IPCSA Sustainability Guidelines and Recommendations for Port Community Systems (PCSs)

Prepared by the IPCSA Sustainability Working Group
Lead authors: Stephanie van den Berg, Inga Morton, with contributions from IPCSA members
International Port Community Systems Association (IPCSA)
October 2025

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

Table of contents

IPCSA Sustainability Group Acknowledgements

Alan Gates (CNS, United Kingdom)
Alexis Ghyselen (SOGET, France)
Aude Paquerot (SOGET, France)
Clément Dessole (SOGET, France)
Dmytro Iakymenkov (Ukraine)
Donna M. Mullins (Kale Logistics, USA)
Evelyn Eggers (DAKOSY, Germany)
Frédéric Gilletta (Haropa Port, France)
Houmed Mohomed Ali (Djibouti)
Inga Morton (IPCSA)
Javier Garrido (Port de Barcelona, Spain)
Jerome Besancenot (Haropa Port, France)
Lucie Charmeteau (Haropa Port, France)
Mark Condon (Kale Logistics, USA)
Marlene. Herbold (DBH, Germany)
Martijn Maatman (Portbase, Netherlands)
Mathilde Marlaud (CNS, UK/ DP WORLD)
Mohamed Bendib (ANP, Morocco)
Nico De Cauwer (IPCSA)
Rim Abdallah (Haropa Port, France)
Ronen Mualem (Israel Ports, Israel)
Sandrine Petit Soarés (Haropa Port, France)
Stephanie van den Berg (Portbase, Netherlands)
Youssef Bokhabrine (Portnet, Morocco)

Executive Summary

Port Community Systems (PCSs) are increasingly recognized as critical enablers of sustainable, efficient, and transparent maritime logistics. As digital integration hubs connecting all port stakeholders, PCSs have the unique capacity to drive decarbonization, regulatory compliance, and collaborative innovation across global supply chains.

This report provides practical guidance for PCS operators to embed sustainability into their strategies, operations, and data-sharing services. Drawing on insights from the IPCSA Sustainability Survey 2025, international standards such as ISO 14083 and the GLEC Framework, and examples from leading PCS implementations, these guidelines outline how digital platforms can accelerate the maritime sector's green transition.

Global trends such as decarbonization, electrification, just-in-time operations, and digital corridors are reshaping logistics. In parallel, evolving legislation—CSRD, CBAM, FuelEU Maritime, and the IMO's decarbonization strategy—demands accurate and verifiable emissions data. PCSs are well positioned to serve as trusted intermediaries, enabling standardized data collection and transparent reporting aligned with international frameworks.

Internally, PCS operators can reduce their own environmental footprint through renewable energy, efficient data management, and sustainable governance. Externally, they can empower the port community with digital tools for emission measurement, optimization, and compliance. Best practices from IPCSA members such as Portbase (Netherlands), DAKOSY (Germany) SOGET (France), and HAROPA PORT (France) demonstrate how PCS-enabled solutions—ranging from modal shift optimization to real-time emission visibility—translate policy into measurable outcomes.

PCSA Sustainability Survey results from 2025 reveal strong engagement across the IPCSA network: 50% of respondents have formal sustainability policies, 55% have reduced their carbon footprint, and all support collaboration and knowledge sharing. Key challenges remain in data quality, regulatory complexity, and scaling digital innovation.

To advance collective impact, the report recommends that PCS operators adopt formal sustainability strategies, align with ESG and ISO 14083 frameworks, expand data-driven services, and strengthen partnerships for emission assurance. Through collaboration and standardization, PCSs can play a leading role in the global decarbonization of maritime logistics.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

Introduction

Ports are gateways to global trade — and Port Community Systems (PCSs) are the digital engines that keep them running smoothly. As trusted, neutral platforms connecting all stakeholders in the maritime logistics chain, PCSs already play a vital role in making ports more efficient and transparent. Today, they are also becoming powerful enablers of sustainability, helping port communities reduce emissions by measuring and sharing relevant data, optimize energy use, and accelerate the shift toward greener logistics.

Sustainability is the ability to meet present needs without compromising the ability of future generations to meet their own needs. It encompasses a balanced approach to economic growth, environmental stewardship, and social equity, ensuring that resources are used efficiently and responsibly.

These IPCSA Sustainability Guidelines provide a practical and strategic framework for PCS operators to embed sustainability into their operations and services. Developed by the IPCSA Sustainability Working Group, the guidelines draw on international standards, best practices, and member insights to show how digital collaboration can turn environmental ambition into measurable action.

“The IPCSA Sustainability Working Group’s main purpose is to share the knowledge and insights from successful sustainability strategies and processes, really focusing on Port Community Systems and together working towards more emission-free, resilient port logistics.”

— Stephanie van den Berg (Portbase), IPCSA Sustainability Lead

As the maritime sector moves toward decarbonization, PCS operators stand at the intersection of technology, policy, and community. By integrating Environmental, Social, and Governance (ESG) principles into their strategies and leveraging data-driven tools, they can empower ports and their partners to measure, report, and reduce emissions in line with global frameworks such as the Paris Agreement, the IMO’s decarbonization strategy, the EU Green Deal, and the UN Sustainable Development Goals.

Through collaboration, transparency, and innovation, PCSs have the potential to transform sustainability from a shared goal into a shared reality — enabling cleaner, smarter, and more resilient port logistics worldwide.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

1. Trends and Market Developments

The maritime sector is experiencing an unprecedented transformation driven by decarbonization, digitalization, and sustainability imperatives. As a cornerstone of global trade, shipping accounts for roughly 3% of global greenhouse gas emissions and faces increasing regulatory and market pressure to reduce its environmental impact.

Port Community Systems (PCSs), as trusted digital integration platforms, stand at the heart of this transition. By enabling data transparency, optimizing port calls, and facilitating collaboration across transport modes, PCSs are uniquely positioned to accelerate the sustainability agenda.

This chapter outlines the key global trends shaping sustainable maritime logistics and highlights how PCSs can act as catalysts for decarbonization, efficiency, and community resilience.

1.1. Decarbonization and Alternative Fuels

Reducing greenhouse gas emissions is the foundation of maritime sustainability. **The IMO's 2023 GHG Strategy** commits the sector to reach net-zero emissions "by or around 2050," with interim checkpoints for 2030 and 2040. Meeting these goals requires a rapid transition to low- and zero-carbon fuels and new propulsion technologies.

Key developments:

- **Green Methanol:** Emerging as a leading transitional fuel, produced from renewable energy and captured CO_2. Major carriers like Maersk have already launched methanol-powered vessels.

- **Ammonia:** Offers zero-carbon combustion but presents handling and safety challenges requiring further technological development.

- **Hydrogen:** Provides near-zero emissions but faces storage, cost, and energy density constraints.

- **Biofuels:** Offer drop-in compatibility with existing engines but must be sustainably sourced to avoid land-use and lifecycle-emission concerns.

- **Liquefied Natural Gas (LNG):** A widely adopted bridge fuel that cuts CO_2 but raises concerns over methane slip.

Relevance to PCSs:

PCSs can support decarbonization by enabling accurate fuel and voyage data exchange, facilitating compliance reporting, and integrating emission-tracking tools that align with ISO 14083 and the GLEC Framework.

1.2. Energy Efficiency, Digitalization, and Smart Operations

Energy efficiency remains one of the most cost-effective pathways to emission reduction. Digital technologies are transforming both vessels and port ecosystems into intelligent, data-driven operations.

Emerging trends:

- **Just-in-Time (JIT) Arrivals:** Synchronizing vessel arrival times with berth availability to minimize waiting, congestion, and fuel burn.
- **Port Call Optimization:** Integrating PCS data with vessel traffic systems and terminal schedules to coordinate port calls and reduce idle time.
- **AI-Driven Route Optimization:** Using weather, ocean, and traffic data to determine optimal routes for minimal fuel consumption.
- **Wind-Assisted Propulsion and Hull Air Lubrication:** Physical innovations that further enhance vessel efficiency.
- **Smart Ships and IoT:** Continuous performance monitoring enables predictive maintenance and real-time optimization.
- **Green Corridors:** Collaborative, data-enabled shipping routes designed to demonstrate scalable zero-emission transport between key ports.

Relevance to PCSs:

PCSs provide the digital backbone for JIT arrivals, green corridors, and port call optimization by sharing standardized, real-time data across carriers, terminals, and authorities.

1.3. Electrification and Shore Power

Electrification is advancing rapidly, especially in short-sea shipping, inland waterways, and port operations. Battery-powered ferries and hybrid propulsion systems are becoming mainstream in several European countries.

Examples:

- **Battery-Electric Vessels:** Viable for short routes and supported by national incentive programs.
- **Hybrid Systems:** Combine diesel and electric power to balance efficiency and operational flexibility.
- **Cold Ironing (Shore Power):** Allows ships to connect to the port's electrical grid while at berth, eliminating auxiliary engine emissions and improving local air quality.

Relevance to PCSs:

PCSs can facilitate energy usage reporting, connect port energy systems with vessel call data, and support ports in monitoring emission reductions achieved through shore power integration.

1.4. Circular Economy and Resource Efficiency

A sustainable maritime ecosystem depends on minimizing waste, extending asset lifecycles, and reusing materials.

Key initiatives:

- **Green Ship Recycling:** Complying with the Hong Kong Convention for safe, environmentally sound dismantling.
- **Zero-Waste Vessel Concepts:** Onboard systems for waste segregation, water treatment, and energy recovery.
- **Material Circularity:** Using recyclable or lighter materials in shipbuilding and port infrastructure to reduce lifecycle emissions.
- **Ballast Water Treatment:** Preventing invasive species spread and protecting marine ecosystems.

Relevance to PCSs:

PCSs can support data exchange on waste management, recycling, and compliance documentation, enabling transparency and reporting for circular operations within port communities.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

1.5. Sustainable and Resilient Ports

Ports are becoming clean energy hubs and digital logistics platforms that drive the decarbonization of global supply chains.

Trends include:

- **Green Port Infrastructure:** Deployment of renewable energy systems, electrified cranes, and zero-emission vehicles.
- **Automation and Digital Twins:** Simulating operations to optimize efficiency and resilience.
- **Climate Adaptation:** Designing port assets to withstand sea-level rise and extreme weather events.
- **Energy Hubs:** Ports are emerging as bunkering and production centers for green hydrogen, methanol, and ammonia.

Relevance to PCSs:

PCSs can integrate environmental and operational data to measure port-level sustainability performance and facilitate community-wide collaboration on emissions reduction and energy transition projects.

1.6. ESG, Finance, and Due Diligence

Sustainability is increasingly linked to financial performance. Investors and regulators are demanding verified ESG data and transparent reporting.

Key drivers:

- **Corporate Sustainability Reporting Directive (CSRD) & EU Taxonomy** require detailed environmental disclosures.
- **Green Finance Instruments:** Loans and bonds tied to measurable emission reduction targets.
- **Supply Chain Due Diligence:** Increasingly mandates environmental and human-rights accountability.

Relevance to PCSs:

PCSs can act as trusted data intermediaries, aggregating verified ESG data for ports, operators, and logistics partners—enabling compliance and building trust with financiers and regulators.

1.7. Biodiversity, Social Responsibility, and Governance

Beyond emissions, sustainability extends to protecting marine ecosystems and supporting inclusive, resilient port communities.

