



Mistra C2B2 annual report 2025:

# Consolidation and deliverance

# Annual report 2025

## INTRODUCTION

The new program director: "A very interesting dynamic"	4
"No one has more mandate"	6
Andreas Bach: "We can solve the challenges"	7
A complex field of coexistence	8

## OPPORTUNITIES AND CHALLENGES

Fishing, defence and renewable energy	10
Securing the Baltic Sea's built seascapes	12
Disentangling risks and opportunities of offshore wind	14
Trends in Baltic Sea collaboration amid geopolitical tension	16

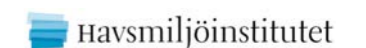
## SCIENCE AND INNOVATION

"The sea is an incredibly valuable resource"	20
Takes a closer look at atmospheric conditions	22
C2B2's Test week brought Arbon Earth to Bornö	24
Publications that matter	26

### About C2B2

C2B2 is a research program hosted by the University of Gothenburg and funded by the Swedish Foundation for Strategic Environmental Research (Mistra). The scope of the program is to find a sustainable way to govern the Swedish water basins. C2B2 started in September 2023 and will run for four years, with a possible extension of four more years. Ten research organisations are partners in C2B2. Get in touch: [c2b2@gu.se](mailto:c2b2@gu.se).

In addition to publishing scientific articles and reports (see page 26), C2B2 organises multiple events and communication activities. During 2025 we have organized 14 stakeholder workshops in C2B2's LivingLabs, 7 Meetings with C2B2's Online Breakfast Club, a 3 week online hackathon, a workshop on windfarms and ship emissions, our second onsite Test Week / Demo Day and published 4 newsletters. We have also contributed to the 4th mission arena of BlueMissionBANOS, Östersjödagarna in Almedalen, and the first Swedish Biodiversity Symposium.



Please cite as:

Mistra C2B2 (2026). Mistra C2B2 annual report 2025: Consolidation and deliverance. Report. Zenodo. <https://doi.org/10.5281/zenodo.15062884>

Coverphoto, and photos were else not noted: Thomas Drakenfors, C2B2.

# The new program director: "A very interesting dynamic"

**At the turn of the year 2025–2026, there was a change within C2B2. Per Knutsson, director of the Center for Sea and Society, took over as the new program director.**

**– An exciting and important program, he says.**

With its five different work packages, C2B2 is a comprehensive operation.

– In total, around 40 people are involved from different academic institutions and research organizations, says Per Knutsson, who has a doctorate in human ecology and has extensive experience in collaborative projects related to the ocean.

He is also active as a lecturer at the School of Global Studies. At the turn of the year, he took over from the former program director Torsten Linders, who led the program during its first years.

– The whole blue economy is an exciting field where a lot is happening. In this program, researchers and people who live and work in our ocean basins come together. It creates a very interesting dynamic, says Per Knutsson.

**What is the first thing you have tackled as the new program director?**

– As for anyone else who starts with something new, at first it is about getting acquainted with the people involved, getting to know what is going on and what is in the works. It is a fun and interesting process.

**What do you find most interesting about C2B2?**

– There are several very interesting things. We have LivingLabs, a focus on innovative technologies, marine biology expertise and also important expertise in the social sciences. This gives an exciting and vital setting. As we are now also starting to see results in the form of various deliverables, 2026 looks promising.

**How will you work with the program?**

– My role is about having a good helicopter perspective, helping to set the direction when needed and ensuring that those working in the program have the resources they need to do a good job.

**What kind of results have you seen so far?**

– A program of this kind, with so many researchers from several different disciplines involved in highly complex collaborative processes, takes a while to get started. Now that we

are halfway through, we are seeing how it is yielding results. Our deliverables are coming in, and it looks very interesting. C2B2 is creating knowledge, and it is happening in a field of great importance to society.

**Can it make a difference?**

– Yes, we can. To manage the blue economy, and to do it sustainably ... these are crucial issues that remain in focus throughout our work within the program. The environment and the climate, the economy, infrastructure issues, food supply and more. We are addressing these issues, and we are not just doing it in a reactive way. This is about looking ahead, finding opportunities and creating innovations. It feels incredibly exciting.

**Security concerns are a growing part of what affects the oceans around Sweden. How do you regard that?**

– As something really important that gives further incentives to what we are doing in the program. The sea is certainly an area where military considerations make a difference and have an impact. Among other things, we see this when it comes to offshore wind power in relation to military considerations. There, a conflict of interest is present, a type of conflict that we handle in our LivingLabs.

**What do you think about the future of the program after 2027?**

– What we are doing is important and is also showing results. I consider the possibilities for high-quality research with a strong societal relevance and impact to be very good. And we will certainly do our very best to accomplish that.

**Finally, what does the sea mean to you personally?**

– I'm from Gothenburg, a city where the sea is always present, part of the DNA of the inhabitants. On a more personal note, I take a swim in the sea as often as I can, all year round. I also enjoy seafood and kayaking. My love for the sea makes working with C2B2 extra fun.

**Per Knutsson**

**Age:** 54.

**Residence:** Köinge, outside of Falkenberg.

**Family:** Partner, two daughters, two bonusdaughters.

**Interests:** Loud guitar music, Kenya, the ocean, chickens and eggs, road trips in a camper van.

**Supports:** AIK (football) and human rights.

**Listens to:** Nick Cave.

**Drives:** VW Golf and a camper van.

*Leading C2B2 forward. – My role is about having a good helicopter perspective, says program director Per Knutsson.*



*Meeting in Karlskrona. Karina Barquet leads LivingLab East. Also at the picture, Elina Cuellar, Development Project Manager at OX2.*

## “No one has more mandate”

**The work within C2B2’s LivingLabs is progressing as planned. In May, LivingLab East had its second workshop, located in Karlskrona.**

**– A very good meeting, people came from all over Stockholm, Gothenburg and even Gotland, says Karina Barquet, SEI.**

According to her, the LivingLabs method creates a good foundation for achieving results: finding a way forward to manage conflicts of interest around the blue economy in the Baltic Sea Proper, LivingLab East’s focus area.

– When we meet, everyone has an equally strong voice, no one has more mandate than anyone else. And it’s about bringing different arguments to the table and pushing and shoving them together, she says.

**Does it work?**

– Yes, it does. The participants are very committed and

work hard to move forward with the issues.

But, she says, it’s not just about work.

– We also have fun along the way and build new relationships that are at least as important for creating long-term change.

**In the summer of 2027, C2B2’s first four years will end, will you have time to achieve results in the two years that remain?**

– Even though we have been working with LivingLab East for almost a year, we are still in the start-up phase. Despite that, we are already seeing results.

**Can you name a few?**

– Yes, we have created an open dialogue and are now seeing identified needs being translated into concrete actions and new projects. The goal is for our stakeholders to feel that their efforts are worthwhile and to remain engaged.

**What do you think about a continuation after 2027?**

– That is our hope, so that we can build on another four years ahead.

