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ORIGINAL ARTICLE

Green strategies in ports: a stakeholder management perspective

Giovanni Satta[1] · **Francesco Vitellaro**[1] · **Abdel Ganir Njikatoufon**[1] · **Marcello Risitano**[2]

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Abstract

This paper delves into the intricate relationship between green strategies and stakeholder management within the port industry. We employ a robust conceptual framework and a tailored methodology, encompassing all sixteen Italian Port Management Bodies and analysing 344 related green strategies. A unique indirect approach is introduced to identify the primary stakeholders targeted by these strategies. The research identifies three primary categories of green strategies: energy efficiency, electric supply infrastructure development, and renewable energy promotion. These strategies align with increasing environmental expectations and stricter regulations. Terminal operators and local communities emerge as primary stakeholder groups, underscoring their growing influence in port management decisions. This research bridges a substantial gap in the academic literature by shedding light on the benefits of green strategies for the principal port stakeholders and the pivotal role of these strategies for stakeholder management in ports. Port managers can leverage these insights to make informed strategic decisions, strengthen their corporate social responsibility initiatives, and better address environmental concerns while meeting stakeholder expectations. Furthermore, the paper offers valuable guidance to policymakers aiming to stimulate additional investments in environmental sustainability, thereby meeting the expectations of port stakeholders and enhancing port competitiveness.

Keywords Green strategy · CSR · Stakeholder management · Stakeholder prioritisation · Sustainability · Port managing bodies · Ports · Italian ports

1 Introduction

Over the past decades, there has been a notable shift in societal expectations concerning the role of businesses (Buysse & Verbeke 2003). Stakeholders increasingly call for a more holistic approach to defining success, emphasising corporate

Extended author information available on the last page of the article

decisions' broader environmental and social implications (Klefsjö et al. 2008). In response to this mounting pressure, numerous organisations have dedicated significant resources to implement comprehensive environmental management practices, to improve their economic, environmental, and social performance (Rodrigues & Ensslin 2023). Drawing from stakeholder management theory, as articulated by Freeman et al. (2000), businesses are now encouraged to create value for diverse stakeholders, encompassing employees, investors, customers, and suppliers, all while considering environmental concerns. The interplay between environmentally responsible corporate strategies and effective stakeholder management is paramount (Aragòn-Correa et al. 2020). However, significant gaps persist within the academic literature, necessitating urgent empirical investigation, especially in the transport sector.

The port industry has experienced substantial transformation and innovations in recent years (Bergqvist & Monios 2019). The sector places a high premium on safety and adherence to regulatory standards—for instance when it comes to port-worker training—due to the risks confronting both port workers and port users, as well as because of the environment impacts of port operations (ILO, 1998). This unwavering commitment to safety reinforces the persistence of specific conservative procedures and protocols. Nevertheless, the port sector has recently encountered significant technological innovations and organisational restructuring, reshaping port management and the maritime supply chain (Di Vaio & Varriale 2018). Environmental sustainability has emerged as a central concern, marked by a growing interest in reducing emissions and other externalities (e.g., noise), and transitioning to cleaner operational practices (Alamoush et al. 2021; Felício et al. 2023). Indeed, this transformation represents a significant departure from historical practices and presents Port Management Bodies (PMBs) with new challenges. PMBs are now tasked with incorporating the environmental concerns of port stakeholders into their decision-making processes. This adjustment is crucial for ensuring compliance with increasingly stringent environmental regulations, and maintaining competitiveness in the industry, with green strategies (GS) serving as the equitable means to achieve these objectives.

Despite the increasing significance of GSs, more theoretical and empirical research is needed, to examine how the selection, planning and execution of GSs from PMBs depend upon their stakeholder prioritisation practices. Additionally, there is a need for a taxonomy of GSs to enhance scholars' and practitioners' understanding of the environmental advantages associated with such *corporate social responsibility* (CSR) interventions, and the Port Stakeholder Groups (PSGs) that benefit from them. Identifying salient beneficiary PSGs of GSs can aid port managers in strategic decision-making and contribute to refining CSR strategies.

Considering the existing void in literature, this paper endeavours to address the following two research questions (RQs):

RQ1: What are the primary typologies of GSs implemented by PMBs and their corresponding CSR objectives?
RQ2: Which PSGs emerge as salient beneficiaries of GSs implemented by PMBs?

The paper makes a significant contribution to the academic field of management by presenting a conceptual framework and research methodology for the empirical analysis of GSs from the standpoint of stakeholder management. The research rigorously applies the proposed methodological framework to all sixteen Italian PMBs, offering an extensive case study that yields theoretical insights and practical implications to researchers and port management professionals. Furthermore, it offers insights for policymakers, focused on facilitating additional investments in environmental sustainability objectives, aligning them with the expectations of PSGs and thereby enhancing the competitiveness of ports.

2 Theoretical foundations

2.1 Green strategies and CSR-related objectives in the port industry

In the coming years, ports worldwide will encounter various environmental challenges associated with climate change adaptation, mitigation, emission reduction in port activities, and adherence to stricter environmental regulations (Poulsen et al. 2018; Castellano et al. 2020; Alamoush et al. 2021). Consequently, integrating a "green" perspective into port management and development plans allows PMBs to pursue sustainable growth and meet the expectations of multiple stakeholders (Bergqvist & Monios 2019).