Emerging areas:

- **Marine Biodiversity and Blue Economy:** Initiatives to protect coastal habitats and integrate nature-based solutions into port planning.
- **Social Sustainability:** Workforce upskilling, fair labor practices, and community engagement in port operations.
- **Cyber-Resilience and Data Ethics:** Ensuring secure, transparent, and responsible use of digital data in the maritime sector.

Relevance to PCSs:

PCSs can embed governance standards, cybersecurity frameworks, and ethical data-sharing principles into their operations, reinforcing trust and accountability across the maritime ecosystem.

Conclusion

The transformation of maritime transport is reshaping global logistics through cleaner fuels, smarter operations, and more transparent data flows. For Port Community Systems, this transition represents both a challenge and a profound opportunity.

By enabling standardized data exchange, supporting emissions reporting, and fostering collaboration across the supply chain, PCSs can become critical accelerators of maritime sustainability — turning global policy goals into measurable progress at every port call.

2. Compliance and Legislation

Maritime sustainability is now shaped as much by regulation as by technology. International and European rules are expanding rapidly, requiring verifiable emissions data, transparent supply chains, and responsible governance.

Port Community Systems (PCSs) are becoming indispensable to compliance — offering secure data flows, standardised interfaces, and automated reporting that help communities meet these obligations efficiently.

IPCSA Sustainability survey (2025) shows that a significant majority of PCS operators (76.47%) recognise the relevance of this legislation, with many already feeling its impact. The EU's Corporate Sustainability Reporting Directive (CSRD) is the most frequently cited act, signalling a shift towards treating ESG information with the same rigor as financial data. While there is broad consensus (64.71%) that PCS should play a role in supporting community implementation, a clear divide exists on enforcement, with nearly half (47.06%) rejecting a direct enforcement role.

The primary strategic opportunity for PCS lies in leveraging their position as trusted data-sharing hubs to simplify compliance for their communities, thereby enhancing their value proposition. However, significant challenges persist, including a lack of clarity on the precise role of the PCS, the overwhelming complexity of regulations, critical gaps in data availability and knowledge, and client reluctance to invest in new sustainability tools. The path forward requires PCS operators to navigate these obstacles to become the indispensable digital infrastructure for the new era of sustainable logistics.

2.1. Legislative Acts Relevant to Port Community Systems (PCS)

The following tables provide an overview of the relevant legislative acts based on their jurisdiction (International, Regional, or National/Local), detailing their focus and relevance to PCS operations.

Table 1: International and Global Legislative Acts

Regulation / Framework	Objective/Scope	Key Details / Status	Data demands and PCS impact
IMO GHG Strategy	**Objective:** Achieve net-zero GHG emissions "by or around 2050," with –20% (2030) and –70% (2040) checkpoints versus 2008. **Scope:** International shipping.	Adopted 2023; future economic measures (e.g., carbon levy or global fuel standard) under discussion.	**Data Demands:** Fuel and activity data through IMO DCS; future price-based reporting expected. **Impact on PCS:** Facilitate data exchange for IMO DCS/CII and prepare for price-linked emission data in the next strategy cycle. PCS supports Just-In-Time (JIT) arrivals, fuel readiness, and emissions data management. Referenced alongside decarbonization regulations.
IMO EEXI / CII / SEEMP Part III	Increase energy efficiency and reduce the carbon intensity of ships. **Scope:** Ships ≥ 400 GT (EEXI); ≥ 5 000 GT (CII).	EEXI in force 2023; CII ratings from 2024; SEEMP Part III reviews by 2025/26.	**Data Demands:** Fuel use, distance sailed, port-time data, corrective action plans. **Impact on PCS:** Supply verified voyage and berth data to owners and verifiers to calculate CII and support SEEMP audits.
MARPOL Convention (Annex VI)	**Objective:** Prevent pollution from ships by limiting SOx/NOx and establishing Emission Control Areas (ECAs). Sets strict limits on SOx and NOx emissions from ship exhausts. **Scope:** Global; stricter requirements in ECAs.	Ongoing since 2005; regularly tightened.	**Data Demands:** Fuel sulphur content, engine certificates, ECA compliance records. **Impact on PCS:** Exchange fuel type and certificate data; digitise ECA declarations and inspection evidence. Impacts port compliance monitoring and enforcement.
SOLAS Convention (IGC/IGF Codes)	**Objective:** Ensure safe use of LNG and other low-flashpoint fuels. Safety codes mandatory for LNG bunker vessels and ships using low-flashpoint fuels. Scope: LNG bunker vessels and ships using alternative fuels.	Ongoing and mandatory.	**Data Demands:** Bunkering notifications, safety checklists, certifications. **Impact on PCS:** Digitise fuel notifications and exchange safety documents with authorities and terminals. Relevant to ports developing infrastructure for alternative fuels.
IMO Mid-Term Measures (MEPC 83 Draft)	Draft fuel GHG-intensity standard and global pricing mechanism. **Scope:** mandatory for large ocean-going ships over 5,000 gross tonnage, which emit 85% of the total CO2 emissions from international shipping.	Set to be formally adopted in October 2025 before entry into force in 2027.	**Data Demands:** New fuel standard for ships and a global pricing mechanism for emissions. **Impact on PCS:** PCS data is critical for Monitoring, Reporting, and Verification (MRV).

IMO FAL Convention & Maritime Single Window (MSW)	Aim to streamline and simplify procedures related to maritime transport. **Scope:** Global	Mandatory electronic reporting (since 2019) and compulsory MSW (from 2024).	**Data demands:** standardised and harmonised approach to the arrival, stay, and departure of ships, **Impact on PCS:** PCSs extend MSW data across the port community and act as facilitators of compliance.
IMO Guidelines on Port Community Systems	**Objective:** To provide common understanding of PCS, the role of PCS within harmonization, standardization and interoperability, PCS and Single Window (SW) environment interaction, as well as provide baseline considerations for PCS development. **Scope:** Global	Issued in April 2024. Recommendation status/guidance on PCS scope, governance, and interoperability.	**Impact on PCS:** Provides a practical blueprint for PCS design and integration.
WTO Trade Facilitation Agreement (TFA) (Art. 10.4)	**Objective:** (TFA) aims to expedite the movement, release, and clearance of goods across borders. Article 10.4 of the TFA specifically addresses the issue of single window systems. **Scope:** WTO Members Requires national governments attempt to establish or maintain a SW system, which allows traders to submit through a single-entry point.	The agreement entered into force on February 22, 2017. The timeline for implementing the provisions of Article 10.4 varies among WTO members, as each country has the flexibility to determine its own schedule based on its capacity and needs.	**Data demands:** data connected to importation, exportation or transit of goods based on: - Standardisation, - Interoperability - Data Accuracy and Timeliness - Security and Confidentiality **Impact on PCS:** PCS often provides the operational backbone for TFA compliance.

WCO SAFE Framework & Data Model	SAFE Framework main objective is to facilitate the exchange of information between customs and other government agencies, businesses, and international organizations. While WCO Data Model is designed to standardise and harmonise the data requirements for customs procedures.	SAFE framework: Ongoing. SAFE framework emphasises advance electronic submission of data to customs authorities to enable risk assessment and targeted inspections, thereby ensuring that high-risk consignments are identified before they reach borders. WCO Data Model: Ongoing. By Data Model, customs administrations can ensure interoperability between different IT systems, reducing duplication and errors in data submission.	**Data demands/ Safe Framework:** information about the parties involved in the shipment, the goods being transported, and the means of transport. **Data Model:** Outlines the data sets required for various customs procedures and facilitates the electronic exchange of information. **Impact on PCS:** PCSs act as the trusted data-sharing hub.
ISO 14083 / GLEC Framework	Quantification and reporting of GHG emissions arising from transport chain operations.	Sets guidelines for measuring and managing greenhouse gas emissions from transportation. It provides a standardized approach to calculate and report emissions, helping organizations to identify areas for improvement and implement effective reduction strategies	**Data demands:** identifying and quantifying emissions from various transportation activities, such as road, rail, air, and maritime transport. Data on fuel consumption, vehicle types, distances travelled, load factors, and emission factors **Impact on PCS:** Provides the harmonized calculation methodology needed for mandatory reporting (e.g., CSRD Scope 3, FuelEU Maritime).
UNSDG (UN Sustainable Development Goals)	The goal is to address global challenges and achieve a better and more sustainable future for all. The SDGs consist of 17 goals. **Scope relevant to PCS:** SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action).	Established in 2015 as part of the 2030 Agenda for Sustainable Development, with the aim of achieving them by the year 2030.	**Impact on PCS:** Promoting sustainable economic growth (Goal 8) aligns PCS by enhancing efficiency and reducing logistical issues, driving economic development and job creation. PCS support infrastructure resilience and innovation by integrating smart technologies (Goal 9). PCS can support enhancing environmental responsibility by helping to calculate the ecological footprint of port operations (Goals 12 and 13).

Table 2: Regional (European Union) Legislative Acts

Regulation / Framework	Objective / Scope	Key Details / Status	Data Demands and PCS Impact
EU MRV (Shipping Regulation 2015/757, revised)	**Objective:** Monitor, Report and Verify (MRV) emissions for EU voyages. Scope: CO_2, CH_4, N_2O from EU-related voyages and at berth.	Forms the basis for EU ETS. Revised MRV is in force from 1 Jan 2024 (adding CH_4 and N_2O). Scope extends from 1 Jan 2025 to ships 400 GT (general cargo / offshore).	**Data Demands:** Updated Monitoring Plans verified annual emission reports. **PCS Impact:** Provide MRV-grade voyage and fuel data to verifiers; ensure consistency with ETS allowance reports.
EU ETS (Maritime Extension)	**Objective:** Cap-and-trade system extended to cover maritime transport to price shipping emissions. Scope: 100% of intra-EU voyages + 50% extra-EU; ships 5 000 GT (passenger/cargo).	Applies from 1 Jan 2024. Surrender phase-in: 40% (2025), 70% (2026), 100% (2027 onwards). CH_4 & N_2O count from 2026.	**Data Demands:** Verified emission reports aligned with MRV data. **PCS Impact:** Aggregate and validate MRV data for allowance planning and submission to administering authorities. Increases the need for pollution information; PCS might hold important data for Scope 3 calculation.
FuelEU Maritime (FEM) (Reg. 2023/1805)	**Objective:** Reduce GHG intensity of energy used on ships; mandate OPS (Onshore Power Supply) use in EU ports. Scope: Ships 5 000 GT calling EU ports.	Applies 2025 onwards. OPS is mandatory from 2030 (TEN-T ports) and 2035 (all EU ports with OPS).	**Data Demands**: Monitoring plans verified annual GHG intensity data, OPS usage records. **PCS Impact:** Embed OPS requests and proof of connection in port-call procedures; link fuel data to the FuelEU database. Increases demand for robust data collection and reporting mechanisms on fuel usage.
AFIR (Alternative Fuels Infrastructure Reg. 2023/1804)	**Purpose:** Guarantee infrastructure for alternative fuels and shore power. Sets mandatory national targets for infrastructure. Scope: TEN-T core & comprehensive ports.	Effective 2023. OPS availability targets by 2030 (core TEN-T ports). Mandates shore power installation in ports by 2030.	**Data Demands:** OPS availability, booking and connection proof. **PCS Impact:** Manage OPS requests and capacity data within berth planning modules. Directly impacts Ship Notification processes (request for shore power); PCS could acquire info on vessels requiring shore power.
CountEmissionsEU (Proposal 2023)	**Objective:** Standardise emission calculation methods across EU transport modes using EN ISO 14083. Scope: All transport/logistics services.	Expected adoption 2025–2026.	**Data Demands:** Methodology alignment for GHG calculation inputs (distance, fuel type, load factor). **PCS Impact:** Ensure PCS data structures match ISO 14083 elements (distance, modal split) to enable compliant emission reports.
CBAM (Carbon Border Adjustment Mechanism)	**Objective:** cost for EU and imported goods. Price correction mechanism for carbon emitted during the production of carbon-intensive goods entering the EU. Scope: Iron/steel, aluminum, cement, fertilizers, electricity, hydrogen.	Transition Oct 2023–Dec 2025 (report-only); fully active Jan 2026.	**Data Demands:** Embedded-emission data and carbon price proofs; annual verified declaration. **PCS Impact:** Include CBAM EORI and emission fields in import workflows; connect suppliers and importers for data exchange. Data exchange between market players will increase significantly; import processes require updates.

