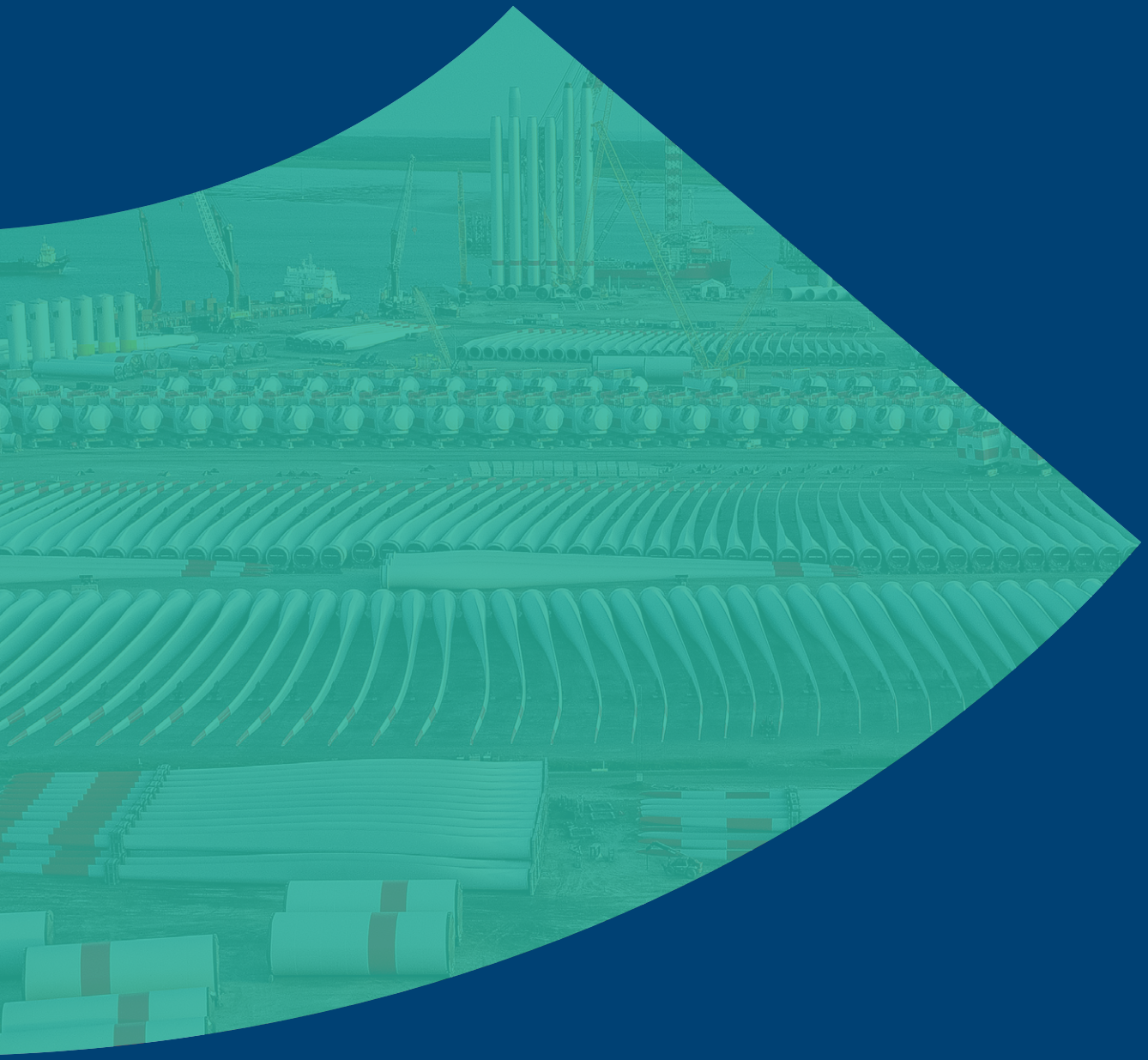
PORT ESBJERG

innovation hub

BACKGROUND & VISION | JUNE 2025

PORT ESBJERG



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Through Port Esbjerg Innovation Hub, we create the necessary framework for our companies to develop groundbreaking solutions.

