

BALTIC RIM ECONOMIES

SUSTAINABLE MARITIME INDUSTRY

Edited by Eini Haaja

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DOMINGUEZ ARSENIO

Decarbonize, digitalize,
diversify: Navigating
the maritime makeover



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Sustainable
development of cruise
tourism: Pioneering
progress at the Port
of Hamburg



CHISTOPHE TYTGAT

Interesting times for
European shipbuilding



JOE BETTLES

EU policies drive green
shipping in the Baltics



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BALTIC RIM ECONOMIES

**The Centrum Balticum Foundation publishes
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**In the BRE review, public and corporate
decision makers, representatives of Aca-
demia, as well as several other experts con-
tribute to the discussion.**

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Guest Editor | Eini Haaja
(responsible for writer invitations)

Technical Editor |
Sonja Lavonen

Centrum Balticum
Vanha Suurtori 7
FI-20500 TURKU, Finland

www.centrumbalticum.org/en

centrumbalticum@centrumbalticum.org

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KAI MYKKÄNEN

Improving the condition of the Baltic Sea is also a matter of security

Expert article • 3643

When my family and I embark on our sailing trips, we never miss the chance to dive into the refreshing waters of the Baltic Sea. Sadly, these opportunities are becoming increasingly rare as algae blooms, driven by the Baltic's severe pollution, continue to spoil this experiment year after year.

The state of the Baltic Sea is undeniably alarming. The water pollution is clear to be seen, with algae blooms caused by eutrophication standing as a reminder of decades of neglect. Excessive nutrients from agricultural runoff have been flowing into the Baltic Sea for far too long, contributing to this ongoing crisis.

Improving the Baltic Sea's condition is a collective responsibility, and in Finland, we are committed to leading by example. We are starting with the most immediate and impactful measures. This year, we will implement a ban on discharging sewage from ships into the Baltic Sea, a move that, while only enforceable within Finnish territorial waters, underscores the need for international cooperation to ensure that this harmful practice is truly halted. Additionally, we will amend the Environmental Protection Act to prohibit the dumping of dirty snow into the sea. These are straightforward actions that can be quickly implemented, but they are only the beginning.

The most pressing issue, however, remains the nutrient runoff from agricultural fields into the Baltic Sea. This is not a recent problem; it has developed over decades as nutrients have been carried from fields to rivers and from rivers to the sea. This is also a security matter and the solution for this will also improve our self-sufficiency. Nutrients can and need to be circulated, which would allow us to improve the domesticity of our food production by reducing the need for imported fertilizers. It is crucial that nutrient-rich manure is transported from areas with nutrient surpluses to nutrient-poor regions. Supporting the processing of manure nutrients into a more easily transportable form is part of improving agricultural security. One could even argue that it is foolish to import tens of thousands of tons of phosphorus fertilizers to Finland from abroad, while with effective recycling, we could replace nearly 90% of the usage according to the estimate by the Natural Resources Institute Finland, thus becoming almost self-sufficient in phosphorus fertilizers.

National actions are crucial for improving the condition of our shared sea, but there are challenges that can only be addressed through cooperation. Recently, I have discussed with my colleagues the immediate and direct threat posed by the increasing number of Russian oil tankers navigating the Gulf of Finland. These vessels do not always meet Western maritime safety standards, raising the risk of an oil spill in the Baltic Sea—a risk that is deeply concerning.

But what can be done? Are we limited to merely preparing for an environmental disaster, monitoring these aging tankers as they sail off our coast, posing significant environmental risks and financing Putin's war project in Ukraine? The solution is not simple. The principle of innocent passage is highly valued in international maritime law, but exceptions exist. A state has the right to intervene if a vessel deliberately endangers

the environment, particularly if it poses a significant threat to the natural resources within its territorial waters or economic zone. Finland's options are limited, as these ships operate in international waters near our coast, but by working with Denmark and larger at the EU level, we must find solutions before this threat turns into a catastrophe. Meanwhile, one concrete response to this increased risk could be relocating EMSA's oil spill response vessel further north in the Baltic Sea.

Another area where cross-border cooperation is essential is in reducing emissions from maritime traffic. The maritime industry, along with the International Maritime Organization (IMO), has set ambitious targets. By 2030, greenhouse gas emissions from ships must be reduced by at least 20% compared to 2008 levels, and at least 70% by 2040. The IMO's ultimate goal is to achieve carbon neutrality in maritime transport by 2050. Within the EU, we have the opportunity to lead by example, implementing legislation and regulations that encourage the global maritime industry to meet these goals.

The condition of the Baltic Sea will improve if we take consistent, sustained action. Restoring the health of the Baltic Sea is not a sprint but a marathon, where every small step brings us closer to a cleaner, healthier sea. The state of the sea changes slowly, but precisely for this reason, action must be taken now. I still hope to take a swim next summer during our sailing trip in a Baltic Sea free from algae blooms—and oil. ■



Kai Mykkänen
Minister of Climate and the Environment
Finland



ARSENIO DOMINGUEZ

Decarbonize, digitalize, diversify: Navigating the maritime makeover

Expert article • 3644

The global maritime industry is entering an era of unprecedented transition. Decarbonization, digitalization and the drive for diversity are compelling both governments and industry to rethink the future of maritime and reorient their approaches. In a changing world, the International Maritime Organization (IMO) is taking the lead in bringing stakeholders together to navigate the challenges and opportunities that arise. Now is a time for clear vision and bold action – which is why early movers in both public and private sectors are essential.

Setting a course towards net zero

Since the 2023 IMO Strategy for the Reduction of Greenhouse Gas Emissions from Ships ('IMO GHG Strategy') was adopted in July 2023, the momentum around green shipping has continued to accelerate. This is no small feat for an industry that has served as the very backbone of global trade for centuries, powered largely by fossil fuels.

The IMO GHG Strategy includes enhanced ambitions aligned with the Paris Agreement on Climate Change, to reach net-zero GHG emissions from ships by or around, i.e. close to, 2050. Indicative checkpoints have been set for 2030 (to cut emissions from ships by at least 20%, striving for 30%) and 2040 (cut emissions by at least 70%, striving for 80%), in addition to 5% uptake of zero-emission fuels by ships by 2030.

Achieving those targets will require the commitment of all parties. Already, mandatory short-term measures have entered into force in 2023, setting out energy efficiency and carbon intensity requirements for all ships. Mid-term measures have been proposed, namely a global marine fuel standard and a pricing mechanism for ships' GHG emissions. These are currently being discussed by Member States for potential adoption in 2025 and entry into force in 2027.

Implementation faces a range of challenges – such as availability of alternative fuels, their associated high costs, and the need to upskill seafarers to handle new fuels and green technology safely. The engagement of stakeholders across all sectors – from businesses to non-governmental organizations, academic and research institutions, ports, and governments – is crucial to supporting effective solutions.

That said, I am encouraged by the innovations already being pioneered by early movers, including those in the Baltic region. For instance, the recent establishment of the first ever green corridor on the Baltic Sea between Turku, Finland, and Stockholm, Sweden with the goal of being 100% carbon-neutral by 2035, could provide key lessons for the wider sector.

Go green, go digital

The advancement of new technology brings with it valuable opportunities to boost the green transition, which the IMO is actively pursuing. Since 1 January 2024, all IMO Member States are required to use a one-stop digital platform or "Maritime Single Window" (MSW) to exchange key information while processing the arrival, stay and departure of ships at ports. MSWs greatly streamline procedures, boosting efficiency and reducing a ship's "idling time" and GHG emissions.

The IMO-Norway GreenVoyage2050 Project has supported the development of "Just-In-Time" operations, which focuses on port call and speed optimization – timing the arrival of ships at berths to avoid waiting times, allow for less speed and prevent unnecessary fuel consumption and emissions.

Norway has also produced the world's first fully electric and autonomous container ship, with zero emissions – the **Yara Birkeland**. This shows the massive potential of merging decarbonization and new technology, while managing cyber risks and reskilling workers. IMO's ongoing work to develop a legal instrument to regulate the operation of maritime autonomous surface ships ('MASS Code') touches on some of these aspects.

In the march towards digitalization, it is also important to ensure that developing countries, in particular, Least Developed countries (LDCs) and Small Island Developing States (SIDS), are not excluded. This is why a number of IMO's technical cooperation programmes focuses specifically on supporting LDCs and SIDS in their sustainable maritime development.

Supporting diversity at sea

IMO recognizes that equality for women means progress. Countries with more gender equality have better economic growth and companies with more women leaders perform better. However, shipping remains heavily male-dominated, with women making up less than a third of the overall maritime workforce and less than 2% of seafarers.

This needs to change. A concerted, systematic effort is required to make maritime work more attractive and supportive of women, through regulation, training, awareness-raising and culture change. IMO's efforts include professional development and training through its Women in Maritime programme, as well as developing regulations for preventing and combatting violence and harassment, including sexual harassment, bullying and sexual assault.

But more needs to be done. On a personal level, I have chosen to appoint a gender-balanced senior management team at the IMO Secretariat and refrain from participating in panels or events unless gender representation is respected. I encourage all to do the same.

Forging a future together

The maritime sector is at a crossroads where decarbonization, digitalization, and diversity converge. While the challenges they present are significant, it is also a moment of opportunity that calls for courage, creativity and tangible cooperation. I am confident IMO holds these foundations to take shipping forward to the next level. ■



Arsenio Dominguez
Secretary-General
International Maritime Organization
United Kingdom



SVEINUNG OFTEDAL

IMO will take shipping to net-zero emissions

Expert article • 3645

The adoption of the 2023 IMO Strategy on Reduction of GHG Emissions from Ships was a historic achievement. It was historic for the International Maritime Organization and for international shipping, and also an important achievement in the larger global cooperation to respond to the climate crisis. It is agreed to reach net-zero GHG emissions by or around, i.e. close to 2050, taking into account different national circumstances. Further, a timeline for the follow-up was agreed which identifies that the basket of mid-term GHG reduction measures should be finalized and agreed by the Committee (MEPC) by 2025.

There is no doubt that there will be multiple impacts of this decision. First, IMO Member States need to agree on the legal framework which will deliver on the ambitions for emission cuts agreed in the Strategy. Although it is already agreed that the basket of measures should contain a technical element and an economic element, it is a complex task to agree on an "IMO Net-Zero Framework". In order to reach net-zero emissions, this framework will imply a shift to the use of fuels/energy with gradually lower GHG intensity. Further, the IMO will revise the energy efficiency framework to ensure reduction of CO₂ emissions per transport work, as an average across international shipping, by at least 40% by 2030, compared to 2008.

The emission reduction pathway for shipping will need to be coupled with a global energy transition with substantial scale-up of sustainable renewable fuels. Likewise, the emission reduction pathway will need to be coupled with increased supply of trained seafarers and other maritime personnel being able to operate new technologies and fuels safely. Ongoing work at the IMO will ensure that safety provisions for the use of new types of fuels and energy sources will be in place at the time of expected scale up of deployment of climate friendly fuels and technologies. Achieving emission cuts in line with the Strategy will imply substantial investments in fuel production, fuel infrastructure and ships. It may be that new long-term partnerships will be established to make the early phase of the transition to low- and zero emission shipping economically viable.

In moving forward, the IMO is assessing the impacts on States of a measure/combination of measures. Particular attention is given to the needs of developing countries, in particular the Least Developed Countries (LDCs) and Small Island Developing States (SIDS), and the assessment is an important aspect to take into account as appropriate before adoption of the measure(s).

At several junctures in the history of the IMO groundbreaking decisions have been made to respond to the global challenges of shipping related to safety, security and environment. Last year the MARPOL Convention celebrated its 50 years of environmental protection in all corners of the world. During these 50 years the regulatory improvements have been agreed in a cooperative atmosphere during a period of constantly

changing geopolitical reality. Also, during these 50 years climate change have entered the scene as the most pressing global challenge which will require the most complex transition in the modern history of shipping.

2025 will be a decisive year for the IMO. This is the year when the next, and perhaps most important, step in the history of climate regulations at the IMO will need to be agreed.

The willingness and ability demonstrated at the IMO to ensure that global shipping will deliver on climate actions, is a strong message of standing united to orchestrate a transition which will make shipping serve global trade with net-zero emissions. ■



Sveinung Oftedal

Chief Negotiator – Green Shipping
Norwegian Ministry of Climate and
Environment
Norway

sveinung.oftedal@kld.dep.no



SIMONE MARASCHI

Sustainable development of cruise tourism: Pioneering progress at the Port of Hamburg

Expert article • 3646

The sustainable development of cruise tourism is a multifaceted challenge. It requires the collaboration of various stakeholders across the maritime ecosystem, including ports, cruise lines, technology providers, tourism stakeholders and regulatory bodies. In Hamburg, this collaboration has been a cornerstone of our approach to sustainability, particularly since 2016, when the city pioneered the first shore power facility at the Cruise Center Altona, the first of its kind in Europe at the time. This project, developed by the Hamburg Port Authority in close partnership with AIDA Cruises and industry associations, has set a benchmark for ports worldwide. Currently, Hamburg is one of few ports worldwide offering shore power infrastructure. But the entire industry is making significant efforts to become more sustainable, with many other ports following suit.

Sustainable growth - environmentally, economically and socially – has always been a key focus in developing Hamburg as a cruise destination. Hamburg has risen to the challenge of balancing the economic opportunity of the port with environmental responsibility, while also meeting the expectations of Hamburg's residents for a city-friendly port. Measures extend beyond sustainable practices and pollution prevention in air and water to encompass energy and resource efficiency. Cruise Gate Hamburg is working to 'greenify' its operations, including the installation of solar panels and introduction of EV charging points for trucks and buses at Cruise Center Steinwerder or the implementation of digital traffic guidance systems at the new Cruise Center Hafencity. Through strategic investments, collaborative efforts and a forward-thinking approach, Hamburg aims to set standards for sustainable cruise development, benefiting the local environment and society, while ensuring the long-term success and resilience of cruise tourism in Hamburg.

Looking from a broader perspective, the Cruise Industry has made substantial strides in sustainability. Industry-wide efforts and investments in research and development have led to exploring new propulsion systems and alternative low-carbon fuels. The cruise sector, along with shipyards, technology manufacturers and research institutions, has been at the forefront of these advancements, achieving significant milestones that benefit the entire maritime industry. Innovations, such as LNG-powered ships, hybrid propulsion systems and the exploration of fuel cells and batteries to further reduce emissions are just a few examples of how the industry is pushing the boundaries of sustainable maritime operations.

The journey towards sustainability is ongoing and it is crucial for the industry to continue working closely with local stakeholders. Effective route planning, for instance, can help mitigate overtourism, a pressing concern in many popular destinations. By proactively proposing solutions, the Cruise Industry can avoid regulatory measures that may not suit the unique dynamics of cruise tourism. Collaborative efforts can

ensure that both the economic benefits of tourism and the well-being of local communities are balanced. In Hamburg, we do not face the problem of overtourism like some destinations. Open communication and transparency are essential for the acceptance of cruise tourism and tourism in general. We strive for this in coordination with key partners in the cruise business in Hamburg, be it from the tourism sector, political stakeholders, agencies, service providers or tour operators.

And let's not forget: the Cruise Industry significantly contributes to value creation on both local and global scales. Globally, 1.2 million people benefit from the Cruise Industry's activities, with nearly 40% residing in Europe. Across Europe the industry supports over 400,000 jobs. Cruise lines, passengers, local service providers, and cruise-related events all contribute to the economic strength of a city or region and the tourism sector as a whole. The influx of cruise passengers stimulates the local economy, creating jobs and fostering economic growth. For Hamburg, the annual Gross Value Added generated by the cruise business is approximately 420 million euros, involving nearly 4,500 full-time jobs, making it a significant economic factor for the city. The ripple effect of the Cruise Industry's economic impact underscores the importance of maintaining a sustainable and thriving cruise tourism sector, benefitting not only the port but the entire region.

The sustainable development of cruise tourism at the Port of Hamburg exemplifies the power of collaboration and innovation. By continuing to work together, we can ensure that the Industry remains a leader in sustainability, driving positive change for the environment and the economy alike. Together, we can navigate towards a greener and more sustainable future. ■



Simone Maraschi

Managing Director
Cruise Gate Hamburg GmbH
Germany

simone.maraschi@cgh.hamburg.de

Photo by:
Cruise Gate Hamburg



TAPANI PULLI

Towards carbon neutral shipbuilding

Expert article • 3647

The cruise ship industry has long been associated with luxury, leisure and exploration. However, as the industry has grown, so has its environmental footprint. Cruise ships are significant consumers of fuel, contributing to greenhouse gas emissions, and other ecological impacts. As global awareness of environmental sustainability increases, the cruise shipbuilding industry faces growing pressure to develop more sustainable practices and technologies. In this text, I treat the challenge from the perspective of Meyer Turku, the builder of the most complex cruise ships in the world.

The main objectives allowing cruise shipbuilding to become more sustainable are related to the product, the ship itself: reduction of greenhouse gas emissions, energy efficiency, waste management and recycling, and minimization of marine pollution.

Such a complex set of targets requires shared ambitions and a close cooperation of several parties: shipyards, customers, partner networks, research institutes and schools, municipalities etc.

Along the years, remarkable achievements have been made, mainly in the fields of alternative fuels and propulsion technologies, energy-efficient ship design, advanced wastewater treatment systems and smart ship technologies.

While significant progress has been made in developing more sustainable cruise ships, several challenges remain. The adoption of alternative fuels and propulsion technologies is challenged by the lack of infrastructure and the high costs associated with these technologies. Additionally, the transition to more sustainable practices requires significant investment from cruise lines, shipbuilders, and governments.

In its **sustainability strategy**, Meyer Turku commits to

- designing a buildable carbon neutral ship concept by 2025
- reaching carbon neutrality (for the shipyard's own operations) by 2030
- setting a good example by practicing active local industrial responsibility
- pushing the network to being equally or even more responsible

Meyer Turku's ambitions are supported by the large research and development program **NECOLEAP** launched in 2022. It aims at securing the competitiveness of the Finnish shipbuilding industry and high-level cruise ship expertise and know-how also in the future and is financed jointly by Business Finland, Meyer Turku and partners. Today, NECOLEAP has over 25 projects supporting in different ways digitalization and the development of a climate-neutral ship. Among the largest projects are Canelis, MeyMod, NavisSpace, Silent Engine, NeCom, SusFlow, and Necoverse.

Meyer **AVATAR** is an umbrella project steering these various project results. AVATAR was established to develop and implement the future climate-neutral technologies and know-how needed in designing and building next generation vessels. AVATAR stands for both digitalizing our climate-neutral competence and implementing the emerging technologies to virtual environment. Through AVATAR, it is possible to gather a portfolio of climate-neutral technology concepts, ship concepts and a library of alternative materials and products. Behind it are heavy investments in RDI to better understand future needs and demands and to adapt to them.

Through AVATAR, it is possible to implement future technologies in the next ship concepts in the short term, and Meyer is currently building a comprehensive path from R&D results directly to ship applications. The development of climate-neutral ship design expertise requires a new kind of approach and cross-cutting cooperation of the entire organization, as well as the involvement of a wide ecosystem.

In the future, the Meyer AVATAR process will continue in its role of supporting the right timing of integration of emerging technologies. The tools and processes that assist us along our journey towards climate neutrality can also support us with other sustainability aspects and in creating climate positive products.

As the ships' sustainability develops, so does that of the shipyard. Meyer Turku aims at being carbon neutral (for the shipyard's own operations) by 2030. A big step towards this direction has already been taken: Meyer Turku has used only certified carbon neutral electricity since 2018. Starting from 2023, also all district heating used the shipyard has been carbon neutral. This makes Meyer Turku a global pioneer among shipyards of its magnitude and underscores Meyer Turku's unwavering commitment to environmental stewardship in the maritime industry.

Building a ship takes an entire village of partners. Implementing the green transition requires the true commitment of us all. I appeal to the whole maritime industry to take all measures to explore this inevitable challenge that at the same time is a great business opportunity. ■



Tapani Pulli

Deputy CEO
Meyer Turku Oy
Finland



CHRISTOPHE TYTGAT

Interesting times for European shipbuilding

Expert article • 3648

SEA Europe has long called for a maritime industrial strategy to protect Europe's shipbuilding capacity. In June 2024, EU Member States within the Competitiveness Council responded positively by urging the European Commission to develop such a strategy.