CSRD (Corporate Sustainability Reporting Directive)	**Objective:** Mandate assured ESG reporting ("double materiality"). Mandates extensive corporate reporting on ESG issues, including Scope 3 emissions, across the entire value chain. Scope: Large EU companies and listed SMEs.	Phased implementation FY 2024–2028.	**Data Demands:** Granular value-chain data (esp. Scope 3), digital XBRL format. PCS Impact: Provide operational data (energy use, modal split, OPS) to support Scope 3 and ESRS metrics. PCS can create value by facilitating and making data collection easier for carbon footprinting.
CSDDD (Corporate Sustainability Due Diligence Directive)	Purpose: Ensure companies address human-rights and environmental impacts in operations and supply chains. Mandates identification, prevention, and mitigation of adverse impacts across global value chains. Scope: Large EU and non-EU companies with EU turnover.	In force 2024; phased implementation from 2027.	**Data Demands:** Annual due-diligence statements, supplier risk data. **PCS Impact:** Enable exchange of supplier declarations and audit evidence linked to cargo movements. PCS is well-positioned to facilitate the necessary increase in data exchange between companies and partners.
EUDR (EU Deforestation Regulation)	**Objective:** Ban products from deforested/illegal land. Prohibits products linked to deforestation; mandates Due Diligence Statements (DDS) and precise geo-location data. Scope: Cattle, cocoa, coffee, palm oil, rubber, soy, wood and derivatives.	Medium/large operators 30 Dec 2025; micro/small 30 Jun 2026 (current law; possible further delay under discussion).	**Data Demands:** Geo-location and legality proof; Due-Diligence Statement (DDS). **PCS Impact:** Support DDS upload and segregation of compliant product flows. PCS can facilitate extensive data exchange required and manage separate flows of compliant/non-compliant goods.
RED III (Renewable Energy Directive)	**Objective:** Raise EU renewables share and require RFNBO (Renewable Fuels of Non-Biological Origin) tracking. Scope: Cross-sector, including maritime fuels.	In force 2023; national targets to 2030.	**Data Demands:** Fuel origin and certification. **PCS Impact:** Store and exchange certificates of sustainable fuel use for FuelEU and corporate reporting.
Digital Product Passport (DPP – under ESPR)	**Objective:** Provide product-level digital record of sustainability attributes (e.g., material composition, recycled content, carbon intensity, durability). A tool for sharing product data across its lifecycle. Scope: Applies initially to selected sectors (e.g., batteries, textiles, furniture, metals).	ESPR in force 18 Jul 2024; first working plan and acts 2024–2025; sectoral DPPs phased in from 2026 onward.	**Data Demands:** Standard digital identifiers and machine-readable attributes. **PCS Impact:** Attach DPP IDs to cargo declarations; share product data (carbon intensity, recycled content) with importers and customs. PCS might facilitate the sharing of this data, potentially tracking the chain of custody.
EU Data Act (Regulation (EU) 2023/2854)	**Objective:** Define data-access rights for connected products and services; enable fair B2B/B2G sharing and cloud portability. Harmonises rules on fair access and use of industrial data. Scope: Non-personal/industrial data from	Applies from 12 Sep 2025 (some clauses later).	**Data Demands:** Access/portability mechanisms, usage policies, security requirements. **PCS Impact:** Act as trusted data intermediary for operational and environmental data while ensuring compliance with data-sharing rights. Potentially leverages PCS as a trusted

	IoT devices and services (cranes, meters, reefer sensors, OPS systems).		'node' for air and sea freight within a federated data collaboration environment.
Energy Taxation Directive (ETD) (revision)	**Objective:** Align energy tax levels with climate objectives and remove fossil fuel advantages. Ensures taxation of energy products reflects their environmental and health impact.	Revision under Council negotiation (2024–2025).	**Data Demands:** None explicitly listed but implies granular energy usage data. **PCS Impact:** Enable cost/emission scenario tools for community members as fuel taxation rises. PCS might have the ability to calculate used energy for shipments, useful for route optimisation.

Table 3: Examples of National and Local Legislative/Regulatory Acts

Regulation / Framework	*Region / Country*	*Focus / Objective*	*PCS Relevance (and Survey Participants)*
California Air Resources Board (CARB) & Clean Air Action Plan	**US (Port of Los Angeles)**	Local environmental regulations and air quality management.	PCS operations must align with local mandates. Cited by The Port of Los Angeles.
Green Resolution 18-19 (Energy Managements)	**UAE (RAK Ports)**	Local rules on energy management.	Local sustainability policies and targets affect PCS integration. Cited by RAK Ports UAE.
Amendments to Customs Act & Draft Regulation on PCS Functioning	**Bulgaria (BPI Co.)**	Institutional change to mandate the use of PCS in Bulgarian seaports.	Requires institutional action by the PCS operator to align legal requirements with operational use. Cited by Bulgarian Ports Infrastructure Company (BPI Co.).
UK Port Policies	**UK Ports (e.g., DP World Southampton)**	Local sustainability policies and targets.	CNS helps align stakeholder actions to meet these local policies.
Various Local Spanish Acts	**Spain**	Local laws and strategies relevant to the Green Deal and other directives.	Cited by APBA.
Ecological Transition Plans for Ports	**France**	- Include roadmaps for deployment of alternative fuels by 2025 - Cover circular economy, industrial ecology, and biodiversity management - Focus on shore-side electrification and hydrogen production solutions	Required for each major seaport (GPM)
Digital Transformation Requirements	**France**	- Implementation of "Tell us once" and "Paperless" initiatives through a maritime one-stop shop by 2025. - Merging of Cargo Community Systems (CCS) for unified tracking of cargo - Cybersecurity protocols for port information systems.	

2.2. Critical Implementation Challenges and Bottlenecks

Despite the strategic opportunities, PCS operators and their communities face significant hurdles in adapting to the new legislative demands. These challenges span regulatory interpretation, data management, client adoption, and physical infrastructure.

Challenge Category	Description & Supporting Quotes
Lack of Clarity & Role Uncertainty	A primary hurdle is the ambiguity surrounding the PCS's specific obligations and the evolving nature of the rules. Portbase notes it is **"Not clear yet what a role our PCS can play in complying with legislation,"** a sentiment echoed by HAROPA PORT's citation of **"Evolving legislation and uncertainty."**
Regulatory Burden	The sheer volume and complexity of the new laws are overwhelming for some. APBA identified **"Too many and complex regulations"** as its main difficulty.
Data, Knowledge & Communication Gaps	A fundamental bottleneck is the low level of industry knowledge and the difficulty of sharing data. DAKOSY AG observes, **"Nobody is communicating and knowledge about measuring sustainability data is low."** The Israel Ports Company highlights the challenge of **"Sharing information between various parties for the purpose of emission calculations, etc."**
Client Adoption & Investment	There is a commercial challenge in convincing clients to invest in new sustainability solutions (SOGET).
Enforcement & Infrastructure	Practical implementation is hampered by gaps in oversight and physical capacity. RAK Ports UAE cites a **"Lack of formal enforcement."** The Port of Los Angeles points to limitations in **"Physical Infrastructure and Marine Terminal Equipment Availability."**

2.3. Ambiguity in Supervision and Enforcement

IPCSA Sustainability Survey 2025 shows that there is no consensus on whether a PCS should actively supervise or enforce sustainability regulations.

- **Full Enforcement Role:** A minority of 5 organizations (29.41%), including Portbase and The Port of Los Angeles, state they are organised to supervise and enforce regulations for both the PCS and its users.

- **Partial or No Enforcement Role:** A larger group of 8 organizations (47.06%) rejects or minimizes a direct enforcement role. SOGET explicitly states it is "Not the role of the PCS," while APBA notes the PCS "contributes to comply, but it is not a direct player on this issue." A further four organisations see their role as limited to enforcing rules only for the PCS itself or only for its users.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

2.4. Regional Variations in Legislative Focus

The specific regulations and challenges prioritized by PCS operators vary significantly based on their geographic and jurisdictional context.

EU Members: The focus is overwhelmingly on the EU Green Deal regulations. Organisations are actively investigating compliance with CSRD, CBAM, FuelEU Maritime, and the EU ETS. The Bulgarian Ports Infrastructure Company (BPI Co.) prioritizes domestic institutional changes, specifically the **"Adoption of a regulatory act mandating the use of PCS"** and amendments to the Customs Act as key sustainability efforts.

Cross-Cutting Themes for Port Community Systems based on EU legislation

- **Verified and interoperable data** (ISO 14083 alignment and CountEmissionsEU methodology).
- **Integration of fuel and OPS evidence** (FuelEU, AFIR, RED III).
- **Embedded-emission data for goods** (CBAM, DPP).
- **ESG and due-diligence data exchange** (CSRD, CSDDD, EUDR).
- **Data governance and access rights** (Data Act).
- **PCS as compliance enabler:** trusted infrastructure for reporting, verification, and community collaboration.

North America (US): The Port of Los Angeles is driven by powerful sub-national bodies like the **California Air Resources Board (CARB)** and its associated **Clean Air Action Plan**, with challenges cantered on physical infrastructure.
Middle East (UAE): RAK Ports UAE is influenced by the **UNSDG** and local policies like **Green Resolution 18-19** but identifies the primary challenge as a **"Lack of formal enforcement."**

Conclusion

The regulatory landscape now links sustainability directly to digital transparency. From the IMO GHG Strategy to the EU ETS and CountEmissionsEU, verified data has become the currency of compliance.
By embedding emission tracking, shore-power records, and supply-chain credentials into their platforms — and aligning data governance with the Data Act and DPP standards — Port Community Systems can turn complex regulation into efficient digital services that support every actor in the maritime community and advance collective decarbonization.

3. Policy and Strategy

Sustainability has become a defining element of competitiveness and resilience in port communities. Ports concentrate emissions from ships, cargo handling, and hinterland transport — making them both a significant source of greenhouse gases and a strategic point of intervention. Even small efficiency gains in these interconnected systems can deliver measurable environmental and economic benefits.

For Port Community Systems (PCSs), sustainability is not only about corporate responsibility; it is a strategic opportunity to lead the digital transition toward greener logistics. By embedding sustainability into their organizational policies and community services, PCS operators can directly contribute to achieving international targets such as the Paris Agreement, the IMO's decarbonization strategy, the EU Green Deal, and the UN Sustainable Development Goals (SDGs).

3.1 Why Sustainability Matters for PCS

PCSs function as the digital backbone of port ecosystems, connecting shipping lines, terminals, authorities, and logistics providers. This unique position allows them to influence — and quantify — how port communities operate.