PORT ESBJERG INNOVATION HUB IN A GLOBAL CONTEXT

Today, more than 200 companies operate in Port Esbjerg. They contribute significantly to value creation and are deeply connected to the future of both the city and the port. Renewal and innovation are essential to remain competitive, and that calls for close cooperation between the port and its businesses.

These activities help secure jobs and support the local economy in Esbjerg Municipality. As a key hub for energy and maritime activity in Denmark, Esbjerg is constantly evolving in a globalized world. To maintain growth and competitiveness, innovation isn't just an option—it's a necessity.

In this dynamic setting, the idea of an innovation network at Port Esbjerg has emerged as a strategic way to encourage new ideas, technologies, and partnerships. By bringing together the many players connected to the port—from established offshore energy and logistics companies to startups and research institutions—we're building a unique environment for innovation.

This brochure outlines the thinking and structure behind the concept, and the first steps in developing such a network.

The goal is to spark new solutions in areas like sustainability, digitalization, and smarter port operations—and to strengthen the region's role as a leading center for maritime innovation and energy technology.

By analyzing the specific needs and opportunities at Port Esbjerg, we can show how a focused innovation network can create real value for everyone involved and contribute to a sustainable future for the port and its businesses.

Innovation has always been part of the DNA at Port Esbjerg. But by organizing ideas and encouraging collaboration across companies and institutions, we believe we can take innovation to the next level. That's why we've developed a model for the Port Esbjerg Innovation Hub—one that structures the process and considers our position within Europe.

In that context, Europe's competitiveness also needs to be assessed, as it influences future funding opportunities from the EU.

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> To stay competitive and keep growing, innovation isn't just an option — it's essential.

THE DRAGHI REPORT: EUROPE'S COMPETITIVENESS AND ITS RELEVANCE FOR PORTS

The Draghi Report, officially titled *"The Future of European Competitiveness – A Competitiveness Strategy for Europe"*, is a comprehensive analysis of the EU's position in the global economy. It was prepared by former Italian Prime Minister Mario Draghi. The report highlights several key challenges facing the EU, including a shrinking share of the global economy, lagging innovation, and growing dependence on external suppliers for critical raw materials and technologies.

Draghi argues that the EU must carry out a series of structural reforms to regain its competitive edge. He emphasizes the need for swift and coordinated action to avoid what he calls a "slow decline" in the face of global competition. His recommendations are expected to shape future EU policies and strategies.

The Need for Transformation in the Industrial Ecosystem

Support for European ports—through programs like Connecting Europe Facility—will likely be tied to the priorities outlined in the Draghi Report. That means innovation, green transition, circular economy, and security will be key focus areas for the industrial ecosystem around Port Esbjerg.

In this context, it's important to consider how a network can be built to support this transformation. The starting point is the industrial ecosystem itself, and the changes needed to keep it competitive in the years ahead.

Some of these changes will directly affect the relationship between Port Esbjerg and the companies operating there. Port Esbjerg Innovation Hub is designed to help guide and support that process.

Draghi argues that the EU must implement a series of structural reforms to regain its competitiveness. He highlights the need for:

Massive investments

Especially in technology and the green transition, aimed at closing the innovation gap between Europe, the United States, and China.

A stronger industrial policy

To support strategic industries and safeguard supply security.

A reform of competition rules

To enable the growth of larger European companies capable of competing globally.

Faster and more effective decision-making processes

To prevent individual member states from blocking key initiatives.

A stronger focus on European security and reduced dependency

Especially in areas like energy and critical raw materials.

