BLUE MISSION BANOS

Supporting the Mission Ocean Lighthouse in the Baltic and North Sea Basins

Deliverable 5.2: KPIs for a carbon-neutral, circular blue economy

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Abstract	This BlueMissionBANOS project deliverable 5.2 presents a comprehensive analysis and validation of key performance indicators (KPIs) considered to be essential for establishing and monitoring a sustainable blue economy in the BANOS (Baltic and North Sea) area. The work builds on the BlueMissionBANOS project deliverable 5.1, and is based on a systematic co-creation approach, which was applied to formulate and validate the 10 most essential KPIs for each Mission relevant sector in the BANOS area. The report also identifies future monitoring needs and qualitative KPIs, along with the criteria for KPI selection to be used in future to set the recommendations on how to formalise the monitoring approach.
Keywords	BlueMissionBANOS, Mission Ocean, sustainable blue economy, key performance indicators, Baltic Sea, North Sea, aquaculture, energy, waterborne transport, ports, multi-use

HISTORY OF CHANGES		
Version	**Publication date**	**Changes**

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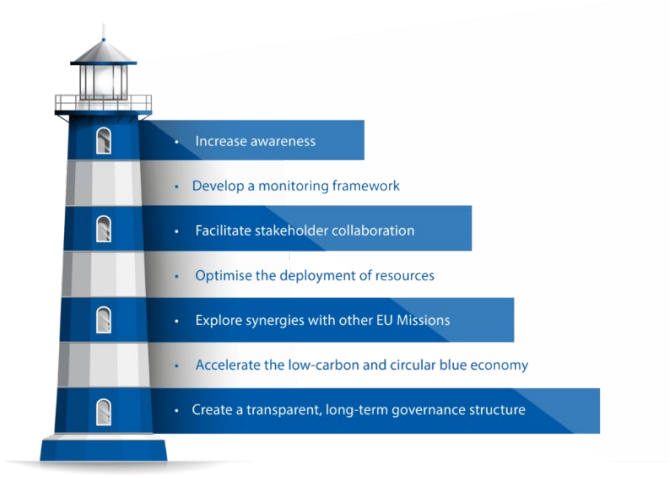
BLUEMISSION BANOS PROJECT

BlueMissionBANOS (BMB), as a Coordination and Support Action (CSA) for the Baltic and North Sea (BANOS) Mission Ocean Lighthouse, inspires, engages, and supports stakeholders across the BANOS region in taking positive action to reach the Mission Ocean objectives. In particular, it facilitates the uptake of a sustainable, carbon-neutral, and circular blue economy by connecting national, regional, and transnational actors from politics, industry, and science, thereby creating a governance model that is conducive to innovation.

While fostering the transition towards the blue economy, BlueMissionBANOS supports the prevention and elimination of water pollution and the protection and restoration of biodiversity and marine and freshwater ecosystems. The project focus is on reducing governance fragmentation, facilitating evidence-based decision-making and fostering citizen engagement across the BANOS area. These supporting actions raise awareness, showcase opportunities, and inspire stakeholders to actively contribute to the transition and the preservation of oceans, seas and waters to 2030 and beyond.

To accelerate the transition towards an innovative and circular blue economy, in line with regions' strategic priorities, as defined by their Smart Specialisation Strategies (S3), BlueMissionBANOS organises several regional pilot demonstration arenas (Mission Arenas) involving innovators, business support and training organisations, local stakeholders and any interested parties to accelerate the uptake of innovative solutions in support of Mission Ocean. Furthermore, BlueMissionBANOS develops a consistent monitoring framework to assess progress in achieving carbon neutrality and circularity.

Finally, BlueMissionBANOS facilitates synergies and matchmaking between actors working towards achieving the Mission Ocean objectives in the BANOS area by providing a catalogue of services, technical expertise and projects that can foster progress, collaboration and knowledge sharing. The BlueMissionBANOS project is funded under the call HORIZON-MISS-2021-OCEAN-04 by the European Union under Grant Agreement ID 101093845 and runs from December 2022 until November 2025.



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ACRONYMS

BANOS	Baltic and North Sea
BESF	Blue Economy Sustainability Framework
BMB	BlueMissionBANOS - Supporting the Mission Ocean Lighthouse in the Baltic and North Sea Basin
CSA	Coordination and Support Action
CSE	Consumer Support Estimate
DCF	Data Collection Framework
EC	European Commission
EU	European Union
FAIR	Findability, Accessibility, Interoperability, and Reusability [of data]
FFS	Fossil Fuel Subsidies
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GES	Good Environmental Status
GHG	Greenhouse Gas
GVA	Gross Value Added
HELCOM	Baltic Marine Environment Protection Commission (Helsinki Commission)
IUCN	International Union for Conservation of Nature
KPI	Key Performance Indicator
MO	Mission Ocean
MS	Member State
MSP	Marine Spatial Planning
MW	Megawatt
MWh	Megawatt hour
NGO	Non-Governmental Organization
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic

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PP	Project Partners
RD	Research, Development
RD&D	Research, Development and Demonstration
RE	Renewable Energy
R&I	Research and Innovation
SBE	Sustainable Blue Economy
UN	United Nations
USD	United States Dollar
WBT	Waterborne Transport
WFD	Water Framework Directive
WP	Work Package
WS	Workshop
ZEWT	Zero-Emission Waterborne Transport

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EXECUTIVE SUMMARY

This BlueMissionBANOS project deliverable 5.2 presents a comprehensive analysis and validation of key performance indicators (KPIs) considered to be essential for establishing and monitoring a sustainable blue economy in the BANOS (Baltic and North Sea) area. It contributes towards providing a robust initial framework for measuring and promoting the EU Mission: Restore our Ocean and Waters sectors, namely aquaculture, energy, waterborne transport, ports, and multi-use activities. The deliverable provides definitions of KPIs, including sector specific definitions and a sustainability framework, enabling detailed exploration of outputs, outcomes, and impacts within the sustainable blue economy.

The report capitalizes on BlueMissionBANOS project deliverable 5.1 ("*Sustainable, Climate Neutral and Circular Blue Economy in the BANOS Area: Current Status and Assessment and Monitoring Approaches"*). It is based on a systematic co-creation approach, which was applied to formulate and validate the 10 most essential KPIs for each sector in the BANOS area. This involved the mapping of existing KPIs through stakeholder consultations and expert workshops. The consultation and interactive workshop processes ensure that the KPIs presented in this report are validated and cross-checked by relevant stakeholders and aligned with available data sources.

All together 50 sector-specific KPIs (10 per sector) were identified. In addition, six general KPIs (applicable to multiple blue economy sectors) are presented. Available online data sources were identified for 18 of the 50 validated KPIs, revealing the need for improvements in data collection, curation, access, and harmonisation in each sector across the BANOS area. These results highlight the importance of ongoing monitoring and adaptation to ensure these indicators remain relevant and effective in promoting the sustainability of these rapidly developing sectors.

The report also identifies future monitoring needs and qualitative KPIs, along with the criteria for KPI selection to be used in future to set the recommendations on how to formalise the monitoring approach. These guidelines and strategies for the implementing of KPIs will ensure they can be effectively integrated into policy and practice to monitor and promote a sustainable ocean economy. Finally, the report provides principles for establishing a baseline for the sustainable blue economy in the BANOS area, serving as a reference point against which progress can be measured.

The work will continue with BlueMissionBANOS task 5.4 that aims to provide recommendations for future monitoring framework in BANOS area and identify potential means how to transfer the monitoring practises to other European sea basins.

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1 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

The EU Blue Economy is expected to deliver growth over the coming years, driven by the transition to a sustainable and circular economy, the ambitious net zero climate targets, and a focus on innovation and research.

As consumers become more conscious of the environmental impact of their choices, there is a growing emphasis on sustainable practices in all Blue Economy sectors (European Commission, 2024). It is therefore essential to establish a baseline for the assessment of the development of the blue economy. However, currently there are significant challenges and gaps to successfully implement this, including limited data availability especially in some blue economy sectors, as well as scattered data, lack of a harmonised approach to data collection, inconsistent monitoring practices, and a lack of coordinated efforts among regional stakeholders (European Commission, 2023). This report contributes to the creation of this baseline and proposes a method, or key performance indicators, to assess the fulfilment of EU Mission "Restore our Ocean and Waters" (Mission Ocean) objectives, particularly in the Baltic and North Sea (BANOS) area.

The aim of this report is to formulate and validate key performance indicators (KPIs) for a sustainable, carbon neutral and circular blue economy, with a focus on establishing a baseline for the sustainable blue economy (SBE) in the BANOS area. The report is based on the results of the BlueMissionBANOS project deliverable 5.1 entitled "*Sustainable, Climate Neutral and Circular Blue Economy in the BANOS Area: Current Status and Assessment and Monitoring Approaches*". These findings are being used to identify best practices, frameworks and methodologies to develop KPIs for a sustainable, carbon-neutral and circular economy.

To ensure an open and transparent process and to include stakeholder perspectives, the draft KPIs and future monitoring needs were discussed with the expert group (described later) and other key stakeholders who contributed to the development of the KPIs for a sustainable blue economy in the BANOS area.

