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Regional Needs, Opportunities and Challenges in the Energy Transition based on Seaport Resources and Capacity

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Stakeholder Seminar Invitation and Adaptation

The DECOINTER project promoted a Stakeholder Dialogue Seminar titled "Regional Needs, Opportunities and Challenges in the Energy Transition based on Seaport Resources and Capacity." Scheduled for October 7, 2025 at Gdańsk International Fair (AMBEREXPO) during the Baltic Ports Conference 2025 and BALTEXPO, the event targeted maritime stakeholders including port authorities, terminal operators, service providers, energy suppliers, and logistics firms.

Structured as an interactive design sprint workshop, the seminar featured modules such as horizon scanning, persona development (e.g., terminal operators, logistics managers), needs/pain points analysis, value proposition design, and solution prioritisation. Key objectives included mapping energy transition trends alongside digitalisation/AI impacts, identifying stakeholder personas and their pains/gains, and developing actionable value propositions for port decarbonisation digital services.

Despite the open invitation with registration deadline September 30, 2025, **no project-external participants registered**. Consequently, the in-person format was cancelled in favour of a streamlined **online seminar** supplemented by targeted **individual interviews** with selected stakeholders. This pivot ensured continued progress on DECOINTER objectives while maintaining regionally relevant insights.

Executive Summary

This report synthesizes the outcomes of a stakeholder dialogue seminar held on 10 December 2025, focused on accelerating the energy transition in the Baltic Sea region by leveraging seaport resources and capacities. Discussions underscored the strategic role of ports as energy hubs—for offshore wind logistics, onshore power supply (OPS), green hydrogen and alternative fuels—and highlighted systemic needs (infrastructure modernization, clear regulatory frameworks, skills), alongside opportunities (repurposing existing assets, innovation clusters, cross-border cooperation). Key challenges include high upfront investment, grid constraints, permitting complexity, technology maturity and workforce shortages. Participants converged on actionable solutions: holistic planning, fast-track permitting, public–private financing, targeted education and digital tools (digital twins, AI) to optimize grid integration and port energy management.

Context and Objectives

Seaports anchor regional economies and are pivotal to decarbonization due to their role in logistics, industrial activity and energy flows. The seminar (within the DeCoInter initiative under the Interreg South Baltic programme) aimed to identify regional needs, opportunities and challenges, and to co-create a practical roadmap for ports to become active contributors to the green energy transition. Objectives: (i) align stakeholders on priorities; (ii) surface barriers and enabling conditions; (iii) compile recommendations into a phased action plan for 2025–2028.

Method: Stakeholder Dialogue & Brainstorming

The seminar combined plenary briefs with breakout sessions using a collaborative whiteboard (Miro). Participants conducted horizon scanning (emerging trends), impact analysis (how challenges affect roles/ports), and solution framing (tools and support needed). Moderators rotated across rooms to assist both content and technical facilitation. Outputs were captured as post-its and pitches (3–4 minutes per group).

Regional Baseline: Baltic Sea Ports in Transition

Offshore wind is the backbone of the regional renewable system; large-scale projects are planned/ongoing across Denmark, Poland, Lithuania, Germany and Sweden. OPS deployment is advancing (e.g., cruise OPS in Rostock; expansion underway in Klaipėda and Polish ports). Hydrogen initiatives range from pilot electrolysers (MW-scale) to gigawatt ambitions (e.g., Rostock). Solar PV and biomass are considered for port energy mixes, constrained by space availability. Grid upgrades are in progress but remain a bottleneck for integrating offshore wind, OPS and hydrogen.

Needs Assessment

Infrastructure modernization: berth electrification, OPS, substations, storage (liquid/gaseous fuels). Clear and harmonized regulatory frameworks; streamlined permitting across jurisdictions. Workforce development: skills in hydrogen safety, offshore wind logistics, digital/AI-enabled energy management. Integrated planning between port–city–grid operators; spatial planning for competing waterfront uses. Resilience and cybersecurity capabilities for increasingly digitalized operations.