THE INDUSTRIAL ECOSYSTEM AROUND PORT ESBJERG

Port Esbjerg is part of a larger industrial ecosystem - a network of interconnected players working together to keep operations running and drive development. At the core is the infrastructure: quays, cranes, warehouses, and transport links. But surrounding this are many layers of activity.

Port-based companies are a vital part of the ecosystem. These include shipping lines that move goods in and out, logistics firms that handle transport and distribution, manufacturers that import raw materials or export finished products, and service providers offering everything from ship repairs and refueling to customs clearance and agency services.

Supporting actors also play a key role. Public authorities like customs and environmental agencies help set the framework. Educational institutions and research centers contribute knowledge and skills, while financial institutions enable investment and growth.

What makes a port-based ecosystem unique is the physical proximity and constant flow of goods and information. Businesses are often clustered around the port, which creates opportunities for synergy and collaboration. Shared challenges can lead to innovation and new partnerships.

A well-functioning industrial ecosystem is dynamic and adaptable. It attracts new companies and investment, creates jobs, and contributes to both regional and national economic growth. Innovation often happens where different skills and needs intersect—making the port a natural catalyst for progress in areas like green transition, digitalization, and logistics optimization. At Port Esbjerg, this is clearly visible. Companies in offshore energy, logistics, and related services form a strong ecosystem that supports one another and drives the development of renewable energy.

Future focus areas for the development of Port Esbjerg

In the context of the industrial ecosystem surrounding the port, it is relevant to consider how a network can be built to support this transformation, with a focus on:

Sustainable port operations
With a focus on electrification and low energy costs

A competitive position within the logistics network
Of which Port Esbjerg is an integral part

Contributing to Europe's green transition
By supporting the expansion of offshore wind and the transformation of the oil and gas industry

Sikring af Esbjerg Havn som en del af fremtidens transportbehov

Contributing to socio-economic development
Through job creation and growth in Esbjerg

BUSINESS IDEAS AND INNOVATION SYMPOSIUMS

In 2022, Port Esbjerg and its companies launched the Port Esbjerg Portal, which showcases the services offered by businesses operating at the port. The portal also reflects part of the industrial ecosystem surrounding Port Esbjerg.

Hackathons and Analysis: From Idea to Action

To keep this ecosystem competitive, innovation is key—and that means generating new ideas through symposiums. One of the ways we do this is by hosting hackathons, where participants explore ways to improve the port's competitive strengths. Before a hackathon takes place, we conduct thorough analyses of the current situation. These are carried out in close collaboration with universities and, where relevant, supported by EU funding.

In general, a port's competitiveness depends on factors like location, pricing, efficiency, and connectivity to inland transport networks. These factors vary depending on the type of cargo and operations involved.

For example, when it comes to modular cargo, Port Esbjerg is well-positioned within the European Transport Network (TEN-T), which improves access to import and export routes across Europe. One case involves car logistics from the Czech Republic to the UK, where vehicles arrive by train and are shipped via daily ferry services—offering an efficient transport solution for transporting this type of cargo between the Czech Republic and the UK, while remaining completely independent of activities in the hinterland og Port Esbjerg.

Competitive Analysis: Esbjerg vs. Bremerhaven

When comparing port calls in Esbjerg to those in Bremerhaven, the overall cost picture looks similar at first glance. But a closer look reveals that tugboat and pilotage services are nearly twice as expensive in Esbjerg. As a result, stevedoring companies earn less, and cargo fees are lower to compensate for the high costs of tug and pilot services.

To improve competitiveness, it's essential to develop business ideas that reduce these costs. One such initiative was the development of drone-based pilotage, which is expected to cut pilotage costs in half once fully implemented.

Reducing tugboat costs proved more difficult. Early in the process, the port explored the possibility of acquiring its own tugboats. While this was allowed under EU port regulations, the number of tow operations wasn't high enough to secure better prices—unless activity increased significantly. Since alternative technologies weren't viable, the focus shifted to making tugboat operations more sustainable. This led to the use of biofuels to reduce CO_2 emissions during port calls. Terminal efficiency has the greatest impact on competitiveness.