1.2 WHAT ARE KEY PERFORMANCE INDICATORS?

Key Performance Indicators (KPIs) are quantifiable metrics used to define and monitor the progress towards strategic goals, ensuring that decisions are grounded in data. These indicators are crucial for the success of Mission Ocean in achieving its objectives[1]. KPIs for Mission Ocean are specifically chosen based on their relevance to the sustainability of marine resources and their capacity to provide actionable insights into economic activities that depend on the sea. By adopting these KPIs, stakeholders can evaluate the efficiency, effectiveness, and environmental impact of the blue economy, facilitating informed policymaking and strategic development. The selection of pertinent KPIs is critical, as it significantly influences the ability to gauge progress, pinpoint areas in need of improvement, and judiciously distribute resources, thereby underpinning the successful monitoring and enhancement of the blue economy. This report examines a number of key indicators, focusing on sectors that are highlighted in Mission Ocean (objective 3) and the associated targets, including

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waterborne transport, ports and associated facilities, renewable blue energy production, low-trophic aquaculture and multi-use. By analysing these indicators, we aimed to provide support for the analysis on the current state and future potential of the blue economy in the Baltic and North Sea area.

1.3 SECTORS IN FOCUS

Based on the baseline study commissioned by the European Commission (European Commission, 2023), the following sectors have been analysed in the BlueMissionBANOS CSA project with a focus on their carbon neutrality and circularity:

1. **Waterborne transport** includes freight (goods, vehicles, etc.) and passenger movement using both maritime and inland waterways. This includes different types of watercrafts, such as ships, cargo and passenger ferries, cargo and fishing vessels and cruise ships[3-6].

2. **Ports and associated facilities** include the infrastructure necessary for transport operations within the port area. Ports are places purposely built for the loading, unloading, storage, and handling of cargo, as well as the boarding and disembarking of passengers from ships and boats. These locations are crucial hubs in the transportation network, acting as important links between land-based and water-based transport systems. Associated facilities include basic port infrastructure that comprise berths, cargo handling gear, storage spaces, passenger terminals, customs, and security structures, fuelling and maintenance spots, administrative buildings, and more[7-10].

3. **Renewable 'blue' energy production and storage facilities** refer to infrastructure and technology that capture and store renewable energy from marine and aquatic sources, such as the ocean, seas, rivers, and lakes. This approach focuses on utilising kinetic energy, thermal gradients, and other natural phenomena associated with water bodies to generate electricity and other forms of energy. It includes multipurpose platforms, wind farms, wave & tidal, hydropower, power-to-x. Blue energy is a way to produce power while reducing greenhouse gas emissions[11-12].

4. **Low trophic aquaculture** refers to an environmentally sustainable approach to cultivate low-trophic species such as algae, filter-feeding shellfish (e.g., mussels, oysters), herbivorous fish, and invertebrates[13]. Such species do not require extra feed but live and grow from the nutrients in the water, supporting the target of carbon-neutral food production. They are therefore environmentally and climate positive in various ways: they filter and remove nutrients from ambient water and offer an alternative to land-based agriculture. Low trophic aquaculture includes circularity aspects as well as challenges and opportunities to processing in view of achieving an overall positive 'Mission' related impact.

In addition to these 4 sectors, this report explores the Mission relevant concept of **multi-use** in marine spaces, which refers to the combined use of resources in close geographical proximity, either by a single or multiple users. This approach spans a diverse array of combined activities in marine environments, indicating a transition from the traditional model of exclusive resource rights to a more collective approach of resource and space sharing[14]. The activities in question, such as aquaculture,

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renewable energy generation, shipping, and tourism, are combined to enhance both efficiency and sustainability.

1.4 THE UNDERLYING SUSTAINABILITY FRAMEWORK

As the Blue Economy Sustainability Framework (BESF) guides sustainable marine and coastal development, balancing economic activities with maintaining the health of marine ecosystems and emphasising environmental, economic, social and governance factors, it provided a methodological basis for this report.

In this report, sustainability is considered under four dimensions: *economic, environmental, governance,* and *social*, to ensure a comprehensive assessment of its multifaceted impact[15].

- The *economic* dimension focuses on the financial viability and growth prospects of sustainable practices, emphasising long-term profitability and resource efficiency.
- The *environmental* dimension assesses the impact on natural ecosystems, aiming to minimise pollution, conserve resources, and maintain biodiversity.
- *Governance* encompasses the policies, regulations, and ethical standards that guide sustainable initiatives, promoting transparency, accountability, and inclusive decision-making.
- Lastly, the *social* dimension evaluates the impact on communities, including health, well-being, equity, and cultural preservation.

Together, these dimensions (Fig. 1) provide a holistic framework for evaluating sustainability, ensuring that initiatives are not only environmentally sound but also economically viable, ethically governed, and socially beneficial, thereby fostering a balanced approach to sustainable development.

By incorporating the sustainability framework, this work aimed to promote balanced and comprehensive development in line with global sustainability standards, while contributing to the Sustainable Development Goals and the European Green Deal.

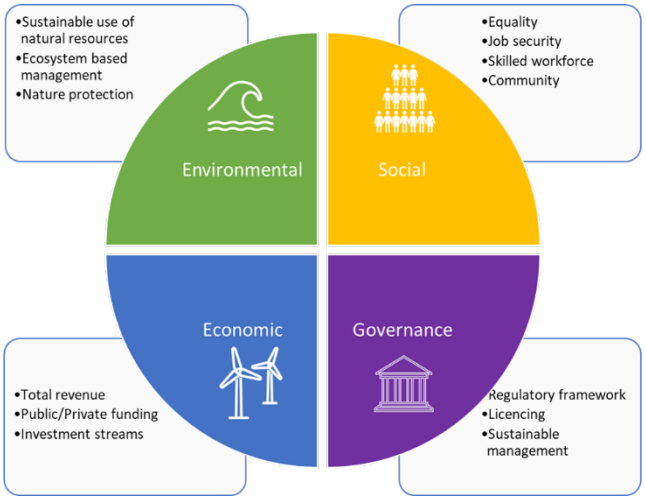

Figure 1. The sustainability framework consists of four dimensions: environmental, social, economic and governance aspects. Examples of how to measure the different dimensions (i.e. KPIs) are listed outside the circle.

1.5 THE TEMPORAL DIMENSION OF KEY PERFORMANCE INDICATORS

The temporal dimension of KPIs for Mission Ocean can be approached by categorising indicators into *outputs, outcomes,* and *impacts*[16]. This categorisation helps in understanding the immediate

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effects, intermediate changes, and long-term contributions of the initiative towards the sustainability of the blue economy:

- *Outputs* are the direct results of activities within the Mission. These are immediate deliverables or services produced by the project,
- *Outcomes* reflect the short to medium-term changes or benefits resulting from the outputs. These indicators show the effect of the project on its direct participants or sectors.
- *Impacts* are the long-term effects of the project, often reflecting broader societal, economic, or environmental changes.

2 METHODOLOGY FOR DEVELOPING KPIS

The methodology for the development of the key performance indicators was conducted in the following six consecutive phases (Figure 2):

1. Desktop study: mapping of existing KPIs – a desktop study
2. An in-person stakeholder workshop
3. 1st online consultations with experts: shortlisting the most appropriate KPIs
4. Final validation and cross-checking with available data sources
5. 2nd online consultation with experts: Identification of future monitoring needs: qualitative and future KPIs
6. Drafting of the final KPIs for sustainable blue economy in BANOS area

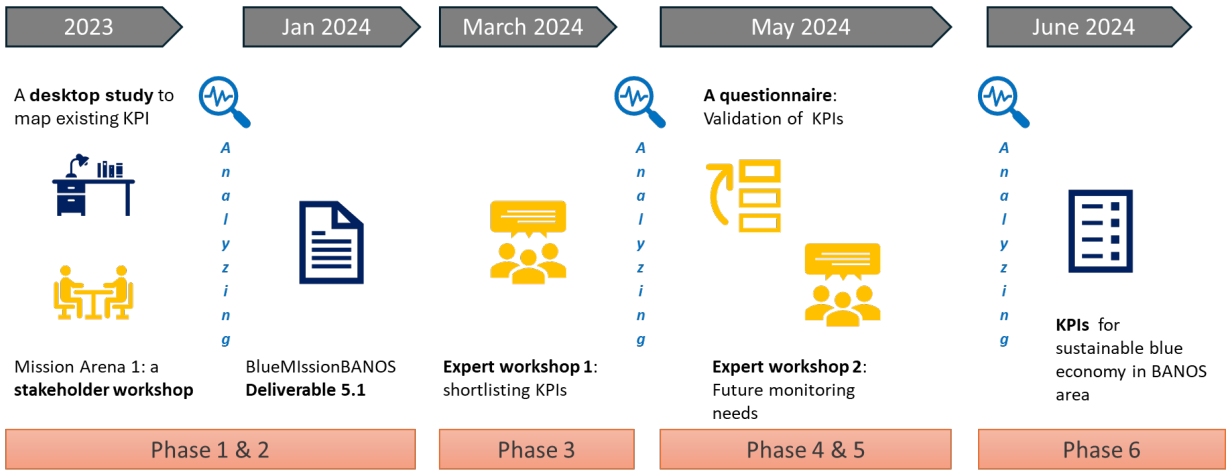

Figure 2 Methodology for development of the KPIs for sustainable blue economy

2.1 MAPPING OF EXISTING KEY PERFORMANCE INDICATORS

An initial KPI desktop mapping exercise was conducted as part of the BlueMissionBANOS deliverable 5.1[17]. The study identified 419 existing Mission Ocean & Freshwaters, objective 3 (blue economy) relevant indicators, which also included new KPIs formulated in stakeholder workshop (section 2.2). The indicators were also categorized by their sectors, KPI pathway and sustainability framework

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category (for a complete list see D5.1 Appendix[18]). The desk-top study formed the bases for the expert workshops (section 2.3), during which potential gaps were identified and existing KPIs were evaluated.