Sustainability integration across PCS operations has several benefits:

- **Emission reduction leverage:** Digital tools that optimize port calls, reduce congestion, and promote modal shift can cut significant emissions across the logistics chain.
- **Regulatory readiness:** PCS platforms can help communities comply with rapidly evolving legislation (EU ETS, FuelEU Maritime, CSRD, CBAM).
- **Business resilience:** Sustainable operations enhance reputation, attract investment, and mitigate climate-related risks.
- **Data transparency:** PCSs can provide trusted emission and ESG data that enable fact-based decision-making and investment.

By championing sustainability, PCS operators can shift from being data intermediaries to becoming **strategic enablers of green transition**.

3.2 Building a Sustainable PCS Strategy

A well-designed sustainability strategy provides direction, accountability, and measurable outcomes. It should combine internal commitments with community-facing services that advance sustainability across the wider logistics ecosystem.

Key Elements of a PCS Sustainability Strategy

1. **Vision and Policy Commitment:**
Define a clear sustainability vision, endorsed by leadership and aligned with international frameworks (e.g., SDGs, IMO GHG Strategy, ISO 14001).
2. **Governance and Accountability:**
Establish a sustainability officer or working group responsible for setting targets, monitoring progress, and reporting results. Include sustainability in board-level decision-making and procurement policies.
3. **Targets and Metrics:**
Set measurable goals such as reducing internal GHG emissions (Scope 1 & 2) by a defined percentage, enabling Scope 3 data exchange for the community, and expanding digital services supporting modal shift or OPS use.
4. **Transparency and Reporting:**
Publish annual sustainability reports aligned with recognized standards (e.g., GRI, CSRD, ESRS) and communicate progress to partners and customers.

3.3 Internal Sustainability Actions

Before enabling others, PCS operators can lead by example through their own operations.

- **Energy and IT Efficiency:** Use renewable energy in offices and data centers; optimize cloud infrastructure; apply lifecycle management for servers and hardware.
- **Sustainable Procurement:** Include ESG criteria in supplier selection and contracting.
- **Mobility and Travel:** Minimize travel emissions through hybrid work and low-carbon mobility policies.
- **Employee Engagement:** Train staff on sustainability awareness, innovation, and eco-friendly workplace practices.
- **Carbon Footprinting:** Measure and offset unavoidable Scope 1 and 2 emissions as part of continuous improvement.

These actions demonstrate accountability and credibility when advocating for sustainability externally.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

3.4 External Strategy: Empowering the Port Community

PCSs can create the largest sustainability impact through their **services and partnerships**. Acting as digital facilitators, they can support emission reduction and compliance across the entire port ecosystem.

Key External Focus Areas

- **Data Services:**
  Provide datasets that make accurate calculations possible, and ensure ISO 14083 and GLEC-aligned tools to calculate and share transport-related emissions.
- **Just-in-Time and Port Call Optimization:**
  Enable smarter arrival planning to reduce vessel idle time, fuel consumption, and port congestion.
- **Modal Shift and Hinterland Visibility:**
  Offer data-driven insights to promote efficient rail, barge, or truck combinations.
- **Shore Power Integration:**
  Manage OPS booking, verification, and emission reporting.
- **Circular and Waste Reporting Tools:**
  Facilitate waste declarations and energy recovery data exchange between terminals and authorities.
- **Compliance Enablement:**
  Develop services supporting reporting for CSRD, FuelEU Maritime, CBAM, EUDR, and other frameworks.

Through these services, PCSs help communities transition from regulatory compliance to proactive decarbonization.

3.5 Governance and ESG Alignment

Embedding sustainability requires strong governance and alignment with international Environmental, Social, and Governance (ESG) standards.
Key actions include:

- Integrating sustainability into corporate risk management and internal audit processes.
- Linking ESG targets to key performance indicators (KPIs) and staff incentives.
- Participating in regional and international sustainability networks (e.g., IPCSA Working Groups, port coalitions).
- Ensuring transparent communication and stakeholder engagement through workshops and open data initiatives.
- Governance alignment builds trust and positions PCS operators as credible partners in the global transition.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

3.6 Examples from IPCSA Members

- **Portbase (Netherlands):** Integrated sustainability as a strategic pillar, clear sustainability strategy and KPIs and modal shift insights with an emission reduction dashboard.
- **DAKOSY (Germany):** Developed an end-to-end emission data exchange model aligned with the Smart Freight Centre framework and ISO 14083.
- **SOGET (France):** Introduced the *S)One Green* platform providing certified CSR and GHG reports for logistics chains.
- **HAROPA PORT (France):** Implemented smart traffic management systems reducing truck waiting times and port emissions.
- **Port of Antwerp-Bruges (Belgium):** Partnered with Routescanner to enable route selection based on emissions performance.

These examples demonstrate how PCS-driven initiatives can translate sustainability policy into measurable community impact. For more information also see the “best practices” chapter.

Conclusion

Sustainability strategy for Port Community Systems is not an optional add-on, it is a core element of digital transformation and competitiveness.
By combining internal efficiency, transparent governance, and community-wide services, PCSs can accelerate decarbonization, strengthen compliance, and foster collaboration among all port stakeholders.
A clear, data-driven sustainability strategy enables PCSs to transform ambition into action, ensuring that port communities not only meet today’s regulatory demands but actively shape the sustainable supply chains of tomorrow.

4. Data Sharing for Sustainability

Ports are critical nodes in global supply chains, concentrating emissions from ships, terminal operations, and hinterland transport. The logistics sector accounts for an estimated 8–10% of global greenhouse gas (GHG) emissions, and freight demand is projected to double by 2050. To meet the goals of the Paris Agreement and the EU Green Deal, ports must take an active role in decarbonization.

Port Community Systems (PCSs) — trusted, neutral digital platforms connecting shipping lines, terminals, authorities, freight forwarders, hinterland operators, and shippers — are uniquely positioned to support this transition. Traditionally focused on efficiency and compliance, PCSs can now act as data orchestrators for sustainability, enabling visibility and transparency of emissions across the logistics chain.

Their potential impact lies in their neutrality and scale: PCSs already connect thousands of community members and can serve as the trusted infrastructure for exchanging sustainability-related data. However, their role depends on community collaboration and supportive governance. PCSs should therefore be seen not as the solution itself, but as key enablers of scalable sustainability transparency.

While PCSs rarely generate or model emissions data directly, they connect the datasets that make accurate calculations possible. By combining operational events, container flows, and port activities, they support emission-data specialists in constructing end-to-end supply-chain views — at least for the segments visible from the port's perspective.

The central question is: which data should be shared through PCSs to maximize sustainability impact?

This chapter outlines the key data elements, service opportunities, and partnership models that can enable this, based on global best practices (Portbase, DAKOSY, SOGET's *S)Green*), international frameworks (GLEC, ISO 14083), and Smart Freight Centre (SFC) guidance.

4.1 Which Data Needs to Be Shared

To deliver meaningful sustainability outcomes, PCSs must integrate operational, cargo, energy, and contextual data at shipment or container level. These data points underpin emission calculations and performance optimization.

4.1.1 Vessel and Voyage Data

- Vessel ID (IMO number), type, engine class, fuel type
- Bunker and fuel reports: quantity, type, sulfur content (supporting EU ETS, FuelEU Maritime)
- Arrival/departure times, anchorage waiting times, auxiliary engine use
- Shore power connection data (duration and energy drawn)
- AIS-based voyage data: actual sailed distance, average speed, routing

4.1.2 Cargo and Container Data

- Container ID, weight, and cargo type (including refrigerated or hazardous)

- Bill of Lading details (origin, destination, commodity code)
- Terminal dwell time (storage-related energy use)
- Reefer electricity consumption

4.1.3 Terminal and Handling Data

- Equipment type and energy source (diesel, LNG, electric cranes, AGVs, straddle carriers)
- Energy use metrics per move or per container
- Waste declarations (e.g., Notification Waste Disposal in Portbase)
- Renewable energy generation or green power sourcing

4.1.4 Hinterland Transport Data

- Mode used (truck, rail, barge)
- Vehicle/vessel identifiers and emission standards (Euro class, Stage V, etc.)
- Distance travelled and load factor
- Empty mileage ratio (particularly for road transport)

4.1.5 External Contextual Data

- Emission factors aligned with ISO 14083 / GLEC v3.1
- Weather and traffic conditions affecting fuel use
- Modal shift availability (barge/rail schedules, capacity via Routescanner, Nextlogic)

4.2 PCS Services that Enable Sustainability

PCSs should not replace emission calculators but instead **enable data flow and transparency** for sustainability applications. Practical examples show how this can be achieved:

4.2.1 Emission Visibility and Reporting

- **SOGET (Le Havre):** *S)Green* uses PCS data to feed TK'Blue's engine, generating ISO 14083-compliant well-to-tank and tank-to-wheel GHG reports.
- **Portbase (Netherlands):** Developing "emission add-ons" linking PCS operational data with platforms like EcoTransIT, Routescanner, and BigMile.
- **DAKOSY (Germany):** Building standardized data exchange for each transport-chain element to support end-to-end reporting.

4.2.2 Operational Optimization

- **Just-in-Time Port Calls:** Sharing ETA/ETD and berth-slot data reduces anchorage time and fuel use (up to 14% savings per call).
- **Hinterland Visibility:** Coordinating truck, rail, and barge slots cuts congestion and empty mileage.
- **Route and Modal Shift Tools:** Integration with services such as Routescanner and Port Alert enables emission-based transport decisions.

4.2.3 External Partnerships

PCSs can multiply their impact through partnerships with:

- **Carbon accounting engines** (examples: EcoTransIT, Searoutes, BigMile, TK Blue) for verified emission modeling.
- **Energy providers** for real-time data on shore power use and terminal energy mix.
- **Green freight programs** (SmartWay, Lean & Green, Clean Cargo) for benchmarking and certification.

4.3 Data Sharing Principles

From the IPCSA Sustainability Survey and Smart Freight Centre guidance, several principles are essential to credible sustainability data exchange:

1. **Standardization:** Use ISO 14083 / GLEC v3.1 methodologies covering well-to-tank (WTT) and tank-to-wheel (TTW) emissions.
2. **Granularity:** Provide shipment- or container-level data while allowing aggregation for ports and terminals.
3. **Data Quality Indicators:** Include quality flags (primary vs modelled data) alongside emission results.
4. **Neutral Governance:** Maintain trust through impartial data handling and confidentiality safeguards.
5. **Interoperability:** Build APIs connecting PCSs to carriers, TMS/WMS, and carbon-accounting platforms.
6. **Verification and Assurance:** Encourage third-party verification; adopt the SFC bronze–silver–gold assurance levels as a benchmark.

4.4 Recommendations for PCS Worldwide

1. **Leverage existing data** — Use timestamps, cargo weights, and modality data already within PCS to form a sustainability backbone.
2. **Develop modular "sustainability add-ons"** — Introduce optional emission services gradually to lower adoption barriers.
3. **Enable modal-shift decisions** — Provide comparative tools showing cost, time, and emission performance across modes.
4. **Build partnerships** — Collaborate with emission-data and assurance providers for credible reporting.
5. **Adopt harmonized frameworks** — Use ISO 14083 and GLEC v3.1 as global baselines for consistency.
6. **Create a minimum sustainability dataset** — Include vessel ID, fuel type, container weight, hinterland mode, dwell time, and shore power usage.
7. **Promote transparency at two levels** — Shipment-level for private users; aggregated dashboards for community and authorities.
8. **Future-proof PCS** — Prepare to integrate Digital Product Passport data, CSRD-aligned disclosures, and potential carbon taxation inputs.
9. **Encourage voluntary data sharing — but prepare for regulation** — Widespread data exchange will accelerate once frameworks like CSRD, EU ETS, or IMO rules make it mandatory. PCS should foster early collaboration and readiness.

