research and Innovation Roadmap (2).

As the blue bioeconomy is not a clearly defined and established sector and no official statistical economic data are available – with the exception of the (fish) aquaculture sector – it is difficult to assess its overall economic significance and job creation potential for the BSR. It is unlikely that the blue bioeconomy will provide mass employment in the region. However, it can be realistically expected that related activities will provide a range of different new job opportunities: from simple harvesting and cultivation-related activities in coastal regions to high-end jobs in research, innovation and product development.

Table 1 summarises the core drivers and challenges for the development of the BSR's blue bioeconomy and the development fields concerned in these. The following sub-chapters provide a brief overview on the state of play in these four development fields of the blue bioeconomy.

Table 1: Core drivers and challenges for the development of the BSR's blue bioeconomy

Political strategies promoting blue growth and the blue bioeconomy on various levels (UN, EU, BSR, national, regional, local)
BSR countries' obligation to achieve Good Environmental Status (GES) and continuing challenges caused by eutrophication and pollutants as a driver for innovative measures & technologies
Inconsistent and unclear regulatory framework regarding specific blue bioeconomy activities
Strong R&D capacities and high innovation potential of BSR R&D institutions and SMEs in blue bioeconomy-related disciplines
Lack of dedicated and efficient blue bioeconomy business support and technology transfer structures
Increasing consumer demand for sustainable, regionally produced high-quality products and awareness of the benefits of blue bioeconomy business models
Strong tradition of pan-Baltic cooperation and presence of blue bioeconomy-related BSR-wide networks and platforms
Technical advances in e.g. marine robotics, simulation and modelling techniques increasing efficiency

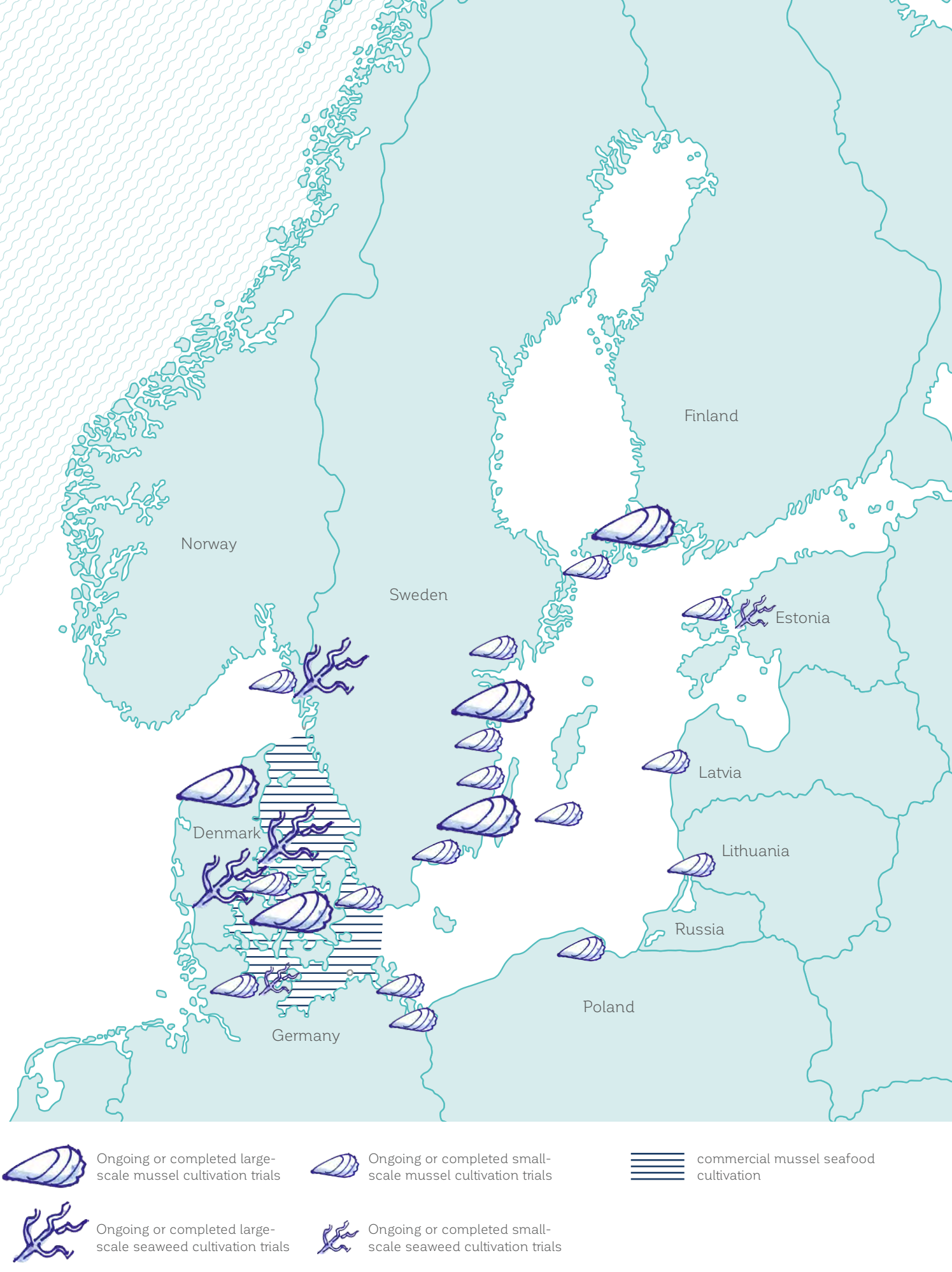


Figure 2: Locations of on-going and completed mussel and seaweed cultivation trials in the BSR. Adapted and updated from the SUBMARINER Compendium (9).

HARVESTING AND NEW USES OF WILD AQUATIC BIOMASS

Current activities falling under this development field are relatively small-scale initiatives on the regional and / or local levels. The following are among the key initiatives in the field:

- Some SMEs in Denmark and Estonia (e.g. Nordisk Tang, Dietz Seaweed, Est-Agar) **harvest wild local macroalgae populations for the food market**. Either they sell the algae directly as a food, process them into products such as snacks, algae pesto or algae mustard or produce algae-based furcellaran for the food industry.

- All over the BSR, municipalities **collect beach-cast macroalgae** with the principal aim of cleaning up beaches. Primarily in Sweden and Denmark, activities have been going on to find additional economic uses for the collected beach-cast algae, so far it is mainly used in biogas production. Solrød municipality in Denmark intends to process 7,400 tonnes of beach-cast algae in the newly opened Solrød biogas plant (4).

- There are also several local bottom-up initiatives working on the **remediation of highly eutrophied water bodies**. Measures tested here include the collection of beach-cast macroalgae and harvesting reed which in turn is used e.g. as pasture for animals or for biogas production.

- Another area that is gaining more and more attention is the development of **new business models based on previous waste streams in fish processing**. Most of the examples referred to so far are, however, from the West-Nordic countries and thus outside the BSR (5).

The harvesting of wild aquatic biomass faces a number of challenges limiting its growth potential and hampering the development of business models solely relying on wild aquatic biomass. These challenges include knowledge gaps on availability of biomass, the heterogeneity, seasonality and unpredictable supply of suitable wild crops as well as an unclear and inconsistent regulatory framework regarding the harvesting of wild biomass and its status on the consumer market as a novel food, either for human or animal consumption. The collection of wild biomass still provides interesting perspectives when considered from a wider, circular economy perspective. It also remains relevant for its environmental and socioeconomic benefits and in its possible spill-over effects on sectors such as agriculture, tourism or energy production.

BLUE BIOMASS PRODUCTION

Mussel cultivation for human consumption is an existing and growing business in the Western parts of the BSR, with annual production volumes in the range of 2,000 tonnes for Denmark (6) and 1,500 tonnes on the Swedish west coast (7). Germany cultivates 5,000 tonnes of mussels (8), but so far almost exclusively in the North Sea – with the exception of one farm producing blue mussels in the Kiel Fjord.

In the eastern and northern parts of the Baltic Sea, the mussels do not grow to a marketable size for human consumption because the water's salinity is lower than in the west. However, meal made of Baltic Sea mussels could be used as feed in agri- and aquaculture, replacing e.g. imported fish and soybean meal. What is more, cultivating and harvesting blue mussels in the right place can increase the water quality and transparency as mussels filter water and take up nutrients through their food intake. Mussel farming can thus complement source-related measures and make an important local contribution to counteracting eutrophication, the Baltic Sea's primary environmental challenge. Several test cultivations have taken place on the eastern coast of Sweden and on the Åland islands, and currently several projects – among them Baltic Blue Growth, MuMiPro and BONUS OPTIMUS – are building on these prior experiences with the aim of demonstrating that full-scale mussel farming in the Baltic Sea is possible and should be further developed.

The greatest difficulty in the Baltic Sea context is to make the cultivation economically viable and to create a market for small and thin-shelled mussels to be used in the feed industry. Previous reports (9) therefore indicate that the ecosystem services provided by farming mussels in the Baltic Sea also need to be valorised, becoming a source of income for the mussel farmers to make the cultivation pay off. Provided that suitable cultivation sites can be designated and that economic measures could be introduced, a recent Danish report considers the potential of scaling up mussel cultivation to a level of up to 100,000 tonnes a year in Denmark alone and estimates the value of the ecosystem services provided by these production volumes to be in the range of € 12–32 million (DKK 91–239 million) (6).

Unlike in other parts of the world with more favourable natural conditions and / or strong traditions of algae use, **macroalgae (seaweed) cultivation** is still in its infancy in the BSR. In the context of two parallel research projects in Sweden and Denmark – Seafarm and MAB4 – large-scale seaweed cultivations have been established in Swedish and Danish waters and the prospects for processing cultivated seaweed biomass (in both cases *Saccharina latissima*) into feed and food components, biomaterials and energy in a multistream biorefinery concept are currently being investigated.

So far only a few businesses use algae biomass cultivated in the Baltic Sea as a raw material (see box). Some large global companies such as CP Kelco, DuPont or FMC Cooperation, which have a strong presence in the BSR, produce seaweed-related products such as thickeners, stabilisers or rheology modifiers for the food industry. However, these companies import all their seaweed biomass from abroad (in the case of CP Kelco mainly Indonesia, the Philippines and Eastern Africa). Currently, these companies do not see any perspectives for domestic seaweed cultivation to become competitive in terms of volumes and prices (10).

// First commercial macroalgae cultivations //

Examples of companies paving the way for macroalgae cultivation in the BSR are the German SME OceanBASIS, which operates a seaweed cultivation and produces cosmetic products based on seaweed extracts and the Estonian company Est-Agar AS, which has plans to extend its furcellaran production (until now based solely on collected wild biomass) by also cultivating seaweed between the islands of Vormsi and Hiiumaa.

BLUE BIOTECHNOLOGY

A large variety of marine micro and macro organisms such as bacteria, cyanobacteria, microalgae, fungi, sponges, mussels and macroalgae can serve as sources for blue biotechnology product development, which passes along a long value chain (see Figure 3) “with the value and potential return from the product increasing as it becomes transformed by biotechnological techniques” (11).

A huge market potential and enormous growth rates are projected for the blue bioeconomy sector both globally and for Europe. These take into account that many of the expected blue biotechnology products target markets such as pharmaceuticals, human and animal nutrition, industrial chemicals or cosmetics and are expected to have a large societal as well as economic value.

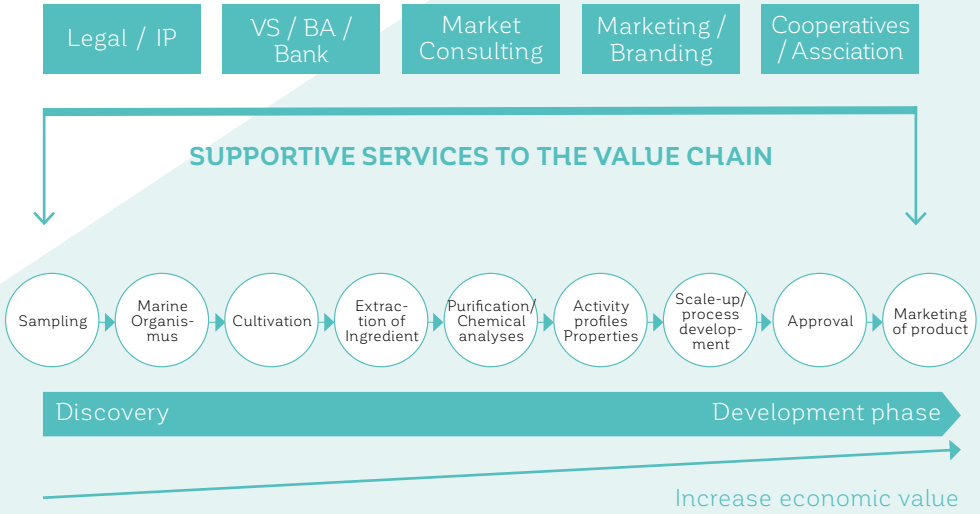


Figure 3: Generic blue biotechnology value chain

//Ranked highest //

The high expectations associated with blue biotechnology are also reflected by the online survey results: respondents ranked the importance of this development field highest of the four development fields, both for the BSR in general and for their own institutions’ work.

Nevertheless, assessments have come to the conclusion that blue biotechnology in Europe and the BSR does not yet live up to this full potential. Because of strong scientific capacity and the availability of specialised laboratories and experts, there are some first concrete “success stories” and showcases. More of these will be needed to increase the visibility and raise the awareness for the large potential of blue biotechnology in the BSR.

The following main barriers were identified in previous assessments [(9) and (11)]:

- Complexity and the high cost of sampling a huge diversity of potentially promising bioresources;
- Complexity and high level of uncertainty regarding legal and regulatory framework (e.g. regarding property rights under marine governance, benefit sharing or novel food regulation);
- In the smaller BSR countries, a lack of critical mass to realise the full value chain development within one country;
- The dependence upon SMEs to translate R&D results into a marketable product for commercialisation;
- The high risk and vulnerability of SMEs in terms of their financial stability.

An assessment carried out by the SUBMARINER Network identified 42 projects and initiatives dealing with blue biotechnology-related topics in the Baltic Sea Region. However, it also showed that most of these initiatives are EU-wide research and innovation projects led by institutions from outside the region. Only very few of the screened projects and initiatives do have a specific focus on the BSR (3).

// Baltic Blue Biotechnology Alliance //

The Alliance is developing a self-sustaining network matching blue biotechnology actors from all parts of the BSR with the resources, competences and expertise that they require to progress with concrete marine biobased product development ideas.

SUSTAINABLE FISH AQUACULTURE

Aquaculture is the fastest-growing food production sector globally and also strongly promoted on a European level through the new Common Fisheries Policy and the European Blue Growth initiative. The BSR countries are not among the main aquaculture producing countries in Europe and have so far shown a relatively weak performance in the aquaculture sector. Together, the eight EU Member States in the BSR contributed as little as 10 % of both the volume and value of the total European aquaculture production in 2014 (8).

For the coming years, BSR countries have set themselves ambitious growth objectives in their multiannual national aquaculture plans 2014–2020: The growth targets range from an increase of 25 % for Denmark – which already has the strongest aquaculture industry of the BSR countries – to as much as 250 % (for the period 2013–2023) for Latvia, where aquaculture so far plays only a minor role.

There is consensus that these growth objectives cannot be met solely by expanding the existing production in traditional open net cage cultivation systems in the sea. This is due to BSR countries' obligation to reduce their nutrient inputs into the Baltic Sea, but also due to a lack of suitable sites in marine waters. To allow for an expansion of offshore net cage production in the Baltic Sea, novel feed with minimized outlet and more environmentally friendly production systems will have to be applied on a broader basis, as for example recommended by HELCOM which is currently developing new best available technology (BAT) standards for sustainable aquaculture (12). The BSR has already made some progress in improving both land- and sea-based aquaculture technologies towards introducing novel more environmentally sustainable production methods with improved nutrient and emission management, such as:

- **Model farms:** Already widely applied in approximately 50 % of Danish trout farms, the so-called model farms apply water recirculation and water treatment techniques in open air ponds and have managed to significantly reduce the water intake and environmental impact compared to traditional open pond aquaculture;

- **Recirculating aquaculture systems (RAS):** These systems are closed, land-based, freshwater or saltwater systems allowing for production of fish and other high-value seafood (e.g. shrimps) under controlled conditions, with low water exchange and advanced filtration techniques. Although the Nordic countries are at the forefront when it comes to know-how and expertise on these complex production systems, so far only a few fully commercial RAS productions targeting the market for human consumption are in place. One of the few examples for this is the Polish company Jurassic Salmon Sp. z o.o producing Atlantic salmon in an RAS system using geothermal water. In Denmark, some 8 % of the total aquaculture production is currently produced in RAS systems (13). High investment needs and operating costs, technology that is in parts still immature and a lack of relevant competences among the existing fish farmers have been identified as the most important barriers for a major breakthrough of RAS technologies so far;

- **Integrated multitrophic aquaculture (IMTA):** IMTA is an innovative production method that involves the integrated cultivation of fed species together with extractive species that feed on nutrients released by the fed species. It has been discussed as a possibility to expand the fish production volumes of offshore aquaculture in the Baltic Sea by compensating the additional nutrient inflow by co-farming e.g. mussels and / or macroalgae, which in turn take up nutrients from the water. The concept has been technically tested, but no commercial IMTA site is as of yet in place. The main challenges are the lack of marine space designated to such activities, regulatory uncertainties and differing national interpretations of the relevant EU regulations as well as difficulties in establishing markets for the co-cultured species, in particular mussels.

Overall, growing consumer awareness and a growing demand for food from regional, environmentally friendly production can be observed. Provided that consumers are ready to pay more for sustainably produced aquaculture products, this trend will result in a larger share of regional aquaculture products in the overall fish consumption in the BSR. This would overcome the currently most important disincentive to regional production: the global oversupply and low prices on the global market.

Growing consumer awareness might also lead to a wider application of aquaculture certifications and higher quality standards on which to base them. An important aspect in this context is also the development of more sustainable fish feed based on regional protein sources. "Improve sustainable fish feed" has been ranked the second most important challenge and opportunity by our survey respondents. The development field of sustainable fish aquaculture is highly relevant to the development field "biomass production" in the sense that many initiatives in the field of biomass production target the fish feed market with their activities. Examples such as the Benella brand introduced by the Finnish company RaisioAgro already market more sustainable fish feed as an advantage (5).

BLUE BIOECONOMY: VISION 2030

A clear and consistent regulatory framework is in place throughout the BSR, which is key to foster growth and safeguard investments in the blue bioeconomy. A stable regulatory framework has been created, clarifying uncertainties about the accordance of blue bioeconomy activities with environmental legislation and food safety regulations. At the same time, the BSR countries have aligned their regulatory frameworks, in particular their national interpretation and implementation of relevant EU directives (e.g. WFD, MSFD), as to create harmonised market conditions for blue bioeconomy actors throughout the whole region.

Macro-regionally coordinated financing programmes are catalysing private investments in blue-green activities. In combination with the clear and stable regulatory framework, this has made the BSR's blue bioeconomy a strong blue growth sector, delivering various marine bio-based products and services. A growing number of these products and services are available on end-consumer markets and are marketed as high quality regional, sustainable, biobased products with additional benefits for the Baltic Sea environment and regional and local economies. The end consumers, in turn, have a positive attitude towards these regionally produced, blue-green, high-quality products and services, for which they are prepared to pay premium prices.

Because of its R&D excellence and the presence of strong, transdisciplinary, pan-Baltic networks in the field, the BSR is a global knowledge hub for blue biorefinery and circular economy approaches in the sustainable use and conversion of marine resources. Specific regions and municipalities within the BSR are models, showcasing the benefits of integrated blue bioeconomy approaches.

