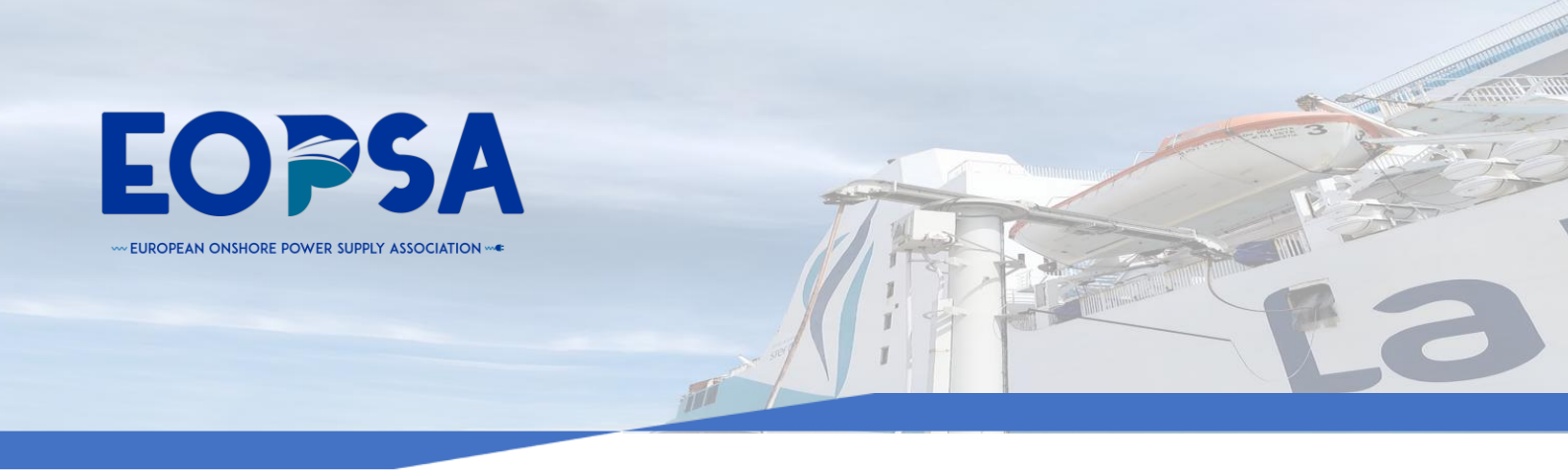

#Onshore Power Supply - #OPS

Port Energy Paradigm: Competitiveness, Resilience, Sustainability

Advancing Energy Communities and Decentralized Generation through Microgrids / Energy Hubs.

Why we can!

July 2025

#ENERGIZING PORT ELECTRIFICATION
#LETSGETCONNECTED
#JOINUS

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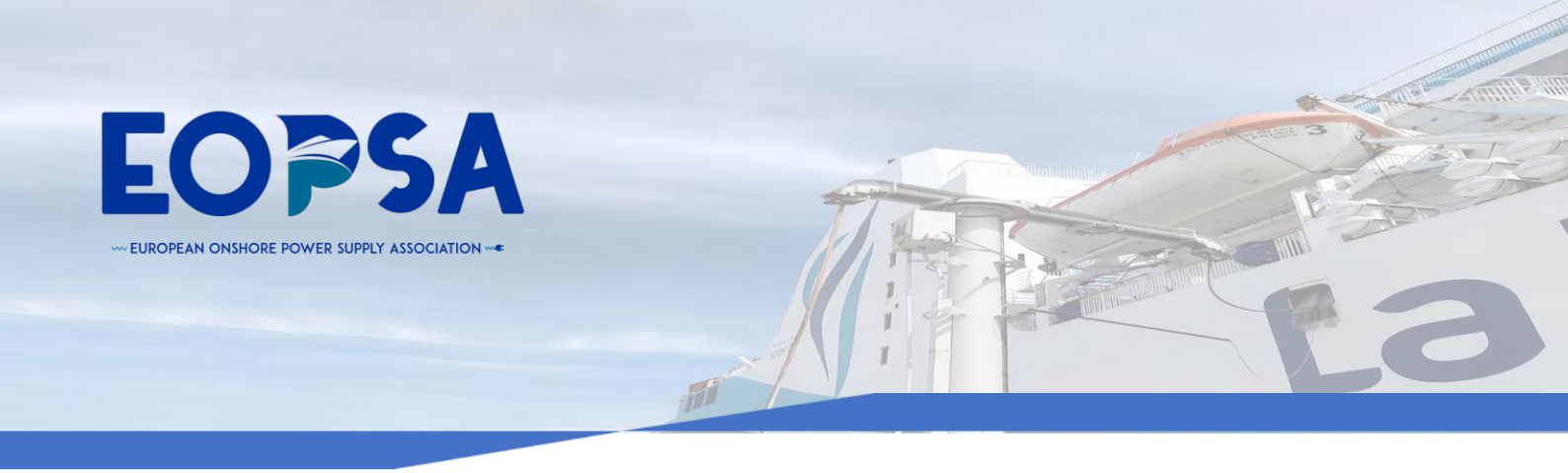

Introduction:

The European Onshore Power Supply Association (EOPSA) stresses the importance of port decarbonization in achieving global, European and national climate objectives.