With the incoming European Commission, SEA Europe will continue advocating for this strategy as a basis for strong industrial policies and regulations that support Europe's leadership in complex shipbuilding, whilst helping the industry to regain strategic shipbuilding markets, and pursue new business opportunities.

Turning the tide in a fast changing geo-political climate

European shipping currently controls 40% of the global fleet but orders 90% of its ships from Asia. However, in a geo-political climate of increased political tensions, military threats and less reliable trading partners, the EU's heavy dependency on Asian shipbuilding has become an economic and security risk – thus a non-negligible vulnerability – that must be derisked in line with the European Commission's policies on "strategic autonomy," "economic security," or "resilience".

Similar to other strategic sectors, the incoming European Commission must establish a sectoral maritime industrial strategy. This strategy should facilitate the formation of a Maritime Industrial Alliance and a European Ships' Act, aiming to mitigate vulnerabilities and dependencies on foreign countries by bolstering Europe's shipbuilding industrial capacity, while sustaining its current global leadership in complex shipbuilding and advanced maritime equipment production. The sustainable and digital transitions of waterborne transport and the Blue Economy present significant opportunities to surpass Europe's international competitors in quality, efficiency, and safety, reclaim strategic ship types for Europe's Blue Economy, and penetrate new markets, such as offshore renewable energy.

The Work Ahead: A Maritime Industrial Strategy that fits with the new political priorities

Prior to introducing a Ships' Act and Maritime Industrial Alliance, the European Commission must urgently implement a maritime industrial strategy, as requested by the Competitiveness Council. In SEA Europe's opinion, this strategy must be founded on four essential pillars:

- **Industrial sovereignty and competitiveness:** European shipyards must regain orders from shipowners, especially in strategic sectors like cabotage, shortsea shipping, and offshore renewable energy.
- **Supportive regulatory framework:** The European Green Deal and Net Zero Industry Act have provided opportunities but failed to establish a framework for making the business case for competitive, sustainable shipping and shipbuilding in Europe.
- **Technological leadership:** The EU must boost R&D and innovation, and scale up sustainable and digital technologies. Programs like Horizon Europe should continue, whilst new partnerships should be established.
- **Skilled workforce:** European shipyards must retain, re/upskill and recruit workforce, whilst facing competition from other industries and a fast retiring workforce.

Under favourable framework conditions, European shipyards and maritime equipment manufacturers— known as the maritime technology industry— can produce 10,000 sustainable and digitalized vessels by 2035, invest over €10 billion in highly efficient, automated, and sustainable production facilities, and recruit as well as re/upskill 500,000 qualified workers. This ambitious vision aligns seamlessly with the new political priorities of Commission President von der Leyen for a Clean Industrial Deal, Defence, and the EU Oceans Pact.

Inaction is no longer an option; otherwise, not only is the EU's standing as a maritime power at risk, but also the maritime industry's credentials are jeopardized, including global leadership in innovative and complex products, €128 billion of annual production value, and 1.1 million highly skilled jobs. ■



Christophe Tytgat

Secretary General
SEA Europe (Shipyards' & Maritime
Equipment Association)
Belgium



ANDREAS NORDSETH

Navigating towards a sustainable maritime future

Expert article • 3649

Our collective ambition to achieve sustainability in the maritime sector is not just a necessity but also an opportunity to reshape the future of global shipping and its impact on our planet.

The need for climate action

Climate change is undeniably one of the most pressing issues of our time, significantly affecting the maritime industry. The urgency to de-carbonize and reduce greenhouse gas (GHG) emissions resonates deeply within our sector, responsible for approximately 2-3% of global GHG emissions. However, sustainability goes beyond climate action. It encompasses a holistic approach to environmental stewardship, economic viability, and social responsibility.

The global dimension of maritime sustainability

The maritime industry is inherently global, and the journey towards sustainability requires a united effort. It is essential for all stakeholders—governments, industry leaders, and international organizations—to collaborate and align their efforts. We need frontrunners who can demonstrate the feasibility and benefits of sustainable practices, inspiring others to follow suit. These pioneers are not just trailblazers; they are vital for setting benchmarks and driving industry-wide change.

A significant milestone was reached in the summer of 2023 when the International Maritime Organization (IMO) adopted a revised strategy to reduce GHG emissions from international shipping, with a target to reach net-zero GHG emissions by or around 2050. This strategy underscores the importance of global regulation and the collective commitment needed to drive substantial change in international shipping.

Advancements and challenges in the green transition

We stand at the dawn of a green transition in international shipping, with the initial steps revealing both promise and challenges. The adoption of green fuels, such as ammonia, hydrogen, and methanol, represents a pivotal shift towards reducing our carbon footprint. Yet, the scale-up of green fuel production remains a significant hurdle. It is imperative to build a robust and large-scale infrastructure that supports the availability and accessibility of these sustainable alternatives.

Energy efficiency is another cornerstone of this transition. Enhancing the energy performance of our fleets through innovative technologies and operational strategies can substantially decrease overall consumption. This dual approach of adopting green fuels and improving energy efficiency is crucial to curbing emissions and promoting sustainable practices across the industry.

The role of technology and innovation

To reach a sustainable maritime future, we must embrace the transformative potential of technology. Artificial intelligence (AI) and digitalization offer unprecedented opportunities to optimize shipping routes, enhance fuel efficiency, and predict maintenance needs, thereby reducing environmental impact. AI can be a catalyst in achieving smarter, greener maritime operations, ensuring that technological advancements do not leave an adverse mark on our planet.

New growth opportunities

A sustainable maritime future brings new economic opportunities. The production of green fuels, for instance, presents significant growth potential for regions capable of harnessing renewable energy resources. This shift can drive economic development, create jobs, and foster innovation in parts of the world that invest in sustainable energy infrastructure. Showcasing these opportunities is crucial to gain support and investment in the green transition.

The road ahead

We have only just begun to glimpse the possibilities of a fully sustainable maritime industry. The path ahead is fraught with challenges, but it is also brimming with potential. As we refine our technologies and strategies, we must remain steadfast in our commitment to a sustainable future that benefits not only the environment but also the global economy and society at large.

The maritime industry has always been a cornerstone of global trade and connectivity. Now, it must also become a beacon of sustainability and innovation. By leveraging technology, fostering international cooperation, and investing in green fuel infrastructure, we can navigate towards a future where the maritime industry is not only efficient and profitable but also environmentally responsible.

In conclusion, the green transition of shipping is not merely an option; it is an imperative. The stakes are high, but the rewards are even greater. Together, we can chart a course towards a sustainable maritime industry showing our commitment to the planet and future generations. ■



Andreas Nordseth
Director-General
Danish Maritime Authority
Denmark



JOE BETTLES

EU policies drive green shipping in the Baltics

Expert article • 3650

The maritime industry is at a pivotal moment. As the world's economies strive to reduce greenhouse gas (GHG) emissions in line with the Paris Agreement, the cost gap between conventional and sustainable marine fuels leaves the sector without a commercial case for going green. While efficiency improvements can lower fuel consumption, achieving net-zero GHGs will ultimately require ships to use sustainable energy sources. Without government action to address this cost gap and boost the supply of clean energy, investments in sustainable ships and infrastructure could be delayed, locking in fossil fuels for decades.

The EU has risen to meet this challenge with new policies that, for the first time, create a business case for sustainable marine fuels. The Baltics, already a center of green energy, will benefit from new EU incentives that create more demand for sustainable fuels. Data from Eurostat shows that in 2022 the Baltic Sea Region accounted for 37% of the EU's GDP in 2022 but 46% of the total installed wind and solar capacity. As a leader in the transition to green energy, the region is poised to turn new policy-driven demand into greater production of sustainable fuels.

Demand for green shipping in the EU has been stimulated by the introduction of two landmark maritime policies: the EU Emissions Trading System (EU ETS) for shipping and the FuelEU Maritime Regulation. Starting in January 2025, the FuelEU mandates ships sailing to ports in the European Economic Area to reduce the annual GHG intensity of the energy used onboard. By setting increasingly stringent limits on GHG intensity, it drives companies to replace bunker fuel oil with sustainable alternatives. Flexibility measures further incentivize the use of the most sustainable fuels, such as those made from hydrogen produced with renewable energy, by allowing companies to sell surplus compliance to other ships. Selling compliance has been a key revenue source for electric vehicle companies like Tesla, which sell credits to automakers unable to meet fuel standards in the US, China, and EU.

Sustainable fuels are further incentivized by the EU ETS, effective from January 2024. The policy extends the EU's cap-and-trade program to the maritime sector, requiring ships to buy allowances equal to the tonnes of GHGs emitted. With prices ranging from 50 to 100 Euros per tonne in 2023, the EU ETS incentivizes efficiency and the transition to sustainable marine fuels, which are not taxed under the scheme.

Incentives for sustainable marine fuels are well-aligned with green industrial policies in the Baltics. A study by the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping on Northern European & Baltic Green Corridors highlights how ports like Gdynia, Roenne, and Gothenburg are positioning themselves as green fuel hubs. However, to make these hubs a reality, fuel producers need contracts with customers before large investments can be made. With the FuelEU and EU ETS, companies can be confident that sailing green will lower costs and generate revenues, increasing the appeal of such contracts. We see this dynamic playing

out with two of the first shipping routes to fully operate on methanol produced from renewable energy, both of which are container vessels on feeder routes in the Baltics. These vessels entered into agreements with a fuel supply company, ensuring a reliable supply of green methanol while helping to build a new green fuel industry.

Policy-driven offtake, combined with efforts to support production, can scale new green fuels at a critical point in the transition. Since green fuels are not yet widely used, each new production plant improves economies of scale and learning-by-doing, driving down costs. For the Baltics, expanding fuel production hubs diversifies energy sources, builds new industries, while helping to close the cost gap between fossil and sustainable fuels.

The Baltic region serves as a powerful example of how targeted government policies can stimulate the development of green industries and drive the energy transition. With the FuelEU and EU ETS creating a business case for sustainable marine fuels, the Baltics can align green industrial policies with a policy-driven market for clean energy. This not only serves the region's priorities for clean and secure energy but also positions it as a leader in the global effort to decarbonize shipping.

As the International Maritime Organization (IMO) considers measures to achieve net-zero emissions by 2050, the lessons from the Baltics can guide global climate action. By showcasing how government incentives can effectively drive demand that aligns with efforts to increase supply of sustainable fuels, the Baltic economies can influence the adoption of strong international regulations that further support green industries. This has benefits for the regional economy while accelerating the pace at which the world achieves climate ambitions. ■

For detailed insights on how the FuelEU is influencing the decisions to go green, explore our series at www.zerocarbonshipping.com/fueleu/.



Joe Bettles

Market Analyst
Mærsk Mc-Kinney Møller Center for Zero
Carbon Shipping
Denmark

joe.bettles@zerocarbonshipping.com



ULLA TAPANINEN

Regulations towards shipping decarbonisation

Expert article • 3651

In 2023, the International Maritime Organization (IMO) set a goal of reducing greenhouse gas emissions of shipping to approximately zero by 2050. Also, in July 2023, the European Parliament decided on the maritime Fit for 55 package, which will regulate the carbon content of shipping fuels, fuel distribution and taxation and include shipping as part of the emissions trading system.

Regulations

The first international regulations to reduce shipping's greenhouse gases was made over a decade ago (**EEDI**). In 2011, the IMO set goals by which the structure of new ships must be designed so that ships' fuel consumption and, thus, greenhouse gas emissions are reduced. In 2021, the IMO set a similar requirement also for the existing ships (**EEXI**).

In 2021, the IMO approved **CII** – i.e., the Carbon Intensity Indicator. According to CII, the ship must reduce certain amounts of greenhouse gas emissions per transport performance. All these regulations tighten gradually, forcing shipping companies to be more and more energy efficient.

The energy efficiency improvement methods for vessels include: modification of hull parameters; propulsion system optimisation; hybrid propulsion system and alternative energy sources, like shaft generators and steam turbines; periodic cleaning of the hull, optimisation of the engine and propellers; waste heat recovery; cold ironing; hybrid battery-diesel propulsion; fuel-cells; wind power; solar photovoltaic system; and hydrogen cells. Finally, energy can be reduced also with the operational measures like slow steaming, route optimisation and trim optimisation.

The EU has also set a goal that the annual calculated carbon content of the fuel used at sea should decrease. This **FuelEU Maritime** means that part of the fuel used must be carbon-free, in which case biofuels or other new non-fossil fuels such as methanol are used. This regulation is also gradually tightening, and it is likely to impact shipping significantly.

Among new, alternative fuels electricity is the most likely solution for short trips, but different hydrogen-based fuels, like methanol and ammonia, are planned for longer trips. Currently, ships are often built with engines that can use several fuels. Multi-fuel engines usually use fossil liquid fuel, but they can also use gas, LNG or other liquids such as hydrogen or its derivatives; or electricity.

Market incentives

This year, a market-based control tool started, the **ETS**, which stands for Emission Trading System. ETS means that after each year, an operator must surrender enough allowances to cover its emissions; otherwise, heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or sell them to another operator short of allowances. In 2024, the shipping companies must purchase allowances for 40 per cent of their emissions. The situation will tighten in the following years, and in 2027, rights must be purchased for 100% of emissions.

Results

It has been shown that the energy efficiency of new vessels has improved substantially after companies have adapted to EEDI regulations. Simultaneously, the investments have saved money for the shipping companies. In fuel side, electrifying vessels can be in many cases financially advantageous, but other non-fossil fuels are likely to become more expensive than present fossil fuels.

In summary, the new environmental regulation system has many sides. The energy efficiency methods decrease the costs of shipping, while switching to the new non or low carbon fuels in most cases increase the shipping costs. In addition, the Emission Trading Systems gives the shipping companies freedom to choose between decreasing the emissions or buying new allowances.

As a final remark, shipping companies face a situation where more and more ship financiers want the ships they finance to be productive and competitively operational for decades. This means that it is not any more easy to get financing for the old-fashioned non-energy efficient vessel able to run only on fossil fuels.

The only way that shipping companies can be competitive in the future shipping market is to prepare their operations and their fleet towards the green transition. The regulations for the vessels, new fuels, emission trading and demands of customers and financiers require deep understanding of technical and operational alternatives. ■



Ulla Tapaninen

Tenured Full Professor Maritime Transport
Estonian Maritime Academy
Tallinn University of Technology
Estonia

ulla.tapaninen@taltech.ee



ANITA LĪVIJA ROZENVALDE, ANETE BĒRZIŅA,
ANNIJA DANENBERGA & FLORIAN BORTIC

Are we as BSR communities blue-green yet?

Expert article • 3652

Since humanity learned to traverse seas and oceans, these waters have motivated vast innovation to optimise resources. Now, with the Baltic Sea experiencing milder winters (from 7 (1950-1979) to 16 (1993-2022) over a 30-year period) and continued decline or stagnant (bad) status of biodiversity, innovation is also propelled by green transition aspirations. E.g., in the face of available fossil fuel depletion, the Baltic Sea is assessed to hold a 93GW potential for offshore wind energy, production of 5GW is operational, but more is to be unlocked as innovation unlocks more powerful turbine options with higher longevity. **The Baltic Sea Region (BSR) track record shows we are working but is this enough?**

The technological potential to implement a green transition in maritime economies is increasing. However, this is in parallel to counteracting societal factors. In the BSR we have seen that uptake of new technologies and blue industries can be slow: 1) due to established maritime industries being joined by new and not yet appropriately regulated ones in limited marine space; 2) due to lack of public support. Additionally, successful greening efforts can create a renewed perception of endless resources for individuals, which can put new pressures on maritime resources.

Maritime spatial planning (MSP) has been recognised as one of European Green Deal enablers. While the BSR countries have a history of well-established collaboration through VASAB and HELCOM, each country opened internal cooperation opportunities to draft their respective MSPs. The maritime industries that are relatively novel for the country in question, can become catalysts for long negotiations, like offshore wind where no offshore wind parks have been built yet, such as in Latvia. All BSR countries having adopted MSPs is a testament to our ability to negotiate a slice of the sea for each use. However, with innovation, more potential marine territory uses are coming on the horizon alongside more conflict. Indeed, we put emphasis on conflicting maritime priorities – e.g., fishing, biodiversity, renewable energy. Here multi-use can become a disruptor to this conflict focus by challenging planners and maritime stakeholders to rather seek out complementary aspects of different sea uses. While EU regulation such as the Renewable Energy Directive is now establishing a foundation for mainstreaming multi-use, it still fits into a regulatory gap on the national level of BSR like novel maritime greening solutions themselves. Thus, this aspect of advancing greening is the responsibility of maritime spatial planners and policymakers and how they accept the shift from conflict to complementary thinking in the MSP processes, initiate regulatory change and introduce and communicate it to other stakeholders.

The aforementioned responsibility has to be further extended to a change in MSP stakeholder collaboration with the wider public. While the sea beyond neck-deep in the water can feel like no man's land to citizens, in our democratic MSP processes their voice has and should continue to have weight as their Baltic Sea is being shaped. The green transition slowing hurdle that is often encountered in case of innovation is that the public discourse is set by the first or the loudest piece of information that reaches the public or the public does not feel a sense of ownership over the solutions. Thus, the maritime planner and policymaker must seek ways to increase transparency and advance co-creation. The amount and diversity of information is key, as well as how experts use accessible language and early avenues of participation. Differing opinions and public opposition will not cease to exist, however, this can set the tone for less antagonistic and smoother MSP processes.

Now, let us consider the case of a single individual in the BSR – they do not have an active role in running maritime industries, but perhaps they read materials and participated in MSP drafting themselves or their friends did. They love to go to the seaside, enjoy the views, swim and their favourite food is herring. In this context their perspective of the sea is a combination of knowledge about the realities of the environmental state of the Baltic Sea, competing interests and their personal preferences. This is a theoretical person, but the balance of knowledge and relating to our Baltic Sea holds the potential for an individual behavioural shift – towards actions that take away the stress on sea and improves its environmental status.

The Baltic Sea Region is advancing towards a blue-green transition by harnessing technological potential and fostering collaborative maritime spatial planning, yet it faces significant environmental, regulatory, and societal challenges that require enhanced public engagement. Initiative for innovation should persist but we must enable its full potential by shifting our problem-solving approaches and developing new methods for working with stakeholders involved. ■

Anita Livija Rozenvalde

Deputy Unit Head
Spatial Planning Policy Unit
Ministry of Smart Administration and Regional
Development of the Republic of Latvia
Latvia

Anete Bērziņa

Senior Expert
Spatial Planning Policy Unit
Ministry of Smart Administration and Regional
Development of the Republic of Latvia
Latvia

Annija Danenberga

Project Coordinator
Spatial Planning Policy Unit
Ministry of Smart Administration and Regional
Development of the Republic of Latvia
Latvia

Florian Bortic

PR Manager
Baltic Environmental Forum Germany
Germany

Interreg Baltic Sea Region project
Baltic Sea2Land consortium partners



VERANIKA KHLUD & IEVA DEMJANENKO

Sustainable Flow: Latvia's green maritime path

Expert article • 3653

The issue of sustainable development is not just a theme, but a pressing concern for the Baltic region countries, including Latvia. As a critical hub on maritime trade routes, Latvia plays a vital role in the maritime industry, significantly impacting the environment. Shipping remains one of the largest carbon dioxide (CO₂) emission sources, necessitating immediate and active measures to reduce the carbon footprint.

Latvia's maritime industry constitutes a significant part of the national economy, especially given its geographic location and well-developed port infrastructure. However, the intensity of maritime transport and logistics contributes to critical environmental challenges, particularly in terms of greenhouse gas emissions. According to data from the Ministry of Environmental Protection and Regional Development of Latvia, maritime transport accounts for a significant share of the country's total CO₂ emissions. Considering Latvia's commitments under the Paris Agreement and European targets for emission reductions, it becomes clear that the maritime industry must take steps to achieve sustainable development.

Focusing on implementing new technologies, upgrading current vessels, and implementing new procedures in the maritime industry is essential to minimizing the carbon footprint. Furthermore, Baltic countries like Latvia actively embrace renewable energy sources such as wind and solar power to support and power port infrastructure. There are ongoing initiatives to install solar panels and develop systems to harness and utilize wind energy at the Free Port of Riga.

Success in reducing the carbon footprint depends not only on the implementation of technologies but also on appropriate regulatory measures. In 2020, Latvia adopted a National Climate Action Plan, which includes measures to reduce emissions in the maritime sector. These measures include stricter emission standards for ships, modernising the existing fleet, and incentives for transitioning to more environmentally friendly fuels.