2.2 AN IN-PERSON STAKEHOLDER WORKSHOP

The workshop "Measuring the Future Success of Sustainable Blue Economy in the Baltic and North Sea" (Gothenburg, Sweden in November 2023) was held during the 1st Mission Arena to consult with a wide range of stakeholders, including representatives from policy and government, research, NGOs and industry, from Germany (Western Baltic), Denmark (East), Sweden (West/South) and Norway (South). Over 50 participants attended this workshop to discuss monitoring the sustainable blue economy in the BANOS area. The interactive workshop was divided into two tasks: identifying what each dimension of the sustainability framework (environmental, social, governance, economy) means for each sector and identifying potential new KPIs for measuring these dimensions. The discussion results are detailed in Appendix 3 of D5.1[17] and form the basis for developing new KPIs.

2.3 1ST ONLINE CONSULTATION WITH EXPERTS: SHORTLISTING THE MOST APPROPRIATE KEY PERFORMANCE INDICATORS

An online workshop was organised to identify the best and most suitable KPIs listed in the desktop study D5.1, as well as identify gaps by proposing new KPIs.

Online expert workshop 1. Shortlisting KPIs

The online workshop was organised on Teams on 13 March 2024, making use of Miro (a digital collaboration platform designed to facilitate remote and distributed team communication and project management)[19]. 21 experts participated in the first workshop, representing various Mission Ocean (objective 3) relevant blue economy sectors.

A Miro whiteboard workspace was created for the purpose of the workshop (Figure 2.). The 2.5-hour workshop was divided into three steps, during which participants worked in groups of 3-5 people according to their primary or secondary sector choice. The workshop was followed by step 4 that included the analyses of the workshop results by the BlueMissionBANOS CSA project team.

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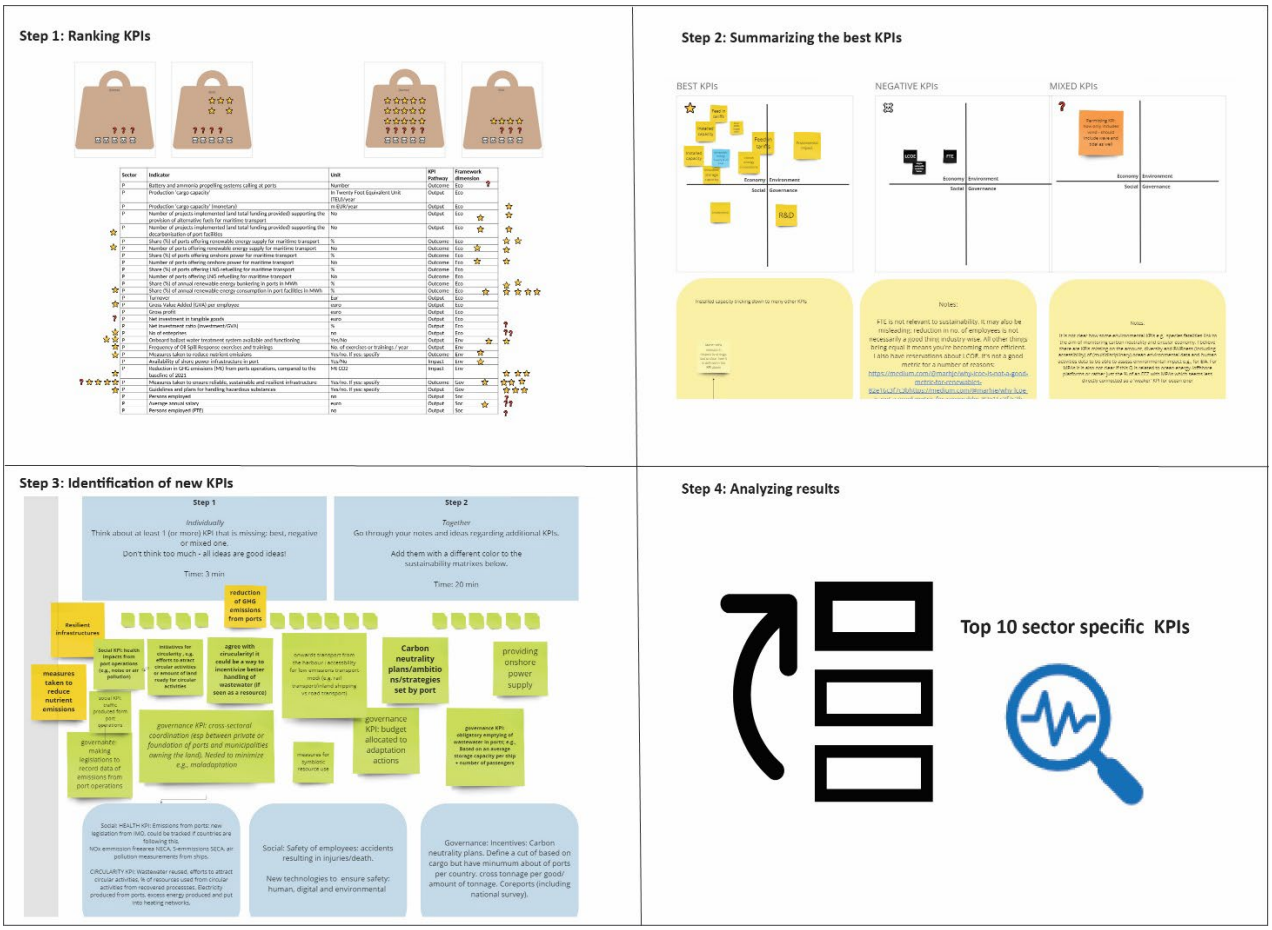

Figure 3. The Miro expert workshop was designed to engage and consult with experts as part of the KPI development process. See text for more details.

Step 1: First, each group member introduced themselves with an informal exercise as an icebreaker. Participants were then given a list of existing KPIs from D5.1 relevant to their sectors and had time to familiarise themselves with them. Afterwards, they were given 15 stars, 5 skulls and 5 question marks to rank the existing sectoral KPIs. Participants could give as many stars as they wanted to KPIs that they found important, skulls to those they found problematic or disliked and question marks to those they were unsure of.

Step 2: The results of step 1 were discussed in a group and a summary of the KPIs was created, indicating which were deemed to be important, problematic and questionable. The placement of the KPIs in the sustainability framework was also discussed and decided.

Step 3 focused on the identification of new KPIs. Participants were first asked to independently list ideas for additional KPIs. This was followed by a joint discussion and the identification of missing KPIs.

Finally, after working in smaller sector-specific groups, experts reconvened to summarise their findings for the whole group. At the end of the workshop, participants were asked to provide feedback on the first workshop using Miro.

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Step 4 after the workshop, the results were compiled and analysed by the BlueMissionBANOS team and the top 10 most highly rated KPIs (based on star-ratings and summary discussions) then progressed to the next validation step (section 2.4).

2.4 FINAL VALIDATION AND CROSS-CHECKING WITH AVAILABLE DATA SOURCES

Sector-specific questionnaires were formulated for final validation purposes with experts (Appendix 1; an example of the blank questionnaire). The questionnaire included two main parts as well as the possibility to indicate relevant data sources and to comment on the choices made:

1. A list of 10 shortlisted KPIs was provided based on the results from the 1st online workshop (section 3.3), and participants were asked to rank them from most to least favourite.

2. An assessment of the readiness level of the KPI based on the KPI selection criteria (for content see section 2.6 of this document) was conducted. For this, the experts were asked to use a scale from 1-5, with 1 indicating that less than half of the selection criteria were fulfilled and 5 indicating that all eight criteria were fulfilled and the KPI was ready for immediate implementation.

In total 14 questionnaires (of 35 sent invitations) were returned by the end of the deadline. Subsequently, the results were cross-checked and analysed internally by the BlueMissionBANOS WP5 team. If the readiness level was ranked 4-5 by the experts and the existing data source had been clearly identified, the KPI was interpreted to be ready for the setting of the baseline and subsequent incorporation into the Wavelinks platform[20] (BlueMissionBANOS milestone 5.2: Baseline for carbon-neutral, circular blue economy due in September 2024).

2.5 2ND ONLINE CONSULTATION WITH EXPERTS: IDENTIFICATION OF FUTURE MONITORING NEEDS: QUALITATIVE AND FUTURE KPIS

The second expert workshop was held online on 8 May 2024, and the Miro platform was utilised using similar features and design as in the first workshop. Eight participants attended the workshop representing various Mission Ocean and Freshwaters (objective 3) stakeholder groups.

The workshop was organised in two parts, with both parts being discussed in randomly selected mixed groups. Each group had a predefined rapporteur from the BlueMissionBANOS CSA project. The two parts of the workshop were themed as follows:

Part 1: Future monitoring needs for the sustainable blue economy in the Baltic and North Sea region

Brainstorm-based discussion that focused on the following questions:

- Where is the sustainable blue economy going and what does the year 2030 look like?