Onshore power supply (OPS), also known as shore-side electricity, offers significant benefits to both ports and vessels. By connecting ships to renewable power sources while docked, it significantly reduces emissions of greenhouse gases, air pollutants, vibrations and noise from generators. This leads to improved air quality and a quieter environment in port areas, benefiting both workers, citizens and nearby communities. Additionally, OPS helps vessels reduce fuel costs and comply with stricter environmental regulations. Overall, it supports the transition to greener, more sustainable maritime operations. OPS was initially addressed in Directive 2014/94/EU and has since been reinforced in Regulation (EU) 2023/1804 (AFIR), which mandates OPS deployment at core TEN-T ports. However, implementation gaps remain for vessels such as fishing boats, port service craft, tugs, offshore support vessels and more.

European shipping emits 124 million tonnes of CO2 per annum. Onshore power supply can eliminate up to 100% of CO2 and particles emissions while connected, benefiting health and environment.

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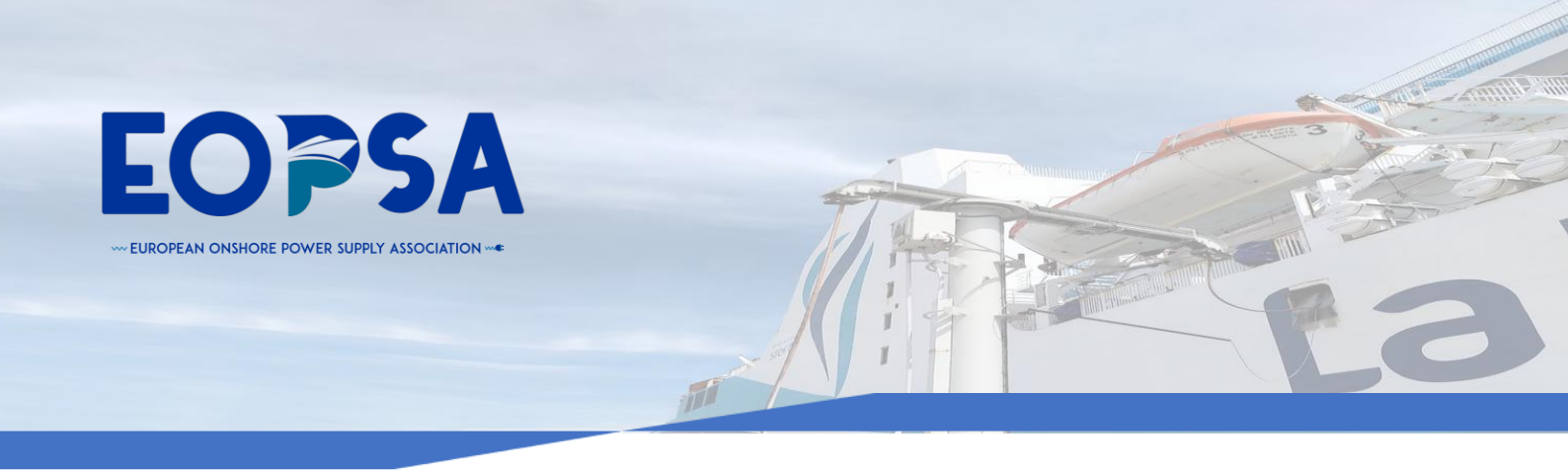
EUROPEAN ONSHORE POWER SUPPLY ASSOCIATION



The global energy landscape is undergoing a fundamental transformation, driven by the urgent need for decarbonization, enhanced energy security, and increased resilience.

At the forefront of this shift is the concept of energy communities—collaborative, industry, companies and/or citizen-driven networks focused on renewable energy generation and management. Central to this vision are Microgrids / Energy Hubs, decentralized energy systems that empower communities to produce, store, and consume renewable energy locally.

EOPSA takes pleasure in presenting the case highlighting the role of energy communities and Microgrids / Energy Hubs in achieving sustainable energy goals, addressing regulatory frameworks, technological innovations, societal benefits, and the critical need to mitigate grid risks.

Benefits of Onshore Power Supply (OPS):
OPS is key to sustainable port operations, providing environmental, competitive, and economic benefits. By reducing emissions and aligning with green energy policies, OPS helps ports stay competitive while creating economic advantages, including innovation-driven growth and fuel cost savings. OPS in certain ports will not be a positive financial proposition on its own and will therefore substantially benefit from the advent of modern Microgrids / Energy Hubs and energy communities.

Microgrids / Energy Hubs: A Pillar of Energy Communities
Microgrids / Energy Hubs are localized energy systems capable of operating autonomously or in conjunction with the main grid. They integrate renewable energy sources such as solar, geothermal, hydrokinetic, wind etc. with energy storage solutions, enabling real-time energy management. Microgrids / Energy Hubs provide a foundation for energy communities by offering the following benefits:

- **Resilience:** Microgrids / Energy Hubs enhance energy security by reducing dependency on centralized grids and mitigating risks from power outages.
- **Environmental sustainability:** By prioritizing renewable energy, Microgrids / Energy Hubs contribute to significant reductions in greenhouse gas emissions.
- **Competitiveness and Economic benefits:** Energy communities leveraging Microgrids / Energy Hubs benefit from reduced energy costs, potential revenue from surplus energy, and local job creation.