## Andreas Bach: “We can solve the challenges”

**A former sea captain with a background at RISE ... in September, Andreas Bach, operations manager at the organization Lighthouse, took a seat on C2B2’s board.**

**– What C2B2 is working on around marine technology crossed with research is home ground for me, he says.**

With his background in the merchant navy, the sea is also a kind of home ground. Andreas Bach worked for many years as a midshipman, sailor and mate. He was also commander of a dredging barge for a period.

But eventually he moved on to the Swedish Maritime Administration where he became business area manager. A desire to work with development then took him on to RISE.

There he had a part-time job that he combined with working for the Swedish Marine Technology Forum network, an organization that works to strengthen the Swedish marine technology industry. Among other things, by bringing new technology – niche for its segment – to the market.

### Switched to Lighthouse

This summer, after several years as head of unit for Maritime System Innovation at RISE, Andreas Bach got a new job as operations manager at Lighthouse.

The sea and the maritime seem to be something of a common denominator for most of what you have been doing?

– That’s right, I have been sailing since I was a kid and love those environments. I have also dived a lot.

Although, he says, the last summer has not exactly been characterized by a love of the sea.

– Not even a swim, actually.

**Why?**

– You could say I traded the sailboat for a tractor.

He and his wife earlier this year moved to a horse farm in northern Skåne. So now life is more about things like which fields should lie fallow than about nautical charts.

But even if the horses and the beautiful Skåne countryside is nice, the interest in the sea is deep-rooted and when he was asked to take a seat on C2B2’s board, there was not much to think about.

### Knows C2B2

He is familiar with the program from before. For a short period, Andreas Bach was involved as the leader of C2B2’s work package 2, focusing on data-driven innovation and new technology. After a while, however, he had to quit.

– The unit I worked in at RISE grew and my job there became more demanding, I simply didn’t have the time. Now, as a new member of the board, he sees a number of potentials that he wants to help develop.

– I can contribute with aspects of shipping and marine technology, linked to research and innovation. But it is not enough to do research, what we come up with must be put into practice and used if we are to achieve the climate goals. Andreas Bach can support this with his network of contacts to companies in that world.

He says that C2B2 is highly interesting, both for himself and for society. The questions about how we should manage our ocean basins are crucial for the future.

– Can we solve the challenges? Yes, I am convinced of that.

But, he says, for the transition to work, it is not enough to create a lot of new smart technology. Things like regulations and business models also need to be reviewed.

– Take fuels, for example. As long as fossil fuels are significantly cheaper than renewables, those who invest in renewables will end up in a bad position commercially. It will be tougher to compete.

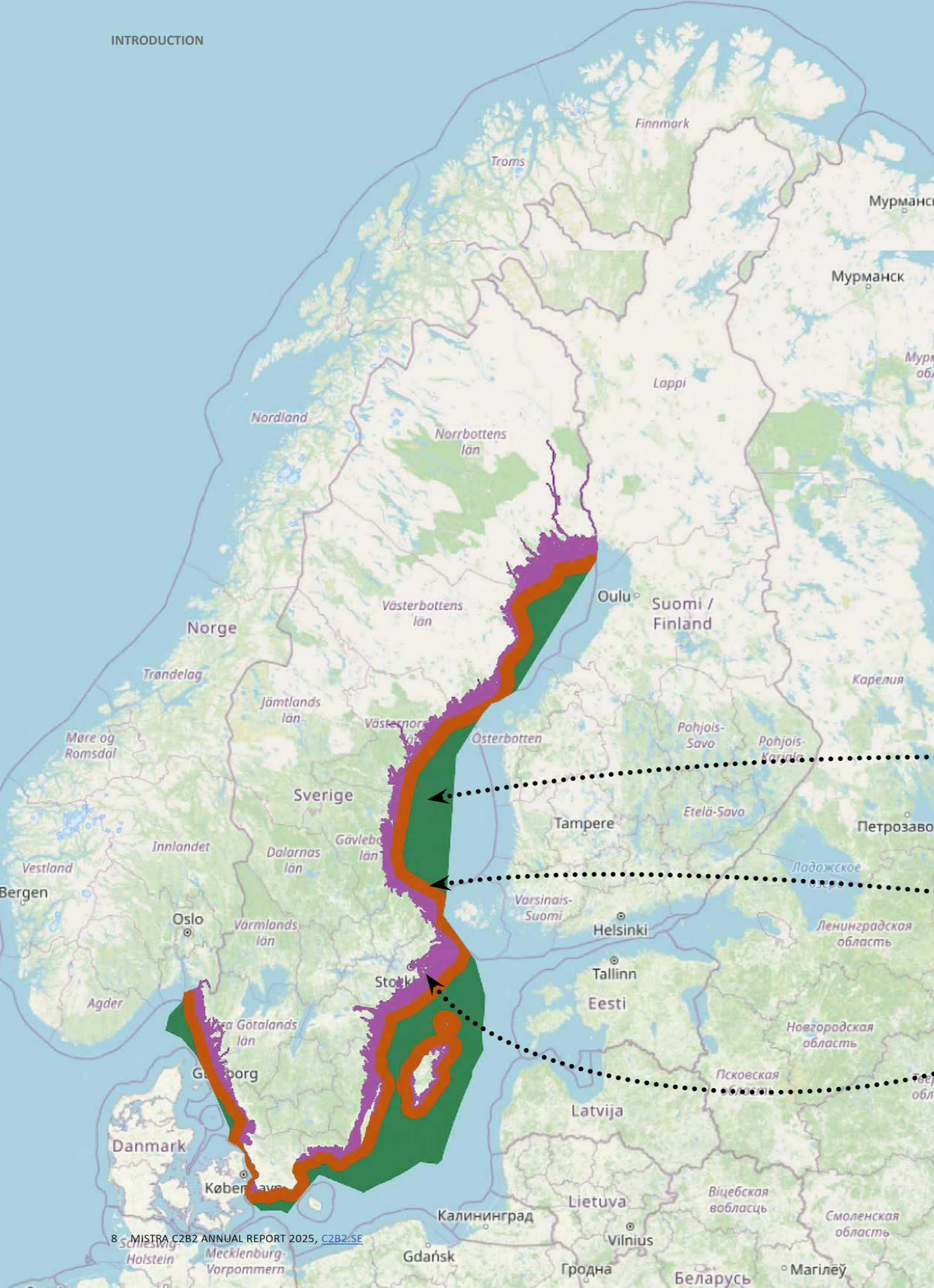
**Within C2B2’s LivingLabs there are a number of stakeholders with different motivations. How can they be made to keep pace?**

– By understanding each other’s activities and finding synergies in it. We need to co-create benefits where there is an upside for the participating organizations. Not entirely simple perhaps, but I am convinced that it can be done. I also believe in starting small. If you get started and do something, it usually grows to something bigger.



## A complex field of co-existence

The Blue Economy is a somewhat complex field, where many different actors coexist – often in common geographic areas. Here are some figures that give a picture of the blue economy and how it is structured.



