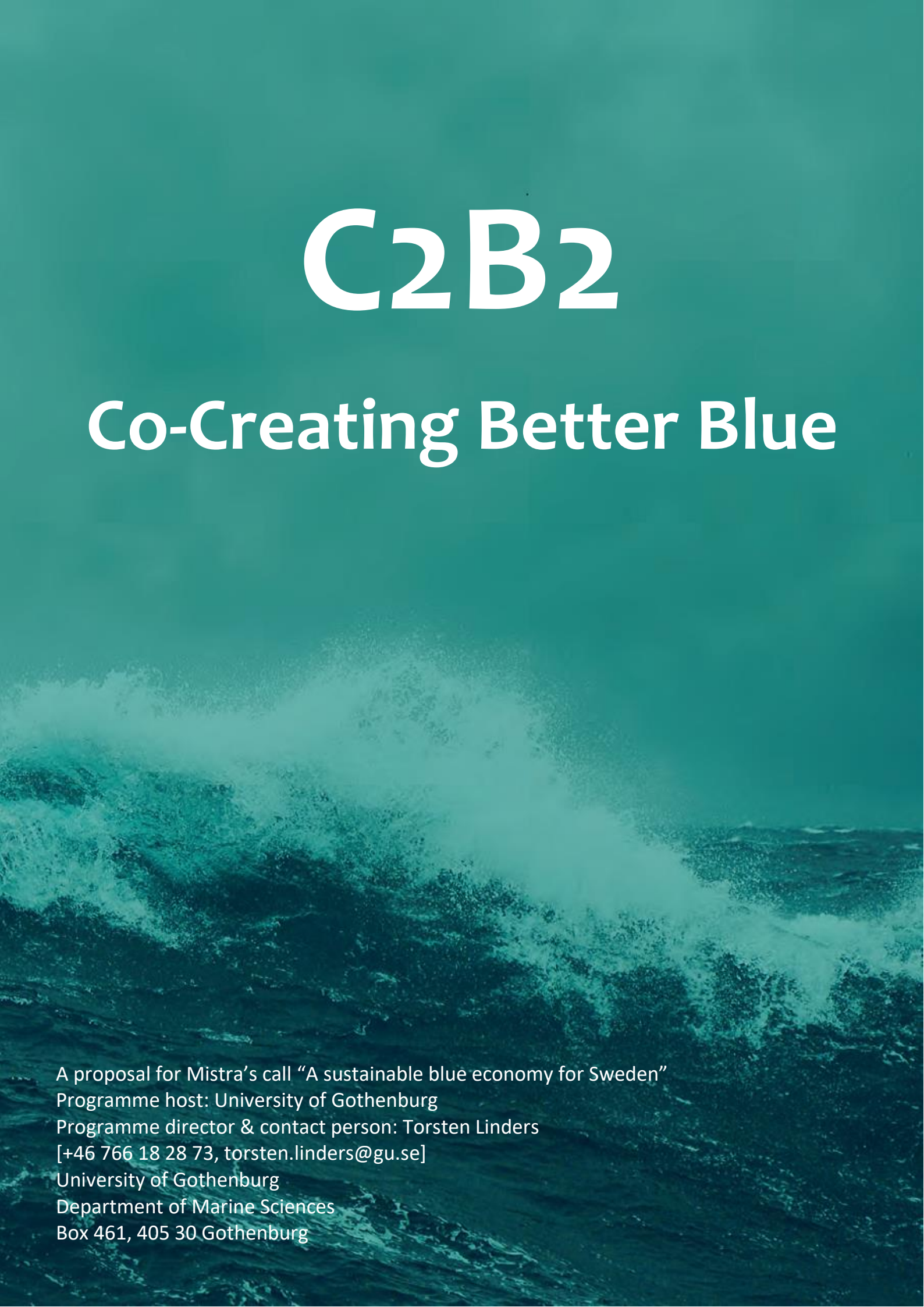

C2B2

Co-Creating Better Blue

A proposal for Mistra's call "A sustainable blue economy for Sweden"

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Abbreviations of C2B2 partners:
Chalmers – Chalmers University of Technology
CIT – Chalmers Industriteknik Group
IHE - IHE Delft Institute for Water Education
IVL – IVL Swedish Environmental Research Institute
RISE – RISE Research Institute of Sweden
SEI – Stockholm Environment Institute
SIME – Swedish Institute for the Marine Environment
SMHI – Swedish Meteorological and Hydrological Institute
SND – Swedish National Data Service
SU – Stockholm University
UGOT – University of Gothenburg
UMF – Umeå Marine Sciences Centre
WMU – World Maritime University

Abbreviations of other organisations:
HELCOM – Baltic Marine Environment Protection Commission (the Helsinki Commission)
OSPAR – OSPAR Commission (Oslo and Paris Conventions)
SEPA – Swedish Environmental Protection Agency
SGU – Geological Survey of Sweden
SMA – Swedish Maritime Administration
STA – Swedish Transport Agency
SwAM – Swedish Agency for Marine and Water Management

Summary in English

As countries increasingly turn their attention to the sea for diversifying their economies and ensuring the critical provision of services, there is an urgent need to radically change the way we think and use the ocean, away from a blue growth-based approach and towards a *sustainable* blue economy. This is particularly urgent in Sweden where our relationship with and dependency on the ocean have changed dramatically during living memory. It requires no less than ***a transformation in the way we think about the marine space and the activities increasingly deployed in our seas***, and an assessment for how multiple goals can be realized more effectively and sustainably. Such an assessment requires in turn bringing different actors and agendas together in a constructive dialogue. As a larger part of society has an ever-increasing stake in the ocean, it is imperative that we develop new forms of stakeholder collaboration combined with science-based ecosystem governance practices. C2B2 envisions ***a more sustainable, open and democratic, multi-sector and multi-actor blue economy and sustainable society.*** C2B2 aims to bring about transformative change through participatory governance supported by relevant and insightful data and knowledge by re-imagining the role of quintuple helix actors across the blue economy in Sweden in processes '*from data to knowledge to decisions and action'*. The programme has been specifically designed to deliver a 'co-created better blue' which - by its very design - consists of highly developed collaboration with the users of the research results, namely the diverse set of stakeholders involved in multi-level participatory governance of the ocean. Three distinct pathways will ensure successful achievement of the C2B2 outcomes and impacts: data, people and systems. **Central to the C2B2 approach is the LivingLabs co-creation methodology, applied to the development of three demonstration cases to trigger transformative changes towards participatory ocean governance, involving relevant sectors and actors in Sweden's three marine basins**. C2B2 brings together 13 partners from academia and research organisations, 25 co-funding associated partners from industry and public sector, as well as stakeholders from civil society, and will actively recruit more actors to join during the programme period. The overall C2B2 approach provides a major advance beyond the current State of Art by i) going beyond a single-sector approach; ii) implementing the quintuple helix concept at a practical level by using data to 'give nature a voice'; iii) extending the LivingLabs co-creation methodology to the complex setting of the sustainable blue economy; iv) practicing responsible Action Research by initiating and developing these co-creation processes and embedding them as routines for participatory governance, to ensure the adoption of collaborative and adaptive management practices beyond the C2B2 programme lifetime; and v) establishing a continuously evolving knowledge system for science-based ecosystem governance. The extensive demonstration and validation of this approach in C2B2 means this can also be replicated elsewhere in Sweden and internationally.

Summary in Swedish

När länder i allt högre grad riktar sin uppmärksamhet mot havet för att diversifiera sina ekonomier och säkerställa kritiskt tillhandahållande av tjänster, då finns det ett akut behov av att radikalt förändra vårt sätt att tänka och använda havet, bort från en blå tillväxtbaserad strategi och mot en hållbar blå ekonomi. Detta är särskilt akut i Sverige där vårt förhållande till och beroende av havet har förändrats dramatiskt under bara ett par generationer. Det kräver inget mindre än ***en omvandling av vårt sätt att tänka runt den marina domänen och de aktiviteter som i allt högre grad används i våra hav***, och en bedömning av hur fler mål kan förverkligas mer effektivt och hållbart. En sådan bedömning kräver i sin tur att olika aktörer och agendor möts i en konstruktiv dialog. Eftersom en större del av samhället har ständigt ökande intressen i havet, är det absolut nödvändigt att vi utvecklar nya former av samarbete mellan intressenter kombinerat med vetenskapsbaserade ekosystembasered förvaltning. C2B2's vision är ***en mer hållbar, öppen och demokratisk, blå ekonomi med fler sektorer och fler aktörer och ett hållbart samhälle.*** C2B2 syftar till att åstadkomma transformativ förändring genom deltagande styrning, stödd av relevanta och insiktsfulla data och kunskap, genom att ge en ny roll till den femdubbla helixen av aktörer i Sveriges blå ekonomin, i processer "från data till kunskap till beslut och handling". Programmet har utformats specifikt för att leverera ett "samskapat bättre blått" som - genom sin design - består av ett högt utvecklat samarbete med användarna av forskningsresultaten, nämligen de många olika intressenter som är involverade på flera nivåer i deltagande styrning av havet. Tre distinkta vägar kommer att säkerställa att C2B2 framgångsrikt uppnår resultat och effekter: data, människor och system. **Centralt i C2B2sangreppsätt är LivingLabs samskapande metodik, tillämpad i utvecklingen av tre demonstrerade fall för att initiera transformativa förändringar mot deltagande havsförvaltning, som involverar relevanta sektorer och aktörer i Sveriges tre havsbassänger.** C2B2 samlar 13 partners från akademi och forskningsorganisationer, 25 samfinansierande associerade partners från industri och offentlig sektor, samt intressenter från civilsamhället, och kommer aktivt att rekrytera fler aktörer under programperioden. C2B2s övergripande angreppsätt innebär ett betydande framsteg i förhållande till nuvarande 'State of Art' genom att i) gå längre än en strategier för enskilda sektorer; ii) implementera femdubbla helixkonceptet på en praktisk nivå genom att använda data för att "ge naturen en röst"; iii) utvidga LivingLabs samskapande metodik till den komplexa miljön för den hållbara blå ekonomin; iv) utöva ansvarsfull aktionsforskning genom att initiera och utveckla dessa samskapande processer och bädda in dem som rutiner för deltagande styrning, för att säkerställa införandet av samarbetande och adaptiv förvaltningspraxis efter C2B2-programmets livslängd; och v) etablera ett ständigt utvecklande kunskapssystem för vetenskapsbaserad ekosystemstyrning. Den omfattande demonstrationen och valideringen av detta tillvägagångssätt i C2B2 innebär att detta även kan replikeras på andra håll i Sverige och internationellt.

1. Vision, aims and expected impacts

Point of departure

The ocean – the new frontier of human activity – is being redefined by new discoveries, technologies, national strategies, and ecological imperatives. Yet it is undeniable that the status of most seas is in decay - and if the goal would be to restore or improve their status, then most human activities should be banned. Instead, we witness that in recent years the blue economy is promoted as an answer to energy and food insecurity as well as to an increased demand for shipping of goods, and transport of people and services. So humanity depends on marine livelihoods, but the blue economy is also rapidly increasing pressure on the long-term sustainability of marine ecosystems.

As countries increasingly turn their attention to the sea for diversifying their economies and ensuring the critical provision of services, there is an urgent need to radically change the way we think and use the ocean, away from a blue growth-based approach and towards a *sustainable* blue economy.

Marine industries are changing at high speed, while technology is evolving fast. ***Ocean governance is, however, lagging behind due to little physical presence in the ocean, sparse, patchy and expensive data collection, as well as conflicting goals among stakeholders over the use of the marine space.*** Interests clash from opposing goals, on the one hand, **to** protect our ocean and achieve the climate goals, and on the other hand, to expand the blue economy to tackle socioeconomic challenges such as transport, food and energy security. Additionally, openness and inclusiveness in ocean governance also lag dramatically behind due to low levels of ocean literacy, poor awareness of ocean-related challenges, and data coverage several orders of magnitudes worse than on land and in the coastal zone.

Moving away from blue growth and towards a sustainable blue economy requires ***a transformation in the way we think about the marine space and the activities increasingly deployed in our seas***. This transformation demands an assessment for how multiple goals can be realized more effectively and sustainably. Such an assessment requires in turn bringing different actors and agendas together in a constructive dialogue. As a larger part of society has an ever-increasing stake in the ocean, it is imperative that we develop new forms of stakeholder collaboration combined with science-based ecosystem governance practices.

This is particularly urgent in Sweden where our relationship with and dependency on the ocean have changed dramatically during living memory, from being one of Europe's major shipbuilding and fishing countries, to using the ocean mainly as a route for export/import, and the coast for leisure. Now we need to re-engage with our extensive and very diverse offshore areas in new ways, via marine renewable energy production, by implementing knowledge-based marine spatial planning, and by sustainably managing the ecosystem services of our ocean. Sweden needs a sound yet flexible approach to deal with the biogeographical, and social-economic diversity related to the governance of a sustainable blue economy from the northern most part of Gulf of Bothnia all the way to Skagerrak.

Vision

The programme *C2B2 - Co-creating Better Blue* envisages a world in which we address our ocean challenges via holistic, collaborative, and adaptive management practices for science-based ocean governance and a sustainable blue economy: *a more sustainable, open and democratic, multi-sector and multi-actor blue economy and sustainable society.*

Aims

The overall aim of C2B2 is to trigger transformative change in ocean governance in Sweden away from a single-use/single-actor paradigm, and towards multifunctional use through co-creation founded on data for ecosystem resilience. This is essentially about creating the conditions for a robust, inclusive and just transition towards participatory ocean governance. To achieve this, C2B2 will purse three interrelated aims:

1) To provide the **basis for a continuously evolving knowledge system** for science-based ecosystem governance in Sweden by advancing and interlinking three pillars: ecosystems and climate science; open, data-driven innovation & emerging technology; and governance theory and practice.
2) To **demonstrate in practice** in LivingLabs how the transition towards science-based ecosystem governance of a sustainable blue economy can be achieved by initiating, developing and embedding co-creation processes as routines for participatory governance, ensuring adaptive management practices beyond the C2B2 programme lifetime.
3) To reshape **our relationship with the ocean** by instilling new ways of working together and practicing science-based ecosystem governance, so that more actors and individuals can realise that they (could) have a direct stake in the offshore space.

Expected impacts

The overall expected impacts of C2B2 address the Mistra aspiration of a sustainable blue economy for Sweden and resilient marine ecosystems. The programme's overall impact logic (see Annex 1) has been carefully designed to ensure that the C2B2 activities and the programme results achieve the C2B2 aims. The substantial demonstration of triggering transformative changes towards participatory ocean governance in the three main Swedish basins leads to tangible *short-term* impact in terms of inclusive participation of diverse stakeholders in multi-level governance, contributing with generated data, knowledge and actions to the observation and protection of the oceans.

In the medium term, the C2B2 programme is expected to contribute to establishing an enhanced scientific knowledge base, increased stakeholder involvement and more effective ocean governance and management via enhanced institutional frameworks and processes; to the use of open by design, multi-purpose (permanent) offshore infrastructure by various sectors; and to participatory governance that evolves over time based on embedded co-creation and social learning.

In the long term, C2B2 is expected to contribute to place-based social cohesion and relations to the sea; improved knowledge and skills of archipelagos and coastal communities with stronger social and economic links within and to the offshore; cultural ecosystem services provided by the sea/coastal landscape; as well as sustainable employment, occupation and value chains.

Three distinct pathways will ensure successful achievement of these outcomes and impacts:

1. **Pathway 1- DATA**: change how data about the ocean is produced, perceived, and accepted, accessed, combined, and used in science, policy and society.
2. **Pathway 2 – PEOPLE:** enhance who is engaged in ocean governance and how they participate and embed these new participation practices.
3. **Pathway 3 – SYSTEMS:** strengthen the interactions of stakeholders locally and across multi-level governance; strengthen existing approaches such as marine spatial planning to be more integrative and sector sensitive.

2. Scientific value, including state-of-the-art

2.1 Challenges

Our ocean holds the key to a more sustainable future. It is critically important for regulating climate and for providing food, hosting an unknown richness of minerals and other non-renewable resources, biodiversity, biomass and genetic resources, and not least space for energy production, transport, recreation and natural habitats.

However, our way of using and governing the use of the coastal and marine space, including emissions from air and land, rising CO_2 levels and a changing climate exert a huge, combined stress on marine ecosystems and their services (Heinze et al. 2021). Moreover, many of the economic ocean sectors are in a rapid phase of "blue acceleration" (Jouffray et al. 2020). According to the High-Level Ocean Panel, this acceleration could lead to seas supplying 40 times more renewable energy, 6 times more food, 12 million new jobs, trillions in return on investment and 20% of the greenhouse gas emission gap to limit warming to 1.5-2 degrees (Stuchtey et al. 2020).

A key concern with this blue acceleration is our history of overexploitation and unsustainable use of common resources and the increasing pressures on key ecosystem services. Balancing the ambitious conservation targets of protecting 30% of marine space by 2030 (IUCN 2021/UK 30by30 initiative) with a fast-expanding blue economy challenges our current systems to govern our common ocean and their assets unveiling their limitations.

Challenges to achieve a Fossil Free Energy Transition

Forecasts for 2050 show that the global electricity demand will almost double (IEA, 2021). The EU's target is that by 2030, 32% of all electricity production will originate from renewables; and Sweden aims at 100%, renewable electricity production by 2040 (Energimyndigheten, 2019). This will require better technology that allows for more effective and cleaner sources of energy, less intrusive and more flexible structures that reduce impacts on ecosystems and societies, but also better planning in the total energy mix considering regional differences in energy production and demand and resilient/robust supply systems.

Offshore wind power can stand for 45 percent of electricity needs by 2050. A tenfold increase in offshore wind power in Sweden is forecasted by 2030. By 2050, an extension to 167 TWh of offshore wind power is estimated to be the most cost-effective way to meet the increased electricity demand (Svensk Vindenergi, 2021).

It is expected that an expansion of offshore wind power in Sweden will lead to falling electricity prices, particularly in southern Sweden, where electricity prices today are highest. This could even out today's large price differences between Sweden's electricity areas. Electricity production in southern Sweden, where the need for new electricity production is high, is also expected to increase (Svensk Vindenergi 2021).

Challenges to achieve Food Security

The global food demand is projected to increase to 50-70% by 2050. Research shows that the ocean could provide over six times more food than it does today - more than two thirds of the animal protein that will be needed to feed the future global population. With such an expected increase, the sustainable production of blue food will depend on factors such as policy reforms, technological innovation and the extent of future shifts in demand (Costello et al. 2020).

From a global perspective, an increase of regional marine food's primary production is crucial for food and nutrition security and for resilience in periods of crisis, but also to create economic prosperity and reduce transport needs. Today, the degree of self-sufficiency if Swedish seafood is low and hence most seafood is imported (Hornborg et al, 2021).

Recent studies have identified fisheries as one of the most impactful human activities in Swedish offshore marine areas, resulting in that most commercially important fish stocks are in an increasingly perilous state (Johansson, 2021).

Swedish coastal fisheries in the Baltic Sea have been deemed unsustainable in terms of the status of their main fish populations, their economic profitability, and even as a source of secure employment (Jagers et al., 2012; Johansson, 2021). And in the North Sea, although fishing has declined since the reform of the EU Common Fisheries Policy in 2002, its marine ecosystems are still in a perturbed state and there has been a shift from pelagic to benthic production (Johansson, 2021). There is also competition within the food production sector between aquaculture and fisheries as well as between large scale and small scale more sustainable coastal fisheries.

While the increasing interest in aquaculture is so far mainly close to the shore or on land, technology is being developed for farming in more offshore areas as well. There is an intensive debate in Sweden on the difficulties for new aquaculture facilities to obtain the required permits for establishment and operation. Moreover, in the sight of spatial competition, multiuse could be an option, but it meets similar difficulties in terms of permits, knowledge gaps and communication across sectors.

The Blue Economy

There are different understandings of what constitutes the "blue economy". According to the World Bank (2017) there is broad recognition that a blue economy needs to entail the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while restoring and preserving the health of the ocean. For the IUCN (2022), efficiency and optimization of natural marine resources within ecological limits is paramount in the blue economy. The ocean is seen as a space for development where marine spatial planning, especially at national level integrates the interests and needs of conservation, sustainable use, extractive activities, marine transportation and coastal tourism, and ensures that the integrity and functioning of coastal and ocean systems is maintained. For the UN (2022), a blue economy should be economically viable (prosperous) and environmentally sustainable, but also culturally appropriate and foster social equity and human well-being. For the EU (2021), a sustainable blue economy is a means to achieving the objectives of the European Green Deal and ensure a green and inclusive recovery from the pandemic. While most definitions include an angle of sustainability, the extent to which the blue economy should cater for various goals, such as economic recovery, climate neutrality, circular production, preserving biodiversity, mobility, trade, etc., differs between the different conceptualizations. We use the term **sustainable blue economy** here to stress the need to strive for sustainable use of the ocean by various sectors.

Challenges to achieve Clean and Effective Mobility and Transport

According to the World Bank's Global Mobility Report (2017), global freight volumes are projected to grow by 70 percent from 2015 to 2030. Passenger traffic is expected to increase by 50 percent, which is estimated to correspond to an additional 1.2 billion vehicles on the earth's road network – which is already congested. Shipping will handle a significant portion of the growing volumes. According to the OECD[1], trade volumes are expected to triple globally by 2050.

On a national level, regardless of the above increase, Sweden is completely dependent on functioning import and export routes. As much as 90 percent of our imports and exports are done by sea at some point (NRIA Sjöfart 2021). Shipping is also an important part of marine tourism in Sweden, as indicated in the OECD's Sustainable Ocean Economy Report (OECD 2022). Pre-pandemic (in 2018), international sea passenger transport receipts grew from 45 million in 2008 to 205 million USD.

The European Green Deal calls for a 90% reduction in greenhouse gas emissions from all modes of transport, and this includes maritime transport – including fishing operations, freight, passenger traffic, defence operations, and all related infrastructure such as electric charging stations and circular sources of fuel – which currently account for 2-3% of the annual global CO_2 emissions.

Besides emissions, shipping also causes a range of direct environmental pressures on the marine environment. For example, over one third of the copper load in the Baltic Sea is estimated to originate from shipping (Ytreberg et al. 2021). Copper and other toxic substances released from ships will lead to marine ecosystem deterioration, thereby indirectly contributing to reducing the ocean's capacity as a carbon sink (Roth and Gustafsson 2021). Importantly, projections of the Baltic Sea through to 2050 indicate that shipping will become the major source of strong acid addition to surface waters, particularly if there is widespread use of wet scrubber systems (Turner et al. 2018).

[1] https://www.oecd.org/ocean/topics/ocean-shipping/

Challenges to achieve Good Environmental Status

The environmental status of the seas surrounding Sweden has still not reached the targets set out in national and international regulatory frameworks (primarily the EU Marine Strategy Framework Directive and the EU Water Framework Directives). An ecosystem-based approach has been proposed as an approach to address negative environmental trends and complex interactions (Grimvall et al. 2019).

While there has been some progress in many of the contributing basins in the region, there is a need to improve the clarity of the regulations to match environmental conditions and ensure compliance, which requires monitoring of ecological data and dynamic transfer of scientific knowledge (Bohman 2018). Furthermore, the governance system in marine areas is highly dispersed due to the decentralized multi-actor system with unclear decision-making mechanisms (Morf et al. 2021). As a result, the legal implications of an ecosystem-based management are unclear (Nilsson and Bohman 2015). Beyond national legislation, there are serious bottlenecks when it comes to ensuring vertical policy coherence (i.e., from international to national and local) which has resulted in a patchwork of European policies, national policies, private initiatives and regulations on different levels that often conflict with each other (Boyes and Elliott 2014; Langlet 2018).

Cross-cutting challenges

Integrated approaches such as Marine Spatial Planning have been suggested play a key role to support that clean energy production at the very least does not interfere with the interests of other marine activities, and at best is placed to positively contribute to ecosystems and existing industries such as fishing and tourism. Here, thorough analysis of present systems and governance innovation are needed to oversee the regulatory system and ensure that planning and sector management are environmentally sustainable and not merely energy efficient.