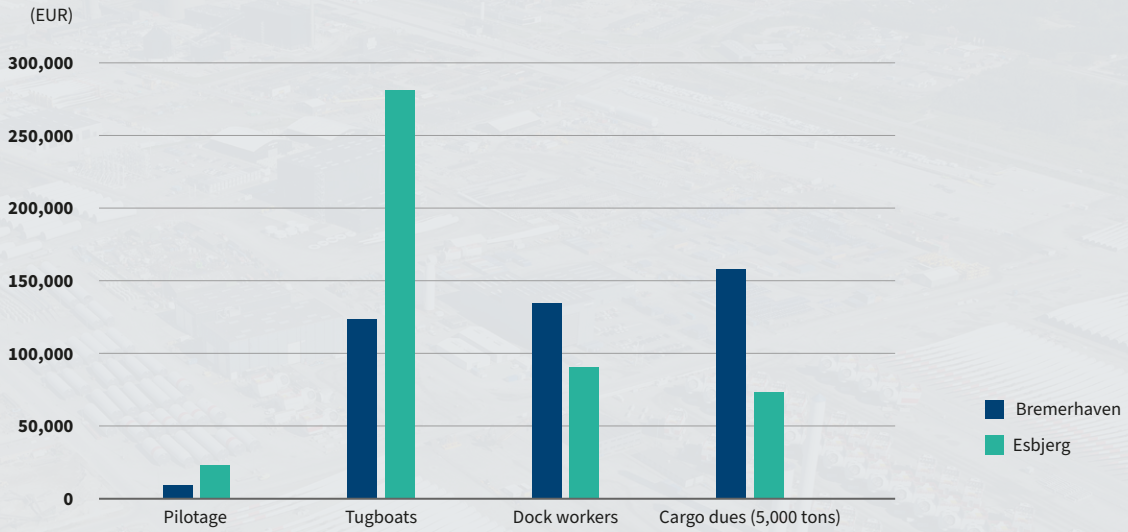
Efficient Terminal Operations as a Competitive Factor

For example, consider a roll-on/roll-off ship that needs to load and unload 500 trailers. The speed of these operations depends on the number of terminal tractors and the skills and experience of the dockworkers. If efficiency drops by 20%—from 100 to 80 trailers per hour—the cost of the port call increases by 25%.

If the same efficiency is maintained but only half the number of tractors are available, costs rise by 53%. To offset a 20% drop in efficiency by lowering wages, dockworker pay would need to be cut by 43%. This clearly shows that competitiveness depends on both equipment and skills. Any transformation of the industrial ecosystem must take both into account.

Such transformation could involve electrification, streamlined logistics, and innovation driven by business idea symposiums. These ideas should be backed by research and studies, with some developed and tested through 'Living Labs'.

Expenses



Examples of Expenses

Number of trailers loaded/unloaded per hour	100	50	80	50
Number of terminal tractors operating on the terminal	10	5	10	5
Number of dock workers for loading/unloading	25	12	25	12
Hourly wage for a dock worker (DKK)	350	350	350	350
Daily rate for roll-on/roll-off ship (DKK)	250,000	250,000	250,000	250,000

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Port Esbjerg Innovation Hub is a key driver in strengthening our position and attracting new business to the port.