Citizens of these regions and across the BSR understand and experience the positive environmental and socio-economic effects that the blue bioeconomy activities bring to their coastal communities – from cleaner beaches and clearer waters to new job opportunities in rural, coastal areas.

HARVESTING AND NEW USES OF WILD AQUATIC BIOMASS

An increasing number of municipalities around the Baltic Sea have turned the challenges of mass production of organic matter on the one hand and beach-cast algae along their coastlines on the other into opportunities. As the legal and regulatory situation regarding the use of wild aquatic biomass has been clarified to a large extent, wild biomass (e.g. algae or reed) is removed along the coastline or collected from beaches in many places. This makes an important contribution to remediating some of the "eutrophication hotspots" (such as semi-enclosed bays) and results in a higher quality of life for local communities and more opportunities in coastal tourism. At the same time, the wild biomass is used e.g. as a food or feed ingredient, in agriculture or bioenergy production, providing additional income and jobs.

// BIOFISK //

With the island of Falster as a showcase, a new Danish bioeconomy concept called "BIOFISK" plans to use collected beach cast algae as a substrate for insect larvae, which will in turn be tested as an alternative protein source for fish feed.

BLUE BIOMASS PRODUCTION IN THE BALTIC SEA REGION

Mussel farming is an established activity to locally improve water quality and recycle nutrients from sea to land in all parts of the Baltic Sea. The already existing market for mussels from the Western Baltic Sea for human consumption has grown. A new market has been established for a high-value feed product for agricultural and aquaculture uses based on mussel biomass. This product is produced at an industrial and economically stable level and is thus making an important contribution to the model of "closing the nutrient loop", according to which nutrients are recycled from the water back to land and reused in agricultural or aquaculture production. At the same time, mussel and / or algae farms serve as compensation measures for fish mariculture in integrated multitrophic aquaculture (IMTA) systems, allowing a moderate growth of fish production in the sea, as well.

The environmental services provided by mussel farming, such as increased water transparency and nutrient uptake, are recognised and accepted measures throughout the BSR. Related payment mechanisms for these environmental services have been developed and tested on regional and national levels.

Commercial macroalgae cultivation is in place in the Baltic Sea, having a positive effect on the local water quality and being a well-known raw material for a range of algae-based products produced according to the biorefinery concept. Algae-based products are available on certain high-value niche markets – from feed to food ingredients and biobased plastics.

New products are continuously being developed to make best use of what has previously been regarded as waste or side-streams, such as by-products from the fishing and aquaculture industries such as mussels shells or fish skin.

// Seafarm //

The Swedish Seafarm project is developing techniques for cultivating seaweeds to be used as raw material in a biorefinery for the production of food, feed, biobased materials and bioenergy.

BLUE BIOTECHNOLOGY

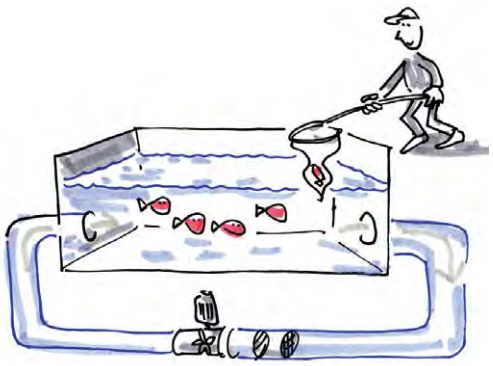
Blue biotechnology is widely established and used as an enabling technology for thriving food and feed, pharma, cosmetics and other industries in the BSR. More and more blue biotechnology products and services have entered global markets. Considerable upscaling has taken place in certain key markets such as cosmetics, nutraceuticals, high-value pet feed or medical technology markets, which serve as a springboard to differentiate products and access novel markets, e.g. in pharmaceuticals.

Blue biotechnology works as an enabler through the whole value chain, also having positive effects on the neighbouring development fields of blue biomass production and sustainable fish aquaculture. It is fostered by public and private funds working together seamlessly. Promoting blue biotechnology is understood as a common task in the BSR and the sector is known to, understood and trusted by banks and private investors. Within the BSR's R&D institutions, blue biotechnology is a strategic focus area to make sure that the required knowledge is built up and maintained and the full innovation potential of blue biotechnology delivered. Established network structures are in place, supporting smart cooperation between R&D institutions and companies, especially in the commercialisation phase to speed up market entry for blue biotech products.

SUSTAINABLE FISH AQUACULTURE

The production of farmed fish and seafood within the BSR has seen substantial growth, allowing the BSR countries to produce as much as 60 % of fish consumed within the region.

This growth is mainly realised in land-based recirculating aquaculture systems (RAS) by scaling up, by integrating the fish production in industrial symbiotic systems and by improving management practices. The BSR, especially the Nordic countries, are global innovation leaders in recirculation technology. In some BSR countries, regulations also allow a moderate scaling up of the offshore fish aquaculture, with cultivations moving to further offshore locations and applying Best Environmental Practice (BEP) and Best Available Technology (BAT) regarding optimised management, retention and / or compensation of fish farms' nutrient emissions as well as improved environmentally friendly feed production.



Sustainable raw materials, such as marine biomass from the Baltic Sea, is used for fish feed in the majority of aquaculture operations in the region. The by-products from the operations are utilized in multistream biorefineries and entering the circular bioeconomy.

Consumers have a positive attitude towards regionally and sustainably produced, high-quality fish and seafood products and are ready to pay a higher price for these compared to imported products from retail markets.

// Regional RAS value chain and InnoAquaTech //

In Mecklenburg-Vorpommern, Germany, an economically successful regional value chain has been established by a consortium of fish farmers, technology providers, fingerling producers and distributors of african catfish (*Clarias gariepius*) produced in RAS systems.
This example has been one of the foundations for the project InnoAquaTech, which is promoting the cross-border development and transfer of innovative aquaculture technologies in the South Baltic Region. The project has particular focus on integrated systems, such as RAS.

STRATEGIC ACTION FIELDS

During the stakeholder involvement process leading to this report, the following four strategic action fields were identified as the most relevant for achieving the vision of the BSR's blue bioeconomy in 2030:

- Regulation;
- Communication, networks and marketing;
- Technology;
- Finance and funding.

In the following sub-chapters, strategic actions for each of these strategic action fields are suggested, as are the identified *potential actors* to implement the actions.

REGULATION

Inconsistencies in the regulatory framework and uncertainties regarding the accordance of blue bioeconomy activities with partly outdated regulations are key barriers to commercialisation. Therefore, creating a clear and consistent regulatory framework is a key priority to foster innovation and growth and to safeguard investments in the blue bioeconomy. Suitable and accepted economic measures need to be developed and tested to pay for the ecosystem services delivered through blue biomass production in the Baltic Sea, such as clearer waters and nutrient uptake.

Recommended strategic actions are:

- **Clarify and align the regulatory framework:**
  - Carry out comprehensive assessments of perceived and real legal / regulatory barriers to blue bioeconomy activities, based on blue bioeconomy business cases from all over the BSR. *Potential actors* include practitioners (e.g. aquaculture operators), environmental lawyers as well as business support organisations;
  - Initiate a BSR dialogue on the implementation of the Nagoya Protocol regarding utilisation of genetic resources and maintenance of biodiversity to create a common understanding among the BSR countries.
- **Simplify licensing:**
  - Simplify licensing procedures for cultivation sites, e.g. by installing "one-stop-shop" licensing or by giving licenses for longer periods of time.
- **Economic measures for environmental services provided by marine resources:**
  - Identify best practices and suitable systems in other sectors and countries;
  - Develop and suggest suitable systems and mechanisms for BSR context.
  - Establish an inter-ministerial working group as the decision-making body dealing with the policy recommendation developed by the expert advisory group. Possible members of this working group include national ministries responsible for aquaculture / blue bioeconomy issues; the EUSBSR PACs Bioeconomy, Innovation, Nutri; HELCOM and HELCOM-VASAB working group on MSP;

// Recommendations for overcoming regulatory barriers //

Set up an independent multi-disciplinary expert advisory group to initiate policy discussions and develop policy recommendations for decision-makers for overcoming the identified regulatory barriers, e.g. common standards and strategies for mariculture regulations concerning nitrogen and phosphorus quotas, together with BAT / BEP level or the harmonisation of the national interpretations of relevant EU directives, such as the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD).

// BSR Bioeconomy Council //

The BSR Bioeconomy Council is an informal policy dialogue platform attached to the Nordic Council of Ministers composed of members who are actively involved in the development of enabling bioeconomy policies and initiatives in the BSR. Its aim is to support the macro-region and its stakeholders in speeding up the transition towards a bioeconomy.

// Piloting ecosystem service payments //

Suggested economic measures for ecosystem services need to be tested and piloted in pioneer regions as showcases demonstrating their potential for the BSR.

Potential actors: Swedish coastal regions interested in promoting mussel cultivation, Swedish Board of Agriculture

// Marine ecosystem services projects //

The current Interreg projects NutriTrade and Baltic Blue Growth as well as the BONUS project OPTIMUS are investigating different alternative measures to pay for the ecosystem services provided by mussel cultivation and will start discussions with regional stakeholder groups.

COMMUNICATION, NETWORKS AND MARKETING

Showcasing concrete success stories is a key prerequisite to conveying the opportunities that lie in the blue bioeconomy. To make people aware of the advantages and high quality of blue biobased products from the BSR, the blue sectors need strong branding and marketing campaigns, highlighting the environmental and health benefits of their products. At the same time, a strong "blue lobby" is needed to influence decision-makers to clarify and / or update partly outdated regulations. Through a bottom-up approach using hands-on education and information campaigns, this innovative but scattered industry can come together and convince the public of the many advantages it has to offer.

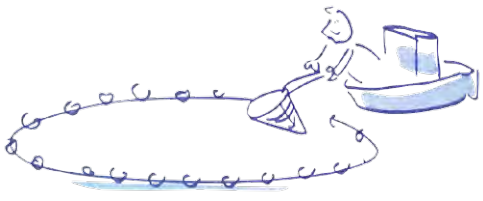
Recommended strategic actions are:

- **Aquaculture and blue biomass certification programmes:**
  - Promote wider application of certification programmes for sustainable and responsible fish and biomass production (e.g. ASC, EU Organic Certification) among producers to increase end consumers' trust in sustainability standards of BSR's blue bioeconomy;
  - Revise the requirements and standards in relevant certification labels and / or the EU standards for organic aquaculture, e.g. by including requirements for nutrient compensation or maximum nutrient emission labels;
- **Marketing and branding initiatives to end consumers:**
  - Develop and implement large-scale professional marketing and branding initiatives for Baltic Sea blue bioeconomy products and services to create a positive image and attitude for high-quality blue biobased products and services from the BSR.
- **Public understanding and local ownership:**
  - Involve local inhabitants and / or citizens' groups through information and dialogue formats to create understanding and (local) ownership for specific blue bioeconomy initiatives;
  - Implement citizen-science projects and include blue bioeconomy in schools' curricula to increase the public understanding of the blue bioeconomy's potential.

// Branding BSR blue biobased products //

- Strong focus on aspects such as regional production, identity and economy, health benefits, environmental and sustainability benefits, in particular positive effects on the Baltic Sea environment as such;
- Create strong social media strategies to increase narrative-based marketing, incentivise consumers to spread the story and increase their commitment and ownership.

Potential actors: SUBMARINER Network, John Nurminen foundation, sector & producers' organisations, restaurants, prominent chefs, retailers, tourism sector as well as (environmental) NGOs.



// Marketing farmed fish in Finland and Poland //

The Benella brand developed by the Finnish company Raisioaqua is used to promote sustainably cultivated and healthy rainbow trout that has been fed with the brand owner's feed product, based on rapeseed oil and locally sourced marine ingredients. The brand is given free of charge to participating farmers and stresses the environmental and health benefits of the Benella fish.

"Teraz Pstrąg" ("Trout Now") was a marketing campaign implemented by the Polish Trout Breeders' Association in the years 2011–2014. During these 4 years, the award-winning advertisement campaign contributed to an increase in trout consumption of up to 40 %.

// Fjordhaver //

The Danish Fjordhaver (Fjordgardens) project works with local communities around the Limfjord to empower citizens to cultivate mussels, seaweed and oysters for their own consumption. The idea is to create "Fjordgarden" associations similar to those for allotment gardens.

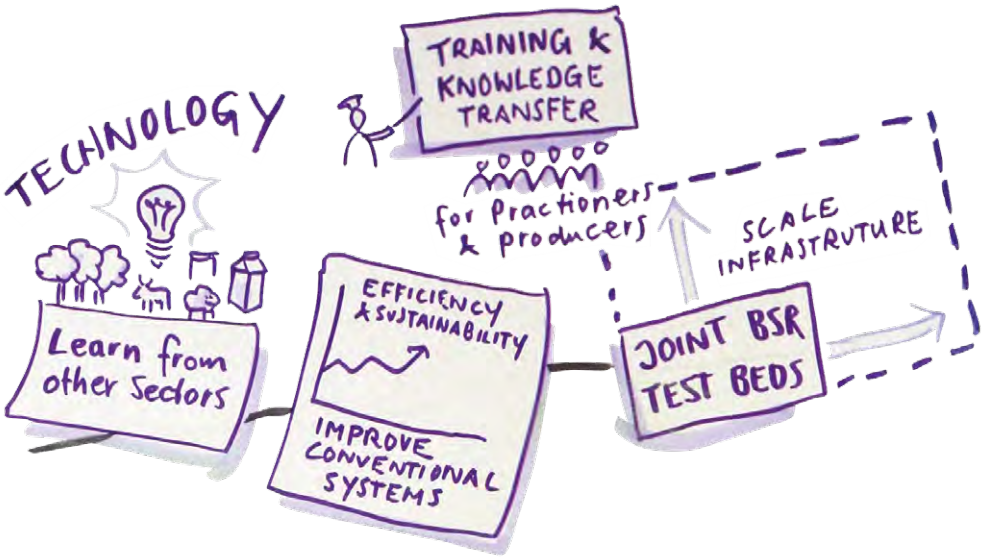
- **Networking and communication within the blue bioeconomy community:**
  - Based on success stories and best practice cases, develop and implement information and training initiatives to make existing knowledge and innovation better accessible to businesses;
  - Create cooperatives for blue bioeconomy companies collaborating on marketing and supply chains to reduce the burden and costs for individual SMEs and strengthen the joint narrative of the marketing initiatives;
  - Strengthen collaboration and communication with other parts of the bioeconomy (e.g. forestry, agriculture, fisheries) to foster exchange of experiences and knowledge;
  - Consolidate existing networks and foster their systematic dialogue to create synergies and reach critical mass for action and to promote collaborative projects;
  - Create a "blue lobby group" to influence decision makers on a transnational level with regard to regulatory issues and to "make room" for blue biomass cultivation in MSP.

// The SUBMARINER Network //

The SUBMARINER Network promotes innovative approaches to the sustainable use of marine resources. It is a cooperation and communication platform for related actors from the BSR countries. Its members engage in a variety of different projects and jointly develop position papers and publications.

TECHNOLOGY

Enhanced technologies leading to increased efficiency and sustainability are a key need in many blue bioeconomy-related activities. Besides fostering the actual technology development in these areas, encouraging and improving technology transfer, both in pre-competitive and competitive stages, is equally decisive. In this context, focus should be on improving the dialogue with related sectors (e.g. agriculture, forestry, industrial biotechnology) to foster the wider uptake and integration of already existing technologies and technology transfer instruments in blue bioeconomy activities. A key bottleneck for the commercialisation remains the lack of accessible infrastructure for scaling up and validating lab-scale findings. Actions aiming to provide easier access to existing infrastructure or create joint BSR test beds in certain areas should therefore be encouraged.



Recommended strategic actions are:

- **Blue technology development and optimisation:**
  - Develop an optimise blue biomass harvesting, preservation and storage techniques to reduce costs and increase efficiency, e.g. by closer cooperation of producers with those from agriculture and forestry sectors;
  - Support and implement further R&D activities to optimise biorefining processes, in particular for multi-stream inputs and mixed biomass feedstock, and create pilot sites for "blue biorefineries";
  - Improve efficiency of recirculating aquaculture systems (RAS) and model farms by further technology development and training of fish farmers;
  - Develop, test and adapt novel mariculture cultivation systems with optimised management, retention and / or compensation of fish farms' nutrient emissions;

// Testing novel aquaculture cultivation techniques //

To give aquaculture production in the Baltic Sea the possibility of expansion, novel cultivation techniques, such as closed containment systems, with substantially improved management and / or retention of fish farms' nutrient emissions will have to be tested and adapted to Baltic Sea conditions.

Potential actors: Dansk Akvakultur, DTU

- **Accessible infrastructure for scaling up:**
  - Create joint BSR centres of excellence providing open access to test bed infrastructure needed to bridge the gap between R&D laboratory and full commercial scale and to accelerate the commercialisation and market entry of blue bioeconomy products and services. The focus areas of these infrastructures should be coordinated among BSR countries' innovation, research and funding agencies;
  - Encourage BSR actors to better connect with and make wider use of existing facilities and infrastructures outside BSR (e.g. European Marine Biological Resource Centre, EMBRC).

- **Improved and enhanced technology transfer**
  - Improve efficiency of technology transfer structures for BSR blue bioeconomy, e.g. by:
    - Fostering the wider uptake of existing and functioning technology and innovation transfer instruments from other neighbouring sectors to the blue bioeconomy;
    - Linking technology transfer instruments for blue bioeconomy to a possible BSR-wide funding platform;
    - Encouraging technology transfer by increasing programmes for boosting innovation and attracting investments across borders.

FINANCE AND FUNDING

An increasing awareness for blue bioeconomy business models due to clearer regulation and communication opens up possibilities to ease the access to finance and funding for blue bioeconomy actors, in particular SMEs, through the creation of new financial schemes, both at local and transnational levels. Public funding should increasingly be used to catalyse private investments in the blue bioeconomy.

Recommended strategic actions are:

- Better align public funding instruments with blue bioeconomy actors' needs for interdisciplinary and cross-sectorial projects;
- Coordinate public and private funding (matchmaking) throughout BSR to facilitate a flexible and simple administration;
- Support the development of novel financing instruments easing the access to finance for blue bioeconomy actors, e.g. through micro-financing institutions (MFIs) also providing finance (credits) to SMEs to create local ownership and engagement;
- Increase the dialogue and communication with relevant financing institutions to increase the awareness for possibilities of blue bioeconomy related sectors and their specific needs;
- Use public funding to catalyse private funding: co-fund blue bioeconomy through H2020.

// Develop a local micro funding scheme //

- Each region identifies particularly interesting regional bioeconomy potentials;
- Regions jointly develop an operating system for a micro-funding scheme, identify different funding sources (e.g. regional ERDF funds, private investments) and ensure long-term commitment among stakeholders and funders.

Potential actors: Guldborgsund Municipality, Aarhus University, local / regional stakeholders (enterprises, citizens), similar clusters for other regions in the BSR.

// Business development support //

- Based on the current initiatives such as the Interreg project Baltic Blue Biotechnology Alliance, set up a permanent BSR-wide business support infrastructure supporting blue bioeconomy start-ups and SMEs;
- Focus should be on joint interdisciplinary capacity building and targeted technical assistance in fields such as market research and marketing, legal issues, business planning and development as well as easing access to risk capital.

Potential actors: partners of the Baltic Blue Biotechnology Alliance, SUBMARINER Network, business schools and business support organisations

// European blue bioeconomy public-private partnerships (PPPs) //

- Develop a European Innovation Partnership (EIP) on blue bioeconomy to ensure a better and more targeted coordination and alignment of existing funding instruments.