Latvia is also actively participating in the European "Fit for 55" initiative, which aims to reduce greenhouse gas emissions by 55% by 2030. Various measures are being discussed as part of this initiative, including the introduction of a carbon tax on shipping, which could incentivise shipping companies to adopt cleaner technologies.

The International Transport Development Association (ITDA) is a professional association that aims to advance sustainable development in the transport, maritime, ports, and logistics sectors. It fosters collaboration among stakeholders in these fields, promotes the adoption of innovative technologies, and supports compliance with international environmental regulations. One of the significant projects aimed at reducing the carbon footprint in Latvia and the Baltic region is "Sustainable Flow", implemented since 2023. This project, in collaboration with Estonia, Finland, and Sweden, is focused on creating more environmentally friendly port operations and infrastructure and reducing CO₂ emissions. The International Transport Development Association is Latvia's leading partner in the project, overseeing the installation of solar panels to supply the port with electricity from renewable sources and developing specialised software to optimise energy consumption, making resource use more efficient and environmentally safe.

Collaboration with partners from Estonia, Finland, and Sweden is not just beneficial, but essential for Latvia to leverage the advanced experience and technologies of these countries to achieve maximum results. These countries are also implementing similar projects in their ports, creating conditions for the exchange of knowledge and best practices. This project is expected not only to reduce CO₂ emissions significantly but also to improve the energy efficiency of the ports involved in the initiative, marking an important step towards creating 'green' corridors for shipping in the Baltic region.

Despite the successes, Latvia faces several challenges on the path to reducing the carbon footprint in the maritime industry. One of the main barriers is the high cost of implementing new technologies and modernising infrastructure. This includes the initial investment required for installing solar panels and developing specialised software, as well as the ongoing maintenance costs.

Nevertheless, the prospects for Latvia and the entire Baltic region are not just positive but promising. Considering the growing support from the European Union and international commitments to emission reductions, Latvia has every chance to become a leader in sustainable shipping. ■



Veranika Khlud

Project Manager
International Transport Development
Association
Latvia



Ieva Demjanenko

Project Manager
International Transport Development
Association
Latvia



MILLA HARJU

A network connecting clean shipping initiatives

Expert article • 3654

Despite of being established 15 years ago, the EU Strategy for the Baltic Sea Region (EUSBSR) does not necessarily ring a familiar bell to many. It was designed as a tool to address mutual challenges that the Baltic Sea countries faced in order to find solutions to them together. Its three main objectives are 1) Save the Sea, 2) Connect the Region, and 3) Increase Prosperity.

The Strategy entails 14 policy areas (PA) of interest, which each have their own objectives and actions - PA 'Ship's' ambitious objective for instance aspires to turn the Baltic Sea into a model region for clean shipping, with the following three action items:

1. Support measures including digitalization in reducing emissions from shipping,
2. Support research on emerging thematic challenges related to clean shipping and its impact on the environment and wildlife in the Baltic Sea;
3. Support development of shore-side facilities to enhance clean shipping measures including infrastructure for climate-neutral and clean fuels.

These actions are about to be imposed for scrutiny, as the whole EUSBSR Action Plan is due for an update over the next two years. Each PA will be taking a good look on their current state, achievements, and the most topical issues in their field: are all the actions relevant, achievable, measurable? The update will in effect bring in a fresh breath of (sea) air via re-evaluated, topical themes.

As we embark to the task, it is necessary to ponder what is currently taking place, and coming in the field of clean shipping. Currently, or still, the most prominent issue of course is the question of the alternative fuel: what will it be? Will the industry choose ammoniac over hydrogen? Would electricity even be viable for longer voyages? Are biofuels really a better option, when you look at potential spillages impact on marine life? What are the factors that we should consider when making the choice, and who has the authority to prioritize them?

We are also hearing a lot more about underwater noise, national bans on waste water discharges into the sea (finally!), development of onshore power supplies (OPS) and of course - the FuelEU Maritime's impact on industry. Characteristically to the Baltic Sea issues, one cannot really address one challenge without it having an impact to all of them - which from other perspective of course means that by solving a problem you are at least half way there to fix another one! Power is in numbers, and the more projects and initiatives we have across the area, the quicker we can come to best practices and solutions. The PAs act as networks or umbrellas accommodating all of those projects and initiatives, therefore connecting minds and efforts and ensuring that no wheels are invented simultaneously in other ends of the region.

One of the main tasks of those coordinating the EUSBSR's political areas, is to act as bridges between the projects and the political level. In order to ensure that the forest is seen from the trees from both ends, a continuous dialogue must take place and the messages should also be shown to have an effect in the long run. One of PA Ship's recent projects, EMERGE, set on to 1. *comprehensively quantify and evaluate the effects of a range of potential emission reduction solutions for shipping in Europe*, and 2. *develop more effective strategies and measures to reduce the environmental impacts of shipping*. Now, after finishing their project and publishing results, they have succeeded in submitting three information documents to the International Maritime Organisation (IMO), which will potentially be taken into consideration in the Sub-committee on Pollution Prevention and Response, and if all goes well, have an impact on the upcoming regulation concerning scrubber water discharge.

Projects are producing incredible amounts of highly valuable data in all corners of the Baltic Sea Region, and this is just one example of how that data could make a difference. PA Ship aims to ensure, that the projects that are advancing clean shipping efforts will get footing and as much spotlight as possible to make their results seen and heard in the maritime sector, and also set its own actions to match the tasks accordingly. ■



Milla Harju

Special Advisor / EUSBSR Policy Area Ship Coordinator
Finnish Transport and Communications Agency Traficom
Finland

milla.harju@traficom.fi



IGNĖ STALMOKAITĖ

Policy coordination for green shipping corridors in the Baltic Sea

Expert article • 3655

The concept of green shipping corridors emerged as part of global efforts to reduce maritime emissions and accelerate the energy transition to zero carbon shipping. Under the [Clydebank Declaration](#), signed during the United Nations Climate Change Conference in Glasgow (COP26), more than twenty countries committed to fostering partnerships and coordination needed to facilitate the launch of at least six green shipping corridors – ‘zero-emission maritime routes between two (or more) ports’ – by the middle of this decade.

In the context of global efforts to pioneer green shipping corridors, the Baltic Sea stands out as a key example of regional cooperation aimed at supporting the transition to zero-carbon fuels, aligned with strengthened global and European regulatory frameworks. These include the International Maritime Organisation’s revised GHG reduction strategy, the FuelEU Maritime initiative, and the inclusion of shipping in the EU Emission Trading System. Historically, cross-border policy coordination has been instrumental in strengthening the environmental protection from the pollution of shipping, for example, by designating the Baltic Sea as a Particularly Sensitive Sea Area (PSSA) and an Emission Control Area (ECA) to control SO_x and NO_x emissions from shipping. Policy coordination and project cooperation on green shipping initiatives in the Baltic Sea Region are enhanced through various intergovernmental platforms, frameworks, and working groups, including the HELCOM Green Team (Sub-group on Green Technology and Alternative Fuels for Shipping), the Council of the Baltic Sea States Expert Group on Sustainable Maritime Economy, the EU Strategy for the Baltic Sea Region Policy Area Ship, and the Conference of Peripheral Maritime Regions, among others.

Among these platforms, the Council of the Baltic Sea States (CBSS) plays an important role in coordinating policy efforts and information exchange related to green shipping corridors in the Baltic Sea Region. As an intergovernmental organisation for political dialogue and practical cooperation, the CBSS and its Expert Group on Sustainable Maritime Economy (EGSME) provides a forum for knowledge exchange and cross-border coordination between governments, maritime authorities, and industry stakeholders. EGSME group is comprised of national experts from CBSS Member States’ line ministries dealing with maritime affairs, the European Commission’s Directorate General for Maritime Affairs and Fisheries as well as observer organisations. Under the guidance of the German EGSME Chairmanship (2022-2023), the group has initiated the work on green shipping corridors in the Baltic Sea Region and established a network of national contact points for green shipping corridors in all CBSS Member States. This work continued under the Finnish EGSME Chairmanship (2023-2024) and is currently being carried out by the Estonian EGSME Chairmanship (2024-2025).

While government support is instrumental in the early development stage of green shipping corridors, particularly in enabling partnerships and establishing financial support mechanisms, maintaining momentum will require addressing the growing gap between policy expectations and delivery capacity. Furthermore, closing the fuel cost gap, increasing international cooperation and enhancing data sharing across borders will be critical areas for continued policy coordination and intervention. Collaborative public-private efforts remain key to ensuring that green shipping corridors can scale effectively. ■

**Ignė Stalmokaite**

Dr., Guest Researcher
Centre for Technology, Innovation
and Culture
University of Oslo
Norway

igne.stalmokaite@tik.uio.no

JULIA PAHL

CO2 emissions reduction through port call optimization

Expert article • 3656

Maritime transport is fundamental for the global economy as it accounts for over 80% of the world's trade. The Clydebank Declaration aims to establish six zero-emissions green corridors with entirely decarbonized maritime routes between two or more ports by 2025. Conversely, total emissions of the world fleet increased by 4,7% between 2020 and 2021.

Most ports serve ships on a first-come-first-served basis leading to inefficiencies and negative environmental impacts as vessels sail at a pre-defined speed to their destination port to potentially find port resources not ready forcing them to wait outside the port area at anchorage. Ships waiting outside the port area complicate port traffic including entering and exiting from the various terminals and increase risks for accidents. This is the case for all cargo types encompassing containers, roll-on-roll-off (roro) cargo, bulk, oil and gas. While port call operations for container and roro shipping are better to plan as ships work on predetermined routes with fixed port call frequency, tramp shipping is much more complicated as cargo shipping works on complex terms and their work routine like taxi-driving.

The orchestration of port traffic by providing real-time information of ship positions and estimated times of arrivals (ETAs) of ships as well as readiness notices of port resources and services is a challenge as a great number of stakeholders is involved in the port call process. For instance, ships need to have services ready at pilot boarding place such as pilotage and/or escort tugs. Beforehand, vessel tracking management services need to confirm or allow ships to enter the port area. The ship operator or ship agent is further responsible for requesting services when the ship is at berth ranging from services of quality control of cargo to fueling the ship and providing provisions to the crew. Moreover, documentation of cargo to be unloaded as well as customs declarations need to be exchanged.

The envisioned and required impact

Early and real-time information exchanging about ship arrivals and port and terminal resources readiness notices can save up to 21% of fuel of overall ship voyages as ships can decide to slow down to target an ETA at the pilot boarding place that allows them to sail at optimum fuel-consumption speed and thus eliminating waiting time at anchorage. Average anchorage times can account for 5-10% of a ship voyage duration while running auxiliary engines consuming ca. 15% of the voyage's marine fuel. Thus, arriving "just-in-time" (JIT) does not only permit ships to sail slower and reduce fuel consumption, but also to eliminate anchorage-induced air pollution in port vicinity. Reducing fuel consumption on the ocean leg clearly comes to a benefit of the ship operator, but reduced waiting-time-induced fuel consumption in port vicinity comes to great enhancement of living conditions to people living and/or working in port vicinity and thus to society.

Enhancing port efficiency through better planning and execution of processes due to exchange of high-quality real-time data further permits to reduce energy consumption – now from the landside including the port, terminals, and hinterland traffic. Hinterland-based port-inbound road traffic could be aligned to more synchronized traffic by, e.g., providing trucks time slots when to approach the port or terminal gate area and/or directing cargo-trains to approach the unloading/loading station in such a way that cargo is ready just-in-time when ships berth to avoid congestion in the terminal. IMO requires 50% reductions of greenhouse gas emissions (GHG) over 2008 levels by 2050 and air pollutants such as NOx, SOx, and particulate matters in port areas as well as 70% of CO2 emissions per transport.

How to achieve coordination and traffic orchestration?

The orchestration of traffic needs real-time information exchange to be able to coordinate the various activities. The European Commission pushes innovations further that permit coordination and collaboration among all stakeholders in the port call process and selected two projects in mid-2023 that aim to apply JIT principles to maritime logistics and to demonstrate the effects on GHG emissions and maritime safety. One of them is the Maritime just in time optimiSatION (MISSION) project that will develop a digital voyage and port call optimization system as well as related functionalities to be integrated into existing IT-systems. In that way, collaboration between stakeholders should be possible to synchronize not only ship and berth schedules including ship speed optimization and navigation, but also port and terminal operations and services thus reducing fuel and energy consumption including GHG emissions on the one hand as well as enhancing (port) operational efficiency on the other hand. ■



Julia Pahl

Dr., Associate Professor
University of Southern Denmark
Odense, Denmark

julp@iti.sdu.dk



KENNETH LØVOLD RØDSETH & KJETIL FAGERHOLT

Planning of zero emission ferry services

Expert article • 3657

There are approximately 100 high-speed ferry connections in Norway. Because the current fleet runs on fossil fuels and has a low passenger base, high-speed ferries are among the costliest and most emission-intensive means of public transport. On May 10th, the Norwegian Government organized a hearing for a legislative proposal for zero emission requirements for ferries and high-speed ferries, mandating zero emission technology for high-speed ferries already by 2025.

Phase-in of zero emission high-speed ferries will be costly. Novel and holistic transport planning is needed to limit operator and passenger cost increases in order to reach the goal of emission-free high-speed vessel. This is the key takeaway from our studies using optimization and economic analysis.

Emission-free high-speed ferry routes cost more

A transition to zero emission high-speed ferry services will be costly, even for short connections. Zero emission technologies require electricity, which currently exhibits substantial price volatility and can also result in significant development costs due to limited available transmission network capacity. Our research suggests that electrification of existing high-speed ferry routes will result in abatement costs ranging from 200 to 1 600 Euro per ton of carbon dioxide (CO₂) removed. These figures exceed the Norwegian authorities' reference price for the social costs of CO₂ of 175 Euro per ton in 2030. This is in part because of battery-powered vessels' limited range, which can require an increase in fleet size to uphold the current level of service.

Battery swap and hydrogen technologies can be adopted where range is a challenge for battery-electric vessels, which our calculations show can significantly improve the technical and economical feasibilities of zero emission high-speed ferry connections. Hydrogen is a less mature technology that will only become competitive when it has many users – also counting other sectors than high-speed ferries. But even in this case it can be demanding to maintain current routes as alternative fuels have inferior energy densities compared with fossil fuels, and more extensive charging/filling can result in passengers spending more time in transit.

New technology demands novel transport planning

The introduction of zero emission vessels changes the cost structure and the operational framework conditions of the high-speed ferry sector. This requires rethinking current operation plans and timetables to meet the premises of the new technologies. Important measures include adapting existing routes to reduce sailing distances or to reduce sailing speed to lower the energy consumption.

Cost-saving measures for ferry operators can adversely affect passengers through longer travel times or inferior level of service. This comes at the risk of having fewer public transport users and increased car traffic. However, a sole emphasis on upholding current timetables is likely to result in unnecessary operator cost increases and make the implementation of the proposed requirements for emission-free high-speed ferries challenging, both for the central government and the county governments that oversee public transit in Norway.

These are key trade-offs and considerations for forthcoming tenders for high-speed ferry operations. Comprehensive transport planning also involves looking into possibilities to replace expensive high-speed ferry transport by other means of public transport, such as buses, as well as planning for shared use of bunkering infrastructure to mitigate the substantial capital cost barrier to a green transition of the maritime fleet. Through novel and holistic transport planning, the additional costs of zero emission vessels can be significantly reduced. ■

The authors are associated with the research project ZEVS that studies technical and economical feasibilities of zero emission high-speed passenger vessels. More information about the project can be found under <https://www.toi.no/zevs/>, <https://app.cristin.no/projects/show.jsf?id=2560947> and <https://prosjektbanken.forskningsradet.no/project/FORISS/320659>.



Kenneth Løvold Rødseth

Chief Research Economist
Institute of Transport Economics
Norway

klr@toi.no



Kjetil Fagerholt

Professor
Norwegian University of Science and
Technology
Norway



JUULIA SUIKULA

Fertilizer ports need to reduce nutrient discharges

Expert article • 3658

The Baltic Sea, one of the world's most unique marine environments, is also among the most vulnerable. Eutrophication—caused by the excessive runoff of nutrients like nitrogen and phosphorus—has long threatened this fragile ecosystem. These nutrients fuel harmful algal blooms, leading to oxygen depletion, loss of biodiversity, and disruption of local economies dependent on the sea's health. Surprisingly, one significant yet often overlooked source of these nutrients is the marine transportation of fertilizers. In fact, a single fertilizer port can discharge as much nitrogen into the Baltic Sea annually as a wastewater treatment plant of a medium-sized Finnish city.

Each year, over 44 million tonnes of fertilizers pass through Baltic Sea ports—a figure that continues to grow. While these fertilizers are crucial for global food security, their transport poses a serious risk of accidental nutrient releases. Spills during the loading, unloading, and storage of dry bulk fertilizer are common and directly contribute to the nutrient load in the Baltic, aggravating eutrophication. Due to the sea's limited water exchange, these nutrients persist longer, compounding their harmful effects.

To tackle this issue, it's critical for ports, terminals, shipping companies, manufacturers, and policymakers to adopt measures that minimize the nutrient load from fertilizer transport. The John Nurminen Foundation is dedicated to advancing the Baltic Sea's environmental health through practical, measurable solutions that reduce nutrient pollution. We engage stakeholders across the maritime, agriculture, and forestry industries, advocate for sustainability-focused policies, and raise awareness about the impact of nutrient discharges.

One of our key projects involves partnering with fertilizer ports to identify and implement strategies to reduce nutrient runoff. By sharing best practices and innovative technologies, we aim to significantly reduce the environmental impact of fertilizer transport. Addressing nutrient pollution requires comprehensive strategies that integrate best practices, policy support, and collaboration among all stakeholders.

The most critical moments for nutrient losses occur during the transfer of dry bulk fertilizers between ships and quays. Often, these losses can be avoided by implementing simple, cost-effective practices. For instance, one effective method is ensuring that buckets are not overfilled during loading and unloading. Yet, because spills do happen, it's essential to maintain strict cleaning routines for berths, ships, and cargo holds. Proper cleanup helps remove any residues that might otherwise enter the seawater. Implementing a clean-up checklist can further ensure thorough cleaning after handling fertilizers.

Training and education also play a vital role. When personnel understand the environmental impact of nutrient losses and their role in preventing them, they are more likely to adopt best practices. By equipping all staff with the knowledge and skills necessary to manage fertilizers safely, we can reduce the risk of spills and accidents. Additionally, monitoring these processes provides valuable insights into where improvements can be made. For example, sampling stormwater at ports can help track the amount of phosphorus and nitrogen being discharged into the sea, allowing for targeted interventions.

While progress has been made, much work remains. Preventing nutrient discharges from marine transportation of fertilizers is essential for the sustainability of the maritime industry and the protection of the Baltic Sea. Direct stakeholders, including ports, terminals, shipping companies, and fertilizer manufacturers, are vital to this effort, but the involvement of policymakers and permitting authorities is equally crucial. Unlike other point source polluters, such as wastewater treatment plants, which are closely monitored and regulated, marine traffic remains a significant blind spot. This gap must be addressed, and appropriate regulations implemented.

The John Nurminen Foundation remains committed to leading these efforts, ensuring a thriving and resilient Baltic Sea for future generations. Through our collective actions, we can safeguard this precious marine ecosystem and set the course for a sustainable future in maritime operations. ■

**Juulia Suikula**Project Manager
John Nurminen Foundation
Finlandjuulia.suikula@jnfoundation.fi

ULF SIWE

Policy Area Safe – a Baltic safety network

Expert article • 3659

The EU Strategy for the Baltic Sea Region (EUSBSR) fosters international cooperation in the Baltic Sea Region. The Strategy is divided into three main objectives: Saving the Sea, Connecting the Region and Increasing Prosperity.

The strategy has an action plan which is implemented through 14 Policy Areas. The policy area for maritime safety and security (PA Safe) is responsible for four of the actions:

- Providing reliable navigational conditions to the Baltic Sea,
- Developing winter navigation to meet future challenges,
- To be a forerunner in digitalisation and automation and
- Ensure accurate preparedness and response for maritime accidents and security issues.

The actions are implemented by projects receiving funding from different EU sources, like Interreg, Horizon and CEF. The EU member states in the region make up the Steering Group and contributes to the work, which includes cooperation with other regional bodies like HELCOM and VASAB.