LIVING LABS AS A DRIVER OF INNOVATION

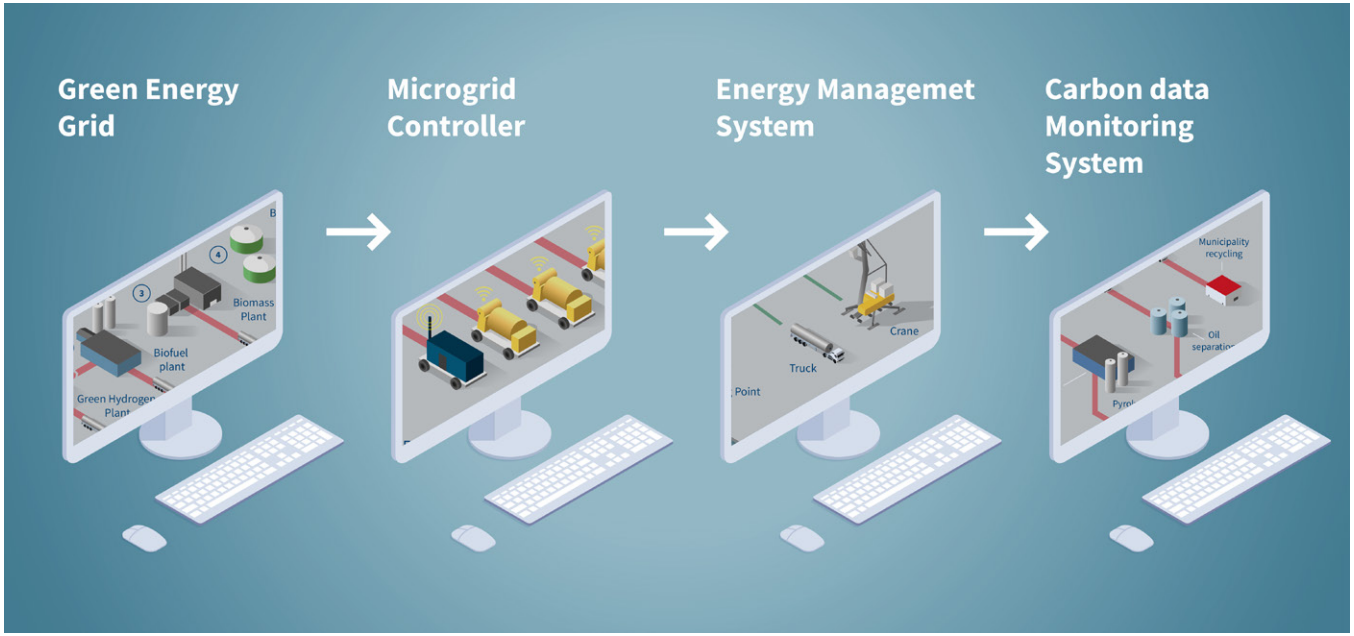
Living Labs are open innovative environments set in real-world contexts, where learning takes place throughout the entire lifecycle of a project. The goal is to create sustainable impact.

At Port Esbjerg, a Living Lab brings together public and private interests to develop new business areas that are scalable. These labs typically involve collaboration, experimentation with technology or software, user involvement in the development process, service design linked to the final solution, and relevance to broader European developments.

One example is the transformation of fuel cells into shore power systems, which helped enable the first commercial hydrogen production based on electricity from offshore wind turbines. Living Labs at Port Esbjerg often involve local companies and authorities, contributing to learning and the development of new solutions. Projects related to energy, electrification, and recycling are especially relevant.

Port Esbjerg is currently involved in several EU-funded projects focused on green transition and technology development. These include: NORTHERNSEALYTS (deepening of the fairway), DIOL (drone pilotage), Hydrogen Valley, H2S, Hydrogen Derivatives and EUDP Welltec (CO_2 storage). EU-supported projects typically require collaboration across multiple stakeholders and must benefit the public. Port Esbjerg has previously applied for EU funding for electrification and deepening of the fairway, with mixed results. One project that didn't receive funding in 2021 is still being pursued. It includes a Carbon Data Monitoring System, Energy Management System, Microgrid Controller, and Clean Energy Grid.

The port's decarbonization and electrification efforts are summarized in the Getting to Zero Plan, which outlines how various shore power systems help reduce CO_2 emissions. Several of these systems are examples of Living Labs, allowing local companies to develop technologies that can later be scaled into new business areas.