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- What would tell us that the most sustainable blue economy in the Baltic and North Sea region has been reached?
- What is yet to be measured in your field or sector?

At the start, participants were given individual thinking time and an opportunity to write down their ideas on virtual post-it notes. This was followed by group discussions, leading to a joint summary of the results.

Part 2: Refining future monitoring needs and discussing baselines

Participants followed up from the first part with a brainstorm-based discussion based on the outcomes of Part 1. The actual implementation followed the same formula as in Part 1 with individual work followed by group discussion and a joint summary. Predefined questions to guide the work included:

- What is the readiness level of your sector to monitor the success to reach a sustainable blue economy in the BANOS region?
- What is already working?
- What is not yet working?
- What are the features of the baseline for the sustainable blue economy in the BANOS region?

2.6 KEY PERFORMANCE INDICATOR SELECTION CRITERIA

Eight criteria were developed for the KPI formulation and selection (Table. 1)[21]. The criteria were distributed to experts who participated in the online workshops, and they were encouraged to use them when, for example, ranking the KPIs during the 1st Miro workshop (section 2.3) and when filling in the validation questionnaire (section 2.4). In addition, criteria were also consulted by BlueMission-BANOS team as part of the internal evaluation and analyses of the results (Figure 2, phases 3-6). Of the eight criteria, three were considered critical and subsequently essential for setting the baseline for monitoring a sustainable blue economy in the BANOS area.

Table 1. Selection criteria for KPIs. Criteria are ordered based on their importance. The first three, highlighted in blue, are considered critical.

Relevance to sector and sustainability area Sector specificity: The KPI should directly relate to the specific sector it is meant to represent, capturing its unique impact on or contribution to the sustainable blue economy. Sustainability focus: Each KPI must align with the sustainability area it is supposed to measure (economy, environment, governance, social), reflecting key aspects of sustainability relevant to that area.
Data availability Accessibility: Data for the KPI should be readily available or obtainable with a reasonable effort, ensuring that monitoring is feasible over time. Data resolution agrees with the needs.

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Reliability: The data source should be credible and consistent, coming from verified and respected sources (e.g., governmental agencies, recognised research institutions).
Measurability and quantifiability Clear definition: The KPI should have a clear and unambiguous definition, making it straightforward to measure. Quantifiable: It should be possible to quantify the KPI, allowing for objective assessment and comparison over time.
Actionability Influenceability: Stakeholders should be able to influence the KPI through their actions, making it a useful tool for guiding decisions and interventions. Sensitivity to change: The KPI should be sensitive enough to reflect changes over time, allowing stakeholders to track progress or regression.
Comparability Standardisation: The KPI should allow for comparisons over time within the same sector and sustainability area, as well as across different regions or entities when relevant. Benchmarking: It should be possible to set benchmarks or targets for the KPI, facilitating goal setting and performance assessment.
Stakeholder engagement Stakeholder relevance: The KPI should be significant to key stakeholders, including industry players, policymakers, and communities, ensuring their engagement and support. Transparency and communication: It should be easy for stakeholders to understand the KPI and what it represents, facilitating transparent communication and reporting.
Integrability Holistic perspective: The KPI should complement other selected KPIs, together providing a comprehensive view of the progress of sustainable blue economy. Cross-sectoral and cross-area integration: KPIs should be capable of illustrating interactions between sectors and sustainability areas, highlighting synergies or conflicts.
Forward-looking Predictive value: The KPI should not only reflect the current state but also have the potential to indicate future trends or outcomes, aiding in proactive planning and risk management.

3 VALIDATION OF KPIS

Experts were consulted to rank the top10 KPIs (Figure 2). The KPIs were ranked from 1-10 (1=most favourite, 10=least favourite) and in addition the implementation readiness level was evaluated. In the evaluation the experts were encouraged to use the KPI selection criteria (see section 2.6). The readiness level of the implementation of the shortlisted and ranked KPIs was evaluated on scale of 1-5, 1= only 1/2 selection criteria fulfilled, 5 = all 8 criteria fulfilled and KPI ready to be implemented immediately

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In general, the same approach and methodology was used for validation of KPIs for each sector to ensure consistency. However, working in small sector-specific groups (e.g. as part of online expert workshops sections 2.3) resulted in diverse discussions on existing and novel KPIs. At the same time however, group dynamics varied between sectors and their composition were not homogenous in terms of numbers or organisational representation. The aquaculture sector, for example, was very active and went into detailed discussions, while for example, the waterborne transport group was somewhat less confident as several participants had listed this sector as their secondary option and not a primary choice. In addition, the readiness level assessments were limited by the number of questionnaires that were returned by due date.

Participant feedback on the workshops was generally good and results were also seen positively. (mainly in Workshop 1, section 2.3). The follow comment was received on the working methods: "*This is not my favourite tool (Miro)... but it proves effective in situations like this*". Also, some criticisms were received that were addressed during the introduction of the second workshop. These included: "*more focus on the goal of this exercise: Who will use the KPI's in future? The EC to monitor/evaluate the achievement of the Mission objectives? Funders implementing funding measures? This was not clear*.", and: "*Please explain if there are interlinkages to other lighthouse projects. Are they developing own KPI's?*". Also, there was uncertainty about the implementation of the produced work: "*The link between the KPIs and the activities to be implemented in the Mission is often unclear. This is the question of the attribution. To be sure that the progress of KPIs is linked to the actions and activities of the Mission*.", and; "*Consider how to bring in cross-cutting KPIS e.g., data into the monitoring e.g., ocean environmental, socio-economic and other data are important to assess the carbon neutrality of the operations, impact (even supply chain)*."

Results for each sector are presented below in section 3.1-3.5. In addition, in section 3.6 general KPIs that rose from the sector specific discussions, and which are applicable to multiple blue economy sectors are listed.

3.1 AQUACULTURE

Of the KPI selection criteria, the experts stressed the importance of measurability and quantifiability, including clear definitions, in their choices. Discussions focused, for example,on low-trophic aquaculture vs. zero carbon sustainable aquaculture and whether finfish farming that utilises zero-carbon feed should be included. Also, questions were raised regarding the sustainability of low-trophic aquaculture, e.g. because of the potential impact on food webs, and comments were made regarding the importance of choosing the site for any new activity wisely in respect to impact on ecosystems/biodiversity as well as on e.g. the impact of harvesting technology.

The top KPIs were generally representing an economic framework of sustainability, with KPI #1 focusing on measuring production of low-carbon aquaculture foods. However, as aquaculture products are used much beyond food production this KPI could be potentially expanded to include all products derived from low-carbon aquaculture. Alternatively, the total amount of products on the market / amount on the market produced from biomass cultivated in the BANOS area could be considered as an additional KPI. In addition, the profitability KPI (#7) was seen as important, as up to 80% of aquaculture businesses are small, which makes the business landscape and practices very heterogeneous, and means that the profit margins are typically very small. For example, extra costs can

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easily cause these businesses to become unprofitable. Clarity around the definition of phosphorus uptake (KPI #9) of low-trophic aquaculture was also seen as important, leading to relatively low readiness level for the KPI. How to consistently, for example, measure and evaluate P uptake into the biomass of farmed mussels and collect valid data for this practise is currently missing. Furthermore, it was noted that financial compensation for ecosystem services is not yet implemented anywhere, thus the readiness level of this KPI was evaluated lowest.

Table 2. Ranking of potential aquaculture KPIs. The proposed unit for measurement of each KPI is in brackets.

KPI #	Description	Evaluated readiness level	Framework	Stage	Data available
1	Volume of foods from zero carbon sustainable aquaculture (tonnes)	4	ECO	IMPACT	N
2	Production of "*harvested marine plants and algae*" (m EUR/year or Landings weight in tonnes/year)	5	ECO	OUTPUT	N
3	Market price/volume of low-trophic aquaculture products (€/tonnes)	5	ECO	OUTCOME	N
4	Ecosystem-based aquaculture sites (nr)	2	ENV	OUTCOME	N
5	Financial compensation for positive contribution to ecosystem services (euros)	1	GOV	OUTCOME	N
6*	People employed in aquaculture sector (nr)	5	SOC	OUTPUT	Y[1] (23)
7	Profitability (and amount of new investments) (€/nr)	3	ECO	OUTPUT	Y[1] (27)
8	Origin and type of feed used (traceability) (unit to be defined)	4	ENV	OUTPUT	N
9	Phosphorus uptake value (concentration (µmol/L)	3	ENV	OUTCOME	N
10	On-farm documentation available with detailed information on chemical use (Y/N)	3	ENV	OUTPUT	N

**Can be generalised and made valid for all sectors. See section 3.7.*

[1]See data sources from table 8, number in brackets indicates the data source.

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3.2 ENERGY

Several KPIs from the economic framework were recognised by experts. Especially the amount of installed RE capacity was seen to be trickling down to many KPIs. The validity of full-time employment in the energy sector was also discussed, because it was not necessarily seen as relevant to sustainability, i.e., reduction in number of employees could also mean more efficient operations (shift from societal sustainability to economic sustainability). Experts also pointed out that KPI listing was missing on the KPI(s) on the amount and diversity of (multidisciplinary) ocean environmental data and human activities data meeting the findability, accessibility, interoperability, and reusability (FAIR) principles to be able to assess environmental impact of renewable energy. This was seen to apply to other sectors as well. Experts expressed reservations towards LCOE (Levelized Cost Of Electricity) as a metric for sustainability of energy operations, and raised questions as to how e.g., species fatalities are linked to carbon neutrality and the circular economy.