PA Safe stimulate the creation of project ideas and support project consortium forming to take ideas into real projects. PA Safe further disseminate projects objectives and results, assist the projects on policy issues. The policy area makes sure that the project results live on many years after the projects are finished. It connects ongoing projects which facilitates cross-fertilization and future cooperation in new PA Safe projects.

One project that helped provide reliable navigation and helped the region to be a digital forerunner was FAMOS. It provided modern bathymetric measures (depth) in most countries but it also developed an advanced model for the actual surface of the Baltic Sea. Since the earth is not completely spherical the surface is actually varying as well due to differences in gravitation. Not all countries were involved in the gravitational model, but the following BalMarGrav project completed the model by retrieving measurements from archives in the former "Eastern Bloc" countries and updating the FAMOS model – a very cost efficient method.

The EfficientFlow project helped increase safety and sustainability. It provided an open source software to exchange port service timing information. This formed the basis for the world's first Just-in-Time arrival solution for bulk shipping in the Port of Gävle. Ships get information on the exact availability of the quay and all connected services. Instead of sailing fast and then wait at anchor, the ships slow down and save fuel and emissions. The Euronews TV channel [featured the results](#).

To summarize, PA Safe is a facilitator that helps increase safety and sustainability in the Baltic Sea Region. The main strength is the network of experts that grows and interacts. ■



Ulf Siwe

Policy Area Safe Coordinator
Swedish Maritime Administration

ulf.siwe@sjofartsverket.se



MATTHEW J. SPANIOL

Cyberwar checklists for executives and policymakers

Expert article • 3660

State-of-play:

The Baltic Sea Region is the frontline in cyberwarfare, but the outlook is not favorable: Ubiquitous connectivity and the Internet of Things are compounding surface area exposure; Inadequate cybersecurity measures are leaving an increasing number of companies open to considerable risk; Small and medium sized organizations especially struggle to keep their defenses up, and insurance companies are less willing to provide coverage against cyberattacks. The region remains slow to adopt global policies, illustrated by delays in implementing amendments to International Safety Management (ISM) and International Ship and Port Facility Safety (ISPS) codes.

The SECMAR consortium, tasked with advancing secure digitalization for sustainable blue economies, issued a foresight report on cybersecurity for executives and policymakers.¹ The remainder of this column summarizes the emerging attacker enablers, defender trends, and recommendations for companies, policymakers, and industry. The column can be used by executives and policymakers as a starting point for a discussion with cybersecurity professionals to determine the status of protections.

Attacker enablers:

Cyberattackers have easy access to a wide variety of weaponized softwares and new techniques such as prompt injections, developer mode exploits, neural network translators, evasions, deepfakes, adversarial AI, and LLM-supported malicious code generation and attack vector discovery. Improving anonymity and un-traceability are lowering the risks for attackers who are organizing across increasingly fluid networks. Skill specialization, such as vulnerability brokers, are improving criminal productivity and knowledge sharing. Major culprits still include the unsanitized USB flash drive and the transmitter inside a gifted ballpoint pen, but new modes of delivery are expected.

Defender trends:

Cyberdefense improvements include enhanced system design, business continuity planning and cyberwargame simulations (digital and tabletop), AI-enabled bug-hunting and threat detection, and improved incident reporting protocols. Cyberdefense firms are increasingly specializing, and more SMEs are completely outsourcing their IT departments while larger organizations are investing more time, energy, and resources into information campaigns to change user attitudes.

Recommendations for companies:

1. Prioritize cybersecurity from the onset—first protect, then connect.
2. Implement effective controls like banning personal electronics.
3. Shift to a “whitelist” approach of approved cybersecurity practices.
4. Ensure cybersecurity training and certifications are up to date for personnel.
5. Large corporations should extend cybersecurity assistance to smaller suppliers.
6. Regularly audit systems for compliance with international standards.

Recommendations for policymakers:

1. Mandate real-time sharing of cyber threat intelligence across industries.
2. Support standardization of cybersecurity measures.
3. Promote cross-border forums to accelerate policy implementation and enforcement.
4. Invest in cybersecurity education and international competitions to boost talent pools.
5. Geofence critical infrastructure, including ships, to prevent unauthorized access.
6. If necessary, create legislation that penalizes non-compliance.

Recommendations for industry:

1. Improve tokenization and authentication across connected systems.
2. Enhance encryption protocols and phase out legacy communication systems.
3. Segment critical infrastructure to reduce the impact of potential breaches.
4. Cultivate a culture of cybersecurity awareness among the ecosystem partners.

Conclusion:

When an attack does occur, the prognosis is clear: Disruption leads to crisis which leads to panic. The key to avoiding the fallout lies in proactive measures, including adopting a unified approach to cybersecurity, enhancing communication and collaboration between stakeholders, and fostering continuous improvement across all fronts. The lists provided above are never exhaustive, as each point has numerous sub-points that will not fit this column. And these recommendations are already out-of-date by the time you read this because threats are forever evolving. But let them serve as a reminder, and use them to check in on your cybersecurity. As Robert Müller (former Director of the FBI) reminds us, “[t]here are only two types of companies: Those that have been hacked and those that will be hacked.” ■

I would like to thank SECMAR's Lawrence Henesey, Giovanni Di Noto, Shaun Reardon, and Stefan Ivarsson for their valuable feedback and insightful comments on earlier versions of this column.



Matthew J. Spaniol
Assistant Professor of Strategic Foresight
Department of People and Technology
Roskilde University
Denmark

¹ SECMAR report available [here](#).



MARKUS HELAVUORI

Cooperation for sustainable shipping

Expert article • 3661

The maritime industry is the backbone of global trade and although shipping is an effective and environmentally friendly mode of transport, it continues to have negative impacts on the environment. The regulatory reach of an individual country is limited, and due to its international nature, the maritime industry is most effectively regulated globally through the International Maritime Organization (IMO). However, regional organizations like the Baltic Marine Environment Protection Commission (HELCOM) also have an important role to play.

The Baltic Sea Action Plan towards sustainable shipping

The updated Baltic Sea Action Plan (BSAP), adopted at the HELCOM Ministerial Meeting in 2021, contains almost 200 actions aimed at achieving good environmental status in the Baltic Sea. Many of these actions, which the governments of all HELCOM Contracting Parties have committed to, are designed to make shipping more sustainable. These include measures to limit harmful discharges of e.g. grey water, sewage, chemicals, waters from exhaust gas cleaning (EGCS), as well as measures to limit underwater noise, marine litter and the spread of non-indigenous species.

Some BSAP actions are to be implemented at the national level by the HELCOM member countries. These include commitments to ensure the availability of onshore power, securing ship financing and innovation funding, enhancing the use of alternative fuels and energy sources and implement economic incentives. The HELCOM Maritime Working Group as well as its Sub-group on Green Technology and Alternative Fuels for Shipping (Green Team) a forum for coordinating these efforts, sharing experiences and overcoming bottlenecks that hinder progress.

Other BSAP actions are to be implemented jointly within the HELCOM framework. Importantly, many of these actions could lead to joint proposals by the HELCOM Contracting Parties to amend and strengthen various IMO regulations in order to further limit the impacts of shipping in the Baltic Sea. This is an opportunity to repeat previous HELCOM successes, where such joint proposals led to the adoption of amendments to the MARPOL Convention and the designation of the Baltic Sea as a special area under IMO MARPOL Annex IV (sewage) and Annex VI (emissions to the air).

National and regional initiatives beyond global regulation

While the maritime industry is most effectively regulated through the IMO, national and regional measures should not be underestimated. There are a few notable precedents of this worldwide, and in the Baltic Sea a promising example is the national prohibitions, currently under development in some countries for discharges of untreated EGCS waters and other ship wastes.

An earlier example is the “no-special-fee” system adopted by HELCOM already in the late 1990s. The system encourages ships to deliver all waste to port reception facilities instead of illegally discharging it at sea. It later served as a benchmark in the revision of the EU Port Reception Facilities Directive, thereby extending its key principles throughout the EU.

The national discharge prohibitions currently being developed may also facilitate the uptake of such improved standards throughout the Baltic Sea and beyond, thereby reducing the pressures on the marine environment at a more rapid pace than that which can be expected through pursuing such standards solely through the IMO.

Addressing unforeseen risks

Efforts to protect the environment from the pressures caused by maritime activities are, however, incomplete if only regulatory and financial aspects are considered. Even if existing and future regulations are enforced by national authorities and complied with by all ships, unforeseen events can still lead to significant environmental damage. Risk awareness is crucial, and authorities must be prepared to respond to any type of spill. This is more important today than ever due to increasing traffic, larger ships, novel fuel types and products transported, expanding offshore developments, tens of thousands of submerged munitions corroding on the seabed as well as extreme weather events caused by climate change. In addition, the current geopolitical situation in the Baltic Sea region complicates matters. Besides hybrid operations and related threats, the “shadow fleet” consisting of tankers with unclear origin, as well as questionable technical condition, insurance and navigational experience in Baltic Sea conditions is a significant concern which needs to be taken into account to ensure a sufficient capacity for response and cooperation in case of an incident.

Regulatory and technical advancements have already made the maritime industry significantly more sustainable than it was just a few decades ago. With continued intergovernmental cooperation, it is destined to become more so, but commitment from the industry and all levels of society will be required to meet the objectives set at regional and global levels. ■

The views expressed in this article are those of the author and do not necessarily reflect those of the Helsinki Commission or the Contracting Parties to the Helsinki Convention.



Markus Helavuori

Deputy Executive Secretary and Professional Secretary
Baltic Marine Environment Protection Commission (Helsinki Commission – HELCOM)
Finland



JAAP GEBRAAD

The power of cooperation

Expert article • 3662

The European waterborne transport sector is dynamic featuring a diverse array of public and private stakeholders. This includes maritime and inland waterway shipowners and operators, shipyards, equipment manufacturers, ports and terminals along with public and private infrastructure and service providers, universities, research institutes and social partners. And all these stakeholders are interdependent.

The sector is **critical for Europe's trade and economy**, moving nearly 90% of international trade, with 81% of the external EU trade and 40% of internal EU trade being carried by waterborne transport. The sector is not just crucial for trade; it is also a significant employment driver in the EU, providing 4.2 million direct jobs. Moreover, it contributes EUR 500 billion to the EU's yearly Gross Domestic Product (GDP). Waterborne transport is characterised by its unique attributes. One of its key features is the diversity of ships and services it offers, coupled with its inherently international character and economy of scale leading to high energy and cost efficiency. The sector plays a significant role towards reinforcing the **EU's resilience in terms of trade, security, defence, energy supply, sustainability**, thus being an enabler of the transition towards sustainable energy while safeguarding **strategic resilience** and a robust supply chain.

The sector is making significant investments to ensure it remains a worldwide frontrunner, embracing and facilitating the green and digital transformation. To effectively meet these targets, the waterborne transport sector must remain competitive. This requires possessing the required human and industrial capacity to foster innovative solutions. The aim of the sector is to become even more sustainable and environmentally friendly, focus on human centric approaches, integrate digital technologies effectively and enhance overall resilience. It is of utmost importance for the sector to uphold this position especially in the face of challenges such as absence of level playing field, regulatory uncertainty and increasing competition from third countries.

For the sake of completeness, the first part of this column is derived from a Joint Declaration, launched in March 2024 by the European associations representing the waterborne transport sector. The declaration summarizes the mission of the sector, as well as the need for an integrated approach.

The need for an integrated approach applies to Research, Development, Innovation (RD&I), and the deployment of innovations, as well. RD&I and its deployment, are key to be able to comply with environmental targets, and to enhance the sustainable competitiveness of the waterborne transport ecosystem. The Waterborne Technology Platform (TP), representing over 120 members from 19 EU Member States and four countries associated to Horizon Europe, provides policy guidance to the EU institutions regarding the RD&I priorities of the sector. Since 2021, the Waterborne TP has been coordinating the private side of the Co-Programmed Partnership on Zero-Emission Waterborne Transport in the framework of Horizon Europe. Establishing a coordinated Strategic Research and Innovation Agenda together with the private and public stakeholders of the sector is a major achievement. The significant amount of investments made by the private sector, on top of the co-funding provided via Horizon Europe, clearly shows the commitment of the sector to develop and deliver solutions for societal challenges.

At the time, recognising the strategic importance of this sector for Europe, and underlining the essential differences with other modes of transport when it concerns solutions for societal challenges, remains key. Often, combining (all) modes of transport under one initiative is considered as more effective. Whilst there are commonalities, and duplication of efforts should be avoided, every segment, even within the waterborne transport sector, has different specificities and requirements. Marinization of technologies, and initial steps to support market deployment within the waterborne transport sector, will remain key. Furthermore, RD&I is not only essential when it concerns developing technologies and concepts, but it will have a major impact on the competitiveness of the sector as well. Only with dedicated initiatives for the entire waterborne ecosystem, supported by both private and public stakeholders, the objectives of sustainability and competitiveness, or sustainable competitiveness can be achieved. Unifying the waterborne transport sector under one initiative already implies including multiple forms of mobility under one roof. ■



Jaap Gebraad

Secretary General

Waterborne Technology Platform



EEVA RANTAMA

Interreg – more than money

Expert article • 3663

Funding for transnational cooperation in the Baltic Sea region

For more than 25 years, the Interreg Baltic Sea Region Programme has funded transnational cooperation in the Baltic Sea region. The Programme is one of the European Cohesion Policy instruments driving the transition of the Baltic Sea region to a green and resilient future. It offers European Regional Development Funds (ERDF) for transnational cooperation projects that address shared challenges in the region. In each of the last 7-year programme periods, it has provided around EUR 200-240 million for projects.

The Programme's priorities have evolved with the needs and political priorities in the region. The Baltic Sea itself and activities related to it have remained central. To date, the Programme has supported around 40 projects fostering a more sustainable maritime industry, with budgets ranging from EUR 0,5 to 8,0 million. These projects address critical issues, including reducing emissions in ports, decarbonising shipping, finding alternative fuels and energy sources, harmonising waste and wastewater treatment in ships, organising the use of marine space, introducing new digital tools, and managing biofouling. Maritime safety is also a major focus, with projects working on reliable navigation and coordinated emergency preparedness at sea and in ports.

More than money

Interreg Baltic Sea Region is more than just a source of funding. The projects create a neutral space for authorities and experts from different fields and countries to collaborate outside their official mandates and think outside the box – and so find the best ideas and solutions to shared challenges. Transfer of knowledge and capacity building across public authorities, industries and local communities have been the core benefits of the projects.

Within the maritime industry, Interreg projects have come up with practical solutions, harmonised approaches across countries as well as policy recommendations and investment proposals that rely on a broad knowledge base. For example, the EnviSuM project provided policymakers and ship owners with sound evidence that strict, global environmental regulations of shipping can benefit human health and the environment without compromising business viability. The ECOPRODIGI project introduced tailored digital solutions for shipping companies, ports, shipyards and their suppliers, making processes more eco-efficient and sustainable. The Baltic LINes project provided recommendations to maritime spatial planning authorities on how to accommodate autonomous shipping, growing offshore services, and changes in shipping patterns. Meanwhile, the ongoing Blue Supply Chains project supports port authorities and operators in decarbonising port operations. Twenty partners from eight Baltic Sea Region countries work together to advance electrification, provide strategies for alternative fuels and set up green transport chains.

Beyond single projects for greater impacts

To amplify the impact of individual projects, the programme connects related projects and links them with other funding programmes through project platforms. For example, CSHIPP project platform brought together knowledge created in projects of Interreg, maritime research programme BONUS and Connect Europe Facility on how to reduce the environmental effects of shipping, make shipping cleaner, and enhance its business potential. Together with the HELCOM Maritime working group, partners identified the next steps toward future HELCOM recommendations for clean shipping in the Baltic Sea.

Interreg projects do not work in isolation but should be linked to policies, development strategies and networks in the region. EU Strategy for the Baltic Sea Region (EUSBSR) and its policy areas Ship and Safe provide an important framework for maritime projects. These Interreg projects help the policy area coordinators reach their set objectives, such as making the Baltic Sea Region a model region for clean shipping.

Greater need than ever for transnational cooperation to continue

The demand for Interreg Baltic Sea Region funding remains high. By the end of this year, almost all the current Programme 2021-2027 funds will be allocated to new cooperation projects. At the same time, discussions about the future EU Cohesion Policy including the role of Interreg programmes have started. The need for transnational cooperation for a sustainable region is greater than ever. It is up to all of us who believe in the power of joint experimentation and learning, and well-founded investment decisions through transnational cooperation to advocate for the importance of Interreg programmes. Together, we can ensure that Interreg Baltic Sea Region continues to improve the lives of people in the region for years to come. ■



Eeva Rantama

Team Leader Programme Unit
Interreg Baltic Sea Region Managing
Authority/Joint Secretariat
Germany

eeva.rantama@interreg-baltic.eu

www.interreg-baltic.eu



MICHELE ACCIARO

Strategies for a greener blue economy

Expert article • 3664

Three billion people rely on the oceans for their livelihoods, and about 40% of the World's population lives in coastal areas, not to mention the role that our oceans play in mitigating the impacts of the climate crisis and sustain thriving ecosystems. The blue economy is central to our wellbeing and its importance is increasingly acknowledged by governmental and private actors, although more is needed to account for all the different dimensions of the green transition beyond decarbonisation.

An increasing number of businesses in the blue economy are trying to reconcile profitability with environmental sustainability. If on the one side it is true that still too few organisations have been taking a proactive enough approach towards the environment, on the other side an increasing number of firms are attempting at integrating environmental considerations in their activities. Or at least they are talking about it.

A handful of blue-economy firms are often referred to as leading the green transition. For example, the container and logistics giant Maersk, made headlines in 2023 with the launch of its green-methanol strategy, and the largest seafood processing firm Thai Union, issued in 2021 sustainability-linked bonds for over US\$ 185 million to institutional investors. The green transition in the blue economy, however, has yet to gain momentum. The World Bank estimates that the blue economy contributes US\$ 2.5 trillions to the world economy, but not much of this is truly sustainable.

Most of the top 100 companies, known as the Ocean 100, that generate 60% of the total revenues produced by ocean-related industries, are offshore oil and gas businesses¹. As many of those firms are stock listed, however, reputation and shareholder engagement will incentivise at some point a transition that goes beyond mere greenwashing or superficial commitments to sustainability, which are also increasing. According to Morgan Stanley, in 2022, over 500 equity funds in public markets had an average exposure of over 3% to the "Life Below Water" SDG goal. Of these, about 100 had an exposure above 10%. These exposures reflect investments in both water-focused funds and those addressing broader themes like sustainable food production and the clean energy transition, where healthy oceans play a key role.

The extent that firms are developing products and services for businesses that are truly resilient, regenerative, and responsible is difficult to assess. In the start-up environment, a number of novel business concepts and technologies are emerging aimed at accelerating the green transition in the blue economy. UpLink, the open innovation platform of the World Economic Forum, teamed up with a coalition of incubators and venture capital firms and launched 1000 Ocean Startups (1000OS) to support start-ups with an ocean impact. While 1000OS is developing a set of metrics to assess the impact of these business concepts on the oceans, it is still too early to see how these initiatives will contribute to the green transition.

This is a positive development, as the central role of businesses in tackling some of the grand challenges of our times cannot be understated. While regulation is needed to accelerate the reduction of environmental impacts worldwide on our oceans, it is probably through the interplay between business and governments that a more fundamental change towards an economic system that is better aligned with the planetary boundaries can be achieved. In this vein in 2020, the UN Global Compact,

launched its Ocean Stewardship 2030 Roadmap², highlighting the need for sustainability leadership in the blue economy.

Although recently political and public discourse has somewhat shifted, the urgency of the green transition remains high due to escalating natural disasters and the mounting costs associated with climate and environmental crises. Furthermore, many of the policies put in place over the years are starting to influence the private sectors' decisions. Private sector's participation in the green transition is likely to increase as more green finance becomes available and the criteria for sustainability-driven investment tightens through stricter ESG and CSR standards.

There is the need that under a wider set of economic conditions and as a result of various degrees of government intervention, a green transition can be attractive for private investors. Blue-economy businesses can also be built on opportunities for improving living conditions worldwide and contribute to correct inequality by leveraging on resilient and regenerative oceans. While the promises of cheap renewables and zero-carbon technologies might be overstated, there are areas at the intersection of ecology and business that should be further explored.