In one Living Lab focused on fuel cell-based shore power, the system was developed by a local company, which also handles hydrogen transport from the production site to the port. Many stakeholders were involved, including authorities who gained valuable experience in the approval process. Hydrogen is expected to become one of the key fuels of the future, making it essential to be able to transport and store it safely. It's also important to assess which Living Labs are most relevant to the competitiveness of the industrial ecosystem around Port Esbjerg.

Eksempler på Living Labs på Esbjerg Havn

Living Labs focusing on energy, electrification, and recycling may be considered relevant, such as:

- Drone operations supporting port businesses
- Charging stations for truckmasters, reach stackers, and forklifts
- Bulk system and terminal upgrades to handle more products
- Microgrids to support low energy prices
- Waste recycling as a business model (e.g. slop oil from ships)
- Optimization and sharing of unused resources within the port

These Living Labs will help strengthen the port's competitiveness in the coming years. Just as important is building skills and sparking interest in the industrial ecosystem among today's and tomorrow's workforce.

SECURING THE WORKFORCE OF THE FUTURE

Esbjerg is centrally positioned in relation to renewable energy production, offshore operations, logistics, and maritime industries. As these sectors evolve, it's essential to ensure a skilled and adaptable workforce for the future.

All signs point to a growing demand for labor in the coming decade. That's why retraining, upskilling, and education are key to succeeding with the green transition. The challenge is significant, and collaboration across sectors is absolutely vital.

We need knowledge and research focused on the future industrial environment. This requires partnerships with universities, but just as important are training facilities for educating and upgrading the current workforce.

It's also crucial that children and young people get to know the port and its companies—and learn how to solve future challenges in creative and collaborative ways. There are currently around 7,500 jobs at companies based at Port Esbjerg. Assuming a typical staff turnover of 10%, that means 750 new employees are needed each year. For comparison, there are 12,500 school pupils in Esbjerg, including around 1,400 ninth graders. This highlights the need to spark interest in the port and its businesses among local students.

The Next Generation – Collaboration with SDG-House Genin

To help educate the next generation of workers for port-related companies, Port Esbjerg Innovation Hub shares facilities with SDG-House Genin (Generation Innovation). Genin is a private non-profit organization in Esbjerg focused on sustainability and school-business partnerships.

Their core activity is free, case-based learning programs where children and young people work on real sustainability challenges from local companies. Students get to develop innovative solutions using practical idea development tools. Port Esbjerg also contributes with real-life cases. You can learn more about Genin at www.genin.dk.

The goals for SDG-House Genin includes:

- Making education more hands-on
- Increasing awareness of local businesses and the green transition
- Training "green change agents" for future workplaces
- Raising awareness of Port Esbjerg

Skills Development and Continuing Education

The current workforce also needs opportunities for further education. That means providing facilities for training a flexible workforce that can operate across industries—such as offshore wind and oil & gas, which share many skill sets. The idea is to bring these shared courses and programs together in a competence center, where there's a direct link between the work to be done, employer requirements, and employee opportunities.

Applied Research and Real-World Cases

Applied research and studies will continue to be necessary. It's important to engage the next generation in this way of working, because it leads to innovation. Funding for applied research is typically secured through grant applications, as seen in current projects. One example is the challenge of collecting CO_2 from trucks—a real issue, since 13% of Europe's total CO_2 emissions come from transport.

TRIPLE-LOOP LEARNING IN THE INNOVATION NETWORK

The development of the Port Esbjerg Innovation Hub should be understood in the context of triple-loop learning within the industrial ecosystem represented by the many companies operating at Port Esbjerg. This ecosystem has long been shaped by collaboration across businesses, but going forward, it must be able to adapt to change with a shared purpose in order to remain competitive.