While in principle, ecosystem-based management is being adopted by many management organisations, operationalising integrative and ecosystem-based management is challenging (e.g. Cedergren et al. 2020 for fisheries co-management, Morf et al. 2019 for MSP, Prutzer et al. 2021 for water co-governance; Sandström et al. 2014). A mismatch in institutional arrangements, created by the traditional sectoral focus of marine environmental and resource management and existing administrative boundaries are key factors obstructing implementation (Alexander & Haward, 2019). Coping with complex marine issues requires an inclusive approach with a wide array of values, perspectives and knowledges, to ensure common understanding, acceptable distribution of costs and gains, and legitimacy (e.g. Jentoft & Chuenpagdee 2009).

In response to this context, C2B2 goes beyond a single-sector approach and instead ***C2B2 focuses on addressing what we deem as the real challenge of the coming decade: governing multiple demands in increasingly claimed and fragile marine ecosystems.*** This demands science-based, integrative and adaptive governance that considers the challenges arising from specific societal or sector goals while guiding how goals from multiple agendas can be realized, including capitalizing from synergies between goals and mitigating potential trade-offs (Stephensen et al. 2019).

2.2 Overall C2B2 concept

The breath and magnitude of the above challenges as well as of the opportunities brought about by an expanding blue economy requires a science-based ecosystem governance of a sustainable blue economy situated within the larger context of transition governance, i.e. the "*proactive steering of societal transformations towards sustainability*" (Halbe and Pahl-Wostl, 2019). This view embraces the full complexity of multi-actor processes in these transformations and requires not only the governance of the process of change, but also finding ways to change current forms of (ocean) governance to ensure sustainability. C2B2 focuses on bringing about transformative change through participatory governance supported by relevant and insightful data and knowledge. **C2B2 reimagines the role of quintuple helix actors** [academia, industry, government, civil society, and the natural environment] **across the blue economy in processes 'from data to knowledge to decisions and action',** increasing opportunities for participation, deliberation and influence, building open infrastructure and strengthening capacity to support the inclusion of data and knowledge in multilevel governance. Importantly, in this conceptualisation, data is a means to 'give nature a voice'.

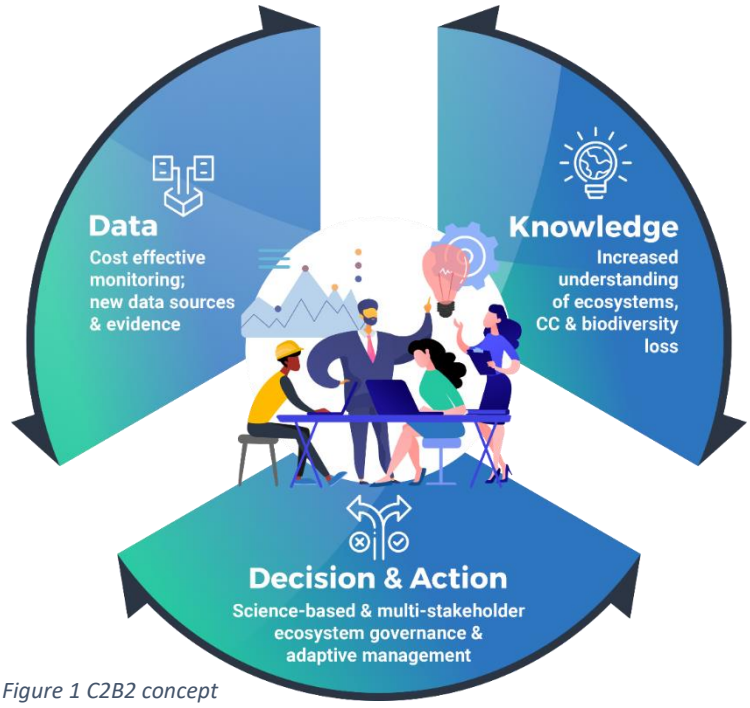

Figure 1 C2B2 concept

Advancing three inter-related pillars of science-based ocean governance

C2B2 will provide the basis for a continuously evolving knowledge system for science-based ecosystem governance through the interconnection of three thematic pillars: 1) open ecosystem and climate change science; 2) open, data-driven innovation & emerging technology, and 3) ocean governance and adaptive management. Insights developed in one pillar will feed into the co-creation process while advancing the other two pillars, e.g., innovative sensor data collection advances ecosystem science and adaptive management practice. Fully set within Open Science (UNESCO, 2021) and Open Innovation paradigms (Chesbrough, 2003), the co-creation process will open up the scientific and innovation processes to diverse societal stakeholders, incl. competitors, while providing Open Data as well as Open Access to results throughout. The C2B2 research programme will initiate and develop these co-creation processes and **embed them as routines for participatory governance, to ensure the adoption of collaborative and adaptive management practices beyond the C2B2 programme lifetime**.

Pillar 1. Open ecosystem and climate science: Despite recent advances in ecosystem science and climate science, gaps still exist relating to how human activities on land and at sea affect offshore ecosystems' resilience, loss of biodiversity, and climate change-induced ocean acidification and warming. This pillar conceives relevant scientific knowledge stemming from different disciplines (e.g. natural as well as social sciences) and including non-traditional and local knowledge. In order to advance scientific knowledge of ecosystems, biodiversity loss and climate change impact in Swedish offshore areas, this pillar will identify key data and knowledge gaps. Integrating new data sources (in collaboration with pillar 2) to advance our scientific understanding, this pillar provides integrated and adaptive change assessments, forecasts, and simulations of the ecosystems, and consolidate the best available knowledge and data of the ecosystems, the climate, land-sea interactions and the effect on biodiversity from blue economic and human activities, understandable by different audiences.

Pillar 2. Open, data-driven innovation & emerging technology: To enable data-driven innovation by commercial and non-commercial actors, both data and a data acquisition infrastructure are needed. This programme will enable data collection on marine ecosystem parameters, atmospheric parameters incl. air pollution and GHG-emissions, as well as economic and human activities, and other relevant indicators. One means to achieve this is by **re-imagining blue economy sectors as data collection platforms.** Existing blue economy sectors (e.g., shipping, fisheries, offshore installations) can serve as key contributors to data collection about offshore ecosystems above and below the surface on numerous parameters, especially when combined with emerging technologies such as AI, machine learning, and autonomous drones above and below the water. For example, collaborative mechanisms for data collection already exist on a relatively small scale for fisheries and shipping. Swedish shipping company Stena Line is world leading in using ships as sensor platforms together with operational agencies, such as SMHI, in the Ferrybox programme. Other mechanisms include 'fishing for data'[7] initiated by Berring Data Collective, now being implemented on the Swedish West coast. Further offshore installations (e.g., wind farms and subsea cables) can be made open-by-design. New data collection platforms will work in tandem and complement dedicated monitoring platforms, such as research vessels, scientific marine drones and buoys. The new platforms will contribute to unique datasets, which until now have proven very costly and complex to obtain. Of paramount importance is the integration of any new data acquisition into existing databases and aggregation efforts. Further, an open innovation approach (as prescribed in ISO 56002 and 56003) will be promoted, in which users, competitors and other stakeholders may collaborate from early stages of the innovation process. Marine data stewardship will provide subject-specific support to ensure the availability of marine data in line with the FAIR data principles (Findable, Available, Interoperable, Reusable), open data management and integration into existing aggregators.

Pillar 3. Ocean governance & adaptive management: As the expansion of the blue economy is inevitable, exclusivity of marine uses or conservation thus will not suffice as the governance approach to existing and new human activities in the marine domain. Still, human activities and their impact have to remain within the carrying capacity of the ecosystems that maintain our livelihoods, hence the need to shift from blue growth to a sustainable blue economy, from exclusive use and single purpose to multi use, and from end-of-pipe to circular. Good governance in general entails the principles of legitimacy, transparency, accountability, human rights, rule of law, and inclusiveness (OECD, 2015). Ocean ecosystem governance has an added dimension of complexity as diverse (sectoral) human activities in a given (offshore) ecosystem must be coordinated and managed towards a common outcome, i.e., a resilient and sustainable ecosystem. Moreover, adaptive management requires close interaction among 1) monitoring activities and hence the advances in the technology pillar; 2) research and knowledge production activities, including those in the open science pillar; and 3) the application of new insights and knowledge in current management practices. This pillar therefore closely collaborates with the other two and draws on existing theory, practice and emerging insights related to participatory governance and adaptive management. It will also advance these and formulate recommendations based on social science research in the LivingLabs.

2.3 C2B2 Methodology

Co-creating participatory ocean governance and a sustainable blue economy as social innovation. To fulfil the aims of the programme to trigger transformative change and create the conditions for a robust, inclusive and just transition towards participatory ocean governance, we will apply a social innovation lens. We understand social innovation as the multi-stakeholder processes needed to carefully combine both technological and non-technological innovations (Wehn et al., 2021). C2B2 will extend the social innovation framework and action research methods developed in the Ground Truth 2.0 and AfriAlliance projects by one C2B2 partner to the ocean governance realm, employing a *quintuple helix social innovation co-creation approach* involving academia, industry, government, civil society, and the natural environment. Fundamentally, our co-created science-based ocean governance will include key stakeholders from the outset and extend current multi-stakeholder participation in marine environmental management[2] with the sound integration of science, technology and innovation.

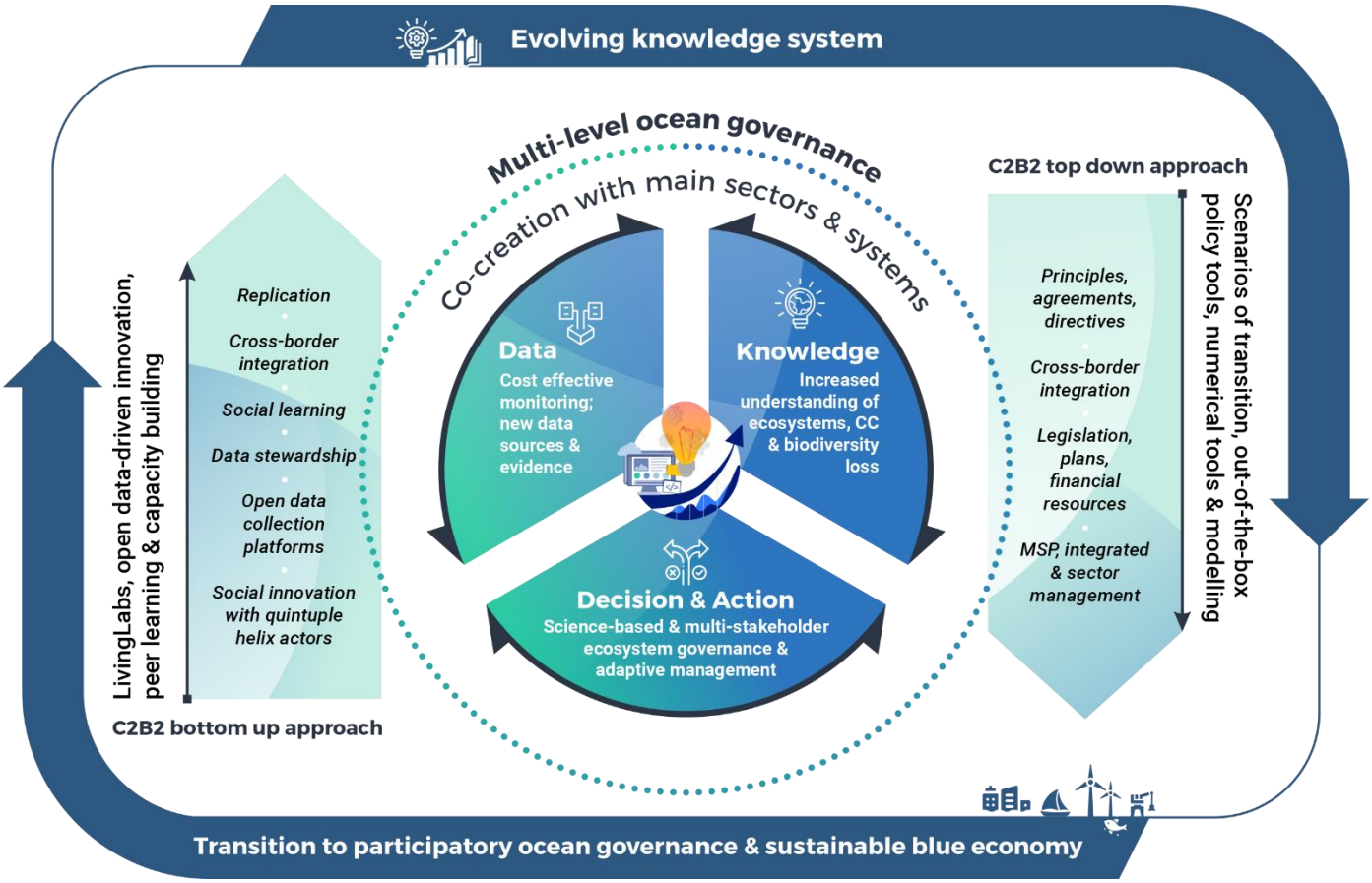

Figure 2 C2B2 methodology

Already to develop the present proposal, a broad range of stakeholders has been involved in the discussions. C2B2 is based on an inherently transdisciplinary and interdisciplinary approach (see Figure 2), leveraging and, where relevant, combining relevant concepts, methods and approaches spanning marine, ecosystem and climate science, engineering, and social sciences and humanities in an integrated bottom up and top down approach.

As part of the **C2B2 bottom up approach**, C2B2 will employ a LivingLabs co-creation methodology and develop three demonstration cases involving relevant sectors and actors in Sweden's three marine basins. **LivingLabs** is a well-established methodology for dealing with complex socio-technical-ecological systems. It is based on social science theories, i.e., innovation experiments with stakeholders in real-life settings, that a) *create value for users by understanding their needs and motivations*, b) *give future users influence on the decisions*, c) *aim for sustainability in economic, ecological and social terms, d) involve multiple perspectives and collaborate widely for openness*, and e) *conduct activities in a real-life context* (Ståhlbröst and Holst, 2012). Our LivingLabs methodology has been previously tested and validated in six countries in Europe and Africa, addressing different challenges in diverse geographic, socio-economic, cultural and political settings (Wehn et al., 2019; Wehn and Pfeiffer, 2020). Iterations and validation points during the co-creation create spaces for social learning among participants and ensure that co-created plans are realistic, accepted, and legal, and avoided designs dominated by one stakeholder group, or based on assumptions of one group about the motivations of another.

[2] E.g. Co-management North Bohuslän: continuous management of Sweden's first marine national park in the Koster Sea

These activities will be interlinked with

- ***scientific efforts*** to identify key data and scientific knowledge gaps in ecosystem and climate science and to advance scientific knowledge about ecosystems, biodiversity loss and climate change impact in Swedish offshore areas. We will explore the land-sea interaction in the offshore blue economy and use existing and novel data sources, as well as numerical models to quantify the effect on biodiversity from permanent offshore installations, and especially (bottom-fixed) wind farms. Numerical tools for assessments and simulations of the ecosystems and climate of the case study areas will feed relevant scientific knowledge into the discussions in the LivingLabs;
- ***technological advances***: to address identified gaps, an open innovation process (incl. via a strategically disseminated Open Call for Solutions) will serve to generate innovative, open by design approaches to data collection and knowledge co-creation that will be tested in the LivingLabs and demonstrated and exploited during open innovation events. We will provide benchmarks for open by design, multifunctional system solutions to help re-imagine blue economy sectors (that have traditionally operated to deliver specific services) as platforms for hosting multiple activities based on their offshore presence. Marine data stewardship will serve to coordinate, integrate and soundly manage marine data generated by the C2B2 programme and beyond.

For the **C2B2 top down approach**, our starting point are the existing multi-level governance structures, approaches and resources (principles, agreements, directives; legislation, strategies and policies, financial resources, MSP, integrated and sector management). Using scenarios of transition, comparative policy-based tools and international collaboration, we will explore where radical changes and where incremental adjustments to the status quo can lead to beneficial outcomes for society and biodiversity.

The activities, changes and results generated in each LivingLab will be accompanied by research activities using an **Action Research approach** (plan, act, observe, reflect) to trigger changes in the real-life setting, and then to research and study these to create new empirical knowledge. In particular, knowledge will be advanced via deliberate (peer) learning at three levels: 1) within LivingLab cases and thematic pillars, 2) across LivingLab cases and thematic pillars, and 3) internationally through international organizations and their working groups and platforms, such as the International Council for Exploration of the Seas (ICES), the Oslo and Paris Convention (OSPAR Commission), the Helsinki Committee (HELCOM), Vision and Strategies around the Baltic (VASAB) and other relevant international expert groups (e.g. IMO, IOC-UNESCO, IPCC), as well as on-going EU and global project collaborations.

Monitoring, Evaluation & Learning of the project activities in the three LivingLabs and **assessment of the project impacts at large:** The evaluation of the C2B2 demonstration activities will serve two purposes. On the one hand, it will enable learning in the ongoing or subsequent activities: the continuous evaluation of the demonstration activities in the LivingLabs is needed for adaptive management, on a practical level, of subsequent programme activities. On the other hand, changes in the socio-political dimensions of the LivingLabs need to be assessed, including unintended or unexpected ones, to determine the effectiveness of the C2B2 approach in different conditions, which will provide the basis for adjusting guidance and tools. The guiding principles for the evaluation activities will be a) to balance the data and information needs of the project and cases with resources requirements and demands of available methods and b) to practice co-evaluation, wherever feasible, with stakeholders engaged in the LivingLabs and across vertical multi-level governance. The assessment of evolving impacts in the LivingLabs will build on existing frameworks and methods (e.g. IHE, SEI) to help the LLs self-report (with optional support) and communicate emerging impacts as stories or impact briefs. Both, the evaluation for informing the demonstration activities and for assessing the effectiveness of the C2B2 approach, will build on the elaborate methods and templates produced by previous projects. This will help capture data and insights generated during the project implementation in structured and efficient ways. These activities will capture initial baselines and changes in governance and management resulting from co-creating the 'better blue' in each LivingLab: i.e., the state of Swedish marine spatial planning and relevant sector management beyond the coastal zone, the role of new governance instruments related to 'open by design infrastructure', changes in the roles of official monitoring actors with monitoring tasks, and social learning mechanisms to instil participatory governance and adaptive management of offshore ecosystems in a multi-stakeholder, inclusive and just setting in the long run.

We will ensure the **sustainability of the project results** and increase local ownership over the process and results via a two-tear approach: the first tier consists of training C2B2 partners in the multi-stakeholder creation processes and developed tools; the second tear will train (local) stakeholders and partners who can help embed the process into formalized decision-making and ensuring sustainability of the implemented technologies, data and knowledge flows and participatory procedures.

The C2B2 programme is divided into three distinct stages:

Stage 1 (M1-6): Inception. Assessment of state-of-the-art in each thematic pillar, including case-specific socio-ecological and governance baselines. Guidance for and training of LivingLab facilitators. Establish research coordination across pillars. Initiation of the C2B2 Partner group and the Stakeholder reference board. Initiation and recruitment to the C2B2 research training group, with one PhD student per thematic pillar. Case-specific and overall initial stakeholder analysis and mobilisation of key stakeholders for each LivingLab. Initiation of internal and external communication channels.

Stage 2 (M7-36): Implementation. Initiation of LivingLabs and joint agreement on problem definition, including data requirements for scientific and management purposes. Iterative activities in LivingLabs to develop interoperable solutions for offshore data collection based on identified data needs. Interoperable combination of new and existing data. Scientific knowledge generation and exploration. Data and knowledge integration in scientific theories and models and current management practices. Continuous social science research on governance dynamics and related challenges, gaps and enablers in all three LivingLabs. Continuous communication and dissemination of results to the large group of C2B2 partners, associated partners and to all relevant stakeholders.

Stage 3 (M37-48): Consolidation. Support and capacity building for new forms of participatory governance and sustainable blue economy in Sweden in terms of data provision, knowledge generation, skills, management practices and recommendations. Joint generation of (new) business models for distinct programme results.

Demonstration of co-creating participatory ocean governance in Sweden

In order to demonstrate in practice how the transition towards science-based ocean governance of a sustainable blue economy can be achieved, the C2B2 programme will set up LivingLabs in three demonstration cases involving relevant sectors and actors in Sweden's three main marine basins. The location of the **selected case study areas** (North, East, West) are shown in Figure 3 and their characteristics are presented in Tables 1-4.

The selected case study areas coincide with SwAM's management areas. It is crucial for C2B2 to address all three basins given the overall aim of C2B2 to trigger transformative change in ocean governance towards a sustainable blue economy in Sweden. Moreover, the Swedish context (environmentally, socially and economically) differs considerably in the regional marine basins. The LivingLabs in these cases will serve to initiate, develop and embed co-creation processes as routines for participatory governance, ensuring adaptive management practices beyond the C2B2 programme lifetime.

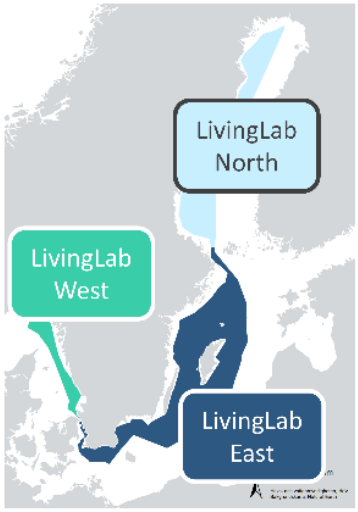

Figure 3 C2B2 case study areas

Table 1 – Characteristics of the three C2B2 case study areas

Characteristics		North	East	West
Ecosystem characteristics	Salinity	Very low	Low	High
	Ecological status according to MSFD	Good	Poor	Good
	Depth	Shallow	Deep	Deep
	Sensitivity to CC	Very high	Medium	Medium
	Biodiversity	Low	Medium	High
	Natural values	Low	Medium	High
	Connectivity with other ocean basins	Very low	Low	High
	Blue infrastructure	Very low	Medium	High
	Winter ice cover	Extensive	Very limited	Very limited
	Mammals prevalence & diversity	Low	Medium	High
	Birds prevalence & diversity	Medium	High	High
	Broad habitat type(s) according to MSFD	*Circalittoral zone* dominates but also areas with infralittoral, and offshore circalittoral mixed sediment,	*Offshore circalittoral* most important but also areas with infralittoral, and circalittoral mixed sediment, mud, sand,	*Infralittoral zone* important, but also areas with circalittoral, and offshore circalittoral mixed sediment, mud, sand, coarse sediment,

Characteristics		North	East	West
		mud, sand, coarse sediment, rock and biogenic reef	coarse sediment, rock and biogenic reef	rock and biogenic reef. Upper bathyal sediment or rock and biogenic reef.
Geogr.	Size	38 000 km^2	75 000 km^2	10 000 km^2
	Maximum distance from shore	100 km	120 km	60 km
Blue industry sectors	Fishing	Mostly small scale and coastal	Coastal and large scale pelagic	Coastal and large scale pelagic
	Offshore installations	A few interconnectors for electricity and communication	One small wind farm; many interconnectors for electricity and communication; Nord Stream 1 & 2	Many interconnectors for electricity and communication
	Transport, industrial ports	Medium use of seaways, several important industrial ports	Very intense use of seaways, several important industrial ports	Intense use of seaways; Port of Gothenburg, largest port in Sweden
	Other	Cultural heritage	Defence, tourism, energy market	Defence, tourism
	Future trends	Test site; Wind power and national power grid	Escalating defence concerns; wind power and national power grid	Wind power and national power grid
Ocean governance & marine spatial planning	Experience with co-creation	EBMM Pilot Stockholm Archipelago (SwAM)	Established science-policy hub (Gotland Blue Center); EBMM Pilot Southern Bothnian Sea (SwAM)	Fisheries co-mgt 8-Fjords project; Co-management North Bohuslän
	International collaboration	Extensive with Finland	Extensive but complex multinational	Extensive with Norway & Denmark, other North Sea countries.
	Range of stakeholders engaged in decision making	National MSP: *some*; Regional/local planning: *many*; consultation & sector management	National MSP: *some*; Cross-sectoral collaboration: *low-medium*	National MSP: *some*; Regional/local planning: *high*; consultation & sector management
	Capacity/resources of local authorities	Low-Medium	Low-Medium	Urban high, rural low
	MPAs (HELCOM/OSPAR)	~2 % (+35% proposed)	~5 % (+5% proposed)	~20 % (+10% proposed)
Existing data / tools (ecosyst. social, economic)	Data completeness	Medium	Medium	Medium
	Data quality	High	High	High
	Data access	Medium	Medium	Medium
	Data collection via citizen science	Low	Medium	High
	Tools	Symphony (SwAM); operational forecasting model (SMHI)	Symphony (SwAM); operational forecasting model (SMHI)	Symphony (SwAM); operational forecasting model (SMHI); KASK 3D model; Koster Sea Model (UGOT)

The LivingLabs in each case study will cover selected case study area(s) based on interests and priorities (see Tables 2-4). The stakeholders related to each LivingLab include selected C2B2 partners, associated partners and other actors. During the programme implementation, a full stakeholder analysis will identify all relevant stakeholders for each LivingLab.