Potential actors: PAC Bioeconomy, transnational networks (e.g. SUBMARINER Network or ScanBalt), Bio-based Industries Consortium (BIC), European Commission (DG MARE and other DGs)

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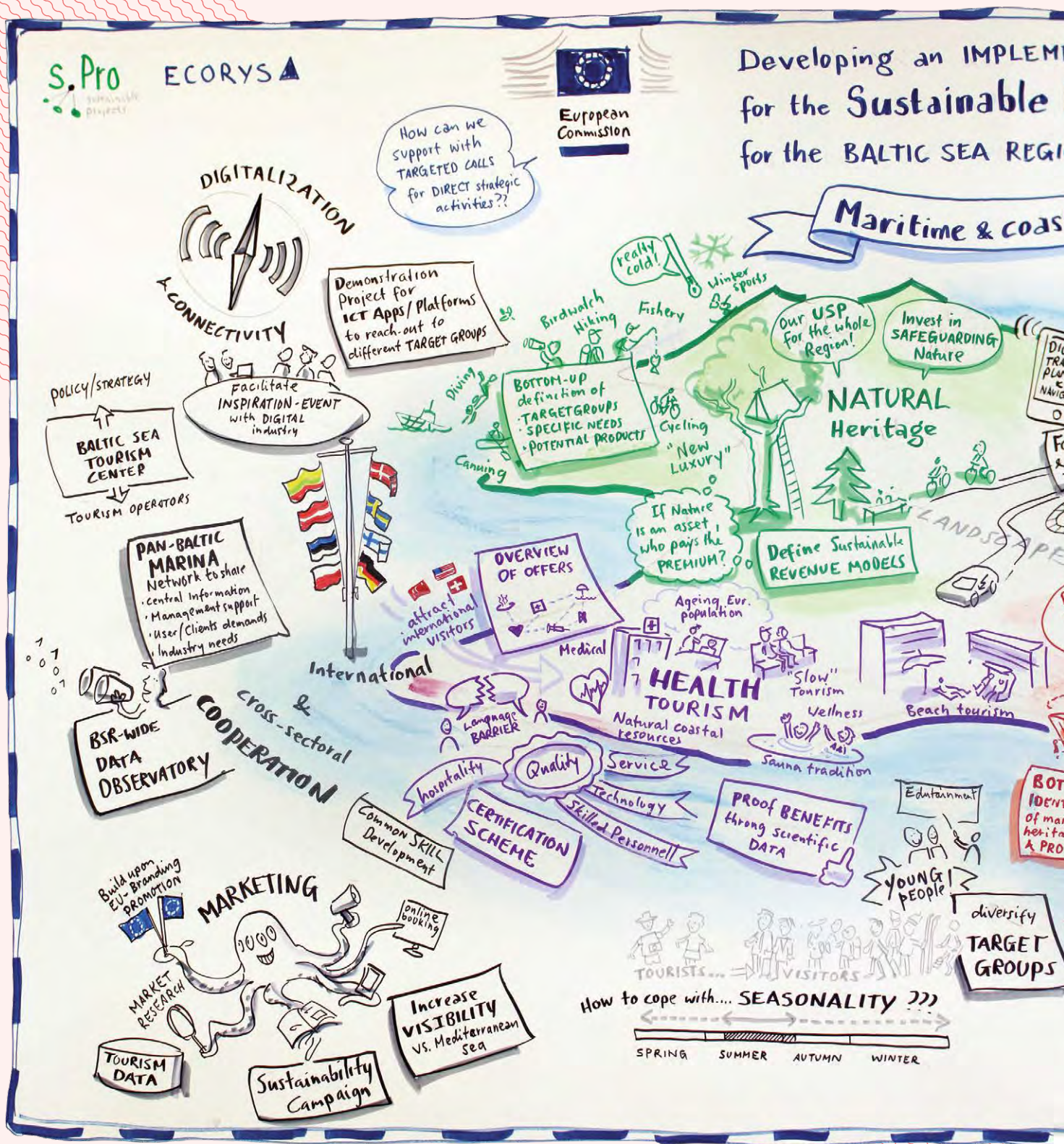
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ECORYS
European Commission
Developing an IMPLEM
for the Sustainable
for the BALTIC SEA REGI
How can we support with TARGETED CALLS for DIRECT strategic activities??
DIGITALIZATION
& CONNECTIVITY
Demonstration Project for ICT Apps/Platforms to reach out to different TARGET GROUPS
Maritime & coas
really cold!
Winter sports
Birdwatch
Hiking
Fishery
Our USP for the whole Region!
Invest in SAFEGUARDING Nature
POLICY/STRATEGY
BALTIC SEA TOURISM CENTER
TOURISM OPERATORS
facilitate INSPIRATION-EVENT with DIGITAL industry
Diving
Canning
BOTTOM-UP definition of
· TARGETGROUPS
· SPECIFIC NEEDS
· POTENTIAL PRODUCTS
Cycling
"New Luxury"
NATURAL Heritage
If Nature is an asset, who pays the PREMIUM?
Define Sustainable REVENUE MODELS
PAN-BALTIC MARINA
Network to share
· central information
· Management support
· User/Clients demands
· Industry needs
OVERVIEW OF OFFERS
attract international VISITORS
Ageing Eur. population
Medical
HEALTH TOURISM
Natural coastal resources
"Slow" Tourism
Wellness
Sauna tradition
Beach tourism
Language BARRIER
International & cross-sectoral COOPERATION
BSR-WIDE DATA OBSERVATORY
hospitality
Quality
Service
Technology
Skilled Personnell
CERTIFICATION SCHEME
Common SKILL Development
PROOF BENEFITS throng scientific DATA
Edutainment
YOUNG PEOPLE
diversify TARGET GROUPS
Build upon EU-Branding PROMOTION
MARKETING
online booking
MARKET RESEARCH
TOURISM DATA
Increase VISIBILITY vs. Mediterranean Sea
Sustainability Campaign
TOURISTS ... VISITORS
How to cope with.... SEASONALITY ???
SPRING
SUMMER
AUTUMN
WINTER


ENTATION STRATEGY
Blue Growth Agenda
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What does Maritime & Coastal Tourism look like in 2030?
What STEPS do we need?
Maritime "UBER"
FOSTER LNG Infrastructure
LNG
Bigger Ships → larger ports
more congestion
INFRASTRUCTURE
ster ACCESSIBILITY MULTIMODALITY of TRANSPORT MEANS
TURNAROUND vs. TRANSIT PORTS
ITC
online BOOKING
MARINA Destination/ services
PORT TOURISM PACKAGE
Happiness of INHABITANTS!
Employment
Recognize the role of LOCAL operators and businesses!
CULTURAL Heritage
FOOD
MODERN CULTURE
Hansa
HISTORY
Vikings
TOM-UP IFICATION itime ge Sites DUCTS
Complement tangible sites with DIGITAL EXPERIENCE PRODUCTS
The joint Baltic Sea NARRATIVE
HORIZONTAL THEMATIC PLATFORMS
CULTURAL ROUTES
AUTHENTIC MARITIME HERITAGE EXPERIENCE
Heritage CARD
COMMON BRAND / Joint concept / identity
BOTTOM-UP
It's the PRODUCTS that make the policy work
Multiplicate SOLUTIONS
Build SYSTEMS
FINANCE
Projects must SURVIVE beyond 36 months of funding
EVENTS
CROSS-FINANCING SCHEMES FOR LOCAL/REGIONAL DESTINATIONS
private
Public
book Boats with CREWS
young people
Recreational BOATING
avoid pollution
age
Technical support for STARTERS
floating houses
safety & access
EVENT Calendar
• Thematic
• Target groups
SUSTAINABILITY
Electric infrastructure
CREATE A COMMON understanding of...
BSR is THE sustainable tourism destination!
TECHNOLOGY
STANDARDS
SERVICES
REGULATION
Dialogue
Local Stakeholders
Operators
WIN-WIN!
already HIGH SATISFACTION
Reduce EMISSIONS!
CRUISE
Differentiate Megaships
experience cruises
Public List of Sustainable cruise operators
Invest in local smallscale cruising
CHRISTIAN RIDDER
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TOURISM

DEFINITION AND SCOPE OF "COASTAL AND MARITIME TOURISM"

In this report, the UNWTO definition of tourism is applied: Tourism is a social, cultural and economic phenomenon that entails the movement of people to countries or places outside their usual environment for personal or business / professional purposes. These people (residents or non-residents) are called visitors, which may be either tourists (if this entails an overnight stay) or excursionists (if not). (1)

In the Sustainable Blue Growth Agenda for the BSR, coastal and maritime tourism has been identified as one of the blue growth sectors. It includes "coastal tourism", "cruise" and "yachting and marinas" as so-called "maritime economic activities". We use the following definitions to differentiate between coastal and maritime tourism:

- *Coastal* tourism includes all sea-related tourist and recreational activities in the coastal areas - both in rural as well as in urban areas. In geographical terms, coastal areas are defined as those bordering the sea or having at least half of their territory within 10km of the coast;
- *Maritime* tourism covers predominantly water-based activities, e.g. recreational boating (i.e. "yachting and marinas"), cruises and nautical sports like recreational fishing as well as operations of landside facilities (e.g. marinas or cruise ports).

With these definitions as a starting point, as well as input from the survey and desk research, the following development fields were identified as important for the sustainable growth of coastal and maritime tourism the BSR:

Nature tourism: In the context of this report, nature tourism includes visits to nature protection areas, sand dunes or bedrock sites in the BSR; the activities of snorkelling, kayaking, beach walks or cycling along the coastline of the Baltic Sea as well as experiencing forests in coastal areas.

Cultural heritage tourism: This involves visits to the places, viewing of artefacts and participation in activities that authentically represent the past or present maritime identity of the people in the BSR, both in coastal areas and in the sea (underwater cultural heritage).

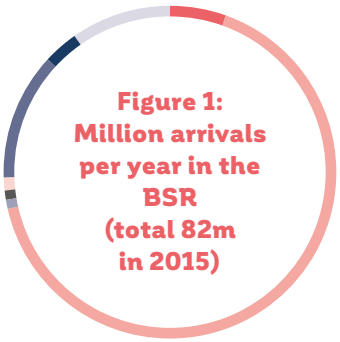
Recreational boating: This is understood here as the operation of marinas and related services, sailing and yachting (including motor boats) the brokerage and charter of boats and other services to yachters as well as recreational fishing. It does not refer to the building of leisure and sport boats.

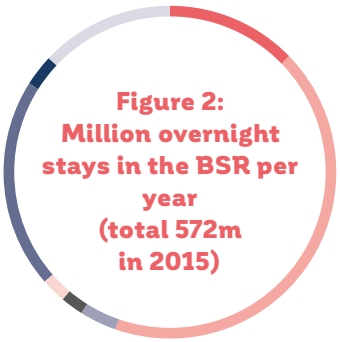
Cruise tourism: This is a form of travelling, involving an all-inclusive holiday on a cruise ship following a specific itinerary according to which the ship calls at different ports. This report deals mainly with facilitation activities at destination ports, e.g. the interface with other coastal and maritime tourism development fields.

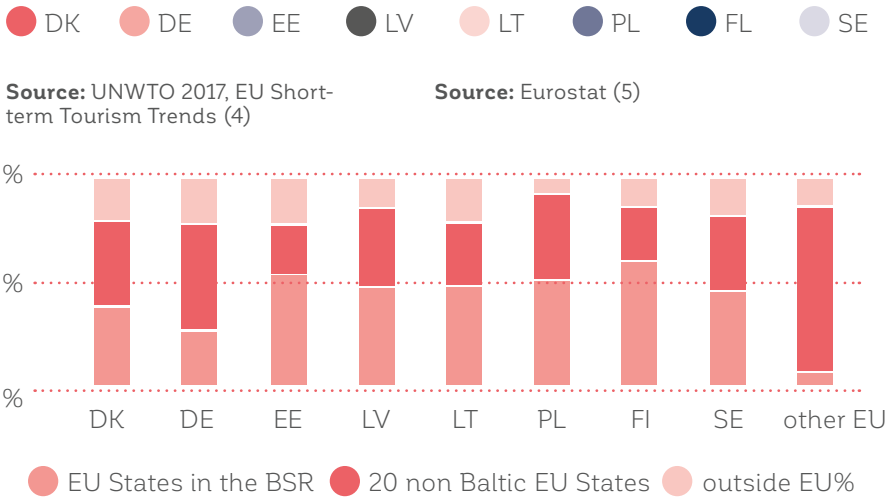
Health & wellness tourism: For the purpose of this report, this includes wellness tourism (e.g. wellness destinations, health resorts and companies offering proactive retreats and treatments for both body and mind related to natural marine resources of the BSR such as water, mud, salt, sand etc.). It does not refer to medical tourism, i.e. travelling outside the country of residence for the purpose of receiving medical care.

Beach tourism is an important part of coastal and maritime tourism in the BSR. However, in the survey stakeholders considered it to be least relevant for the sustainable growth of coastal and marine tourism in the BSR. That is because the challenges in beach tourism are not development and growth-related, but rather concern dealing with limited capacities (crowded beaches) and protecting and maintaining coastal landscapes (both natural and cultural heritage). It is therefore not included here as a separate development field. Although some of the strategic actions recommended in this paper are also relevant for beach tourism.

STATE OF PLAY







Source: UNWTO 2017, EU Short-term Tourism Trends (4)

Source: Eurostat (5)

Figure 3: Destinations for holiday travels undertaken by EU residents

Source: Flash Eurobarometer 414 (6)

Coastal tourism is a mature and well-developed sector in the BSR (2). The Blue Growth Agenda states that coastal tourism is of major importance for the region, not only in terms of Gross Value Added (GVA), but also as an employment sector responsible for more than 306.000 jobs in 2011 (2). In Germany, employment in coastal tourism grew by 11% annually between 2008 and 2010. It is expected that coastal tourism globally will double by 2030 (3). How this will affect the Baltic Sea Region mainly depends on the development of successful initiatives with the ability to boost the sector.

As shown in the two figures above, in 2015 UNWTO recorded 82 million international arrivals to the eight EU Member States in the BSR (including non-coastal tourism in these countries), an increase of 37% compared to 2010, while the whole EU-28 recorded 478 million international arrivals (4). In the same year, 572 million overnight stays were recorded in the eight EU countries in the BSR (5).

Most tourists in the BSR come from the eight EU Members States in the BSR itself: In 2014 around 40% of them travelled within the BSR (see figure above for country-specific values). On the other hand, the BSR was the destination for only around 8% of the total holiday travels undertaken by EU residents from outside the BSR (6). In 2014, the share of foreign visitors among all visitors in Mecklenburg –Vorpommern was 5.1% (7). About half of these foreign visitors were from other BSR countries.

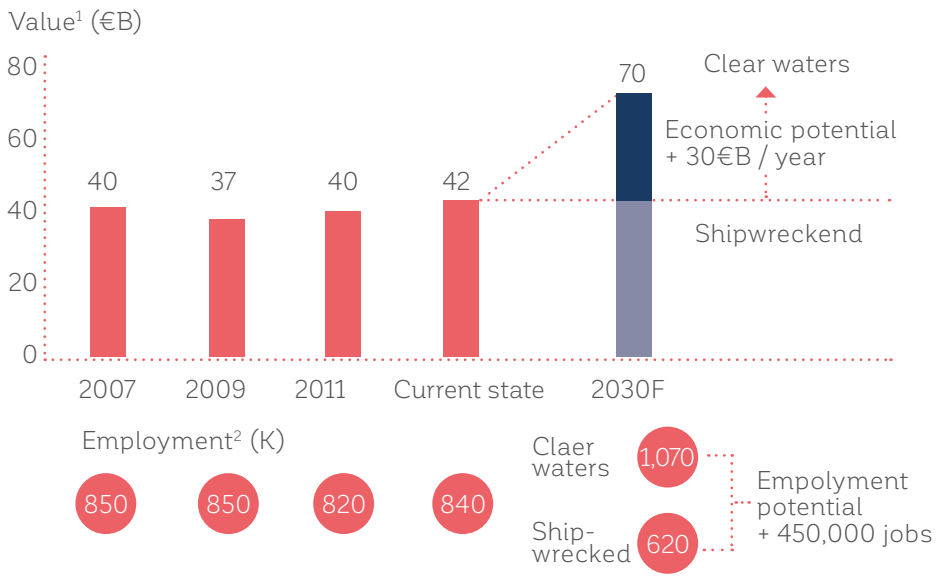


Figure 4: Economic potential of maritime tourism

Sources: BCG 2013 (9); Eurostat; Fisheries Center; Fiskeriverket; national statistics; World Travel and Tourism Council (WTTC); BCG anaysis.

Note: Coastal tourism approxmation-based visitor surveys and NUTS3 regional didision; WTTC. [1]Value= gross / real value added at constant (2012) prices. Total value (direct plus indirect plus induced) is equivalent to all tourism spending minus purchases made by the industry. [2]Employment= total number of jobs generated (direct plus indirect plus induced).

STATE OF PLAY

In 2015, no destination in the BSR made it into the top 20 tourism destinations (NUTS 2 regions) in the EU (in terms of overnight stays).

On average around 40 % of all overnight stays in the eight EU countries in the BSR take place during the summer months of June, July and August (in SE and FI, this figure stands at almost 50 %). In the winter months (December, January, February) the share varies between 11 % (DK) and 19 % (FI) (8).

The Boston Consulting Group (9) states that in 2012 an estimated €42 billion was generated in the coastal regions of the Baltic Sea. Despite the economic downturn in early 2010, coastal tourism has risen by 5.3 % annually since 2009. The strongest boost has been observed in Sweden, which had an annual growth rate of 6.9 %. In Finland, the number of visitors increased by 26 % between 2008 and 2012.

Using scenarios developed by the WWF, BCG (9) researched the tourism sector and concluded that better governance and a change in ecological behaviour among actors can lead to an extra economic potential of €30 billion a year and 450.000 additional jobs in the BSR's tourism sector. While the Baltic Sea is currently facing huge environmental problems, all tourism stakeholders, whether in nature tourism, cruise or recreational boating, recognise this fundamental business value of a clean and healthy environment.

The EU Strategy for the Baltic Sea Region (EUSBSR) has one Policy Area dedicated to Tourism (PA Tourism). It is implemented through two actions and the respective flagship projects. These flagship projects are dedicated to the networking and clustering of tourism stakeholders and the mobilisation of the full potential of sustainable tourism in the spirit of the 2030 Agenda for Sustainable Development of the UN.

On both the macro-regional and regional scale, tourism is increasingly being acknowledged as an important growth sector. Several Smart Specialisation Strategies (RIS3) in the BSR focus on a specific form of tourism (10). An example is the region of Turku (South West Finland), where sustainable tourism has become top priority, focusing on nature tourism and sustainable cruise tourism. Several regions in the Baltic States, such as the Ida-Viru region (Estonia) and the region of Riga (Latvia), also stimulate investments in harbours and marinas (recreational boating). Thereby they contribute to creating an attractive network for leisure boats, as well as fostering development of health tourism by strengthening cooperation between spa hotels and the health sector.

Table 1: Core drivers and challenges for the development of the BSR's coastal and marine tourism

The seasonality of demand calls for diversification of products and services
The concentration of tourism in a few centres (e.g. cruise ports or seaside resorts) calls for a better development of hinterland destinations
Demographic change and new demand patterns require the development of new target group specific touristic products
Digitalisation opens new possibilities for selling and creating touristic products
Local stakeholders need to benefit from coastal tourism and not suffer from it
The sustainable awareness and the quality of the experience are becoming more important
Political stability: The BSR is a safe and secure place

// Baltic Sea Tourism Forum //

The Baltic Sea Tourism Forum is a well-established annual conference that is partly EU funded and co-funded by partners' cities and regions. The 10th Forum will take place in November 2017 in Turku. Currently it has a strategic and political focus but aims at becoming a BSR-wide exchange platform for the public and the private sector.