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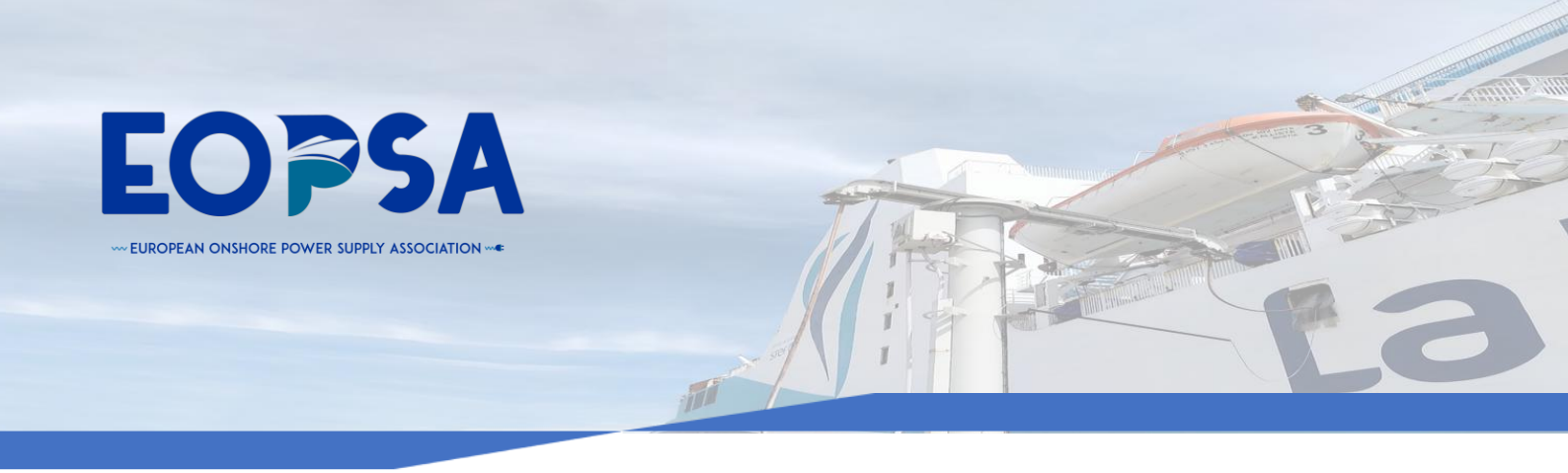

Microgrids as Anchors for Net Zero Acceleration Valleys

The emergence of **Net Zero Acceleration Valleys (NZAVs)** under the EU's Industrial Clean Deal marks a decisive move toward geographically concentrated hubs that drive systemic decarbonization. These valleys aim to co-locate renewable energy generation, clean-tech manufacturing, skilled labour, and energy infrastructure to accelerate the transition to climate neutrality.

Ports, with their unique combination of logistics, industrial density, and large-scale intermittent energy demand, are ideal anchor points in this transformation. They are not only gateways to global trade but also potential catalysts for clean industrial ecosystems.

To increase European industrial competitiveness and resilience, we must treat energy decentralization as a strategic opportunity - on par with any other port and terminal investment. From green steel and green fuels to vessels and cold chains, every new industrial player in the port ecosystem must be powered by smart, local energy systems.

In that, Ports and Terminals need to unlock space, while, aligned with the entire European renewable industry, we seek streamlined and speedier permitting procedures, and coherent funding.

Microgrids / Energy Hubs are the enabling backbone of this ambition. They allow for flexible, localized integration of renewables, storage, and demand response. When embedded into port planning and development frameworks, they ensure resilience and reduce dependence on overstretched centralized grids.