**95 000**  
Sweden's fishing quotas in tonnes in the Baltic and Kattegat-Skagerrak <sup>1</sup>

**50**  
Organizations in C2B2's three LivingLabs

**22 million**  
Passengers travelling between Swedish and foreign ports <sup>2</sup>

**14**  
Stakeholder workshops in C2B2's LivingLabs during 2025

**3 + 6**  
Wind farms in the Swedish EEZ, commissioned + approved <sup>3</sup>

**7**  
Meetings with C2B2's Online Breakfast Club in 2025

**72 000 km<sup>2</sup>**  
Sweden's exclusive economic zone (EEZ) <sup>4</sup>

**42**  
Researchers and communicators in the C2B2 team

**55 000 km<sup>2</sup>**  
Sweden's territorial waters <sup>5</sup>

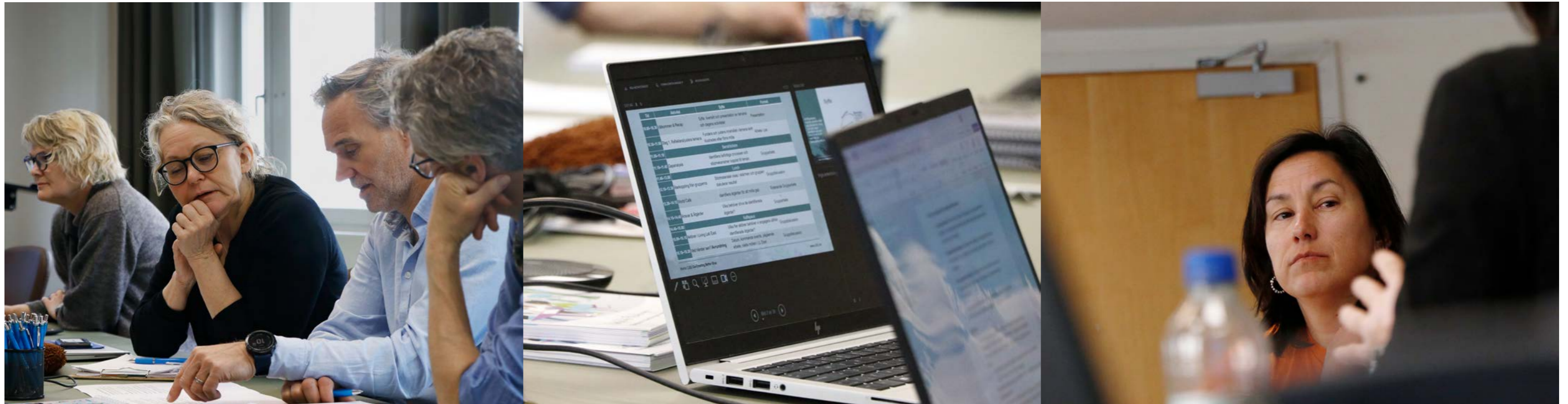
**138**  
Marine research projects in Sweden listed by C2B2 <sup>7</sup>

**28 000 km<sup>2</sup>**  
Sweden's internal waters <sup>6</sup>

**41**  
Marine citizen science initiatives in Sweden <sup>8</sup>

1. 2025, Swedish Agency for Marine and Water Management  
2. 2024, Trafikanalys  
3. Vindbrukskollen  
4. Marine Regions  
5. Marine Regions  
6. Marine Regions

7. The C2B2 list of research projects  
8. MARCSI –Inventory of Marine Citizen Science Initiatives and the FAIRness of the data they produce



*Gone east.* In May 2025 LivingLab East met up at Regionens hus in Karlskrona in the south-east of Sweden.

# Fishing, defence and renewable energy: finding common ground in the Baltic Sea

**How can different interests such as fishing, energy production, security and environmental protection coexist in the Baltic Sea? This question is being explored in a “living lab” where a range of stakeholders are working together as part of the project Mistra Co-Creating Better Blue (C2B2).**

The “blue economy” is becoming increasingly important for Sweden, which also means that conflicts of interests are increasing, as many sectors come together in the same space. The question of how different interests could coexist in a crowded sea begins to become more urgent, most recently illustrated by a decision by the Swedish government to block 13 offshore wind power projects, citing national defence concerns on the Swedish east coast.

To meet these fast-growing needs for better collaboration,

the project Mistra Co-Creating Better Blue (C2B2), launched 2023, will test different methods in practice through three so-called living labs. SEI leads one of these labs, Living Lab East, which brings together Swedish actors with links to the Baltic Sea, primarily public sector agencies, civil society and businesses, as well as researchers.

– Interest in this project is increasing because the situation in the Baltic Sea is changing so quickly, partly due to rising geopolitical tensions, but also because the blue economy is growing fast. There are more and more actors crowding into a fragile sea with big environmental problems, says Karina Barquet who leads LivingLab East.

## Aligning many interests

The questions to be addressed by LivingLab East are decided by the participants through a five-step planning method called participatory backcasting. At the beginning of 2025, the first step – defining the Baltic region’s key challenges –

was completed. Balancing energy production and safety are in focus, not least since the Swedish Armed Forces opposed offshore wind power. Parts of the fishing industry have also expressed concern about the effects of offshore wind power. The Baltic Sea is also an important transport route and a popular tourist area. At the same time, major environmental problems include overfishing, pollution, eutrophication and noise.

## Four themes

Step two was taken in May during a workshop in Karlskrona with the aim of developing a shared vision. After many discussions, the group landed on four themes where they believe they can fulfil a function and complement work already being done by other actors:

- Collaborative decision-making. Marine planning efforts and collaboration in the Baltic are often fragmented. The group can contribute through process innovation and by serving as a neutral collaboration platform.
- Resilient ecosystems. Instead of viewing nature only as something to protect, and thus only a cost, LivingLab East also focuses on how restored ecosystem functions can actively contribute to solving problems.
- Better knowledge and data sharing and public involvement. An important aim for the collaborators in the LivingLab East is to make data sharing easier. The goal is to make environmental data more accessible for the public and make marine-use planning more transparent. Such activities could

also increase public understanding of marine issues and people’s relationship to the ocean, enhancing what is referred to as ocean literacy.

- Innovation for the future blue economy. While marine “test beds” are growing in number, many focus on narrow issues. Living Lab East can instead facilitate cross-sector innovation.

## Facilitating trade-offs

The next steps for the collective work processes in LivingLab East include researching solutions to then develop and prioritize among them. The final stage will be testing and implementation.

- I think our work will lead to better management of the Baltic Sea while at the same time providing insights valuable to researchers, says Karina Barquet. She emphasizes that the project is especially timely, given the sensitive geopolitical situation and the current period of rapid technological change, both of which raise new questions about how to protect critical infrastructure and ecosystems alike as activities in the Baltic Sea increase.
- Hopefully, Mistra Co-Creating Better Blue can increase understanding of the trade-offs we face and how important information can be collected, who has the right to access it, and how it can be shared, Karina Barquet says.