NATURE TOURISM

Large, relatively untouched natural ecosystems still thrive in many parts of the BSR. Sweden and Finland have very long coastlines and a large archipelago, Latvia has 200 km of coastline with unspoilt beaches, and Poland and Germany have many nature parks directly at the Baltic Sea coast. Besides their social and environmental value, nature parks play an important role in regional economies by creating viable touristic SMEs, increased economic development and employment opportunities. Finnish research has shown that every €1 invested in Finnish nature parks generated €10 for the Finnish economy (11).

The demand for nature tourism is partly driven by urbanisation. People long to live in urban spaces but when on holiday, many crave a sense of space, nature and peacefulness. More recently, clean air and untouched nature attract, in particular, Asian tourists from megacities that suffer from pollution and congestion. Further urbanisation around the world will increase the demand for nature tourism.

// Nature tourism most important //

94 % of the online survey respondents stated that nature tourism is important or even very important for the development of coastal and maritime tourism in the BSR.

Local case

The Chinese global online retailer "Ali Express" will send about 50.000 employees to Lapland in 2017 to enjoy its nature and peacefulness.

CULTURAL HERITAGE TOURISM

Cultural heritage is intrinsically connected to Baltic countries as part of history, daily life, culture and also tourism. Many sagas, chronicles and legends are connected to historical sites, which can be visited as part of a trip to a Baltic Sea country. They do not only refer to the Hanse or Vikings but create a framework for food, design, architecture and the general way of life in the BSR. Maritime heritage tourism is largely connected with other sectors such as nature tourism. Visitors interested in maritime cultural heritage also share an interest in a lot of the maritime natural heritage. Recently, more services are being offered as a hands-on experience of maritime culture, e.g. by fishers and seafarers, restaurant owners, operators and employees of museums, sights, castles and ports but also architects or spatial planners.

A regional perspective on cultural maritime heritage going beyond the local destination is currently still lacking, as there is a high degree of **fragmentation** in maritime cultural heritage across the BSR. There are thousands of local operators, but most of them lack the knowledge, networks and resources to put their attractions into a wider (or even pan-Baltic Sea) context. New initiatives, such as the "Monitoring Group of the Baltic Maritime Heritage", an informal network of maritime museums across the BSR, attempt to improve the level of connectivity within parts of the sector.

With 2018 proposed as the European Year of Cultural Heritage by the European Commission, maritime heritage tourism has the potential to attract more tourists.

RECREATIONAL BOATING

Sailing lost in popularity after the 1980s. **The number of sailors is decreasing** and the average age of boat owners has increased, partly due to the decrease of boat ownership as a status symbol among younger sailors. However, renting **charter boats** is becoming popular especially among young recreational boaters. This trend creates its own challenges as the upkeep of charter boats is expensive and the business model (including pick-up and drop-off locations for the rented boat) is not yet mature.

Around 3.5 million leisure boats are used in the coastal areas of the Baltic Sea Region. There are many recreational boating activities in the BSR, with prices more attractive than those in the Mediterranean. Furthermore, **marinas** in the BSR are safe and accessible, have a strong tradition and picturesque environments. In urban areas, they are becoming increasingly attractive and popular residential settings. Despite these good conditions, **international visitors make up only a small percentage** of recreational boaters in the BSR.

CRUISE TOURISM

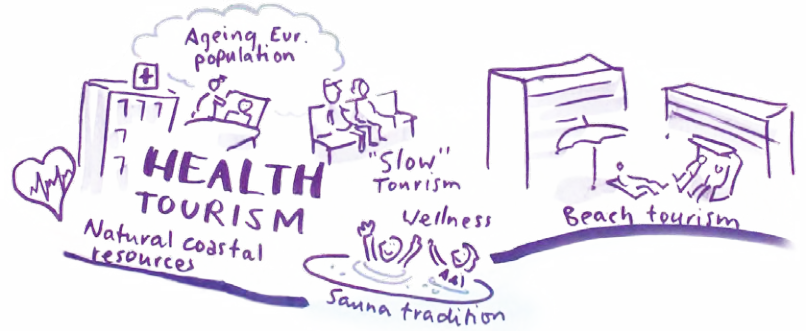
The Baltic Sea is one of the leading destinations for cruise tourism in the world. Between 2000 and 2016, the number of passengers increased by an average annual rate of 9.9 % per year (from 1.1 million in 2000 to 4.3 million in 2016) (12). At the same time, the number of calls increased by an average annual rate of only 2.7 % per year (2,163 calls in 2016), meaning that the size of the vessels (and the number of passengers per vessel) has also increased. Seven ports (Copenhagen, St. Petersburg, Tallinn, Helsinki, Stockholm, Rostock, Kiel) together account for almost 80 % of all calls in the BSR.

Almost all passengers leave the ship during their stay (European average is only 80 %). Some 50 % of the passengers buy an excursion (mostly directly from the cruise company in advance) (13 & 14). The economic value of this is significant. Transit passengers visiting Cruise Baltic ports spent an average of €79.22 in each port with tours and retail shopping accounting for almost 80 % of this spending. Cruise lines spent an estimated €355.8 million throughout the region as a result of the cruise calls at Baltic ports (e.g. for provisions, hotel supplies, fuel and equipment used on-board). Expenditures by the cruise lines and their passengers and crew totalled €708.6 million in 2015 throughout the Cruise Baltic region (13 & 14).

The cruise sector is already successfully promoting the whole BSR as one destination. It has been attracting more international guests than other segments of maritime tourism. Furthermore, the sector has been successful in developing new market segments. The variety of cruise passengers' demographics (age, nationalities, gender etc.) is expanding rapidly. Family cruises are becoming more popular, including amusement and adventure trips.

Some challenges remain for the sector. While 9 out of 10 passengers are very satisfied or satisfied with their cruise in the Baltic, passengers indicate that they desire more 'individual' experiences / excursions. Increased cooperation with other tourism sectors could foster this. Furthermore, there is still a high degree of seasonality: The season for cruises, which once was limited to July and August, now begins in May and runs into September.

HEALTH & WELLNESS TOURISM



Maritime health tourism is a relatively small sector and fragmented around the Baltic Sea. The health tourism sector in the BSR mostly targets tourists from the BSR region itself, but also visitors from North America, China and Russia (the latter in particular in the Baltic States) to make use of the facilities. The growth potential for the sector is high, due to an ageing European population that will increase the demand for health services.

Conditions for an increase in health tourism in the Baltic Sea Region are favourable. The region's mild summers and natural coastal resources offer a competitive advantage. Health tourists are able to combine their health-related trip with other tourism interests. Furthermore, BSR countries have a long tradition of "wellness". This includes the active Nordic lifestyle with physical activity and sport, sauna traditions, healthy eating (local ingredients) and nature-based activities but also the mental wellbeing (relaxation, stress management, silence) as well as social wellbeing (meaningful social interactions and encounters, but also digital detox).

// Smart specialisation //

Two partners of the project "Smart Blue Regions", the Riga Planning Region (Latvia) and the Ida Viru Region (Estonia) have made health & wellness tourism one of their specialisation fields in the respective smart specialisation strategies.
In 2012, a Health Tourism Cluster was created in Latvia and it has developed a Health Tourism Strategy.

TOURISM: VISION 2030 GEOGRAPHICAL AND SEASONAL BALANCE

In 2030, maritime tourism in the BSR has gained further economic importance. Smart solutions exist to better distribute tourists over the whole year and the whole BSR. Demand is driven by a broader range of visitors, who are not necessarily "holiday-makers" bound to the holiday season. They could include visitors from the "MICE segment" (i.e. Meetings, Incentives, Conferences and Exhibitions) or elderly people who are not bound by school or work holidays. As a result the capacity limits of the individual natural areas, cultural attractions, popular port cities or seaside resorts are respected even if the overall number of visitors in the region is higher than it was in 2017.

Nature tourism is a cornerstone of BSR tourism in 2030. More people visit the Baltic Sea Region for its natural heritage not just in the summer months, but also during winter as nature experiences have become more related to non-summer seasons. The north Baltic in particular is now a very popular destination, with much closer links to the South and Central Baltic Sea in 2030. Smart and simple access to remote areas (i.e. multi-modal systems) ensures that the BSR is more readily accessible under controlled conditions when it comes to nature tourism.

There is close cooperation with local residents, ensuring strong liaisons between the natural heritage and the cultural heritage sector, allowing visitors to immerse themselves in the local Baltic cultures and customs. Cultural heritage sites are connected through a strong and engaging joint narrative that also includes other tourism fields, like nature or health tourism. The cooperation is based on a horizontal connectivity strategy between the formerly fragmented sites across different countries and regions.

Small-scale cruising and ports have fully developed their economic potential due to diversification between ports (with mega ships and standard cruises versus ports with smaller ships and experience cruises). This allows for more individual and flexible routing to previously neglected ports. Overall, the number of calls is distributed more evenly across ports in the BSR. Visitors are attracted by and transported to hinterland areas not only but especially during the peak season (and therefore away from e.g. cruise ports or seaside resorts popular with beach tourists).

In recreational boating, the main sailing season remains relatively short but marinas offer an attractive environment year-round for off-season visitors who are not sailing but simply want to enjoy the maritime atmosphere.

COMPETITIVENESS AND COOPERATION

In 2030, a number of diverse, new cross-cutting products and services exist, focusing on specific target groups (age range, nationality, marital status etc.) or types of service (adventure, wellness, culture etc.). As such, maritime tourism makes use of the demographic change and provides attractive offers to elderly people (e.g. age-based marinas, wellness packages and cruise offers).

More international tourists visit the BSR because of its natural and cultural heritage. They have on average a higher purchasing power than the traditional beach tourists. International (non-EU) visitors come from Asia (China, Japan), North America and other European countries (incl. Russia). The increased international competitiveness is based on intensified transnational cooperation within the sea basin. A pan-Baltic data portal on maritime tourism with common indicators exists, which is monitored to continuously identify trends (including needs / demands of clients and businesses) and to develop projects.

// Market information //

The PA Tourism in the EUSBSR aims to develop an 'Annual Status Report on Tourism in the BSR' using common indicators and statistical parameters. The project AGORA 2.0 set up "BASTIS" (www.bastis-tourism.info), a one-stop-shop for tourism market information in the Baltic Sea Region. Currently there is no funding available to update it.

Nature tourism in 2030 is a joint BSR attraction and many package deals are offered in combination with other tourism sectors, such as the cruise industry and the cultural heritage sector. New products promote the attractiveness and accessibility

of nature parks, coastal and marine archaeology, maritime heritage, underwater tourism, gastronomic activities etc. The authentic experience of nature is in itself a quality product that has to be carefully managed in order to respect the capacity limits of unspoiled nature.

There is a regional perspective on cultural maritime heritage in 2030, which offers more coherence across the BSR. This regional perspective includes both private and public stakeholders. A network of cultural maritime heritage sites operates on a sub-regional scale. On a even wider geographical level, a joint narrative of maritime heritage across the BSR is used effectively for marketing. This helps to attract more and new visitors (beyond the domestic) from within and outside the BSR. Touristic products allow visitors to feel and experience the place and its culture – in reality as well as in virtual and augmented reality.

In the field of cruise tourism, the Baltic Sea is a major competitor of the Mediterranean Sea and attracts many international tourists. Cruise tourism is the gateway for many international tourists to the BSR. Ports and other destinations in the BSR provide tourists and visitors with interesting excursions, including natural and cultural heritage tourism offers, which can be booked in advance together with the cruises

// Rental / chartering important//

78 % of the online survey respondents stated that increasing rental / chartering possibilities is an important opportunity for recreational boating in the BSR.

themselves (e.g. the "Baltic Lighthouse Cruise", "Baltic Fisher Cruise", "Baltic Birdwatching Cruise").

In 2030, recreational boating in the BSR is associated with comfort and high quality standards. Marinas are seen as interesting destinations in themselves, liaise closely with regional tourist boards and provide a broad variety of additional services (charters, events, maintenance, education but also services related to other development fields, e.g. wellness or gastronomic heritage). It is common to charter or to share boats, whereas the ownership of boats is less common than it was in 2017. Marinas are fully digitalised, making it easy for recreational boaters to book places and services online.

Health tourism is an important tourism segment that makes use of natural coastal resources such as seawater, wind and algae. More senior European citizens travel to the Baltic Sea Region, which is a safe destination with moderate climate and offers a wide range of health and wellness-related touristic products. Quality standards are aligned across the BSR and the regions and destinations cooperate closely when it comes to training of staff for wellness and cosmetic facilities. International city breaks combined with health tourism are popular.

SUSTAINABLE GROWTH AND LOCAL ADDED VALUE

In 2030, maritime tourism uses environmental resources responsibly, respects the socio-cultural authenticity of host communities and ensures viable, long-term economic operations that provide fairly distributed benefits to all stakeholders. The good environmental status of the Baltic Sea itself and its marine and coastal surroundings is valued as an indispensable prerequisite for tourism. Joint efforts are developed to achieve and maintain it.

// Public-private //

"Baltic Sea Tourism Center" is a project (2017- 2019) with the aim of developing sustainable development structures that can function as an interface between public and private bodies, i.e. the political level and the tourism industry.

The **"Iceland Northeast Region Strategy"** is a case study from outside the BSR that demonstrates the added value of a bottom-up tourism strategy connecting natural and cultural heritage.

The importance of maritime tourism is driven at the local level, where businesses, citizens and authorities identify areas of common interest. They collate these in local strategies, securing lasting commitments among the local operators. Particularly in the field of maritime heritage, this bottom-up approach is used in order to ensure visitors have an authentic experience of the local / regional maritime heritage. Local stakeholders use interactive GIS tools to gather bottom-up insights and map local points of interest (site development by local residents).

The Sustainable Development Goals of the UN Agenda 2030 provide the framework for a harmonised system of maritime tourism strategies across the different geographical levels (local, regional, national, transnational). In the BSR, actions to achieve these goals are coordinated by the EUSBSR / PA Tourism.

Both the supply (tourism stakeholders), as well as the demand side (visitors), highly value (environmental) sustainability and appreciate the BSR as a politically stable region. "Sustainable tourism" products such as sea walks, nature museums & aquariums, wildlife and bird watching are relevant tourist attractions and attract new types of local and international visitors. These products' primary selling point is their quality of experience, rather than their characterisation as "eco".

In 2030, up to 50 % of cruise vessels run on LNG and all the major cruise ports in the BSR have the necessary bunkering infrastructure. Passengers consider clean fuels as part of their buying decision – both on-board as well as in the ports, where emissions and congestion are reduced considerably compared to 2017. Good cooperation structures exist between cruise operators, port facilities and municipalities, which help to maximise the added value for the region.

A pan-Baltic network of marinas is established, which can draw on attractive infrastructure that includes residential development and electric infrastructure (and other renewable energy sources). A wide range of services ensures increased employment in marinas. This means that marinas are not only a harbour for yachts and sports boats but also an important part of the local community, providing jobs and homes. Marinas are also a holiday destination in themselves, not only offering sailing trips, but also many others services (like wellness or cosmetic treatments).

STRATEGIC ACTION FIELDS

During the stakeholder involvement process leading to this document, the following three strategic action fields were identified as the most relevant for achieving the vision of the BSR's coastal and maritime tourism in 2030:

- Product and service innovation
- Cooperation of actors, destinations and segments
- Marketing and promotion

In the following sections, these strategic action fields are elaborated and *potential actors* for implementing the identified actions are named. While the specific actors might differ from action to action, participants in the stakeholder dialogue stressed the importance of always guaranteeing the involvement of tourism professionals. The overall level of cooperation and exchange between the public and the private sectors needs to be improved.

PRODUCT AND SERVICE INNOVATION

Product innovation is a prerequisite for international competitiveness. It helps to attract visitors with a higher purchasing power but it also prevents the BSR from losing existing clientele to other parts of the world. Digitalisation is a key enabler for innovation. On the one hand, it can be decisive for the customer before and during their travels (information and booking). On the other hand, it can also create a new digitalised customer experience, using virtual and augmented reality. Service innovation is closely related to accessibility, which in itself is an important facilitator for achieving a more balanced growth across the BSR.

Recommended strategic actions are:

- **Invest in digitalising offers and products**
  - User-friendly geo-data portals for ecotourism (e.g. PC and mobile apps with maps for hikers, horse riders, flora and fauna identification). *Potential actors* include nature parks and municipalities.
  - Develop products and services using virtual and augmented reality. *Potential actors* include site operators and IT companies.
  - Creating digital tools (e.g. PC and mobile apps) connecting the individual health demand of clients to offers of health providers. *Potential actors* include spa hotels, regions and IT companies.
  - Facilitate inspiration events between tourism stakeholders and clusters / organisations / companies (including start-ups) working on digitalisation of products. *Potential actors* include tourist boards and municipalities.
  - Integration of niche tourism themes and their PC and mobile apps (e.g. building an ICT platform to link a culinary route, birdwatching and sauna). *Potential actors* include tourist boards, municipalities and IT companies.

// BalticMuseums: LoveIT! //

This is a project (2017- 2020) developing new IT-enabled tourism products for natural and cultural heritage tourist destinations in the South Baltic

- **Identify new business models**
  - Create authentic (local) maritime heritage experience (not just one single site): Stimulate different sites in a small area (city, region) to create a common cultural heritage narrative and develop actions on promoting this narrative to the outside world). *Potential actors* include tourist boards, municipalities and local businesses.
  - Development and testing of sustainable revenue models between different local stakeholders (e.g. if nature is an "asset" who pays the premium?). The money received will be used transparently to finance local innovation. *Potential actors* include municipalities and their local businesses & site operators.

// Sharing of sailing boats //

A "Drive Now" for sailing boats in a network of marinas around the Baltic Sea:

- Developing and testing of new PC and mobile booking apps for chartering of boats;
- Cooperation with IT companies and involvement of potential customers;
- Improve cooperation with existing booking portals;
- Develop solutions for boat maintenance.

Potential Actors: Marinas, IT companies, shipyards specialised on sports and leisure boats, tourist boards

// 'New luxury' offers //

Development of 'new luxury' offers:

- Quality products other than traditional material luxury;
- This could refer to nature experience (sleeping in a tent on a remote island 'glamping'), authentic maritime heritage experience (becoming a lighthouse keeper for a week) or food traditions (catching, smoking and eating of fish);
- Testing 'new luxury' products with potential customers in a real environment.

Potential Actors: Operators of heritage sites, local entrepreneurs, tourist boards, municipalities

PRODUCT AND SERVICE INNOVATION

- **Improve accessibility**
  - Increase accessibility of integrated, user-friendly, multi-modal transport opportunities: bus tours to hiking spots and biking routes (on international level). *Potential actors* include tour operators and municipalities.
  - Improve accessibility for all, focusing on the elderly and visitors with physical disabilities (seats for resting, facilities for wheelchairs, etc.). *Potential actors* include municipalities and their local businesses.
  - Creating a maritime public transport network by aligning schedules of maritime and non-maritime transportation routes (a Baltic 'Hurtigruten' project). *Potential actors* include regions and transport providers (public and private, passenger and cargo).

- **Analyse data**
  - Improve data collection and use (market for business intelligence, development of specific approaches to data collection and using big data to analyse costumer demand). Market research and trend analysis must be one of the priorities in the next years. It is necessary to measure and scan the performances (also of the different development fields) in order to understand what the sector actually needs to foster sustainable development. *Potential actors* include research institutions and tourist boards.
  - Initiate an annual Status Report on Tourism in the Baltic Sea Region, making use of general indicators to monitor projects in order to evaluate the long-lasting effects. *Potential actors* include research institutions, tourist boards and regions.