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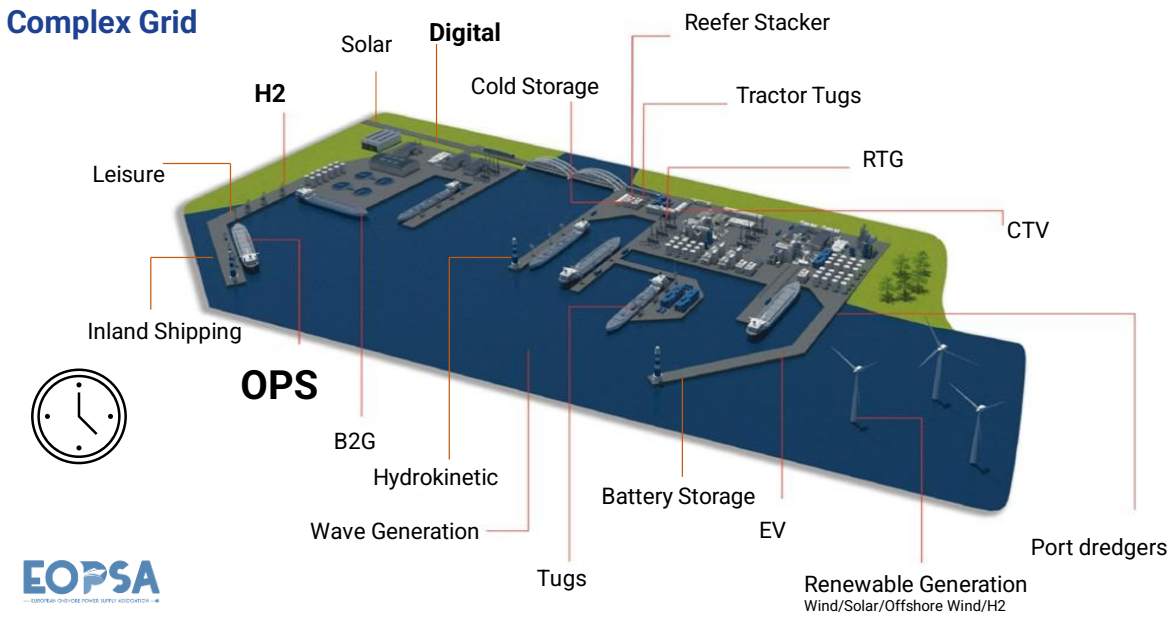
Addressing increased grid risks

The rapid electrification of industries, transportation, and digital technologies is placing unprecedented strain on existing grid infrastructures. In ports, this challenge is particularly acute, with electricity demand expected to triple or quadruple by 2030 at major hubs like Valencia, Rotterdam, and Marseille. Onshore Power Supply (OPS) for ships at berth, electrification of cranes, reefer racks, and other high-consumption equipment are major contributors to this surge. For example, OPS alone could account for 28% of total electricity demand in Valencia by 2030. These trends raise the risk of grid overload, congestion, and blackouts.



According to the Alternative Fuels Infrastructure Regulation (AFIR) and supported by EOPSA research, compliance with OPS legislation alone will require an additional average of 150 MW of power generation capacity per European port. This highlights the urgent need for strategic planning, enhanced energy infrastructure, and investment in local renewable generation to meet this growing demand sustainably.

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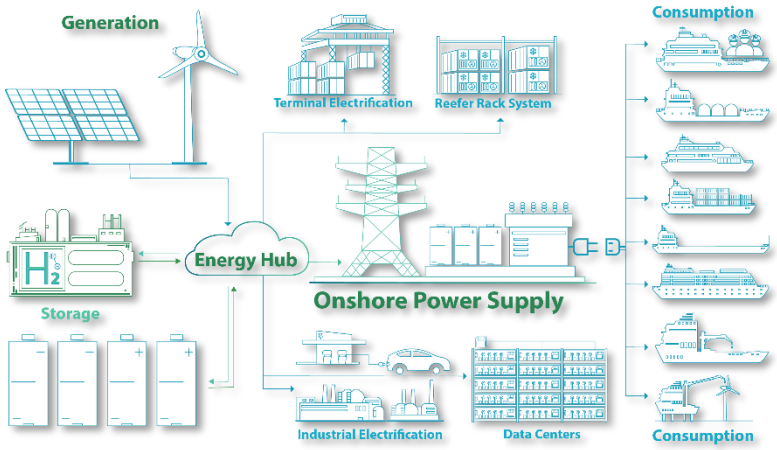
Microgrids / Energy Hubs are uniquely positioned to mitigate these risks by enabling localized energy generation and management. Serving demand at the local level through Microgrids / Energy Hubs reduces the strain on centralized systems and ensures more stable energy distribution. Key strategies include:

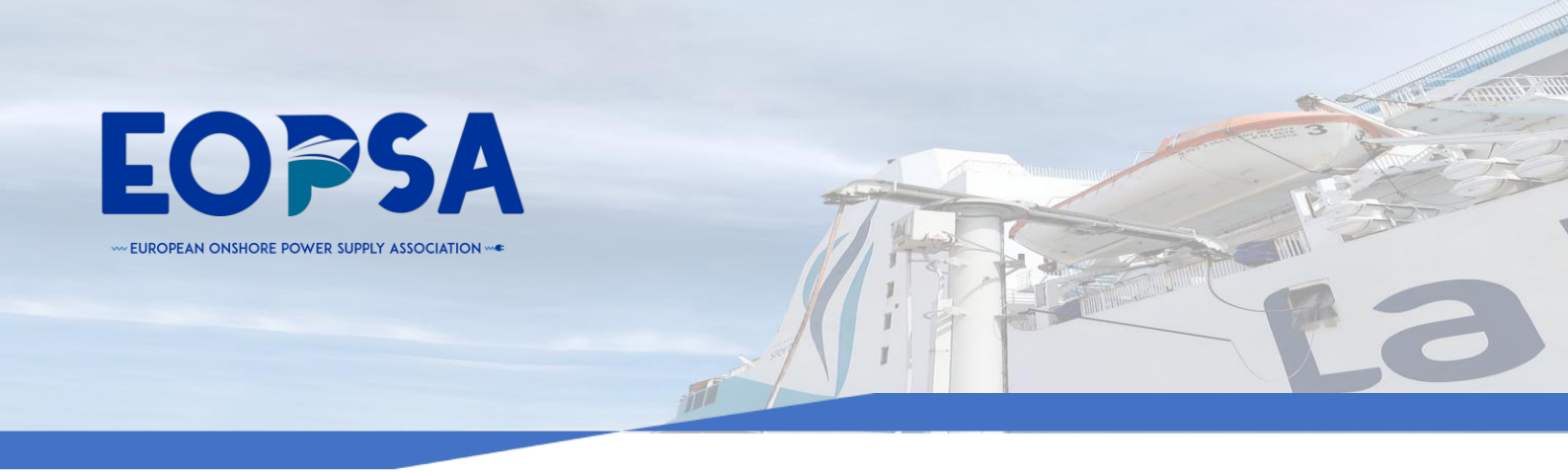
- **Demand response:** Real-time management of energy use to balance supply and demand fluctuations.
- **Energy storage integration:** Utilizing battery systems to store excess renewable energy for peak demand periods, as piloted in the Port of Portsmouth.
- **Distributed generation:** Decentralized production minimizes dependency on long-distance energy transmission, alleviating grid congestion..