*First published at [sei.se](https://www.sei.se) in June 2025, text by Maria Skiöld, SEI.*

# Securing the Baltic Sea's built seascapes: Balancing innovation, security, and sustainability

**Karina Barquet, Hans Livång, and Torsten Linders explore how the Baltic Sea is evolving into a 'built seascape.' They highlight the necessity for cooperation and security strategies, alongside renewable energy and improved digital connectivity developments, to harmonize innovation with environmental protection.**

The Baltic Sea is transforming. Once defined by natural marine ecosystems and traditional maritime activities, it is now evolving into a 'built seascape' – a marine environment increasingly shaped by human infrastructure. Offshore wind farms, subsea cables, and digital monitoring systems are expanding rapidly, driven by the need for renewable energy, improved digital connectivity, and enhanced security (Paolo et al. 2024). These changes bring significant opportunities and present complex challenges that demand new governance, cooperation, and security approaches.

A paradox lies at the heart of this transformation; while offshore infrastructure is essential for economic growth and sustainability, it is also highly vulnerable. Recent incidents of sabotage, cyberattacks, and geopolitical tensions have highlighted the risks of critical offshore systems. Additionally, the technologies shaping these built seascapes often serve dual purposes, used by both civilian and defence actors. The question is how to balance innovation, security, and environmental protection while ensuring that governance keeps pace with rapid technological advancements.

## Built seascapes

The promise and the risk Human activity in marine environments has always existed, but today's built seascapes represent a fundamental shift.

Temporary interactions such as fishing or shipping can impact aquatic ecosystems and even disturb the seabed. Still, offshore wind farms and undersea infrastructure represent human presence at sea by adding (semi) permanent constructions to the marine environment. This requires a different form of long-term planning, maintenance, and protection. In the EU, this transformation is particularly evident as countries invest in offshore energy production to

strengthen energy security and meet climate goals, which aligns with the REPower EU. However, this growing reliance on offshore systems also introduces new risks.

One of the most pressing concerns is the vulnerability of critical infrastructure. The damage to subsea gas pipelines and communication cables in recent years has exposed the fragility of these networks. The Baltic Sea, surrounded by multiple nations, some with competing interests, is a region where infrastructure security is increasingly under scrutiny. While offshore wind farms could contribute to clean energy production, they raise concerns over data security, navigation safety, and geopolitical tensions. Addressing these risks requires approaches that integrate security measures without hindering innovation.

## The role of data and technology

Data and technology are at the core of ensuring resilient seascapes. Offshore wind farms, undersea cables, and digital sensors generate vast amounts of data, which can be used for energy management, environmental monitoring, and maritime safety. For instance, real-time ocean monitoring can optimize shipping routes, track climate change impacts, and detect potential security threats. However, the benefits of this data depend on how effectively it is shared and managed.

Much of the data collected from offshore infrastructure remains siloed within specific industries or government agencies. While energy companies monitor turbine performance and subsea cables, defence agencies track underwater movements, and environmental researchers study marine biodiversity, these datasets are rarely integrated. A more collaborative approach where stakeholders share critical insights while maintaining necessary security restrictions could enhance economic efficiency and regional security.

However, this integration is not without challenges. Many technologies used in built seascapes have dual-use capabilities, meaning they can serve both civilian and military purposes (Vaynman & Volpe, 2023). For example, surveillance systems designed for offshore energy operations could also be used to track naval activity, raising concerns about data access and national security. Finding the right balance

between open data exchange and necessary restrictions will be crucial for future governance.

## Governing a complex and shared space

Governance is at the center of the built seascape debate. As a semi-enclosed and highly geopolitical space, the Baltic Sea presents unique governance challenges. International agreements such as the United Nations Convention on the Law of the Sea (UNCLOS) provide a legal framework, but they do not fully address the complexities of offshore digital infrastructure, cybersecurity, and the integration of civilian and defence technologies.

A key challenge is ensuring that governance keeps pace with technological change, particularly as the expansion of offshore infrastructure brings both opportunities and vulnerabilities. For instance, the rise of offshore wind farms in the Baltic Sea presents an energy security advantage. However, their integration with undersea communication cables and surveillance networks raises concerns about cybersecurity threats and geopolitical risks (Bueger & Liebetrau, 2021).

Similarly, the dual-use nature of maritime technologies, such as autonomous underwater drones used for both environmental monitoring and naval reconnaissance, complicates regulatory oversight (Vaynman & Volpe, 2023).

Policymakers, industry leaders, and researchers must work together to develop regulations that encourage innovation while safeguarding critical infrastructure. Regional cooperation among Baltic Sea nations will be essential to address these challenges, as demonstrated by Sweden and Finland's long-standing collaboration on icebreaker operations and digital navigation safety (Boström & Österman, 2017). Additionally, NATO's increasing focus on hybrid threats in the region underscores the need for standardized security protocols and coordinated response strategies (Liebetrau & Bueger, 2024). By establishing shared frameworks for data governance, risk mitigation, and cross-sectoral collaboration, states can enhance both economic resilience and national security in this rapidly evolving seascape.

Public-private partnerships can also play a crucial role in strengthening the resilience of built seascapes. Energy companies, maritime industries, and research institutions are already investing in advanced monitoring systems and AI-driven analytics to enhance infrastructure security.

For example, offshore wind operators have tested the integration of surveillance sensors into wind turbine networks, allowing them to detect vessel movements and underwater disturbances, thereby contributing to both energy security and maritime situational awareness (OX2 2024). Similarly, NATO's Maritime Command (MARCOM) has explored collaborations with civilian actors to improve undersea infrastructure monitoring, leveraging data from commercial sensor networks and AI-driven threat detection tools (Willet, 2025). The use of federated data-sharing models, where environmental and security data can be accessed selectively without compromising sensitive information, represents another promising area of cooperation (Trice et al., 2021). By working together, these stakeholders can create more resilient

systems that benefit economic development and environmental sustainability, ensuring that offshore infrastructure remains secure and operational in an increasingly complex geopolitical landscape.

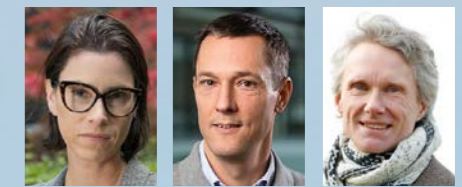
The Swedish research program Mistra Co-Creating Better Blue (C2B2) (Wehn et al., 2023) experiments with LivingLabs to let stakeholders find effective governance solutions in the increasingly crowded and contested marine space. The participants in the C2B2 LivingLab for Baltic Proper especially have to deal with rapidly evolving security realities.

## Towards a resilient future for the Baltic Sea

The transformation of the Baltic Sea into a built seascape presents significant opportunities and new risks. Offshore energy production, digital connectivity, and advanced monitoring systems are essential for economic growth and sustainability, but they also introduce security vulnerabilities that cannot be ignored. Effective governance, enhanced cooperation, and strategic use of data will be key to ensuring that these built environments remain resilient and sustainable. Moving forward, policymakers, industries, and researchers must adopt a more integrated approach to managing built seascapes.

By strengthening cross-sectoral collaboration and improving data governance, we can navigate the challenges of this new maritime era – ensuring that the Baltic Sea remains a secure, thriving, and sustainable ocean space for generations to come. Looking at past and present global experiences of civilian-military and cross-sectoral collaborations could help navigate the current geopolitical landscape.