Conclusion

Port Community Systems can transform from process facilitators into **sustainability enablers**. By sharing operational and environmental data at container and chain level, they empower shippers, ports, and authorities to:

- Gain accurate emissions visibility
- Optimize vessel calls and reduce congestion
- Support modal shift and decarbonization
- Ensure compliance with EU, IMO, and global regulations

PCSs do not directly control emissions but make their measurement and management possible. Emission reductions occur only when stakeholders act on insights — yet without PCS infrastructure, sustainability data would remain fragmented and unreliable.
International cooperation and adoption of harmonized standards such as ISO 14083 and GLEC v3.1 will be essential to realize this potential.
Data is the new fuel for sustainable logistics — and Port Community Systems are the engines that make it flow!

5. Data Standards and Analytics for Sustainability

Data without standards cannot drive sustainability. For emission transparency to scale across ports and logistics chains, the data exchanged via Port Community Systems (PCSs) must follow **common methodologies**, use **interoperable formats**, and be **analyzed consistently** to generate credible insights.

PCSs are ideally positioned to implement and enforce these standards. By aligning operational data with international emission accounting frameworks such as **ISO 14083**, the **GLEC Framework v3.1**, and the **Smart Freight Centre's (SFC) assurance model**, PCSs can ensure that sustainability data is comparable, verifiable, and actionable.

At the same time, analytics — from basic aggregation to advanced AI modelling — can transform raw operational data into **evidence of emission reductions**. This chapter explores how PCSs can define and apply data standards, leverage analytics, and enforce sustainable service use across their communities.

5.1 Data Standards for Emission Communication

A shared data language is the foundation for meaningful emission reporting. PCS operators can act as the **custodians of interoperability** by aligning data capture and exchange with recognized international standards.

Key Frameworks

- **ISO 14083:2023** – Standard methodology for quantifying and reporting GHG emissions from transport chains (all modes).
- **GLEC Framework v3.1** – Developed by the Smart Freight Centre; recognized by ISO 14083 as the global reference methodology.
- **EN 16258** – The predecessor to ISO 14083, still relevant for legacy systems.
- **CountEmissionsEU (Proposal)** – EU initiative to harmonize logistics emission calculation and reporting, expected 2025–2026.

Standardization Role of PCSs

- Ensure that data elements collected (vessel ID, route distance, cargo weight, fuel type, etc.) map directly to ISO 14083 categories.
- Adopt common data formats (e.g., UN/CEFACT, IATA ONE Record, DCSA) to ensure interoperability across systems.
- Maintain data quality indicators — distinguishing between **primary**, **secondary**, and **default** data.
- Implement validation rules and automated data checks to improve consistency and reduce reporting errors.

By embedding these standards in their digital architecture, PCSs become trusted gatekeepers of comparable and credible sustainability data.

5.2. Turning Data into Measurable Impact: Analytics and Insights

Once standardized, sustainability data enables advanced analytics that reveal where and how emission reductions occur. PCSs can apply analytics at three levels: **descriptive**, **diagnostic**, and **predictive**.

Descriptive Analytics – Measuring What Happened

- Aggregate GHG emissions by terminal, mode, or port call.
- Benchmark emission intensity per TEU, tonne, or voyage.
- Track energy consumption and shore-power usage trends.

Diagnostic Analytics – Understanding Why

- Identify hotspots: waiting times, inefficient routing, or underutilized hinterland capacity.
- Compare emissions between different operators or modes (road vs. barge).

- Combine operational KPIs (e.g., berth occupancy, yard dwell time) with emission data to quantify inefficiencies.

Predictive Analytics – Anticipating Improvements

- Model potential emission savings from just-in-time (JIT) operations or modal shift.
- Simulate future compliance scenarios (FuelEU Maritime, ETS costs).
- Apply AI-driven forecasting to predict community-wide emission baselines.

PCS analytics thus provide the quantitative foundation for **evidence-based decarbonization strategies** across ports.

5.3. Calculating Emission Reduction through PCS Services

PCSs can go beyond measuring emissions — they can help **demonstrate reduction potential** through the use of specific digital services.

Example 1: Port Call Optimization

By sharing ETA/ETD and berth-slot data, JIT operations can reduce vessel idle time.

- Average reduction: 10–14% less fuel burned during port approach and waiting.
- Emission impact: approx. 1–2 tonnes CO_2 per port call (for a Panamax-size vessel).
- Data sources: AIS, berth planning, fuel type, and anchorage duration.

Example 2: Onshore Power Supply (OPS) Utilization

PCS-based OPS booking and reporting can quantify avoided emissions.

- Average reduction: 2–3 tonnes CO_2 per call for container vessels using OPS instead of auxiliary engines.
- Data sources: connection time, energy drawn, grid emission factor.
- Linked regulation: FuelEU Maritime and AFIR.

Example 3: Hinterland Modal Shift

Using PCS-integrated modal choice tools (e.g., Routescanner, Portbase Hinterland), operators can select lower-emission options.

- Potential savings: up to 60–70% CO_2 reduction when shifting from road to rail/barge.
- Data sources: transport distance, mode, load factor, emission factor.

Example 4: Waste and Circular Management

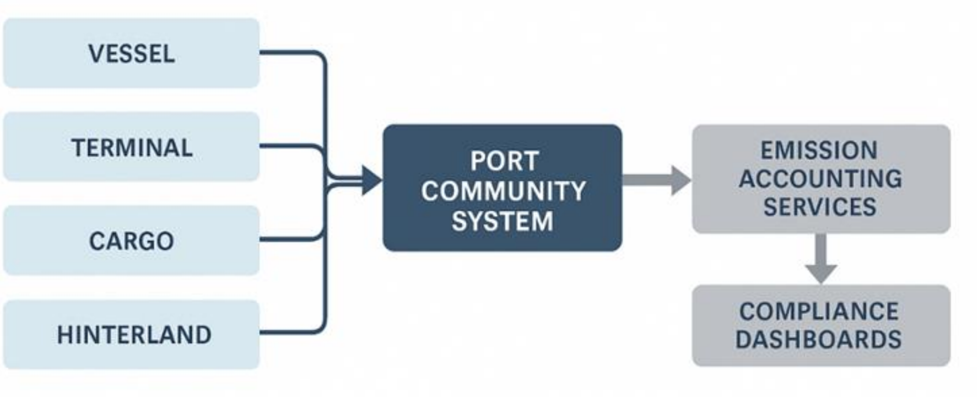
PCS waste declaration modules can track recycling and reuse rates.

- Impact: measurable reductions in landfill waste and associated emissions.
- Linked to EU circular economy and port ESG indicators.

Example 5: Digital Efficiency and Paperless Processes

Digital coordination and paperless procedures have been shown to reduce administrative visits and document exchanges at ports, translating into material CO_2 savings. Such outcomes illustrate how community-wide adoption of PCS services directly supports environmental objectives.

Figure 1: Emission Data Flow Through Port Community Systems



This schematic depicts how vessel events (ETA/ETD, shore power usage), terminal equipment metrics, cargo attributes (weights, reefer energy) and hinterland movements (mode, distance, load factor) are standardized in the PCS and exchanged securely with carbon accounting engines for ISO 14083 / GLEC-compliant reporting.

These examples illustrate how PCS services, when backed by standardized data and verified analytics, can **quantify real sustainability benefits** across the logistics chain.

5.4. Enforcing Data and Service Impact

For sustainability gains to be credible, PCS-enabled services must be both **adopted and verified**. Enforcement can take several forms:

- **Regulatory Enforcement:**
  Integration with FuelEU Maritime, ETS, and CSRD reporting frameworks ensures that PCS data is used in mandatory compliance processes.

- **Community Enforcement:**
  Port authorities can link PCS usage to green incentives (e.g., reduced port dues for OPS users, or preferred berthing for JIT-compliant vessels).

- **Data Assurance:**
  Third-party verification of data and methodology builds credibility for emission claims (following SFC's bronze–silver–gold model).

- **Performance Dashboards:**
  Publishing aggregated emission results motivates continuous improvement and fosters transparency across the community.

Through these mechanisms, PCSs move from being passive data platforms to **active enforcers of sustainable behavior**.

5.5. Recommendations for PCS Operators

1. **Align with ISO 14083 and GLEC Framework v3.1** for emission calculation consistency.
2. **Integrate analytics modules** into existing PCS dashboards for emission monitoring and trend visualization.
3. **Quantify emission reductions** resulting from digital services (e.g., JIT, OPS, modal shift).
4. **Establish data assurance protocols** with third-party verifiers.
5. **Embed compliance logic** for ETS, FuelEU, and CSRD into PCS workflows.
6. **Collaborate with data partners** (e.g., Routescanner, BigMile, Searoutes, EcoTransIT) to enhance model accuracy.
7. **Report collective results** through community sustainability dashboards.

Conclusion

Data standards and analytics form the backbone of credible sustainability action.
By embedding ISO-aligned methodologies, leveraging advanced analytics, and quantifying emission reductions from digital services, Port Community Systems can move from *data exchange* to *data-driven transformation*.
Through standardized and verifiable insights, PCSs not only help ports demonstrate compliance — they prove their collective impact on decarbonization.
In doing so, they elevate digital port communities into evidence-based sustainability ecosystems capable of driving real-world change.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

6. Collaboration and Community Impact

Sustainability in maritime logistics cannot be achieved by individual organizations alone. The interconnected nature of port ecosystems—linking shipping lines, terminals, port authorities, customs, hinterland operators, and logistics providers—makes **collaboration essential**.
PCSs by design, exist to connect these actors. Their neutral and trusted position allows them to act as the digital backbone of collaboration, facilitating shared data, harmonized standards, and joint progress toward sustainability goals.
The International Port Community Systems Association (IPCSA) plays a key coordinating role in turning this collaborative potential into reality. Through collective learning, benchmarking, and shared innovation, IPCSA helps its members align around global sustainability priorities and speak with one common digital language.

6.1 The Power of Collaboration in the Port Ecosystem

Sustainability is both a technical and a social challenge. While emission reductions can be quantified through data and analytics, real impact depends on cooperation between all parties in the logistics chain. Collaboration through PCSs creates value in three main ways:

1. **Shared Standards and Interoperability** – Common data models and methodologies enable ports and logistics partners to exchange sustainability information seamlessly, reducing duplication and ensuring comparability.
2. **Collective Action for Decarbonization** – Coordinated port-call optimization, modal-shift initiatives, and data-driven emission reporting only succeed when all stakeholders participate.
3. **Community Transparency and Trust** – Neutral platforms such as PCSs make it possible to share verified sustainability data while safeguarding commercial confidentiality.

By connecting digital infrastructure with human cooperation, PCSs turn fragmented efforts into coordinated community progress.

6.2. IPCSA's Role in Driving Global Collaboration

The IPCSA Sustainability Working Group provides a dedicated space for members to exchange expertise, align standards, and develop common tools. It acts as a catalyst for **collective innovation** across the international PCS network.

6.3. Building Impactful Community Partnerships

PCSs can extend collaboration beyond the port gates, linking industry, academia, and policymakers in pursuit of measurable sustainability results.