Regulatory Frameworks: Empowering Energy Communities

The European Union (EU) has recognized the potential of energy communities and Microgrids / Energy Hubs through its Clean Energy for All Europeans Package. Provisions for renewable energy communities (RECs) and citizens energy communities (CECs) establish a robust legal framework, enabling:

- **Ownership and governance:** Citizens, local authorities, and small businesses can collectively own and manage renewable energy projects.
- **Market access:** Energy communities gain rights to access energy markets, allowing them to sell surplus energy and participate in demand-response mechanisms.
- **Consumer protection:** Transparent pricing and consumer-friendly contracts promote equitable participation.



Moreover, the EU's electricity market reform, adopted in 2024, aims to create a more stable, predictable, and sustainable energy market. This reform encourages energy sharing schemes and supports renewable and citizen energy communities, recognizing their role in achieving a carbon-free future.

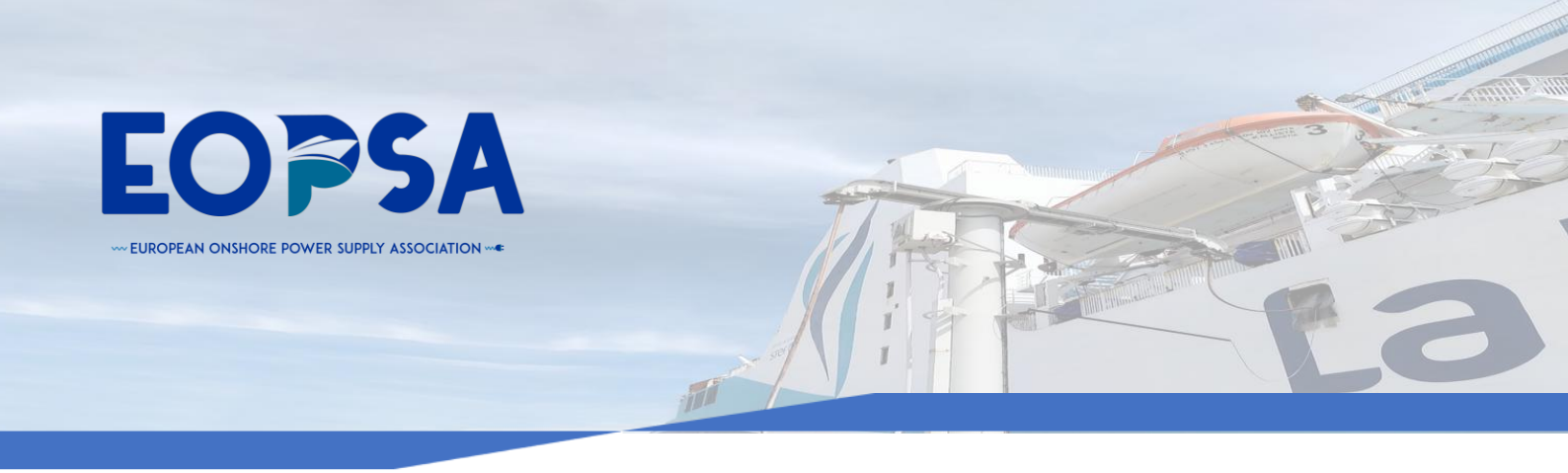
A series of directives are already creating the basis for the deployment of the Port Microgrid / Energy Hub:

Directive (EU) 2019/944: establishes common rules for the internal electricity market in the EU, aiming to empower consumers, enhance competition, and support the integration of renewable and decentralised energy. It formally recognises the role of active customers and citizen energy communities, enabling them to generate, store, and share electricity while participating fairly in energy markets. The directive promotes microgrids, local energy hubs, and smart metering, aligning with EOPSA's vision for decentralised, resilient, and community-driven energy systems.