// An 'UBER' for boats //

- Facilitate the hiring of private boats to tourists in order to increase accessibility of remote natural areas (e.g. Finnish / Swedish archipelago);
- Development of a PC and mobile app;
- Testing service in a real environment.

Potential Actors: Local ship owners, nature parks, IT companies, municipalities

COORDINATING COOPERATION BETWEEN ACTORS AND DESTINATIONS

For achieving sustainable growth and creating local added value it is necessary to build maritime tourism strategies on the interests of local stakeholders (businesses, site operators, citizens, local municipalities etc.). Horizontal cooperation between destinations and sites across the BSR helps to pool resources in order to generate the necessary international competitiveness.

The development fields that have been identified should not be separated from each other. Most tourists and visitors want to combine a cruise with a culinary excursion, nature tourism with a wellness treatment or a sailing trip with a maritime heritage experience. This requires a cross-cutting cooperation.

// Nine sustainability objectives for tourism //

Economy	Society	Environment
Strengthen local / regional economy	Satisfaction of most stakeholders impacted	Minimise resource use
Employ local people	Participation of local people in decision-making	Reduce environmental load
Sustainable capacity planning	Respect for local / regional culture	Preserve biodiversity

Source: NIT Kiel (15)

Recommended strategic actions are:

- **Organizing destination management, engaging and empowering local stakeholders**
  - Provide a common platform for local stakeholders to develop the specific elements of nature tourism in relation with the range of possible maritime activities (e.g. fishing, recreational boating, diving, inland visits). *Potential actors* include local stakeholders (businesses, sites and citizens) and local / regional tourist boards.
  - Increase cooperation between international cruise line operators and local municipalities in order to jointly invest in the social and economic development of a region. *Potential actors* include cruise line operators and municipalities.
  - Develop strategies to maximise local benefits from visitors before and after the calling of a cruise boat. *Potential actors* include cruise line operators and municipalities.

// Authentic, all-embracing maritime heritage atmosphere //

Creating of an authentic maritime heritage experience:

- Stakeholders in a village related to a maritime heritage site jointly develop a scenario for an authentic maritime heritage site;
- This requires not only the participation of museums and sites but also the cooperation of local restaurants, shops and street markets in order to create the authentic atmosphere;
- Support schemes for (in)tangible demonstrations of maritime heritage;
- The site needs to be tested with potential customers in a real environment.

Potential Actors: municipalities local stakeholders (businesses, sites and citizens) and local / regional tourist boards

COORDINATING COOPERATION BETWEEN ACTORS AND DESTINATIONS

- Define mobility strategies with local stakeholders that help to provide visitors with access to remote areas by using the transport means (ships, boats) of local residents. *Potential actors* include municipalities, local residents and nature parks.

- Support for small-scale coastal fishers and protection of fishery heritage as a crucial factor for the Baltic maritime cultural heritage, which is a main tourist attraction. *Potential actors* include municipalities, fisher associations and tourism boards.

- Develop tourism concepts (e.g. also in combination with other sectors) that support employment of local people during the whole year (and not just in the summer). *Potential actors* include municipalities and tour operators.

// Fishery heritage //

The ongoing project "Fish markets" (until end of May 2019, led by the University of Greifswald) offers a contribution to the protection of fishery heritage and to develop tourism offers and services in small fishery harbours.

- **Enhance horizontal cooperation across the BSR**
  - Develop a horizontal connectivity strategy, focusing on the means to connect and ways to develop a joint market. Local operators do not have the resources or knowledge to connect to the larger, sub-regional or even transnational level. *Potential actors* include research institutions, tourist boards and municipalities.

  - Create or use already existing horizontal thematic platforms (e.g. based on connectivity strategies), where stakeholders in the same thematic field work together on product development and marketing actions (e.g. lighthouses, fishery, military heritage or food). *Potential actors* include research institutions, tourist boards and municipalities.

// Joint Baltic maritime heritage //

„VIABAL" is a EUSBSR flagship project lead by the Swedish Landsorts community aiming to start in 2018. It wants to increase the visibility and accessibility of the joint Baltic maritime heritage. An existing platform on European Culinary Heritage – with partners from the BSR - is www.culinary-heritage.com. The project proposal BalticRIM addresses the topic of underwater cultural heritage and is lead by the State Archaeological Department of Schleswig-Holstein.

  - Increase (international) cooperation within the cultural heritage sector between the *potential actors* (NGOs, local municipalities, private enterprises and tour operators on maritime sites) using the existing networks.

  - Invest in story tree development: Develop a Baltic Sea narrative on its maritime cultural heritage, which forms the framework for the hundreds or thousands of "stories" that relate to single events, persons or sites across the BSR. The local story is the springboard for the visitor who can connect it to the wider Baltic Sea narrative. Pilot actions are to create joint tourism products along each storyline by topic (e.g. in the fields of fishery, food, shipping or military heritage). *Potential actors* include municipalities, tourism associations and research institutions.

  - Establish a truly transnational, pan-Baltic marina cooperation network with a modest membership fee and a broader focus than marketing. *Potential actors* include marinas and regions.

  - Work together on research to better understand the different demands of clients / users for services and the needs of the industry (private sector).
    - Explore the development of a centralised information system, thereby improving contact on operational marina issues;
    - Work together on a Baltic-wide system for sailors about additional services offered in marinas around the Baltic, such as maintenance hot spots etc.

Potential actors include research institutions, marinas and regions.

// Cooperation is key //

83 % of the online survey respondents indicated that improved cooperation between heritage sites is an important opportunity for maritime heritage tourism in the BSR.

// Marina cooperation //

„South Coast Baltic" is a joint initiative of boating regions that could be expanded to a pan-Baltic level.

- **Facilitate cross-cutting cooperation**
  - Link nature tourism to other tourism products: Develop pilot actions for supplementing nature tourism products with other tourism products (e.g. maritime cultural heritage, international boating / cycling / hiking routes in coastal areas of the BSR but also paragliding, rafting or hot air balloon trips). *Potential actors* include site operators, municipalities and local tourist boards.

  - Organise excursions to cultural heritage sites at cruise ports and develop and promote these excursions together.

// Excursion packages for cruise tourists //

Creation of "win-win" excursion packages for cruise tourists
- The cruise industry can offer attractive packages / excursions to their guests;
- Local operators in the field of e.g. nature and cultural heritage attract international visitors;
- Establish exchanges with (and visits of) international (non-BSR) tour operators.

Potential Actors: Cruise line operators, site operators, tourism boards

// Natural and cultural heritage //

The Latvian Government has made linking nature tourism with other touristic products a priority. "Lauku celotajs", the Latvian Rural Tourism Association, is ready to take a leading role. The Swedish Landsorts community is ready to explore the potential of bringing natural and cultural heritage together.

Potential actors include cruise line operators, municipalities and site operators.

- Initiate cooperation between airlines, train operators and bus companies together with cruise lines and ports, focussing on improving efficiency of feeder lines and their sustainability. *Potential actors* include cruise line operators, ports and transport companies.

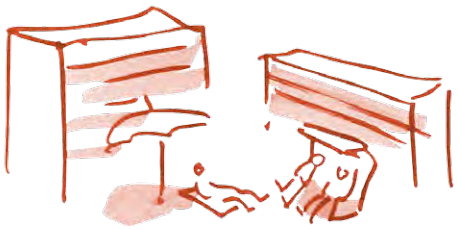
- Come up with a more sustainable approach for coastal tourism in cities. Cultural heritage and cruise tourism are among the factors that lead to congestion and stress in the summer months. *Potential actors* include cruise line and tour operators, port and hinterland municipalities.

- **Create common quality standards**
  - Develop environmental and sustainable standards for nature tourism on a pan-Baltic level to enforce a higher quality level. *Potential actors* include site operators and tourism boards.

  - Create a Maritime Tourism Academy in the region that aims to work together on improving and aligning specific skills by organising trainings, workshops and educational programmes with

// Turku Tourism Academy //

Turku Tourism Academy is a multidisciplinary network of two universities, five universities of applied sciences and the destination management organization Visit Turku. It conducts tourism related research (incl. wellness tourism) and educates future professionals for tourism management, service delivery, and research.



a focus on remote learning and e-learning. *Potential actors* include universities (the Finnish Satakunta University of Applied Sciences is capable and willing to lead projects in this field of development) and tourism associations.

// Focus on tourists with special needs //

83 % of the online survey respondents indicated that comfort and high quality services for tourists with special needs are an important opportunity for health tourism in the BSR.

  - Development of off-season tourism packages for health and wellness tourism meeting the same high quality standards across the BSR (or a smaller sub-region). *Potential actors* include spa hotels and regions.

  - Promotion of the health tourism sector in an international atmosphere for clients coming from outside the Baltic Sea Region. *Potential actors* include regions and tourism boards.

  - Harmonise the quality standards of the services of marinas across the region including the requirements for skipper diplomas (including environmental education). *Potential actors* include marinas and regions.

MARKETING AND PROMOTION

New innovative marketing concepts are needed to ensure the sustainable growth of the maritime tourism sector. This does not necessarily mean that the concepts should aim for quantitative growth but rather on increasing the geographical and seasonal balance. Targeted marketing requires knowledge about the target group and its preferences. A diversification of promotion tools allows the user to address target groups more specifically. The strategic actions on visibility aim to make the whole BSR as a destination more visible globally. On the other hand, they aim to increase the visibility of niché products that have the potential to combat seasonality within the BSR.

Recommended strategic actions are:

- **Develop innovative marketing concepts**
  - Develop "clean air tourism campaigns" for non-EU markets. An immediate first step could be to use events and activities organised within the context of the 2018 EU-China tourism year. *Potential actors* include the European Travel Commission, tourism boards and regions.
  - Pilot projects on integrated product promotion on multiple tourism products at one destination, for example by combining recreational activities such as diving trips, island excursions, kayaking and visiting natural or cultural heritage sites. *Potential actors* include tourism boards, municipalities and tour operators.
  - Strengthen the internal understanding among stakeholders and destinations on a common Baltic Sea identity. This is a very complex and long process as an "identity", which could be used for joint marketing of e.g. nature and maritime heritage tourism, involves all aspects of social life. *Potential actors* include tourism boards and regions.
  - Identify, understand and address relevant target groups (e.g. attracting primarily socio-demographic target groups with a higher purchasing power) and develop the brand and marketing strategy around their preferences. *Potential actors* include research institutes, tourism boards and regions.
  - Focus on gaining better value rather than necessarily more visits (link to assessment of carrying capacity and higher value niches of "potential demand"). *Potential actors* include research institutes, municipalities and tour operators.

// 'Behind the scenes' tourism offers //

- Promotion of niché touristic products that are also suited to the low season (e.g. within the 2018 European Year of Cultural Heritage);
- Products that allow a real experience of maritime heritage (e.g. experiencing the fisher's job, sailing a Viking boat, accommodation in remote lighthouses etc.);
- Couple the touristic offers with press coverage (e.g. by inviting journalists to test them).

Potential Actors: Tour operators, tourism boards, PR agencies

// Baltic Sea identity //

PA Tourism is supporting an ongoing process dealing with a common Baltic Sea identity.

- **Apply a multitude of promotion tools**
  - Make use of existing travel apps (e.g. TripAdvisor, Booking.com) by continuously placing information on nature tourism products for selected target groups. *Potential actors* include tour operators, local businesses and municipalities.
  - For the elderly target group: Distribute non-digital, user-friendly overviews of healthcare offers and wellness opportunities. *Potential actors* include spa hotels and municipalities.
  - Finding innovative and new ways of promoting recreational boating, e.g. though social media / vloggers or by initiating a cross-border / transnational social media campaign. *Potential actors* include marinas and regions.
  - Enlarge the role of the media that is relevant for the target group (newspapers, magazines, TV, social media including vloggers and bloggers) and invite journalists to test innovative touristic products. *Potential actors* include tour operators and municipalities.
- **Increase visibility**
  - Develop joint labels (e.g. for "sustainable cruise tourism"), signs (e.g. "clean air area" for nature tourism) and certification schemes (e.g. for health and

// 'Heritage Access Card' //

- Up-scaling the Finnish Museum Card to other countries and regions in the BSR;
- Joint marketing of maritime heritage sites;
- Developing of a division key for revenues;
- Testing new card and monitoring of visitor trends.

Potential Actors: Heritage site operators and museums, tourism boards, research institute

wellness tourism) across the Baltic Sea Region countries to guarantee high quality standards. *Potential actors* include tour operators, tourism boards and regions.

- Promote the marina as more than a stop-off for recreational boaters: Explore marinas as a touristic destination, where additional services are offered in other development fields. Improve promotion of events around the Baltic close to marinas and let the marinas be part of organisation of events. *Potential actors* include marinas, tourism boards and regions.

- Initiate mapping of thematic capacities and Unique Selling Points (USP) by local stakeholders (including citizens) in order to communicate them to the visitor. *Potential actors* include municipalities and tourism boards.

- Cruise lines need to invest in accommodating for the increasing desire of passengers to have 'individual experiences' e.g. in the fields of health, nature, sports, wellness and maritime heritage. Related touristic offers in the hinterland need to be made visible to cruise line operators who can bundle them to packages for their cruise guests. *Potential actors* include site and tour operators, regions and tourism boards.

- Invest in providing boating training during the winter to combat seasonality. Also develop other actions for the winter season such as event hosting, yacht club activities, winter relays for boaters, ice skating, fishing and cultural activities. *Potential actors* include marinas, municipalities and tourism boards.

- Position marinas as an attractive destination for new (or refurbishing) residential building projects, and thereby better integrate the marina in the city or village's urban landscape. *Potential actors* are municipalities, regional and national governments.

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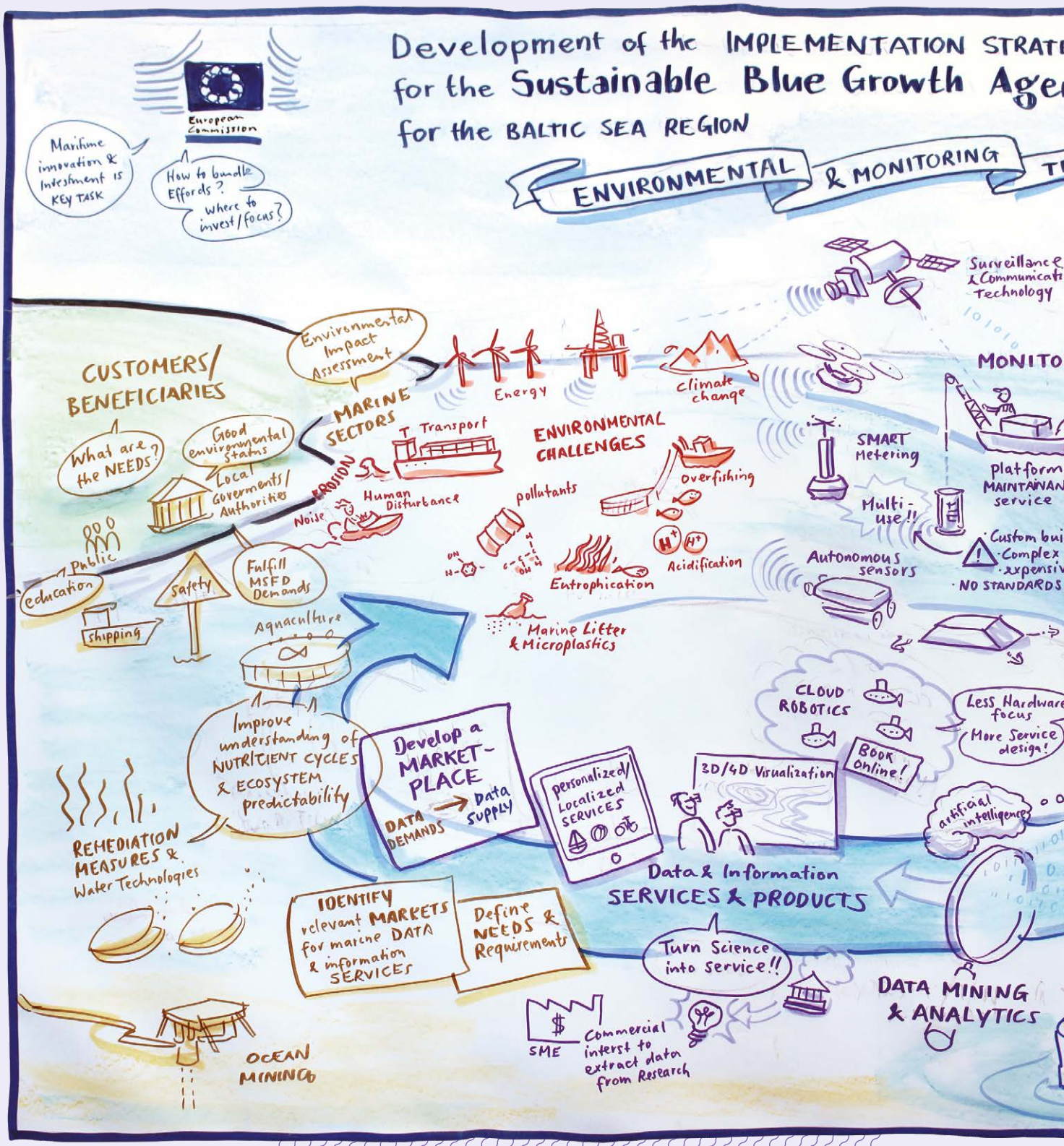
Development of the IMPLEMENTATION STRATE
for the Sustainable Blue Growth Age
for the BALTIC SEA REGION
European Commission
Maritime innovation & investment is KEY TASK
How to bundle Efforts? Where to invest/focus?
ENVIRONMENTAL & MONITORING
Surveillance & Communicati Technology
CUSTOMERS/ BENEFICIARIES
What are the NEEDS?
Good environmental status
Local Governments/ Authorities
Public education
Safety
Fulfill MSFD Demands
shipping
Aquaculture
Environmental Impact Assessment
MARINE SECTORS
Energy
Transport
EROSION
Noise
Human Disturbance
ENVIRONMENTAL CHALLENGES
pollutants
overfishing
Acidification
Eutrophication
Marine Litter & Microplastics
climate change
MONITO
SMART Metering
Multi-use!!
platform MAINTANAN service
Autonomous sensors
Custom bui
Complex
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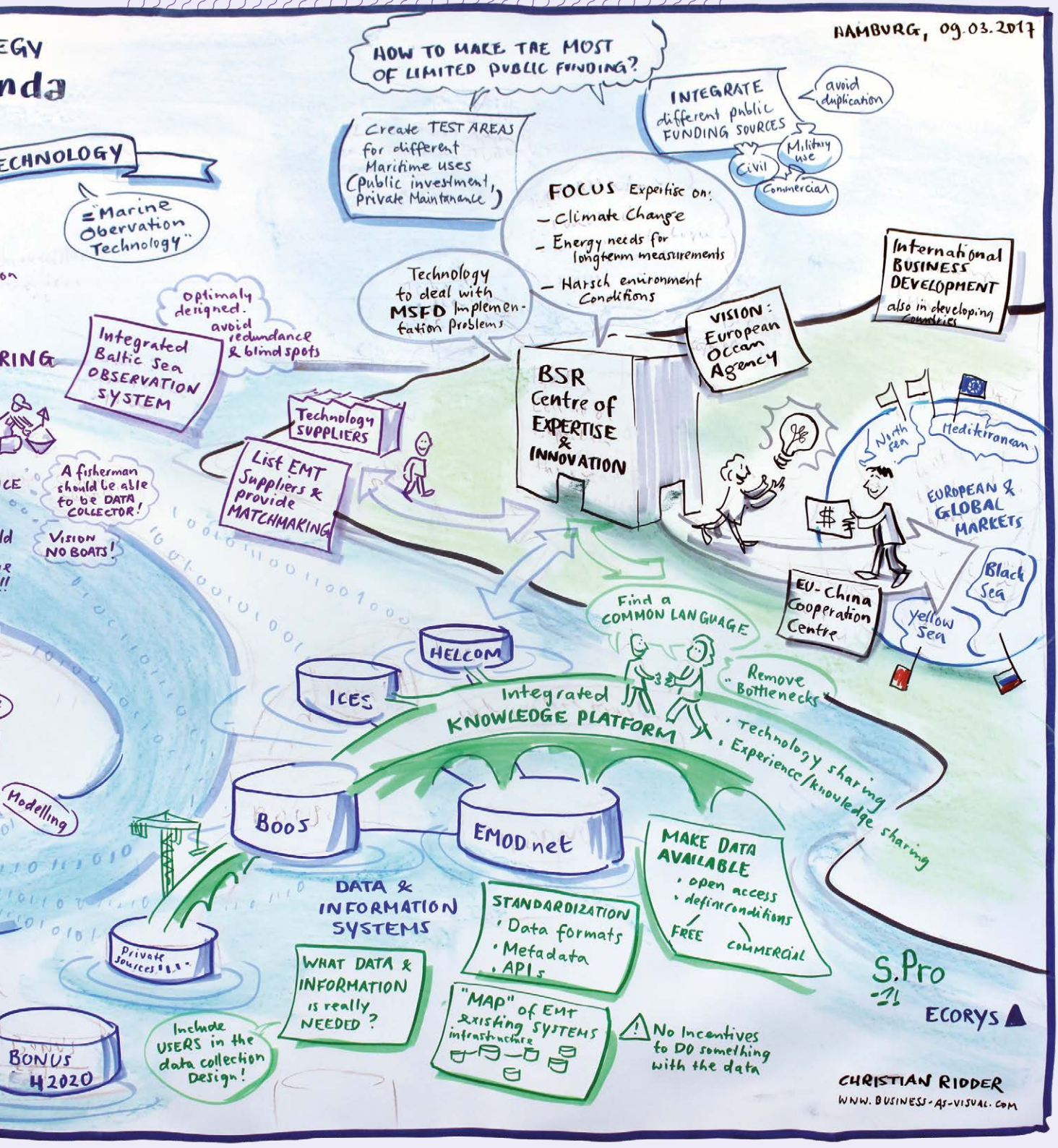
NO STANDARDS
CLOUD ROBOTICS
Less Hardware focus
More Service design!
BOOK online!
3D/4D Visualization
artificial intelligence
Develop a MARKET-PLACE
DATA DEMANDS → Data supply
personalized/ Localized SERVICES
Improve understanding of NUTRITIENT CYCLES & ECOSYSTEM predictability
REMEDIATION MEASURES & Water Technologies
Data & Information SERVICES & PRODUCTS
IDENTIFY relevant MARKETS for marine DATA & information SERVICES
Define NEEDS & Requirements
Turn Science into Service!!
DATA MINING & ANALYTICS
SME
Commercial interest to extract data from Research
OCEAN MINING