*Footnote: [The article was first published in Open Access Government-magazine, March 2025. Last modified 8th April 2025.](#)*



**Karina Barquet**

**Hans Livång**

**Torsten Linders**

# Disentangling risks and opportunities of offshore wind for marine ecosystems

**Offshore wind brings new challenges alongside new opportunities for marine governance. Ecosystem models help to shed light on the complex interplay between humans and nature.**

When water stretches as far as the eye can see, the assumption lies near that the seas are infinite. However, what seems endless is often already divided among stakeholders, each with their own interest in the resources and opportunities the oceans provide. In this crowded and much-competed space, the arrival of offshore renewable energy causes additional friction among established industries, such as shipping, fisheries, tourism or national defence, which each fear for their share of the “blue cake”.

Achieving a fossil-free future is a necessity to combat and mitigate climate change. This is not possible without renewable energy, and increased use of offshore wind is key to reaching this goal. Considering the poor state of our oceans, a central challenge is, therefore, to facilitate the expansion of the energy sector, while at the same time mitigating conflicts with existing operations and protecting or even often restoring marine ecosystems, which form the basis of our well-being.

## Conversation instead of isolation

The Swedish transdisciplinary program “Co-Creating Better Blue” (Mistra C2B2) involves academic and industry

partners, as well as a number of competent authorities. To foster a governance model by which we can navigate around and diffuse conflicts, Mistra C2B2 engages stakeholders in a dialogue around mutually agreed-upon challenges, thus providing a platform (“LivingLabs”) to transform and co-create the future use of the sea.

Efficient work on common visions and solutions requires a solid knowledge base, but when it comes to processes below the sea surface, there is a lot we don’t know. One aim of the project is, therefore, to improve our understanding of how offshore wind parks impact the structure and functioning of marine ecosystems and biodiversity in the long term. To tackle this, we are applying a state-of-the-art, spatial ecosystem food web model of the offshore Skagerrak in the eastern part of the North Sea.

## Make it complex – or not?

A golden rule in modelling is to keep a model as simple as possible. Nevertheless, to model wind parks in offshore ecosystems, a certain level of complexity is required to account for the numerous direct and indirect effects on the ecological system. For example, any negative (or positive) effect on seals or other predators are likely to cause trophic cascades through the food web by altering the predation pressure on prey species. Such effects would go under the radar when looking at seals in isolation.

In contrast, using a food web model has the potential to inform about where and how offshore wind is likely to impact the ecosystem during the operational phase (Fig. 1A).

Focusing on a timeframe of 30 years (the approximate longevity of a park), we have identified the following main drivers of change for marine ecosystems:

- Barrier effects on seabirds, meaning increased mortality due to collision risks and a loss of foraging habitat.
- Underwater noise in the low-frequency range, continuously caused by physical movement of the rotor blades and impacting noise-sensitive species, especially marine mammals.
- Artificial reef effects are due to the introduction of artificial hard substrates, allowing for the settlement of hard-bottom-associated flora and fauna.
- Changes in fisheries patterns owing to the incompatibility of offshore wind and industrial fishing gears, first and foremost benthic trawling, resulting in strongly reduced fishing activity within a wind park and an allocation of fisheries to adjacent areas.

Other potential mechanisms often mentioned in the literature but not incorporated in the model are behavioural disturbances of certain species due to electromagnetic fields and changes in plankton dynamics due to aerodynamic phenomena in the wake of turbines.

## Everything, everywhere, all at once

Accounting for the interconnectedness of marine species and a suite of direct and indirect impacts mediated by offshore wind in spatially explicit ecosystem simulations provides a more comprehensive picture of large-scale system changes beyond species-specific impacts. These simulations allow us

to test a range of management scenarios, from differences in wind farm layouts and fisheries allocations to exploring the potential of multi-use solutions. The latter includes exploring and promoting synergies between offshore wind on one hand, and aquaculture, fisheries, shipping or additional renewable energy technologies (wave, solar, etc.), on the other.

This approach will provide a scientifically solid basis for balancing the opportunities and challenges posed by complex interactions among business sectors and contribute to the C2B2 aim of supporting ecosystem-based marine spatial planning, helping to transform degraded marine ecosystems into diverse, productive, and resilient systems for the benefit of future generations.

*Footnote: [The article was first published in Open Access Government magazine, June 2025.](#)*



Mats  
Lindegart



Samuel  
Morsbach

# Trends in Baltic Sea collaboration amid geopolitical tension

**Russian aggression has triggered a wave of collaboration among other Baltic Sea countries, with many new initiatives. SEI organized a discussion between actors from Denmark, Estonia, Lithuania, Poland and Sweden to explore the rapid changes so far and trends for the future.**

The Baltic Sea plays an important role in the economy of the region but faces serious environmental degradation. In the 1990s, after the end of the Cold War, the nine basin countries began working together to reduce harmful emissions and protect the vulnerable environment. But since then, the atmosphere has changed, especially after Russia's full-scale invasion of Ukraine in February 2022.

In response to the new situation, eight of the region's countries have intensified their collaboration regionally, bilaterally, and through entities such as the EU and NATO. At the same time, competition over space is growing between different economic sectors like energy, fishing, transport and tourism, which all try to expand in the increasingly crowded Baltic Sea basin.

## Different perspectives

Collaboration and co-existence are rapidly emerging as defining issues in this part of the world, and SEI recently organized a discussion on the topic with perspectives from Denmark, Estonia, Lithuania, Poland and Sweden. The event "Regional Cooperation in the Baltic Sea in an Era

of Geopolitics" was moderated by SEI Senior Research Fellow Karina Barquet and took place on 26 June during Sweden's political week Almedalen on the island of Gotland. It can be watched here.

## Historic mobilization

– We in Poland feel that we have witnessed a historic mobilization and strengthened collaboration among the Baltic Sea region allies and partners, said Karolina Ostrzyniewska, Ambassador of Poland to Sweden.

She described this as a response to the "increase of Russian hybrid campaigns in the region", with joint efforts to tackle threats to critical infrastructure and track the rise of a Russian shadow fleet to circumvent sanctions.

– This collective action is our regional response that is safeguarding not only security but also the environmental and economic stability of the Baltic Sea region, Ostrzyniewska said.

She emphasized the close links between economic, environmental and security issues, with the shadow fleet as a clear example. When aging and often uninsured vessels carry large volumes of Russian crude oil through Baltic Sea waters, it not only undermines sanctions but increases the risk of collisions and oil spills.

## The role of energy security

The Lithuanian ambassador to Sweden, Linas Linkevičius, echoed these concerns and emphasized energy as a key issue linking economic, environmental and security dimensions.

In 2023, Lithuania became the first EU country to completely stop importing oil, gas and electricity from Russia. This marked a remarkable shift: just a decade earlier, Lithuania had one of the highest energy import dependency rates in the

EU – nearly 70% – with 96.1% of its imported energy coming from Russia as recently as 2020 (Janeliūnas 2023).