Opportunities

Repurposing existing industrial assets for renewable energy logistics (assembly, maintenance, storage). Development of green hydrogen and alternative fuel hubs (import/export, bunkering). Innovation clusters and testbeds within ports; shared R&D and pilot projects. Cross-border coordination on energy corridors (electricity interconnections, hydrogen pipelines). Digitalization (digital twins, AI forecasting) for grid optimization and port energy management.

Challenges and Risks

Funding uncertainty (short-term schemes vs. long-term investment needs); high upfront CAPEX for OPS/hydrogen/offshore logistics. Grid capacity constraints and connection delays; limited electrical infrastructure for large OPS. Complex and slow permitting; non-harmonized regulations (including unclear H2 standards). Limited land/space; competition among logistics, energy uses and urban development; military vs. energy use conflicts. Technology immaturity in hydrogen production, storage, transport and bunkering; equipment supply constraints. Workforce shortages; attraction and retention challenges; need for reskilling across age groups. Environmental constraints (marine protected areas, cable routing) and social acceptance. Cybersecurity threats and broader security/resilience requirements.

Cross-cutting Enablers

EU and national policy push (EU Green Deal/Fit for 55); OPS mandates for major ports. Significant public funding (ERDF, NextGenerationEU, national programmes) for OPS, hydrogen pilots, grid upgrades. Rising market demand for green energy and low-carbon logistics; port–city cooperation for integrated planning. Data and digital tools improving planning efficiency and reliability of variable renewable integration.

Stakeholder Insights from the Seminar

The recent stakeholder dialogue seminar exemplified this collaborative approach. Participants worked through complex challenges including funding uncertainties, regulatory barriers, and technological risks. The interactive sessions revealed common ground among stakeholders who might otherwise view each other as competitors or adversaries. Port authorities and shipping companies discovered shared interests in reducing operational costs through efficiency improvements. Environmental organizations and industry representatives found alignment around the need for credible monitoring and transparent reporting.

The brainstorming sessions during the seminar generated practical insights that inform project implementation. Participants identified specific barriers to alternative fuel adoption including limited infrastructure, high capital costs, and regulatory uncertainty. They also highlighted opportunities for collaboration including shared research and development costs, coordinated infrastructure investments, and harmonized regulatory approaches.

Infrastructure Modernization

- **Upgrade of port facilities to support renewable energy cargo:** ports must adapt to handle increasing volumes of clean energy carriers (e.g., green hydrogen, ammonia, biofuels).
- **Electrification and grid integration:** ports need enhanced electrical grids to support onshore power supply for vessels and industrial users, reducing carbon emissions.
- **Storage and handling facilities:** capacity for bulk and specialized storage (liquid and gaseous fuels) requires expansion and technological upgrades.

Policy and Regulatory Support

- Clear, consistent policies are required that incentivize green investments within port areas, including subsidies, tax breaks, and streamlined permitting processes for renewable infrastructure.
- Cross-sector coordination between energy, transport, and environmental agencies is necessary to address complex regulations affecting ports.

Skills and Workforce Development

- Training programs focused on new technologies (e.g., hydrogen handling, offshore wind support)
- Workforce adaptability to emerging green industries related to port operations.

Opportunities

Leveraging Existing Infrastructure

- Many seaports already have substantial industrial capacities that can be pivoted towards renewable energy activities without starting from scratch, reducing upfront investment risk.
- Ports can become hubs for offshore wind assembly and maintenance, capitalizing on their proximity to offshore renewable sites.

Green Hydrogen and Alternative Fuels

- Ports can serve as pivotal nodes for importing/exporting green hydrogen and alternative fuels, creating regional energy hubs.
- Possibility of developing integrated energy logistics chains combining sea, road, and rail transport.

Innovation and Collaboration Platforms

- Ports can foster innovation clusters, hosting testing facilities and pilot projects for clean technologies.
- Enhancing stakeholder collaboration (industry, government, academia) to accelerate technology adoption.