Key Partnership Areas

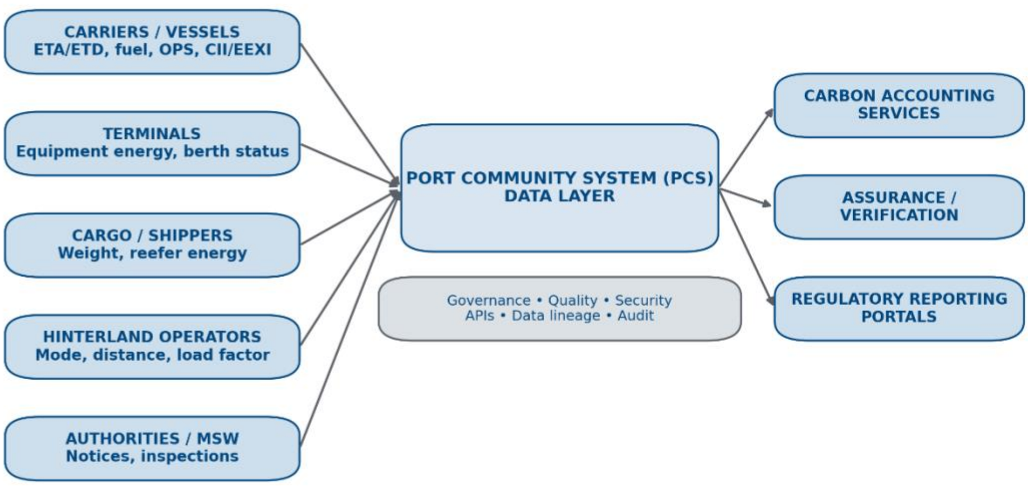
- **Port Authorities and Terminal Operators:** Co-develop digital tools for emission monitoring, OPS management, and congestion reduction.
- **Logistics and Shipping Companies:** Share data for end-to-end carbon visibility and standardized reporting.
- **Energy and Technology Providers:** Integrate renewable-energy and efficiency data directly into PCS workflows.
- **Academia and Research Networks:** Partner on modelling, benchmarking, and impact assessments.
- **Public Agencies and Regulators:** Use PCS data to inform policy decisions and evaluate progress toward decarbonization targets.

These partnerships help turn each port into a **living laboratory for sustainable logistics**, combining data, policy, and innovation in one ecosystem.

6.3.1 Example: Digital Collaboration

This example of digital collaboration illustrates how multi-party sharing of port call data and predictive analytics can improve Just-in-Time (JiT) arrivals, reduce anchorage and queueing, and cut fuel consumption and emissions across the call. PCS platforms provide the neutral foundation to standardize inputs and distribute insights to all stakeholders.

Figure 2: Data Sharing Architecture for Scope 3 Emission Accounting



The architecture highlights inbound data from carriers, terminals and hinterland operators, governance and quality checks within the PCS, and outbound interfaces to assurance providers and compliance systems.

6.4 Measuring and Amplifying Community Impact

Collaboration achieves its full value when results are visible and shared. PCSs can help quantify and communicate community-wide sustainability progress by:

- Developing **community emission dashboards** that aggregate data from port users and highlight collective achievements.
- Tracking **participation metrics**, such as OPS adoption rates, JIT utilization, or modal-shift performance.
- Publishing **annual sustainability summaries** for the port community, aligned with CSRD and ESG disclosure standards.

Sharing findings through IPCSA to contribute to global benchmarking and peer learning.
Transparent reporting reinforces credibility, encourages participation, and turns data collaboration into measurable environmental impact.

6.5. Recommendations for Strengthening Collaboration

1. **Establish joint sustainability goals** at community level, aligning port authorities and PCS users.
2. **Adopt shared data standards** (ISO 14083, GLEC v3.1) to ensure interoperability across ports.
3. **Leverage IPCSA's global network** for training, benchmarking, and technical alignment.
4. **Encourage public–private partnerships** to accelerate digital and green transitions.
5. **Recognize and share success** through IPCSA's Sustainability Initiative and shared case studies.

Conclusion

Collaboration is the cornerstone of sustainable maritime logistics.
Through IPCSA's global network and the neutral infrastructure provided by PCSs, ports and their stakeholders can move beyond compliance toward genuine community transformation.
By sharing knowledge, harmonizing standards, and jointly measuring progress, PCS operators create ecosystems that are not only more efficient—but also more transparent, resilient, and sustainable.
Together, these connected communities are shaping the blueprint for the next generation of green and digital ports worldwide.

7. Best Practices and Case Studies

Across the IPCSA network, PCSs are demonstrating how digital collaboration can translate sustainability ambitions into measurable results.
By connecting diverse stakeholders and embedding sustainability into everyday services, PCSs are reducing emissions, improving transparency, and enabling regulatory compliance across the global logistics chain.
This chapter presents selected **best practices** from IPCSA members — including **Portbase (Netherlands), the Port of Barcelona (Spain), CNS (United Kingdom), and others** — to showcase how PCSs are putting sustainability into action. Each example illustrates the link between data, digital innovation, and real environmental impact.

7.1. Portbase (Netherlands): How PCS Can Drive Sustainability

A Holistic Approach to Sustainability

For Portbase, sustainability is not a separate ambition — it is at the heart of its mission:
"Building the smartest port communities. Together we unlock the potential of data to create a seamless, sustainable and secure flow of goods."

This vision is brought to life through a **circle of influence model**, integrating sustainability across three levels:

- **Organization:** Reducing its own footprint while fostering a safe, inclusive, and vital workplace.
- **Portfolio:** Embedding sustainability into digital services to improve efficiency and reduce emissions.
- **Ecosystem:** Extending impact through partnerships, knowledge exchange, and international cooperation.

The **UN Sustainable Development Goals (SDGs)** guide Portbase's strategy, ensuring alignment with global sustainability objectives.

Tangible Results

Portbase's approach is delivering measurable results. The **Emission Reduction Dashboard**, developed with external partners, visualizes reductions in CO_2, NOx, SO_2, and particulates across PCS services such as import, export, and hinterland logistics.

Within its operations, Portbase advances toward **climate neutrality** through sustainable mobility, IT procurement, and revised purchasing policies.
By enabling smarter data sharing across the chain, the PCS has achieved **205,000 tons of CO_2 savings** and **€41 million in added value** in 2023.

Sustainability is firmly embedded in Portbase's **governance and corporate culture**, reinforced by HR policies, a sustainability code of conduct, and active participation in the **IPCSA Sustainability Working Group**.

Key Learnings

- **Awareness before adoption**: Cultural readiness is crucial.
- **Measure what matters:** KPIs are key to track progress.
- **Regulation drives momentum**: EU frameworks like ETS, CBAM, and CSRD create clarity and urgency.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

- **Collaboration multiplies impact:** Shared data delivers the greatest efficiency and emission gains.
- **Change takes time:** Gradual implementation builds trust and engagement.

The Road Ahead

Portbase's **roadmap to 2030** focuses on achieving climate-neutral operations, integrating standardized emission reporting into PCS services, and deepening collaboration with ports, governments, and IPCSA partners to scale sustainability impact across Europe's logistics ecosystem.

Conclusion

Portbase exemplifies how a Port Community System can act as a **catalyst for sustainable logistics** — combining digital innovation, measurable emission reduction, and ecosystem collaboration. Its integrated approach shows that data sharing is not only smart logistics — it is also a driver of a more sustainable future

---

7.2. Port of Barcelona (Spain): Integrating Sustainability through Digitalization

The **Port of Barcelona** aims to become a **zero-emission port by 2050**, with its PCS, **PORTIC**, acting as a digital enabler for low-impact operations.

Key Achievements:

- **Positive Impact Port Initiative** and **Sustainability Observatory** to monitor environmental and social performance.
- **Nexigen Project:** €160 million investment in **onshore power supply (OPS)** infrastructure for electrified docks.
- **PCS modernization:** Energy-efficient data centers, achieving a **175-ton CO_2 reduction over five years**.

A 2021 Port Authority study showed that **digitalization improved environmental efficiency by 13%** and **reduced the overall carbon footprint by 12%.**

Key Learnings:

- Sustainable transformation requires both **digital and physical infrastructure upgrades**.
- **Transparent ESG reporting** promotes accountability and stakeholder trust.
- **Public–private collaboration** accelerates innovation and adoption.

Next Steps

- Expand OPS coverage to all terminals.
- Increase renewable energy integration.
- Enhance PCS capabilities for environmental data capture and reporting.

7.3. CNS (United Kingdom): Modal Shift and Carbon Insetting Innovation

CNS, in partnership with **DP World UK**, has introduced groundbreaking initiatives that link digital logistics tools with measurable carbon savings.

Key Initiatives:

1. Modal Shift Programme:
Encourages rail over road transport for imported goods through financial incentives.
CNS enhanced the PCS and billing systems so that customers are automatically credited or charged based on modal choice.

2. Carbon Insetting Programme:
A world-first container port carbon inset system offering credits to Beneficial Cargo Owners (BCOs) who use lower-carbon shipping or rail options.

- Credits: **50 kg CO_2** per import laden container.
- Over **100,000 TEUs registered** within the first two months.
- Enables BCOs to measure and report reductions in Scope 3 emissions.

3. Data Infrastructure:
A new **UI portal and Container Enquiry API** enable real-time tracking, JIT updates, and automated emissions data integration.

Key Learnings

- **Digital tools make sustainability measurable:** Emission credits and modal choice can be directly linked to PCS data.
- **Transparency builds trust:** Customers see tangible value in visible carbon savings.
- **Partnerships enable innovation:** Collaboration with terminal operators and customs authorities was crucial for system integration.

Conclusion

CNS demonstrates how a PCS can evolve into a **data-driven sustainability service provider**, aligning business incentives with emission reduction and enabling traceable, verifiable carbon accounting.

7.4 IPCSA Member case studies

Table 2: IPCSA Member Case Study Overview
Comparative snapshot of objectives, levers (e.g., slot booking, OPS, emission reporting), and outcomes across selected PCS members.

Member (Country)	Objectives / Focus	Key Levers & Mechanisms	Outcomes / Reported Effects	Notes (Data & Reporting)
DAKOSY (Germany)	Embed sustainability in internal operations and community services; reduce congestion and emissions.	Vessel arrival coordination & passage planning; mandatory truck slot booking; internal measures (Environmental Officer, greener mobility, energy audits).	Reduced gate congestion and idling; smoother port calls; improved energy efficiency.	Community tools coordinated via PCS; internal governance supports continuous improvement.
dbh Logistics (Germany)	Cut organizational footprints and optimize logistics processes with secure digital services.	Secure digital release order in German seaports; Bremen PCS platform for real-time visibility; rail IT to optimize planning and reduce idle time.	Enhanced security and paperless workflows; better capacity utilization; resource savings.	Baselining Scope 1–2; employee engagement; transparency on progress through recognized assessments.
Portic (Spain)	Support Port of Barcelona's zero-emission strategy through digital + physical upgrades.	Onshore Power Supply (OPS) investment; energy-efficient PCS infrastructure; observatories and reporting.	Lower emissions at berth; improved monitoring and transparency.	PCS enables OPS coordination and data capture aligned with port electrification program.
SOGET (France)	Provide standardized, multi-modal emissions reporting and visibility for the community.	S) Green module using S)ONE data; ISO 14083-aligned CSR/GHG reports across road/sea/river/rail.	Consistent emissions visibility for stakeholders; supports compliance reporting.	Emphasizes standardized inputs and broader coverage of relevant externalities.
Portbase (Netherlands)	Integrate sustainability into mission; enable modal shift, reduce waiting times; climate-neutral trajectory.	Emission-reduction dashboards; hinterland optimization; standardized emissions reporting in PCS services; support for green corridors.	Measured reductions via improved planning and modal shift; shorter waiting times.	Active international collaboration and harmonization of reporting approaches.
Community Network Services (CNS) (United Kingdom)	Incentivize low-carbon choices and improve container visibility for JIT operations.	Collaboration with DP World UK on modal-shift and carbon-insetting; EORI-based linkage of imports to BCOs for fuel credits; portal for credit management; 'Where's My Container' and Container Enquiry API.	Greater transparency and incentives for low-carbon fuels; improved JIT coordination.	First reference as 'Community Network Services (CNS)'; subsequent use as 'CNS' in report narrative.