RED III (Directive (EU) 2023/2413): RED III is the revised Renewable Energy Directive, adopted in 2023 to accelerate the EU's clean energy transition. It raises the EU's binding renewable energy target to 42.5% of gross final energy consumption by 2030, with an aspirational goal of reaching 45%. The directive strengthens provisions for permitting, grid integration, and cross-border cooperation. It also promotes the role of renewable energy communities, self-consumption, and sectoral targets for transport, industry, and buildings. RED III is a key pillar of the EU Green Deal and the REPowerEU strategy.

Regulation (EU) 2019/943: Focuses on the internal market for electricity, facilitating the integration of renewable energy and enhancing market flexibility.

Amending Directive (EU) 2024/1711 and Regulation (EU) 2024/1747: Part of the recent electricity market reform, these amendments aim to make energy prices more stable and less dependent on fossil fuels.



Technology and innovation: Enabling decentralization

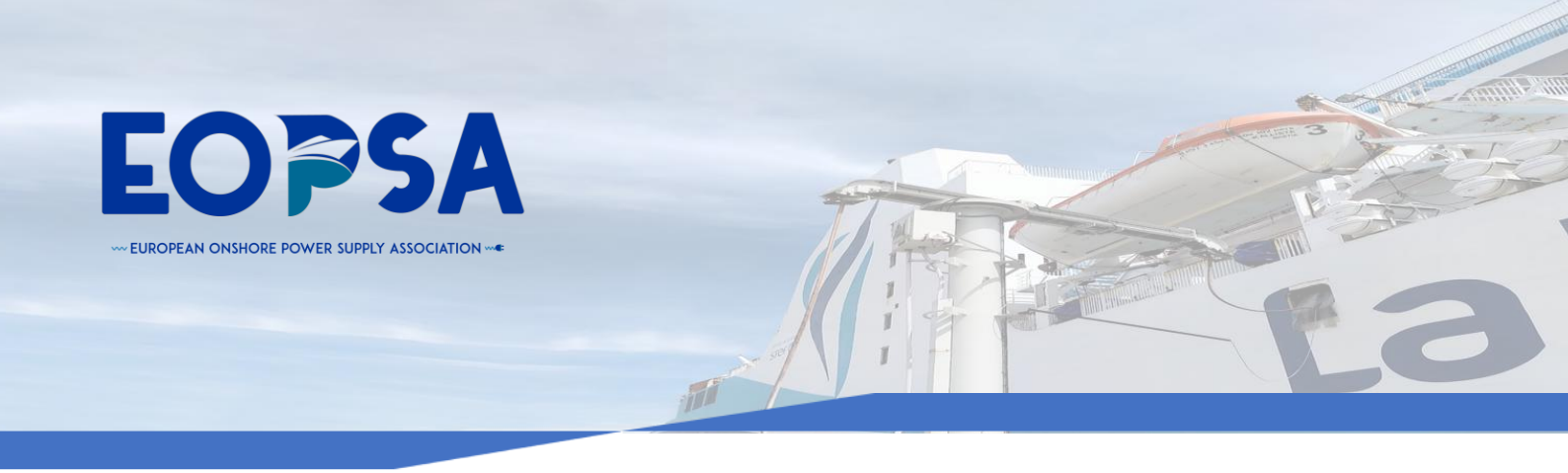
Advancements in technology are critical to the success of Microgrids / Energy Hubs and energy communities. Key innovations include:

- **Smart grid integration:** Enhanced digital infrastructure enables seamless communication between Microgrids / Energy Hubs and the main grid, optimizing energy flow.
- **Energy storage solutions:** Battery systems and other storage technologies ensure reliability and balance supply-demand fluctuations.
- **Blockchain for energy trading:** Decentralized ledgers facilitate secure and transparent peer-to-peer energy transactions within communities.

Societal benefits: Beyond energy

Energy communities and Microgrids / Energy Hubs transcend energy generation, fostering social cohesion and economic empowerment. By placing citizens at the centre of the energy transition, they:

- Promote energy democracy by involving stakeholders in decision-making processes.
- Encourage local investment and economic development through community-led initiatives.
- Strengthen social bonds by uniting members around shared sustainability goals.