– We are now expanding our wind farm capacity, with new parks planned for 2030–2032, the ambassador noted.

– Our ambition is to become a net exporter of electricity by 2035.

The case of Lithuania has been presented as proof that it is possible to simultaneously slash carbon emissions, increase energy revenues, and strengthen national security.

– Energy is geopolitics. You can be a member of NATO, of the European Union, but if you're dependent on energy supplies, especially single source, you are always dependent. You can be blackmailed, which we have experienced all the time, Linkevičius said.

Small countries can band together to increase their leverage, and the ambassador hailed the collaboration and cables that connect Lithuania with, for example, Poland and Sweden.

## Balancing different interests

Today's level of collaboration is however insufficient, according to Karen Marie Sandgren, Founder of the consultancy Nordic Energy Connection. In her view, there is still very little policy alignment and strategic coordination beyond commitments and memorandums of understanding. One reason is that the countries of the region read the situation differently, which is not surprising in a complex situation. Sandgren mentioned energy as a case in point.

– Many of the countries around the Baltic Sea believe that developing offshore wind would be a great idea for the green transition or for energy security [...] and everybody but Sweden seems to think that this can happen in collaboration with the armed forces, she said, referring to a Swedish government decision in November 2024 to halt offshore wind development in the Baltic Sea as it could endanger security interests.

Sandgren stressed that the questions about security concerns were valid and must be assessed, but she believed that Sweden would benefit from learning from the experiences of countries like Denmark, Poland and the Baltic countries.

– Everybody is working very hard with the armed forces to find solutions. There are ways to navigate this complex space that promote better co-existence, she said.

For the future, she hoped for better formats for collaboration and strategic alignment between countries.

– Despite the frameworks from the EU and other organizations, we need a powerful task force or some sort of organization that can hold all these national governments to

account to ensure that we are on the same page.

## How to manage an avalanche of data

Torsten Linders, from the University of Gothenburg, heads the multistakeholder project Mistra Co-Creating Better Blue (C2B2), which seeks to develop better forms of collaboration in the seas surrounding Sweden. The project runs three living labs to test solutions, with a lab in the Baltic Proper part of the Baltic Sea led by Karina Barquet.

Linders noted the great difference between terrestrial and sub-sea data. On land, data is abundant and widely shared, while the sub-sea is still rather data sparse and dominated by secrecy.

– But that is changing, and I think it will continue to change. When we collaborate regionally, we should try to get ahead of that change and not build collaboration on secrecy, but rather on the sharing of information and data.

He believes that the strong trend towards transparency that we see on land will soon also come to the sub-sea domain, bringing both opportunities and risks. It is important to discuss, for example, how to manage data gathered by offshore industries.

## Juggling security issues and the blue economy

Hans Liwång, Professor at the Swedish Defence University, welcomed the discussion about how to simultaneously manage the blue economy and security interests, including variations between different countries.

– Sweden is perhaps the slowest or most backward country, but there are other examples where we are different. So, I think we need to talk more about this, he said.

The fact that emerging technologies often have both civilian and military applications can lead to greater openness between the defence sector and society at large, which Liwång believes could bring new knowledge and more innovation.

– I would like to see more regional cooperation on this because we have friends around the Baltic, and we can do more together, he said.

Liwång stressed how interdependent countries are, meaning that they will be impacted by the policy choices of their neighbours. As an example, Sweden can only stop its own expansion of offshore wind, but the Swedish armed forces will need to manage offshore wind parks that other countries establish in the Baltic Sea.

– There are offshore wind parks in the Baltic Sea, so all parties need to learn more about the effects of those – on defence, on the environment, on the sea and other aspects.

### Inspiring each other

Energy is an area where regional collaboration is already well established. Sulev Alajoe, Managing Director of Estonian Islands Energy Agency, described the intense knowledge exchange between four islands in the Baltic Sea: Åland (Finland), Bornholm (Denmark), Gotland (Sweden) and Saaremaa (Estonia).

– Three of us are studying what Bornholm is doing as it is becoming an energy hub between the Danish and German market. This is a good example. You need to plan offshore installations internationally, between countries, not just carrying out your national marine spatial plans, he said.

Alajoe hopes to see greater investment in offshore wind and so-called power-to-x technologies that could make renewable energy more flexible and predictable. In his view, this is important for the region to be economically competitive, but also to strengthen national security, demonstrating

that countries in the region can work together.

– Fear cannot be our main approach but the other way around – we should collaborate more. We have a joint Baltic Sea basin where we can build wonderful joint projects and interconnect our electricity markets. We must show that we are not frightened anymore.

The panellists argued that fostering cross-sectoral dialogues in the region is not just beneficial, but essential. By bringing together stakeholders across energy, defence, environment, and civil society, we can strengthen collective understanding, anticipate emerging risks, and build the foundations for a more secure and sustainable future.

### Trends for the future

The session was organized by the two projects Mistra Geopolitics and Mistra Co-Creating Better Blue, both of which study how environmental, economic and security issues intersect.

Karina Barquet, with an important role in both projects, noted how critical these perspectives have become.

– In an era of shifting power dynamics and growing pressure on marine spaces, we urgently need new models for cooperation. The Baltic Sea is not only a frontline of geopolitical tension, it is also a testing ground for how we can align environmental sustainability, energy resilience, and security. What happens here will shape strategies far beyond this region, highlights Barquet.

First published at [sei.se](http://sei.se) in July 2025, text by Maria Skiöld, SEI.



**The panel.** Karina Barquet moderating a conversation between Karen Marie Sandgren, Hans Liwång, Sulev Alajoe and Torsten Linders.

Photo: Maria Skiöld, SEI



**Scrutinizing.** Chalmers PhD student Tarun Kadri Sathiyam examines his glider, arranged in a hardware-in-the-loop.

# “The sea is an incredibly valuable resource”

**In the spring of 2025, Camilla Sandström – Professor of Political Science at Umeå University – became Scientific Director of C2B2. She now sees a program that has found its working methods and is entering a phase of higher pace and increased delivery. – It’s an exciting interdisciplinary dynamic within C2B2 that makes the work both stimulating and enjoyable, she says.**

A distinctive approach characterises C2B2, where not only social scientists and natural scientists collaborate across disciplines. Stakeholders from various sectors also contribute through C2B2’s LivingLabs. According to Camilla Sandström, this way of working creates special conditions for achieving interesting results.

– Everything is discussed and scrutinised, which can lead to new insights that are difficult to achieve in other ways,” she says.

#### **What are you involved in besides C2B2?**

– I am a Professor of Political Science specialising in environmental and natural resource governance in Umeå. In addition, I hold a UNESCO Chair focused on biosphere areas (Bio-sphere Reserves as Laboratories for Inclusive Societal Transformation). Another project focuses on the Ngorongoro Crater in Tanzania, dealing with managing the conflict between lions and humans in the area.

#### **Your professorship in Umeå, do you have a particular focus there?**

– A significant part of my work has concerned forests in various interdisciplinary projects. There are similarities with what we work on within C2B2. Forests and the sea share characteristics. Even though forests are privately owned, they are a common resource that contributes green carbon and clean water to society. We also share these areas, forests and seas, with many different activities. My research is about identifying governance models for how society should manage natural resources sustainably.

