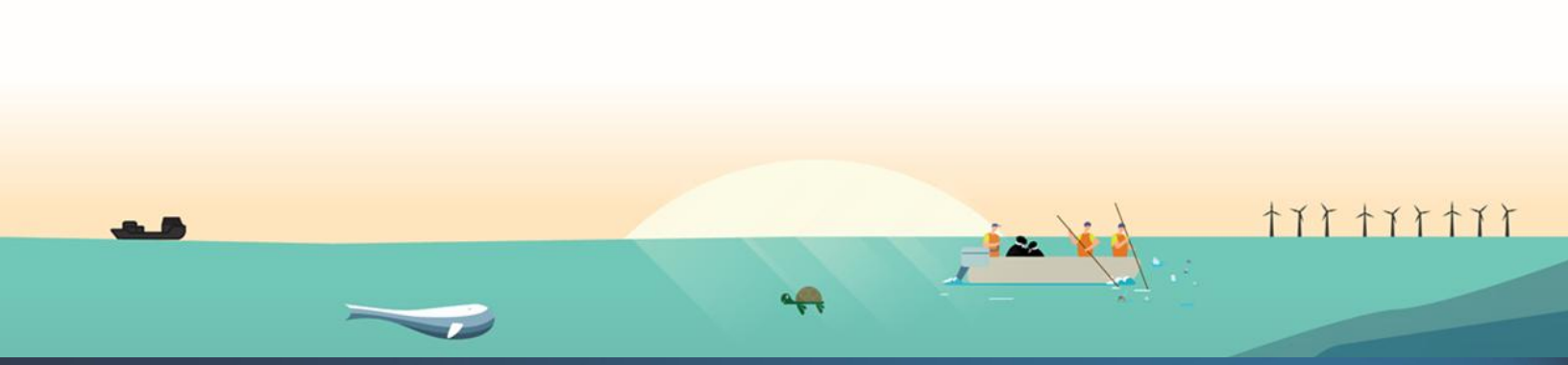

Recommendations on port actor connectivity

Policy Brief

December 2025

Highlights

Context:

- North Adriatic Sea ports

***Objective*:**

- Increase transport by inland waterways and short sea shipping by 50% by 2050

Institutional barrier:

- Actor connectivity

Issues:

- Interoperability
- Coordination
- Transparency

Recommendations:

- Port Digitalisation
- Standards
- Cross-Port Innovation
- Technical Support
- Green Alignment

Policy context

The PERMAGOV project aims to strengthen EU marine governance and accelerate progress toward European Green Deal (EGD) objectives. This Policy Brief contributes to the development of the European Maritime Space (EMS), based on data from a case study on North Adriatic ports. Achieving the EU's goal of shifting freight to inland waterways and short sea shipping is critical for reducing road transport emissions and decarbonising the maritime value chain. However, this transition may be hindered by institutional barriers.

Institutional barriers are structural and procedural limitations within governance systems that restrict policy implementation. They emerge from formal rules, informal practices, and organisational arrangements that shape decision-making and behaviour. They often arise from fragmented legal frameworks, overlapping jurisdictions, and rigid norms that impede coordination and innovation.

Drawing on interviews with North Adriatic port representatives and validation by maritime logistics scholars from Croatia, Italy, and Slovenia, and a workshop with actors from across the whole supply chain, PERMAGOV identifies weak **actor connectivity** as the most pressing governance challenge to address. Despite the availability of digital tools, poor interoperability, lack of common standards, and limited transparency prevent stakeholders from operating as a cohesive network, slowing both digitalisation and decarbonisation. This Policy Brief provides actionable recommendations to overcome this barrier and enable ports to become climate-neutral, digitally integrated hubs aligned with the EGD and the Sustainable and Smart Mobility Strategy.

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The twin transition in EU ports

The European Union positions *decarbonisation* and *digitalisation* as the two central pillars of Europe's sustainable transformation. Digital transformation is a key enabler for achieving the sustainability objectives of the European Green Deal, demonstrating that in EU strategy, digitalisation and decarbonisation are complementary policy priorities. For the maritime sector – particularly for ports – these priorities translate into a combination of regulatory compliance, technological adaptation, and operational optimisation. Decarbonisation in ports involves meeting stringent EU regulations and implementing operational improvements that reduce greenhouse gas emissions and improve energy efficiency.

Operationally, ports must optimise cargo flows, improve hinterland connectivity, and adopt energy-efficient infrastructure to reduce emissions across the supply chain. By 2030, all ports on the TEN-T core network are required to provide shore-side electricity and alternative-fuel infrastructure, as stipulated in **Regulation (EU) 2023/1804**. Ships calling at these ports will be obliged to connect to Onshore Power Supply (OPS) where available under **Regulation (EU) 2023/1805**, contributing directly to the EU's legally binding target of a 55% reduction in greenhouse gas emissions by 2030 (**Regulation (EU) 2021/1119**). Additionally, the inclusion of maritime transport within the EU ETS (**Directive (EU) 2023/959**) further incentivises emission reductions and creates a financial framework to support investment in low-carbon solutions.

Digital transformation is equally critical for achieving the EU's environmental and operational goals. The Digital Decade Policy Programme (**Decision EU 2022/2481**) sets out expectations for ports to enable real-time data exchange, supporting efficient OPS planning, emissions monitoring, and automation of cargo and logistics processes. Smart data platforms allow predictive scheduling, minimising vessel idle times, reducing energy consumption, and improving overall port throughput.