Challenges and recommendations

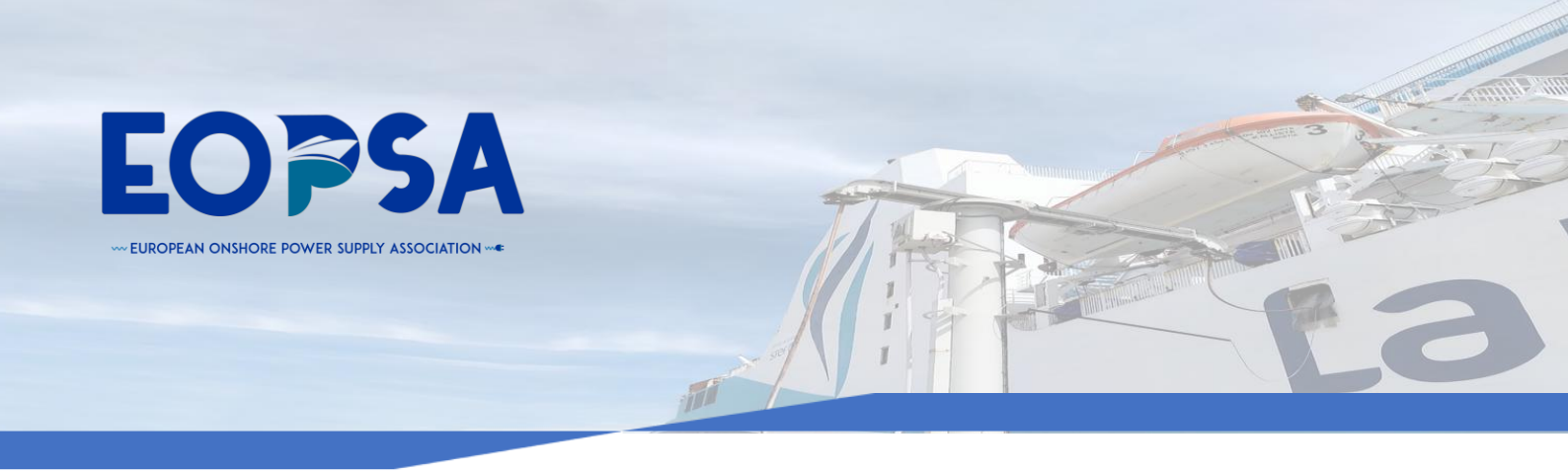
Despite their transformative potential, energy communities and Microgrids / Energy Hubs face challenges such as regulatory complexity, financial barriers, and technological integration. These challenges are particularly evident in port ecosystems, where electricity supply is characterized by unpredictable and multi-facetted demand. Ports must serve diverse energy needs, including onshore power for ships, cranes, RTGs, reefer racks, data centres, and other high-consumption equipment. For example, electricity demand in Rotterdam is expected to grow nearly fourfold by 2030. Addressing these issues requires:

- **Policy harmonization:** Starting with the Net Zero Acceleration Valley concept. streamlining regulations across member states to create a cohesive framework for energy communities, with, as far as EOPSA is concerned, a focus on port ecosystems.
- **Financial support:** Providing adequate and equivalent financial incentives and low-interest loans to lower entry barriers for community projects in ports.
- **Capacity building:** Investing in education and training programs to empower citizens, port authorities, and local stakeholders.
- **Research and development:** Supporting innovation in Microgrids / Energy Hubs technologies tailored to the unique demands of port environments, ensuring resilience and efficiency.

Conclusion

Energy communities, underpinned by Microgrids / Energy Hubs technology, represent a transformative approach to achieving sustainable and resilient energy systems. In the context of port ecosystems, their relevance becomes even more critical due to the high variability and complexity of electricity demand. Microgrids / Energy Hubs offer tailored solutions for localized generation and management, reducing grid strain and enabling ports to meet their operational and sustainability goals.

Policymakers, industry leaders, and community stakeholders must collaborate to overcome barriers and unlock the full potential of decentralized energy generation. By fostering energy communities, especially in strategic sectors like ports, we can build a future where clean, affordable, and reliable energy is accessible to all.



Call to action

We call on EU policymakers, national governments, and port stakeholders to act decisively. The time for feasibility and fragmented pilots is over. We propose a bold, coordinated approach across regulation, financing, planning, and market participation to enable Microgrids / Energy Hubs in ports.

To achieve this, we urge the European Commission and Member States to:

- Mandate microgrid and OPS planning in national strategies;
- Increase competitiveness and resilience by leveraging energy decentralisation as **Port & Terminal industrial opportunity**
- Launch a dedicated funding instrument for port microgrids;
- Update OPS legislation to cover all ship types;
- Require Grid Stress Audits in all major ports;
- Guarantee market rights for port-based microgrids;
- Embed energy communities in future port concessions;
- Deploy digital twins for smart energy management;
- Enforce renewable energy quotas in port operations;
- Prioritize flexible systems in EU funding calls;
- Create a European Port Electrification Observatory;

EOPSA stands ready to support these initiatives and contribute technical expertise, stakeholder engagement, and strategic guidance. The opportunity is clear. The time is now.

By addressing the unique opportunities of ports and enabling localized energy solutions, we can pave the way for a sustainable and resilient energy future