Triple-loop learning—sometimes described as "learning about learning"—goes beyond the more familiar concepts of single-loop and double-loop learning. While the first two focus on improving actions and questioning underlying assumptions, triple-loop learning digs deeper into the values, beliefs, and intentions that guide our decisions and actions. It asks the fundamental question: How do we know what's right? This is the most reflective level of learning, where we examine the intentions behind our actions and the frameworks we use to make decisions. It's about understanding why we do what we do—and whether those reasons are still relevant.

PORT ESBJERG INNOVATION HUB

Electrification and the Microgrid Concept

In the case of electrifying port terminals, triple-loop learning might involve a broader discussion about purpose and how specific initiatives align with that purpose. Electrification must not compromise cost levels or operational efficiency if competitiveness is to be maintained.

The environmental impact of the shipping industry is acknowledged by the European Union, as reflected in the Fit-for-55 package and the Alternative Fuel Infrastructure Regulation (AFIR). The latter requires shore power for passenger roll-on/roll-off and container ships at TEN-T ports by 2030. The rationale for starting with these vessels is clear: passenger ships often dock in urban areas, and container ships are among the largest emitters. In this context, pollution from ships becomes a critical issue, as the combined environmental impact and proximity of ports to cities make shore power essential.

Port Esbjerg has been purchasing certified green electricity for over five years and has installed a significant number of shore power systems—though not yet for the large RoRo vessels that call at the port. However, electricity prices fluctuate across Europe, and high costs for shore power have negatively affected the port's competitiveness. Stable electricity prices suggest that renewable energy sources should be installed within the port area. This is where the idea of a microgrid offers tangible benefits for powering shore systems and charging mobile port equipment.

The concept is to establish a microgrid with its own sources of electricity from solar and wind. The microgrid will be supported by battery systems, which also serve as backup for critical port functions. This increases the port's resilience, especially as it is considered critical infrastructure. Therefore, support is being sought for a microgrid that operates independently of the public grid. The goal is to supply green electricity to port terminals handling modular cargo—covering both shore power for ships and electrification of terminal operations, aiming for zero CO_2 emissions.

The project includes green electricity production from one wind turbine, a floating solar panel system, and one fuel cell. The microgrid will be able to supply power to four shore power systems for RoRo ships and charge the battery pack on one of these vessels. Additionally, it will power refrigerated trailers and charging stations for trucks. Finally, it will supply electricity to ten terminal tractors.

Load Patterns and Energy Demand

The illustrated 24-hour activity can be divided into three load scenarios. The high-load case involves a RoRo ship, a Pure Car Truck Carrier (PCTC), and a car carrier operating simultaneously. These operations are supported by ten electric terminal tractors. The total energy demand over the 24-hour period is 86,800 kilowatt-hours.

The ships are assumed to operate during daytime hours. The RoRo ship calls daily, while the PCTC and car carrier each call twice a week. This creates challenges for building a microgrid that operates independently of the public grid.

Business Potential of Microgrids and CO_2 Reduction

In addition to the previously described scenario, two further microgrid load cases can be calculated, assumed as follows:

- Microgrid Medium Load: This involves a Roll-on/Roll-off vessel and a Pure Car Truck Carrier operating simultaneously. The operations are supported by ten (10) electric terminal tractors. The total energy demand over a 24-hour period is 82,000 kilowatt-hours.
- Microgrid Minimum Load: This involves a single Roll-on/Roll-off vessel. The operations are supported by five (5) electric terminal tractors. The total energy demand over a 24-hour period is 47,840 kilowatt-hours.

Because energy demand fluctuates, the microgrid will also include a battery energy storage system to balance the grid and match supply with demand at any given time. The need for such a system is best illustrated by showing the load pattern over a 24-hour period for each of the microgrid load scenarios.

During peak operations, especially when ships are docked, energy demand exceeds production. To address this, a 10 megawatt-hour battery energy storage system will be installed. On a weekly basis, terminal energy consumption is estimated at 408,000 kWh, compared to a calculated production of 817,600 kWh.