Challenges

Financial Constraints and Investment Risks

- High upfront capital required for infrastructure retrofitting and new green facilities, with uncertain ROI timelines.
- Need for public-private partnership models to mitigate risks and leverage financing.

Technological Uncertainties

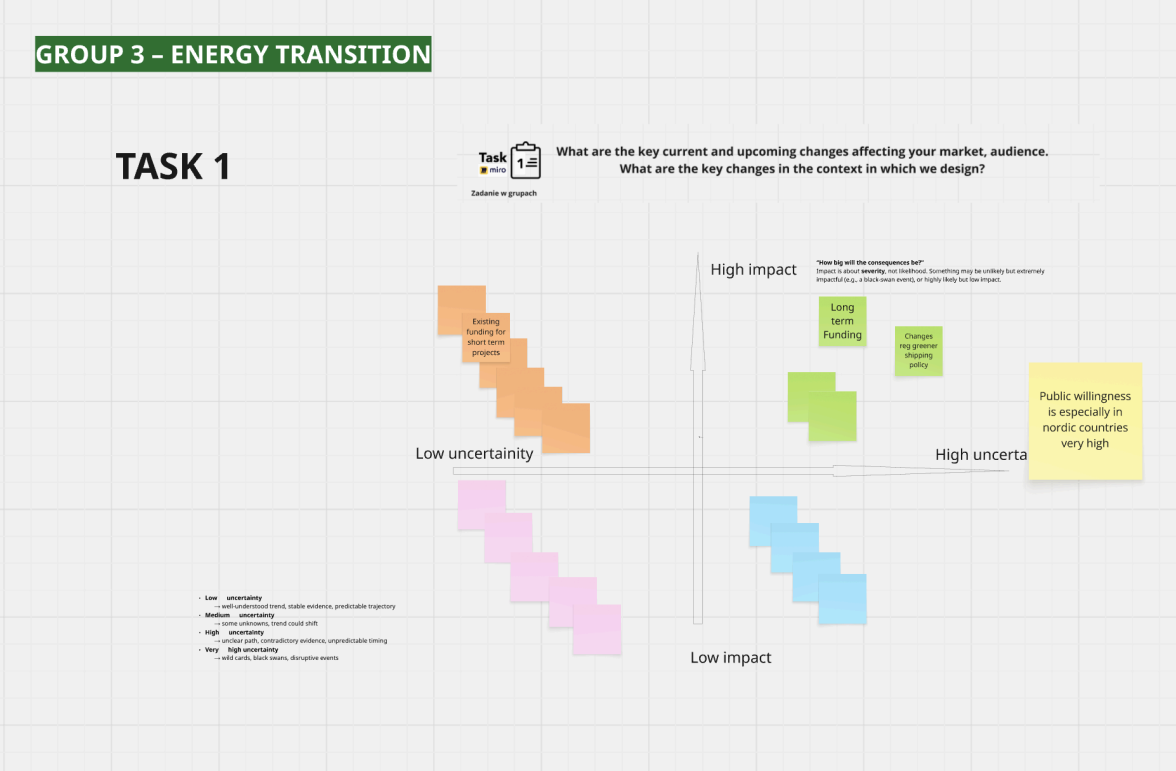
- Emerging technologies (e.g., hydrogen storage and transport) still face safety and efficiency challenges.
- Ports must balance innovation with operational continuity and safety compliance.