Electricity grid operators and port authorities must ensure sufficient grid capacity to meet growing OPS demand, facilitate vessel charging, and support broader port electrification initiatives. Achieving this requires integrating network-flexibility tools, local energy storage solutions, and transparent data-sharing mechanisms between ports, utilities, and shipping operators. This digitalisation effort underpins both operational efficiency and environmental accountability, enabling ports to function as nodes in Europe's emerging network of green shipping corridors.

Looking further ahead, the EU's proposal for a 90% reduction in emissions by 2040 (**COM/2024/63**) envisions ports not only as low-emission hubs but also as integrated smart-energy systems, combining renewable energy generation, storage, and demand-side management. Digital platforms will coordinate energy flows, optimise OPS schedules, and support logistics automation across multimodal networks. By 2050, climate neutrality will be mandatory under the European Climate Law, reinforced by the revised TEN-T (**Regulation (EU) 2024/1679**). This legislation sets binding milestones for sustainable, well-connected, and future-ready port infrastructure across the European Maritime Space, encompassing environmental performance, digital capability, and resilience. In practice, this will require ports to combine low-emission fuels, electrification, energy management systems, and advanced digital platforms to function as fully integrated, climate-neutral transport hubs.

The institutional barrier

Actor connectivity, i.e. the ability of stakeholders to coordinate and exchange data, knowledge, and expertise, remains uneven across EU ports due to fragmented governance, voluntary cooperation arrangements, and incompatible digital systems. While the IMO Compendium on Facilitation provides a reference model for semantic and technical interoperability (e.g. port calls, Just-In-Time arrivals), adoption is inconsistent, and EU-level alternatives are still emerging. Strengthening connectivity requires harmonised governance, alignment with international standards, trusted data-sharing protocols, and targeted incentives to scale successful local solutions into systemic change. This can be summarised in three main issues:

Interoperability

- Ports, shipping lines, and logistics providers use multiple digital tools, but semantic and technical alignment is lacking.
- Inconsistent standards force manual data reconciliation, reducing quality and creating inefficiencies.
- Without harmonised technical and semantic standards supported by clear governance, interoperability remains a major barrier to a connected maritime decarbonisation strategy.

Coordination

- Port governance is decentralised, with EU initiatives such as the Maritime Single Window (Regulation (EU) 2019/1239) implemented unevenly across Member States.
- Gaps in coordination between ports, shippers, and regulators lead to duplication and conflicting procedures.
- The absence of a neutral coordinating body or structured digital alliances limits scaling of successful local solutions (e.g. Trieste's Sinfomar Port Community System).

Transparency

- Emissions data is shared with varying frequency and granularity; some ports report in real time, others annually, hindering benchmarking and decision-making.
- Concerns over data ownership, security, and commercial sensitivity discourage open sharing.
- Without agreed methodologies and trusted protocols, transparency gaps undermine trust and slow progress toward data-driven decarbonisation.

Implications

Weak actor connectivity, driven by governance gaps and limited data-sharing, creates fragmented digitalisation, undermining progress toward Green Deal objectives. Persistent shortcomings in interoperability, coordination, and transparency prevent ports from scaling solutions such as real-time emissions management, shore power integration, and efficient hinterland logistics. Without systemic improvements, efforts remain siloed, duplication persists, and both cost savings and environmental benefits are lost. Robust port e-governance is essential to overcome this barrier and enable cohesive, climate-aligned digital transformation.

Recommendations

To address the issues raised above, the project recommends the following to the EMS coordinator:

1. Accelerate Port Digitalisation through Dedicated EU Schemes

Support interoperable Port Community Systems and shared digital platforms through targeted funding (e.g. the *Connecting Europe Facility (CEF) Regulation (EU) 2021/1153*), prioritising tools that enable data exchange across maritime, logistics, customs, and control authorities.

2. Mandate EU-Wide Interoperability, Data Protection and Cybersecurity Standards

Implement EU wide standards for data exchange and cybersecurity, in line with the *NIS2 Directive (EU) 2022/2555* and the *Critical Entities Resilience (CER) Directive (EU) 2022/2557*, including requirements ensuring transparency at the consignment level for ETS-related emissions and costs.

3. Fund Cross-Port Digital Innovation and Interoperable Reporting

Fund collaborative pilots to develop shared digital solutions and interoperable reporting in line with the *European Maritime Single Window Regulation (EU) 2019/1239*, enhancing coordination with logistics and government services while reducing fragmentation and competitive barriers.

4. Provide Technical Assistance for Secure, Integrated Digital Solutions

Offer EU-level support for ports, grid managers, shippers, and regulators to build capacity and deploy secure, interoperable digital solutions, integrating energy, logistics, and customs systems in line with the EU Digital Strategy (*JOIN(2025) 140 final*).

5. Align Digitalisation with Green Deal and EU Taxonomy Objectives

Link EU digital funding to EU Taxonomy criteria (*Regulation (EU) 2020/852*) to ensure sustainability alignment. Prioritise port development projects that improve energy efficiency, optimise cargo and logistics flows, and enable smart grid integration through coordination with TSOs and DSOs for grid flexibility and storage capacity.

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