EMT



ENVIRONMENTAL AND MONITORING TECHNOLOGY

DEFINITION AND SCOPE OF "ENVIRONMENTAL AND MONITORING TECHNOLOGY"

Marine environmental and monitoring technology encompasses a broad range of technologies and services (e.g. in situ measurements, remotely-operated vehicles, automated real-time observations, space-based observations, data management services and modelling). These address the systematic measurement, collection and analysis of data, and its subsequent transformation into knowledge. The thematic area includes both environmental and operational monitoring.

Environmental monitoring provides the scientific basis for our understanding of the health and functioning of the marine environment, for obtaining sustainable growth within other maritime functions, and for selecting optimal sites and managing them appropriately as well as for achieving Good Environment Status (GES) of marine waters in accordance with the Marine Strategy Framework Directive (MSFD) and thus fulfilling the environmental pillar of the Integrated Maritime Policy.

Operational monitoring underpins safe offshore and coastal activities and infrastructures, such as offshore platform and pipeline maintenance, shipping and commercial fishing vessel traffic, and response to oil spills and other marine pollutants.

Both types support marine and coastal as well as climate and weather monitoring, and are essential to management and planning decisions concerning marine resources, maritime operations, and offshore and coastal infrastructures as well as safety at sea. The main value of marine environmental and operational monitoring is derived from the savings that can be realised when correct decisions are made. In fact, in an example applied to the implementation of the MSFD, Nygard et al. (1) show that the value of improved information concerning the status of the sea can be an order of magnitude greater than monitoring costs. This reasoning can be applied to a broad range of sectors that rely on marine monitoring, including risk assessments for natural hazards, climate change and coastal erosion, maritime safety, maritime tourism, shipping, shallow water as well as deep-sea mining, aquaculture, fisheries, offshore wind, oil and gas, carbon capture and storage, and marine pollution.

Environmental and operational monitoring relies on a range of common technologies and services that can be grouped into four development fields as follows:

1. **Technologies to monitor and survey the system:** These include smart sensors, autonomous systems (e.g. gliders, floats, floating buoys and drones), satellite observation systems, subsea engineering infrastructure (e.g. offshore platforms, moorings, anchoring, cables and robotics), communications and power supply technologies to support environmental and operational monitoring in the public and private sectors.

2. **Marine observation and operational maintenance monitoring services:** These include services used for the deployment, recovery, inspection and maintenance of instrumentation, offshore structures and marine observation platforms. Professions include boat handlers, winch operators, scuba divers, welders, and various types of marine engineers. They perform services related to instrument maintenance, calibration, validation and auditing, all of which are relevant to both long-term monitoring programmes and occasional events, and are used by both the private and public sectors.

3. **Data management systems:** These encompass the range of services and infrastructure needed to support data collection including relevant expertise, data policies and standards as well as data archive facilities that are needed to:

   a. manage and ensure the long-term safe keeping, quick access and effective extraction of the vast volumes of data that are being generated and collected; and

   b. assemble marine data, data products and metadata, and make them more available to public and private users who rely on quality assured, standardised and harmonised marine data.

4. **Data analytics and information services:** This includes the whole range of analytical services such as ocean modelling, forecasting and product development as well as intelligent support for operational (maintenance) processes (e.g. digitalisation of shipping or the operational maintenance of offshore structures such as wind parks).

Research and development facilities have an essential role to play across all these development fields both in terms of developing new sensors and models and testing new technologies and services (including data management protocols, data analytics and artificial intelligence). In addition, appropriate support needs to be available to transfer promising new technologies and services to the market.

STATE OF PLAY

Environmental and monitoring technology is a key enabler for blue growth as it provides the crucial infrastructure to support our understanding of the health and functioning of the Baltic Sea. It is lynch pin for obtaining sustainable growth within other maritime functions, and for assessing risk to coastal and offshore investment.

The Baltic Sea ecosystem is fragile and particularly vulnerable to the effects of natural variability, human induced eutrophication, the introduction of alien species, inputs of organic pollutants, and large-scale human disturbance such as ocean acidification and climate change. In the Baltic Sea and Skagerrak, eutrophication, over-fishing and intensive use from the transport sector have been the foremost causes of ecosystem deterioration. In the future, the symptoms of climate change (e.g. warming, ocean acidification, freshening) are likely to constitute real and daunting environmental threats (2).

The economic significance of environmental and operational monitoring has been established and is becoming more significant. Over the past years, the gross added value of the environmental economy has been constantly increasing (Figure 1) even though the overall European economy has gone through a major crisis during that time period. For the full period of 2000 to 2013, while the EU28 GDP has grown by around 40 %, the gross value added of the environmental economy has increased more than twofold.

Environmental monitoring is considered to have high future potential in the BSR (Figure 2), a reflection both of its importance in view of all the environmental challenges the region faces, their prominence in terms of

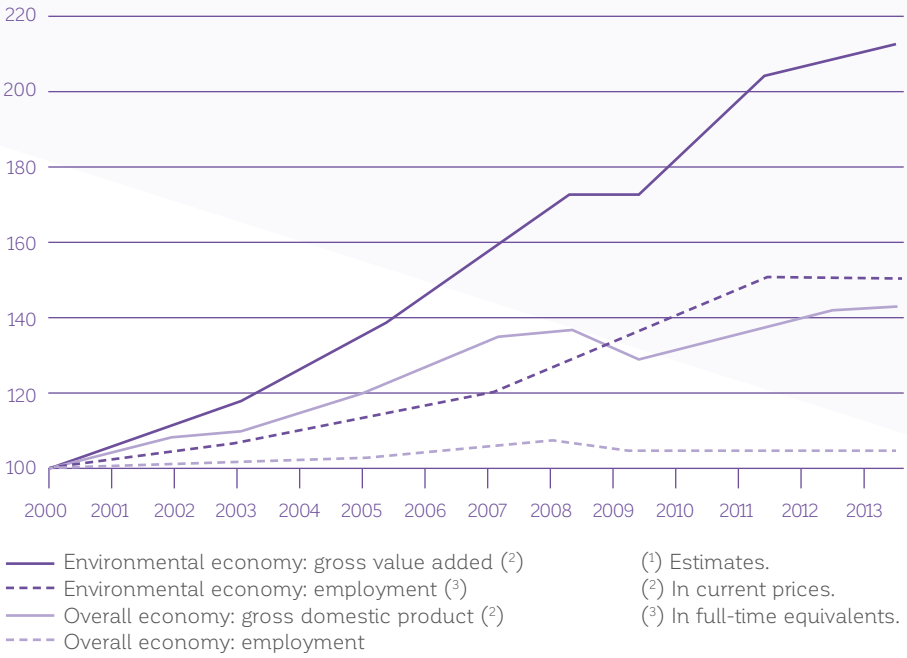


Figure 1: Development of key indicators for the environmental economy and the overall economy, EU-28, 2000-13 (2000 = 100) [1]

[1] Eurostat: http://ec.europa.eu/eurostat/statistics-explained/images/archive/4/41/20170503162031%21Development_of_key_indicators_for_the_environmental_economy_and_the_overall_economy%2C_EU-28%2C_2000%E2%80%9313_%28%C2%B9%29_%282000_%3D_100%29_YB16.png

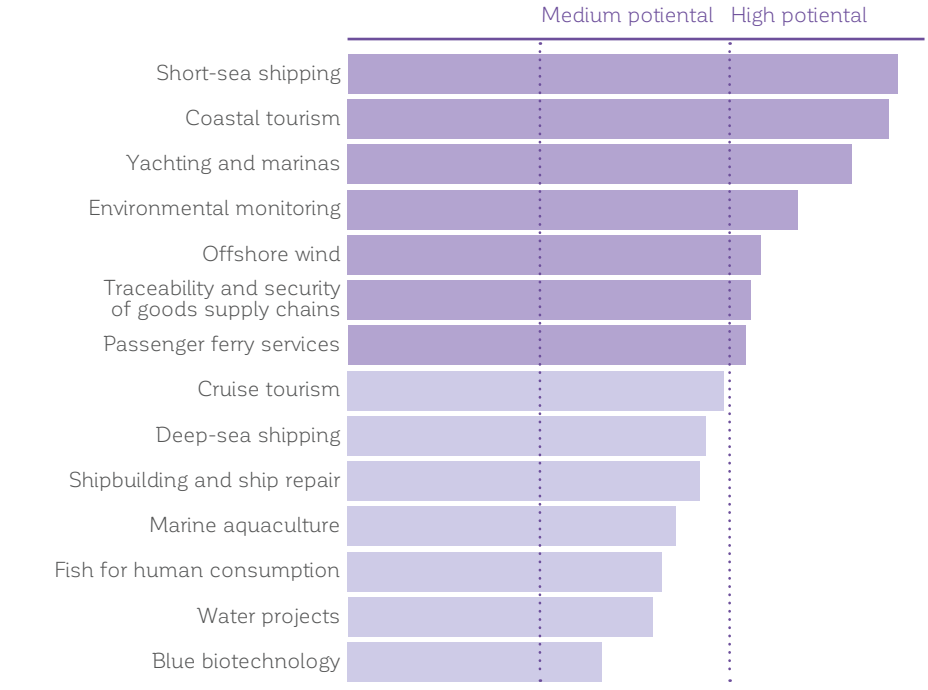


Figure 2: Maritime economic activities with most future potential in BSR (3).

policy relevance, spill-over effects, sustainability and the underlying dependence of blue growth on well-functioning marine ecosystems and the growth of other maritime economic areas and hence, their environmental and operational monitoring needs.

Recent growth in the Baltic Sea Region (BSR) within marine environmental monitoring technology is most likely driven by the need for low / mid cost technology to meet Member States' commitment to achieve GES by 2021 (3). But it is also a reflection of the recent growth within the offshore wind sector, in particular from Germany and its consequent spill-over effects.

There is significant growth potential related to not only operational monitoring activities required by renewable energy sectors, but also vessel tracking services and automatic identification systems used on ships and commercial fishing fleets, and monitoring for fisheries and aquaculture, indicating that further growth can be expected as Member States expand their blue economies. As the use of maritime space increases, site selection and management decisions related to new infrastructures (e.g. tunnels, pipelines, etc.) and cumulative impact assessments will increasingly depend on environmental and operational monitoring.

While growth is expected in environmental and operational monitoring, a rigorous analysis of the actual market demand from different blue growth sectors has not yet been carried out. Unlike the other thematic areas discussed in this report, the EU Strategy for the Baltic Sea Region (EUSBSR) does not have a dedicated Policy Area (PA) for Environmental and Monitoring Technology.

Table 1: Core drivers and challenges for environmental monitoring technology

EU directives and regulations such as Maritime Strategy Framework Directive (MSFD), Water Framework Directive (WFD), Maritime Spatial Planning Directive (MSPD)
New uses and combined uses of ocean space and platforms
Growth in other maritime economic areas and their environmental and operational monitoring needs
Pressure to achieve cost efficiencies, especially regarding public funding
Complex knowledge-driven innovation and technologies

TECHNOLOGIES TO MONITOR AND SURVEY THE SYSTEM

Within the BSR, marine monitoring technology is a very small, niche market, but the BSR is a strong leader in finding solutions for eutrophication, hazardous substances, over fishing and working in harsh environments. It has a good standing internationally with regards to high quality research with a solid scientific foundation (3). The efforts of the Helsinki Commission (HELCOM) are a testimony to this, as is the number of leading marine research institutes in the region. Due to its natural characteristics as a distinct, comparatively small sea basin with substantial areas under ice and extensive shallow waters, the BSR offers a convenient environment for the development of adaptive and on-demand monitoring services and can serve as a test bed and stepping stone to the deployment of the technologies in larger regions.

The development field operates as a collaboration between small and medium sized enterprises (SMEs) and research institutes supplying government and commercial requests for monitoring. Marine technology SMEs are distributed across the region, however, most are concentrated in Germany, followed by Sweden, Finland and Estonia. Germany tends to lead the sector and benefits from the German Association for Marine Technology[2] (GMT), a non-profit association, which acts as a voice for national competence in marine technology and represents the interests of companies and research institutions in the area of marine technology towards the public and policy makers. GMT currently represents over 100 companies and research facilities.

Providing systematic monitoring and maintenance services can be expensive and a challenge, in particular in the BSR, due to the harsh nature of the environment. The increasing monitoring needs (both from the private as well as the public sector) in the BSR require affordable solutions. There is pressure to find cost efficiencies both within the public and private sectors.

Moreover, appropriate monitoring (and monitoring technologies) require platform maintenance and subsea infrastructure to support monitoring operations. New uses and multiple uses of ocean space and platforms are creating opportunities for new services and technologies.

There is a need for innovative solutions to monitor water quality, share information on water quality and access offshore platforms and infrastructures for maintenance purposes.

Technological innovations are expected to play a crucial role in clarifying the magnitude and trends of the challenges the BSR faces and supporting ecosystem based management. There is a need for better information on: bottom sedimentation and resuspension; air-sea carbon fluxes; marine pollution related to noise; and marine litter, especially plastic, paraffin, etc. (4). The evolution of autonomous systems, robotics equipped with smart sensors, and artificial intelligence and machine learning capabilities provides a new mode of access to the sea and an opportunity to expand monitoring capacity (above and underwater) to a completely new level. Real-time autonomous sensing – using, for example, drones, gliders, satellites and robotics – cuts operational costs significantly, while increasing coverage and providing immediate access to respond to emergencies. Deployment of instrumentation on ferries and fishing vessels also plays a role in this context. More and more, offshore industries are relying on this type of technology for surveys, inspections, maintenance, monitoring, mapping and recovery operations. The Boston Consulting Group estimates that more than $67 billion will be spent worldwide in the robotics sector by 2025 (of which $5 billion (7%) will be spent on underwater robotics), compared to only $11 billion in 2005 (5).

However, there are technical and cultural challenges to adopting autonomous systems. From a technical perspective, it is a challenge to make things work robustly, especially for long-term deployments in changing environmental conditions. Moreover, the more complex systems get, the harder it is to make them operational. From a cultural perspective, there is some resistance from traditional underwater industries in adopting new autonomous technologies; trust in the system's reliability and safe performance must be developed. Both of these challenges point to the need to make robust test environments available and the need to develop operational standards for autonomous monitoring technologies, such that economies of scale can be achieved. Only then can new technologies establish the references they need to bring a new technology to market.

It is remarkable that while 535 people have been in outer space and 12 people have walked on the moon, only 3 people have reached the bottom of the ocean and returned!
(**Source:** *www.krakensonar.com*)

[2] www.maritime-technik.de/en-index.php

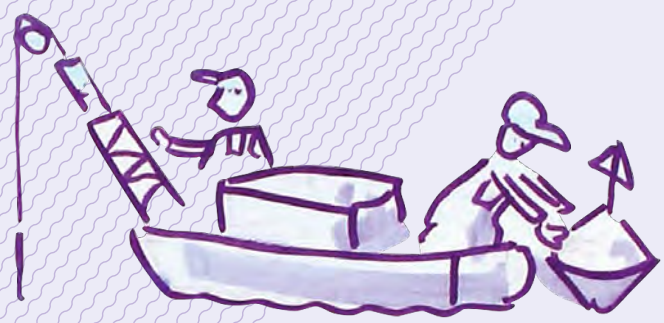
MARINE OBSERVATION AND OPERATIONAL MAINTENANCE MONITORING SERVICES

Responsibility for marine monitoring programmes usually lies with national and / or regional agencies that have the mandate to collect marine data and make certain information about the marine environment available for regulatory purposes and the public good (e.g. safe and efficient activities at sea, environmental and pollution hazards, climate change, etc.). Offshore operators also monitor their installations for their own purposes.

Mandated agencies typically collaborate on the installation and maintenance of marine monitoring programmes with research institutes and / or private companies. Regular environmental programmes can provide a steady stream of business for marine technology SMEs, as they require the systematic provision of reliable, routine products and services. In particular, services related to instrument maintenance, calibration, validation and auditing are crucial in order to collect meaningful, consistent and comparable data.

A number of monitoring platforms are in place in the BSR, but they are not necessarily optimally designed. There is a need for coordination both on location of observatories and the type of technologies that are used at national and international levels. Oceanographic and environmental monitoring programmes may have been established in parallel but with different requirements in time and space in mind, resulting in different instrumentation, data streams, and maintenance schedules.

SMEs are often required to provide customers of marine technology highly customised applications of technology, effectively turning each deployment into an experiment. As a business model, this is difficult to sustain.



DATA MANAGEMENT SYSTEMS

In parallel with the development of oceanographic, environmental and operational monitoring technologies and services, there is the need to deal with the vast volumes of data that are being generated and collected, their transformation into knowledge and their long-term safe keeping.