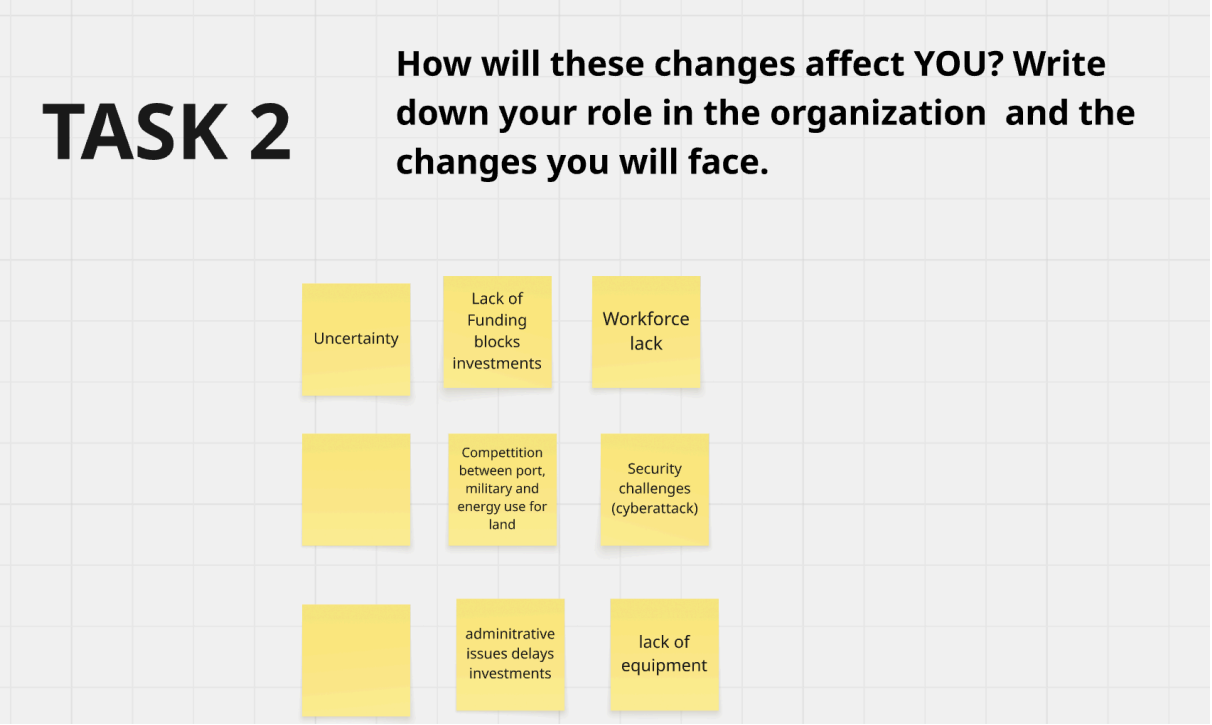
Coordination Complexities

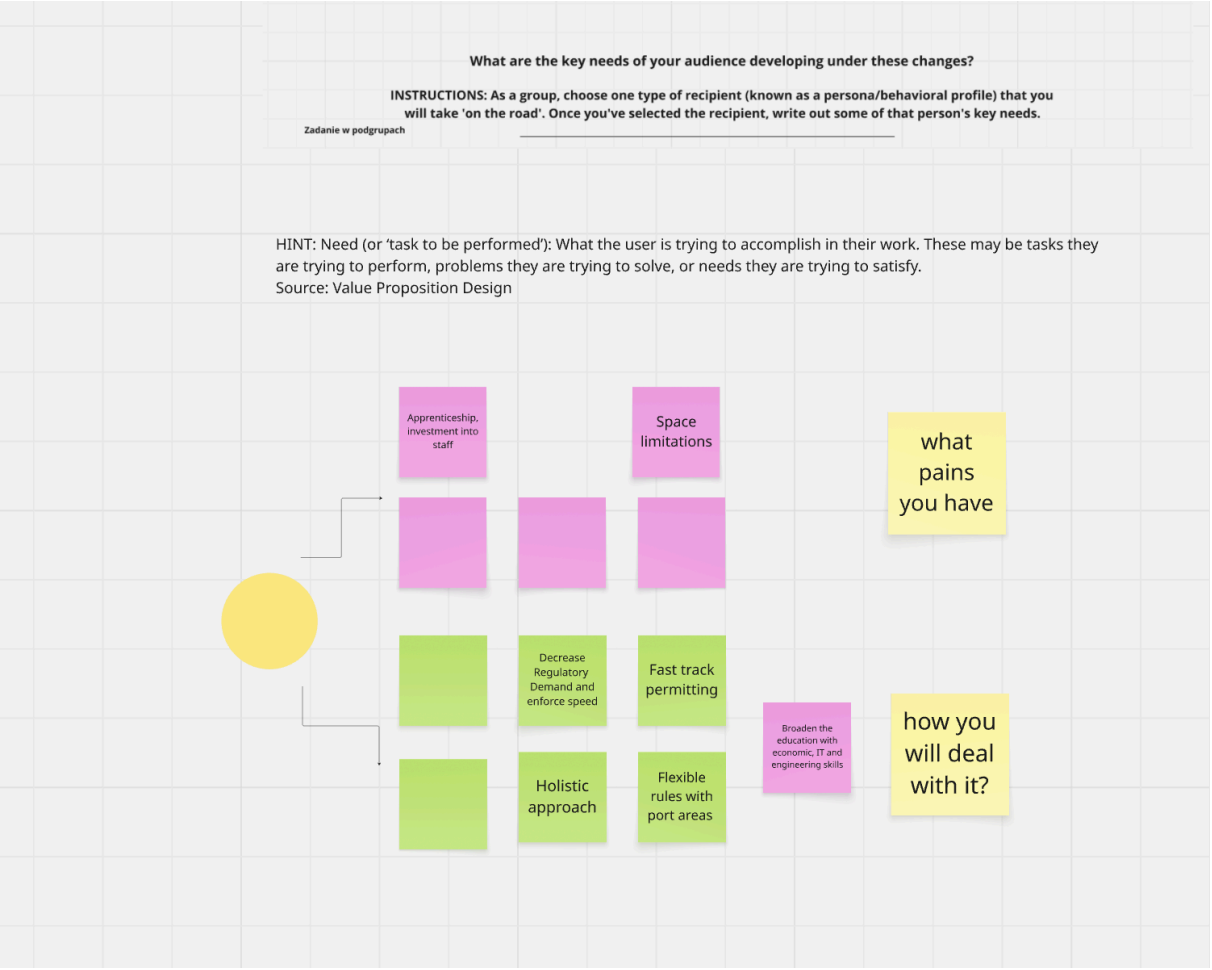
- Multiple stakeholders with differing priorities: port authorities, shipping companies, local communities, regulators.
- Achieving integrated planning across sectors and governance levels is often slow and complex.

Environmental and Social Impacts

- Transition activities might impact local ecosystems and communities, requiring thorough impact assessments and engagement.
- Ensuring equitable economic benefits across regions remains a priority.




TASK 2
How will these changes affect YOU? Write down your role in the organization and the changes you will face.
Uncertainty
Lack of Funding blocks investments
Workforce lack
Competition between port, military and energy use for land
Security challenges (cyberattack)
adminitrative issues delays investments
lack of equipment


What are the key needs of your audience developing under these changes?
INSTRUCTIONS: As a group, choose one type of recipient (known as a persona/behavioral profile) that you will take 'on the road'. Once you've selected the recipient, write out some of that person's key needs.
Zadanie w podgrupach
HINT: Need (or 'task to be performed'): What the user is trying to accomplish in their work. These may be tasks they are trying to perform, problems they are trying to solve, or needs they are trying to satisfy.
Source: Value Proposition Design
Apprenticeship, investment into staff
Space limitations
what pains you have
Decrease Regulatory Demand and enforce speed
Fast track permitting
Broaden the education with economic, IT and engineering skills
how you will deal with it?
Holistic approach
Flexible rules with port areas

Recommendations and Action Plan

The energy transition for seaports requires a coordinated and strategic approach that integrates planning, technology, finance, regulation, and workforce development. A comprehensive transformation strategy should begin with collaborative governance frameworks that unite port authorities, municipalities, and regional stakeholders. These strategies must be supported by detailed evaluations of existing infrastructure, including electrical systems, shore power capabilities, hydrogen facilities, and spatial planning considerations. Integrated urban–maritime development plans will be essential to optimize land use and balance competing demands across logistics, energy, and urban growth.