Table 3. Ranking of potential energy KPIs. The proposed unit for measurement of each KPI is in brackets.

KPI #	Description	Evaluated readiness level	Framework	Stage	Data available
1	Installed offshore renewable energy capacity (wind, wave, tidal) (MW)	5	ECO	OUTCOME	Y[1] (24)
2	Renewable energy (RE) supply, % of total energy supply (%)	5	ECO	OUTPUT	Y[1] (27)
3	Share of growth in RE capacity in lighthouse area against baseline of 2021 (%)	5	ECO	IMPACT	Y[1] (24,14)
4	Share of innovative renewable energy (%)	3	ECO	OUTPUT	N
5	Share of CO_2 reduced in the lighthouse area using RE (%)	2	ENV	IMPACT	N
6	RE public RD&D budget, % total energy public RD&D (%)	4	ECO	OUTPUT	Y[1] (23)
7	Increase in technology readiness level (nr)	3	ECO	OUTCOME	N
8*	Persons employed full time (nr)	2	SOC	OUTPUT	Y[1] (23,27)
9	Total gross electricity generation/% of European supply chain (%)	3	ECO	IMPACT	N

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10	Positive social perception of off-shore renewables (unit to be de-fined)	2	SOC	OUTCOME	N

** Can be generalised and made valid for all sectors. See section 3.7.*
[1]See data sources from table 8, number in brackets indicates the data source.

Clear definitions and readily available data were seen critical for reaching high readiness level in energy sector KPIs. As such, the economic KPIs with well-defined units that reflect on installed capacity and renewable energy supply received high readiness levels. In contrast low readiness (2-3) level was reflected with no available data and or arbitrary units. The only exception seems to be KPI #8 Persons employed full time. Here the low readiness level may reflect on some experts' opinion on the usefulness of the indicator rather than its possibility to track progress.

3.3 WATERBORNE TRANSPORT

Measuring emissions reduction was seen as the most important KPI by the experts to track progress of the waterborne transport sector towards sustainability. Pollution reduction, such as regarding ballast water and the development of regulations and standards were mentioned as important besides aiming for e.g. reduction of fuel usage. Also reducing the occurrence of accidents and commitment to IMO objectives was mentioned. Discussions also covered safety and security, data sharing and incentives for industry, as well as inland transport and the importance of coveringthe entire life cycle of a vessel. The workshop results indicated that many of the draft KPIs (derived from D5.1) were relevant. However, discussions focused on potential problems with how to clearly measure these. Hence measurability and quantifiability were seen as critical criteria for the development of robust KPIs for the sector. In addition, comparability was seen as an important criteria and discussions focused on, for example, at what stage the progress should be compared, i.e., the definition of the baseline for these measurements was debated. In addition, the questionnaire results further implied that several of the suggested KPIs may not be concrete enough to be implemented directly, hence further clarification and clear definitions may be required to push the readiness level of the KPIs to a higher level.

Table 4. Ranking of potential waterborne transport KPIs. The proposed unit for measurement of each KPI is in brackets.

KPI #	Description	Evaluated readiness level	Framework	Stage	Data available
1	Maritime Transport CO_2 Emissions (experimental) (Mt CO_2eq)	4	ENV	IMPACT	Y[1] (23)
2	Number of directly deployable solutions developed using climate neutral, sustainable alternative fuels applicable to ships	4	ECO	OUTCOME	Y[1] (4)

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	with high energy demand, e.g., long distance shipping (nr)				
3	Number of green corridors and other initiatives (nr)	3	ECO	OUTCOME	Y[1] (18)
4	Data sharing: nr of companies already sharing data on GHG emissions (nr)	5	ENV	OUTPUT	N
5	Number of MSs and Horizon Europe associated states who have adapted R&I programs to increase synergies with ZEWT (nr)	5	GOV	OUTCOME	Y[1] (4,26)
*6	National funding RD schemes, moving towards MO goals (nr)	4	GOV	OUTPUT	Y[2]
7	Sustainable leisure boating, % increase in vessels (%)	2	SOC	OUTCOME	N
8*	Number of people employed in WBT have increased compared to baseline (%)	3	SOC	OUTCOME	Y[1] (27)
9*	Safety and security - frequency of accidents (nr)	3	SOC	OUTPUT	Y[1] (25)
10*	Mission Ocean pledges/charter (nr)	3	GOV	OUTPUT	Y[1](13)

** Can be generalised and made valid for all sectors. See section 3.7.*

[1]See data sources from table 8, number in brackets indicates the data source.

[2]National funding statistics and other data sources are available in several countries, see also section 5.

3.4 PORTS

Measuring of reduction of GHGs in ports' activities was seen as an important KPI to experts, and workshop discussions focused on how it could be best measured and what operations from ports should be included here. In the end the KPI #1 *Number of ports offering renewable energy supply for maritime transport* was seen the most important KPI, being an incentive that supports the decarbonisation of ports, followed by KPI #2 reduction of GHG emission in general. Both these highly ranked KPIs, however, appear to be lacking freely available data sources. Data for KPI #1 could possibly be retrieved by desktop studies or contacting ports directly and collecting information manually.

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Other topics raised by the experts were nutrient loading (environmental framework), health and safety aspects of operations (societal framework) and circularity. Measuring actual nutrient concentrations was not seen useful because of the uncertainty of the origin of nutrients. Instead, incentives that support nutrient reductions, such as taking waste free of charge from ships or giving price reductions to companies utilising port infrastructure to empty waste, were seen as more appropriate and useful. A new KPI #9 was derived from expert workshop discussions to measure the health and safety of workforce. A circularity KPI was also discussed, and suggestions were made, for example, related to the reuse of wastewater or efforts to attract circular activities to ports in general. Excess energy/electricity produced from ports was also mentioned, for example whether it could be used in district heating networks. Circularity KPIs, however, did not make it to the top 10 (table 10) due to difficulties in meeting the KPI evaluation criteria (including all three critical criteria). Also for this sector, hazardous substances, ballast water and oil spill responses were mentioned, as well as the resilience of infrastructure and the ability of new technologies to ensure safety.

Table 5. Ranking of potential port KPIs. The proposed unit for measurement of each KPI is in brackets.

KPI #	Description	Evaluated readiness level	Framework	Stage	Data available
1	Number of ports offering renewable energy supply for maritime transport (nr)	4	ECO	OUTCOME	N
2	Reduction in GHG emissions (Mt) from port operations, compared to the baseline of 2021 (Mt)	3	ENV	IMPACT	N
3	Number of ports offering onshore power for maritime transport (nr)	4	ECO	OUTCOME	N
4	Ports with a carbon neutrality strategy (% or number of ports)	4	ENV	OUTPUT	N
5	Number of projects implemented (and total funding provided) supporting the decarbonisation of port facilities (nr)	4	ECO	OUTPUT	N
6	Measures taken to ensure reliable, sustainable and resilient infrastructure in ports (unit to be defined?)	3	GOV	OUTCOME	N
7	Share of annual renewable energy consumption in port facilities in MWh (%)	4	ECO	OUTPUT	N

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8	Measures and incentives by ports taken to reduce nutrient emissions (nr)	3	ENV	OUTCOME	N
9*	Safety of employees: accidents resulting in injuries/death (nr)	4	SOC	OUTPUT	N
10*	Gross Value Added (GVA) per employee (€)	3	ECO	OUTPUT	Y[1(27)]

** Can be generalised and made valid for all sectors. Valid for all sectors. See section 3.7.*

[1]See data sources from table 8, number in brackets indicates the data source.

3.5 MULTI-USE

Experts noted that economic KPIs for multi-use give a good overview and are useful when it comes to the BANOS lighthouse theme, however, they were often deemed too general. Good environmental status was seen as an overarching goal for multi-use operations, so it should be included in the KPIs through proper environmental impact assessment for the respective geographic location. Howeverut it was stated that in order to improve implementation of multi-use, economic factors should also be considered, and silos should be avoided, as these may reduce chances to reach GES. Experts recommended that KPIs should be focused on Mission objectives, both localised but also connecting to different lighthouse themes. It was also highlighted that KPIs should reflect the local situation and it could be an additional criterion included in the evaluation of suitable KPI alongside data availability. Experts also noted that KPIs should be streamlined with OSPAR and HELCOM objectives, as well as with global efforts.

Table 6. Ranking of potential multi-use KPIs. The proposed unit for measurement of each KPI is in brackets.

KPI #	Description	Evaluated readiness level	Framework	Stage	Data available
1	Sea-space saved from multi-use vs. single use (km^2 or %)	5	ENV	IMPACT	N[2]
2	Total carbon sequestration capacity of multi-use spaces or multi-purpose platforms (kt CO2 eq/year)	3	ENV	OUTCOME	N
3	Biodiversity: no net loss of biodiversity/ ecosystems (unit to be defined)	2	ENV	OUTCOME	N
4	Inclusion of multi-use/maritime park concept into national maritime spatial plans (yes/no)	5	GOV	OUTCOME	Y

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5	Contribution to GES achievement as a criterion for tenders / inclusion of incentives for GES improving actions (nr?)	3	GOV	OUTCOME	N
6*	Data sources meeting FAIR criteria with clearly defined ownership and responsibility (%)	3	GOV	OUTCOME	N
7	Reduction of permitting process time (days)	3	GOV	OUTCOME	N
8	Creation of a sustainable blue economy governmental structure (unit to be defined)	2	GOV	OUTCOME	N
9	Number of operational platforms that combine at least two uses of water space (multipurpose or multi-use) that are aligned with the objectives of the sustainable Blue Economy	3	GOV	OUTCOME	N
10*	Types of jobs created (nr)	5	SOC	OUTCOME	N

** Can be generalised and made valid for all sectors.Valid for all sectors. See section 3.7.*

[1]See data sources from table 8, number in brackets indicates the data source.