Please note that the objectives of each LivingLabs present draft versions based on initial interactions with stakeholders during the proposal phase. Therefore, some objectives are more advanced than others. All objectives will be co-created and agreed by the LivingLabs stakeholders during the project implementation.

Table 2 - Case study NORTH

Characteristics

Ecosystem: The ecosystems in the Gulf of Bothnia are characterized by significant freshwater input, low connectivity with the open ocean and cold winters. This generates an environment with low salinity, lower biodiversity and a seasonal ice cover. The large river runoff also delivers significant nutrient and organic matter loads (from both natural and human sources). Further, as ongoing climatic changes are more pronounced in the Arctic and sub-Arctic (up to 3 times faster than lower latitudes), this area is a sentinel of the impacts of climate change. In the Southern part of the case study area, there are notable increases in phosphorous concentrations, increasing biomass of filamentous cyanobacteria and declining oxygen concentrations in bottom waters. The land uplift in Sweden is at its highest in this case study area with a maximum of 10mm/year in the northern Quark.

Economy and users: The north of Sweden is experiencing a strong economic growth, combined with ambitions of creating world leading sustainable industrial production and utilization of natural resources. The global drive towards electrification, and a high demand for metals and energy security have all made the region attractive. The Gulf of Bothnia has small and medium sized fishery, and many planned sites for offshore wind farms. The seaways are crucial for many globally exporting industries located in the north of Sweden. The port of Luleå is home to the Swedish fleet of icebreakers.

Society and governance: The north of Sweden is sparsely populated, covering 60 % of the land area but only home to 12 % of the population, of which most live along the coast. Sweden's only neighboring country around Gulf of Bothnia is Finland, with many shared characteristics, challenges, opportunities, and indeed collaborations. Governance innovation areas: Höga Kusten, Kvarken and Haparanda archipelago in terms of integrative coastal planning and cross-border collaboration. There are no areas beyond jurisdiction of EU member states in the Baltic Sea (except areas under Russian jurisdiction), which means that all water is covered by the EU Marine Strategic Framework Directive (MSFD) and the Water Framework Directive (WFD). HELCOM, however, includes Russian waters and cooperates with the EU.

Issues

The region is experiencing especially pronounced climate change. There is a substantial legacy of environmental impact from process industries, for example fiber banks caused by the pulp industry, which can cause both pollution and very substantial emissions of methane. Overall, the Gulf of Bothnia is characterized by less competition for space and less international complexity, compared to other Swedish offshore areas, but the fast industrialization of energy-intensive industries is likely to have an impact on marine ecosystems.

Stakeholders

C2B2 LivingLab lead: UMF

Public sector: County Administrative Board in Gävleborg; Municipality of Härnösand, HELCOM, SwAM, SEPA, SMA, Svenska kraftnät, Geological Survey of Sweden

Private sector: Sweden Pelagic Federation, Hitachi Energy, LifeFinder Systems International AB, Ecobarge Sweden AB, Clinton Marine Survey AB, Terntank, Sveavind Offshore AB, Cetasol AB, Sensative AB, Combine AB

Civil society: Stiftelsen för Östersjölaxen, Kustfiskarna, Sportfiskarna, Upplands Fågelskådare, BirdLife Sverige, Coastal water councils, WWF, The Swedish Society for Nature Conservation (SSNC)

Academia: UMF, IHE, SIME, UGOT, CIT

Objectives of the LivingLab North

Scientific - ecosystem & climate	Improved understanding, based on additional/new data sources, of how human offshore presence and economic activity may be a driver for sustainability and climate change mitigation.
Technological	An offshore test area where industry (shipping, fisheries, offshore installations), public sector and civil society conduct experiments in a multifunctional space and collaborate around joint data acquisition and utilization.
Governance & adaptive mgt	Sustainable offshore governance in the context of rapid climate change.

Table 3 - Case study East

Characteristics

Ecosystem: The Baltic Sea is the world's largest body of brackish water, with unique ecosystems and habitats, created by the combination of large freshwater input from rivers and the very restricted exchange with the open ocean, through the Danish straits. The Baltic proper is eutrophicated, with high primary production (including Harmful Algal Blooms, HABs) and drastic cycles of hypoxia during the past 30 years, which in some places have

turned into permanent hypoxia and anoxic bottom conditions (Shahabi et al., 2022). This is ruining crucial habitats, such as spawning grounds for cod, and in addition causes a chemical feedback loop with large leakage nutrients from the sediments.

Economy and users: The Baltic Proper is one of the most heavily trafficked seaways in the world, with great importance to international trade and to the national security interests of the countries in the region. Sweden has the largest EEZ, including the central area surrounding Gotland. The region is traditionally and recently the focus of intense military and security concerns. Gotland is often regarded as one of the weak spots in Sweden's military defense. International trade and connection are also intense along the sea bottom, with interconnectors for communication and electricity, and with the contentious gas pipelines Nord Stream 1 & 2, which run through the Swedish EEZ to the East of Gotland. Sweden has extensive plans for offshore wind farms, including in the shallower areas around Gotland, and some areas may be deemed adequate for sand extraction. Commercial fishing takes place over wide areas. The catch is to a large extent used for animal feed. The tourism industry is large around the whole of Baltic Proper, including Gotland.

Society and governance: Gotland is Sweden's largest island, located in the centre of the Baltic Proper. While the island has only around 60,000 permanent inhabitants, it receives over a million tourists on a yearly basis, mainly during the summer season. A substantial share of the summer population is made up of seasonally returning house owners. This group has increased following the pandemic and extended its presence throughout the year. Seasonality and changing demographics are substantial challenges for management of resources and services. There are no areas beyond jurisdiction of EU member states in the Baltic Sea (except areas under Russian jurisdiction), which means that all water is covered by the EU Marine Strategic Framework Directive (MSFD) and the Water Framework Directive (WFD). HELCOM, however, includes Russian waters and cooperates with the EU.

Issues

- The area around Gotland is an intense hotspot for a mixture of complex and highly international issues.
- Working for the restoration of more resilient ecosystems and climate change mitigation and adaption, while also managing multi-sector and multi-national interests, including trade, fisheries, and energy security.
- Omni-present and now increasing military concerns.

Stakeholders

C2B2 LivingLab lead: SEI

Public sector: Region Stockholm, Blue Centre Gotland, County Administrative Board Gotland, Region Gotland, Municipality of Gotland, HELCOM, SwAM, SEPA, SMA, SEA, Svenska kraftnät, Geological Survey of Sweden

Private sector: LifeFinder Syst. International AB, Sensative AB, Fossil Free Marine Europe AB, Ecobarge Sweden AB, Marell Boats AB, Terntank AB, Cetasol AB, Sveavind Offshore AB, Sweden Pelagic Federation, Hitachi Energy AB, SeaTwirl AB, Fossil Free Marine Europe AB, Clinton Marine Survey AB, Windeed AB,, Combine AB

Civil society: Sportfiskarna, Initiativ Utö, Svenska Båtunionen, Stockholms Ornitologiska förening, Skärgårdsstiftelsen i Stockholms län, Sveriges Organiserade Fiskeguider, Nämdö Green Archipelago, Nordiska skärgårdssamarbetet, The Swedish Society for Nature Conservation (SSNC), WWF, Algal Bloom citizen science

Academia: SIME, UGOT, CIT, WMU, IHE, Chalmers

Objectives of the LivingLab East

Scientific - ecosystem & climate	Improved understanding, based on new data sources, including citizen-based approaches, to monitor ecosystem health, increase predictability and reduce impacts on society, for example tourism losses due to algal blooms. Explore how human offshore presence (e.g. energy, shipping) and economic activity can co-exist with ecosystem resilience, and even have a positive impact on biodiversity.
Technological	Shared data acquisition – private, citizen-science, and public actors - in offshore settings to understand opportunities for multifunctional regenerative interventions and improve predictability of ecosystem effects.
Governance & adaptive mgt	Connecting small, medium and large-scale actors, operating in new and upcoming marine industries and their value chains. Develop mechanisms for predictable and realistic conditions for sustainable management of the offshore environment in an intensely international and geopolitically sensitive context.

Table 4 - Case study West

Characteristics

Ecosystem: The area is characterized by its extensive archipelago, oceanic salinity, generally well-oxygenated bottom-water and very high benthic and pelagic biodiversity as well as a complexity of food-webs. This is due to the area's connectivity to the North Sea and the Atlantic, contributing to large biodiversity through dispersal of (1) deep-sea species; (2) shallow-water and pelagic species through coastal and oceanic currents; and (3) populations of marine sea-birds from the North Sea. Despite present and emerging environmental problems and user-conflicts, this area has generally been classified as the Swedish region having the best environmental status (Marine Strategy Framework Directive) as well as ecological status (Water Framework Directive). The area hosts Sweden's only marine national park (Kosterhavet, bordering the Norwegian national park Hvaler) and substantial parts of the Swedish contribution to the Habitats Directive Natura 2000-network of protected areas.

Economy and users: There are numerous overlapping interest such as shipping, energy production, pipelines/cables, fisheries, recreational interests and conservation values. Ships bunker fuel here both at port and out at sea and the main part of Sweden´s fishing fleet is located and operating from here. Vessels from Norway, Denmark and Germany also fish here on EU agreements. Port of Gothenburg is by far Scandinavia's largest industrial port and many shipping companies and related businesses has their base for operations here. In many ways, this sea is the "gateway" to the other ocean basins.

Society and governance: The West coast hosts both Sweden's second largest city as well as rural coastal areas, the latter often with very high seasonality in population. The area features governance innovation and experiments with integrative and participatory character such as collaboration plans for coastal sustainability and conservation, coastal planning and integrated coastal zone management in the Gothenburg region and Northern Bohuslän. In northern Bohuslän a unique cooperative model for fisheries regulation has been accomplished by the "Koster-Väderöfjord agreement" and Co-management Norra Bohuslän (Cedergren et al. 2020, Piriz, 2004 and 2005). Moreover, the municipalities in the area were the first in Sweden to carry out extensive physical planning of their ocean space. The closeness to Norway and Kosterhavets National park's "sister" park of Hvaler has sparked numerous cross border collaboration projects. The Boarder Committee of Svinesund (a border committee under the Nordic Council of Ministers) has taken a particular interest in the blue economy and its possibilities as a cross border growing business-sector (Lundgren et al 2020). Although many human activities occur along the coastline, it is for example common for recreational sailors to cross over to Denmark via Kattegat or to Norway via Skagerrak and many coastal people and tourists have a relation also to the open sea.

Issues

- Conflict of goals between conservation of biodiversity and both old and emerging blue sectors, as well as between fisheries and the emerging offshore wind power sector.
- Keeping the relatively high environmental status at the same time as the blue economy is growing. This includes looking at the land-sea interactions to analyze how infrastructure on land affects the possibilities of development in the offshore zone.
- Strong ocean currents and rapid bio-fouling means that data acquisition is especially challenging. Currents also cause a massive occurrence of marine litter in the area.

Stakeholders

C2B2 LivingLab lead: CIT

Public sector: County Administrative Board Västra Götaland and Koster Sea National Park, Region Västra Götaland, City of Gothenburg,, Sotenäs Municipality and Symbiosis Center, Fiskekommunerna, Svinesundskommittén, 8-Fjords, OSPAR, SwAM, SEPA, SMA, Svenska kraftnät, Geological Survey of Sweden

Private sector: Fisheries Co-Management North Bohuslän, Sweden Pelagic federation, SeaTwirl AB, Hitachi Energy, Vinga Konstruktion AB Bottenlusen, LifeFinder Systems International AB, Sensative, Ecobarge Sweden AB, Clinton Marine Survey AB, Terntank, Cetasol AB, Zephyr Renewable AB, Inocean AB, Combine AB, Mooringo AB

Civil society: Sportfiskarna, Gullmarn secondary school, Koster Seafloor Observatory, Sailing4Science, The Swedish Society for Nature Conservation (SSNC), WWF, Keep Sweden Tidy, Strandstädarna

Academia: SIME, IHE, UGOT, Lighthouse (Chalmers), SWPTC (Chalmers)

Objectives of the LivingLab West

Scientific - ecosystem & climate	Improved understanding on the effect of fisheries and offshore wind farms on biodiversity based on additional/new data sources.
Technological & innovation	Improved offshore data coverage, by expanding both acquisition and uptake of data from robots, ships-of-opportunity and offshore installations. Expanded usage of methods critical for

	biodiversity (e.g., eDNA, image analysis by AI). Effective socio-ecological models and digital twins.
Governance & adaptive management	Incorporating socio-ecological models and digital twins in local and regional governance. Develop mechanisms for high stakeholder involvement and acceptance for resolving competition between fisheries, offshore wind power and conservation.

2.4 C2B2 advance beyond the State of the Art

Overall, C2B2 aims to bring about transformative change through participatory governance supported by relevant and insightful data and knowledge by re-imagining the role of quintuple helix actors across the blue economy in processes 'from data to knowledge to decisions and action'. C2B2 will implement its approach in three demonstration cases in real-life settings in the three main marine basins in Sweden, providing the basis for substantial theoretical and practical advances. Our co-created science-based ocean governance will include key stakeholders from the outset and extend current multi-stakeholder participation in marine environmental management with the sound integration of science, technology and innovation.

The overall C2B2 approach provides a major advance beyond the current State of Art by

i) going beyond a single-sector approach,
ii) implementing the quintuple helix concept at a practical level by using data to 'give nature a voice';
iii) extending the LivingLabs co-creation methodology to the complex setting of the sustainable blue economy,
iv) practicing responsible Action Research by initiating and developing these co-creation processes and embedding them as routines for participatory governance, to ensure the adoption of collaborative and adaptive management practices beyond the C2B2 programme lifetime, and
v) establishing a continuously evolving knowledge system for science-based ecosystem governance.

This provides the basis for paving the way for transitions towards governing multiple demands in increasingly claimed and fragile marine ecosystems. The extensive demonstration and validation of this approach in C2B2 means this can also be replicated elsewhere in Sweden and internationally.

Furthermore, C2B2 will provide progress beyond the current State of the Art in the following specific areas.

Land-Sea interactions

Current SoA: What we can do out at sea is to a large extent decided by how we plan and use our coastline. Activities in our off shore zone depend on infrastructure and materials on and from land. There is a growing competition along our coastline between real estate development in attractive locations on the one hand, and infrastructure for industry on the other. Ports and maintenance facilities are being pushed away further from cities and other infrastructure, hindering the development of offshore activities and services. The development and establishment of underwater cables, wind turbines and other equipment out at sea also requires connections to, and infrastructure on, land.

C2B2 advance beyond SoA: The value of the blue economy may originate from an offshore area in terms of i.e. biomass uptake, but the value chain very much continues on land where the larger part of the value is created. Hence, when we are discussing the blue economy, we also need to consider value chains and value chains certainly move up on land. In the C2B2 programme, we will therefore look at the connections between the value generated in the offshore area, mapping specific value chains, and thus mapping how potential new governance methods would affect the generated value, job opportunities and of course the environment. This includes understanding how existing value chains in traditionally land-based sectors in Sweden could become part of new sustainable blue value chains (e.g., water and wastewater treatment, modular plug-in approaches, electrical appliances, IT, tourism).

Quantifying effects of offshore installations on biodiversity

Current SoA: Biodiversity is increasingly recognised as a fundamental aspect of a healthy ocean and a cornerstone for marine ecosystem services and a sustainable blue economy. Correspondingly, the importance of surveying and monitoring marine biodiversity is increasingly accepted. Currently this is done by means of identifying species in samples of water or sediment, and to some extent in images/videos. This time-consuming work requires highly trained specialists. Strict prioritising is necessary, in terms of species, sampling frequency and spatial cover. The detrimental effect on biodiversity from large scale and intense fisheries has been established, including from trawling. The same can be said about the effect from intensely trafficked seaways and ports, including from smaller boats and marinas. While the environment of the (shallow) offshore domain is now being transformed by the rapid expansion of permanent installations in the shape of wind farms, very little is known about the effects on biodiversity by offshore installations.

C2B2 advance beyond SoA: C2B2 will address this gap by providing baselines for biodiversity and realistic methods for effective monitoring during the full life cycle of offshore wind farms. C2B2 will show how data intense and broad sampling methods (like eDNA and video analysis using AI) will allow for quantification of possible detrimental effects

on biodiversity during construction, operation and decommissioning. It will also allow quantification of the much speculated about possible positive effects on biodiversity from wind farms, by the introduction of hard surfaces (artificial reefs) and by shifting spatial usage away from detrimental fisheries and shipping.

Use of open by design, multi-purpose offshore infrastructure

Current SoA: Multipurpose offshore infrastructure is increasingly hailed as a way to address issues arising from the multiple demands placed in coasts and seas, while meeting growing demands through the integration of various user functions in a single unit (Schupp et al., 2019). Large and small offshore, multifunctional solutions (incl. floating) are increasingly highlighted as viable options for providing services (Dafforn et al., 2015; Huang et al., 2018) while improving effective resource use, decreasing economic risks for investors, and avoiding potential conflict over land disputes as they are perceived as less intrusive to existing land-based socio-economic activity. The most known example is that of Multi-Purpose Platforms (MPPs) or Multi-Use Platforms (MUPs), which are offshore platforms serving the needs of multiple offshore industries (e.g., energy and aquaculture). These platforms aim at exploiting the synergies and managing the tensions arising when closely co-locating systems from these industries (Abhinav et al., 2020). The literature in MPPs and MUPs is however, relatively recent, and there are many aspects that are yet to be explored and contextualized, including the connection between multifunctionality and open by design. Moreover, there is an important local element connected to regulations, permits, and the web of actors involved in the marine space, which make it fundamental to assess multifunctional interventions on a case base (Przedrzymirska et al., 2021).

C2B2 advance beyond SoA: C2B2 will advance knowledge of multifunctional interventions, including the potential of less explored characteristics such as modularity, mobility and open by design. This includes exploring the conditions which can allow organizations across sectors in the marine space to design open and multifunctional services and applications, but also, whether and how open and multifunctional services and applications can in turn enhance synergies through collaboration among actors and ultimately change the way we plan, govern and monitor our seas. An important characteristic of open by design is agility – the ability to adapt or reconfigure production systems (Gligor et al., 2019). C2B2 will explore what more agile blue systems could look like, whether in the deployment of offshore monitoring devices, in the business model of a firm, or in the design of marine spatial plans.

Open data collection platforms for knowledge co-creation

Current SoA: Both in Europe and globally, there has been huge progress during the last decade towards harmonising and collaborating on marine environmental monitoring, and subsequently aggregating and making the data openly available. This creates superior value and usefulness for any given monitoring effort. However, just as importantly, collaboration on marine environmental monitoring creates (and indeed requires) close partnerships across boundaries of organisations and countries. We are starting to see cross-fertilisation of ambitious multi-actor efforts in the full process of knowledge creation, tackling issues of increasing complexity and scope. However, these partnerships around marine data collection are currently still limited to established public agencies and academia, and they do not yet include the private sector and civil society sufficiently. Truly open platforms for data collection create (and indeed require) close partnerships between a wider range of new actors from different sectors of society, in order to solve technological and operational challenges.

C2B2 advance beyond SoA: C2B2 will demonstrate technically and operationally open platforms for data collection. By doing so, we will show that the current benefits of partnerships between established monitoring agencies and professionals can be taken to a new level by including the private sector and civil society. Most importantly, new actors will raise new questions re. what data should be collected, how, and why. C2B2 will break up established assumptions of what ocean knowledge we need and who will be involved in co-creating that knowledge.

Marine data stewardship

Current SoA: Marine environmental data are today often aggregated at international joint services, for the benefit of all organisations and individuals. The EU has been very active in promoting this, under the Copernicus umbrella and with services like EMODnet and SeaDataNet. Aggregation and openness mean that well-designed methods and protocols for both data provision and extraction are absolutely essential, including machine-to-machine interfaces (APIs, Application Programming Interfaces). Experienced data professionals at traditional monitoring organisation (for example SMHI in Sweden) set up new data streams, make adjustments and amendments to existing streams, and routinely run into issues and challenges that have to be solved. The data aggregating services offer support and help functions ('data stewardship') for both, data suppliers and data users, and they provide education and capacity building, primarily to public agencies. The possibility of including data sources outside of dedicated national monitoring agencies, for example those from Citizen Science and from industry, have gained recent attention. Correspondingly, the EU also wants its aggregated data to be used (and provided) by a wider set of organisations and individuals, outside of the traditional realm of large national agencies and academia. However, expanding the group of data users and providers to more actors and new sectors will generate a radically expanding need for data stewardship, which is currently not available. Such data stewardship will require more than education. It will require continuous attention and support,

including with nitty-gritty details such as file formatting. Such stewardship will require both competencies and time at a level that can only be expected in-house in large organisations but not in smaller organisations, incl. civil society.

C2B2 advance beyond SoA: C2B2 will focus strongly on data, as expressed in our motto 'from data to knowledge to decisions & actions', see sections 2.2 and 2.3. In a quintuple helix (academia, industry, public sector, civil society, natural environment), four of the branches can be represented by people and organisations, but the natural environment can only be represented by data. C2B2 will reach its vision to a large extent by letting people from different sectors provide and use marine data, to interpret and create knowledge from marine data, and to take action they believe in. We are absolutely convinced of the transformative power of opening up this process, but at the same time we are acutely aware of the data-related challenges involved in doing so. C2B2 will facilitate marine data stewardship for all actors, including new providers and/or users of marine data. Central for this effort are our partners Swedish National Data Service (SND) and SMHI, which is Sweden's designated National Oceanographic Data Centre. SND and SMHI will work within C2B2 to set up a national structure for marine data stewardship.

Participatory governance

Current SoA: Governance research across various fields increasingly agrees on a number of basic characteristics, principles and requirements for successfully addressing the challenges identified earlier for governing for a better blue in a changing sea and climate: integration across sectors, knowledge types, disciplines, governance tiers, geographical boundaries and scales to match to the issues to address; experimentation, adaptation and learning to address uncertainties, participation, inclusiveness and empowerment, legitimacy and transparency, capacity and resources (Bohman, 2019; Halbe and Pahl-Wostl, 2019; Karlsson, 2019; Loorbach, 2010; Prutzer, et al., 2021; Wehn. et al., 2018). Yet a deeper understanding of governance gaps and development needs, and what needs to be prioritised, both in specific cases and in Sweden in general, is still missing.

C2B2 advance beyond SoA: The combined bottom up and top down approach of C2B2 will generate the scientific understanding of how we can move from single-use, single-sector practices towards truly integrative, multifunctional ecosystem-based governance. Existing theory, analysis of existing multi-level governance structures, approaches and resources (principles, agreements, directives; legislation, strategies and policies, financial resources, MSP, integrated and sector management), scenarios of transition, comparative policy-based tools and international collaboration will be combined with emerging insights from actual practice related to participatory governance and adaptive management in the LivingLabs. This will allow C2B2 to generate a better understanding of the (often region- and place-specific) land-sea linkages of key economic activities and the distribution of benefits, costs and regulations, mandates and responsibilities along these lines, and where radical changes and where incremental adjustments to the status quo can lead to beneficial outcomes for society and biodiversity. C2B2 will provide a provide a global to local perspective on good practices for MSP and integrative marine and coastal management.