From a technological perspective, priority should be given to installing shore power systems at high-traffic berths and upgrading power distribution networks to accommodate increased loads. Hydrogen infrastructure must be introduced progressively, with robust safety protocols and pilot refueling operations to build confidence and operational experience. Ports should also establish dedicated facilities for offshore wind energy, leveraging existing assets for construction and maintenance activities. Advanced digital tools, including predictive analytics and digital twins, should be deployed to enhance grid management and optimize energy flows.

Financing this transition will require innovative partnerships and blended funding models. Public–private collaboration should be structured to distribute risk equitably, while institutional funding can be complemented by sustainable finance instruments such as green bonds. Developing cross-border partnerships will enable shared investment in large-scale infrastructure, including interconnectors and hydrogen corridors, ensuring regional integration and resilience.

Regulatory frameworks must evolve to support these ambitions. Streamlined permitting processes for strategic decarbonization projects are critical to avoid delays, while harmonized technical standards for hydrogen and shore power across jurisdictions will facilitate interoperability. Environmental safeguards and stakeholder engagement should be embedded early in project development to ensure compliance and social acceptance.

Finally, the success of this transformation depends on human capital. Specialized training programs in hydrogen operations, shore power management, and digital security should be launched in collaboration with academic institutions, offering professional certifications and apprenticeships. Workforce retention strategies must emphasize continuous learning, career development, and competitive employment conditions to attract and sustain talent in emerging maritime technologies.

Category	Key Actions
Strategic Planning	Develop regional seaport energy transition plans with multi-stakeholder governance. Conduct comprehensive capacity and needs assessments (grid, OPS, hydrogen, spatial). Adopt holistic port–city–region spatial planning to balance competing land uses.
Infrastructure & Technology	Prioritize OPS deployment at high-traffic berths; upgrade substations and cabling. Phase-in hydrogen-ready storage and safety systems; pilot bunkering with clear protocols. Establish offshore wind logistics hubs (assembly, maintenance) leveraging existing quays and yards. Deploy digital twins and AI forecasting to optimize grid integration and operations.
Finance & Partnerships	Structure public–private partnerships with risk-sharing mechanisms. Blend grants with green bonds and development bank instruments; create project pipelines. Set up cross-border joint ventures for corridor-scale assets (interconnectors, pipelines).
Regulation & Permitting	Introduce fast-track permitting for strategic decarbonization assets. Harmonize H2 and OPS standards across the region; establish one-stop permitting windows. Embed environmental safeguards and community engagement early to accelerate acceptance.
Skills & Workforce	Launch targeted training (hydrogen safety, OPS operations, cybersecurity, digital energy). Create apprenticeships and certification pathways with universities and TVETs. Implement retention strategies (career mobility, continuous learning, attractive port roles).

Monitoring & Evaluation

KPIs: OPS hours delivered, shore-power energy (MWh), GHG reductions (tCO2e), grid connection lead-times, training completions.

Data governance: standardize data collection; ensure cybersecurity and privacy compliance.

Independent reviews: annual audits of progress and stakeholder satisfaction; public reporting.

Conclusion

Baltic Sea ports are uniquely positioned to catalyze the regional energy transition. By aligning planning, investment, regulation and skills—and by harnessing digital tools—the region can overcome current constraints and build resilient, competitive green port ecosystems. Continued stakeholder dialogue and coordinated action will be essential to convert ambitions into operational reality.

Stakeholder interviews:

Port Perspectives on Energy Transition

To gather strategic insights following our stakeholder seminar on accelerating the Baltic Sea energy transition, we conducted in-depth interviews with the responsible executives from key regional ports. These discussions with port CEOs and harbour masters provided valuable perspectives on infrastructure needs, regulatory challenges, financing models, workforce requirements, and concrete action recommendations for the 2025–2028 period.