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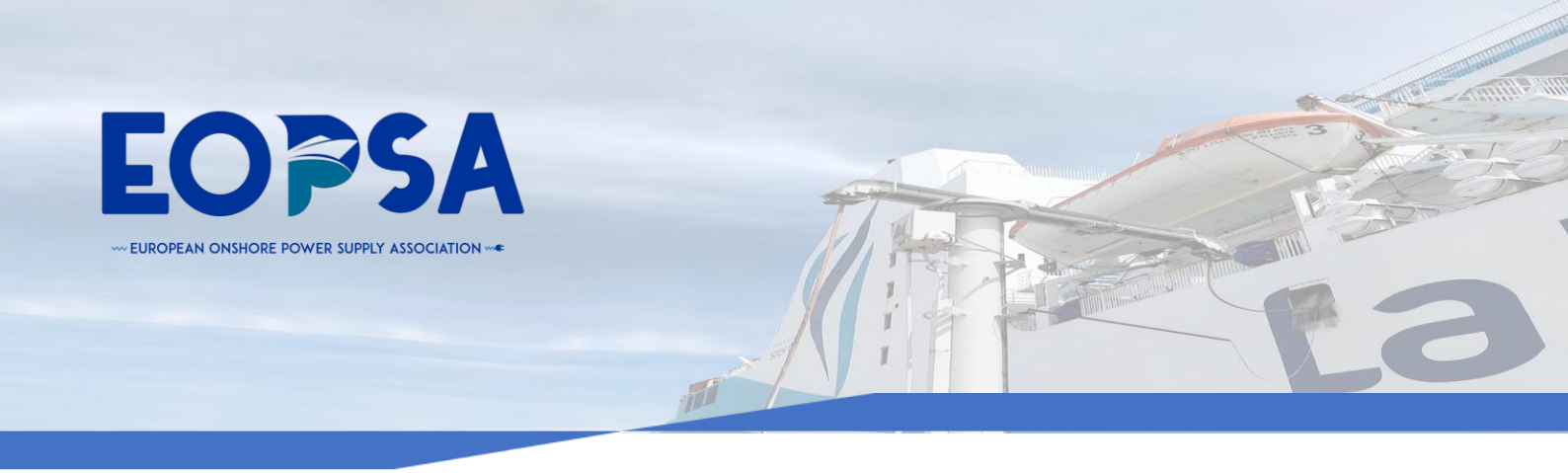
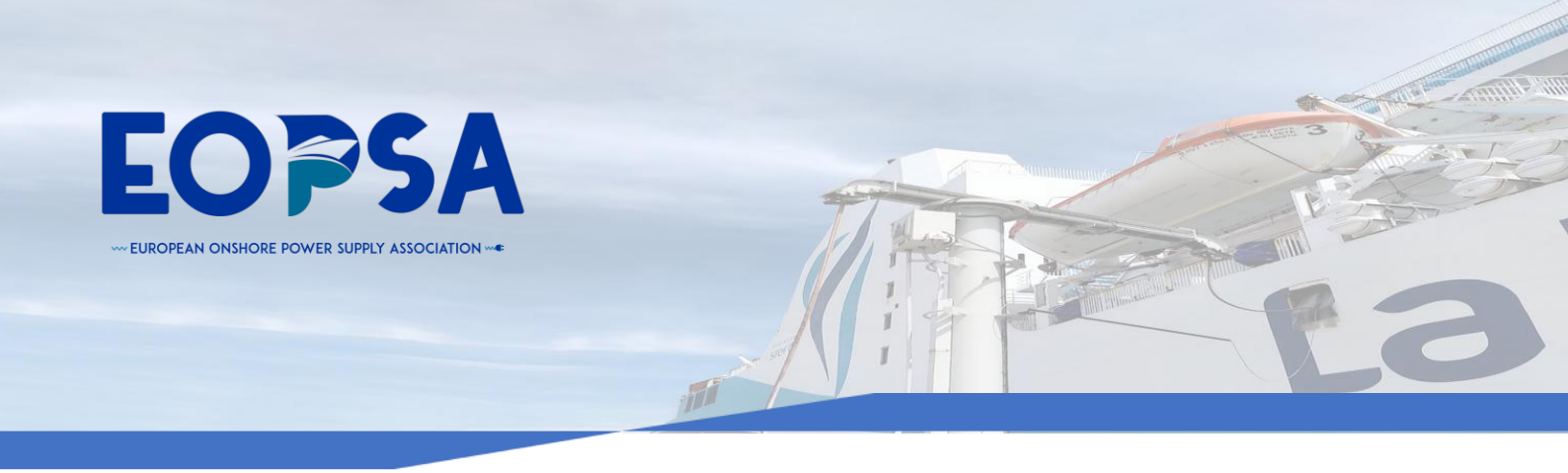


Stakeholders:

Climate Action (CLIMA)
Environnement (ENV)
Energy (ENER)
Infrastructure & Logistics (OIB)
Maritime Affairs & Fisheries (MARE)
Mobility & Transport (MOVE)
Internal Market, Industry and SMEs (GROW)



EOPSA, the European Onshore Power Supply Association was established in 2021 to bring together experts in port electrification and shore connections.
EOPSA brings together experts from energy generation, shipping companies, port authorities, technology companies, software companies and process experts.

EOPSA's mission is to promote the widespread adoption of onshore power supply as a sustainable solution to reduce noise, vibration and air pollution resulting from the use of fossil fuel engines in port and port city environments.

More information about our mission can be found here:
www.eopsa.eu

Sources
https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable-mobility-europe/alternative-fuels-infrastructure_en
https://op.europa.eu/en/publication-detail/-/publication/60f97fad-70b5-11ef-a8ba-01aa75ed71a1/language-en
EOPSA, IEA, IRENA
https://energy.ec.europa.eu/index_en

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