One option to unlock these opportunities, is that blue-economy businesses can adopt so-called *blue-ocean strategies*³—innovative approaches that create new market spaces by addressing unmet environmental and social needs. By shifting focus from competing in overcrowded markets to pioneering sustainable practices, businesses can tap into underexplored areas such as marine biodiversity conservation, eco-tourism, building with nature, or circular concepts within the maritime sector, in addition to renewables and decarbonisation. These strategies could enable companies to deliver both ecological benefits and competitive advantage, fostering long-term value creation through innovation, while simultaneously contributing to the green transition and the improvement of the health of our oceans.

A blue economy that is truly regenerative, resilient and fair to all that it affects requires new ways of thinking. Only with collaboration among investors, governments, businesses and their relevant stakeholders we can hope to be able to leverage on the opportunities offered by a truly sustainable blue economy. Without the blue economy, the green transition is incomplete, as the health of our oceans is fundamental to addressing climate change, sustaining livelihoods, and preserving biodiversity. A truly sustainable future depends on our collective ability to integrate ocean stewardship into the broader green transition, creating solutions that benefit both people and the planet. ■

2 UN Global Compact. *OCEAN STEWARDSHIP 2030 Ten ambitions and recommendations for growing sustainable ocean business (2020)*.

3 S. Mesut. *Blue economy and blue ocean strategy*. *J. Ecol. Nat. Resour.* 5, 000263 (2021).



Michele Acciaro

Associate Professor
Department of Strategy and Innovation
Copenhagen Business School
Frederiksberg, Denmark

mac.si@cbs.dk



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ESKO PETTAY

Green transition in the maritime industry – finally

Expert article • 3665

Slow pace of the green transition while greenhouse gas emissions have been increasing year after year has been frustrating and worrying. Most of the major emitters haven't shown enough progress regarding climate change mitigation. Maritime industry and shipping have not been exceptions to this, and emission trends have not been compatible with targets set by climate science.

A lot of environmental regulation has been introduced for the maritime industry during the last decades but the biggest issue, greenhouse gas emissions, has not been properly regulated until now. It is justified to criticize the major international decision-making organizations for concentrating on smaller and less significant issues first. This is likely because small non-disruptive decisions have been politically much easier to agree upon. And naturally designing and ratifying globally binding regulation is no easy task.

The world is running out of time to tackle climate change, but encouragingly maritime industry is finally starting to regulate greenhouse gas emissions.

Emission trading and other regulation is starting to affect how much fossil fuels shipping can use and the yearly allowance will be constantly reduced.

International Maritime Organization IMO's GHG Strategy now aims for reducing greenhouse gas emissions by 20%, striving for 30% in 2030 and then 70%, striving for 80%, in 2040 compared to 2008, and reach net-zero "by or around, i.e. close to, 2050".

Emission reductions should have started decades ago, which would have made the task much easier, but since history can't be changed this is where we are. The need for emission reductions is urgent and the goal is technically quite ambitious.

All stakeholders must work together towards the common goal to achieve carbon neutrality by 2050. Technically this goal can be reached as long as we don't allow e.g. the oil producers to continue to water down our climate change mitigation efforts.

Upcoming regulation will ensure that alternatives to fossil fuels will become available and financially more competitive. So far fossil fuels have been superior to most alternatives both technically and financially.

Sustainable maritime future consists of myriad of solutions. Sustainable waste-based biofuels are limited in quantity but a great option in some regions. Synthetic fuels made e.g. from clean hydrogen and captured carbon has a lot of potential when availability of low emission electricity improves. It must be stated that in some countries, such as Finland, electricity is already low-emission and affordable. Battery-electric vessels are already viable on short regular routes and this technology keeps improving. Wind propulsion has a limited potential in modern operational environment but can provide significant savings in fuel consumption.

None of the above-mentioned solutions would be competitive against fossil fuels without regulation since the externalities of fossil fuels have not been priced in. If the full cost of the damages fossil fuels are causing would have been included in the price, oil and natural gas would have become uncompetitive already years ago.

We at Meriaura are aiming to be carbon neutral during the 2030's, well before IMO's goal. We believe this is possible due to a good head start we have thanks to our production and usage of nearly zero emission waste-based bio-oil. Meriaura has been able to reduce emissions also by improving energy efficiency and optimising schedules. Our energy efficiency will further improve, and the share of bio-oil will increase in 2026 when we will receive two new bio-oil capable vessels. But the progress will not stop there, and we are closely monitoring the development and availability of new synthetic fuels and other options. Our exact route to carbon neutrality is not fixed yet but we are sailing the right direction at full but environmentally sustainable speed.

We want to be able to show the world that environmentally sustainable shipping is possible and encourage decision-makers to ensure that the regulatory environment is in line with what climate science is telling us. It is also worth pointing out that green transition in maritime industry is a massive opportunity for Finland. ■



Esko Pettay
Sustainability manager
Meriaura
Finland



MIA ELG

Going green the right way

Expert article • 3666

I feel that the maritime industry is on the brink of a significant transformation, driven by the green transition. I began my career with studying and improving ship energy efficiency 17 years ago, and while energy and environmental efficiency have always been relevant, progress in design has been incremental and rather slow. But now, the green transition in shipping is advancing on multiple fronts. End customers and cargo owners are demanding greener, more transparent supply chains for their products. Furthermore, securing financing for shipbuilding increasingly depends on demonstrating the vessel's environmental performance. Most importantly, for practical design and engineering, the rules governing ship environmental performance are undergoing rigorous development.

From a technical standpoint, the green transition for ships means minimising their environmental impact across various emission- and waste categories, and sustainability criteria. However, the most immediate focus is currently on reducing carbon-equivalent emissions, with a shift from purely measuring ship emissions to a "well-to-wake" perspective. Decarbonisation involves both increasing energy efficiency through operational and technical improvements, as well as achieving absolute emissions reductions through the use of clean fuels. Electrification, renewable energy sources such as solar and wind power, and carbon capture are also part of the "absolute emission reduction" toolbox. One of the key technical challenges in decarbonising ships is that new, cleaner fuels and technologies require additional space, increased weight and introduce new safety risks compared to traditional designs.

The goal of achieving "net-zero by 2050" means that many of the ships being designed today will need to operate in a decarbonised manner during their lifetime. That is why each new design project already faces a large selection of fundamental questions beyond the typical conceptual design process. First, what "net zero" fuels or energy sources shall be considered for this vessel over its operational lifetime? Second, which major energy-saving or emissions-control technologies should be incorporated into the ship's design? Finally, what machinery solutions will best support these choices? In the past, these questions were clear for each major ship type.

From a ship design perspective, I can assure you that we are ready. The logical next step, and my personal focus in ship design development, is on holistic modeling of systems efficiency - simulating various operational and regulatory scenarios. We now have many new technologies, increased digitalisation, vast operational data, and growing computational power for machine learning and optimisation. With these, we can design much more efficient ships than we could a decade ago. For example, in a recent EU-funded joint-industry project, we demonstrated that a combination of good design and energy-saving technologies can reduce energy consumption by 50% compared to a state-of-the-art ship in operation. Such efficiency gains would allow us to store less "green fuel" onboard - a logical consequence of this step. Achieving these goals required a new level in collaboration - technically, but even more so on a human level. In creating new energy systems, diverse thinking, a trusting environment, and a shared goal are crucial.

While I would like to conclude on this positive note, I feel compelled to send a strong message to our industry and legislators. Despite the complexity of design, I believe that the greatest obstacle to shipping decarbonisation is that the current regulatory framework does not yet require sufficiently ambitious reductions in absolute emissions from the global fleet. This would necessitate the adoption of clean fuels and zero-emission technologies. As a result, many ships today are designed to be "ready" for methanol, hydrogen or ammonia, but they aren't being built to run on these fuels from day one. We currently lack the infrastructure for green fuel production and distribution, as well as the commercial incentives to drive these changes. Due to the current fuel prices, many energy efficiency investments are being piloted but ultimately shelved, waiting for better economic conditions.

Regulatory incentives for emissions reductions are only now being introduced in the EU, with the Emission Trading System (ETS) and the upcoming FuelEU Maritime directive encouraging the uptake of low-carbon fuels. The IMO is lagging behind in this development but will hopefully catch up soon. To make green shipping a reality, policies must develop in a consistent and rigorous manner, pushing forward the necessary infrastructure for clean fuels and technologies. Once the incentives are in place, business will follow. Still, it feels like the shipping world is ready for decarbonisation - with us ship designers in the front row!



Mia Elg
R&D Manager
Deltamarin Ltd.
Finland



PATRIK RAUTAHEIMO

Reducing emissions from maritime transport requires predictable and determined policies

Expert article • 3667

Maritime transport is at a turning point as international regulations to reduce emissions tighten. The International Maritime Organization aims to achieve net-zero emissions in shipping by 2050, meaning that most ships will use different fuels than they do today. Achieving emission targets requires building new vessels and retrofitting the existing fleet to lower emissions.

The Finnish maritime industry has a long history of selling environmentally friendly technology to international markets. The industry comprises over a thousand companies, including equipment manufacturers, turnkey suppliers, design firms, system suppliers, software companies, and shipbuilding, ship repair, and offshore yards. Many companies have also significantly reduced their own production emissions in recent years. In the future, when enough carbon-free steel is available for shipbuilding, the carbon footprint of shipbuilding will drop to a fraction of its current level.

The long-term fuel mix will depend on both supply and demand developments. LNG ships are currently being ordered in large numbers, methanol is gaining ground, and ammonia use is expected to increase over time. Electric and hybrid vessels and energy-saving technologies are advancing. Additionally, many technologies are needed to reduce energy consumption to achieve zero emissions.

Low-carbon fuels place entirely new demands on ships, opening up new markets for Finnish companies. Low-emission fuels generally take up much more space than the currently most common fuel, marine gas oil. For example, electric ships are only suitable for short distances near ports because the batteries required for ocean travel would take up too much space. Hydrogen also requires a lot of storage space, making it suitable as a power source only for short routes. However, ammonia and methanol are suitable for ocean transport.

Elomatic has been a pioneer in greening maritime transport. As early as 2010, the company developed the first concept design for the Finnish Border Guard's LNG-powered vessel m/s Turva. Since then, Elomatic has been involved in designing several different ships powered by various low-carbon energy sources. Elomatic has also designed ready-made ship concepts powered by ammonia for different shipping companies recently.

Thus, there is no shortage of technology; the question is who is willing to invest in green technologies and fuels. Reliable plans are also needed for building infrastructure, such as port refueling infrastructure and energy production.

Synthetic fuels are needed

Ensuring sufficient zero-emission energy sources for maritime transport requires utilizing bio-based raw materials, such as fats and lignocellulose, and producing fuels using electricity. With the increase in wind power in the Baltic Sea, the area would have more clean energy for producing, for example, green hydrogen, which should be produced close to the point of use. In the future, production and refueling could take place offshore, where wind conditions are optimal.

Green synthetic fuels produced from hydrogen separated from water using electricity are expected to become more common in about 15 years. Clean energy is key to producing these P2X fuels.

For example, producing ammonia requires a ship that can use the fuel, a plant that produces it, and wind turbines that generate electricity to produce hydrogen. The cost of the new vessel itself is only one-fifth of this total. In order to build capacity for eFuels or as well as for biofuels, long term contracts between shipping company and fuel producers are required. For zero-emission fuels to be competitive, a price on CO₂ emissions is needed. If there is doubt that current high ambition targets are not going to be regulated as they should (for example high enough CO₂ emission cost) it is very difficult for shipping company to commit for long term eFuel contracts that increase their cost significantly when comparing to shipping company that uses fossil fuels. Policy in this area should be consistent and reliable.

A cross-sectoral carbon tax is the most sensible way to support the green transition in maritime transport. For example, biochar is currently burned rather than refined into fuel for the shipping industry, which could change with a carbon tax. The EU emission trading system for maritime transport is a good step forward. Emission allowances allocate emission reductions to where it is cheaper to reduce emissions than to purchase allowances.

The technology is ready, the Finnish maritime industry is ready; now we need determined policies, infrastructure investments, and a price on emissions to accelerate the green transition in maritime transport in the Baltic Sea. ■

Patrik Rautahaimo

Chairman of the Board
Finnish Maritime Industry and Elomatic
Finland



JARI JOKELA

Navigating towards a circular future

Expert article • 3668

The cruise industry is facing growing pressure to adopt sustainable practices, driven by public opinion and tightening regulations. While carbon emissions often dominate the conversation, it's equally important to focus on opportunities for improving waste management onboard. With recycling rates currently at just 20–30%, there is an urgent need for innovation and better practices, as traditional methods like burning all waste onboard are no longer viable long-term solutions.

Adopting circular economy principles in the maritime sector reduces environmental impact and makes economic sense. The passenger-ship industry is gradually adopting these principles, recognizing the benefits of circularity. The future lies in reducing incineration and enhancing recycling efforts, setting off on a circular journey to a more sustainable model.

A shift in the mindsets

What benefits the environment is typically the most feasible option, both socially and economically. As a key supplier of waste- and wastewater-treatment solutions for cruise ships, we have witnessed a shift in the industry's mindset. What was once viewed as a cost burden is now seen as a path to long-term efficiency. Regulatory changes have further encouraged cruise operators to challenge the status quo and rethink their waste management strategies.

There is an increased need for new technologies and expert services enabling greater recycling and reuse, which reduces overall consumption and environmental impact. Our R&D focus is on transitioning from traditional waste treatment methods to circular and biocircular solutions.

Through extensive field studies onboard cruise ships, and years of research collaboration with our ecosystem partners, we've gained invaluable insights into the current state of maritime waste management. Tailored solutions and services are essential to addressing the challenges of ship operations.

Circular by 2030

Evac's research program is focused on transforming the maritime industry through circular practices by 2030. While systemic change is complex, we have identified numerous opportunities to optimize waste operations onboard. Our goal is to equip our customers with the tools and knowledge to navigate the challenges of circularity.

Collaboration across the entire maritime value chain is key to long-term success. Shipbuilders, cruise operators, regulators, and technology providers need to work closely together to share best practices and support each other's development ambitions. As a result, ship design and construction are evolving to include sustainable materials, energy-efficient systems, and practices that minimize waste and maximize recycling.

We expect the cruise industry to take significant strides toward circularity by the end of the decade. By embracing circular economy principles and implementing innovative solutions, we can enhance environmental stewardship while driving economic growth and social progress. With a commitment to change, we can collectively chart a course towards a future with no waste. ■



Jari Jokela

Head of R&D
Evac Group
Finland

jari.jokela@evac.com

www.evac.com



MIKKO ESKOLA

Improving marine environmental efficiency – A complex equation

Expert article • 3669

Modern cruise ships today are complex engineering masterpieces that require a high level of skill to keep them running safely and maneuvering in the middle of the ever-tightening international regulatory boundaries. When the regulations tighten this means that the industry is forced to develop improved technologies that comply accordingly.

In improving environmental efficiency, the focus during the past years has been in fuel and energy efficiency applications. No under sight should be made to the waste and technical maintenance side either. The size of new ships constantly tends to grow thus simultaneously adding to the total amount of waste being produced. It is not to be forgotten that the human waste producing aspect is always present no matter how much technology advances.

The complexity of operating a constantly moving platform on a global itinerary, with multinational crew, organizing supply logistics, solving crewing challenges and yet trying to keep all operation foremost safe but also financially viable is an extremely complex equation. The consequences of eventual non-compliance are not only limited to fines but can seriously damage the company's public image and reputation, resulting in loss of revenue.

The quota between tight hygiene requirements versus the usage of different types of chemicals has long been the under sighted area in this equation. Chemical products are indeed needed for maintaining a clean, hygienic, and safe operation all around. These include cleaning, disinfection, dishwashing, and personal hygiene products as well as laundry detergents to mention a few. There are also many technical maintenance products that are needed to keep the onboard systems running efficiently. A single ship may have tens and tens of different heavy chemicals in use at any given moment.

Chemical suppliers often like to mention that their products are the most environmentally friendly solutions around and wastewater treatment system manufacturers tend to claim that their systems are 100% capable of handling different types of waste from human feces to wash waters from different areas of the ship. This market driven tendency is problematic itself but the new regulations banning the so-called Green Washing are very much welcome.

Once observing the waste streams from the different onboard sources no one can fully explain how the chemicals interact in their different combinations and concentrations once they enter the wastewater treatment system downstream. Added to this equation the onboard pipelines themselves collect deposits. If the onboard system is not fully able to handle these waste streams as designed, they get discharged in their current state to the oceans. The total volume can easily be well over 100 cubic meters of gray water daily discharged from one single cruise ship.

Years back our company SmartPipe developed and patented a solution to treat onboard pipe runs. In this approach single dosing units were installed along the onboard pipelines pumping a treatment chemical to the pipe keeping it clear of eventual deposits. At a later stage we started looking into replacing all chemicals with bacterial solutions. In this approach the safe food grade bacteria in the product simply consume any organic deposits in the pipe. The bacteria are the very same type which is being used in wastewater treatment systems this way only enhancing the end water treatment result.

The results were promising, but installing tens of units around the ship was a complex solution and the next step was to look at doing things more efficiently. In this setup the dosing system itself will through different sensors monitor the condition of the pipeline and make decisions based on the actual need. This way we can solve the ever-persistent problem of overdosing of products and save operative costs to the shipping line as well.

However, innovation advanced and we further looked at the root causes that load the systems. In an onboard environment the single most loading component to the wastewater treatment systems is galley originated fats oils and grease that together with alkaline cleaning products get washed to the pipeline. To solve this, we developed a process where 95% of the oils in the galley wastewater are recovered with a small unit that collects the oil from the water before it ever even enters pipe. This way we can eliminate the core problem at source and complete the process by a minimal amount of bacterial treatment product consuming whatever deposit is left after the recovery process.

Innovation is driven by not being completely happy with the current solution. This is the state of mind in which new things evolve. It is a long route ahead of us but with small steps we slowly improve the situation so that also future generations can enjoy the marine environment and it's pristine waters. ■

**Mikko Eskola**

Director
R&D and Innovation
SmartPipe System Oy
Finland

mikko.eskola@smartpipe.fi



SAARA HÄNNINEN

Lifecycle thinking in the shipbuilding industry

Expert article • 3670

The Finnish marine sector has specialized in complex vessels like cruise ships and icebreakers and earned a competitive edge in the large cruise ship market with close collaboration of supplier network. In the future, transparency in sustainability will be seen as one of the key competitive advantages in cruise shipbuilding. Within the sector, there is much desire for sustainability innovations to reduce the use of raw materials and resources and to improve energy efficiency. Tools based on lifecycle thinking, such as Life cycle assessment (LCA), Life cycle costing (LCC), carbon footprints and handprints, provide a systematic, impartial, and globally accepted method to assess the sustainability of products and services. Traditionally, the lens has been in the operational phase, however, there is a great potential to decrease ships' lifecycle costs and emissions already in the early design and building phases. Let the goal be, for example, to build a carbon neutral ship in a carbon neutral shipyard, LCA can be used specifically to determine and evaluate the environmental impacts of the product or activity related to shipbuilding. LCC supports optimizing the total cost of ownership for achieving long-term profitability and improving energy efficiency.

Life cycle assessment is an ISO (International Organization for Standardization) standardized method. ISO 14040 defines the main principles and features of life cycle assessment, where ISO 14044 defines the requirements and gives guidelines for carrying out the assessment. LCA focuses on the product's environmental aspects and potential environmental impacts ideally during its entire life cycle (cradle-to-grave), starting from the acquisition of raw materials, through production, use and decommissioning, all the way to the final disposal of waste and possible recycling (Figure 1). LCA can be roughly divided into two steps: 1. Describing used raw materials and expected emissions occurring during a product's life. This inventory step requires data gathering from databases and one's own processes. 2. Allocating the inventory results in different impact categories, such as climate change and depletion of abiotic resources. This is referred to as the life cycle impact assessment (LCIA).



Figure 1: The lifecycle of a product (ship).

Material and energy flows are modelled with special LCA software and databases. The complexity of the shipbuilding value chain and the consequent massive number of materials, products and suppliers brings on challenges that may be tackled with prioritizing and digital data handling. A method called Network LCA is responding to this challenge with automated data collection from the network; it is a tool for LCA data collection, data analysis and sharing the LCA results inside the network. It allows the comparison of alternative products and their environmental impacts. It should be noted that accessing different data sources is not only a technical question; organizations tend to be overprotective about their data and restrict access even from the closest business partners. One solution is to use a trusted operator who constructs a network-level shared LCA model.