This means the microgrid cannot meet demand during high-load scenarios, but in minimum-load scenarios, there will be a surplus of electricity. The current terminal load pattern does not fully utilize the available energy, making it necessary to remain connected to the public grid. Regardless, the overall goal is to achieve stable electricity prices, electrify terminal operations, and reduce costs for ships.

The guiding principle is to lower the cost of port stays while ensuring zero emissions from operations. The cost of using shore power systems is comparable to the alternative use of onboard diesel generators. However, the cost profile for electric terminal tractors is expected to differ from the current setup.

For example, a ship with a 1,600 kWh port generator operating at 80% load consumes 9 tons of diesel per day, with a total cost of DKK 39,716. If the electricity is supplied by the microgrid, costs are expected to be 10–15% lower. In addition, CO_2 emission reductions will also carry economic value, especially in the light of the FuelEU Maritime regulation.

FuelEU Maritime sets maximum limits for the annual average CO_2 emissions from the energy used by ships over 5,000 gross tonnage calling at European ports. The targets are designed to ensure that the carbon intensity of fuels used in the sector gradually decreases over time—starting with a 2% reduction in 2025 and reaching 6% by 2030. Greener ships are essential to remain competitive, but shore power must also be available. A RoRo vessel with 20% port time is estimated to achieve a 2% reduction in CO_2 emissions by using electricity from the microgrid.

To launch the microgrid, it will be important to form a coalition

24-hour load pattern

of shipping companies and the terminal operator, who—together with the port—can recognize the benefits of acquiring certified green shore power at stable prices, thereby reducing port-related costs.

In contrast to the previously mentioned 2% CO_2 savings, the goal is also to achieve up to 15% cost savings by using green electricity from the microgrid compared to the ship's onboard generators. The microgrid thus demonstrates how a business idea can be developed and, in collaboration with knowledge institutions, reach the next level—specifically through the preparation of a funding application to realize the project.

The project will also require pilot testing with the purchase of an electric terminal tractor to measure efficiency and ensure training facilities for port workers to learn how to charge and replace batteries.

At its core, the Port Esbjerg Innovation Hub is about learning to learn—and continuously rethinking the "why" behind our actions and decisions to ensure they align with the broader context. Implementing triple-loop learning in the industrial ecosystem requires a structured approach involving multiple steps and engagement from many different stakeholders, as illustrated on the following page.

A Shared Innovation Centre in the Historic Fiskepakhuset: Port Esbjerg Innovation Hub

The Port Esbjerg Innovation Hub will be established in Fiskepakhuset (The Fish Packing House) at Port Esbjerg. This historic building was designed by architect C.H. Clausen and built in 1901. Covering 1,920 m^2, it has undergone several renovations and refurbishments to preserve its historical character while being modernized for its new functions. Fiskepakhuset is part of Port Esbjerg's rich cultural heritage and stands as an example of how historic buildings can be integrated into modern business environments.

As the home of the Port Esbjerg Innovation Hub, the Fiskepakhuset will be designed as a space for collaboration, new ideas, and sustainable development. It will host:

- An environment that fosters innovation and cross-disciplinary collaboration between port businesses, research institutions, and other stakeholders.
- Facilities for education, workshops, and development activities for both the current workforce and future generations.
- Opportunities to showcase sustainable solutions and Living Lab projects from participating companies.

As a central part of the Port Esbjerg Innovation Hub, the facilities will also be shared with the SDG-House Genin, as previously mentioned.
The entrance to the Port Esbjerg Innovation Hub is located at Dokvej 3A.


Business ideas from port companies
Collaboration with knowledge institutions
Running scalable pilot projects as 'Living Labs'
Securing training facilities
Workforce development
"THE ESBJERG WAY"

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Our shared location in Fiskepakhuset creates a unique synergy.

PORT ESBJERG

innovation hub

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