#### **What is the lowest common denominator?**

– Governance and management. There are differences as well. The marine sphere, for example, has a completely different international dimension compared to forests, and marine ecosystems are more complex. Forests are a key part of Swedish identity, more so than the sea, which is reflected among citizens and in politics. When I look at this, I’m surprised that the sea barely has a dedicated minister.

#### **Do we need to strengthen marine policy?**

– Yes, not least because the ocean is an important future food resource, an asset whose conditions we are currently undermining. That is why C2B2 is an important research program. The sea is an incredibly valuable resource, yet it tends to fall under the radar of decision-makers, which is a concern. We often talk about the size of Sweden’s land area, but more rarely about the size of Sweden’s economic zone.\* Bringing marine issues higher up on the agenda is important from several perspectives, for defence, for sustainable transport, and for food security.

#### **What are the most difficult scientific challenges?**

– That research and science follow one logic, while practice follows another, especially in terms of pace. Research is slow, systematic and methodical. Practice operates within a different economic reality and is more impatient. At the same time, while they want rapid progress, it can be difficult to get them to share data, which can create friction. That’s why it’s important to find shared perspectives and environments where we can test things together. That is usually how bridges can be built between these different logics.

#### **Are these challenges unique to C2B2?**

– No, these are dilemmas faced by all research programs that involve stakeholders. C2B2 is also a program with a high level of ambition, and there are expectations to deliver at a certain level, which places demands on us.

#### **What about the potential to reach decision-makers with the program’s results, can C2B2 contribute to real change?**

– Key central government agencies and important stakeholders are involved, and we have established arenas for collaboration and research. Now it’s about moving forward, perhaps

initiating studies or experiments that facilitate planning, business development and coexistence for those operating in marine basins. One example is C2B2’s ice conference in Luleå (March 2026), a way of working strategically with infrastructure, involving actors such as the Swedish Maritime Administration, wind power companies and the tourism sector.

#### **On a more personal note, why is this interesting to you?**

– If my research can contribute to mitigating the climate crisis, increasing biodiversity and maintaining competitiveness, that feels meaningful to me, both as a researcher and as a private individual.

#### **And what is your personal relationship to the sea?**

– At heart, I’m very much a landlubber, having grown up in the inland of Västerbotten. But the sea is fascinating, and the connection between land and sea is interesting. They influence each other in many ways.

*\*Footnote: Sweden’s internal waters, territorial waters and economic zone at sea covers a total of 155,000 km<sup>2</sup>, see page 7. Sweden’s land area covers 410,000 km<sup>2</sup>.*

#### **Camilla Sandström**

Age: 58.

**Residence:** Bjurholm and Dikanäs.

**Family:** Partner, children and grandchildren.

**Interests:** Outdoor life and golf.

**Supports:** MoDo (hockey).

**Listens to:** Jazz.

**Drives:** Toyota RAV4 hybrid.

# Takes a closer look at atmospheric conditions

**In Sweden, cyclones are something we associate more with for example the waters off Japan than our own ocean basins. But they also occur in our latitudes.**

**– Although not as intense, says Hui-Wen Lai, meteorologist and climate scientist affiliated with C2B2.**

For Hui-Wen Lai, strong winds are home turf.

– I focus on research into the atmosphere, and then you get into a number of quite difficult weather phenomena. Such as storms, heat and typhoons, she says.

To simulate weather systems and explore the processes and mechanisms, she uses different regional weather models. It is fascinating, she says, to break down natural systems using the laws of physics and mathematical equations.

– Then you realize that there is still a lot we do not know about nature.

Hui-Wen is from Taiwan. She came to Sweden in 2018 with a master's degree in atmospheric science and meteorology from Pennsylvania State University. In 2023, she defended her thesis at the Department of Geosciences in Gothenburg, a thesis on climate variations in precipitation on the Tibetan Plateau. It was supervised by Deliang Chen, professor of physical meteorology and also affiliated with the University of Gothenburg, an authority with an international reputation in climate research.

– The purpose of my thesis was to better understand precipitation patterns and the weather systems that shape them there, over the Tibetan Plateau. The results also show that high-resolution weather models can

effectively simulate these processes. This helps us understand what drives changes in precipitation, both in the past and perhaps also in the future, says Hui-Wen Lai.

## Postdoc in Gothenburg

She is now doing her postdoctoral research in Gothenburg, and continues to investigate extreme precipitation events in Asia, also here with Deliang Chen as supervisor. Both are also connected to C2B2's work within work package one which focuses on ecosystems and climate.

### How did you become part of C2B2?

– They needed a climate scientist and contacted Deliang Chen, who thought we should do it together, says Hui-Wen Lai.

She now works partly with C2B2 and finds it exciting.

– It is my first interdisciplinary experience in the job. We work with researchers in natural and social sciences, and with actors from different parts of the business world who are connected to the blue economy.

Stimulating, she says, to get to know other types of issues than those she has worked with before, and to see how the different perspectives interact.

But what about marine sciences? No, she doesn't have experience with that since before. Which of course is part of the point of the interdisciplinary approach,

that expertise from different directions is gathered and pitted against each other to achieve synergistic effects.

## Assesses the Swedish climate

When it comes to Hui-Wen Lai's own contribution within C2B2, she says that it is about making assessments of the climate and learning how it behaves in the different areas that are in focus: Skagerrak-Kattegat, the Baltic Sea and the Gulf of Bothnia.

– I investigate atmospheric conditions, such as air temperature, extreme precipitation, winds and drought. Both in the different LivingLab areas and in Scandinavia as a whole. Back to the question of typhoons – the weather phenomenon that is known, among other things, for having stopped Kublai Khan's attempt to invade Japan in the late 13th century. According to Hui-Wen Lai, there are similar winds here in Sweden too.

– What we have here in Sweden are extratropical cyclones, strong winds and precipitation that are similar to typhoons.

It often leads to things like floods, landslides and damage to the forest.

– However, the mechanisms behind extratropical cyclones and tropical cyclones or typhoons are different, she says.

*Knows weather. Climate scientist Hui-Wen Lai is part of C2B2. She investigates atmospheric conditions in the various LivingLab areas and in Scandinavia as a whole. – C2B2 is my first interdisciplinary experience in the job, she says.*

# C2B2's Test week brought Arbon Earth to Bornö

**Carbon dioxide traps are a way to tackle the excess CO2 in the atmosphere. One player in this field is the Gothenburg based company Arbon Earth, which participated in C2B2's Test week 2025 on Bornö a couple of weeks ago.**

**– A good place to both test things and build networks, says co-founder and CEO Magnus Willner.**

For Magnus Willner – a mechanical engineer at heart – various IT solutions are something of a career path.

– It started when I was young and studying in Hawaii. Several people I met there had difficulty finding housing, so I built a system for apartment brokerage.