3. Benefits to society

The C2B2 programme has been specifically designed to deliver a 'co-created better blue' which - by its very design - consists of highly developed collaboration with the users of the research results, namely the diverse set of stakeholders involved in multi-level participatory governance of the ocean. In its demonstration activities, C2B2 directly works with blue economy sector actors; citizens, communities (from diverse backgrounds) and civil society organisations; municipalities and local authorities; regional and national agencies and policy and decision makers; scientists from diverse disciplines as well as (commercial) data aggregators, technology developers and SMEs. Moreover, the C2B2 programme will generate a range of benefits to society beyond those delivered for stakeholders in the demonstration cases: *social* by reshaping our relationship with the ocean and benefiting broad groups*; institutional* by enabling cross-sectoral dialogue, enhancing marine spatial planning via multi-functionality and contributing to Sweden's digitization strategy; and *economic* by contributing to enhancing Sweden's competitiveness and prosperity.

Reshaping our relationship with the ocean

One of the specific aims of C2B2 is to reshape our (societal) relationship with the ocean. 'Being out there' in various forms and more permanently means a larger part of society has a stake in the ocean. ***C2B2 will instil new ways of working together and practicing science-based participatory ocean governance, so that more actors and individuals have a direct stake offshore.*** This will affect place-based social cohesion and relations to the sea including stronger social, cultural and economic links to the offshore environment, sustainable employment opportunities and value chains within an increasingly sustainable blue economy. Moreover, the C2B2 approach is inherently inclusive, equitable and gender-equal (see also section 4) and the programme – during its very implementation – is designed to benefit not merely the 'privileged few' but broad groups that otherwise often remain disadvantaged and/or excluded from governance relevant processes, economic opportunities and cultural experiences, including those related to the ocean.

Enabling cross-sectoral dialogue in Sweden

Expectations about the services and resources that can be derived from our seas and the opportunities for job creation and economic growth derived from these activities seem to grow with every new outlook. This raises concerns over the

future health of the ocean. In Sweden, the North Sea and the Baltic Sea have long been important spaces for economic development and trade and are expected to play a vital role in the transition to a fossil-free society. However, they also face serious environmental impacts that jeopardize ocean health, which is the basis for a sustainable blue economy.

There is an urgent need to find solutions to common challenges and break away from sectoral thinking. Such an approach requires a fundamental shift in how our ocean is valued and exploited and an integrated and adaptive ecosystem-based management for our seas. This is highly ambitious since such an approach demands better alignment of regulations, planning, and monitoring criteria with ecosystem boundaries. It demands a fundamental shift in how we organize and utilize the marine space that goes beyond prioritizing economic growth only, to ensuring a more effective delivery of multiple gains for society, the environment, and climate.

It is therefore fundamental to understand both the status as well as the potential of the sustainable blue economy. If we neglect the industrial and economic expansion towards marine areas and fail to integrate the ecosystem approach with a socio-economic one, there is a risk of unplanned growth at the expense of marine ecosystems and social justice. Thus, ***the proposed C2B2 programme provides the unique opportunity to talk and learn about a growing sustainable blue economy, if we are to avoid the same mistakes committed onshore.*** C2B2 will enable this dialogue and tackle difficult conversations by creating an environment of collaboration and creativity.

Enhancing marine spatial planning in Sweden

There is a need to include the biosphere into our forecasts of a sustainable blue economy and move beyond the dominant single-use and single-sector paradigm. This demands a move towards approaches that can facilitate the combination of activities for multiple social, economic and environmental gains.

Multifunctional planning is highlighted in both research (Przedrzymirska et al., 2021) as well as in national policy (HaV, 2020; Miljömålsbereddningen 2020; Nyström Sandman et al., 2020) and local management (Schubert et al., 2018) as a potential planning mechanism to ensure more sustainable marine practices. Multifunctional planning through co-use, coexistence, or co-location of activities and resources offers a way out of the silo paradigm (Schupp et al., 2019). Multifunctionality is closely related to the ecosystem approach through a systems perspective. However, multifunctionality goes beyond landscape traits to also incorporate human-made artifacts, value chains and services (Barquet & Green, 2022).

Marine spatial planning provides a clear entry point to operationalize multifunctionality, in that it is foreseen to help optimize 'the use of marine space to benefit economic development and the marine environment' (European Commission, 2008). It is closely related to resource-sharing, which makes it an important instrument of circular economy, and has therefore received increased attention and support from the EU Commission (though still absent in the Marine Framework Directive).

An important part of multifunctionality is the shift away from sectoral goals towards a mission-oriented approach (European Commission, nd). This demands a shift in focus from ad hoc investments, such as single purpose infrastructure, towards actions that are steered towards transformational changes - such as the development of new general-purpose and cross-sectoral solutions (Mazzucato, 2016). ***C2B2 will pave the way by demonstrating how this can be done in practice.***

Contributing to Sweden's digitalization strategy

An important part of the Swedish governance system is its aim to connect decision-making with scientific evidence, where data is seen as an increasingly important prerequisite for innovation, sustainable growth, and reduced resource consumption.

The goal of a science-informed governance system is reflected in the country's national strategy to become a world leader in data-sharing, Artificial Intelligence (AI) and digital innovation with the aim of strengthening welfare, competitiveness and a sustainable society (Regeringen, 2021).

Transforming data to knowledge is a central aspect in the transition towards smart maritime governance. For instance, SwAM's report for Marine Spatial Plan in Skagerrak and Kattegat highlighted that better knowledge of cumulative effects on ecosystem values are found near the coast due to higher data availability (SwAM, 2018). Thus, incorporating mapping results of marine values and involving academic actors are priorities to increase knowledge generation and reduce uncertainty in the marine spatial planning process (Karlsson, 2019).

Recent experiences from the Nordic Innovation Organization showed that hackathons are prominent tools aimed at promoting visibility of public data and establishing synergy between multiple societal sectors by working together towards a common goal. These activities can contribute to Sweden's efforts of connecting knowledge with private sector initiatives in order to develop innovative solutions for the blue economy. Results from this can contribute to promoting Sweden's leadership in digitalization and responsible use of open data.

In line with the Green Deal, ***C2B2 will contribute to Destination Earth Initiative*** - the EU's next step to develop a Digital Twin of the Ocean. The Digital Twin Ocean's ambition is to make ocean knowledge readily available to citizens, entrepreneurs, scientists and policymakers to design the most effective ways to restore marine and coastal habitats,

support a sustainable blue economy and mitigate and adapt to climate change. ***C2B2 will strengthen marine data stewardship, paving the way from Data – Knowledge – Decisions & Actions.***

At a broader level, ***C2B2 will promote advanced technology, which can help address complex problems and demands.*** Data and digitalization used in governance and planning provides opportunities to contribute to new understandings on the interactions between ecosystems and human activities, as well as new means for monitoring and use of marine resources and the impacts from such use.

Promoting Sweden's competitiveness and prosperity

Europe's blue economy provides 4.5 million direct jobs and is a fast-moving segment of the EU economy (European Commission et al., 2021). The blue economy has modernised, diversified and innovative sectors have evolved providing new prospects and creating jobs. This trend is expected to follow in the rest of the world, so that by 2030 the blue economy is expected to double both in terms of value added and employment but with a high risk of ocean ecosystem degradation.

Shipping is the most important sector of the Swedish blue economy, with a yearly turnover of 85 billion SEK. More importantly, around 90 % of Sweden's export and import of goods pass through Swedish ports, and in addition 67 million persons per year (Maritime Cluster of West Sweden, 2022). Ongoing research and innovation efforts are focusing on the dramatic challenge of maintaining this lifeline, while at the same time improve sustainability, including the shift to *fossil free shipping* (Lighthouse, 2021). ***C2B2 will bring together key stakeholders and the most active research environments in co-creation in three LivingLabs focused on some of the most crucial shipping areas for Sweden***, exposing the urgent efforts of the shipping sector to the realism of competing or possibly synergetic interests of the other main sectors of the expanding blue economy.

Fisheries today are a much lesser economic activity in Sweden, corresponding to about 1.4 billion SEK per year (Fiskbranschens Riksförbund, 2022). The sector used to contribute with a significant part of Sweden's food supply (historically even a crucial role for city populations' survival) and maintains strong local importance. Currently the Swedish offshore fishery is largely disconnected from the main value chains in Sweden, with Swedish catches being landed abroad and used as animal feed, while the Swedish sea food industry uses imported catch and cultivated fish (Hornborg et al. 2021). The current emphasis on producing seafood by aquaculture is focusing on the coastal zone, because of the much larger physical and logistical challenges offshore. ***C2B2 will provide knowledge about how a sustainable fishing sector can exist in tomorrow's blue economy.*** C2B2 will do this by focusing on high nutrient and novel seafood, on innovation and multifunctionality, and on viable value chains in three areas with widely different characteristics, both environmentally and economically.

Tourism is a very important sector in the Swedish economy, contributing to about 10 % of both BNP and employment (Maritime Cluster of West Sweden, 2022), with a large share focused in coastal areas. Marine offshore tourism is a small segment, possibly of emerging significance. ***C2B2 will demonstrate new forms of sustainable tourism in the offshore domain.*** More accessible technology and infrastructure (sensors, cameras, communication, automation, robotics) together with *fossil free boating* has the power to transform marine offshore tourism into a broad activity, centered around experiencing marine life, history and archelogy, citizen science and technology (not necessarily expensive or fast boats). C2B2 will demonstrate that Sweden both has the offshore sites that can rival the most exotic places on land (both on site and from the sofa) and the knowledge to create a new technologically advanced and sustainable tourism segment.

Marine renewable energy production is listed as an established sector by the European Commission and the EU now has a total installed offshore wind capacity of 15 GW across 11 countries (European Commission, 2021). Even though Europe is by far the world leader, Sweden is currently a long way behind the leading European countries. Sweden plans to change this dramatically within the coming two decades. Sweden's current wind power capacity of around 10 GW (almost all on land) is set to more than double by 2040, mostly by expansion offshore (Svensk Vindenergi, 2021). The transforming power of this should not to be underestimated. The wide introduction of hard surfaces and stable mounts, of access to power and to fast data communication will transform how Sweden interacts with its offshore domain. ***C2B2 will demonstrate the far-reaching scope for cascading effects and opportunities in the offshore energy economy***. An illustrative and much mentioned example (e.g. European Commission, 2021) is the prospect of co-locating offshore wind farms and aquaculture, possibly upending the challenges mentioned above. However, C2B2 will demonstrate that the synergetic effects can transform all sectors of Sweden's blue economy, including shipping and tourism, as well as our capacity to monitor and create knowledge about the ocean environment. The vast majority of existing plans (and all mature plans) for offshore wind in Sweden are for bottom-fixed solutions. Given the huge implications of the existing plans, we believe it will be sufficiently challenging to consider these within C2B2. Among our associated partners we also have leading expertise in floating offshore wind solutions, which is increasingly looking like a possible game changer in the (not so distant) future.

4. Management and organisation

The overall C2B2 governance structure has been designed for effective and efficient programme delivery via strategic, executive and operational levels and is illustrated in figure 4.

C2B2 is hosted by the University of Gothenburg (UGOT), which will appoint the programme board in consultation with, and following approval by, Mistra. The programme board will be responsible for the strategic management of C2B2 (incl. for the 10% reserve from the budget, as requested by Mistra) and take decisions to be implemented by the subordinate programme director. The responsibilities of the programme host, the board and the programme director are clearly stated in the instructions for Mistra programmes and will be implemented accordingly.

The programme host UGOT is Sweden's most important marine university, host to a number of organisations and centres of paramount importance for science-based ocean governance, including the Swedish Institute for the Marine Environment (SIME) and the Swedish National Data Service (SND). UGOT is furthermore *alma mater* to the largest share of marine professionals in Sweden, including many of the staff at Swedish Agency for the Marine and Water Management (SwAM) and the marine section of Swedish Meteorological and Hydrological Institute (SMHI), with its offices located in Gothenburg.

Final responsibility for programme execution and the delivery of the programme outputs rests with the host. C2B2 will be **embedded in Sweden's largest university** (by numbers of students 2021). UGOT will support the programme management with its dedicated functions for HR, legal affairs (including agreements), procurements, communication and media technology. Administratively, C2B2 will be embedded in the UGOT Faculty of Science, at the Department of Marine Sciences (DMS), which is the node of UGOT's marine profile area, ensuring close connection with all relevant scientific disciplines. The department will support C2B2 with financial control, including communication with financial staff of partners and associated partners.

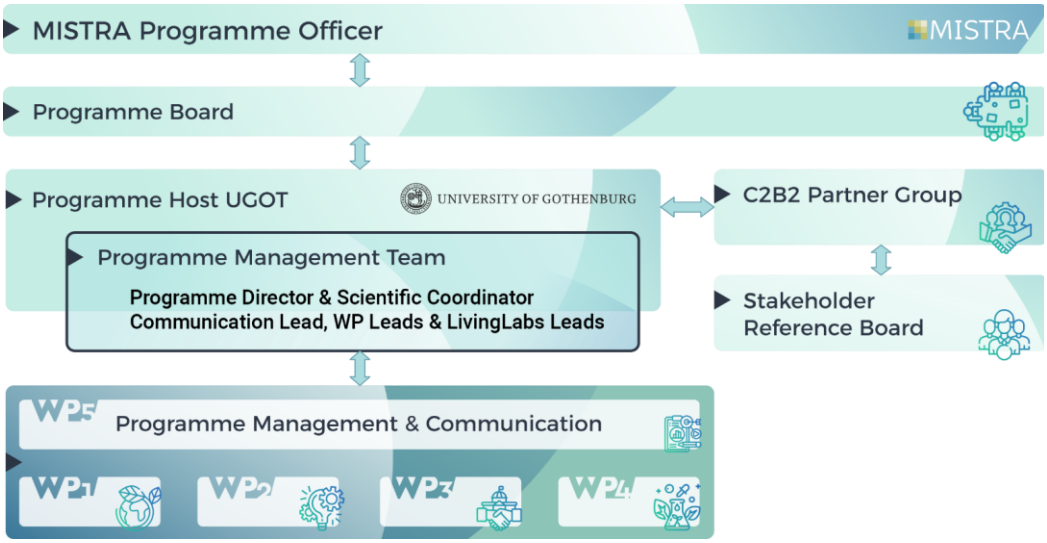

Figure 4 C2B2 governance structure

C2B2 will work very closely with UGOT Centre for Sea and Society (hosted by DMS), **ensuring close engagement of key societal stakeholders and the transdisciplinary research** being fostered by the centre. C2B2 will furthermore work closely with UGOT Marine Infrastructure (also hosted by DMS), which includes two research stations (Kristineberg Center for Marine Research and Innovation and Tjärnö Marine Laboratory) and a large research vessel (R/V Skagerak)

C2B2 is managed by means of coordinating and instilling efficient decision making, by monitoring progress, by facilitating collaboration and synergies across the WPs and LivingLabs, and by proactively preventing and resolving conflicts. The management aims are:

- compliance with the programme plan and consortium agreement (= *we do what we said we would do*),
- efficient use of programme resources (= *we do not waste resources*)
- communication and dissemination of programme results (= *outcomes and impacts are what count*)

Programme management and communication are operationalized in WP 5 (led by the programme director). To achieve the management aims, the programme director has an executive programme management team, made up of

- the scientific lead (SL), who serves as deputy PD, responsible for the overall C2B2 conceptual coherence and the coordination of the transdisciplinary research processes across the WPs and in the LivingLabs, and also leads WP 4,
- the communication lead (CL),
- the leads of WP 1 – 3 and the leaders of the three LivingLabs.

The programme director, the scientific lead and the communication leader make up the highest executive level, working side by side on a daily basis. The full management team will have formal meetings at least every month, and more frequently during intense coordination periods.

The proposed PD is **Dr. Torsten Linders**, who is already centrally positioned in the dynamic cross-sector marine innovation around UGOT. Linders is currently coordinating both Ocean Data Factory Sweden (ODF) and Swedish Centre for Ocean Observing Technology (SCOOT), which are the arenas from which the C2B2 consortium has grown.

The proposed SL is **Prof. Uta Wehn**, who is Associate Professor of Water Innovation Studies at IHE Delft in the Netherlands, and a world leading expert on co-creation, open science and citizen science in water and environment. Wehn is also the Adlerbert Visiting Professor of Marine Citizen Science at UGOT.

The proposed CL is **Maria Holmkvist**, who is the leading communicator of both the Maritime Cluster of West Sweden and the UGOT Centre for Sea and Society. In Sweden, Holmkvist has unrivalled experience both in marine science communication and in facilitating cross-sector interaction in the marine domain.

The leaders of the WPs are WP1 - **Prof. Mats Lindegart** (UGOT), WP2 – **Prof. Mikael Lind** (RISE), WP3 - **Dr. Andrea Morf** (SIME) and WP4 - **Prof. Uta Wehn** (IHE). The leaders of the LivingLabs are North – **Prof. Nick Kamenos** (UMF), East – **Dr. Karina Barquet** (SEI) and West - **Jessica Hjerpe Olausson** (CIT).

The programme management team works in close communication with all C2B2 partners. All partners are represented in the C2B2 Partner group, which will meet jointly at least twice a year, to ensure coherent and joint vision and understanding of the programme activities.

The Stakeholder reference board is made up of representatives of 25 confirmed associated partners. **All 13 C2B2 partners have contributed to recruiting the current associated partners who will also work in different WPs, including in the LivingLabs**. This board will meet jointly with the C2B2 Partner group at least once a year.

The CL supports the PD with internal communication (as well as external), which will be of pivotal importance, given the large group of C2B2 partners and associated partners and the intense collaboration needed to deliver the programme outputs. During the programme period, we will actively encourage and invite more stakeholders to join the work in C2B2, especially the LivingLabs and the Stakeholder reference board. The CL has a crucial role in this outreach.

All deliverables will be subjected to **quality control** before being released, by technical experts not involved in the deliverable production. These experts are assigned by the PD or the SL. The PD is responsible for ensuring that all partners and associated partners are aware of programme procedures. The SL is responsible for regular review of cumulative results of T4.5 (Peer learning & Capacity Building) and T4.6 (Evaluation) and to initiate appropriate adaptive action as needed. For all formal meetings arranged by the programme, an agenda will be prepared along with a brief note describing the background to the agenda items, and the issues expected to be discussed and resolved. This will be distributed in advance to all participants in the meeting.

The PD is responsible for fostering a **good working environment of the programme** (not inflicting on the formal responsibilities of any organisation as employer). The PD is in this respect advised by the relevant functions at UGOT. Collaboration is at the heart of the C2B2 vision and reflected in the programme activities. The C2B2 partners, and most of all, the partners making up the programme management team, have jointly prepared this proposed programme plan. Before the programme start, a consortium agreement will be drafted by UGOT's legal office and then thoroughly discussed and agreed by the consortium. The joint preparation and detailed understanding of the programme plan and the consortium agreement form the basis for minimizing disagreements and conflicts within C2B2. **Internal communication channels** and the joint meetings for partners and associated partners are important tools for sharing updates about progress and challenges, and thus preventing misunderstandings, disagreements and conflicts. **The CL has a crucial role here**. WP leaders have a responsibility to work proactively for preventing conflicts in their WPs, for promptly acting when needed and for reporting to the PD and the executive team. The LivingLab leaders, who firstly communicate with the WP 4 leader (i.e. the SL), have the corresponding responsibilities. Final authority to resolve disagreements rests with the programme board. Gothenburg Centre for Sustainable Development (GMV) is UGOT's and Chalmers' joint centre for practical implementation of sustainable development at these universities. The PD is responsible for C2B2 making use of the extensive resources and support available at GMV and for C2B2's adherence to UGOT's current (and updated) policies about climate footprint ("Implementera Klimatramverket", vice-chancellor decision 2020-February-27), and about gender, equality and inclusion ("JiGU", vice-chancellor decision 2020-May-26).

5. Skills and networks

The consortium brings together key partners with the core skills and competences needed to implement the transition towards co-created science-based ocean governance (see also Table 5):

1. University of Gothenburg (UGOT) conducts Sweden's broadest research on marine ecosystems and the ocean's role in the climate system and the economy and society.
2. Research Institute of Sweden (RISE) conducts research in close collaboration with industry and public sector. RISE Maritime provides C2B2 with competence and network in all established and emerging offshore sectors.
3. Chalmers is one of Europe's leading technological universities, with Sweden's strongest research in maritime technology, e.g. hosting the Swedish Wind Power Technology Centre. Chalmers also hosts Lighthouse, which is the neutral collaboration platform for research, development and innovation in the maritime sector of Sweden.

4. Swedish Institute for the Marine Environment (SIME) brings together five Swedish marine universities, acting as a transdisciplinary knowledge provider for Swedish authorities and society, notably the Swedish Agency for Marine and Water Management, and has expertise in related policy processes.
5. Chalmers Industriteknik Group (CIT) conducts research and development with the aim of strengthening Swedish innovation capacity and utilizing research.
6. Umeå Marine Sciences Centre (UMF) is a unit at Umeå University. UMF is Sweden's primary competence centre of marine ecosystem and climate of the northern part of the Baltic Sea (Gulf of Bothnia).
7. Stockholm Environment Institute (SEI) is an international research and policy organization bridging science and policy. SEI has seven centres outside of Sweden, including one in Estonia and two in the UK. Through its Tallin and Stockholm offices, SEI has a long tradition of working on innovation in the Baltic Sea Region
8. World Maritime University (WMU) is the premier centre of excellence for the International Maritime Organization (IMO, the specialized shipping agency of the United Nations). WMU conducts unique postgraduate education, research and international capacity building for sustainability.
9. Swedish National Data Service (SND) has a primary function to support FAIR data (Findable, Accessible, Interoperable, Reusable). SND leads a network of around 40 universities and public research institutes, forming a national infrastructure for open access to research data.
10. Stockholm University (SU) provides C2B2 with competence in environmental law and policy.
11. IVL Swedish Environmental Research Institute provides C2B2 with competence in environmental law and first-hand experience in national politics, governance and policy processes.
12. Swedish Meteorological and Hydrological Institute (SMHI) is Sweden's expert authority with the mission to forecast changes in weather, water and climate, as well as the designated National Oceanographic Data Centre.
13. IHE Delft provides key competencies in co-creation methodologies using LivingLabs applied to diverse water and environment challenges as well as relevant social science expertise for governance analysis, environmental policy and impact assessment. IHE works under the auspices of UNESCO and forms part of the UN Water family.

Table 5 C2B2 expertise (per partner)

C2B2 partner expertise	**1. UGOT**	**2. RISE**	**3. Chalmers** Lighthouse	**4. SIME**	**5. CIT**	**6. UMF**	**7. SEI**	**8. WMU**	**9. SND**	**10. SU**	**11. IVL**	**12. SMHI**	**13. IHE**
Scientific expertise (natural & social sciences)													
Marine ecosystem science	■			■		■						■	
Climate science	■		■			■						■	
Ocean gov. & adaptive mgt	■			■			■	■					■
Environmental law								■		■	■		
Social learning, social innov.				■			■						■
Value chains & land-sea connct.		■	■		■		■	■					
Data & technology development													
Data mgt & data stewardship	■	■	■			■	■			■			■	
(Low-cost) sensor development		■	■										
GEOSS, Copernicus, EOSC	■	■							■			■	■
Fusion of in-situ & satellite data		■	■										
Decision & visualiz. systems		■	■										
Offshore tech. & innovation		■	■										
Stakeholder engagement & communication													
Stakeholder engagement	■	■	■		■		■						■
LL & co-creation methodologies		■		■		■	■						■
Comms. & dissemination	■	■		■	■	■	■			■			■
Uptake of data in res. & policy				■			■				■	■	■
International networks & reach							■	■					■
Innovation management													
Cascading funding, public procur.		■	■										■
For/non-profit business models							■						■

High attention has already been paid to **gender balance and equality in the research team** during the programme proposal phase. Indeed, the composition of the key staff involved in the programme is gender-balanced (see Annex II – CVs) and so it the lead of the four content-focused WPs: Mats Lindegarth (m) (WP1), Mikael Lind (m) (WP2), Andrea Morf (f) (WP3) and Uta Wehn (f) (WP4). C2B2 will directly integrate a gender-focused approach in all its activities via

strong attention to gender balance in the recruitment of new personnel (PhD/researchers) and by promoting the participation of female stakeholders in the Livinglabs. C2B2 will participate in the promotion of gender equality in R&D in line with the EC Commission's Gender Equality Strategy (2020-2025) and apply the methodological tools provided by the most recent Gender Innovations Report (EC, 2022), resulting in a gender-equality plan to be produced by WP5 during the inception phase of the programme.