[2]Once multi-use incorporated into national MSP plans, data can be deducted from these (data for some countries thus potentially already available if multi-use concept included).

3.6 SUMMARY OF THE SECTOR SPECIFIC KEY PERFORMANCE INDICATORS

The shortlisted KPIs were divided into sustainability framework dimensions accordingly: 19 KPIs were in economic, 13 environmental, 11 governance and 7 in the social dimension. Most of the KPIs were categorised into direct outputs (17) and short-term outcomes (15), while only 7 were regarded as providing longer term effects(impact).

The estimated readiness levels of the KPIs through all sectors were around 3 (in the scale of 1-5, see above) (Figure 3). Energy sector and multi-use KPIs were thought to be least ready to be implemented (estimated readiness on average 3,4), and ports and waterborne transport sector KPIs were evaluated as most ready (3,6 on average). Interestingly, data availability for KPIs in the waterborne transport sector is highest (8 recognised data sources) and is lowest for the ports and the multi-use sector (1 data source).

Generally, the average readiness level is limited by available data as well as clear definitions of the indicators, or rather the concept behind the indicators. In some cases, data may be available, however, it is still not open and directly accessible from a database where it could be automatically

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downloaded in an easy fashion. Or it may be openly available, however, would still need to be evaluated by a person. An example of an open data source is maritime spatial plans. However, to derive data for KPI #1 or #4 for multi-use (table 6) it would require a desktop approach. In contrast, for the energy sector, data on offshore power production, for example, is available through multiple online data sources (Table 8).

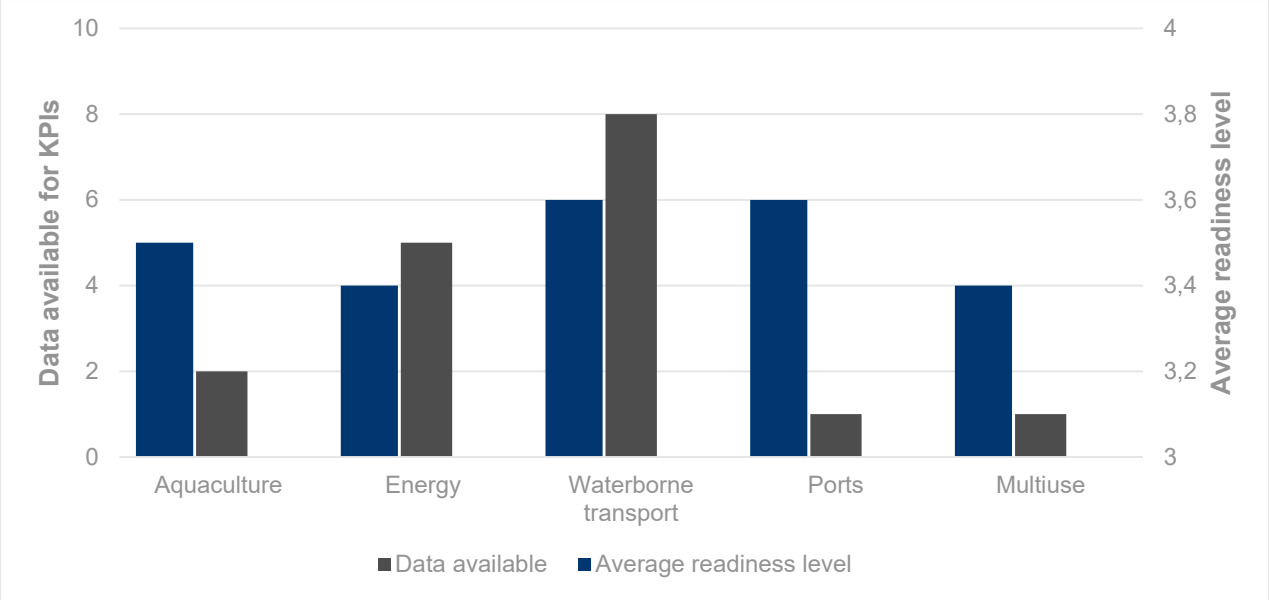

Figure 4. Average estimated readiness level (scale 1-5) and data availability (out of the 10 selected KPIs) for each sector as estimated by the experts.

3.7 VALID FOR MULTIPLE OR ALL SECTORS

During the evaluation of the sector-specific KPIs, several KPIs were seen to crosscut the sectoral boundaries. These are summarised into 6 KPIs (Table 7). As these were not further evaluated by the experts, the KPIs are not ranked in any specific order. Many other general KPIs were also identified in the Phase 1 desk-top study that resulted in D5.1[18] (Figure 2).

Table 7. KPIs that were ranked by experts to be important, and which could be generalised to be valid for multiple Mission Ocean (objective 3) relevant blue economy sectors.

KPI Description	Frame-work	Stage	Data availa-ble
People employed in the sector (FTE, increase from the baseline) (nr)	SOC	OUTPUT	$Y^{1\ (23,27)}$
Safety and security in the sector, e.g., accidents and incidents at sea (unit to be defined)	SOC	OUTPUT	$Y^{1\ (25)}$
Mission Ocean pledges/charters (relevant for Objective 3) (nr)	GOV	OUTPUT	$Y^{1\ (13)}$

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Gross Value Added per employee (€)	ECO	OUTPUT	Y[1] (27)
Amount of RD&D funding for each sector enhancing the transition to blue economy (€)	ECO	OUTPUT	Y[2]
The amount and diversity of (multidisciplinary) ocean environmental data and human activities data meeting the FAIR principles (nr)	ENV	OUTPUT	N

[1]*See data sources from table 8, number in brackets indicates the data source.*

4 OVERARCHING AND FORWARD-LOOKING KPIS

To identify overarching themes in future monitoring needs, input from experts in thematic workshops was collected (Figure 2). The suggestions highlight several key themes which should be considered when planning and establishing future monitoring, as outlined below.

Harmonising data across the region, ensuring that monitoring practices focus on commonalities and integrate inputs and outputs beyond national boundaries to foster a balanced regional approach. This harmonisation is essential to enable a comprehensive understanding of the entire BANOS area. Clear targeting in monitoring activities is also crucial to ensure that the outcomes are meaningful and that the derived impacts are substantial and actionable.

Some of the suggested future monitoring needs covered topics like "*Blue carbon ecosystems (effectiveness, impacts, co-benefits)*", "*Surveillance and monitoring of EEZ through UV's*", "*New marine infrastructure at a regional level (beyond national MSP)*" and "*Cumulative effects of multi-use interventions*". These all highlight the necessity to extend monitoring practices beyond national borders, if the focus should be on the entire BANOS area. It follows that a suitable authority or organisation should be appointed to collect and share information on such regional data. If such an actor cannot be identified, data harmonisation and open sharing can answer at least partly to that need.

Potential KPIs: Percentage of harmonised data sets across member states; Number of regional data-sharing agreements established;

Monitoring inputs and outputs on a regional scale should be combined with assessing cumulative impacts of various activities across national boundaries to maintain ecological balance and sustainability. A regional monitoring framework should align with existing national programmes, ensuring comprehensive coverage of the BANOS area. Integrated impact assessments must consider the cumulative effects of activities from multiple sectors, such as fishing, shipping, tourism, and energy production at an appropriate geographical scale. Promoting transboundary data collaboration will enhance regional understanding and cooperation. Ensuring balanced resource allocation for monitoring activities will reduce disparities among member states. Engaging diverse stakeholders in planning and implementation is essential. Scenario analysis can predict potential future outcomes, helping inform regional planning and policy decisions. In monitoring, cross-disciplinarity was emphasised several times in the workshop discussion. Monitoring activities should not operate in a vacuum, where only one sector or national area is observed at a time. On the other hand, monitoring should

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be able to cover activities' negative and positive effects, and the target of monitoring should be simplistic enough.

Potential KPIs: Proportion of monitoring programmes that integrate inputs and outputs beyond national boundaries; Proportion of monitoring programmes that integrate inputs and outputs beyond sectors; Frequency (or number?) of transboundary data collaboration initiatives.

Clear targeting to ensure meaningful outcomes should involve defining specific, measurable, and achievable goals for monitoring programmes, ensuring that collected data lead to actionable insights and impactful outcomes. Goals should align with broader regional sustainability objectives such as biodiversity conservation and pollution reduction. Developing impact indicators to measure progress is essential. Establishing baseline data for all indicators will enable accurate tracking of changes. The baseline could be chosen in many ways, but if the impact of Mission Ocean is to be assessed, one potential baseline point could be the starting year of the Mission, as was suggested in the expert workshop. When setting the impact indicators, it should be noted that great variation between separate sectors' readiness level was estimated, as well as between actors, such as companies of differing sizes within a certain sector. These differences in the starting point that sets the baseline should be made visible in a meaningful way. Implementing adaptive management practices allows for adjustments based on emerging data. Regular reporting to stakeholders will provide transparent updates on progress. Periodic performance reviews will assess effectiveness and identify improvement opportunities. Ensuring that monitoring data inform policy and management decisions will facilitate evidence-based approaches to regional sustainability challenges.