- **Port of Los Angeles (USA):** Launching the **Carbon Intensity Gateway**, providing open-access emissions data to track and benchmark performance.
- **ValenciaPort (Spain):** Integrating AI-based predictive emission analytics within its PCS to optimize energy use and vessel scheduling.

These examples underline that **sustainability through data integration** is a global movement, not a regional trend.

Conclusion

The case studies presented in this chapter illustrate that **PCSs are no longer passive data platforms but active agents of decarbonization**.
By aligning digital innovation with sustainability goals, each system — from Portbase's emission dashboards to CNS's carbon insetting model — demonstrates how ports can turn regulation into opportunity and data into measurable impact.

The key message for PCS operators worldwide is clear:

Real progress happens when sustainability is embedded in daily digital services, underpinned by shared data, trusted standards, and collaboration across the supply chain.

8. Facts & Figures: IPCSA Sustainability Survey

This report summarises insights from a survey of Port Community System (PCS) operators and stakeholders regarding their sustainability practices, challenges, and outlook.

8.1. Participating Organisations

Total Responses received: 19

A total of **17 unique IPCSA Member organisations** participated in the survey.

- 37% of IPCSA Members participated in the survey.
- Regional participation breakdown:
  - 44% of EU Members took part.
  - 40% of European and North American Members participated.
  - 22% of African Members contributed to the survey.
  - 14% of West Asia Members were involved.
  - There was no response from the Asia Pacific region and the Caribbean & Latin America.

The following organisations provided responses:

- Portbase (Netherlands)
- Bulgarian Ports Infrastructure Company (BPI Co.) (Bulgaria)
- dbh Logistics IT AG (Germany)
- HAROPA PORT (France)
- Israel Ports Company (Israel)
- PORTIC (Spain)
- CNS (UK)
- Nigerian Ports Authority (Nigeria)
- DPCS (Djibouti)
- SOGET (France)
- Autoridad Portuaria de Valencia (Spain)
- Port of Antwerp-Bruges (Belgium)
- The Port of Los Angeles (US)
- RAK Ports (UAE)
- Portel Logistic Technologies (Spain)
- APBA (Spain)
- DAKOSY AG (Germany)

8.2. Key Findings and Trends from Survey Results

A. Sustainability Policy and Strategy

- **Mixed Adoption of Formal Policies**: Among the 18 responses, there is an **even split (50%) regarding formal sustainability policies or strategic plans**, with 9 respondents indicating they have such a policy and the other 9 stating they do not.
- **Diverse Drivers of Strategy**: The responsibility for driving sustainability strategies is varied:
  - For the 18 respondents, drivers are **equally divided (50%) between the PCS/Single Window operators themselves and the port authority or port community**.
  - "The port" is the most common driver (9 respondents).
  - "PCS/SW" itself drives the strategy for 4 respondents.
  - "The port community" drives it for 1 respondent.
  - Some strategies are driven by a **combination of both** (e.g., Portbase highlights both port authorities and Portbase). Other drivers include responding to "requests from the entire maritime trade community".

B. Implemented Sustainability Practices

Key sustainability practices implemented via PCS largely revolve around **digitalization and efficiency to reduce emissions**:

- **Digitalization of processes** and operational process improvements, "Optimized Traffic Flows," "Modal Shift Facilitation," "Smart Resource Allocation," and "Emission monitoring" (HAROPA PORT)
- **Optimized traffic flows** and smart resource allocation. "Optimized Traffic Flows, " (HAROPA PORT)
- **Modal shift facilitation**, including developing digital services to support modal shift from road transport to barge- and rail transport/ Development of "digital services to support modal shift from road transport to barge- and rail transport" (Port of Antwerp-Bruges)
- **Emission monitoring** and insights into emission reduction via services. Insights in emission reduction via services" and "focus on emission reduction as a driver for strategy" (Portbase). Specific examples include "Carbon Intensity Gateway," "Port Call Optimization," and "Universal appointment system" (The Port of Los Angeles).
- Some PCS acknowledge their **indirect contribution** to sustainable governance, port-city integration, and environmental quality through their effective use. "The PCS itself doesn't implement directly sustainability practices, but its effective use in port and logistics processes contributes to sustainable governance, port-city integration, energy transition, maintain the ecosystem and biodiversity, environment quality." (APBA).

C. Measurable Outcomes

- Outcomes are measured using KPIs, emission reduction from services, system reliability, user satisfaction, and annual footprint calculations.
- **Most Common Measurable Outcome**: **Carbon footprint reduction is the most frequently cited measurable outcome** from sustainability programs (55.56%).
- **Other Significant Outcomes**: An increase in **modal shift**, specifically for rail (11.11%) and barge (11.11%) transport, is also frequently cited. Some organizations achieve a combination of these outcomes.

- Measurement Maturity: There are varying levels of measurement maturity; while some extensively track KPIs related to carbon footprint, air quality, energy efficiency, waste management, and noise levels (e.g., Autoridad Portuaria de Valencia), others are "still working on this" (Portbase) or have "not implemented" measurement (PORTIC, RAK Ports UAE, Portel Logistic Technologies). Several organizations explicitly state they do not measure their PCS's sustainability impact (dbh Logistics IT AG, Autoridad Portuaria de Valencia, APBA).
- **83.33% (15 out of 18 organisations) responded "No"** to offering PCS services related to sustainability measurement
- **16.67% (3 out of 18 organisations) responded "Yes"** and provided examples of their sustainability measurement services through their PCS:
  - **HAROPA PORT** offers **"processes optimization"** as an example of PCS services related to sustainability measurement.
  - **SOGET** offers a product called **"S)ONE Green"** which provides data about logistics emissions, serving as a key step towards compliance and measurement.
  - **Port of Antwerp-Bruges** provides **"Routescanner"** for planning supply chain transport, which includes an indication of the carbon footprint.

D. Communication Channels

Progress in sustainable development is communicated through various channels:

- **Internally**: Status updates on KPIs, reporting in meetings, internal platforms, and internal newsletters.
- **Externally**: Annual reports, public sustainability reports, dashboards, websites, email campaigns, newsletters, social media, and participation in public forums and international initiatives. Examples include HAROPA PORT using dashboards and annual reports, and Autoridad Portuaria de Valencia publishing an annual Sustainability Report. Some organizations do not communicate externally on this.

E. Collaboration and Knowledge Sharing

- **Overwhelming Support for Peer Collaboration**: There is an **overwhelming consensus that collaborating with peers would help improve sustainability results, with 100% of respondents agreeing**.
- **High Willingness to Share Success Stories**: **100% of respondents are willing to collaborate via the IPCSA community platform to share sustainability success stories**.
- **Strong Interest in Events**: Interest in participating in IPCSA-organized sustainability events is high, with respondents' keen on workshops, webinars, and conferences/seminars.

Key Motivators for Participation:

- **Recognition** for sharing sustainability initiatives, such as IPCSA Sustainability awards, is a significant motivator, with 66.67% finding it "Likely" to encourage active participation.
- The ability to receive **constructive feedback or suggestions** from other members and leaders on the platform is highly valued, with 78.95% agreeing it would encourage active participation.
- **Comparing their institution's sustainability practices with others** is seen as beneficial for identifying areas for improvement and inspiring new initiatives, with 66.67% finding it "likely" and 78.95% finding it helpful.

F. Legislation and Compliance

- **High Relevance of Legislation**: Sustainability legislation is largely relevant, with **72.22% of respondents finding it relevant**. Of these, 22.22% state its impact is clear, and 50.00% acknowledge its relevance but indicate further investigation is needed. Only 27.78% deem it "not relevant".
- **Key Regulations Mentioned**: Relevant regulations include the Corporate Sustainability Reporting Directive (CSRD), Carbon Border Adjustment Mechanism (CBAM), EU Deforestation Regulation, Digital Product Passport (DPP), MARPOL, SOLAS, FuelEU Maritime, California Air Resources Board, IMO frameworks, UNSDG, the Paris Agreement, EU ETS, and various local laws and strategies.
- **Community Compliance Expectation**: A majority (69.23%) expect their community to comply with sustainability legislation in time, though 30.77% are uncertain or do not expect it.
- **Expected PCS Role**: A strong majority (61.11% "Yes," 11.11% "Maybe") expect their PCS to play a role in supporting their community in implementing sustainability rules. However, some are unsure or believe it is not their role.
- **Willingness to Share Regulatory Information**: There is high willingness (83.33%) to share information on regulations for community benefit.
- **Supervision and Enforcement**: The current organization for supervising and enforcing sustainability regulations is mixed:
    - 27.78% supervise for both PCS and users.
    - 16.67% only for PCS.
    - 5.56% only for users.
    - A significant 27.78% indicate "No, this is not relevant".
    - Some respondents clarify that their PCS "contributes to comply, but it is not a direct player on this issue".
- **Associated Challenges**: Challenges in complying with sustainability legislation include:
    - Heterogeneity of stakeholders.
    - Data availability and interoperability.
    - Technical integration.
    - Evolving legislation and uncertainty.
    - Difficulty in convincing clients to invest in sustainability products.
    - Lack of awareness and formal enforcement.
    - The specific role a PCS can play in complying with legislation is not yet clear.
    - Complexity and lack of communication/knowledge about measuring sustainability data.

G. Data and Technology (AI, Analytics, Sharing)

- **Primary Domain of Involvement**: **Decarbonization is the primary domain of sustainability involvement** for most organizations (76,47 %) often encompassing fuel and energy consumption.
- **Current AI Use**: Most of **PCS's are not currently using AI** to improve ship calls or logistics (66.67%). However, 27.78% are using AI. Emerging AI applications include ETA predictions, port call optimization, ship & logistics events forecast, and setting up Large Language Models (LLMs) for planning processes.
- **Data Sharing Practices**: **72.22% (13 respondents) of organizations are currently not sharing data for sustainability purposes**, while 27.78% (5 respondents) indicated they are currently sharing data for sustainability purposes.
- **Potential Risks and Challenges in Data Sharing for Sustainability** When asked about potential risks or challenges, 15 out of 18 respondents provided answers. The concerns raised highlight various complexities in establishing effective data sharing for sustainability:
  - **Data Confidentiality and Privacy:** This was a frequently cited concern, including fear of sharing incorrect data, data confidentiality, commercial sensitivity, privacy leakage, and data sovereignty.
  - **Lack of Standardization and Fragmentation:** Respondents noted challenges due to a lack of standardization, fragmented systems, and different stakeholders using different data formats.
  - **Legal and Regulatory Constraints:** Specific mentions include GDPR, as well as broader legal and regulatory constraints. One respondent specifically noted intra-Emirate data-related policies.
  - **Consent and Obligations:** The need for consent from various parties to disclose information and the absence of mandatory obligations to report were identified as challenges.
  - **Awareness and Knowledge:** A lack of communication and low knowledge about measuring sustainability data were also mentioned.
  - **Reputational Risks:** The potential for reputational damage was also a concern
  - One organization, The Port of Los Angeles, stated they had **no potential risks or challenges** in data sharing for sustainability.
- **Willingness for Increased Data Sharing**: Despite current challenges, there is an **overwhelming willingness (100% combined "very likely," "likely," and "somewhat likely") to support initiatives aimed at increasing data sharing**, with 61.11% "Very likely" and 22.22% "Likely" to support such initiatives.