The carbon footprint is used to assess and reduce climate impacts. ISO 14067 focuses on the product's carbon footprint, its calculation and communication. Measuring the carbon footprint is only one way of measuring environmental impacts, and global warming is one category of impacts among many whereas LCA considers several. However, the carbon footprint is often the most familiar indicator for both consumers and companies.

Handprint is a new way to evaluate and communicate positive environmental impacts that companies can achieve by offering products that reduce the footprint of their customers. Handprint is a perfect fit for maritime industry products, where the environmental benefits from different design options are often achieved during the operation of the ship. When determining the handprint, two footprints must be calculated: the baseline solution and the offered solution. A handprint is therefore the difference between two alternative solutions which can be applied in addition to carbon emissions, for example, resources, water, air quality or nutrients.

In shipbuilding, LCA and LCC can efficiently support systematic early comparisons and trade-offs between design alternatives from environmental and cost perspectives. Transparency through shared sustainability information is a key for future cruise passengers who are increasingly aware of environmental aspects. Life cycle thinking promotes sustainable shipbuilding practices, driving innovation and environmental responsibility. It provides a factual basis on strategic decision-making, supports product development, and helps to identify reduction potential, not forgetting communicating environmentally friendly solutions to stakeholders. ■

Saara Hänninen

Senior Scientist

VTT Ltd

Finland



JUHANI MÄÄTTÄNEN

Sustainability in cruise ship turnkey projects

Expert article • 3671

Creating and managing an effective network of partners is a key factor in today's maritime industry and especially in the cruise ship industry. The complexity of modern cruise ships requires a versatile and extensive supplier network with expertise from various fields of industry. This has led to the emergence of turnkey companies, such as NIT Naval Interior Team, whose task is to manage complete deliveries of various systems and areas within the ship. This business model has allowed more efficient management and delivery of increasingly complex projects and is one of the strengths of Finnish maritime industry in the current rapidly evolving business environment.

The role of the network of partners also becomes essential when discussing about sustainability in the maritime industry. Sustainability is not a responsibility of only one company alone, as it requires the actions of the whole network and each stakeholder has their own important role. Every supplier of a product or system is an expert of their own product and reducing the environmental impact of it. It is then in the hands of the Owner, Yard – and Turnkey suppliers to find and coordinate the most sustainable products for achieving the best outcome.

During the past years NIT has recognized the growing importance of sustainability and has emphasized this in all of its operations. This can be seen for example in NIT's Quality Management System "GreeNIT" which stands for a novel and sustainable business concept that extends through the NIT's operations from design to procurement and to production. Operations are also measured and controlled and NIT has for example together with VTT developed a Carbon Footprint Calculation tool to identify and calculate the environmental impact of its deliveries and helping its customers – and other network to reduce their emissions. Introduction of the tool has received a positive response within the industry and was even voted as the winner for the 2023 CSI Sustainability Award at the Cruise Ship Interiors Expo in London.

Sustainability is not only about reducing the environmental impact although it is a significant component. It also includes social and economic dimensions and ensuring that business practices are ethical, resources are used efficiently and long term value is created for all the stakeholders. One of the key principles in NIT's way of conducting business is to be the preferred partner not only for the customers but for the network of partners as well. It is obvious that in order to achieve more sustainable deliveries targets and actions should be introduced and shared with partners. In addition, when developing sustainability together, the whole network commits to the shared goals.

NIT's strategic approach is to continue developing more sustainable network and selection of partners who share the same commitment to sustainability. NIT is collecting the environmental impact data such as Environmental Product Declaration, from the network to steer the decision making and operations into a more sustainable direction and calculating carbon footprint of NIT's deliveries sets the target for actions. Utilizing the network of experts in products and materials enables NIT to find the best solutions and implement them the most efficient way, reaching to reducing environmental impact. This approach also encourages our network to continuously develop their deliveries as well and ensuring the competitive edge for the whole Finnish shipbuilding industry and continuation of shipbuilding history into even more sustainable way. ■

**Juhani Määttänen**

Director, Design & Engineering
Oy Naval Interior Team Ltd.
Finland

juhani.maattanen@nit.fi



TAPANI WENDELIN

What do sustainable solutions for ship hotel and catering areas look like?

Expert article • 3672

The marine industry is rapidly developing sustainable solutions in all aspects of operations, still recognizing that much work remains. In ship hotel and catering areas, environmental benefits can be achieved by prolonging equipment life, smart design, reducing energy, water, and steam consumption, minimizing waste, and increasing recycling and reuse.

Quality that lasts with recycling and reuse

Recycling and reuse options for demolished materials and environmentally friendly alternatives significantly impact ship construction and modernization. Extending product lifetimes and promoting circularity support sustainability goals. By identifying solutions that extend the lifetime of products and promoting circularity in the industry, we can support the owners in achieving their sustainability goals.

Optimized and smart designs

Optimizing designs and layouts enhances sustainability and efficiency. Lighter materials reduce fuel consumption. In catering and laundry areas, fewer pieces of equipment and smaller areas reduce material and energy usage. Well-designed layouts increase safety, wellbeing, and productivity. Modular cabin solutions optimize material usage, minimize waste, and reduce human errors. This approach enhances operational efficiency and results in a more sustainable outcome. The more we repeat the same solutions and materials on a ship or even a series of ships, the less waste we will generate, and the smaller relative material margins are needed.

Planned maintenance and condition visibility

Planned maintenance and condition monitoring extend equipment life, prevent breakdowns, and optimize performance. Digital solutions track conditions and manage maintenance schedules efficiently. Like in any other industry or commodity, this proactive approach helps us address issues early, optimize performance, and reduce downtime, leading to more efficient and sustainable operations.

Consumption monitoring systems

Sustainable solutions that reduce consumption often lead to cost savings. ALMACO's GEM (Galley Energy Management System) and REM (Refrigeration Equipment Monitoring System) help galley crews save energy by recommending optimal times to turn equipment on and off. There is a saying that what gets measured gets done, and this is especially true when good results are celebrated and rewarded.

Paradigm shift in refrigeration technology

Freon, commonly used in refrigeration, is harmful to the environment. ALMACO supports CO2 refrigeration solutions for new builds, minimizing greenhouse gas emissions. Switching from traditional solutions to CO2 refrigeration solutions helps minimize greenhouse gas emissions.

Logistics and mobile factories

ALMACO's Mobile Cabin Factory concept reduces carbon emissions and supports local economies. Building cabins on-site reduces emissions from material shipment. With a Mobile Cabin Factory, we don't have to transport fully assembled cabins from the factory to the site. Instead, we can build the cabins on the site or very close to it. This drastically reduces emissions caused by the shipment of materials, as we can ship them directly to the site instead of first sending them to a distant factory.

Global network of suppliers and partners

Choosing the right partners, subcontractors, and suppliers is essential. ALMACO collaborates with entities that share a sustainable mindset, accessing innovative solutions aligned with sustainability goals. We have established a global network of suppliers and partners who share our sustainable mindset, and we are also opting for sustainable solutions from our current suppliers.

Culture eats strategy for breakfast

Peter Drucker famously said, "Culture eats strategy for breakfast." This is also true when it comes to strategies to become more sustainable. A strong culture drives sustainability in product development and customer solutions. Employees aligned with a sustainable mindset are more likely to innovate and implement eco-friendly practices. This kind of culture is cultivated by living as we preach throughout the organization and ensuring sustainability is always on the table and demanded constantly.

ALMACO strives to decrease operation costs as well as collect measurable data for the owners. We also make sure to train and engage hotel and galley crew already before boarding, as well as continuously during operation. Both for internal operations and service portfolio development, ALMACO emphasizes sustainable practices. In 2023, the Finnish subsidiary earned the WWF Green Office Certification.

Safety and quality are nonnegotiable

Prioritizing worker safety and adhering to rigorous standards is crucial. ALMACO complies with the 45001:2018 Occupational Health and Safety Management System and the 14001:2015 Environmental Management System, ensuring employee protection and environmental standards. Our quality processes, including the 9001:2015 Quality Management System Standard, guarantee operational excellence. Commitments like these ensure that our employees work safely while following environmental and sustainability standards.

About ALMACO Group

ALMACO Group is a full-service contractor for the new construction and modernization of Accommodation and Catering areas for the Marine and Offshore industries. ALMACO builds and refurbishes complete interiors of marine vessels and offshore units including cabins, wet units, public spaces, galleys, provision stores, refrigeration machinery, and laundries, as well as complete living quarters. ALMACO works with owners and builders around the world providing full turnkey solutions comprising design and engineering, project management, spare parts, and maintenance. ALMACO was founded in 1998 and has offices in Brazil, Canada, China, Finland, France, Germany, Italy, Singapore, and the USA. ■



Tapani Wendelin

Vice President
Business Process Development
ALMACO Group
Finland

tapani.wendelin@almaco.cc
+358 44 022 6036

www.almaco.cc



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ERJA IMMONEN & ANTTI NIEMELÄ

Sustainability development in metal ceilings

Expert article • 3673

Lautex Oy is a specialized manufacturer of suspended metal ceilings for the construction and shipbuilding industries. In addition to our core offerings, we also serve as a subcontractor for sheet metal industry. We provide ceiling panels, profiles, cassettes, and grating ceilings as comprehensive systems. These systems include suspension materials, air conditioning units, loudspeaker fixtures, and service hatches, all tailored to meet diverse customer requirements. Every product is proudly manufactured in Nummela, Finland.

In the shipbuilding industry, outfitting is often characterized by highly specific customer demands. To meet these needs, we supplement our standard products with custom-made solutions and decorative ceiling constructions, such as beams and domes. Lautex ceilings are not only aesthetically pleasing but also fire-resistant and lightweight, making them particularly well-suited for shipbuilding applications. They are easy to install and dismount, while also maintaining high hygiene standards.

Our primary materials—aluminum and steel—are selected with sustainability in mind. The aluminum we use is 80% recycled, and the steel is 20-25% recycled. This significantly reduces the consumption of virgin materials and lowers our carbon footprint. Importantly, both aluminum and steel are 100% recyclable, further enhancing the sustainability of our products. Our metal ceilings are designed for longevity, with a service life of up to 40 years, offering excellent resistance to wear and tear.

At Lautex, we are committed to reducing our environmental impact. All the electricity we use is CO2-free and certified. Given that we operate in a groundwater area, it is crucial that we do not release any emissions into the groundwater. The quality of groundwater is monitored regularly.

We also have our own powder coating line, which is a more environmentally friendly alternative to wet painting. Powder paints do not contain volatile organic solvents, thus avoiding VOC emissions that harm the environment. For pre-painted materials, our major supplier uses a system that captures more than 99% of VOC emissions.

A few years ago, we conducted a CO2 footprint analysis of our products and identified that the primary sources of CO2 emissions are our base materials: aluminum and steel. To reduce our carbon footprint, we have focused on optimizing product designs by reducing material usage, by optimizing support structures or switching to more sustainable materials. In some ceiling solutions, we have reduced weight by up to 30%, which directly decreases the product's carbon footprint. This approach not only enhances sustainability but also proves to be cost-efficient, unlike some other sustainability initiatives that tend to increase costs. Additionally, some of our products now feature completely new designs. One of our current challenges is the rapid pace of innovation—our technical designers are working diligently to translate new ideas into production-ready drawings. Our 3D design program is integral to both our product development and daily operations.

Lautex suspended ceilings are certified in fire resistance classes C, B-0, and B-15, meeting stringent regulatory requirements. Achieving fire resistance class B, for example, necessitates proper fire insulation, which we accomplish using mineral wool. Although there are promising innovations for lighter stone wool products, functional challenges remain before they can be fully integrated into our offerings. Lighter products, particularly in cruise ships, would significantly reduce emissions over the vessel's lifetime.

For fire resistance class B, steel is a required base material. We are particularly excited about the recent launch of fossil-free steel by our supplier, made from recycled steel using fossil-free energy. We eagerly await our first order of these coils to offer even more sustainable products to our customers.

Currently, we are conducting a full Life Cycle Assessment (LCA) for our main products. This assessment measures the environmental impact of a product throughout its lifecycle. Once completed, we will provide our customers with detailed data that they can use in their own calculations and development processes.

Since 2017, Lautex has been actively involved in sustainability projects, each lasting approximately two years. These projects are a collaboration between the University of Turku, companies in the maritime sector, and a Finnish research institute. Our goal is to be at the forefront of sustainability in our industry. ■

Erja Immonen

Technical Designer
Lautex Oy
Nummela, Finland

Antti Niemelä

Planning and Purchasing Manager
Lautex Oy
Nummela, Finland



MAARIT LAPPALAINEN

Digitization and green transition in shipbuilding industry

Expert article • 3674

Marine industry across the Baltic Sea Region is under pressure to adjust their operations to become greener and more sustainable. Carinafour has developed digital material management processes and tools to support decision making, to create transparency, to reduce working hours, and most importantly, to decrease waste, emissions, and energy consumption in the region.

The Carina Assembly & Logistics System (CALs) is a system that promotes sustainable development and has a positive impact on the environment in many ways. CALs 3 system provides a digital solution that enhances supply chain management and field logistics and improves asset lifecycle management. Software helps companies to optimize the use of materials, reduce material waste and utilize more environmentally friendly materials. CALs 3 supports improving resource efficiency and environmental friendliness in accordance with Agenda 2030 and the goals of sustainable development.

Efficient material management in shipyard ecosystem

A shipyard ecosystem includes several turnkey suppliers, all with their own supply chains and various subcontractors, not all these always operating at the same place where the ship is assembled. Properly functioning material management system is therefore a premise for a well-functioning shipyard ecosystem. What has been challenging for shipyards, is that not all turnkey suppliers and their subcontractors have had proper material management systems in use, and the existing systems have not necessarily been linked to each other nor to the shipyard system. The material information has thus been scattered and possibly inaccurate along the pipeline, making it difficult to get a total picture of the supply chain situation. This has led to full warehouses where excess materials have been stored, since all parties try to buffer to secure the project execution. Unnecessary re-ordering of parts has occurred, due to missing information regarding the material availability. Also, there have been production interruptions due to the material shortages.

CALs 3 tackles the above-mentioned challenges by facilitating the usage of the same system by several turnkey suppliers. All of them can create and schedule their own delivery plans, which the shipbuilding project and central logistics operator can see and follow up. Thus, transparency and control over the material pipeline is improved. CALs 3 can flexibly support turnkey supplier's material planning, supply chain management, deliveries, warehousing, logistics and safety in many different setups.

CALs 3 is a digital material management system, meant for controlling the material and supply chain planning and logistics flow. CALs 3 system has been developed to enhance the material management and to serve effectively the whole industrial ecosystem around the shipyard. The shipyard ecosystem is a complex entity thus, an enormous amount of data is needed for planning, producing, storing and moving different materials properly and timely along the pipeline. CALs has been developed to better meet the needs of demanding supply chain planning and material flow processes, and hereby to enhance the eco-efficiency of the whole shipyard ecosystem.

Fluent automated digital material flow enables even shorter storing times and more accurate deliveries, enhancing efficiency in production in the whole shipyard ecosystem. The system benefits both the material and turnkey suppliers; actors along the whole material management chain can execute and adjust their tasks according to the prevailing situation and timetable. Thus, CALs supported planning and material management system ensures a better control over the timely materials and their installation operations within the turnkey supplier.

Properly integrated digital material management system facilitates more accurate and transparent planning and production management. In practical terms this means that no excess material needs to be produced just to be on the safe side, and no re-ordering of materials is needed, since material production and information is kept updated and can be followed in the system. Thus, resource efficiency is highly increased, and the amount of material waste decreased by using CALs. If a centralized warehouse is taken into use, deliveries to the shipyard can be executed with full loaded trucks, instead of half empty trucks. This way even the transportation waste and emissions can be minimized.

Maarit Lappalainen, Business Director of Carinafour's Digital Supply Chain Management, sees great opportunities from both an environmental and productivity perspective in combining and managing information flows between different actors. ■



Maarit Lappalainen

Head of Digital Supply Chain and Consulting
Carina Solutions Oy
Finland

maarit.lappalainen@c4.fi



MAGNUS HELLSTRÖM & MAGNUS GUSTAFSSON

New business models in the shipbuilding industry enabling the green transition

Expert article • 3675

Shipping is expected to contribute to the green transition and notably the global GHG reduction goals. Much focus has been devoted to improving energy efficiency and using alternative fuels and power sources, and their applicability to different shipping segments. Less has been discussed on how shipyards can contribute to this development and what implication it has for their business models.

Much of the green development has occurred in terms of new propulsion system and energy efficiency technologies. This has reinforced the tendency of shifting the power from the shipyards to the technology providers and vendors, whose share of the ship value has been growing with increasing sophistication of the ship systems and service-oriented business models of the vendors. Ship-builders have indeed also been active in incorporating GHG emission reduction technologies and more efficient hull and system designs onboard the vessels.

One implication of the adoption of renewable fuels is the uncertainty around new ship investments, stemming from the much higher cost and still limited availability of these fuels. This requires a much more active sales approach by the shipyards, where they must work harder to convince ship owners and operators about the performance of the ships and that the chosen technology will not become obsolete during the lifetime of the ship or that the ship is upgradeable and will not lose its value. In addition, the investment decisions are often subject to sector integrations, where the availability of the fuel is dependent on the energy market and actions taken by ports to ensure proper bunkering infrastructure.

Despite that very little has happened in terms of how we build ships. Not even the renewable fuels are likely to change the institutionalized structure of the industry (besides creating a need for more space efficient ship designs and a new sales approach). The design and construction processes are still largely centred around the internal combustion engine and its auxiliary systems.

However, the electrification of transportation that already has shown its advantages in the electrical vehicle (EV) market is also coming to heavy transportation, including shipping. For all-electric battery-powered vessels, the evolution has been rapid. The world's first (large) all-electric car ferry, MF Ampere, with a battery capacity of 1090 kWh, was commissioned in 2014, while the first RoPax (or car and passenger ferry), MS Ellen, started operation in 2019 and was equipped with a 4,3 MWh battery pack. Until recently, the biggest BE vessel in operation today was the Yangtze River Three Gorges 1, with an installed battery capacity of 7,5 MWh. On April 29, 2024, the Chinese container shipping company COSCO reported that its Greenwater 01, an all-electric container ship equipped with batteries exceeding a capacity of 50 MWh, performed its inaugural voyage. Obviously, all-electric propulsion is beginning to be an economically viable option in short-sea shipping, especially for RoPax ferries and other short-range applications.

The removal of the ICE as the primary power source on a vessel could have enormous effects on the ship-building process as it may change the ship construction, remove auxiliary systems such as fuel supply and exhaust gas piping. The implications for shipbuilders are numerous.

Firstly, fully electrified vessels are simpler and easier to build. They may even alter established logics regarding the sequence in which ships are built, which could allow for later capital tie-up in the form of late installation of the capital-heavy batteries. Secondly, as vessel design anyway are rethought a new playground for standardization and platform-based business models opens. With the removal of mechanical systems requiring constant maintenance and an inventory of spare parts, there are less reasons for ship owners to request special design solutions and the use of specific vendors. The idea can be compared to the Volkswagen Group's MEB platform, from which a wide variety of different EVs can be derived. Thirdly, not exclusive to electric vessels (which, however, are easier to automate), the advent of digitalization and the continuing introduction of IoT technologies onboard ships, holds the potential to not only increasing the level of automation but enables data to be collected regarding how ships are operated and how well their designs perform in different conditions. This constitutes a feedback loop to shipbuilders that has not earlier existed and that may have further positive effects like improved energy efficiency.

For the European shipbuilding industry, it is imperative not to miss the opportunities brought about by the electrification of shipping. New technologies and business models should be explored in parallel to use the green transition to strengthen the competitiveness of the European maritime industry as a whole. ■



Magnus Hellström

Professor
Åbo Akademi University
Finland

magnus.hellstrom@abo.fi



Magnus Gustafsson

PhD, Docent
Åbo Akademi University

Partner
PBI Research Institute
Finland

magnus.gustafsson@abo.fi



HELI ARAMO-IMMONEN

Shipbuilding industry should care about GHG Scope 3

Expert article • 3676

Transparency into a company's ESG (environmental, social, governance) practices is becoming exponentially important for business success. Currently, most ESG reporting is voluntary. However, the landscape for mandated sustainability reporting is changing. Many governments are rolling out mandated reporting, often starting with a company's Scope 1, 2 and 3 greenhouse gas emissions.

The Greenhouse Gas Protocol Corporate Standard (GHG Protocol Corporate Accounting and Reporting Standard) is the world's most widely used standard for organizational-level carbon footprint accounting. The purpose of the standard is to guide and harmonize calculations. Standard-based accounting plays a crucial role in avoiding greenwashing.