The programme will include **industry and public sector organisations** as associated partners. The public sector organisations to be involved include SwAM, SMHI, Geological Survey of Sweden (SGU), municipalities, and County Administrative Boards in the three LivingLab areas, Swedish Maritime Administration, and the National Grid (Svenska kraftnät).

Industry actors include offshore installation companies Svea Vind Offshore, Liquid Wind, offshore companies Clinton Marine Survey, Hitachi Energy, Fossil Free Marine, Inocean and Sea Twirl; shipping and boating companies Terntank, Ecobarge, Marell Boats, Sensative, Vinga Konstruktion and Mooringo; large and small fisheries; and data companies Combine, Maranics, LifeFinder, and Cetasol.

Civil society actors (e.g., environmental, local resident, end user and entrepreneurial organizations) for each LivingLab will identified, advancing from the initial analysis during the proposal stage, and will be recruited during the inception stage.

Together, these organisations will strengthen the sector expertise (shipping, fisheries, offshore) required to implement the C2B2 programme activities and to ensure their sound embedding in the respective contexts of the case study areas.

Table 6 Already committed stakeholders (C2B2 associated partners)

	Shipping (incl. leisure boating)	**Fisheries**	**Offshore installations**
LL North	LifeFinder Syst. International AB Sensative AB Ecobarge Sweden AB, Terntank AB, Cetasol AB, Sveavind Offshore AB *County Board Admin. Gävleborg* *Swedish Maritime Administration*	Sweden Pelagic Federation, LifeFinder Syst. International AB Ecobarge Sweden AB, Cetasol AB, Sveavind Offshore ABCombine AB *County Board Admin. Gävleborg* *SwAM* *Geological Survey of Sweden*	Hitachi Energy AB LifeFinder Syst. International AB Ecobarge Sweden AB, Clinton Marine Survey AB, Cetasol AB, Sveavind Offshore AB *County Board Admin. Gävleborg* *Svenska kraftnät,* *Geological Survey of Sweden*
LL East	LifeFinder Syst. International AB Sensative AB Fossil Free Marine Europe AB, Ecobarge Sweden AB, Marell Boats AB, Terntank AB Cetasol AB, Sveavind Offshore AB *County Board Admin. Gotland,* *Region Stockholm,* *Swedish Maritime Administration*	Sweden Pelagic Federation, LifeFinder Syst. International AB Ecobarge Sweden AB, Cetasol AB, Sveavind Offshore AB Combine AB *County Board Admin. Gotland,* *Gotland municipality,* *Blue Center Gotland,* *Region Stockholm,* *SwAM* *Geological Survey of Sweden*	Hitachi Energy AB SeaTwirl AB, LifeFinder Syst. International AB Fossil Free Marine Europe AB, Clinton Marine Survey AB, Windeed AB, Cetasol AB, Sveavind Offshore AB *County Board Admin. Gotland,* *Gotland municipality,* *Blue Center Gotland,* *Region Stockholm,* *Svenska kraftnät* *Geological Survey of Sweden*
LL West	LifeFinder Syst. International AB Sensative AB Ecobarge Sweden AB, Terntank AB, Cetasol AB, Vinga Konstr. AB Bottenlusen, Mooringo AB *City of Gothenburg* *Region of Västra Götaland,* *Swedish Maritime Administration*	Sweden Pelagic Federation, Ecobarge Sweden AB, Cetasol AB, LifeFinder Syst. International AB Combine AB *City of Gothenburg* *Region of Västra Götaland,* *Fiskekommunerna* *Boarder Committee of Svinesund* *8-Fjords* *SwAM* *Geological Survey of Sweden*	Hitachi Energy AB SeaTwirl AB, LifeFinder Syst. International AB Clinton Marine Survey AB, Cetasol AB, Zephyr Renewble AB Inocean AB *City of Gothenburg* *Region of Västra Götaland,* *Svenska kraftnät* *Geological Survey of Sweden*

Note: Separated per LivingLab area and the three blue economy sector interests (shipping, fisheries, offshore installations). Shipping also includes leisure boating. Several organisations are interested in more than one LivingLab and/or more than one sector. *Public sector organisations are indicated with italics.*

The C2B2 programme activities will benefit from the strong **institutional relationships, networks** and initiatives of the C2B2 programme partners and associated programme partners, which include tight links with ongoing and newly

funded EU projects (e.g. ILIAD – Digital Twin of the Ocean, ASTRIIS Digital Twin), the Ocean Knowledge Action Network, the Helsinki Committee (HELCOM) Marine Spatial Planning Working Group and existing networks (e.g. Innovation Platform for Sustainable Sea & Ocean Solutions (ISSS), the International Council for Exploration of the Seas (ICES), the Oslo and Paris Convention (OSPAR Commission) and activities related to UN Decade of Ecosystem Restoration and the UN Decade of Ocean Science for Sustainable Development. Moreover, three C2B2 partners (SEI, WMU, IHE) have a strong international orientation and networks, with WMU and IHE formally linked into the United Nations system (IMO and UNESCO, respectively).

6. Description of work packages, including deliverables

The C2B2 programme will be implemented via five interlinked WPs, aimed at triggering a robust, inclusive and just transition towards participatory ocean governance. The work structure includes three WPs that consolidate and advance the three pillars of an evolving knowledge system for participatory ocean governance: science (WP1), technology & innovation (WP2) and governance practices (WP3). WP4 is the demonstration of co-creating participatory ocean governance in LivingLabs in the three C2B2 case study areas in Sweden, based on and in close interaction with WPs 1-3. The programme management and communication in WP5 will ensure the smooth progress of all C2B2 activities and the wide communication, dissemination and exploitation of the programme results.

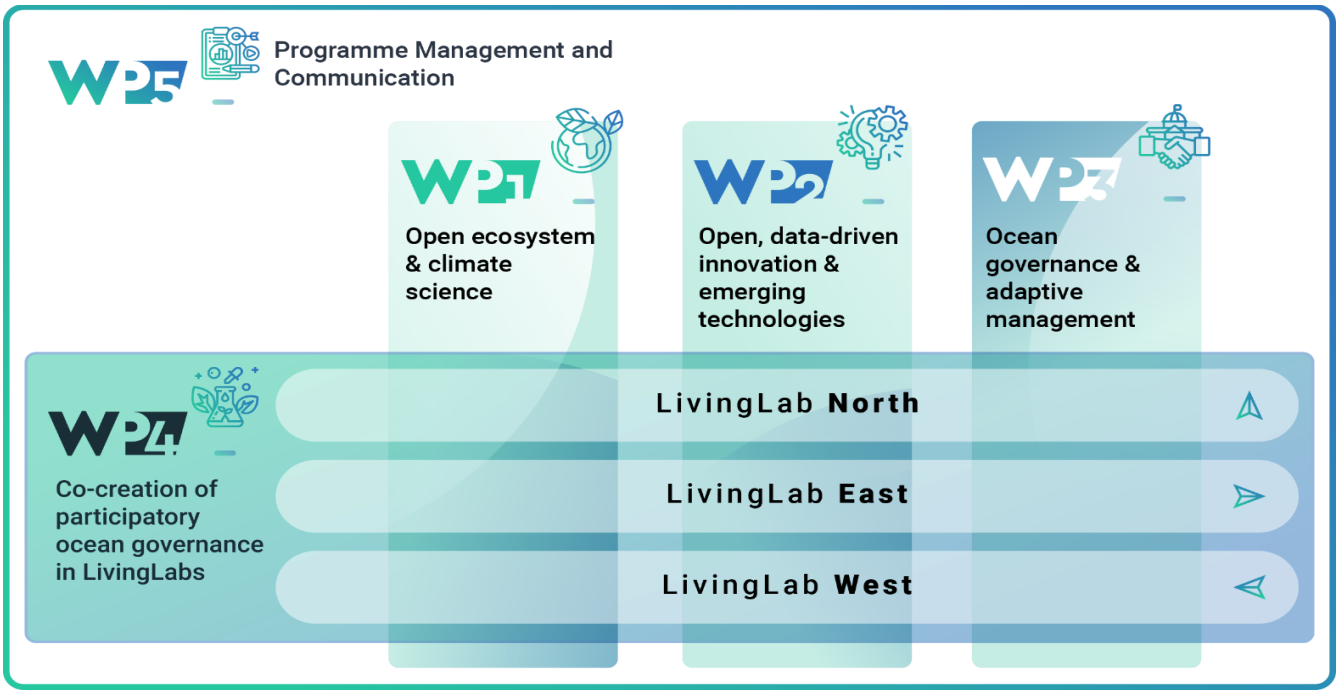

Figure 5 C2B2 WP structure

WP1 Open ecosystem and climate science (Lead: UGOT) -M1-48

Objectives: The purpose of WP1 is to gather key data and scientific knowledge including their gaps and help advance scientific knowledge about ecosystems, biodiversity loss and climate change impact in Swedish offshore areas. This will be done by using new and relevant data on the benthic and pelagic biodiversity and environmental characteristics, as well as existing and planned societal activities and pressures. The focus is on "interconnectors": e.g., across functional parts of ecosystems, across different areas and environmental domains, and the interplay between socio-economic activities and the marine environment, including out at sea and on land. The specific objectives are:

- To synthesise current (gaps in) knowledge about health, resilience and vulnerability of the ecosystems, as well as biodiversity and the effects of climate change.
- To provide integrated and adaptive change assessments, projections, and simulations of the ecosystems, both by means of simplified analytical tools and by numerical tools and modelling.
- To integrate new data sources into the scientific knowledge system that are being advanced by WP2 and tested in the LivingLabs (WP4)

T1.1 Synthesise ecosystem and climate science and knowledge gaps M1-48 (Lead: SIME; participants: UGOT, UMF, SMHI)

This task will initially and continuously present the best available data, information, and knowledge of the ecosystems and the climate in the three case study areas. This includes producing integrated assessments, readily accessible to non-natural scientists, incl. various stakeholders in the LivingLabs in WP4. These will be data rich and regularly updated as well as openly available online and actively promoted. Furthermore, the task will identify uncertainties and the most

important knowledge and data gaps of the ecosystem and climate science. This will be done by querying the science community and the literature, and by participating in the co-creation process in the LivingLabs. A small international workshop with experts will be convened in M6, by invitation only, to produce a widely accepted list facts, uncertainties, and most urgent knowledge gaps. The focus will be on identifying biodiversity components of central importance to ecosystem functions and services. In particular, we will look at impacts of biodiversity loss and climate change on the resilience of ecosystems. The extensively investigated effects from fisheries and shipping will be reviewed and summarized, while the effects from the rapidly expanding offshore installations are covered in a separate task (T1.3).

T1.2 Tools & models for assessments and simulations M1-24 (Lead: UGOT; participants: SIME, UMF, Chalmers, SND, SMHI)

In order to feed relevant scientific knowledge into the discussions in the LivingLabs, this task will present a set of tools for assessments and simulations of the ecosystems and climate of the case study areas. The tools will be suitable for various types of quantifications of developments and impacts. The tools will have different levels of complexity, representing a balance of ease-of-use and detailed presentations of results. The toolbox will include the following:

- The widely used GIS based tool Symphony, developed by SwAM for ecosystem-based marine spatial planning. Symphony is used to quantitatively weigh ecosystems and environmental pressures. With Symphony, the cumulative environmental impact from different MSP options can be objectively and systematically compared.

- A limited area 3D circulation model, based on open access and well documented code, e.g. a scaled down version UGOT's KASK model (Christensen et al., 2018) covering Kattegatt-Skagerrak. Such models have physical parameters as the base, to which depending biological and chemical processes and parameters can be coupled. This can for example be used to assess the effect on the ecosystem by an offshore wind farm (Broström, 2008).

- A coupled socio-ecological model based on UGOT's Koster Sea model (Retting et al., under review). Such models represent the frontline in decision support tools. They deliver uniquely integrated results which are very useful in governance. Empirical data together with expert knowledge and evidence from the literature will be integrated into a Bayesian Belief Network.

- The interactive IPCC WGI AR6 Atlas for assessing regional and global climate information. The atlas is the most accessible method for using the results from WG1 (with C2B2 team member Prof. Chen as lead author) of the IPCC's most recent assessment (Chen et al., 2021; IPCC 2021).

These tools/models will be set up and used to deliver outputs in a relatively fast mode, which will be an important requirement to support the co-creation process in the LivingLabs. Some of these tools/models require training to set up and use, others can be used by experts only. Therefore, this task will also strengthen the capacity of relevant LivingLab participants (e.g. local/regional authorities) to use selected tools.

T1.3 Land-sea interactions in the offshore blue economy M1-36 (Lead: CIT; participants: SEI, SIME, UMF)

This task will explore relevant land-sea interactions of the offshore blue economy in the LivingLabs. Activities offshore are strongly conditioned by characteristics of the coast and its usage, related infrastructure and flows, and the growing competition for space and access to coastal areas is also affecting the offshore space (Kidd et al., 2019; Morf et al., 2022). For example, recreation and real estate development compete with infrastructure, supply and maintenance needs for industry. Moreover, while economic values may originate offshore in terms of, e.g., biomass or energy extraction, the value chain continues onshore, where the larger part of the economic and societal value may be created. This task will therefore, in coordination with WP3 and the LivingLabs in WP4, investigate relevant connections generated between the onshore and offshore in terms of interactions and values, and the balance between onshore and offshore. This will be done by mapping key interactions and value chains (e.g. generated value, job opportunities) relevant for the cases, in total 1-3 chains. Sources and methods will include scientific and grey literature, spatial data, statistics, interviews with key informants, which will be processed through document analysis, flow and interaction chain analyses, spatial & actor analysis. This task will deliver a description of relevant interactions and value chains to be used and complemented in the LivingLabs and from a governance perspective in Task 3.2 and Task 3.3.

T1.4 Quantifying effects of offshore installations on biodiversity M1-48 (Lead: UGOT; participants: Chalmers, CIT)

Ship-based human activities (fisheries and transport) have been part of the offshore blue economy for centuries and more. Currently we are in period of fundamental change, with the rapid expansion of permanent offshore installations, today mostly represented by offshore wind farms. What this will mean for the marine environment, for the blue (and wider) economy, and indeed for humankind's relation to the ocean, remains to be investigated. Existing knowledge of the environmental effects from offshore wind farms can only been considered as preliminary and limited. A recent report from SEPA (Bergström et al., 2021) raises both issues of concerns and some cautious optimism. This task will use existing and novel data sources (incl. from T2.2), as well as numerical tools and models (in collaboration with T1.4) to quantify the effect on biodiversity from permanent offshore installations, and especially wind farms. This includes local impacts in the vicinity of individual installations as well as larger-scale impacts related to differences in management regimes between wind-parks and areas designated to conservation or other types of use. Benthic and pelagic biodiversity

will be quantified using data types including traditional monitoring techniques as well as eDNA and video images. The data analysis will include machine learning algorithms developed by the Ocean Data Factory Sweden partners. Effects will be quantified and assessed from a perspective of the whole expected lifecycle of the installations, from exploration-construction to decommissioning. Preliminary results will be produced during the C2B2 programme period, based on data from already commissioned installations. The task will establish methods and protocols (incl. for data streams) for biodiversity quantifications around offshore installations, incl. baselines in areas of planned explorations.

WP1 Deliverables

- *Synthesis of the offshore ecosystems in the C2B2 case study areas (SIME, M7, M24)*
- *Toolbox with numerical tools & models for ecosystem & climate assessments and simulations (UGOT, M8, M24)*
- *Scientific publication on climate change impacts and resilience in Swedish waters (UGOT, M36)*
- *Scientific publication on land-sea interactions in the offshore blue economy (CIT, M36)*
- *Scientific publication on the effect on biodiversity from offshore installations (UGOT, M48)*
- *PhD graduate + 4 scientific publications on integrated and adaptive change assessments, forecasts, and simulations of marine ecosystems (UGOT)*

WP2 Open, data-driven innovation & emerging technologies (Lead: RISE) M1-48

Objectives: WP2 will help re-imagine blue economy sectors - that have traditionally operated to deliver specific services – as platforms for hosting multiple activities. WP 2 does this by enabling data-driven innovation and technology development based on offshore presence of energy harvest, fisheries and shipping. The specific objectives are:

- To provide benchmarks for open by design, multifunctional system solutions
- To engage commercial and non-commercial actors within the blue economy sectors in multifunctional solutions and new data collection platforms during the open innovation process within and beyond the LivingLabs
- To generate and foster innovative approaches related to the potential of new, open by design approaches to data collection and knowledge co-creation via an Open Call for Solutions (public procurement)
- To coordinate, integrate and soundly manage data via marine data stewardship

T2.1 Open and multi-functional offshore installations by design – SoA M1-36 (Lead: SEI; participants: RISE, CIT, IHE, UGOT, SIME, Chalmers

We explore how three system characteristics could increase effectiveness in the delivery of marine services. First, drawing on global examples and dialogue with key agencies (e.g., SMHI, SMA, SGU) we investigate whether and how multifunctional use can turn offshore installations (permanent, floating, grided, off-grid) and vessels into sensor platforms for ocean monitoring and seabed mapping. Second, we qualitatively and quantitatively analyze the extent to which modularity – the construction of systems through independent components – can reduce investment risks, capital and operational costs (CAPEX and OPEX). Third, we look for evidence to assess whether and how semi-permanent, mobile, floating structures could reduce environmental impacts and increase system redundancy and flexibility particularly related to critical service provision like water or energy (Xylia et al., forthcoming). This work draws on a combination of systematic reviews of white and grey literature globally and primary data collection derived from the discussion and reporting in the LivingLabs to understand the conditions that can enable this type of solutions and outline potential risks. We carry out assessments of costs and an overview of benefits for a selected number of solutions. We look into business models and financing mechanisms for deployment and upscaling. The results of this task will contribute to establishing benchmarks for comparing emerging multifunctional marine solutions, and they will inform distinct sessions during the co-creation process in the Living Labs (WP4), engaging multiple stakeholders in reimagining offshore infrastructures.

T2.2 Requirements for open data collection M1-48 (Lead: RISE; participants: Chalmers, UGOT, IHE, CIT, SMHI, SND)

In order to enable an open innovation climate in C2B2, this task will start off by developing an Innovation Management Plan for the programme and its participants (including associated partners and procured developers/SMEs) in month 6. This will contain programme policy on Open Innovation and IPR as well as a strategy for establishing partnerships with relevant Open Innovation platforms internationally (the Sargasso Maritime Open Innovation platform does presently only have a Scandinavian reach). It will also contain suitable programme specific Innovation KPI's which RISE will use to monitor innovations in the programme and their optimal management, incl. based on partners' IPR analyses.

At its core, this task will explore the potential of new, open by design approaches to data collection, in combination with existing data streams and knowledge co-creation on ocean ecosystem parameters, atmospheric parameters incl. air pollution and GHG-emissions, as well as economic and human activities, and other relevant indicators. Building on the requirements from the scientific community extracted by WP1 and the stakeholder demands from the user-centred co-creation process in the LivingLabs (WP4), this task will create an overview of scientific and case-specific data and knowledge gaps. Requirements will be registered in a requirements management tool and ordered in terms of priority.

Also, the existing technological set up in each LivingLab will be mapped (e.g., data models, system architecture, decision support systems, data sources and data flows). The requirements will inform the search for existing data sources, solutions or relevant advances among the C2B2 partners (Chalmers, RISE). Searches will be done via various channels and platforms (e.g. SARGASSO, existing needs & solutions hubs) and identifying whether existing Earth Observation and emerging sensors and technologies, being developed in Sweden or internationally, can address these gaps. Also, the increasing number of past and present marine citizen science projects may constitute relevant additional/complementary data sources. These will be identified from the elaborate inventory of marine citizen science developed by UGOT which to date contains >730 projects. Unmatched needs will be clustered, if appropriate, and, formulated into concrete specifications for the Open Call for Solutions in T2.3.

T2.3 Innovation in open data collection platforms for knowledge co-creation M6-48 (Lead: Chalmers; participants: RISE, UGOT, IHE, CIT, SMHI, SND

Based on the consolidated requirements and specifications produced by task T2.2, this task will deliver technological development and advances of open data collection platforms in two distinct ways.

A) Lead Chalmers: C2B2 partners Chalmers and Rise will advance relevant existing activities in emerging technologies (AI, machine learning, and autonomous drones; integration of new data sources into existing decision support systems), including via a PhD student. The specific focus will be on deploy-and-forget systems, with no (or low) demands of attention during operations. This requires both carefully balanced performance and a very strong robustness, not only in terms of physical integrity and safety (including autonomous navigation for moving robots), but also for automated energy management, fault detection, data communication and cyber security.
B) Lead: UGOT: The remaining specifications from T2.2 will be used for an **Open Call for solutions** (public procurement) from SMEs, start ups and industry actors, using the extensive experience of various partners (UGOT, RISE, IHE). The Open Call will be disseminated strategically via various channels, especially Sargasso. Sargasso is the Maritime Open Innovation Platform hosted by the Swedish Maritime Technology Forum which connects business cluster member organisations from both the maritime domain and other sectors. Sargasso enables intersectoral innovation for maritime related opportunities and challenges. **This cascading funding will be financed from the secured C2B2 cash co-funding of 4MSEK.** All procurement will be supported administratively by UGOT's procurement office.

The resulting prototypes (by the C2B2 partners and those procured) will be fed into the activities of WP1 and those of the LivingLabs in WP4 and iteratively adapted, based on user feedback collected via the co-design methodology of T4.1. The integration of new data streams into major existing data environments will be done in T2.5. Also, the solution providers will have the opportunity to test, demonstrate and exploit their prototypes and solutions via the C2B2 open innovation events in T2.4 and they will be promoted via the C2B2 dissemination activities in T5.4.

T2.4 Open Innovation events for technology development and data exploitation M8-48 (Lead: RISE; participants: UGOT, IHE, CIT, SMHI, SND, Chalmers

In order to engage technology developers, solution providers as well as blue economy sectors in new data collection platforms during the innovation process within and beyond the LivingLabs, this task will run 10 open innovation events (three different types of events).

Hackathons (RISE): Three hackathons will be used to create sensors, tools, and systems for the collection, processing and visualisation of data collected via multifunctional platforms and fused with other (in-situ and EO) data, in response to the needs identified in WP1 and in the LLs. These events will have technology developers, scientists and data aggregators (public and commercial) interacting at early stages of the innovation process, incl. with potential competitors, at a technical level. This will help promote standardization through the identification of common technical requirements as well as interoperability between (legacy and current) data collection, processing and visualisation technologies. The hackathons will be held in M24, M30 and M36.

Two **Open Data Exploitation Challenges** (lead: RISE) will be held (M32 and M42) to encourage the uptake of the new data streams and technologies amongst the SME community and provide exploitation opportunities. Building on the Data Bakery methodology of the Ocean Data Factory Sweden, a 48 hour kick-off event will allow matchmaking between developers and people 'owning' specific challenges, followed by a period of development.

Offshore test days (lead: UGOT) using UGOT's research vessel Skagerak. These events will allow technology developers and entrepreneurs to test the multifunctionality of their sensors, platforms, robots and other hardware in any Swedish offshore water, and beyond. Successful new data streams will feature in the Open Data Exploitation Challenge. The test days will be a yearly C2B2 event (5 in total), supported

by Swedish Centre for Ocean Observing Technology and by technical staff and scientific marine experts from UGOT, RISE and Chalmers.

Where possible, these events will be integrated with existing conferences, LivingLabs meetings, GEO meetings and other relevant events that take place during the lifetime of the C2B2 programme to open up participation to as wide an audience as possible. We aim to engage a minimum of 30 participants in each event. The dual reporting about these open innovation events will generate insights for recommendations on open innovation that will feed into a policy brief in WP5 for planning agencies, innovators, and financers.

T2.5 Marine data stewardship – FAIR & Open data management and integration into existing aggregators M1-48 (Lead: SND; participants: RISE, UGOT, Chalmers, SMHI, IHE)

The generation of new data sources about the ocean and their combination with existing data is accelerating the need to coordinate, integrate and soundly manage such data using the FAIR data principles. Yet many research institutions and/or groups collecting marine data are too small to afford a Data Steward. All Swedish universities can obtain advice on data management from SND, but subject-specific support to ensure the availability of marine data is not yet available and there is no direct support yet with file management, which in many cases is needed to maximize data utilization. Data stewardship is also recognized by SIME as critical for effective environmental monitoring (Emmerson et al., 2018)

This task will keep track of and provide direct support to C2B2 and other projects that collect marine research data. This will ensure that new data streams (incl. those created in T2.2) will be integrated into major existing data environments (major data aggregators such as Copernicus, the European Open Science Cloud (EOSC) and widely used sector specific systems) in order to maximize their uptake and utilisation.