Potential KPIs: Number of monitoring initiatives with clearly defined impact assessment metrics; Percentage of monitoring programs that achieve their predefined impact targets.

Consideration of the societal impacts of marine activities, particularly the value of coastal landscapes in attracting new inhabitants, the benefits of quieter electric cruise ships, and the health benefits provided by green and blue spaces, such as parks, forested areas or local waterbodies. These considerations are vital in counteracting the industrialisation of marine spaces by designating certain areas as permanently off-limits. Furthermore, monitoring should include ecosystem restoration efforts, addressing the degradation of marine ecosystems by e.g., promoting kelp forests and reducing algal blooms. This requires capabilities to quantify both negative and positive impacts, aiming for net positive outcomes. Human interventions, such as the creation of artificial islands or oyster reefs, might be necessary to achieve Good Environmental Status (GES), underscoring the societal need for ecosystem restoration.

In addition to reducing the societal impacts of marine activities, efficient use of marine space beyond the national perspective should be considered. Sharing the use of resources, for example sharing areas suitable for renewable energy, or sharing RE connections between any two countries could be seen as lessened societal impact on a regional scale.

Potential KPIs: Number of electric cruise (or leisure?) ships operating in the region; Number of urban development projects incorporating green and blue spaces; Renewable energy connections / capacity shared between any two countries.

Application of nature-based solutions and ocean models must be methodical and logical for achieving meaningful outcomes. However, there is a lack of consensus on the actions and targets

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required, which hampers progress. In terms of societal impacts, there is a clear need for jointly developed frameworks by various stakeholders to maximise impact, reflecting the absence of common goals and coordinated efforts. Overall, while some monitoring practices can be readily implemented through existing structures, significant gaps and variances in readiness levels highlight the need for further development and harmonisation across the region, as it is already achieved under the EU Data Collection Framework (DCF). While coordination of national monitoring may exist or can be created for selected indicators, regional or international coordination may be based on voluntarily reporting or lack coordination completely, leaving gaps in the big picture. Data harmonisation and cross border data sharing could partly answer this need. In the planning of the use of ocean space, also the importance of protected areas and ecosystem restauration was underlined.

Potential KPIs: Percentage of monitoring initiatives incorporating nature-based solutions; Integration rate of ocean models in regional planning and policy documents (or policies?); Number of pilot projects demonstrating successful application of nature-based solutions; Number of regional nature-based solutions.

5 TOWARDS IMPLEMENTATION OF KPIS

5.1 DATA SOURCES

A data source or sources were identified for the original KPIs listed in deliverable 5.1. During the expert consultation, other potential data sources were also suggested. These are listed in table 8. Many of the data sources offer data on specific sector, such as aquaculture or renewable energy, as well as data from different dimensions of the sustainability framework, for example from the economic or environmental dimension. More data sources are likely available, collected, for example, by national statistics authorities, transport agencies, funders (scientific and/or business) or international sector-specific associations, even private companies, and the EU Data Collection Framework (DCF). Harmonisation of data across the BANOS area and open access, however, are also limiting factors currently as pointed out in section 4 of this report. Collaborative frameworks or agreements could enhance the effectiveness of data collection and future KPI monitoring in future.

Table 8. Identified potential data sources. Link provided when available.

#	Data source	Description
1	AAC	EU Aquaculture Assistance mechanism's knowledge base
2	AIS maps	Automatic information system map data
3	BlueInvest	https://blueinvest-community.converve.io/
4	CORDIS	EU research and innovation projects results
5	DG MARE	The Directorate-General for Maritime Affairs and Fisheries

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6	EABA	European Algae Biomass Association
7	EEA	Environmental data hub
8	EIB	The European Investment Bank
9	EMODnet	European Marine Observation and Data Network
10	EMPA	European Molluscs' Producers Association
11	EU STECF	Scientific, Technical and Economic Committee for Fisheries
12	EUMOFA	The European Market Observatory for Fisheries and Aquaculture products, a market intelligence tool
13	EU MISSION OCEAN	EU Mission "Restore our Ocean and Waters
14	Eurostat	statistics for Renewable energy, Fisheries, Aquaculture, Transport, the European Green Deal
15	FEAP	Federation of European Aquaculture Producers
16	FEFAC	The European Feed Manufacturers' Federation
17	GMF	The Global Maritime Forum
18	HELCOM	Baltic Sea data and maps
19	INEA (CINEA)	The Innovation and Networks Executive Agency, now The European Climate, Environment and Infrastructure Executive Agency
20	MAC	Market Advisory Council
21	MRV-Thetis	European Maritime Safety Agency's information system
22	OBP	Permanent document and object repository
23	OECD statistics	data and metadata from OECD countries
24	OEE reports	Ocean Energy Europe's annual report on Ocean Energy Key Trends and Statistics
25	National statistics: Statistics Sweden	Example of national statistic (Swedish statistics authority). Similar available for other countries across BANOS area.
26	Sustainable Blue Economy Partnership secretariat	

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27	The EU Blue Economy Observatory	The EU Blue Economy Observatory
28	WindEurope	WindEurope statistics/reports
29	WSP	WSP reports

5.2 DATA COLLECTION AND VISUALISATION OF KPIS

Data collection and KPI visualisation into an integrated web platform is seen as desirable, similar, for example, to the dashboard of EU Blue Economy Indicators.

KPI visualisation and data integration may be possible to include in the WaveLinks.eu website that is currently being developed in the Blue Mission BANOS project, in close collaboration with BlueMissionAA and the PREP4BLUE projects (Figure 5). Wavelinks offers a user-friendly and intuitive web platform to access and search for relevant data and information in the context of the Mission Ocean. Users of Wavelinks can easily explore and filter relevant projects, stakeholders, citizen science initiatives, and engagement methods linked to the Mission Ocean objectives. Wavelinks currently gathers 5900 projects and more than 13000 stakeholders covering the three objectives of the Mission Ocean:

I. Protect and restore marine and freshwater ecosystems and biodiversity, in line with the EU Biodiversity Strategy 2030.
II. Prevent and eliminate pollution of our ocean, seas and waters, in line with the EU Action Plan Towards Zero Pollution for Air, Water and Soil.
III. Make the the sustainable blue economy carbon-neutral and circular, in line with the proposed European Climate Law and the holistic vision enshrined in the Sustainable Blue Economy Strategy.

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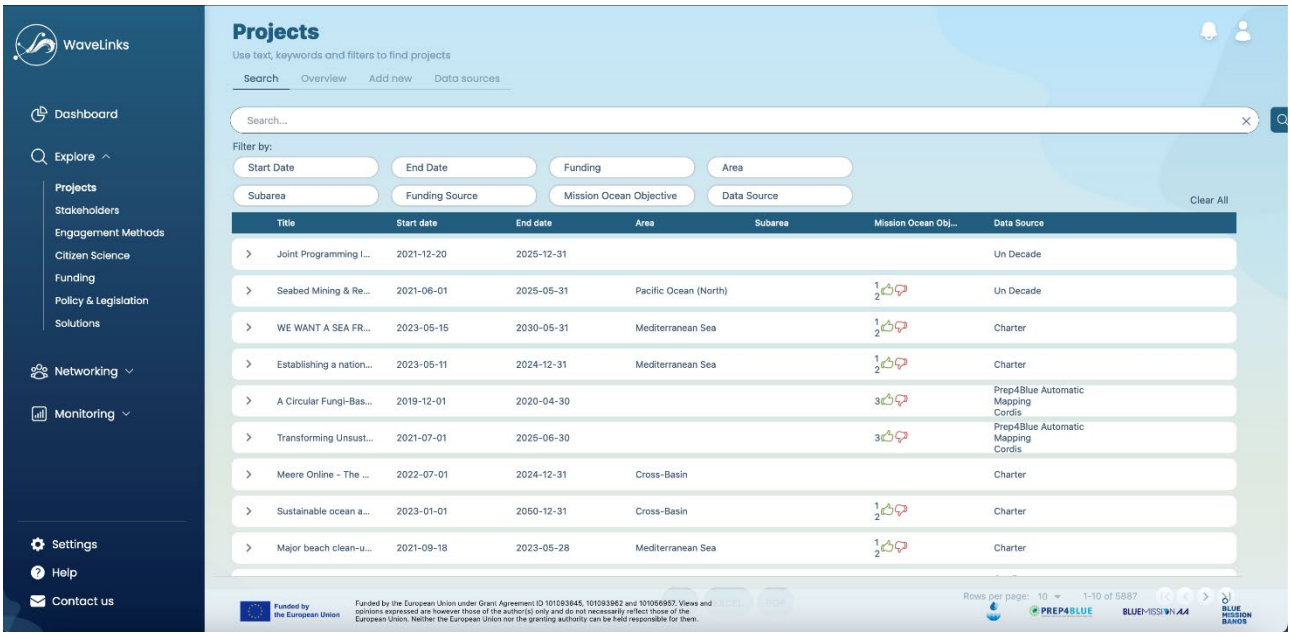

Figure 5 Wavelinks dashboard displaying Mission Ocean projects. Wavelinks could be developed further to contain data collection and visualization of sustainable blue economy KPIs.