The GHG Protocol standard divides emissions into three categories, or scopes. Scope 1 covers direct emissions from a company's own operations, such as emissions from fuels used in energy production and company-owned vehicles. Scope 2 includes all emissions from purchased energy, such as electricity and district heating. Scope 3, on the other hand, includes emissions from the value chain and procurement, such as emissions from raw material procurement, transportation, and the use of manufactured products.

Scope 3 raises the most questions and causes headaches for companies in carbon footprint accounting, as calculating its emissions and finding suitable emission factors can be challenging. However, its significance in carbon footprint accounting is often substantial. Especially in the trade and industrial sectors, significant emissions often arise from value chains and procurement, and excluding them from the calculations can give a misleading picture of a company's emissions.

Contrary to common misconception, including Scope 3 in carbon footprint accounting is not optional. If the accounting is to be conducted in accordance with the Greenhouse Gas Protocol standard, all emission sources identified as significant for the operation must be included in the accounting. This also applies to Scope 3 for those emission sources for which reliable data is available with reasonable effort. Therefore, if an emission source is expected to have more than a negligible impact on the accounting results, it must be included in the accounting.

GHG Scope 3 in the Shipbuilding Industry refers to the indirect greenhouse gas (GHG) emissions that occur in the value chain of shipbuilding companies, outside of their direct operations (Scope 1) and purchased energy (Scope 2). These emissions are categorized under Scope 3 and include a wide range of activities and sources in ecosystem.

Purchased goods and services includes emissions from the production of materials and components used in shipbuilding, such as steel, paint, and electronic systems. Therefore, material traceability needs to cover also GHG footprint of materials.

Transportation and distribution emissions come from the logistics involved in transporting materials to the shipyard. Close operations and intensive supply network are important.

Waste generated in operations covers emissions from the disposal and treatment of waste produced during the shipbuilding process in supplier network. This requires special efforts to be taken in operations management at supplier companies. Also loosely coupled networked supplier consortiums needs to consider their joint operations management systems. Waste is generated on poorly planned network processes, where knowledge diffusion from operator-to-operator is inadequate. This often due to lacking information design between supplying companies.

GHG Scope 3 covers also use of sold products emissions from the operation of ships once they are sold and in use, including fuel consumption and maintenance. It is question of time when are companies accountable for customers' use of their products. In other words, disclosing downstream emissions in value chain. End-of-life treatment of sold products, emissions from the dismantling and recycling of ships at the end of their operational life for example.

Scope 3 emissions are often the largest and most complex to calculate, but they are crucial for understanding the full environmental impact of the shipbuilding industry. While writing this article September 2024, there is already vivid discussion and attempts to develop AI aids to help companies in this reporting task.

Reporting timeline in EU is as follows. Corporate Sustainability Reporting Directive (CSRD) went into effect in January 2023, with a phased introduction of required reporting by company type. 2024 (reporting in 2025) Large Public Interest Entities (PIEs) with more than 500 employees. 2025 (reporting in 2026) other large companies, including those listed on the EU-regulated markets. 2026 (reporting in 2027) small and medium-sized companies listed on EU-regulated market. 2028 (reporting 2029) ultimate non-EU parent companies with substantial activity and presence in the EU. ■

**Heli Aramo-Immonen**

Principal Lecturer, Dr (Tech),

Adjunct Professor

Faculty of Engineering and Business –

Master School

Turku University of Applied Sciences

Finland

heli.aramo-immonen@turkuamk.fi



PETTERI PARTANEN

Green transition in the shipbuilding industry

Expert article • 3677

The shipbuilding industry has been quite conservative branch, and traditionally it has not been a forerunner in the green transition. However, after a slow start the speed and understanding of green transition has improved rapidly.

The International Maritime Organization (IMO) has a crucial role in the regulation of international seafaring. The 2023 IMO GHG Strategy envisages a reduction in carbon intensity of international shipping (to reduce CO2 emissions per transport work), as an average across international shipping, by at least 40% by 2030. The 2023 IMO GHG Strategy also includes a new level of ambition regarding the uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources which are to represent at least 5%, striving for 10% of the energy used by international shipping by 2030.

One example of the high-level ambition in the green transition in the shipbuilding industry is the aim to build climate neutral cruise ships. This should be done in collaboration between companies, universities, and research institutes. The goal is to develop a climate-neutral cruise ship concept by 2025 and achieve carbon neutral shipbuilding by 2030.

Big projects are often in the headlines, but there are many new solutions and good examples also in smaller vessels. Good examples are e.g. electric ferries in the Archipelago Sea between Parainen and Nauvo. And naturally, it's easier to do tests and improvements first in small scale ships.

The demands, the way of thinking and the drive towards a green transition are increasingly spreading through the entire value chain. There is a real interest in making sustainable solutions as well as mandatory solutions that come from the customer's requirements. In the international markets the clients are all the time more interested and demanding concerning the greenness of the supply chain. On the other hand, the smallest companies might not even realise that they are part of green transition when they are modernising their processes.

Virtual test environments for ship design and commissioning helps to reduce CO2 emissions. Especially sea-trial tests cause a lot of emissions to the shipyards. It would be a concrete action towards green transition if even a part of those test could be executed virtually.

Significant innovations can be found also in the refining of traditional raw materials. Steel production is causing at the moment very huge climate emissions. Fossil free steel will reduce emissions in a large scale. Also, the recycling and reusing of the existing steel will help to reduce the emissions.

In addition to shipbuilding, green transition is increasingly taken into account in the operation phase of ships. First comes to mind alternative fuels and new solutions reducing the fuel consumption. Concerning cruise ships the management of the food chains is important. It makes a difference how the food is produced, from where it is transported and how the food waste can be minimised. Again, there is a lot of potential to reduce the carbon footprint.

In addition to building completely new ships, sustainable ship repair offers good solutions. With ship repair it is possible to update old ships to the era of green transition. It also makes the life cycle of ships longer and in that way, one can avoid ship breakings which are made to early.

Lack of skilled workers also affect the shipbuilding industry. Often concerns are focused to the of lack of engineers and planning professionals, but skilled workers are of course needed in the actual building of the ships as well. So, there should be training programs which include green transition through the whole training chain from the vocational level to doctorate. Training programs should be put in practice in fluent collaboration between educational institutes and companies. It's also important to develop training methods to increase the skills of current workers.

There is a desire to attract more young people to the maritime industry. The sector needs more labor when the previous generation retires. The green transition offers young people new and diverse opportunities and increases the attractiveness of the industry among young people.

The future competitiveness of the shipbuilding industry requires adaptation to the green transition in the entire value chain. The future workers appreciate it and so do financiers. The financiers' values include green transition and sustainability. If the shipbuilding industry does not have these values in its daily work, then the financiers will easily find other sectors to finance.

Overall, the green transition offers new opportunities to increase the competitiveness and attractiveness of the shipbuilding industry. This stands out especially in the construction and operation of the most advanced ships, such as cruisers. Adapting green transition is the best way to be competitive in the future global market. ■



Petteri Partanen
Business Manager
Regional Council of Southwest Finland
Finland



JAN NIEMI

Sailing from red to blue oceans

Expert article • 3678

In the maritime industry, the green transition is a pressing and unavoidable reality. Therefore, many maritime technology providers and shipping companies are overly fixated on regulatory milestones. While compliance with legal and regulatory frameworks is essential, it should be viewed as the baseline, not the pinnacle, of their efforts.

The current landscape sees companies racing to meet the minimum requirements set by international and national regulations. This focus on compliance, while necessary, often leads to a myopic view where the primary goal is to avoid penalties rather than to innovate. Working within established industry boundaries results in a crowded “red ocean” where competition is fierce, and differentiation is minimal. Companies boast about their compliance, but this does little to set them apart in a meaningful way.

True competitive advantage lies beyond mere compliance. It requires a shift in perspective from meeting regulatory milestones to creating disruptive innovations and exploring “blue ocean” strategies. Blue ocean strategies involve creating new market spaces, making the competition irrelevant, and unlocking new demand. By creating new market spaces, companies can achieve significant growth and innovation, tapping into uncharted territories. Unique value propositions and new demand often lead to higher profit margins compared to saturated markets. This approach is crucial for maritime companies that wish to lead rather than follow.

To achieve this, maritime technology providers and shipping companies must look beyond the immediate regulatory requirements and focus on long-term, sustainable innovation. This involves investing in research and development, embracing new technologies, and fostering a culture of creativity and risk-taking, but not forgetting about disciplined innovation activities and strategies. However, a significant barrier to this is the prevalent risk-averse leadership within the industry. Many leaders are so focused on mitigating risks and ensuring compliance that they stifle innovation and discourage bold, transformative ventures. This cautious approach is preventing companies from exploring uncharted territories and seizing new opportunities that could provide substantial competitive advantages.

Leadership plays a pivotal role in this transition. Leaders must encourage their teams to think beyond compliance and regulatory milestones, as well as beyond core businesses. They should foster an environment where innovative ideas are nurtured and where the pursuit of excellence goes hand in hand with sustainability. This means setting ambitious goals that go beyond what is regulatory required and striving to achieve them through innovative and disruptive solutions. For example, implementing innovation labs, building corporate ventures, or establishing cross-functional teams dedicated to exploring new technologies and business models outside core activities can drive this change. Business building involves creating new business units or ventures within an existing company to explore new markets or technologies. This approach allows companies to diversify their offerings and tap into new revenue streams. By establishing new business units focused on emerging technologies or untapped markets, companies can diversify their offerings and reduce dependency on traditional revenue streams. This proactive approach not only mitigates risks associated with market saturation but also positions companies as pioneers in the industry. If business building feels like a stretch, then venture clienting might be a solution. Venture

clienting is an effective way for maritime companies to infuse innovation into their operations. By partnering with startups, established companies can access cutting-edge technologies and fresh perspectives that might be challenging to develop in-house. This symbiotic relationship not only accelerates the adoption of innovative solutions but also provides startups with the resources and market access they need to scale. Looking ahead, the maritime industry must navigate not only regulatory changes but also technological advancements and shifting customer expectations. Leaders that embrace blue ocean strategies will be better positioned to lead in this evolving landscape.

In conclusion, while regulatory compliance is a fundamental aspect of the green transition, it should not be the end goal. Maritime technology providers and shipping companies must aim higher, seeking out competitive advantages through innovation and blue ocean strategies. By doing so, they can navigate beyond the crowded waters of compliance and into the open seas of opportunity, where true differentiation and long-term success await. ■

**Jan Niemi**

CEO

Ab Shift Actions Oy
Finlandjan.niemi@shiftactions.com

CAROLIN LUSBY

Navigating the waves of cruise line sustainability

Expert article • 3679

Cruise line travel has experienced a remarkable resurgence, surpassing pre-pandemic levels in popularity. These luxurious floating cities offer an unparalleled vacation experience, taking passengers to exotic destinations while providing a vast array of entertainment options, gourmet culinary delights, and exciting excursions and activities onboard. With itineraries ranging from short 3-day getaways to extended year-long voyages, cruises cater to diverse preferences, with the average journey spanning around seven days. Younger generations have taken a particular interest in cruising, with an impressive 85% of Millennials and Gen X cruisers expressing enthusiasm for future sailings.

As a researcher and professor of sustainable tourism, I have been following the cruise line industry's progress towards sustainability. While some advances have been made, significant challenges remain. The industry's continued growth (which exceeded 31 million passengers in 2023) worsened environmental concerns such as:

- Carbon emissions: Cruise ships still heavily rely on fossil fuels which contribute to climate change.
- Waste management: Vast amounts of plastics, sewage, chemicals are generated onboard.
- Social impacts: Crew wages and welfare, cultural sensitivity and community engagement are often overlooked

Despite comprising only approximately 1% of the global fleet, cruise lines have a disproportionately negative impact on the environment. Specifically, cruise ships emit the highest amount of black carbon per vessel, with each ship generating 10 metric tons of soot or black carbon emissions annually. In contrast, container ships emit 3.5 metric tons per ship per year. The repercussions of black carbon extend beyond environmental degradation, as it poses a significant threat to human health when inhaled. Furthermore, when absorbed in the atmosphere, black carbon blocks sunlight, contributing to increased global temperatures.

Compounding the issue is the limited availability of shore-based power at current ports and ships, resulting in sustained high emissions even when vessels are docked. Notably, cruising has a higher carbon footprint per passenger compared to land-based holidays or camping. The average cruise passenger generates 3.5 kg of waste and 0.83 tonnes of CO₂, underscoring the need for sustainable practices in the cruise industry.

Despite these issues, some cruise lines are taking steps towards sustainability including alternatives fuels (such as hydrogen or LNG and hydrogen or wind assisted propulsion), waste reduction (including implementing recycling programs, reducing single use plastics, and improving waste management). New technologies allow for a more sustainable operation. Industrywide, the Cruise Lines International Association (CLIA) has set sustainability goals, and many cruise lines have sustainability officer on board now.

The sociocultural implications of cruise tourism are significant, albeit less obvious than environmental impacts. The industry's contribution to overtourism has resulted in issues such as overcrowding, local resentment towards tourists, and undue pressure on local resources. With less time in port and all needs met on board, cruise passengers spend a lot less money in a destination than overnight passengers. Notably, cities like Barcelona, Venice, and Amsterdam have experienced a surge in anti-tourism protests, highlighting the need for mitigating measures. In response, Amsterdam has implemented initiatives aimed at curbing the adverse effects of overtourism and cruise tourism, serving as a model for other destinations to follow.

Lastly, food sourcing has been an issue with cruise line supply chains sourcing from big companies. The industry is aiming at increasing locally sourced foods and other supplies which would reduce carbon footprint and also support local economies. Passengers also seem to be more aware and demand more sustainable cruising options. The journey towards sustainability in cruising has begun. We need to ensure it continues for the benefit of our planet and future generations. ■



Carolin Lusby

Dr., Associate Professor and Co-director
Global Sustainable Tourism
Florida International University
Chaplin School of Hospitality and Tourism
Management
Miami FL USA



ELINA VALOVIRTA

Can cruise ship romances promote sustainability?

Expert article • 3680

Romance novels taking place on Caribbean cruise ships are yet another example of how popular literature caters to audience expectations; readers need exciting settings and spaces for romances. Writers, likewise, need new fuel for their books to succeed in the literary marketplace. Titles such as *Caribbean Cruising*, *Cinderella at Sea*, *Santa Cruise* and *Onboard for Love* offer a unique vista to the Caribbean seascape from the deck and the cabin of the luxury cruise liner sailing usually from the US to places like the Cayman Islands, Puerto Rico, and St Kitts. These adult fairy tales are hardly invested in promoting sustainability; their motivation is the same as going on a cruise – pleasure and leisure. But can they inadvertently steer audiences to consider ecological and other sustainability issues?

The answer is a hesitant yes, because romance fiction is embedded in values; both value as capital in a booming industry, but also values in terms of content, such as healthy relationships and notions of a good life. There is every reason to believe, that these values might also feature sustainability, because the texts suggest that the environment matters for romance. As a Caribbean getaway is synonymous with hedonistic leisure and pleasure on the sea and on the beach, several marine activities fill the pages of romances. The story needs activities and opportunities to develop, so the narratives are highly dependent on their surroundings. For example, it would be impossible to enjoy snorkeling or scuba diving, if there were no coral reefs to admire in their breathtaking beauty. A polluted ocean as a setting could hardly elicit romantic feelings to emerge and hence, bring value to the cruise or reading experience.

Another value-laden issue in the novels is the characters' worldview. Genre conventions dictate, that the reader must glean enough information about the cast of characters in order to follow the story effortlessly and, upon finishing quickly, be ready to purchase another title as the market booms. One way to signal who is who in the narrative is through actions, where good guys respect nature like they respect women. A conscientious attitude towards natural elements like underwater flora also denotes to the reader that this would-be lover comes with earnest intentions and the romance *works*. In turn, bad guys like the evil tycoon in Nora Roberts' *The Reef*, destroy the whole sea floor in search of sunken treasures.

Romance literature's subtle interaction with environmentally threatened natural phenomena, like corals in the Caribbean, play a part in sustainability matters, whether consciously or not. Popular romance is produced for readers' escapist pleasure needs, not to preach or politicize. But it is clear, that they must contain elements that readers want from their books, such as value consistency. One such example is the consistent practice of safe sex in the novels that contain erotic scenes. Another is a disclaimer accompanying the novels that explicates that there is no cheating in this story. These elements, just like the characters' treatment of their surrounding environment, means that they are what reader-consumers want – as without them the books would not sell and thus exist. Values matter.

Yet, beyond the paradise discourse lies the industry's sustainability dilemma: factors like climate change and overtourism force sustainability front and centre. It is no wonder that cruise tourism's benefits to the Caribbean and the effects of tourism on the islands and its people have been questioned. Using Caribbean seascapes for the purposes of commodity fiction, invites us to consider water as a commodified space, something used for capitalist purposes like the tourism and cruise industries. Popular romance is a part of that framework: we consume and use water for romance as an investment. We cannot escape how we are all interconnected by the waterways we use – for leisure or for necessity.

This scrutiny of cruise board romance novels joins a growing body of research calling for more holistic approaches to the cruise industry in an effort to fully come to terms with its inner workings and challenges. This provides an opportunity for development in the same way as another field of recent development, ecotourism, does. Romance literature is very quick to pick up on recent trends thanks to the impact of readers as active agents of change.

Readers of bestselling fiction are active, networked global consumer-readers eager to promote, recommend and connect in various ways with their co-readers. In this interesting conjuncture of the literary and cruise industries, there is every reason to believe that multimodal – and mobile – readers could influence industries across the board and for the better, more sustainable experience should they so desire. ■



Elina Valovirta

Collegium Research Fellow
Turku Institute for Advanced Studies
University of Turku
Finland



KLAUS BONDAM

Responsible cruise tourism

Expert article • 3681

As industries worldwide increasingly prioritise sustainability, cruising is no exception. It is an important topic that cannot be neglected, and within Cruise Baltic, it has become a core element of their vision, embodied in their comprehensive “Responsible Cruising” strategy.

As a B2B network consisting of 32 ports and destinations in the Baltic Sea region, Cruise Baltic does not rest on its laurels. Its “Responsible Cruising” strategy aims to adapt to unforeseen circumstances, enhance collaboration, and, ultimately, set new standards for responsible cruising in the Baltic Sea region.

However, the work towards a more sustainable future started years ago. In 2019, the network created The Cruise Baltic Sustainability Manifesto. The first regional initiative focusing on the sustainable way of cruising worldwide. The Manifesto was signed by all partners at the time with the vision of “Making cruising a sustainable vacation offer in 2030”. Although recognising that cruising may never be entirely sustainable, Cruise Baltic aims to reach the vision by communicating “green” initiatives, creating action plans and inspire for change, as with the yearly Sustainability Report. A report that covers the sustainable initiatives created by the partners in the past year.

Shore Power developments and challenges

One of the key elements in Cruise Baltic’s sustainability efforts is the development of Shore Power. This technology allows ships to plug into the local power grid while docked, which significantly reduces emissions. On Cruise Baltic’s website (www.cruisebaltic.com), cruise lines can access a comprehensive overview highlighting where installations are available, planned, or not yet installed. By the end of 2025, 7 out of the 32 ports within the Cruise Baltic network will be able to offer shore power.

However, a significant challenge persists: the gap in supply and demand. While the Cruise Lines International Association (CLIA) anticipates that around 75% of the cruise fleet capacity will be able to connect to Shore Power facilities by 2028¹, many ports struggle to justify the substantial financial investment required. The funding process is often bureaucratic and complex, creating a bottleneck in achieving widespread Shore Power availability.

Year-round cruise destinations

In addition to technological advancements, Cruise Baltic is working with sustainable tourism by extending the cruise season into autumn and winter. Despite the colder climate and shorter days, these seasons offer a unique charm, characterised by a cosy atmosphere and the natural beauty of the region’s golden and snowy landscapes. Cruise Baltic encourages year-round tourism, which not only disperses visitor traffic more evenly but also supports local businesses during off-peak times.

Through focused communication towards cruise lines and travel agents, Cruise Baltic aims to change the perception of Northern Europe’s potential as a year-round destination. The effort to change habits and overcome biases about off-season travel is ongoing and a crucial part of their strategy.