Data from oceanographic and environmental monitoring programmes (for example, Baltic Operational Oceanographic System (BOOS), SeaDataNet, European Marine Observation and Data Network (EMODnet) and HELCOM or International Council for the Exploration of the Sea (ICES) programmes) are collected with public money and therefore efforts are made to make the data freely available to the public through national, regional and / or international data infrastructures. Oceanographic data and marine environmental data are, however, housed separately in different databases with different formats and update schedules. This practice creates bottlenecks, preventing the data from being shared, used and transformed it into something that is relevant for different sectoral needs and thus realising the full value of the observations. Moreover, different approaches to documenting metadata and quality assurance / quality control (QA / QC) protocols make it virtually impossible to match data across disciplines.

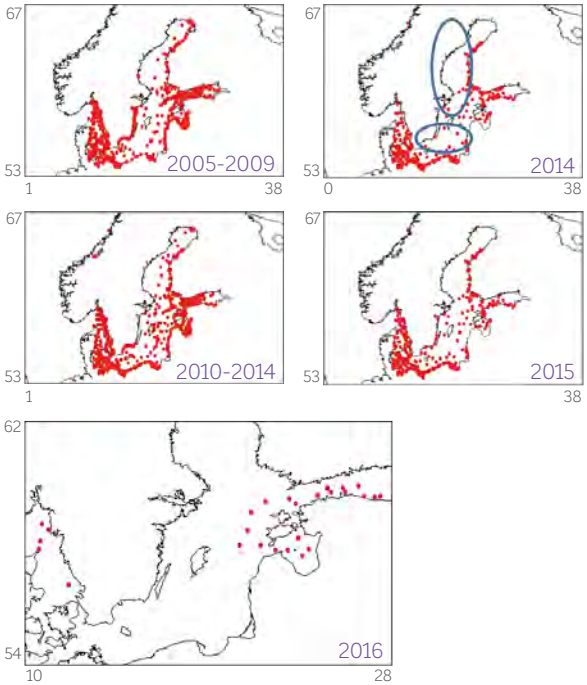


Figure 3: Time delay in availability of R/V Chlorophyll data for CMEMS 2016 Ocean State Report

(**Source:** J. She, Danish Meteorological Institute)

Data is also collected with public money in research projects, creating another layer of complexity in terms of data management and accessibility. Typically, the data is only made available after publication of scientific research. However, many funding organisations now insist on an "open access" clause in their funding contracts for the dissemination of results, publications and data, creating a pathway to accessing research project data, albeit in delayed mode. Access is usually by means of a Digital Object Identifier (DOI) and project data may be eventually banked at a national data centre. If the latter occurs, then the project data will at some point be integrated into the longer time series of environmental and oceanographic monitoring programmes.

Environmental monitoring data is also collected by private companies, as part of an Environmental Impact Assessment (EIA) requirement and / or to support their operations. These data collections are usually made on an ad hoc basis. Results are summarized in reports and not necessarily included in the longer time series generated by the publicly-funded environmental and oceanographic monitoring programmes mentioned earlier. Access to these data streams is not always straightforward. Private companies may have commercial reasons for not making data more freely available, or they may simply not have the resources to manage the data with re-use in mind.

Data management systems are relevant whether marine data is collected as part of a regular monitoring programme, for research purposes or by private industry. However, the source of data collection will dictate how the data is managed, leading to various separate data management approaches and systems which do not necessarily communicate. Examples of these are found between oceanographic, environmental and fisheries monitoring programmes and other various physical, chemical, biological and geological data collected in research projects (e.g. Baltic Organisations Network for Funding Science (BONUS), Interreg and Horizon 2020 programmes). Moreover, maritime spatial planning information systems such as CONTIS (Continental Shelf Information System) tend to remain on the periphery.

Efforts to federate the resources and expertise of the diverse institutes, agencies, and companies in the BSR's public and private sector and provide integrated marine services to marine users and policy makers are evident in the **Baltic Operational Oceanographic System** (BOOS), a regional component of EuroGOOS (European Global Ocean Observing System). BOOS establishes an important regional framework for the provision of operational oceanographic services mainly by public government organisations or research institutes (although membership is also open to the private sector).

HELCOM plays a pivotal role in coordinating and realising **environmental monitoring** strategies and targets for the region. The HELCOM Data and Map service provides access to environmental and oceangraphic data collected as part of the HELCOM monitoring programmes, while **ICES** coordinates the collection of fisheries recruitment, stock assessments and phytoplankton data among Member States to provide the science base for fishing quotas of the Common Fisheries Policy.

There is coordination between BOOS, CMEMS and EMODnet. However, the efforts of the JERICO-NEXT project take coordination and harmonisation of high-quality environmental data a significant step further.

// European Marine Data Management Infrastructures //

Organisations that aim to make various marine data and analysis products available on regional or European scale (6):

- SeaDataNet (Pan-European infrastructure for ocean and marine data management project);
- CMEMS (Copernicus Marine Environment Monitoring Service);
- AquaNIS (Information system on aquatic non-indigenous and cryptogenic species);
- GRDC (Global Runoff Data Centre);
- EMODnet (European Marine Observation and Data Network);
- BSHC (The Baltic Sea Hydrographic Commission).

DATA MANAGEMENT SYSTEMS

The EMODnet Baltic Sea Basin Checkpoint is essentially a first assessment as to the **relevance of marine data services for different sectoral needs** namely, wind farm siting, marine protected areas, oil platform leaks, climate and coastal protection, fisheries management, marine environmental management, and river inputs to the coastal environment. A number of important issues have been identified within each sector. These range from the adequacy of existing data sets for MSFD assessments and the availability of quality information on human activities, to high resolution wind and current data and forecasts for oil spill response (7). These stress tests become particularly relevant as Member States struggle to find a common basis for fulfilling the requirements of various EU Directives (e.g. MSFD).

Recently, data needs for MSP have been the subject of a European sea-basin wide study (8) and regionally through the work of the HELCOM-VASAB MSP Data Expert Group. The MSP Directive provides an impetus for examining environmental and operational monitoring from a cross-sectoral perspective and an integrated view on sectoral needs.

Managing so-called big data presents further challenges. There are two dimensions to the management and use of big data:

1. How to enable quick access and effectively extract and use the increasing amounts of Earth Observation and Earth System model data, and

2. How to harness and analyse data to intelligently support operational (maintenance) processes, (e.g. digitisation of shipping or the operational maintenance of offshore structures such as windparks).

The first dimension is supported by the Earth System Grid Federation (ESGF). ESGF is an interagency and international collaboration that develops, deploys and maintains software infrastructure for the management, dissemination, and analysis of Earth System model output and observational data. It is an open source, robust, distributed data and computation platform, which enables worldwide access to peta / exa-scale scientific data from multiple data centres. However, there is a need for a data management framework for online access to medium amounts of data, allowing for downloading, viewing and analysis of data from distributed multi-server local networks.

The second dimension relates to commercial applications of big data, and therefore relies on commercial cloud and big data management facilities. This technology, which deals with demands of big data is in its infancy and the information and communication technology (ICT) potential has yet to be fully exploited.

// JERICO-NEXT
European Initiative (Horizon 2020, 2015- 2018) //

- Led by Ifremer (33 partners; 7 BSR partners)
- Aims to harmonize, improve and innovate operational coastal observations and marine services. Timely, continuous and sustainable delivery of high quality environment data and information products, through:
  - Harmonisation of technologies and methodologies;
  - Innovations in technology and methodology;
  - Data management;
  - Virtual access;
  - Transnational access to coastal observatories.

// BalticLINES
(Interreg BSR project, 2016 – 2019) //

Coherent Linear Infrastructures in Baltic Maritime Spatial Plans

- Led by German Federal Maritime and Hydrographic Agency (15 BSR partners);
- All BSR MSP authorities and the HELCOM secretariat are pioneering the development of a decentralised data infrastructure for shipping lines and energy corridors in the BSR, whereby various national data sources will automatically feed into one transnational system;
- The data system is from the outset 'purposely' designed – targeting only those data sets, which are really required by planners for questions relating to transnational coherence of shipping routes and energy corridors in Maritime Spatial Plans in the BSR.

DATA ANALYTICS AND INFORMATION SERVICES

There is growing demand from both the public and private sectors for marine data and analysis products to support maritime spatial planning and infrastructure projects and thus reduce uncertainty in planning and investments. However, **science, technology and data analytics are not being fully and effectively harnessed in the ocean management process, with a number of challenges still to be overcome.**

The value of observations is not being realised due to lack of use and re-use of integrated data sets. Securing the quality of time series observations is becoming increasingly important as more and more novel sensors become available. This points to the need for common standards, specifications, calibration and quality assurance protocols. The BSR should follow the example of other European and global initiatives so as to avoid duplication of work.

And, how to make the most of (integrated) data already collected? A comprehensive picture of the relevant markets for marine data and information services is still emerging. What exactly is the market demand? Who wants what? Who will pay? These questions will need to be answered if we wish to ensure continuity of data and information services.

Moreover, there are complex data policy issues which have yet to be addressed by making data open and accessible so that companies can develop innovative knowledge-based products that target BSR development issues. A business model needs to be established, for example, with the premise of selling the results of data analysis (interpretation) and not to sell data itself. Precedents exist already in weather forecast business models.

The environmental problems of the Baltic Sea provide opportunities for innovation and regional development (9) and a high level of specialist expertise has been built up across the region in response to dealing with regional environmental issues. However, consolidation of this critical mass has not been realised, making it difficult for small enterprises to gain bigger shares of a globally growing market. Some regions in the Baltic Sea have started to cluster expertise and / or have included marine monitoring infrastructure as an element in their smart specialisation strategies Research and Innovation Strategies for Smart Specialisations (RIS3). These initiatives should be further enriched by creating reference and demonstration projects across the BSR and establishing cross-sectoral cooperation with other sectors that can provide the carriers for monitoring devices (e.g. shipping, aviation, tourism) and display the innovation.

// Smart Blue Regions project (Interreg BSR, 2016-2019) //

Detailed analysis of RIS3 of selected regions across the BSR.

Regions with maritime monitoring infrastructure or cluster expertise elements included in their smart specialization strategies:

- The Regional Council of Southwest Finland developed a water, cluster which has an active role in the China Europe water platform;
- Polish region of Pomorskie and German region of Schleswig-Holstein have specialisation fields blue economy and regard cross-sectoral cooperation as essential.

// Rolls-Royce Marine remote operations projects //

- Advanced Autonomous Waterborne Applications Initiative: specification and preliminary designs for berth to berth remote operations;
- Developing concepts for control centres together with Technical Research Centre of Finland Ltd.

// Most important development field //

83 % of the survey respondents stated that data analytics and information services are an important or very important development field. This is the best value within EMT.

ENVIRONMENTAL AND MONITORING TECHNOLOGY: VISION 2030

The BSR's marine environmental and operational monitoring infrastructure provides an integrated knowledge platform that supports a sustainable maritime economy. It is relevant for different sectoral needs, proactively uses sea infrastructures and encourages sectors to take part in monitoring and is founded largely upon Baltic-based research and innovation.

Environmental monitoring data is collected and processed using agreed best practices for instrument maintenance, calibration, data exchange, formats and metadata.

// Proactive use of existing sea infrastructures and sectors //

- Grid of smart sensors installed on fishing / leisure / ferry boats and sea constructions;
- Use of operational marine data (incl. models) guiding ship fairways, optimizing fuel consumption (i.e. take advantage of suitable currents to save fuel);
- Fishing vessels pick up marine litter.

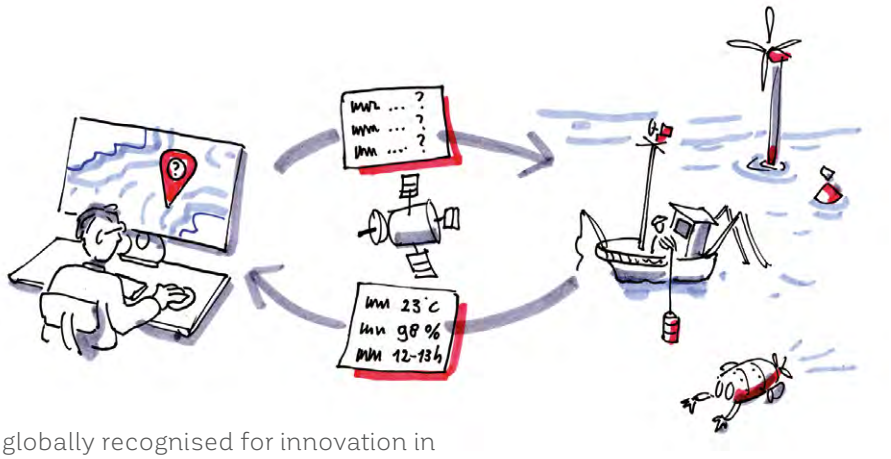
Smart technical solutions for common purposes with respect to environmental and operational monitoring are used in an integrated, optimally designed Baltic Sea observation system. Environmental and operational monitoring supports employment through research, technology development and service provision. Developments in environmental and operational monitoring are based on affordable, robust technologies and systems which enable efficient, long-term monitoring operations, use adaptive, autonomous and cost-effective marine technology that can withstand the demands of harsh environments and vagaries of climate change. Operational standards in technology and data exchange are developed and thus economies of scale are realised.

There is a technological platform to exchange / share knowledge between different national organisations and associations, including interdisciplinary exchange of technological findings (e.g. projects, technologies, national activities). "Balt-net" is an open centre platform for monitoring technologies, changing alliances, testing instrumentation and common protocols. A consortia of major institutes and oceanographic companies guides the issue of common standards and protocols and builds on existing European and global initiatives.

Environmental monitoring is done at the transnational level with an integrated view of maritime security and environmental protection, collecting the essential, minimum set of environmental parameters needed to gain a BSR-wide picture with respect to the Baltic Sea being perceived as one ecosystem. All BSR countries have reached the same advanced level of EMT development. Regular environmental monitoring is carried out by local, private companies in cooperation with public research institutions. Cooperation across the BSR is promoted actively, data exchange is made easy through standards and agreed communication pathways. Efficient public-private partnerships are in place which support the integrated knowledge platform(s).

There are facilities for private and public collectors of data (including research projects and citizen science collection efforts) to reliably deposit data for long-term safe-keeping. There is a virtual Baltic (European) Data Centre where public (e.g. data collected using public resources) and private data are accessible and available through a flexible open data policy, the use of common data exchange standards and easy-to-use application program interfaces (APIs), which cater to different types of data collection efforts.

ENVIRONMENTAL AND MONITORING TECHNOLOGY: VISION 2030



Marine data and information services are provided according to the different sectoral needs and are based on a functioning business model driven by the demand of other Blue Growth areas. Stress tests on the fitness for purpose of marine data and information services are carried out at regular intervals. Cross-sectoral working groups are established and meet regularly to review sectoral needs. Infrastructure is in place to deal with demands of big data analytics.

BSR builds science-based guidance and innovations for sustainable use of BSR marine resources through knowledge sharing and macro-regional cooperation.

The BSR is a hub for environmental and operational monitoring excellence. It exports its environmental and operational monitoring technologies and services and is globally recognised for innovation in environmental and monitoring technologies, including operating in harsh environments, and achieving cost-efficiencies with government funding.

This is promoted actively, not only within the sector but also towards the general public and politicians, through a vehicle such as a Baltic Centre of Excellence (or even a European Ocean Agency). The "BSR Cluster" sets the technological standards for (parts of) environmental and operational monitoring technology. Maritime clusters collaborate on market research and export promotion activities.

// HELCOM-VASAB MSP Data Group //

- Supports data, information and evidence exchange for MSP processes with regard to cross-border / trans-boundary planning issues;
- Facilitates the work of the HELCOM-VASAB MSP Working Group and helps with implementation of the Working Group's work-plan including the Regional Baltic MSP Roadmap 2013-2020.

STRATEGIC ACTION FIELDS

Four strategic action fields have been identified as most relevant to achieving the vision for environmental and operational monitoring technology in 2030. These are:

1. Make environmental and operational monitoring technologies and services more effective
2. Foster efficient monitoring technologies and services
3. Develop the export market for BSR environmental and operational monitoring technologies and services
4. Develop efficient public-private partnerships

In the following sections, these strategic action fields are elaborated and *potential actors* for implementing the identified actions are named. While the specific actors might differ from action to action, it was stressed in the stakeholder dialogue that overall cooperation and exchange between the public and the private sector needs to be improved.

EFFECTIVE ENVIRONMENTAL AND OPERATIONAL MONITORING TECHNOLOGIES AND SERVICES

Establishing effective environmental and operational monitoring technologies and services that are relevant for different sectoral needs requires close collaboration between clients and service providers in order to understand which sectors actually depend on marine monitoring, what exactly their monitoring needs are and where there are commonalities and differences between sectoral needs. Only then can a comprehensive picture of the relevant markets for marine data and information services be developed and appropriate actions are taken to build an effective environmental and operational monitoring sector that is fit for purpose and supports sustainable blue growth, both in the BSR and beyond.

Recommended strategic actions are:

- Establish a **Blue Economy Baltic Maritime Technology Exchange Platform** to strengthen the relationship between SMEs, public authorities and research communities, establish cohesion of needs between sectors, and identify and understand relevant markets for marine technology and data and information services.
- The Blue Economy Baltic Maritime Technology Exchange Platform would **promote an integrated approach** to operational oceanographic and environmental monitoring systems, and **raise awareness** through product development and public involvement. It would set a **Marine Observation Technology (MOT) agenda for the BSR** and develop **integrated environmental and operational monitoring strategy** for different sectors.

// Map marine infrastructure //

Map marine observation technology infrastructure and centres of excellence across the BSR:

- Identify sectors and name leading / important institutions per sector to set a strong basis for the mapping process. Each sector should have a mapping leader to coordinate the sectoral mapping. Sectoral information maps to be merged into a cross-sectoral (complete) map;
- Market analysis across different sectors.

Potential Actors: Appropriate cross-section from industry, government and research such that interests of each sector are represented.

// Market Analysis //

Identify sectoral needs and relevant markets across different sectors for marine data and information services:

- Establish cross-sectoral working groups and carry out regular stress tests on fitness for purpose of environmental and operational monitoring technologies and services.
- Market analysis: build comprehensive picture of the relevant markets for marine data and information services, establishing what exactly the market demand is, who wants what, and who will pay.

Potential Actors: Appropriate cross-section from industry, government and research such that interests of each sector are represented.

// German Association for Maritime Technology (GMT) //

Use the GMT as a launch pad for creating a BSR-wide cooperation and exchange platform on maritime technology, which could provide an overview on capacities, actors and activities and facilitate strategic project cooperation.

// SHEBA Project (BONUS Programme, 2015 – 2018) //

- Led by Swedish Environmental Research Institute (11 partners; 10 BSR partners);
- Sustainable shipping and environment of the Baltic Sea Region;
- Assessing impact of different pollutants to the water quality indicators of the MSFD and WFD and to the air quality indicators.

INCREASE EFFICIENCY OF TECHNOLOGIES AND SERVICES

Efficient environmental and operational monitoring technologies and services are based on economies of scale, which are built on an understanding of common purpose, common operating environments and a sharing of common resources. The efficiency of data usage, including, integrated use of multiple data sets, is a measure of the value of data and depends on efficient data management infrastructure, data quality, data exchange standards, and accessible data policies. Data investors are motivated to maximise the value of data and make the most out of data already routinely collected and improve future monitoring systems.

Recommended strategic actions are:

- **Review efficiency of existing public marine data and information services:** Is there potential for integration of services? Danger of duplication of effort? What is the usage?;

// Pilot MSFD Stress Test Results //

Define and evaluate appropriate data sets for MSFD assessments:
- Identify bottlenecks, obstacles to MSFD implementation;
- Identify appropriate technology / solutions / services to support MSFD implementation;
- Develop proposals for an EU-wide (and even wider) standardization.

Potential Actors: Sectoral stakeholders, research institutes, national MSFD authorities.