To present the KPIs described in this document, Wavelinks can be expanded in its capabilities with the introduction of a dedicated monitoring platform (developed further in BlueMissionBANOS tasks: T5.3 *Systematic approach to data collection including requirements of the MIP* and T5.4 *Recommendations for future monitoring framework and transfer of monitoring practises to other sea basins*) aimed at tracking the development of Mission Ocean Objective 3 targets in the Baltic and North Sea lighthouse area. This new module can provide comprehensive tools and technologies for data collection and ensure robust tracking and visualisation of key performance indicators (KPIs) selected from the Tables 2-7. The monitoring platform of Wavelinks can leverage a robust and scalable technology stack, including Django, PostgreSQL, and Next.js, to manage large volumes of data and traffic efficiently. Data sources for the monitoring platform could thus include contributions from various open-source platforms, such as, the Mission Ocean Charter, UN Decade of the Ocean, Cordis, EC Portfolio and Blue BIO COFUND to name a few. The data sources mentioned above will be reviewed to evaluate if and how their data can be automatically integrated into Wavelinks. The development of the monitoring platform in Wavelinks would be done in close collaboration with all Mission Ocean CSAs but also in collaboration with the Mission Implementation Platform, and will require consideration of future monitoring needs, including technological and methodological advancements, as well as addressing current limitations in data gathering practices

6 ESTABLISHING A BASELINE FOR A SUSTAINABLE BLUE ECONOMY IN THE BANOS AREA

Baseline formulation for monitoring the sustainable blue economy in the Baltic and North Sea area is crucial for establishing a reference point from which progress can be measured. This process involves integrating a diverse range of indicators to capture the multifaceted nature of marine and

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coastal environments (Fig. 4). Establishing clear and measurable goals, as set in the Mission Objective 3 and its targets, is vital for tracking advancements toward regional sustainability objectives. The baseline formulation follows the consolidation of the KPIs, which was carried out in the expert group workshops as described in section 2. Utilising existing data ensures that the baseline is grounded in empirical evidence and maintains consistency with ongoing monitoring efforts. Moreover, assessing the readiness and feasibility of technologies ensures that the baseline is both realistic and achievable. These principles collectively allow effective monitoring and evaluation of interventions aimed at promoting sustainability in the blue economy in the BANOS region.

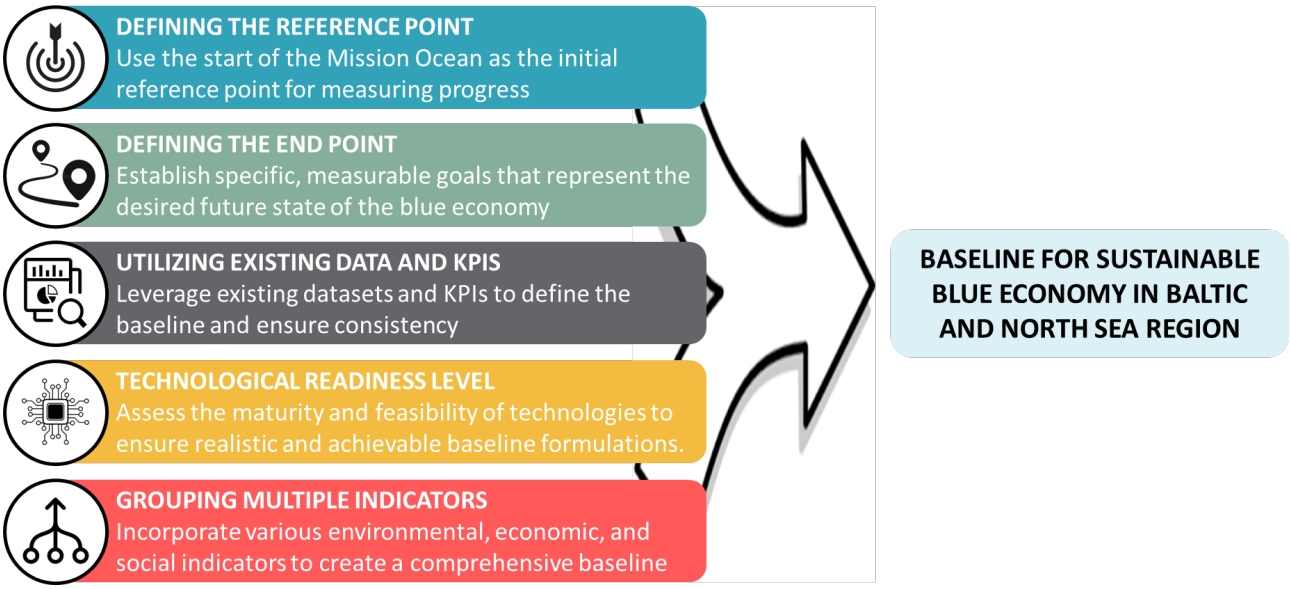

Figure 66. Schematic overview of the multi-dimensional approach needed for successful baseline formulation.

7 CONCLUSIONS

The development of key performance indicators (KPIs) for monitoring the sustainable blue economy in the BANOS area involved mapping existing indicators, organising stakeholder workshops, and conducting expert consultations. This process focused on sector relevance, data availability, and stakeholder engagement, resulting in KPIs for Mission Ocean and Waters (objective 3) relevant sectors, including aquaculture, energy, waterborne transport, ports and multi-use concept in spatial planning. These KPIs aim to track progress, guide interventions, and inform policy decisions, contributing to blue sustainability in the Baltic and North Sea area.

The report highlights the need for harmonising data at national and regional levels and integrating monitoring practices across national borders for a more comprehensive understanding of the BANOS area. It stresses targeted monitoring for meaningful outcomes and highlights potential KPIs for various sectors. Transboundary data collaboration, stakeholder engagement, and incorporation of societal impacts and nature-based solutions into monitoring frameworks are crucial for regional sustainability and ecological balance.

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Challenges included data availability and reliability, as well as varying baselines for sectors and KPIs. Addressing these required the collection of reliable and harmonised data and establishing sector-specific baselines for accurate monitoring. Many KPIs lack sufficient data, scientific justification, or comprehensive understanding, underscoring the need for ongoing research and data collection. In some sectors, it was more difficult to find data and propose KPIs. Integrating water (freshwater) and circularity aspects into this work is particularly challenging, as there are almost no KPIs described for these areas. This also reflects the Mission Ocean's lack of associated activities or targets in these fields.

The recommendations for future monitoring framework and transfer of monitoring practises to other sea European basins will continue to be developed in the BlueMissionBANOS task 5.4.

8 ACKNOWLEDGEMENTS

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9 ANNEXES

Appendix 1: Validation questionnaire for KPIs, Aquaculture Forms as an example

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APPENDIX 1

Aquaculture sector

This Forms questionnaire is part of our EU lighthouse project BlueMissionBANOS, aiming to define the Key Performance Indicators (KPIs) for Monitoring Sustainable Blue Economy in BANOS area for the EU Mission: Restore our Ocean and Waters. KPIs are quantifiable metrics utilized to assess the success of Mission Ocean in achieving its objectives regarding the sustainability of the blue economy. By adopting these KPIs, stakeholders can evaluate the efficiency, effectiveness, and environmental impact of the blue economy, facilitating informed policymaking and strategic development.

* Required

1. Your name? *

Enter your answer

2. Rank the best existing and new KPIs suggested by the Aquaculture expert group in the Workshop1 by dragging the boxes. (The most favorite one to the top, least favorite to the bottom) *

Volume of foods from zero carbon sustainable aquaculture

Production “harvested marine plants and algae”

People employed in aquaculture sector

Market price/volume of low-trophic aquaculture products

Profitability (and amount of new investments)

Phosphorus uptake value

Origin and type of feed used (traceability)

Ecosystem-based aquaculture sites

Financial compensation for positive contribution to ecosystem service

On-farm documentation available with detailed information on chemicals use

3. Comments on the above KPI's and/or their order

Enter your answer

4. Assess the readiness level for each KPI based on the KPI selection criteria from the document attached to the email. The eight criteria are: Relevance to sector and sustainability
area, Data availability, Measurability and quantifiability, Actionability, Comparability, Stakeholder engagement, Integrability and Forward-looking.

Scale: 1 = only 1/2 selection criteria fulfilled, 5 = all 8 criteria fulfilled and KPI ready to be implemented immediately *

	1: least ready	2	3	4
Volume of foods from zero carbon sustainable aquaculture	◯	◯	◯	◯
Production "harvested marine plants and algae"	◯	◯	◯	◯
People employed in aquaculture sector	◯	◯	◯	◯

	1: least ready	2	3	4
Market price/volume of low-trophic aquaculture products	◯	◯	◯	◯
Profitability (and amount of new investments)	◯	◯	◯	◯
Phosphorus uptake value	◯	◯	◯	◯
Origin and type of feed used (traceability)	◯	◯	◯	◯
Ecosystem-based aquaculture sites	◯	◯	◯	◯
Financial compensation for positive contribution to ecosystem service	◯	◯	◯	◯
On-farm documentation available with detailed information on chemicals use	◯	◯	◯	◯

5. Comments on the KPI readiness assessment?

Enter your answer

6. Please list here any data sources that you are aware of concerning the above KPI's

Enter your answer

7. Can we acknowledge your participation in the expert group and associated workshops by name? *

- ◯ Yes
- ◯ No