¹ <https://europe.cruising.org/shoreside-electricity-capability/>

Driving sustainable practices in the cruise industry

With 32 ports and destinations, Cruise Baltic is rich in sustainable initiatives and determined to offer cruise guests unforgettable experiences when visiting the Baltic Sea region. With a strategy rooted in responsibility and collaboration, Cruise Baltic is not only setting new standards for sustainable tourism but also actively working on making each journey through the Baltic Sea a step towards a greener future. ■

For more information about Cruise Baltic and to explore their sustainability efforts, visit their [website](#).



Klaus Bondam

Director
Cruise Baltic
Denmark

klb@woco.dk



ENRIC PONS

Sustainability of the Mediterranean shipping

Expert article • 3682

Maritime transport in the Mediterranean is conditioned by different regulatory frameworks. Firstly, by the International Maritime Organisation (IMO), specially the 2023 Strategy on the reduction of GHG emissions from ships to achieve emission neutrality in international shipping by 2050, as well as the designation of the Mediterranean Sea as a Sulphur Oxide Emission Control Area (Med SOx-ECA). Second, by the EU, whose generally more demanding regulations only affect its member countries. Particularly relevant are the Emissions Trading System (ETS) and the FuelEU Maritime regulation for the use of environmentally friendly fuels.

Shipping companies are adapting their fleets to ensure current and future regulations are met. Although there are shipping companies with diversified vessel orders in terms of fuel technology, methanol seems to be the main fuel bet for container ships, followed by LNG. According to Alphaliner, by mid-2024, the six major container shipping companies had 113 methanol-powered vessels committed. But how many of them will end up sailing in the Mediterranean is unknown. There is no such clear commitment to intra-Mediterranean companies. In the 2023/2027 period, more than 35 new ships are expected to operate using conventional fuel, LNG or hybrid technology (conventional and electric) with the possibility of incorporating other fuels in the future, such as ammonia, biofuels, hydrogen or synthetic methanol. Some shipping companies are even opting to equip their new ships with Exhaust Gas Cleaning Systems (EGCS) or 'scrubbers' instead of using alternative fuels. In the Southern Mediterranean freight shipping companies, no general commitment to decarbonisation of their vessels has been identified, focusing their priorities on the second-hand market.

In the Mediterranean, there is a general interest in developing projects to help ensure the future availability of sustainable fuels. In early 2024, Morocco and the World Bank signed an agreement to conduct a study on the production of green energy in its ports for export and ship bunkering. Between 2023 and 2024, Egypt has signed several agreements for the construction of green methanol production facilities to supply ships with the aim of producing more than 300k tonnes/year and positioning itself as a future bunkering point in the Mediterranean. In the Maghreb, Morocco, Tunisia, Algeria and Mauritania have strategies and projects related to green hydrogen production in different stages of maturity. Particularly noteworthy is the case of Morocco, whose objective is to reach a capacity of 4GW by 2030. Transport&Environment (T&E) has identified 17 synthetic fuel production projects exclusively for ships in Europe. Spain stands out (one third of the potential production) with the largest green methanol production plant project in Europe in the port of Huelva.

Ports, especially in Europe, are focusing their efforts on implementing the necessary infrastructure to supply ships with energy from OPS (Onshore Power Supply) systems in order to cover their energy needs when they are at berth and thus contribute to the marine energy transition. According to the FuelEU Maritime regulation, 1st January 2030 is the date adopted to ensure the existence of OPS systems. In July 2024, the first operational OPS facility in the Mediterranean was inaugurated in Malta and the port

of Barcelona carried out the first connection of a container ship to an OPS system in Southern Europe. European governments are supporting such projects. Italy, for example, has a 570-million-euro plan to incentivise the use of shore-side electricity when ships are at berth. On the Southern shore, this issue is not a priority and only the launch of studies for the establishment of electrical connections to vessels moored at the quay in the port of La Goulette (Tunis) has been identified.

The data show that the regulatory aspect is the main driver for the sustainability of maritime transport in the Mediterranean, which implies the existence of (at least) two-speed transition led by those countries subject to the most demanding EU regulatory framework. For this reason, and in order to ensure that this transition has an efficient impact on the whole region, it is necessary to strengthen coordination and cooperation between the countries involved at a technical and economic level, ensuring that no one is left behind. ■



Enric Pons

Coordinator

The Group of Transport Ministers of the Western Mediterranean (GTMO 5+5)
CETMO (Centre for Transportation Studies for the Western Mediterranean / Centre d'études des transports pour la Méditerranée occidentale)
Spain



TEPPO SÄKKINEN

Climate policy drives decarbonization of shipping

Expert article • 3683

Climate policies impact the future of the maritime sector. Currently, international shipping takes 2% of global emissions. To keep track with global efforts to reach net zero emissions by 2050, emissions from international shipping should decrease by 15 % by 2030 according to the International Energy Agency IEA.

While the target is somewhat moderate, the scope of the challenge is highlighted by the fact that nearly all shipping is powered by fossil fuels. Multiple technological solutions exist to decarbonize shipping, but few are yet utilized in commercial scale.

The good news is that phasing down fossil fuels in other sectors will also decrease maritime emissions. A big chunk of all maritime transport is actually oil tankers and bulk carriers hauling fossil fuels from production sites to consumption elsewhere. Transport of coal, gas and oil constitutes an astounding 40 % of global shipping tonnage. Therefore, using less fossil fuels on land means also less demand for the transport of fossil fuels by sea.

Maritime climate policies must build on feasible technologies and solutions for decarbonization in the sector. Low carbon fuels will be the most significant tool for maritime decarbonization, as full electrification is still a far-off solution for ships running long streaks at seas. Many bio-based or synthetic fuels are interchangeable with their fossil counterparts and can be used in existing engines with little or no modification. Some emerging fuels, such as green hydrogen or ammonia require specific fuel systems.

Fuels have their drawbacks. To put it bluntly, we cannot expect to replace fossil fuels in all uses with alternative fuels. The production cost, energy demand, low energy efficiency and availability of feedstock place constraints for the availability of zero and low carbon fuels. Policies should therefore encourage electrification in all sectors where it's feasible and target low-carbon fuels to sectors such as shipping. The sun is setting for the combustion engine in land transport, but at seas it will remain indispensable for long.

Still, electrification does have a role to play in shipping. Plugging ships to shore power can substitute running fuel engines to generate electricity at ports. Electric motors are creeping into smaller boats or as auxiliary engines for bigger ones. More creative solutions are emerging, too. Ships can harness the wind with rotor sails to complement engines, harking back to the age of sails.

Cutting emissions is not only about technology. Good practices building on logistical efficiency and digitalization, such as just in time arrival to ports can both reduce emissions and decrease costs. Instead of crossing oceans on full steam, burning excess fuel on the way only to wait for hours or days to dock, ships can optimize their speed to match available slots at the destination.

Since this January, maritime transport has been part of the emissions trading system of the European Union. The ETS has been a powerful tool in reducing the emissions from energy and industry by putting a price on carbon. The annual decrease of available emissions allowances creates a tight market and forces companies to face higher prices or cut emissions. Additional EU regulation aims to boost the demand and infrastructure for low carbon fuels in maritime sector.

EU policies are evolving with the times. Whereas the Green Deal was the flagship policy of the previous EU Commission, the new mandate will focus above all else on European competitiveness and security. This does not, however, mean a U-turn on climate. Rather, phasing down fossil fuels is seen as improving the energy security of Europe by decreasing foreign dependencies. The new Commission is expected to soon propose an ambitious midway climate target for 2040.

Policies to decarbonize shipping must be anchored in the understanding of the sectors' vital importance for the society and the economy. For countries around the Baltic sea, up to 90 % of export and import run through sea, year-round also in severe winter conditions. Keeping maritime logistics effective and cost competitive while decarbonizing is therefore vital for our economies, industries and for the security of supply. ■



Teppo Säkkinen

Senior Advisor, Climate, Energy and Industries
Finland Chamber of Commerce
Member of the European Economic and Social Committee
Finland



ULLA HEINONEN & TIINA HAAPASALO

Finland: The gains and pains of being a pioneer in the green transition

Expert article • 3684

In many respects, Finland is considered a pioneer in the green transition. Back in the 1990s, Finland introduced the world's first carbon tax. Climate change mitigation, clean energy, material and energy efficiency and the circular economy have been on the agenda for decades. Today, Finland has one of the most ambitious carbon neutrality targets in the world: according to the national Climate Act, Finland's net emissions should be zero or negative by 2035.

Figures prove that when it is properly implemented, the green transition also promotes economic growth. Finland's total emissions have fallen by 32% from the 2005 level, even though the economy has grown. In addition, the green transition has opened up unprecedented investment prospects in clean energy production, the low-carbon industry and services. However, challenges remain, particularly in the land-use and effort-sharing sectors, where further efforts are needed to meet national targets and EU obligations.

In particular, the EU's emissions trading system, which includes large industrial and energy production plants, has succeeded in making significant emission reductions in Finland. The country's energy transition has progressed rapidly, and emissions have fallen in line with the change in energy production. Emissions from electricity generation have fallen by 87% since 2010, with zero emissions now accounting for 94% of the total production.

Arctic shipping and icebreaker technologies are examples of Finland's pioneering role in the maritime industry. For example, advanced hybrid propulsion technologies have been combined with high-end efficiency in engine power to reduce the climate emissions of the newest icebreaker *Polaris* by up to 9%.

Russia's invasion of Ukraine has accelerated Finland's energy transition and energy independence. Only two years ago, Finland imported significant amounts of electricity, gas and fuels from Russia. Now, imports have been successfully replaced by clean domestic production, wind, solar and nuclear power. Energy production has risen significantly from pre-war levels, while wholesale electricity prices have returned to pre-war levels. There is still significant potential to increase affordable, emission-free electricity production, and the government's objective is to double the production of clean electricity.

Potential for green growth

In Finland, both the public and private sectors see the ambitious climate targets as a tool for economic growth. In our thinking, the green transition is a win-win for both the climate and the Finnish economy and exports, due to Finland's leading position in clean energy and sustainable technologies as well as energy and material efficiency.

According to the Green Investment Data Dashboard, published by the Confederation of Finnish Industries EK, Finland has more than EUR 260 billion worth of investment plans related to the green transition (www.ek.fi/greeninvestments). Most projects are at an early stage, but the volumes are nevertheless unprecedented, considering the size of the Finnish economy.

Finland is in an excellent position to attract investments related to the green transition. Its carbon neutrality target for the year 2035 makes Finland a unique pilot market. The country's strengths include advanced technological expertise and a skilled workforce, exceptional conditions for clean energy such as wind power, solid infrastructure, as well as access to clean water, mineral resources, forests and biogenic carbon from

the forest industry, which can be used, for example, in hydrogen economy solutions. Finland's social stability, high-quality education system and recent NATO membership are valuable assets, as well.

Expectations for policymakers

The climate transition is a demanding challenge for society and the economy. Finland and the EU are among the first to face this. Investments and innovations are needed on an extraordinary scale in order to reach the climate targets and realize the full potential of the green growth. This requires skills, talent, funding, efficient investment-permitting processes, and a well-functioning infrastructure for energy, transport and digitalization. A predictable political and legislative environment in the EU and Finland, as well as policy coherence are essential in order to attract the required long-term and high-risk investments.

According to businesses, the future goal of EU policymaking should be to achieve the climate targets in a cost-effective way, utilizing market-based and technology-neutral measures. The role of the policymakers is to set the direction and targets, but not to pick the winners. The markets are already moving fast towards the green transition. Also in Finland, the energy transition is taking place in a market-driven way. The threats to this market-driven approach are overly detailed regulation and the global state aid competition. State aid is still needed, but only for emerging technologies and higher-risk projects.

It is in the interests of both the climate and the economy that the EU continues to pursue an ambitious climate policy. However, over the next five-year period, the focus should no longer be on producing new regulation and instead we must ensure that the Green Deal regulation that has already been decided is implemented efficiently and effectively. Now is the time to boost sustainable economic growth and competitiveness, improve the Single Market, promote the circular economy and resource efficiency, develop key technologies and knowledge, create innovation and attract investment. We also need regulatory drivers for exploring new technologies such as carbon capture and technological sinks.

The green transition is not something to be compromised – instead it should be advanced in all smart ways. It will help Finland and Europe meet the major challenges of the economy, the environment, citizens' well-being, resilience and security. ■



Ulla Heinonen

Dr., Director, Green Growth
Confederation of Finnish Industries EK
Finland

ulla.heinonen@ek.fi



Tiina Haapasalo

Chief Policy Adviser, Transport and
Infrastructure
Confederation of Finnish Industries EK
Finland

tiina.haapasalo@ek.fi



SHEILA HEYMANS & PAULA KELLETT

Science-policy collaboration for green transition

Expert article • 3685

The European Green Deal outlines a vision for a green future in Europe, and the steps for achieving this transition. Its vision for a net zero Europe by 2050 is very ambitious and will challenge us all.

Given the scale of this vision, no one sector, discipline or country can deliver the green transition alone. Such a vision requires us to look beyond our own science, our own policy area, or our own country, and collaborate. A green transition is inherently complex. We need to fundamentally reconsider how we use the Ocean to ensure clean energy and energy security, to provide sustainable and safe food, and give people access to clean and accessible transport, while also ensuring that we leave a legacy of a sustainable Ocean for our children. Achieving this requires collaboration on an equally grand scale, working beyond our traditional silos to a far greater extent than we have done to date. We need to link research with industry, policy, and with communities. Knowing who to work with, and how to work with them, is not straightforward, as different fields have their own 'language', processes, and norms. Developing best practice for such wide-ranging collaboration will require dedicated research within the discipline of Sustainability Science.

Achieving the Green Deal will affect how everyone in Europe lives, but not achieving the Green Deal will also affect how everyone in Europe lives. For this reason, the green transition should also be a just transition, leaving nobody behind. All stakeholders should have the opportunity to engage in developing green solutions to those fundamental challenges, as those solutions will also have an impact on everyone. We want to move forward to a green future while also preserving maritime jobs, and the maritime culture and heritage that are so intrinsic to European life. Ensuring that everyone's voices are heard and reflected in the developments to come will be key.

A green transition will also require compromise. The transition will not be truly green if, for example, green and net-zero emission maritime industries are achieved at a disproportionate cost to coastal communities and the marine environment. Balancing the sometimes-contradictory requirements for those different aspects (e.g. Green Deal ambitions as well as the Blue Economy strategy, the Marine Strategy Framework Directive and the new Nature Restoration Law) will require us to innovate. In doing so, we should challenge our own understanding of 'the way things are', to consider 'the way things could be'. But how do we know when we have achieved this balance? We will only know that if we have a comprehensive, well-funded and sustained Ocean observing system that provides open data for analysis by all, and if we have a comprehensive platform such as the Digital Twin of the Ocean where we can ask what-if questions, based on well described scenarios and real data, to address these management challenges.

Marine space within European waters is in increasingly high demand as we seek to support our green transition with the resources (e.g. renewable energy and food) the Ocean can supply whilst also maintaining other key maritime activities and protecting the marine environment. The new Nature Restoration Law will make the management of our marine space even more critical, and the need for equitable resource allocation will become even more difficult. Here again, a key challenge will be to collaborate and innovate, looking towards multi-use and complementarity between activities, to make the best use of the space available.

Training will underpin our ability to deliver on a just and all-encompassing green transition. We will need to ensure that we have the right people with the right knowledge and skills across all career levels and maritime sectors to ensure we can achieve the visions we have set out. We will need to identify and nurture the new skills needed and ensure that green jobs in the blue sector are promoted and valued, and that people currently working in those maritime industries that do not fit our new vision can retrain and become part of the green future.

The title of this column is 'key challenges of science-policy collaboration in supporting green transition,' but really, the key challenge is that those collaborations need to be much, much broader to achieve the grand vision of a green future. ■

For more information, contact: info@marineboard.eu

Sheila Heymans

Executive Director
European Marine Board
Belgium

Paula Kellett

Science Officer
European Marine Board
Belgium



EINI HAAJA

What is needed to speed up the sustainability transition?

Expert article • 3686

As this Special Issue shows, the sustainability transition entails various perspectives in the maritime industry. The challenge is highly complex and the objectives rather ambiguous, even though we may have various targets set at the firm, regional and international levels. The challenge emerges from getting every actor engaged in this transition in a feasible way, and from getting various actors to match their actions in order to generate a systemic change. But what are the varying expectations and needs in this respect?

For many business actors, the sustainability transition is a source of future competitiveness – it offers new opportunities to become better than others. For others it is a great challenge that forces them to make changes in their current operations, or they might not have the license to operate in the future. At the same time, the jungle of existing and expected regulatory frameworks for the sustainability transition is not easy to comply with. Therefore, businesses call for **enhanced expertise in terms of following and interpreting the developments in the regulatory landscape**, and also enhanced business-policy dialogue. Our research data collected among policymakers, businesses and various intermediaries shows that different actors have quite superficial perceptions of each other's capabilities to pursue sustainability transition. In particular, policymakers tend to overestimate the skills and resources of businesses to meet the tightening regulations, whereas companies, even some large ones, are struggling with interpreting what to do in practice. Thus, navigating the global business environment with evolving and somewhat contradictory frameworks requires new kind of business-policy interactions and business intelligence.

Secondly, the sustainability transition calls for **open-minded innovation skills**, given that the green transition will not eventually allow us to continue business as usual but new concepts must be developed. For instance, the cruise industry is facing dramatic changes due to the restrictions set by the IMO and various destination ports, demanding for unforeseen flexibility from the cruise ships and the cruise tourism concepts in general. For the European shipbuilders, in turn, the situation is tricky as well as they must comply with the rules set by the EU, put considerable effort in decarbonizing their products and production processes, and figure out how to cover the costs of these development activities. Namely, even though shipowners are forced to explore environmentally friendly solutions, it remains unknown to what extent they can transfer the higher prices into their sales with the end customers. Hence, there is a need for innovative technological solutions as well as business models.

Thirdly, the systemic change for sustainability requires **advanced marketing methods**. In the cruise industry, for instance, the tourists are reported to become increasingly conscious with respect to the environmental harm caused by the industry, and might prefer alternative ways for spending their leisure time. Shipowners are well aware of this development, and are forced to offer their guests increasingly environmentally friendly vacation alternatives. However, tourists enjoying their unique leisure experiences are still not reportedly willing to pay much extra for more sustainable solutions, which presses the business models and sustainable innovation of cruise lines. Thus, new methods

for visualising, proving and selling sustainability are required throughout the value chain, all the way from material manufacturers and shipyards to the cruise lines and travel agencies. Just like enacting regulatory changes and innovating new solutions to meet them, also the marketing phase requires initiative and new competences from all maritime industry actors – independently and in collaboration.

Advancing the skills of all maritime industry actors in these three areas is of key importance for us academics doing our best in supporting the sustainability transition. At the University of Turku, we advance the skills development and the generation of knowledge and practical solutions in these areas in close collaboration with maritime industry actors, ranging from the metaverse solutions created at the Faculty of Technology to the business model innovations and market shaping processes explored at Turku School of Economics. As an example of these faculties' multidisciplinary research projects, the University of Turku coordinates Business Finland funded SusFlow project that explores and advances the information flows for enhanced sustainability in shipbuilding networks. Turku School of Economics also strongly pursues hands-on collaboration with industry actors via Maritime@TSE platform coordinated by the Centre for Collaborative Research (CCR), and supports companies in developing their own strategic foresight skills through methods developed at Finland Futures Research Centre (FFRC), for example. Successful navigation through the global geoeconomic developments and regulatory frameworks, in turn, is supported by the insights generated at the Pan-European Institute (PEI) and Operations and Supply Chain Management unit, for both of which the maritime industry constitutes one of the key research contexts. All in all, **understanding and employing a great variety of business perspectives – not only technological development – is crucial in making the maritime industry rapidly increasingly sustainable.**

To speed up the sustainability transition in the maritime industry, we need the above discussed skills and further collaboration within and between the industry, policymakers and academics. This Special Issue is one attempt to compile and visualize the complexity of views and, consequently, also inspire new interactions between different actors. It has been published as a part of MUUTOS project funded by the Foundation for Economic Education (Liikesivistysrahasto) which seeks to uncover the current and future developments in the maritime industry in the face of megatrends, the sustainability transition constituting the key challenge. Tackling this challenge requires new ideas and expertise, and new ways of bringing various experts together. ■



Eini Haaja

Postdoctoral Researcher
Turku Institute for Advanced Studies (TIAS) /
Pan-European Institute (PEI)
Turku School of Economics
University of Turku
Finland