We will do so by creating an inventory to keep track of past, running and new projects that collect marine data (e.g. checking new grants from Swedish and European research funders; web pages and social media for project announcements; and direct contact with researchers in marine institutions). The PIs of those projects will be contacted early on to find out what data is being collected, and to inform them, if needed, on open data and requirements from the funder, whether the infrastructure used has an open data policy, relevant legislative frameworks. For example, the Open Access Infrastructure for Research in Europe (www.OpenAire.eu / www.Zenodo.org) can be used for data sets that can be freely shared. This requires researchers to be made aware of EOSC/Zenodo, the FAIR Guiding Principles and to actively ensure use http://www.openaire.eu/http://www.zenodo.org/(legally and technically sound) of their data for others to be able to validate their conclusions. Crucially, the PIs will be advised about the large possible benefits to their research by making their data openly available and widely used.

C2B2 will announce and communicate that the programme can be contacted by researchers both during the application process to help them with their data management plan, and during the project lifetime to help them publish their data using the FAIR data principles. The guidance materials, project inventory and lessons learned generated by this task will feed into the efforts to build a national coordination framework for marine research data led by SMHI and SND, funded by Formas.

WP2 Deliverables

- *Open inventory (database) of marine data collection projects (SND) M3, M48*
- *Prototype innovations in data collection platforms for informing governance of a sustainable blue economy (RISE) M24, M48*
- *Scientific publication on opportunities and risks of Marine, Multifunctional, Modular, Mobile solutions (SEI) M36*
- *Scientific publication on advances in ocean data collection platforms (Chalmers) (M40)*
- *PhD graduate + 4 scientific publications on new data collection platform for an expanding sustainable blue economy (Chalmers)*

WP3 Ocean governance and adaptive management (Lead: SIME) M1-48

Objectives: The purpose of WP3 is to implement the C2B2 top down approach by exploring how the ocean governance can ensure viable marine ecosystems in view of expanding offshore industries, by reimagining ocean governance, moving from single-use, single-sector practices towards truly integrative, multifunctional ecosystem-based governance. The specific objectives are:

- To analyse the current state-of-affairs in ocean governance at multiple levels
- To identify crucial international marine spatial planning out-of-the-box tools
- To co-create transition scenarios for a better blue that are adapted to the Swedish context
- To generate recommendations for the future governance of the blue economy in a changing climate.

T3.1 Assessing preparedness of Sweden's ocean governance to climate and earth system change M1-46 (Lead: SIME; participants: SEI, SU, UGOT, WMU, IVL, IHE)

This task assesses the preparedness of Sweden's current ocean governance to address both, accelerated climate and wider earth system change, and increasing and competing demands from multiple and emerging blue sectors. The

analysis will cover two policy levels: i) whether and how international commitments are implemented into national actions; ii) whether and how national action trickles down to regional and local level implementation. We analyse five lenses of ocean governance: architecture and agency, democracy and power, justice and allocation, anticipation and imagination, and adaptiveness and reflexivity (Burch et al., 2019) by reviewing academic literature, analysing key policies documents, interviews and focus group discussions with key stakeholders across the three cases. The analysis will cover policies, regulations, strategies and resources created or (re)directed to operationalize commitments, and the actors and networks with influence in the system. For the local level, relevant management practices and concerns will emerge from the co-creation processes in the LivingLabs (WP4). This will provide an overview of discourse and commitments in relation to actual implementation, helping to identify progress, gaps and level of preparedness of Sweden's ocean governance to systemic changes. Results will feed into the discussions in the LivingLabs (WP4) and the other WP3 tasks.

T3.2 Exploring the governance and legal framework for multifunctional ocean governance M1-36 (Lead: SU; participants: SIME, SEI, IVL, WMU, CIT)

Multifunctionality has been proposed as a possible strategy to overcome competing claims at sea through the combination of economic, conservation, and monitoring activities. But multifunctionality requires conducive regulations, procedures and incentives. Currently these do not exist or hamper the deployment of multifunctional solutions. Legal obstacles include conflicting goals, regulatory gaps, jurisdictional overlaps and the lack of a clearly defined social and ecological balance between goals. Other possible obstacles include lack of awareness, contacts, forums, procedures, knowledge, mandates, practice or capacity. Relevant obstacles and enablers need to be identified and addressed to develop a more efficient governance framework and processes that can e.g. facilitate private-public or cross-sector cooperation. This task first explores how multifunctionality – through co-use, co-location and coexistence – can be made compatible with an ecosystem approach (Barquet & Green 2022; Przedrzymirska et al., 2021). We identify what legislation, policies, processes and institutional characterists promote or obstruct multifunctional ocean governance and also map the relevant actors and their mandates, forums and networks. While taking a systems perspective, the main thematic and geographical focus will be shaped by the LivingLabs. One starting point to address the complexity of the legal framework will be the Marine Strategy Framework Directive, another will depart from spatial planning and integrated management. As necessary, and in coordination with T1.3 and the cases, the analyses of this task will include land-sea interaction aspects of specific uses. Key sources and methods will include scientific and grey literature, regulatory and policy documents, interviews and workshops with key informants, to be analysed and synthesized using standard legal and policy analysis methods. The results from this task will outline the potential and current obstacles to more multifunctional interventions in marine areas, will contribute to Task 3.3 co-creating scenarios for transitioning towards a sustainable blue economy in and will inform recommendations for promoting multifunctionality to be captured in one of the policy briefs in WP5.

T3.3 Scenarios for transitioning towards a multifunctional and sustainable blue economy M1-40 (Lead: SEI; participants: SIME, WMU, SU, IHE, CIT)

Using transition management as analytical starting point (Loorbach 2010), this task will explore through a scenario approach the policy changes that could lead to possible incremental changes – shallow adjustments that within the current state of affairs could lead to beneficial outcomes for marine ecosystems, society, biodiversity and climate – and which ones could lead to radical or deep change – often requiring restructuring. A set of qualitative exploratory scenarios will be constructed using inputs from Tasks 3.1, 3.2 and from WP1 and WP2, along with socioeconomic and environmental drivers/factors. Each scenario will describe a distinct alternative future. For identifying the most important and relevant drivers and further constructing the narratives of future scenarios, we will consult key stakeholders, including marine and coastal planning experts on national, regional and local levels. Stakeholders will also be invited to discuss the results and ways to address them in a Swedish context. Insights and results will be transferred to task T3.5.

T3.4 International comparative marine policy M1-48 (Lead: WMU; participants: IHE, SIME, IVL, SEI, UGOT, SU)

The main objective of this task is to identify crucial international marine spatial planning out-of-the-box tools derived from policy-standards in order to tailor those to fit the Swedish context for strengthening integrated ecosystem management. In close collaboration with T5.5 (International cooperation and liaison), this task will be aligned with contemporary state-of-the-art international initiatives under the UN Decade of Ecosystem Restoration and the Decade of Ocean Science for Sustainable Development. Parallel to this, we integrate best practices and lessons learned from a selected member states of the International Maritime Organization (e.g., Belgium, Germany, Denmark) that could serve as a reference and even standards for other coastal states. Methods include literature reviews and document analyses to i) assess strengths-weaknesses-opportunities-challenges of Swedish marine spatial planning; ii) examine international best practices from selected states through a structured on-line survey and semi-structured expert interviews; iii) appraise

the findings from the international comparative analysis to co-create tools/components for integrated ecosystem and blue economy planning in Sweden.

T3.5 Governance recommendations: reimagining ocean governance M42-48 (Lead: SIME: participants: SEI, SU, WMU, IHE, IVL, UGOT, CIT)

Synthesising the results from WP3, this task will reflect on the outputs of T3.1-T3.4 against relevant literature and other areas of expertise. Gaps for future research will also be identified. For a wider planning and management audience, it will distil recommendations and governance lessons on transitioning to participatory ocean governance and sustainable blue economy in a changing climate, resulting in different, targeted products.

WP3 Deliverables

- *Synthesis of the state of the art in ocean governance in the C2B2 case studies (SIME, M12)*
- *Synthesis of legal framework for multifunctional marine spatial planning (SU, M36)*
- *Scientific publication on transition scenarios for a sustainable blue economy in Sweden (SEI, M36)*
- *Scientific publication on international comparative marine policy: lessons learned for Sweden (WMU, M46)*
- *Scientific publication on addressing systemic change and multifunctionality in marine planning and management (C2B2 top-down approach) (SIME, M46)*
- *Debate article on governance opportunities and gaps for a multifunctional and sustainable blue economy in Sweden (SIME, M44)*
- *PhD graduate + 4 scientific publications in blue economy and ocean governance (WMU)*

WP4 Co-creation of participatory ocean governance in LivingLabs (Lead: IHE) M1-48

Objectives: The overall purpose of WP4 is to provide the basis for setting up and implementing the LivingLabs in the three case studies and to derive insights and recommendations for replicating this approach. Specific objectives are:

- To generate concise and coherent guidance for setting up LivingLabs for co-creating participatory ocean governance
- To ensure all approaches are based on tested concepts and methods and integrate principles of gender equality and inclusiveness in the stakeholder participation activities
- To mentor the LivingLab teams in applying co-creation tools and approaches relevant for the context and priorities of their LivingLabs
- To advance the scientific understanding of social learning as a key mechanism for transition and the uptake of new data streams in science, technology and governance
- To foster collaboration, peer learning and knowledge sharing among the teams and participants in the LivingLabs and with other LivingLabs and external reference case studies
- To strengthen the capacity of local actors to increase ownership over the co-creation process, embed it in formal decision making and ensure sustainability of the C2B2 program results.

T4.1 Methodology for co-creating participatory ocean governance in LivingsLabs and implementation guidance/mentoring (incl. gender and inclusive solutions) M1-48 (Lead: IHE; participants: SEI, SIME)

The task will provide an approach for establishing and running the LivingLab in each case study. It will create process guidance for the expert teams that support the LivingLabs throughout the implementation stage (T4.2-T4.4) consisting of a generic compendium as well as tailored coaching. The co-creation process in each LL will be preceded by a rapid screening and stakeholder analysis (link with T3.1) to identify, per case, which stakeholders should be involved and existing conditions. The co-creation in each LL will be planned, tailored and implemented by a dedicated team of C2B2 partners per case (T4.2-4.4), guided by IHE.

Carefully designed workshops will engage relevant key stakeholders in the context and challenge of each case and in the identification of required data, knowledge, decisions and actions. In this co-creation process, it is key to integrate expertise, knowledge and insights from the three thematic pillars of ecosystems-based ocean governance, also including stakeholders' knowledge, needs and preferences. Also, iterations and validation points during the co-creation process will ensure that co-created plans are realistic, accepted, and legal, and avoided designs dominated by one stakeholder group, or based on assumptions of one group about the motivations of another. Moreover, workshops are designed to create spaces for social learning among participants.

The expertise to conduct the co-creation activities will be shared by IHE with key programme partners who have complementary hands-on facilitation expertise. Advanced knowledge management routines will ensure consistency of the C2B2 co-creation approach via detailed guidance and feedback mechanisms, while supporting tailoring of interaction methods to case-specific contexts, culture, and other particularities.

The mentoring of the LL expert teams will include F2F guidance as well as regular, frequent online meetings, incl. guidance on how to recruit, interact with and maintain interest of key stakeholders of each LL. The outputs of each LL interaction session will be analysed (in collaboration with T1.2, T2.2 and T3.2) and synthesized resulting in agreed

challenges, requirements, changes and objectives (reported in each case's compendium). The task will also contribute to the quality assurance of the programme by implementing ethics procedures and facilitating structured RRI-related discussions (incl. inclusiveness, justice and gender equality) as part of the LivingLabs planning and design processes. This will ensure that all innovative products, services and activities embody RRI (Responsible Research & Innovation) principles and actively support the deconstruction of implicit biases and structural inequality.

T4.2 LivingLab North (Lead: UMF; participants: IHE, SIME, UGOT, CIT)

This task will establish and run the LivingLab in the case study North. This will be done under the guidance of T4.1 and with a dedicated team of C2B2 partners. The details of this case study are presented in section 2.3.

T4.3 LivingLab East (Lead: SEI; participants: IHE, SIME, UGOT, CIT, WMU, Chalmers)

This task will establish and run the LivingLab in the case study East. This will be done under the guidance of T4.1 and with a dedicated team of C2B2 partners. The details of this case study are presented in section 2.3.

T4.4 LivingLab West (Lead: CIT; participants: IHE, SIME, UGOT, Chalmers)

This task will establish and run the LivingLab in the case study West. This will be done under the guidance of T4.1 and with a dedicated team of C2B2 partners. The details of this case study are presented in section 2.3.

T4.5 Peer learning and capacity building (Lead: IHE; participants: all partners)

The task will facilitate the regular knowledge exchange between different groups to ensure continuous learning and adaptive decision-making during the implementation stage in each LL and the consolidation of insights and lessons learned in the finalisation stage of the programme. Specifically, peer learning will be facilitated at three levels: 1) among the LivingLabs teams, 2) among participants across the three LivingLabs (quadruple helix stakeholders incl. programme partners and associated programme partners), and 3) with external reference case studies (such as EBMM Pilot Stockholm Archipelago; EBMM Pilot Southern Bothnian Sea; Fisheries co-management 8-Fjords project). We will carefully structure the interactions for each of these distinct groups to facilitate meaningful dialogue and reflection depending on the constellation of participants. Moreover, based on the results of a structured capacity needs analysis in stage 3 (Sustainability) of the program, joint tailored trainings will be held to strengthen the capacity of (local) actors in all LivingLabs as well as key actors identified in WP3, ensuring sustainability of the implemented technologies, data and knowledge flows and participatory procedures.

T4.6 Evaluation and impact assessment (Lead: IHE; participants: SEI, SIME, CIT, UMF)

Building on existing expertise and proven assessments, the task will tailor and implement the methodology for the integrated and participatory Monitoring, Evaluation & Learning process of the project activities in the three LivingLabs and of the project impacts at large. It will measure and monitor progress towards achieving the C2B2 aims (see section 1) according to identified indicators and outputs and using a range of information sources (e.g. LivingLab compendia and workshop logbooks, project reports, structured interviews with key stakeholders in each LivingLab). It will validate the viability of co-creating evidence-based participatory ocean governance in the three LivingLabs, against both the requirements of various local stakeholders and the broader objectives of the Mistra blue economy call. To assess the impacts of the co-created ocean governance in the LivingLabs, state-of-the art impact assessment methods, incl. co-evaluation with participants, will be used and assess the extent to which the social innovation processes in the LivingLabs have resulted in social learning (Wehn et al., 2018). The results of this task, incl. the elaboration of specific success stories, will regularly feed into the communication and dissemination activities of T5.2.

WP4 Deliverables

- *Prototype LivingLabs methodology and initial guidance with generic case compendium (IHE, M3)*
- *Scientific publication on the transition towards participatory governance in the LivingLab North in the context of pronounced climate change impacts (UMF, M28)*
- *Scientific publication on the transition towards participatory governance in the LivingLab East in the context of heightened security tensions (SEI, M30)*
- *Scientific publication on the transition towards participatory governance in the LivingLab West - managing the expanding blue economy while sustaining high biodiversity (CIT, M32)*
- *Debate article from the LivingLab North for public discussion (UMF, M28)*
- *Debate article from the LivingLab East for public discussion (SEI, M30)*
- *Debate article from the LivingLab West for public discussion (CIT, M32)*
- *Scientific publication on the transition towards participatory governance and a sustainable blue economy in Sweden using LivingLabs (C2B2 bottom up approach) (IHE, M44)*

WP5 Programme Management and Communication (Lead: UGOT) M1-48

Objectives: This WP will ensure the effective and timely achievement of the programme goals in the most cost-efficient manner. The specific objectives are:

- To guarantee a smooth flow of information and efficient decisions-making processes within the consortium;
- To ensure the timely execution of the activities according to the original plan;
- To monitor progress of the planned activity and anticipate as much as possible potential shortfalls;
- To coordinate the financial management of the project by controlling expenditures;
- To report to and communicate with Mistra;
- To ensure regular and effective Project Management Team meetings and timely interactions with the Programme Board

T5.1 Programme coordination and reporting (Lead: UGOT; participants: RISE, SIME, IHE, CIT, SEI, UMF)

This task will deliver the overall programme planning and consortium coordination and ensure administrative, contractual and financial project management as well as obtain a good dialogue with Mistra and the Advisory Board. Within this task, the Programme Director will make sure that activities performed by each consortium member are properly executed. The Programme Director will ensure proper and timely information related to each Work Package is provided and consolidated into high-quality reports. Advice and inputs of the Mistra project officer will be taken into consideration and work plans and budgets adjusted if mutually agreed. Specific project coordination tasks implemented include: i) managing project progress and responding to important changes; ii) controlling manpower resources with running costs, risk analysis; iii) timely submission of reports, deliverables, cost statements, financial certificates etc. to Mistra; iv) financial and legal administration (e.g. transfer of Mistra payments to the partners, maintenance of consortium agreement); v) distribution of documents/ information among the consortium; and vi) external representation of the project. This task will also coordinate the interactions with the Advisory Board and relay their recommendations to the consortium. Annual progress reports will summarise progress against the work plan and meetings of the consortium and with the Programme Board.

T5.2 Quality assurance, risk management and data management plan (Lead: UGOT: participants: RISE, SIME, IHE, CIT, SEI, UMF)

A Quality Assurance Plan will be prepared to include QA procedures to be applied to all internal and external activities, services and deliverables. The goal is to ensure the detection of errors and deviations as early as possible, to enable the consortium to apply corrective actions or contingency plans. This includes the production and implementation of the gender-equality plan; it will form part of the Programme Handbook that will serve to guide programme activities and ensure consistency throughout the programme life time, especially in view of potential programme staff turnover at any of the C2B2 partners. A risk management plan will be prepared at the very beginning of the programme and then updated continuously. The task will monitor risks initially identified, report to the programme management group on the status of such risks and seek actions from the management group as a result of any changed circumstances associated with a specific risk. Actions identified in such instances will be recorded in the risk management register. The Programme Director will keep track of any changes and unforeseen issues affecting the planning of the project in a Change Management Register and will communicate these, as appropriate, to the respective WP and task leader who will report major issues to the programme management team (i.e. problems that may affect activities in more than one WP). The Programme Director ensures that this is communicated to Mistra, especially when changes may impact on the quality of deliverables. The task will also produce the Data Management Plan which will based on standard templates, e.g. H2020 Online Manual and other available guidance resources. This plan will describe the lifecycle and sustainability of all data collected, generated and processed within the programme. This task will also address the legal aspects related to citizen-based data such as privacy, data rights and ownership.

T5.3 Communication and dissemination (Lead: UGOT; participants: All partners)

This task will develop a detailed Communication and Dissemination strategy (M3), which will function as an evolving and living document, throughout the programme lifetime. The draft C2B2 communication and dissemination strategy, including a list of potential dissemination and communication activities, is presented in section 7. At the very beginning of the programme, the visual identity (logo, a set of graphic elements and images, templates for presentations and publications, programme video) based on the material of the proposal documents, and the programme public website containing a portfolio of materials and contents, will be established. The programme website will be constantly updated with the programme's latest activities, especially in the LivingLabs, and outcomes. This task will also coordinate the communication and dissemination of the C2B2 activities and results via social media (including at least 4 short videos) and the development of digital and printed dissemination materials (including 4 policy briefs); via high quality, open access papers in reputable peer-reviewed journals; the presentation of C2B2 results at relevant conferences and the organisation of workshops and conference sessions. The task will also monitor the progress and impact of the C2B2 communication and dissemination activities, resulting in adaptations to the strategy and activities if needed. Finally, this

task will select, via a collaborative process among the C2B2 partners, distinct programme results that should be exploited and devise strategic exploitation plans, using (non)profit business models and plans, as appropriate.

T5.4 C2B2 showcase event M32-M38 (Lead: UGOT; participants: All partners)

A C2B2 showcase event spanning several days will be held in the final stage of the programme (Sustainability) to showcase the C2B2 approach, the activities, outcomes and impacts of the LivingLabs and to promote the wider implementation of participatory ocean governance via co-creation and LivingLabs. Aside from showcasing the major outcomes of C2B2, the event will also serve to help to embed and sustain the C2B2 co-creation approach to ocean governance by further networking key stakeholders in ocean governance in Sweden as well as internationally.

T5.5 International cooperation and liaison with relevant initiatives (Lead: UGOT; participants: SEI, WMU, SIME, RISE)

This task will coordinate the cooperation and liaison with relevant initiatives such as the UN Decade on Ocean Science, International Council for Exploration of the Seas (ICES), Oslo and Paris Convention (OSPAR Commission), Helsinki Committee (HELCOM) Marine Spatial Planning Working Group and existing networks (e.g. Innovation Platform for Sustainable Sea & Ocean Solutions (ISSS), ASTRIIS Digital Twin, Ocean Knowledge Action Network, ongoing and newly funded EU projects (e.g. ILIAD – Digital Twin of the Ocean). Starting with an initial inventory of participation of C2B2 partners in these initiatives (cross-checking also with T3.4), the task will ensure that C2B2 will interact and cooperate with these initiatives where relevant and maintains an international outlook in its activities. The task will also organise dedicated meetings with relevant projects and initiatives relating to C2B2 activities and results and feed the results into relevant C2B2 tasks and meetings.

WP5 Deliverables

- *20 conference papers (All partners)*
- *4 policy briefs (SIME, RISE, SEI, SND)*
- *10 short videos (UGOT)*
- *40 blogs/news articles (All partners)*
- *10 posters (All partners)*

A **summary of the C2B2 deliverables** produced across the Work Packages is provided in Table 7. This shows the substantial production and even spread of outputs across different types: 50 scientific outputs; 3 PhD graduates trained; almost 70 popular scientific outputs; and ~10 technological outputs.

Table 7 Overview of C2B2 deliverables

Scientific outputs	Training of PhDs	Popular scientific outputs	Technological outputs
22 scientific articles 20 conference papers 5 synthesis articles 1 toolbox 1 inventory of projects	1 WP1 1 WP2 1 WP3	1 programme website 4 debate articles 4 policy briefs 10 videos 40 blogs/news articles (website, newsletter) 10 posters	2+2* Demonstrators of offshore open-by-design platforms, for multifunctionality and for autonomous data collection (WP2) 1+1* Demonstrator of decision support system for the offshore domain, using multiple data sources (WP2) 2+2* Protocols for marine environmental monitoring, using eDNA and video (WP1)

** estimated # of solutions to be procured in WP2 using cascading funding, based on the co-created requirements in the LivingLabs*

7. Communication

C2B2 will rely on carefully devised supportive communication and dissemination methods and processes to achieve effective implementation of the programme and to ensure that the project results will be replicable, scalable and have high impact. To this end, early on in the programme, C2B2 will produce a detailed Communication and Dissemination strategy, led by the Communication Lead. Tables 8 and 9 present the preliminary C2B2 communication activities and Tables 10 and 11 the preliminary dissemination activities to science, society and policy. The implementation of the Communication and Dissemination strategy will be monitored, regularly reviewed by the Programme Management Team and updated as needed.