// Usage of public marine data and information services //

Review usage and potential usage of public marine data and information services in the Baltic Sea:
- Review existing services: HELCOM, ICES, BOOS, CMEMS, EMODnet, SeaDataNet, AquaNIS, GRDC, BSHC;
- Explore commonalities and intersection points.

Potential Actors: Different sectoral stakeholders from public and private sectors, data management / analytics companies.

// HELCOM BALSAM Project (2013 – 2015) //

- Testing new concepts for integrated environmental monitoring of the Baltic Sea;
- Final Report: Improving the Coordination in the Monitoring of the Baltic Marine Environment.

// EMODnet Checkpoint //

Continue EMODnet Checkpoint with new challenge areas:
- Marine Strategy Framework Directive
- Maritime Spatial Planning
- Ocean acidification
- Hypoxia
- Operational forecasting
- Marine pollutants
- Underwater noise
- Atmospheric deposition

Potential Actors: EMODnet, sectoral stakeholders, research institutes, regulators, MSP authorities.

- **Common standards / protocols – revisited:** Critical analysis of where common standards and protocols are needed (sampling, instrumentation, data streams, data processing) and where they are not. What are the essential variables? Keep it simple;

- **Examine complex data policy issues:** How to make data open and accessible so that companies can develop innovative, knowledge-based products that target BSR development issues. Look at different business models, for example, where the premise is to market / sell the results of data analysis (interpretation) and not to sell data itself. Precedents exist already in weather forecast business models;

- Analyse critical issues to ensure **continuity of data and information services**. What facilities exist or are needed in order to deposit and secure long-term safety of data collected?;

- Establish **test facilities** for robust deployments of new and complex technologies and different maritime uses. Make seed money available to support testing;

- **Adaptive monitoring to complement / optimise existing regular monitoring:** Define monitoring purpose. Assess existing observing system. Application of observing system simulator;

// Monitoring platforms //

Optimize technologies and locations for monitoring platforms and improve their operation:
- Sectoral benefit demonstration;
- Select hot spot locations;
- Determine requirements for robust and cost-effective equipment (lifecycle cost);
- Training (modules) of monitoring technology handling;
- Training of monitoring needs.

Potential actors: National agencies / authorities, research institutes, monitoring system providers (companies), local service providers.

// Cloud technology //

Develop cloud technology for big data processing. This includes:
- Real time analytics of monitoring data;
- 3D / 4D visualisation generated by sensor rich robotics and data reduction technologies.

Potential Actors: Research Institutes, Monitoring System Providers (companies), IT companies

- **Review and emphasise analytical knowledge base, services and tools** used in sectoral applications in BSR (e.g. ocean and ecological models, MSP assessment tools, MSFD assessment tools);

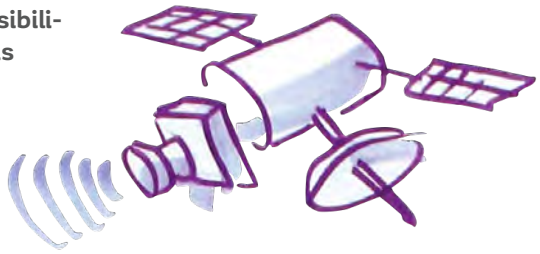
- **Develop business model for Public2Business-Business2Public data service** (e.g. eBay for data and data analysis products – demand and suppliers);

- Assess requirements and **possibilities that autonomous systems present.**

// Baltic Clean Technology Conference for Sustainable Solutions //

Takes place in Rostock, 28-29 September 2017.

Core topics include:
- Deconstruction and recycling of offshore plants;
- Environmental monitoring;
- Condition monitoring.



DEVELOP AN EXPORT MARKET FOR BSR ENVIRONMENTAL AND OPERATIONAL MONITORING TECHNOLOGIES AND SERVICES

The region has a tendency to look inwards and does not necessarily see itself as a potential player in the global marketplace. Through clustering, businesses and SMEs can develop a critical mass, but they need to see the cost efficiency of cooperating. This can be realised through knowledge sharing and macro-regional cooperation on science-based guidance and new innovations for sustainable use of BSR marine resources.

Recommended strategic actions are:

- Develop autonomous sensors for environmental and operational monitoring purposes;
- Invest in technology to be used in harsh environments;
- Better align public funding instruments with environmental and monitoring technology actors' needs for interdisciplinary and cross-sectorial projects;
- Develop novel financing instruments easing access to finance for environmental and operational monitoring technology actors;
- Develop joint export promotion services for enterprises from the BSR (such as market research outside of the BSR, joint fair participation and representation at international conferences);

// Marine Robotics Incubator //

The incubator shall serve as an innovation centre where science meets the industry. Tasks include:

- Develop next generation of marine autonomy;
- Involve strategic partners, associate members, collaborative projects.

Potential Actors: Appropriate cross-section from industry and research

// Ocean technology centre in Rostock //

The Subsea Monitoring Network e.V. brings together 20 members from industry and research. It has initiated this centre which shall provide test facilities for subsea monitoring research, development and production.

// Technology demonstrations of regional excellence //

Create international awareness for BSR specific expertise:

- Technical solutions to support MSFD implementation;
- Technical solutions for long-term monitoring energy needs;
- Marine technology for harsh environments, the Arctic route;
- Adaptive, on-demand monitoring services (e.g. robots as a service, SMART sensors, artificial intelligence);
- Optimal observing monitoring system design.

// Develop a joint Baltic-Yellow Sea Centre for Marine Technology //

- Establish collaborative programme;
- Organise BSR-China match-making events;
- Develop common data standards;
- Joint stress tests (is the data fit for purpose?);
- Annual Blue Economy Report.

Potential actios in the BSR:

- BOOS (DMI)
- SUBMARINER Network
- Blue Regions

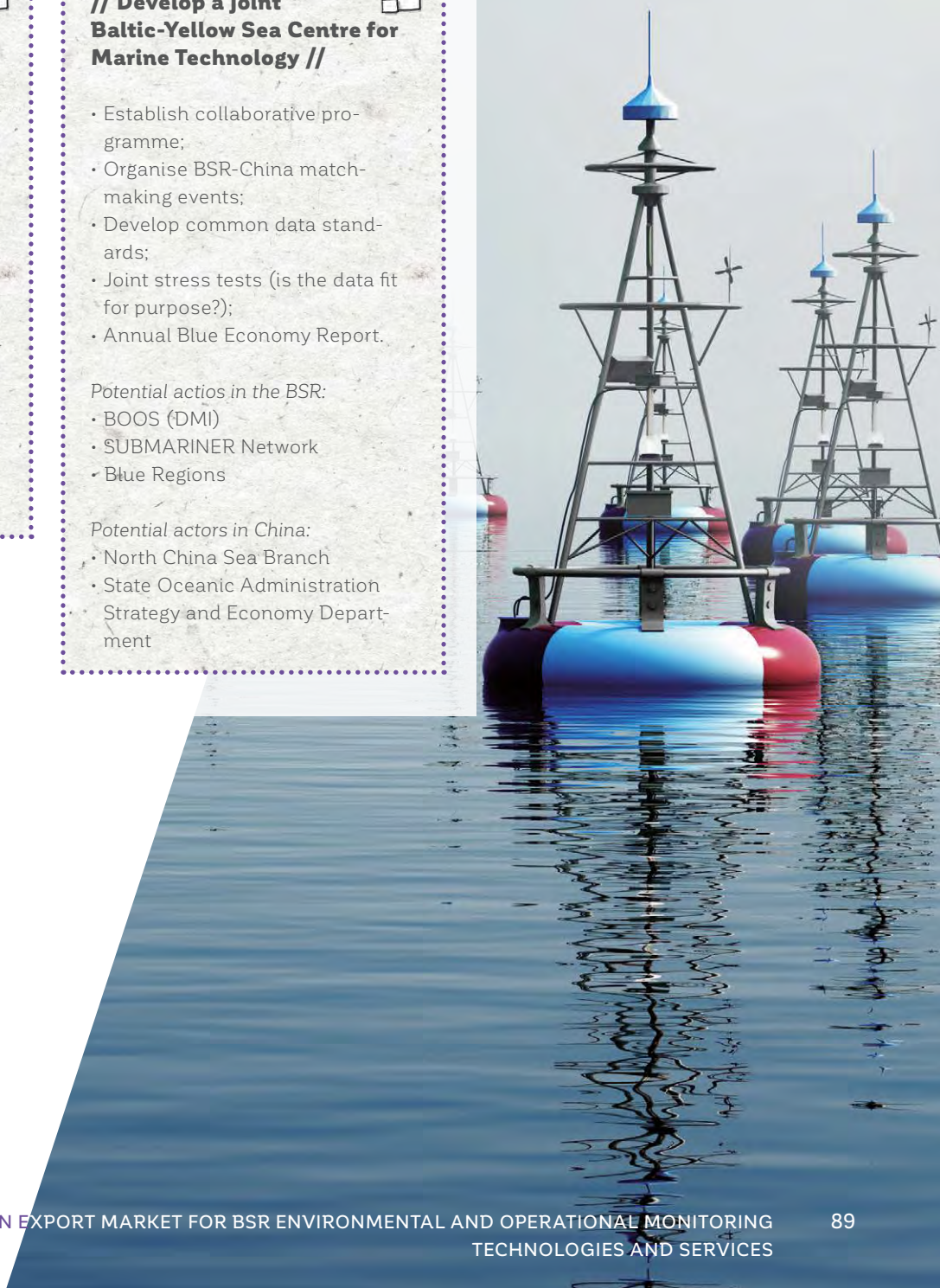
Potential actors in China:

- North China Sea Branch
- State Oceanic Administration Strategy and Economy Department

- Establish reference / demonstration projects for the small enterprises that are producing monitoring technology so they can gain bigger shares of a globally growing market;

- Promote “first use” of novel technology;

- Look for opportunities to run projects in developing countries to open up new markets for domestic business.



DEVELOP EFFICIENT PUBLIC PRIVATE PARTNERSHIPS

SMEs need support of public authorities to invest in innovation and enable companies to build references they need to compete globally.

Recommended stratgic actions are:

- Establish reference / demonstration projects for the small enterprises that are producing monitoring technology so they can gain bigger shares of a globally growing market;
- Establish public / private partnerships and stronger links generally between the private and public sectors and regional strategies;
- Create incentives for public owned companies to develop business cases and finally bring products to market;
- Fund of think tank facilities to increase knowledge exchange between young scientists, engineers and SMEs;
- Show business value for getting continued government / EU funding;
- Investigate different models for partnerships (e.g. Centre of Documentation, Research and Experimentation on Accidental Water Pollution (France) – public-private partnership; Oil and Hazardous Materials Simulated Environmental Test Tank (US) – Privately financed; Blue Bridge project – public-private partnership).

// Need for demo projects //

74 % of the survey respondents stated that it is important to create reference / demonstration projects across the BSR. And 43 % stated that this challenge is not addressed, yet, in the BSR.

ENVIRONMENTAL AND MONITORING TECHNOLOGY: LIST OF REFERENCES

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FINDINGS AND THE WAY FORWARD

COMMONALITIES, CROSS-LINKAGES AND SYNERGIES

Whereas the preceding four chapters clearly show the specific visions and strategic action fields for the four selected thematic areas, there are some noteworthy commonalities which can be detected among them.

Increase effectiveness of actions: Better fit for new purposes

What has transpired throughout all stakeholder dialogues and workshops is the need to foster increased dialogue, cooperation and coordination on Blue Growth industry challenges and investment opportunities between the respective activities of the public sector, research communities and private companies. Even though the Baltic Sea Region is better than others when it comes to transnational cooperation, it still appears that much of this happens within one single community and that increased understanding of each others' needs has to be fostered in order to develop more effective actions while at the same time efficiency would be gained. Often it is also a matter of how to adapt existing structures, systems and approaches as to make them fit for new purposes, which have evolved during the last years due to the blue economy development and which had simply not been taken into account at the time of the creation of the structure in question.

Digitalisation / IT Solutions as a blue economy driver

Similar to other sectors, also the blue economy is remarkably driven by the enormous technological push deriving from new IT / data solutions, which have gained even greater momentum since the publication of the Baltic Blue Growth Agenda two years ago. A common thread throughout all stakeholder workshops was the notion that technology solutions are in most cases already there, but there is still an insufficient understanding of how to make the best use of these solutions – or in other words, that much more could be made of less data and technology – if coordinated properly with a clear and targeted purpose in mind.

Environmental Challenges as a driver for blue innovation

Already noted in the Baltic Blue Growth Agenda, and confirmed in this process is the notion that environmental protection needs are not in contradiction to blue growth promotion, but that the search for finding adequate solutions represents a major innovation and thus economic driver itself.

Overcoming environmental challenges and finding solutions to protect resources are essential elements of a sustainable blue growth agenda as they safeguard the foundation on which this growth is building on. This applies not only to the blue bioeconomy or tourism sector, but also to the shipping sector. Green shipping is not only motivated by political pressure, but is also about creating higher value in port areas, which are among the highest priced property values.

On the other hand sustainable solutions may cost on the short term more than traditional products and services. Throughout all four thematic areas this is perceived also as a barrier for blue growth as it is not always possible to allocate these costs also to the consumer-end prices. At the same time, sustainable blue growth is obviously not only about producing 'luxury' goods for a selected few. In fact all maritime operations have to follow the ecosystem-based approach and thus follow some basic affordability standards.

For and from the Baltic Sea

Another common thread throughout all workshops was the notion that major blue economy gains can also be reaped from exporting blue solutions, products and services, which have worked at the relatively small scale of the Baltic sea-basin, to other countries / regions not only within Europe but world-wide.

In this way, solutions and their financing may not only be viewed from their applicability for markets within the Baltic Sea Region itself, where they function as one system solution, but more for their potential to upscale these 'system solutions' to global markets. Export and general business promotion is, however, so far insufficiently tackled by many of the transnational cooperation projects and should as such also not be dealt with by individual projects – but on a much more strategic upper level.

This does not only apply to technological solutions, but also to the overall regulatory framework. For example, in the shipping sector the International Maritime Organization (IMO) has often been quoted to be the 'right level', where solutions have to be enforced at the very end and in the blue bioeconomy the interpretation of certain EU Directives is often seen as a stepping stone. Nevertheless, it is believed that certain demonstrations can still be applied at the BSR level or even sub-parts of it, before they are arguably up-scaled to larger regions.

Markets & Marketing / Funding & Financing

The right format of funding programmes and financing schemes is obviously of prime importance in order to enable some of the strategic actions to take place in the coming future. It has been noted by numerous stakeholders that it is less a general lack of finance, which is an issue, but more the lack of specific types of finance.

The issue of too much focus on disconnected, short–term project funding has been mentioned already. The value and need of project type funding is obviously accepted, but this is not sufficiently backed by continuous funding for strategic networks, projects and platforms, which bring together the different communities.

Moreover, not enough resources are available for genuine market development efforts as well as market research – be it within or outside the BSR. It has been noted throughout all sector workshops, that there is a lack of understanding on how and whether end-consumers may be ultimately prepared to pay a premium price for higher quality, more sustainable and regional blue economy products. What has been called the new luxury within the tourism workshop, can actually also be translated to all other sectors.

The potentially perceived lack of economic and financial data throughout our *state of play* sections is not so much a result of lack of desk research. It is actually a reflection of the fact that such market intelligence is in many instances simply not existing. Moreover, good marketing campaigns (and the financing of them) are required in order to convey the benefits to be gained from many of the blue economy products. Market, marketing and business development experts or companies as well as retailers are, however, almost completely missing from any kind of projects and initiatives.

TURNING THE STRATEGY INTO ACTION: THE WAY FORWARD

The stakeholder process has identified thematic visions and strategic actions for implementing the Baltic Blue Growth Agenda until 2030. It has also identified relevant stakeholder groups and organisations willing to take ownership and/or leadership in implementing such actions. The actions need to be now translated into concrete projects. This entails answering the following questions:

- Who will take action?
- Who will assume a leading/ coordinating position?
- How will this be financed?
- How will the stakeholders that were not part of this process learn about it?
- How can the BSR governance framework facilitate this?
- What is the time line?

Continuous cooperation coupled with specific targeted actions

The workshops have shown that a meaningful understanding of each other's needs and opportunities takes time. It is an iterative process. The great majority of stakeholders agreed that a dialogue of this kind, if to result in concrete action, needs to be organised as an open-ended but structured process and that funding opportunities should be aligned with it. They should provide strategic partnership building and project pipeline support rather than being exclusively geared towards ad-hoc calls and time-limited projects. At the same time, to demonstrate the added value and achieve visible, short-term results, actions should be prioritised towards "low-hanging fruits" within the wider transformation roadmaps and project pipelines.

This dialogue has also highlighted that where such thematic networks or strategic project development platforms already exist as part of the EUSBSR governance structures (e.g. the Submariner Network in the field of blue bioeconomy or the Baltic Sea Tourism Forum), the focus should not be on duplicating structures but to strengthen the work of the existing platforms by either having them branch out thematically or creating specific sub-groupings, which are

- More industry-demand driven and / or;
- Of a more cross-sectoral nature and / or;
- Focused on a specific region / product.

The Baltic Blue Growth implementation strategy should be fully absorbed and embedded by the EUSBSR, which would require new or expanded umbrella flagship projects/platforms or even overarching horizontal actions/platforms interfacing with the different Policy Areas (PAs) in the Action Plan of the EUSBSR.

From projects ideas to demonstrated blue growth

The process carried out over the last months has been very intense and hopefully inspirational for many stakeholders. Covering four large-scale maritime thematic areas with numerous sub-sectors on a pan-Baltic level, the process has already inspired important new strategic action fields as well as a set of more concrete demonstration projects with a number of solid 'bricks to build on'. However, in order to get to a set of agreed and ready-to-start demonstration projects each of these will need to be more refined and substantiated.

A possible next step would be to provide the different stakeholders / stakeholder groups with the necessary expertise to develop their projects into bankable investment projects.

Secondly, the existing funding programmes, namely INTERREG, should take note of these actions and find ways to support strategic actions coming out of this exercise.

Thirdly, and this may be relevant for the next programming period after 2020, the way the funding is allocated should be reviewed. Real business is understood to be financed by credits or private sector financing, and simply providing grant funding does not seem to have much added value here. They should take note of the real funding and development needs of Blue Growth businesses. This includes, in particular for smaller companies, more readily available technical advice and support services on marketing and market research, risk assessment, investor readiness, etc. Such services / technical assistance facilities could be supported, for instance, through specialised voucher schemes or embedded into investment platforms. Cluster can also play a prominent role here.

// Work towards a BSR Investment Platform //

- Develop an agenda for a Baltic Green / Blue Growth investment platform (e.g. with topics such as bioeconomy and climate change);
- Ensure political leadership (ministers) in the BSR for the investment platform (gate keeping function);
- Align strategies and establish a common BSR-wide operational programme for blue growth thematic areas (building on the results of this report).

Potential actors: BSR national coordinators, ERDF Managing Authorities, Nordic Council of Ministers, relevant BSR PACs, EIB, EIF, Nordic Council of Ministers / PAC Bioeconomy, EIB, transnational networks, EC (DG MARE and other DGs)

Communication and dissemination

This report was developed in a stakeholder driven, bottom-up, fully participative process, therefore increasing the chance of successful project development and implementation, due to ownership among the stakeholders involved. It is suggested to continue this process, drilling deeper and gathering additional input from stakeholders and stimulating the development of new projects, as well as possibly expanding it to other Blue Growth areas during the coming years. It should be also important to provide incentives to stakeholders through, for instance, targeted calls to take the lead in implementing the actions proposed.

As such this report marks the end of a successful stakeholder dialogue and could at the same time be the starting point for a reinforced strategic process on Blue Growth in the BSR.

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