The interviews followed this set of 10 core questions:

1. How do you see your port's strategic role in the Baltic Sea energy transition over the next 5–10 years (offshore wind, OPS, hydrogen, alternative fuels)?
2. Which energy-transition functions are most relevant for your port and why (e.g. offshore wind hub, OPS provider, hydrogen/alternative fuel hub, innovation testbed)?
3. What are currently the main infrastructure and grid bottlenecks in your port for scaling OPS, offshore wind logistics and hydrogen/alternative fuel activities?
4. Which technologies do you consider ready to scale in your port, and which are still at pilot stage only (OPS, hydrogen, digital twins, AI-based energy management)?
5. Which regulatory or permitting issues delay or constrain your green port projects the most, and what single change would help you the most?
6. What are the biggest financial barriers for your key energy-transition projects, and which funding or partnership models do you see as most promising?
7. Which new skills and competencies are most urgently needed in your port to implement the energy transition (technical, digital, organisational)?
8. How do you manage environmental and social impacts of new energy projects, and what has worked best to build and maintain local acceptance?
9. Looking at the 2025–2028 period, what three concrete actions at EU, national or regional level would most effectively help your port deliver on the green transition?
10. What is the single most important next step your port needs to take to accelerate its energy transition in the coming 12 months?

Five ports were interviewed in total, providing a diverse picture of how the Baltic Sea port sector views the energy transition. To keep the analysis anonymised, the findings can be grouped

into **large ports** and **medium-sized ports**, as both categories showed clearly different priorities, capacities and roles in the regional transition process.

Large Ports: Energy Hubs and System Drivers

The large ports see themselves as **strategic energy hubs** with a central role in the Baltic Sea transition. Their focus is on offshore wind logistics, onshore power supply, hydrogen-related infrastructure and digital tools for managing energy flows and port operations. They generally think in terms of large-scale transformation and long-term regional impact.

At the same time, these ports emphasise that their ambitions depend heavily on external conditions. Grid capacity, investment security, permitting procedures and clear regulatory frameworks are seen as critical enablers. The interviews show that the large ports already have projects, partnerships and technical expertise, but they still face major structural bottlenecks that require coordinated action at national and regional level.

Medium-Sized Ports: Flexible and Complementary Roles

The medium-sized ports describe a more **specialised and realistic role** within the wider port system. Rather than competing with the larger ports, they aim to contribute through targeted functions such as project cargo handling, regional logistics support, smaller-scale OPS solutions and selected services for offshore wind or alternative fuel value chains.

Their perspective is shaped by more limited space, fewer financial resources and smaller operational margins. As a result, they tend to prioritise practical, step-by-step measures over large investment programmes. The interviews suggest that medium-sized ports can still make an important contribution to the energy transition, provided they are integrated into regional planning and supported by suitable funding and regulatory instruments.

Shared Messages Across All Interviews

Across all five ports, a number of common themes emerged. First, the energy transition is widely seen as both necessary and strategically important. Second, there is broad agreement that ports need better planning certainty, faster permitting and more reliable funding if they are to implement decarbonisation measures at scale. Third, cooperation between ports, cities, network operators, companies and public authorities is considered essential.

Another shared issue is the need for **skills development**. The ports highlight growing demand for technical, digital and organisational competencies, especially in relation to hydrogen, offshore wind, OPS and digital energy management. Communication and stakeholder acceptance also remain important, particularly where new infrastructure affects local communities or competing land uses.

Different Priorities, Same Direction

The larger ports focus on:

- large-scale infrastructure,
- offshore wind and hydrogen hubs,
- digital optimisation,
- cross-border cooperation,
- investment certainty.

The medium-sized ports focus on:

- feasible, incremental measures,
- regional logistics functions,
- targeted infrastructure upgrades,
- practical funding support,
- inclusion in wider planning processes.

Conclusion

Taken together, the five interviews show a sector moving in the same direction but at different speeds and scales. **Large ports** act as drivers of the transition, while **medium-sized ports** provide flexible and complementary support functions. Both are needed for the Baltic Sea port system to contribute effectively to the green energy transition.

Annex: Glossary

- OPS: Onshore Power Supply for vessels at berth.
- Digital Twin: A virtual model used to simulate and optimize port energy systems.
- H2: Hydrogen; includes green hydrogen from renewable electrolysis.
- Fit for 55: EU package to reduce emissions by 55% by 2030.