Table 8 Communication channels and key messages per target group

Target Group	Relevant bodies	Key Message	Means to reach them
Policy makers and regulators at National and EU level	OSPAR, SwAM, SEPA, STA National Grid, DG ENV, DG ENER, DG CLIMA, DG RTD, EEA WMO,	*"C2B2 demonstrates how key stakeholders can be engaged in jointly addressing challenges for transitioning to a sustainable blue economy."*	Policy briefs, workshops, website, social media, direct contact
Municipalities and networks	County Administrative Boards, municipalities	*"The C2B2 approach provides the means to engage citizens from all backgrounds in the co-creation of solutions and actions to pressing ocean and environmental challenges."*	Website, videos, fairs, exhibitions, newsletters, PRs, direct contacts, conferences, technical publications, debate articles, papers, policy briefs, press releases, workshops, hackathons
Associations, citizen NGOs, vulnerable & disadvantaged groups	The Swedish Society for Nature Conservation (SSNC), Keep Sweden Tidy		
Scientists working on ecosystems, climate change, marine biology, marine chemistry, physical oceanography, socio-ecological systems.		*"C2B2 provides innovative solutions and new interoperable data via multi-functional data collection platforms."*	Strategic liaison, publications, clustering, conferences, hackathons
Business/Industry: Sensor manufacturers, data aggregators, solution providers			Fairs, exhibitions, hackathons, direct contact, PRs, social media, newsletters
International environmental networks, projects and initiatives	Ocean KAN, ASTRIIS, Innovation Platform for Sustainable Sea & Ocean Solutions (ISSS), ILIAD, relevant newly funded EU projects	*"C2B2 is demonstrating in Sweden how the co-creation of data and knowledge can be embedded in marine spatial planning and institutionalised as participatory ocean governance"*	Publications, conferences, direct contact, exhibitions
	OGC, ISO Cloud and research infrastructures such as EOSC, EGI, GAIA-X, DG INFRA	*"C2B2 data and tools should be available in this infrastructure, along with other data, for the benefit of research and policy."*	OGC members meetings and ISO member states EOSC Association blogs and EOSC task forces on EOSC requirements for participation.
	Wallenberg Foundation, Adlerbert Foundation, Bill & Melinda Gates Foundation	*"The C2B2 approach to co-creating participatory ocean governance provides the means to engage key stakeholder in jointly addressing challenges for a sustainable blue economy."*	Websites, conferences, direct contact, exhibitions

Table 9 Communication means and KPIs

Communication Kit	**ALL Stakeholders**	**Regularly from M6**
A programme visual identity, programme brochures, leaflets, infographics, videos and posters will be created describing the programme activities and the innovations developed in the LivingLabs. Different versions tailored to the target group and stakeholders, timeframe of the activities, etc. and the language of the piloting country/region are foreseen. Most of the material will be available as e-documents and printing will occur as required.		
Target Values: Availability of **1** Communication Kit (M6); Videos > **10**		
Knowledge Platform/website	**ALL Stakeholders**	**M3 to at least 10 years after the programme end**
The programme website will integrate all programme results, tools and materials generated through the programme. The first version will be online by M3 and will be updated regularly. A dedicated blog will be updated monthly, where one C2B2 partner per month contributes with an article. UGOT will sustain the programme website at least XX years after the programme. The programme will also be communicated through the websites from the partners.		
Target Values: Online by: **M3**; Unique Visitors by M12: >**1,50**; Unique Visitors by M36: >**4,00**.		
Social Media	**ALL Stakeholders**	**M3 to M48**
C2B2 social media accounts will be created and updated with weekly posts. The social media channels of the partners/staff/cities will be leveraged, further extending the C2B2 outreach (**UGOT** LinkedIn 135k, Facebook 28.4k,		

Twitter 12.8k; **Chalmers** LI 119k, FB 46.8k, Tw 3.9k; **Chalmers Industriteknik** LI 2.1k , Tw 1.9k; **RISE** LI 85k, FB 5.9k, Tw 7.3k; **WMU-GOI** LI 28.4k, FB 114.1k, Tw 5.8k; **Umeå U** LI 83.2k, FB 47.8k, Tw 12.6k; **SMHI** LI 6.4k, FB 40k, Tw 10k; **SEI** LI 53k, FB 11.5k, Tw 38.5k; **SU** LI 229.4k, FB 129.4k, Tw 16k; **IVL** LI 19.5k, FB 0.8k, Tw 2.6k; **SND** LI 0.215k, Tw 0.5k; **SIME** FB 0.7k, Tw 2.6k; **IHE Delft** LI 45.1k, FB 36.6k, Tw 19.7k followers). Short promotional videos will be created for specific programme results. Story-telling from C2B2 partners and LivingLab participants.		
Target Values: Size of online community (by M36): >**5,00**; No. of impressions (monthly average): >**250**. >**5k** likes via partners'/ **>15k** likes via cities' social media		
e-newsletters	**COs, Activists, Environmentalists, Decision- and Policy-makers, Municipalities, NGOs, Businesses/ industry**	**Every semester starting at M6**
E-newsletters provide a snapshot of main activities and achievements of C2B2, broadcasting messages to target contact points via email as highly effective measure of engagement. Use of professional marketing platforms (i.e. Mailchimp). UGOT and other partners' e-newsletters.		
Target Values: e-newsletters released > **6**; Total mailing list contact points > **1,500**.		
Press releases	**Media, Academia, General Public, Municipalities, Businesses/ Industry etc.**	**Regularly**
Online press releases will be prepared in English and shared with national and European media, also via the programme website. Press releases will be prepared whenever important news about the programme or results of the programme are delivered, before key outreach events.		
Target Values: press releases > **5**; Total targeted receivers > **500**.		
Policy briefs	**Decision- and Policy-makers, Funders**	**From M12**
4 Policy briefs will be prepared and disseminated strategically to their respective target audiences: State of the art in ocean governance in Sweden (SIME); Recommendations on open innovation for planning agencies, innovators, and financers (RISE); Transition scenarios for a sustainable blue economy in Sweden and recommendations for promoting multifunctionality (SEI); Marine data stewardship in Sweden - lessons learned from C2B2 and recommendations (SND)		
Target Values: policy briefs = 4; Total targeted recipients > 1**00**.		

Open access publications: An essential part of the C2B2 programme's Open Science approach is to publish all research articles as Gold Open Access (OA) in accordance with cOAlition S, Plan S that is, CC BY-licences. Furthermore, RISE has a standing licence with Springer Science to publish Gold OA with reduced Article Processing Fees (APC) which can be utilized to reduce programme cost associated with OA. Publication fees, as costs, are included in the programme budget. The strategic dissemination of C2B2 scientific results per topic is outlined in Table 10.

Table 10 Scientific dissemination

Topic	Conferences & Workshops	Journals
Climate and ecosystem science; land-sea interactions in the offshore blue economy	Ocean Science, Marine Regions Forum 2023, UN Ocean Conference, EGU, AGU	Nature Climate Change, Nature Sustainability, Nature Water, One Earth, Global Change Biology, Water Research, Environmental Science and Technology, Water Science of the Total Environment
Data science, monitoring, sensors, cyber-physical systems, automation	IFAC Conference on Control Applications in Marine Systems, ACM/IEEE International Conference on Cyber-Physical Systems, IEEE/CVF Computer Vision and Pattern Recognition Conf., Intl. Conf. On Optical Fibre Sensors, Eurosensors	EEE Sensors Journal, Journal of Marine Science and Technology, IEEE Journal of Oceanic Engineering, Optics Express, Applied Optics Sensors and Actuators
Sustainable blue economy	Almedalen, World Economic Forum, UN CoP, UN Conference on sustainable blue economy, UN Ocean Conference, European Maritime Day, Business2Sea	Nature Sustainability, Journal of Marine Systems, Sustainability, Marine Policy, Journal of Cleaner Production, Frontiers in Sustainability, Journal of Ocean and Coastal Economics, Journal of Marine Science and Technology
Transition towards participatory governance and adaptive management	World Water Forum, Water JPI workshops, LivingKnowledge Conference, OECD Water Governance Initiative	Marine Policy, Environmental Science & Policy, Sustainability Science, Planning Practice & Research, Water, Environmental Policy & Planning

The C2B2 programme will organise various events and stakeholder interactions to make the C2B2 (interim) results available, obtain feedback and ensure uptake (see Table 11). Given the salience of the C2B2 result for ocean governance and adaptive management and related policy and legal frameworks, the programme will provide feedback into policy processes by means of targeted actions.

Table 11 Organisation of events/stakeholder interactions

Event/stakeholder interactions	Target	Purpose of the event
LivingLab workshops	30	10 per LL; engage relevant key stakeholders in the context and challenge of each case and in the identification of required data, knowledge, decisions and actions (WP4)
Training sessions	4	Capacity building on WP1 tools and methods
Hackathons	3	Create sensors, tools, and systems to collect, process and visualise data collected via multifunctional platforms and fused with other (in-situ and EO) data (WP2)
Open data challenges	2	Encourage the uptake of the new data streams and technologies amongst the SME community and provide exploitation opportunities (WP2)
Offshore test days	5	Allow technology developers and entrepreneurs to test the multifunctionality of their sensors, platforms, robots and other hardware in any Swedish offshore water, and beyond (WP2)
Marine data stewardship guidance sessions	6	Provide subject-specific support to ensure the availability of marine data in line with the FAIR data principles, open data management and integration into existing aggregators (WP2)
International webinar	4	Wide dissemination of C2B2 scientific results & recommendations; one with IMO's Ocean Research Group (WP3)
Peer learning	12	Foster collaboration, facilitate meaningful dialogue and reflection in different constellations of participants, , including cross-case learning (WP4)
Capacity building interventions	6	Support new forms of participatory governance and sustainable blue economy in Sweden in terms of data provision, knowledge generation, skills, management practices and recommendations. Strengthen governance readiness to promote a better blue through ecosystem-based MSP and IM (WP4)
Meetings with international initiatives	15	Identify crucial international marine spatial planning out-of-the-box tools (to be tailored to the Swedish context) and integrate best practices (WP5)
Conference pres.	30	Wide dissemination of C2B2 scientific results & recommendations (WP5)
Exhibitions	12	Dissemination of C2B2 technological results at comercial exhibitions, incl.. via quick lunch pitches, mingle events (WP5)
Showcase event	1	Showcase the C2B2 approach, the activities, outcomes and impacts of the LivingLabs and to promote the wider implementation of participatory ocean governance via co-creation and LivingLabs (WP5)

8. Budget

C2B2 has a total budget of 62.3 MSEK. We apply for 50 MSEK from Mistra. Table B1 shows that the budget per WP is evenly distributed over the programme period and separated into funding from Mistra and co-funding. Note that following Mistra's template "Programme management and communication" is listed first in the budget tables; in the C2B2 programme this is included as WP5. The strategic reserve for the external programme board is included in WP 5. The C2B2 budget presents a balanced distribution of Mistra's support for the three thematic WPs (WP1–3) and slightly more resources for WP4, which implements the three LivingLabs. The budget stemming from co-funding reflects the confirmed efforts of the associated partners, with the largest contributions for WP2 and for the LivingLabs in WP4.

Table B1. Total budget, kSEK

Total budget, KSEK	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total budget**	**Whereof Mistra**	**Whereof co-funding in-kind**	**Whereof co-funding in cash**	**Total budget**
Programme management and communication (WP 5)	3 208	3 208	3 208	3 208	**12 830**	12 350	480		**12 830**
WP 1	3 932	2 088	2 088	2 088	**10 194**	8 350	1 678		**10 028**
WP 2	3 331	3 331	3 331	3 331	**13 324**	8 700	790	4 000	**13 490**
WP 3	2 704	2 704	2 704	2 704	**10 816**	9 400	1 416		**10 816**
WP 4	3 790	3 790	3 790	3 790	**15 160**	11 200	3 960		**15 160**
Summa	**16 964**	**15 120**	**15 120**	**15 120**	**62 324**	**50 000**	**8 324**	**4 000**	**62 324**

The co-funding secured by C2B2 amounts to 12.3 MSEK and is obtained from participating 'associated partners' (all non-academic), see table B2. The Region of Västra Götaland contributes with 4 MSEK in cash, which is allocated to the cascading funding of demand-driven innovation and technology development in WP2. The data science company

Combine AB and the Geological Survey of Sweden make substantial in-kind contributions to WP1. So far, they have only committed to year 1, but they plan to make similar contributions during years 2 – 4 of the C2B2 programme, pending funding decision (currently in the government's research proposition). The marine tourism company Mooringo AB has the corresponding approach for its commitment to WP2. Other associated partners have made in-kind commitments to the entire C2B2 programme period, most of all to the work in the LivingLabs in WP4, but also to the Stakeholder Reference Board in WP5 and to the thematic work in WP2 and WP3. All associated partners are listed in Table 6 (section 6), detailing which LivingLab/area(s) they participate in.

Table B2. Funding per partner, kSEK

Funding per partner, KSEK	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Budget totalt**	**Where of co-funding in-kind - payroll costs**		**Whereof co-funding in-kind - travel, materials, equipment**	**Where of co-funding in-kind - indirect costs**	**Where of co-funding in cash**	**Total co-funding**
Mistra	**12 500**	**12 500**	**12 500**	**12 500**	**50 000**						
Companies, municipalities, NGOs, and others	**4 464**	**2 620**	**2 620**	**2 620**	**12 324**	**6 166**	***Hours***	**0**	**2 158**	**4 000**	**12 324**
Region of Västra Götaland	1 000	1 000	1 000	1 000	4 000					4 000	**4 000**
Combine AB, Geological Survey of Sweden, Mooringo AB	1 844				1 844	1 366	1 518		478		**1 844**
Other associated partners	1 620	1 620	1 620	1 620	6 480	4 800	7 200		1 680		**6 480**
											0
Universities and research institutes	**0**	**0**	**0**	**0**	**0**	**0**	***FTEs***	**0**	**0**		**0**
					0						**0**
SUMMA	**16 964**	**15 120**	**15 120**	**15 120**	**62 324**	**6 166**		**0**	**2 158**	**4 000**	**12 324**
Mistra	*12 500*	*12 500*	*12 500*	*12 500*	*50 000*						
Co-funding	*4 464*	*2 620*	*2 620*	*2 620*	*12 324*						
Co-funding's share of total funding %					*20%*						

Table B3 presents the requested funding from Mistra per partner. Note that the substantial share for UGOT (27 %) is justified by UGOT's responsibility for programme management and communication, lead of WP1 as well as substantial contributions to other programme activities, including the training of a PhD student. *UGOT's share also includes the 10 % strategic reserve for the programme board, as requested by Mistra.* IHE Delft has the second largest share (10 %), justified by its role as SL and lead of WP4, leading the implementation of the three LivingLabs. The other partners leading WPs and LLs have near equal shares (8 %). The respective budgets of Chalmers (7 %) and WMU (6 %) are justified by their significant contributions to activities and deliverables in WP2 and WP3, respectively, including training of PhD students. Other partners have corresponding budgets for their specific expert roles in the thematic WP1–3.

Table B3. Funding from Mistra per partner, kSEK.

Funding from Mistra per partner, KSEK	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total budget**
University of Gothenburg	3 400	3 400	3 400	3 400	**13 600**
RISE Research Institutes of Sweden	950	950	950	950	**3 800**
Swedish Institute of the Marine Environment	950	950	950	950	**3 800**
Chalmers Industriteknik	1 000	1 000	1 000	1 000	**4 000**
Stockholm Environment Institute	1 000	1 000	1 000	1 000	**4 000**
Umeå Marine Research Centre	1 000	1 000	1 000	1 000	**4 000**
Chalmers University of Technology	900	900	900	900	**3 600**
World Maritime University	750	750	750	750	**3 000**
Stockholm University	350	350	350	350	**1 400**
Swedish National Data Service	450	450	450	450	**1 800**
IVL Swedish Environmental Institute	250	250	250	250	**1 000**
Swedish Meteorological and Hydrological Institute	250	250	250	250	**1 000**
IHE Delft (The Netherlands)	1 250	1 250	1 250	1 250	**5 000**
SUMMA	**12 500**	**12 500**	**12 500**	**12 500**	**50 000**

Table B4 shows cost types and full-time equivalents per WP. In accordance with the Mistra guidance and instructions, a strategic reserve of 5 MSEK (out of the 50 MSEK requested from Mistra) has been set aside at the programme host UGOT in WP5 for allocation by the programme board. Full time equivalents of the budget funded by Mistra corresponds to aproximately 28 FTE, excluding the strategic reserve and the cascading funding budget (co-funded).The value of the FTEs has been estimated from 1 700 working hours per year and a conservative average 900 SEK per hour.

Table B4. Funding from Mistra, kSEK, funding per workpackage, kSEK.

Funding from Mistra **Budget per work package, KSEK**	**Programme mgmt and communi-cation [WP 5]**	**WP 1**	**WP 2**	**WP 3**	**WP 4**	**Total funding from Mistra**
Number of full-time equivalents (FTEs)	4,61	5,36	4,90	6,07	7,05	**27,99**
Direct costs						
Payroll costs	5 222	6 074	5 556	6 881	7 993	**31 726**
Travel costs	200	100	100	100	400	**900**
Costs of materials	50	50	1 000	10	10	**1 120**
Depreciations			50			**50**
External services	50		50			**100**
Other direct costs						**0**
Total direct costs	**5 522**	**6 224**	**6 756**	**6 991**	**8 403**	**33 896**
Contribution to indirect costs	1 828	2 126	1 944	2 409	2 797	**11 104**
Strategic programme reserve	5 000					**5 000**
Total costs funded by Mistra	**12 350**	**8 350**	**8 700**	**9 400**	**11 200**	**50 000**

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Wehn, U., Vallejo, B., Seijger, C., Tlhagale, M., Amorsi, N., Sossou, S.K., Genthe, B. & Onema, J.M.K. (2021) Strengthening the knowledge base to face the impacts of climate change on water resources in Africa: A social innovation perspective. Environmental Science & Policy, 116, 292-300. https://doi.org/10.1016/j.envsci.2020.09.026.

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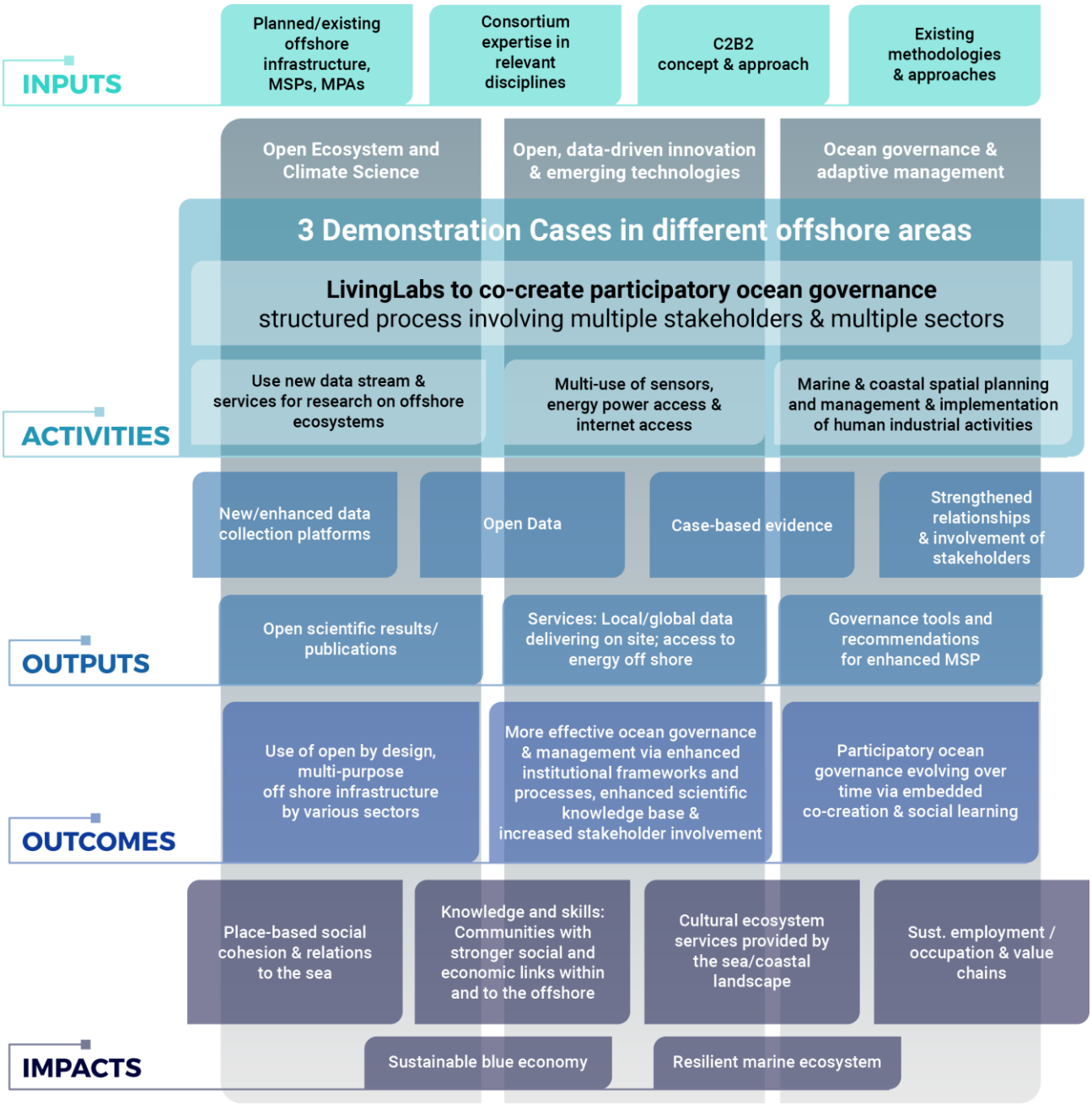
Appendix I – Impact logic



Appendix II – CVs

Programme Director:
Dr. Torsten Linders
University of Gothenburg

Linders is a main contributor to UGOT's role as Sweden's academic node for cross sector collaboration within the marine domain and the blue economy. Notably this includes coordinating SCOOT – Swedish Centre for Ocean Observing Technology, and Ocean Data Factory Sweden.

Linders has a background in oceanographic research, especially ocean in-situ observations and numerical modelling of physical processes. (Before that he served 10 years in the Swedish army, including peace-keeping duties in Kosovo.) Since 2017 he is focusing on initiating and coordinating cross sector projects within the broad field the blue economy, with a special focus data and innovation.

Selected publications:

- Asteman I.P., N. Van Nieuwenhove, T. J. Andersen, T. Linders, K. Nordberg. 2021. Recent environmental change in the Kosterhavet National Park marine protected area as reflected by hydrography and sediment proxy data. *Marine Environmental Research* 166:105265
- Swart S., M. du Plessis, A. F. Thompson, L. C. Biddle, I. Giddy, T. Linders, M. Mohrmann, S-A Nicholson. 2020. Submesoscale Fronts in the Antarctic Marginal Ice Zone and Their Response to Wind Forcing. *Geophysical Research Letters.* 47, e2019GL08664
- Linders T., E. Infantes, A. Joyce, T. Karlsson, H. Ploug, M. Hassellöv, M. Sköld, E.-M. Zetsche. 2018. Particle sources and transport in stratified Nordic coastal seas in the Anthropocene, *Elementa Science of the Antropocene*, 6, p. 29.
- Linders T., P. Nilsson, Wikström A., and M. Sköld. 2018. Distribution and fate of trawling induced suspension of sediments in a marine protected area. *ICES Journal of Marine Science*, 75(2), 785–795

Project coordinator and PI:

- Ocean Data Factory Sweden. Funded by Vinnova, Sweden's innovation agency. (PL)
- SCOOT – Swedish Centre for Ocean Observing Technology, funded by the European Commission. (Coordinator)
- Seacat I & II, experimental surface platform for maritime monitoring. Both projects funded by Vinnova, Sweden's innovation agency. (PL)
- PLAN-SUBSIM – a national implementation of a platform for analysis of subsea images. Funded by Formas, Sweden's research council for sustainable development. (PL)

Steering groups, etc.:

- Member of the steering group for the Revere Lab (Resource for vehicle research at Chalmers University of Technology), responsible for expanding the Lab's high-end competence in automation and AI to the maritime domain.
- Chair of the board for the foundation Bornö Institute for Ocean and Climate Studies, which manages the oldest oceanographic field station in Scandinavia, often regarded as the cradle of Swedish marine research.

Education & training:

- PhD in oceanography, University of Oslo, 2009
- MSc in oceanography, University of Gothenburg, 2005

Scientific Lead:

Prof. Uta Wehn

IHE Delft Institute for Water Education (University of Gothenburg)

Wehn is Associate Professor of Water Innovation Studies, IHE Delft Institute for Water Education, The Netherlands, and Adlerbert visiting Professor of Marine Citizen Science, University of Gothenburg. She is a social scientist from the field of innovation studies with background in ICTs, working at the intersection of data & knowledge co-creation, digital innovation, and water and environment. She has >20 years of combined experience in industry, research and international development, >25 projects; >50 peer-reviewed papers; h-index (25); >3960 citations in Google Scholar.