Conclusions:

Sustainability is Gaining Traction, but Inconsistent: While many PCS acknowledge and engage with sustainability, formal policies and mature measurement practices are not universal. Decarbonization and efficiency through digitalization are primary focuses.

- **Strong Appetite for Collaboration:** PCS operators are highly receptive to sharing knowledge, success stories, and participating in events, indicating a collective desire to advance sustainability.
- **Data Sharing is Critical but Challenging:** There is a clear recognition of the need for increased data sharing for sustainability, but concerns around data privacy, commercial sensitivity, and lack of standardization remain significant hurdles.
- **Legislation is a Driving Force:** Sustainability legislation, particularly EU regulations like CSRD, is a relevant and growing concern, prompting PCS to consider their role in supporting compliance within their communities.
- **PCS Role in Enforcement Varies:** While most PCS expect to play a supporting role in sustainability rule implementation, their direct involvement in supervising and enforcing these regulations is currently inconsistent.
- **Future Focus on Emission Visibility and Digital Efficiency:** PCS are increasingly looking to offer services that provide visibility on emission reduction and are interested in leveraging digital and AI technologies to enhance efficiency as a sustainability measure.
- **Recognition, constructive feedback, and benchmarking against peers** are strong motivators for PCS to actively engage in sustainability initiatives and platforms.

9. Recommendations for Port Community Systems Worldwide

Port Community Systems (PCSs) are uniquely positioned to drive the sustainability transformation of global logistics. Acting as trusted, neutral digital intermediaries, they connect ports, authorities, carriers, and logistics operators — and can therefore translate sustainability policy into measurable community impact. The following recommendations are intended to support PCS operators worldwide in embedding sustainability strategically, operationally, and collaboratively.

1. Adopt a Formal Sustainability Strategy

Establish an internal sustainability policy that aligns with international frameworks such as the UN Sustainable Development Goals (SDGs), Paris Agreement, IMO GHG Strategy, and EU Green Deal.
Integrate sustainability objectives into corporate governance and annual business planning.
Define measurable targets (e.g. energy efficiency, waste reduction, digitalization impact) and report progress annually.

2. Align with Recognized Standards and Frameworks

Implement sustainability data and reporting frameworks such as ISO 14083, the GLEC Framework v3.1, and the Smart Freight Centre End-to-End Guidance for GHG emissions reporting.
Apply the ESG (Environmental, Social, Governance) model to guide performance evaluation, procurement, and investment decisions.
Encourage independent assurance using recognized verification levels (e.g. Bronze–Silver–Gold, as per SFC).

3. Leverage PCS Data for Emission Visibility

Use existing operational data — vessel calls, container moves, hinterland transport, energy use - to generate emission transparency for community stakeholders.
Develop modular sustainability dashboards or add-ons that visualize key indicators such as CO_2 per transport leg, shore power usage, or modal shift rates.
Collaborate with emission-accounting partners such as BigMile, EcoTransIT, or TK'Blue to deliver verified GHG reports.

4. Build Standardized Data-Sharing Mechanisms

Define a Minimum Sustainability Data Set including vessel ID, fuel type, container weight, hinterland mode, dwell time, and shore power usage.
Promote interoperability through APIs and common data models to connect with carrier systems, transport management systems (TMS), and carbon accounting platforms.
Ensure data governance and confidentiality through neutral management, anonymization, and controlled access.

5. Support Modal Shift and Energy Transition

Develop or integrate services that facilitate modal shift from road to barge or rail, offering users comparative data on cost, time, and CO_2 reduction.
Support ports and authorities by providing digital services for shore power, alternative fuels, and electrified equipment monitoring.
Embed emission indicators into port call optimization and Just-in-Time (JiT) arrival services.

6. Foster Collaboration and Shared Learning

Strengthen knowledge exchange through the IPCSA Sustainability Working Group, webinars, and the planned IPCSA Data Hub for sustainability reporting.
Recognize and share successful case studies — e.g., Portbase's emission add-ons, SOGET's S)Green, and DAKOSY's end-to-end emission data exchange — to inspire replication.
Introduce an IPCSA Sustainability Award to highlight exemplary community-driven sustainability achievements.

7. Enhance Regional and Global Inclusivity

Expand participation from underrepresented regions (Africa, Asia-Pacific, Latin America) by offering adaptable templates, multilingual materials, and open-access guidance.
Promote regional pilot projects to demonstrate practical applications of sustainability data sharing and regulatory compliance.

8. Prepare for Emerging Regulations

Monitor and adapt to evolving frameworks such as CSRD, EU ETS, CBAM, and FuelEU Maritime, and provide data interfaces to support compliance reporting.
Anticipate the inclusion of Digital Product Passports and supply chain due diligence data in PCS environments.
Position the PCS as a trusted intermediary between business and government for verified sustainability data.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606

9. Prioritize Trust, Transparency, and Verification

Communicate progress openly through sustainability reports and dashboards.
Apply transparent methodologies and disclose data quality levels (primary vs. modeled).
Encourage members to move progressively toward verified data under ISO 14083 and SFC assurance schemes.

10. Accelerate Innovation and Capacity Building

Explore AI, analytics, and predictive tools for emission forecasting and operational optimization.
Offer training to port communities on sustainable logistics, digital reporting, and compliance.
Integrate sustainability modules into IPCSA's educational initiatives such as the IPCSA Masterclass.

Conclusion

Port Community Systems worldwide can transition from facilitators of logistics efficiency to catalysts of sustainable transformation. By embedding sustainability into data governance, operational services, and community partnerships, PCSs can help ports achieve measurable progress toward decarbonization and resilience — turning sustainability from compliance into competitive advantage.

10. Conclusion

10.1 Key Insights from the Guidelines

Port Community Systems (PCSs) are decisive enablers of maritime decarbonization and regulatory compliance—not by directing physical operations, but by orchestrating trusted, standardized data flows across carriers, terminals, authorities, and hinterland actors. When embedded in governance frameworks and aligned with recognized methodologies (e.g., ISO 14083/GLEC), these data flows make emissions visible, verifiable, and actionable at community scale. The Guidelines set out a coherent, multilayer approach (organization, community, ecosystem) and an eightpillar strategy—from collaboration and green technologies to process optimization, data sharing, training, evaluation, standards, and infrastructure—that together translate sustainability ambition into repeatable practice. They also emphasize the growing compliance perimeter (AFIR, CSRD, EU ETS, FuelEU Maritime, EUDR, DPP, EU Data Act), clarifying where PCSs can serve as neutral, secure intermediaries for reportinggrade information.

The evidence gathered—from the datasharing architecture and PortXchange example to survey feedback—shows a sector moving from pilots to implementation, while still facing challenges around data quality, standardization, confidentiality, and assurance. The IPCSA working group's focus on knowledge exchange, common data needs, and standard alignment directly targets those challenges and accelerates collective learning.

10.2 Lessons from PCS Case Studies

Practical outcomes arise when digital services are tied to clear sustainability levers:

- **DAKOSY:** arrival coordination and mandatory truck slot booking reduce gate congestion and idling, linking operational efficiency to emissions reduction.
- **dbh Logistics:** establishing a baseline and engaging staff converts strategy into measurable internal improvements (energy, mobility, paperless processes), underscoring that transparency and participation are prerequisites for progress.
- **Portic:** combining OPS investments with dataenabled monitoring shows how physical infrastructure and PCS capabilities reinforce each other.
- **SOGET:** the S)ONE/S)Green pathway demonstrates that standardized inputs feeding accredited engines can produce consistent, multimodal, ISOaligned GHG outputs for the community.
- **Portbase:** dashboards, modalshift enablement, and greencorridor participation illustrate how embedding sustainability into the PCS portfolio yields systemwide benefits.
- **Community Network Services (CNS):** incentives (e.g., carbon insetting credits) and improved container visibility for JustinTime decisions show how PCS data can steer customer behaviour toward lower carbon choices.

Across these cases, three crosscutting lessons stand out: (1) start with reliable baselines and common definitions; (2) turn governance, APIs, and assurance into everyday utilities; and (3) align community level services with emerging regulations so compliance effort yields operational value.

10.3 The Path Forward: Trust, Technology, Transparency

To scale impact, the global PCS community should prioritize:

Trust: strengthen neutral governance, role clarity, and privacypreserving datasharing so stakeholders are confident contributing the data needed for Scope 3 and regulatory uses.

Technology: mature interoperable interfaces (APIs, identifiers, quality indicators), expand coverage of relevant datasets (e.g., OPS events, modal choices, energy profiles), and integrate with assurance and reporting portals by design.

Transparency: apply ISOaligned methods and publish clear datalineage and quality metadata, enabling comparable, auditready reporting that supports both compliance and community optimization.

In short, PCSs will accelerate decarbonization when reliable data, robust governance, and interoperable tooling meet shared incentives. By operationalizing the Guidelines' eight pillars, extending data quality and assurance, and deepening international collaboration through IPCSA, ports can deliver a cleaner, smarter, and more resilient maritime ecosystem.

Glossary of Terms and Abbreviations

AFIR: Alternative Fuels Infrastructure Regulation – framework to deploy clean-energy infrastructure across transport networks.

CBAM: Carbon Border Adjustment Mechanism – aligns carbon costs between EU products and imports.

CSRD: Corporate Sustainability Reporting Directive – standardized ESG disclosures integrated in annual reports.

CSDDD: Corporate Sustainability Due Diligence Directive – due-diligence duties on human rights and environment.

EUDR: EU Deforestation Regulation – traceability and legal-origin requirements for selected commodities.

EU ETS: EU Emissions Trading System – cap-and-trade for greenhouse-gas emissions.

ESG: Environmental, Social and Governance – framework to assess sustainability performance.

GLEC: Global Logistics Emissions Council Framework – methodology for logistics emissions accounting.

GRI: The Global Reporting Initiative provides a framework for sustainability reporting by organizations on economic, environmental, and social impacts.

IMO: International Maritime Organization – UN agency for maritime safety and environmental performance.

IPCSA: International Port Community Systems Association – global association of PCS operators.

ISO 14083: Standard for quantifying and reporting GHG emissions from transport chain operations.

PCS: Port Community System – neutral digital platform connecting port stakeholders.

DPP: Digital Product Passport – interoperable product-level data for circular economy and traceability.

PortXchange: Digital collaboration platform for optimizing port calls and reducing emissions.

OPS: Onshore Power Supply – shore electricity to avoid auxiliary engine use at berth.

International Port Community Systems Association UKEIG
Registered Office: The Chapel, Maybush Lane, Felixstowe, Suffolk, IP11 7LL, UK
Tel: +371 29273218 – email: inga.morton@ipcsa.international – www.ipcsa.international
IPCSA UKEIG – Registered Address as above – Grouping No GE000268
IPCSA UKEIG is a UK VAT Registered Company: Registered No. GB 135 735606