## Ahead of Swish – for a while

He has also created software for conducting employee surveys for an OEM in the automotive industry, a system for tennis bookings and built a music game where you can learn to play the piano, guitar and drums. Plus, a payment system for mobile phones ... before the now established Swedish system Swish.

– But before ours was established, Swish had time to show up.

For a while, he helped build up a group of IT consulting firms, which grew to around 60 employees.

Today, Magnus Willner is investing his expertise and creativity in the company Arbon Earth, which develops sea-ba-

sed carbon dioxide traps. Ropes made of natural material are tied to a simple, approximately two-meter-long bamboo tube.

They are provided with cuttings of algae, or spores. The construction – Arbon Earth calls them OceanPods – is then released into the ocean in various places around the world, including in Kenya and Indonesia.

– It must be places with fairly strong outflows and great depths, so islands are often good, he says.

## Stores CO2 for ages

Once out in the ocean, the pods become home to various fish that are given shelter. Then, when the macroalgae have grown large enough, they pull the pod down to the bottom. Down in the darkness, the construction takes with it all the carbon dioxide that the algae have bound up through photosynthesis. And there the carbon dioxide remains, potentially for millions of years.

– It is a solution that has high additionality, high permanence and low emissions, says Magnus Willner.

He compares it with other types of carbon dioxide traps, such as tree planting. Or collecting carbon dioxide and mineralizing it underground – a method called DAC (Direct Air Capture). According to Magnus Willner, tree planting is “the old way”.

– It has low additionality, since it is a natural part of forestry. Also, a bit uncertain.

– The trees can stand there for fifty years, but then the forest burns up and all the carbon dioxide escapes into the atmosphere.

According to him, when it comes to DAC, the method has –

despite large investments and expensive costs per ton – not been able to show any decisive results.

Another way is to produce biochar by burning wood.

– The most common method. 90 percent of all CDR (Carbon Dioxide Removal) projects use it. Unfortunately, the emission figures are high, half of the carbon dioxide goes straight into the atmosphere on the day of burning, he says.

According to Magnus Willner, their own method does not suffer from any of these weaknesses. The additionality and permanence are high, the emissions are low.

Now Arbon Earth is focusing on drawing attention to companies on how, in addition to reducing their carbon footprint, they can also contribute to collecting large amounts of CO2 from the atmosphere, at a low cost.

– It's about 40 euro a month per employee. The cost is like a gym membership. Then you're involved and making a difference, he says.

For that cost, according to Magnus Willner, the company will end up in carbon dioxide balance: collecting as much CO2 as they emit.

## Startup with potential

So far, Arbon Earth is being run as a startup. But, he says, the potential is great even if neither they nor anyone else offers the solution with a capital S to the Earth's climate problems.

– No, one way is not enough, we must work in many ways, broadly.

**“One way is not enough – we must work in many ways”**

To develop their product, Arbon Earth needs to be able to document what happens when the pods have sunk to the bottom – they can end up hundreds of meters below the water surface. That's why they're now developing equipment to film them.

Testing the method of filming was one of the things they did when they participated in C2B2's Test Week on Bornö this September.

– We also participated last year, but this year we had a slightly bigger commitment.

## How did it go?

– Great, we got several interesting inputs. Then the facility on Bornö and the island itself is a cool environment to be in.

## Will you be coming next year too?

– Yes, I would think so, if we have the equipment we need to test. It's a great opportunity.



**Magnus Willner**

**Age:** 50 years old.

**Lives:** Hindås outside Gothenburg.

**Family:** Wife and three children.

**Listens to:** Everything from musicals to Metallica

**Drives:** Lynk&co.

# Publications that matter

C2B2 has run half-time, and a critical mass of publications has been produced by the participants of the program. The reports cover most of the program's scope, from methodology to ecological effects. Here is a cumulative list of what was produced by the end of 2025.



Barquet, K., Sjölander, F. 2025.

## Quiet power: How security interests shape offshore wind and marine spatial planning in Sweden

Energy Research & Social Science 130. <https://doi.org/10.1016/j.erss.2025.104451>

Fiorina, L., Obst, M. 2025.

## AI-assisted benthic monitoring at an artificial reef: BRUV platform design and RF-DETR model for Baltic fauna

Report. Zenodo. <https://doi.org/10.5281/zenodo.17429399>

Rayner, D. 2025.

## Mistra-C2B2/MarineResearchDataProjects: Update2025c

Data set. Zenodo. <https://doi.org/10.5281/zenodo.17046139>

Nilsson, C., Faurby, S., Germishuys, J., Obst, M., and Burman, E. 2025.

## Applying Deep Learning to Quantify Drivers of Long-Term Ecological Change in a Swedish Marine Protected Area

Ecology and Evolution 15(9): e72091. <https://doi.org/10.1002/ece3.72091>

Morsbach, S., and Lindegart, M. 2025.

## Disentangling risks and opportunities of offshore wind for marine ecosystems

Open Access Government July 2025, pp.354-355. <https://doi.org/10.56367/OAG-047-11077>

ICES. 2025.

## Workshop to compile evidence on the impacts of offshore renewable energy on fisheries and marine ecosystems (WKCOMPORE)

ICES Scientific Reports. <https://doi.org/10.17895/ices.pub.28759259.v3>

Barquet, K., Liwång, H., and Linders, T. 2025.

## Securing the Baltic Sea's built seascapes: Balancing innovation, security, and sustainability

Open Access Government April 2025, pp.344-346. <https://doi.org/10.56367/OAG-046-11057>

C2B2. 2025.

## Mistra C2B2 annual report 2023–2024: Towards a sustainable governance of the Swedish blue economy

Report. Zenodo. <https://doi.org/10.5281/zenodo.15062884>

Wehn, U., Bilbao, A., Somerwill, L., Linders, T., Maso, J., Parkinson, S., Semasinghe, C., and Woods, S. 2025.

## Past and present marine citizen science around the globe: A cumulative inventory of initiatives and data produced

Ambio 54, pp.994–1009. <https://doi.org/10.1007/s13280-024-02119-z>

Hjerpe Olausson, J., Richardsson, D., Hawkins, R., and Linders, T. 2025.

## The new blue: Built-up seascapes create new maritime relations

Open Access Government January 2025, pp.432-433. <https://doi.org/10.56367/OAG-045-11057>

Vanacore, E., Sjölander, F., Xafenius, N., and Huseby, S. 2024.

## Key economic figures of the blue economy in Sweden - Data brief

Report. Zenodo. <https://doi.org/10.5281/zenodo.15051814>

Imperiale, A J, and Wehn, U. 2024.

## Sustainability transformations in marine governance in Sweden via social learning

Open Access Government October 2024, pp.370-371. <https://doi.org/10.56367/OAG-044-11077>

Wehn, U., Imperiale, A J, and Crystal, T. 2024.

## Prototype LivingLabs methodology & initial guidance with generic case compendium

Report. Zenodo. <https://doi.org/10.5281/zenodo.13365958>

Wehn, U., Linders, T., and Barquet, K. 2023.

## Co-creating a sustainable blue economy for Sweden

Open Access Government October 2023, pp.408-409. <https://doi.org/10.56367/OAG-040-11027>