Wehn is an experienced leader of large interdisciplinary research and capacity development projects on **co-creation of social innovations** in complex multi-stakeholder settings, tailoring user-centred, participatory approaches incl. **LivingLabs** in diverse cultural, geographic and socio-economic settings. She specializes in Action Research on social learning in water governance for (local) change and impact as well as contributions to theory and practice. She is an expert in Open Science and the 'Science of Citizen Science', focusing on how to harness Open Science and (marine) Citizen Science for participatory governance and sustainable behavior.

Selected publications:

- Wehn, U., Gharesifard, M., Ceccaroni, L., Joyce, H., Ajates, R., Wood, S., Bilbao, A., Parkinson, S., Gold, M., Wheatland, J., (2021) Impact Assessment of citizen science: state of the art and guiding principles for a consolidated approach, *Sustainability Science,* https://doi.org/10.1007/s11625-021-00959-2.
- Fritz, S., See, L., Carlson, T., Haklay, M., Oliver, J., Fraisl, D., Mondardini, R., Brocklehurst, M., Shanley, L., Schade, S., Wehn, U. , … and West, S., (2019) Citizen Science and the United Nations Sustainable Development Goals, *Nature Sustainability*, October 2019, 922-930.
- Joshi, S. and Wehn, U. (2017) From Assumptions to Artifacts: Unfolding e-participation within Multi-level Governance, *Electronic Journal of e-Government*, Vol. 15(2), 116-129.
- Wehn, U. and Evers, J. (2015) The social innovation potential of ICT-enabled citizen observatories to increase e-Participation in local flood risk management, *Technology in Society*, August,187-198.

Project coordinator and PI:

- Ground Truth 2.0 (H2020; 2016-2019) – co-design methodology for social innovations; validation and impact assessment in 6 countries
- AfriAlliance (H2020, 2016-2021) – social innovation platform for water and cli-mate, incl. 10 demand-driven innovation Action Groups throughout Africa
- CSEOL (ESA, 2019-2021) – innovation incubation of citizen science and EO

Steering groups, etc.:

- IHE Delft representative at the OECD Water Governance Initiative (2013-2022)
- Co-Chair of the global Citizen Science & Open Science Community of Practice, appointed representative for UNESCO
- Steering Committee of Ocean KAN (Knowledge Action Network), Future Earth
- Science Reference Group of CSIRO Valuing Sustainability Future Science Platform (Australia)

Education & training:

- PhD (2001) and MSc (1996) in Science and Technology Policy (Innovation Studies), SPRU, University of Sussex, UK
- BSc (Honours) (1994) in Computer Science, Portsmouth University, integrated w. IBM UK Ltd.

Communication Leader:

Maria Holmkvist

University of Gothenburg

(RISE Research Institutes of Sweden)

Holmkvist has 20 years of experience as communicator, including 14 years for Lindholmen Science Park and 6 years for the Maritime Cluster of West Sweden and UGOT Centre for Sea and Society She has extensive experience of strategic work in academic environments and in cross-sector collaborative environments (spanning large and small industry, local and national public agencies, as well as research organisations). She is the communication lead and strategist for both UGOT's marine profile and activities, and Maritime Cluster of West Sweden. She is currently Project Manager & Communications Manager Livsmedelsacceleratorn at RISE.

Selected publications:

- Communication plans for UGOT Centre for Sea and Society
- Communication plans for Kristineberg Center for Marine Research and Innovation
- Communication plans for SWEMARC, Swedish Mariculture Research Center

Project coordinator, etc.:

- Communication lead at the upstart of Kristineberg Center for Marine Research and Innovation.
- Communication lead at the upstart of SWEMARC, Swedish Mariculture Research Center.
- Internal and external communication of the UGOT science faculty move to new premises.
- Project lead for marine arenas at the yearly political conference in Almedalen, Gotland.
- Project lead for UGOT marine podcasts.

Steering groups, etc.:

- Maritime Cluster of West Sweden (management team)
- UGOT Centre for Sea and Society (management team)

Education & training:

- BSc, Media and communication science, University of Gothenburg, 2001

Lead WP1 Open Ecosystem and Climate Science:

Prof. Mats Lindegarth
University of Gothenburg

Lindegarth's research and teaching involve marine spatial planning (MSP), coastal zone **management**, aquaculture, benthic ecology and **statistical modelling**. Current research activities are typically **policy-driven** and focus on **methodological issues** related to sampling, modelling and mapping of benthic biodiversity, monitoring and integrated status assessment of coastal waters. Additionally, he has led and contributed to numerous (>30) commissions from national and regional agencies on subjects such as monitoring, status assessment for the WFD and MSFD, ecosystem services and MSP.

Selected publications:

- Bucas et al. 2013. Empirical modelling of benthic species distribution, abundance, and diversity in the Baltic Sea: evaluating the scope for predictive mapping using different modelling ap-proaches. *ICES J. Mar. Sci.* doi: 10.1093/icesjms/fst036
- Bergström et al. 2013. Evaluating eutrophication management scenarios in the Baltic Sea using species distribution modelling. *J. Appl. Ecol*. 50(3): 680-690
- Lindegarth et al. (Editors). 2016. *Ecological Assessment of Swedish Water Bodies; develop-ment, harmonisation and integration of biological indicators*. Final report of the research programme WATERS.
- Carstensen J and Lindegarth M, 2016. Confidence in ecological indicators: A framework for quantifying uncertainty components from monitoring data. *Ecol. Ind.* 67: 306-317
- Kotta et al. 2020. Cleaning up seas using blue growth initiatives: Mussel farming for eutrophi-cation control in the Baltic Sea. *Science of The Total Environment* 709.
- Nygård et al. 2020 Developing benthic monitoring programmes to support precise and repre-sentative status assessments: a case study from the Baltic Sea. *Environmental Monitoring and Assessment* 192 (12), 1-18

Project coordinator and PI:

- BONUS-SEAM - towards streamlined Baltic Sea environmental assessment and monitoring. BONUS ERA-NET project. (2018-2020) Coordinator.
- BONUS-OPTIMUS. BONUS ERA-NET project. Funded by the European Commission (2017-2020) PI
- IMAGINE - Implications of Alternative Management Strategies on Marine Green Infrastructure. Funded by Swedish Environmental Protection Agency (2016-2019) PI.
- WATERS - Waterbody Assessment Tools for Ecological Reference conditions and status in Sweden Funded by Swedish Environmental Protection Agency and Swedish Agency for Marine and Water Management. (2011-2016) Coordinator.
- BONUS PREHAB - Spatial prediction of benthic habitats in the Baltic Sea. BONUS ERA-NET project. (2009-2001) Coordinator.

Steering groups, etc.:

- The Swedish Institute for the Marine Environment (Steering group, analyst)
- SWEMARC – The Swedish Mariculture Research Center (Steering Group)

Education & training:

- PhD Marine Zoology, University of Gothenburg, 1996
- MSc Biology, University of Gothenburg, 1991

Lead WP2 Open, data-driven innovation & emerging technologies:

Prof. Mikael Lind

RISE Research Institutes of Sweden

Lind is Senior Strategic Research Advisor at RISE Maritime Operations and adjunct Professor of Maritime Informatics at Chalmers University of Technology. He is specializing in **digital innovation** of sustainable transports. He is an experiences project manager and orchestrator of **open innovation**, covering digital collaboration and traffic management within and between multiple traffic means. He has substantial experiences from empowering the aviation sector, the maritime sector, public transportation and ride sharing, and electrification of cars.

Selected publications:

- Lind, M., Ward, R., Bergmann, M., Haraldson, S., Zerem, A., Hoffmann, J., & Eklund, E. (2021). Maritime informatics for increased collaboration. In Maritime Informatics (pp. 113-136). Springer, Cham.
- Lind, M., Hägg, M., Siwe, U., & Haraldson, S. (2016). Sea traffic management–beneficial for all maritime stakeholders. Transportation Research Procedia, 14, 183-192.
- Henfridsson, O., & Lind, M. (2014). Information systems strategizing, organizational sub-communities, and the emergence of a sustainability strategy. The Journal of Strategic Information Systems, 23(1), 11-28.

Project coordinator and PI:

- YardCDM Demo, developing digital collaboration for transport of goods on rail, (2022 – 2024), funded by the Swedish Transport Administration, PI
- FEDERATED: Digital ecosystem innovation in action – a federative approach to sustainable and seamless multi-modal transport chains (2020-2023), funded by EU, PI
- The sustainable port as a digital node (2021), funded by the Swedish Transport Administration, PL
- STEAM: Sea Traffic Management in the Eastern Mediterranean (2020-2022), funded by EU, PI
- STM (Sea Traffic Management) Validation Project (2013-2019), funded by EU, PI
- MONALISA 2.0 (2013 – 2015), developing the Motorways of the Sea, funded by the Swedish Maritime Administration, PI
- Future Airports (2010 – 2014), funded by LVF (Swedish Aviation Agency), PL
- Innovation for Sustainable Everyday Travel (ISET), funded by the Swedish Transport Administration, 2009-2013, PL

Steering groups, etc.:

- Project community member and expert assigned by the World Economic Forum (WEF).
- Expert assigned by UN/CEFACT for projects on track and trace and on ship agents and brokers.
- Domain expert for maritime research with Institute of High-Performance Computing (IHPC) (A*Star), Singapore.
- Co-leader of the Supply Chain Innovation Network with Wolfgang Lehmacher, Anchor Group.

Education & training:

- PhD Information Systems Development, Linköping University, 2001

Lead WP3
Ocean governance and adaptive management:

Dr. Andrea Morf
Swedish Institute for the Marine Environment

Morf is a social scientist working at the science-policy interface in marine/coastal planning and management (participation, conflict management, knowledge integration, evaluation, blue economy); She has >25 years of research and co-developed transdisciplinary research and capacity development, focusing on integrative coastal and marine governance, including with authorities and stakeholders in collaborative work across marine basins. She has extensive experience of evaluating, advising and reviewing public bodies at Swedish, Nordic, European and global level.

Selected publications:

- Morf A., Moodie J., Cedergren E., Eliasen S.Q., Gee K., Mahadeo S., Husa S., Vološina M. & Kull M. (2022). Challenges and Enablers to Integrate Land-Sea-Interactions in Cross-Border Marine and Coastal Planning: Experiences from the Pan Baltic Scope Collaboration, *Planning Practice & Research*, 37 (2022 - 3), 333-354.
- Frederiksen P., Morf A., von Thenen M., Armoskaite A., Luhtala H., Schiele K. S., Strāķe, S., Hansen H.S. (2021). Proposing an ecosystem services-based framework to assess sustainability impacts of maritime spatial plans (MSP-SA). *Ocean and Coastal Management*, 208, 105577.
- Moodie, J.R., Kull, M., Cedergren, E. Giacometti, A., Morf, A., Eliasen, S.Q., Schrøder, L. (2021) Transboundary marine spatial planning in the Baltic Sea Region: towards a territorial governance approach? *Maritime Studies* 20, 27–41.
- Prutzer, M., Morf, A., Nolbrant, P. (2021). Social Learning: Methods Matter but Facilitation and Supportive Context Are Key- Insights from Water Governance in Sweden. *Water* 13 (17): 2335.
- Morf, A., Kull, M., Piwowarczyk, J. and Gee, K (2019). Towards a Ladder of Marine/Maritime Spatial Planning Participation, pp 219-243 in: Zaucha J., Gee K. (eds) *Maritime Spatial Planning – past, present, future*, Palgrave Macmillan, Cham.

Project coordinator and PI:

- eMSP BNSR: Ecosystem based MSP in the Baltic and North Sea Regions (2021-24); EU DG MARE. WP lead, PI, science advisory board chair.
- Advocacy Coalitions – The role of advocacy coalitions, policy brokers and policy learning in the formation of Marine Protected Areas (2016-22); FORMAS: PI.
- Evaluation of Swedish MSP process and design of evaluation framework (2019-21) SwAM; PL
- BONUS BaltSpace. Towards Sustainable Governance of Baltic Marine Space (2015-18); PI
- Pan Baltic SCOPE (2018-19) Baltic Sea MSP capacity development; EU DG MARE: WP lead.

Steering groups, etc.:

- WG Marine Planning Coastal Zone Management (co-chair), ICES.
- IOC-UNESCO MSP Global 2030 Initiative (associated expert).

Education & training:

- PhD Human Ecology (2006), University of Gothenburg
- Spatial planning office (1995-97), Canton Thurgovia, Frauenfeld, Switzerland.
- MSc Environmental Science (1994), Swiss Federal Institute of Technology (ETH) Zurich.

Climate Expert:
Prof. Deliang Chen
University of Gothenburg

Chen is professor in Physical Meteorology, August Röhss Chair Professor in Physical Geography directed towards Geoinformatics, and Head of Regional Climate Group.

Chen's research includes Earth System Science and global environmental change with a focus on climate change and its impact on ecosystems. He is an elected member of six Academies including the World Academy of Sciences and the Royal Swedish Academy of Sciences. He has served on numerous international and national committees and boards, as well as advised various governmental, intergovernmental, and international non-governmental bodies including funding agencies. He is also a Coordinating Lead Author for IPCC. Recently, he was listed in the @Reuters Hot List of top climate scientists in the world.

Selected publications:

Chen has a total citation of 20 519, an H-index of 58 in the last 5 years (since 2017). Totally he has published 500+ articles in peer-reviewed journals (290+ since 2017) such as Science, Science Advances, Nature Energy, Nature Climate Change, Nature Communications, Nature Scientific Data, Nature Geoscience, Nature Reviews Earth & Environment, National Science Review, PNAS, and AMBIO.

- Tang, R., et al including **D. Chen**, 2022: Increasing terrestrial ecosystem carbon release in response to autumn cooling and warming. *Nature Climate Change*. 12, 380-385.
- **Chen, D.**, 2021: Impact of climate change on sensitive marine and extreme terrestrial ecosystems: recent progresses and future challenges. *Ambio*, 50(6), 1141-1144.
- **Chen, D.**, et al., 2020: Hydroclimate changes over Sweden in the 20th and 21st centuries: a millennium perspective. *Geografiska Annaler: Series A*, 103(2), 103-131.

Project coordinator and PI:

- Co-Chair of "Third Pole Environment (TPE)"
- Coordinator of the WCRP/CORDEX flagship project "Convection-Permitting Third Pole"
- National Strategic Research Areas MERGE (ModElling the Regional and Global Earth system)
- BECC (Biodiversity and Ecosystem services in a Changing Climate)
- SNIC project "S-CMIP: Swedish climate research and contributions to the sixth International Coupled Model Intercomparison Project (CMIP6)"
- VR project "Linking accelerated warming over the Tibetan Plateau to the increased frequency of European summer heat waves"

Steering groups, etc.:

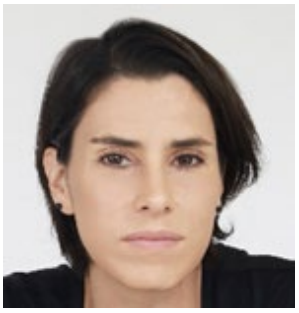
- Member of the International Science Advisory Council of Stockholm Resilience Centre,
- Chair of the Nomination Committee of the Stockholm Water Prize,
- Member of External Science Advisory Group of the Bolin Climate Centre
- Member of the Future Earth Governing Council.

Education & training:

- PhD in 1992 by the Johannes Gutenberg-University Mainz in Germany, under the guidance of Nobel Laureate Prof. Paul Crutzen.

Resilience and risk management expert:

Dr. Karina Barquet
Stockholm Environment Institute



Barquet is Senior Research Fellow at Stockholm Environment Institute (SEI), Team Lead for the Water, Coasts and Ocean group HQ, and Lead for SEI's Global Strategic Engagement for the Ocean. Barquet has a background in human geography with a specialty in multilevel coastal governance. Her work is cross-disciplinary around questions of policy, innovation and adaptation connected to water, coastal and marine landscapes. She has worked with research and innovation projects focused on infrastructure resilience and multifunctional planning, including ongoing work on Marine Multifunctional solutions. She is leading several government-commissioned reports including on the Blue Economy and on transboundary governance of the Antarctic.

Selected publications:

- Barquet K. Järnberg L., Weitz N., Lobos Alva I., 2021. Exploring mechanisms for systemic thinking indecision-making through three country applications of SDG Synergies. *Sustainability Science* **17**, 1557–1572.
- Johannesdottir, S.L., Kärrman, E., Barquet, K., et al. 2021. Sustainability assessment of technologies for resource recovery in two Baltic Sea Region case-studies using multi-criteria analysis. *Cleaner Environmental Systems* **2**, June, 100030
- WSP. 2021. A nutrient trading system for the Baltic Sea region. SwAM commissioned report.
- Rosemarin, A., Macura, B., Carolus, J., Barquet, K., et al. 2020. Circular nutrient solutions for agriculture and wastewater – a review of technologies and practices. *Current Opinion in Environmental Sustainability* **45**, 78–91.
- Barquet K. Järnberg L., Rosemarin A., Macura B. 2020 Identifying Barriers and Opportunities for a Circular Phosphorus Economy in the Baltic Sea Region. *Water Research* **171**, 115433

Project coordinator and PI:

- InnovaCuba 2022-2025, Sida regional funds – PI
- HydroHazards 2020-2024, MSB - coordinator and PI
- Gridless Solutions 2020-2024, Sida core - co-coordinator and PI
- Mistra Geopolitics 2020-2024 – PI for project Geopolitics of the Blue Economy
- Co-Clime, 2018-2022, JPI – PI
- BONUS Return 2017-2021, Bonus Blue Baltic - coordinator and PI

Steering groups, etc.:

- Board Member, Water Centre, KTH Royal Institute of Technology
- Leadership group, International Water Association (IWA) Sweden
- Advisor for B.Green Project for Green Infrastructure, Forum Virium
- Advisor for Baltic Stewardship Initiative, WWF (2020 -2021)
- International expert group SDG indicator 17.14.1: "Number of countries with mechanisms in place to enhance policy coherence of sustainable development"

Education & training:

- PhD (2015) Human Geography, Norwegian University of Science and Technology.
- MSc (2008) International Development & Management, Lund University.
- Ba (2006) Peace & Conflict Studies, Malmö University.

National politics and environmental law expert:

Dr. Åsa Romson

IVL Swedish Environmental Research Institute

Romson is a senior researcher at IVL, with focus on climate law and policy instruments for the transition towards a sustainable society, working in transdisciplinary projects on climate transitions of cities and analyzing the science - policy interface of transformative change. She is developing the institute's work on policy innovation, using her extensive experience on analyzing legal barriers and possible legal proposals. She has more than ten years of experience from policy making as a politician, including as deputy prime minister and minister for climate and the environment. After leaving politics she has been the government's special investigator to analyze the Swedish system for environmental monitoring and evaluation.

Selected publications:

- Romson, Å., Hellsten, S, och Rydstedt, A., (2021) 'Tillståndsvillkor för klimatutsläpp rörande transporter till och från hamnar och flygplatser – rättsligt olämpligt eller rimlig styrning mot klimatmålen?' *Nordisk miljörättslig tidskrift*, nr 1 2021
- Romson, Å. and Forsbacka, K. (2020) 'The Swedish Climate Policy Framework including the Climate Act' in Muinzer, T. (eds) *National Climate Change Acts - The Emergence, Form and Nature of National Framework Climate Legislation*, Hart Publishing.
- Romson, Å., Holm, F., Ivansson, M. (2020) 'Att styra mot minskad bilparkering - om plan- och bygglagen, p-tal och mobilitetsåtgärder', IVL Svenska Miljöinstitutet rapport C554
- Fridell, E., Hansson, J., Jivén, K., Styhre, L., Romson, Å., och Parsmo, R (2022) Studie på sjöfartsområdet - Styrmedel och scenarier för sjöfartens omställning (uppdrag Energimyndigheten), IVL Svenska Miljöinstitutet rapport C665
- Martin, M., Herlaar, S., Lönnqvist, T., Anderson, S., Romson, Å., Hjort, A., and Peck, P. (2021) Implications of electrification for regional biogas municipal transportation systems - Exploring Narratives and Systemic Effects, Final report to 'f3'16:2021
- Mata, É. och Romson, Å. (2019) Hur mycket behöver man mäta för att värdera rätt? i *Innovation och stadsutveckling – en forskningsantologi om organiseringsutmaningar för stad och kommun*; red. Algehed, Eneqvist, Jensen och Lööf; Mistra Urban Future

Project coordinator and PI:

- Project lead for several assignments of Swedish EPA, especially in circular economy and policy reforms towards plastic pollution and recycling

Steering groups, etc.:

- Swedish Institute for Future Studies (chair of the board).
- Stockholm Environmental Law and Policy Centre (board member).

Education & training:

- LLD (2012), Environmental Law, Stockholm University
- LLM (2001) in Environmental Law, Stockholm University
- Bachelor in Humanities (1995) in Nordic languages, Stockholm University

Marine environmental law expert:

Dr. Anna Christiernsson
Stockholm University

Christiernsson is Associate Professor and a Baltic Sea Fellow, with a focus on marine biodiversity law and seascape governance. Her research revolves around the role of law in governing complex and dynamic ecosystems and the interplay between law and ecology. She works on adaptive and ecosystem-based ocean management and fisheries. She has profound knowledge on specific regulatory instruments such as marine spatial planning, marine protected areas, species protection, multi-annual plans and fisheries quotas. Her research includes international, EU and national law. She has extensive experiences in outreach and participation in different legislative processes.

Selected publications:

- Christiernsson (2021). Är naturreservat ett effektivt instrument för att bevara och återställa ekologiskt funktionella landskap? *Nordic Environmental Law Journal* 2021:2, 7-29.
- Bruce, Bradshaw, Ohlsson, Sobek and Christiernsson (2021). Inconsistencies in how environmental risk is evaluated in Sweden for dumping dredged sediment at sea. *Frontiers in Marine Science,* **8**.
- Nyström Sandman, Christiernsson, Gidhagen Fyhr, Lindegarth, Kraufvelin, Bergström, Nilsson, Fredriksson, Bergström and Hogfors (2020). Grön infrastruktur i havet – landskapsperspektiv i förvaltningen av Sveriges marina områden. Report 6930, Swedish EPA.
- Christiernsson and Michanek (2016). Miljöbalken och fisket. *Nordic Environmental Law Journal*, 2016:1, 11-28.
- Christiernsson et al. (2015). Marine Natura 2000 and Fishery - The Case of Sweden. *Journal for European Environmental and Planning Law* **12**(1), 22-49.
- Christiernsson (2015). God miljöstatus och fiske – Hur effektiva är miljökvalitetsnormer? *Nordic Environmental Law Journal*, 2015:2, 93-106.

Project coordinator and PI:

- Legal perspectives on landscape planning for a sustainable climate change transition (2021-2026), Interdisciplinary project funded by Formas.
- Law, sustainable energy use and the preservation of cultural heritage values (2019-2023). Interdisciplinary project funded by the Swedish Energy Agency.
- Transferable fisheries quotas, Interdisciplinary project at Swedish Institute for the Marine Environment (2013-2015).
- Cost-benefit-assessments in ocean governance, Interdisciplinary project at Swedish Institute for the Marine Environment (2013-2015).

Steering groups, etc.:

- Member of the Swedish Academy of Ocean Governance (Havsförvaltningsakademin).
- Expert at *JP miljönet*, a digital journal for practicing lawyers and other working with environmental issues in the public or private sector.

Education & training:

- LLD (2011), Luleå University of Technology.
- LLM (2006), Luleå University of Technology.
- Master Degree in Economics (2002), Luleå University of Technology.

Appendix III – Certificate from planned programme host

UNIVERSITY OF GOTHENBURG

Gothenburg July 12th 2022

Certificate from prospective program host

As prospective host for the programme C2B2 – Co-Create Better Blue, we hereby certify that we are ready to assume the program host responsibilities and make available the necessary resources. We also certify that we accept Mistra's rules for indirect costs. Finally, we certify that we have obtained undertaking of co-funding of at least 20 % in addition to the support from Mistra – consistent with the reported revenue budget.

For the University of Gothenburg,

Prof. Eva Wiberg
Vice-Chancellor

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