PMBs have a pivotal role in the port ecosystem (Van der Lugt et al. 2013; Castellano et al. 2020), taking responsibility for reducing environmental impacts and promoting decarbonisation (Hiranandani 2014; Bergqvist & Monios 2019). As regulators, PMBs enforce environmental regulations and policies, ensuring compliance by carriers, terminal operators, and port users (Poulsen et al. 2018). They are also expected to prioritize the adoption of GSs to meet policy targets, address climate change, and gain support from PSGs (Martínez-Moya et al. 2019; Tai & Chang 2022). Several studies argue that PSGs are increasingly pressuring port management for sustainable solutions (Le et al. 2014; Acciaro 2015; López-Navarro et al. 2015; Chen & Lam 2018; Parola et al. 2018; Stein & Acciaro 2020). Consequently, PMBs have integrated CSR aspects into their planning activities (Dooms et al. 2013).

Prior research has explored GSs in the port sector from different perspectives, including managerial, operational, technical/technological, and normative ones (Acciaro et al. 2014a, b; Lam & Notteboom 2014; Di Vaio & Varriale 2018; Dinwoodie et al. 2012; Puig et al. 2020; Davarzani et al. 2016; Martínez-Moya et al. 2019; Sdoukopoulos et al. 2019; Poulsen et al. 2018; Woo et al. 2018; Zis 2019; Schrobback & Meath 2020; Alamoush et al. 2021). The literature consistently reveals a strong connection between GSs and the concept and principles of CSR, as the environmental objectives of GSs often extend to other areas of port management, particularly in managing stakeholder groups (Dooms 2019). GSs play an important role in enabling PMBs to meet the demands of diverse PSGs and fulfil various CSR objectives, encompassing economic, market, governance, regulatory, and social aspects that complement environmental goals (Acciaro 2015; Ashrafi et al. 2020;

Castellano et al. 2020). Table 1 summarises the six main CSR-related objectives of GSs grounded on well-established academic contributions.

However, the implementation of CSR, particularly in the context of GSs, often encounters various obstacles and barriers (Dooms 2019). One significant challenge is identifying and prioritising relevant stakeholders from numerous groups and individuals with a vested interest in the business (Mitchell & Agle 1997). This issue is particularly prominent in the port industry, where PMBs must align strategic objectives with the demands and interests of diverse PSGs (Acciaro 2015). Dooms (2019) argues that PMBs should prioritise identifying, classifying, and ranking salient stakeholders before devising specific sustainability strategies to ensure efficient resource allocation and achieve desired outcomes. Due to their unique institutional and governance frameworks, this issue has become increasingly critical for Italian ports. A significant gap persists between the intended and the actual reform trends in key areas of port administration, including financial autonomy, stakeholder representativeness, managerial independence, model hybridisation, and the devolution process (Parola et al. 2017). This disparity adversely affects ports' governance and strategies, particularly regarding sustainability actions, as a cohesive national strategy is absent in this industry, resulting in a fragmented array of locally driven initiatives.

The recognition of stakeholder salience necessitates well-defined criteria for evaluating the influence of each PSG on port processes, operations, and performance. However, this procedure has often limitations stemming from the PMB's potentially politically biased behaviours and assessments (Notteboom et al. 2015), as demonstrated in several concrete and anecdotal recent circumstances both in large and small Italian ports (Haralambides 2017). Port managers may prioritise certain PSGs (e.g., employees and labour unions, terminal operators, carriers, regulators) due to the predominantly public nature of PMBs, which prioritise strategic objectives for the public good, rather than market competitiveness. While some PMBs are transitioning towards more independent and commercially oriented management structures, as private firms, most ports worldwide are still government-owned or state-owned enterprises prioritising public interest over market competition (Van Der Lugt et al. 2013).

Despite the heterogeneity and complexity of PSG interests (Le et al. 2014; Ashrafi et al. 2020), to our knowledge, prior studies have not adequately explored the stakeholder prioritisation process for GSs from the perspective of PMBs. This process warrants greater attention from scholars, to contribute to the international discourse on CSR in the port domain and support port managers in making complex strategic decisions. Therefore, this paper addresses this gap by presenting a conceptual framework and an empirical approach, to advance understanding.

2.2 Conceptual framework

We utilise CSR and stakeholder relationship management principles to establish a conceptual framework for examining GSs in ports and identifying salient beneficiary PSGs, as depicted in Fig. 1.

Table 1 Green strategies implemented by port management bodies: CSR objectives

CSR-related objective	Description	Literature
Environmental	Efforts to lower environmental impact, address climate change adaptation and mitigation, reduce harmful emissions, and abatement of externalities on land and water	Bailey and Solomon (2004), Dinwoodie et al. (2012), Acciaro et al. (2014a), Davarzani et al. (2016), Martínez-Moya et al. (2019), Sdoukopoulos et al. (2019), Alamoush et al. (2021)
Economic	Economic and business growth, value creation, competitiveness, enhanced operational efficiency, and cost savings	Acciaro (2015), Puente-Rodríguez et al. (2016), Kang and Kim (2017), Woo et al. (2018), Castellano et al. (2020)
Market	Meeting the expectations of maritime cluster firms, effective response to market and competitor pressures, improve the quality and range of services to better meet customer demands	Acciaro et al. (2014b), Acciaro (2015), Poulsen et al. (2018), Ashrafi et al. (2020), Castellano et al. (2020)
Governance	Ethical leadership, collaboration with port stakeholders, and adoption of sustainable governance models and practices	Lam and Notteboom (2014), Acciaro (2015), Puente-Rodríguez et al. (2016), Poulsen et al. (2018), Yoshitani (2018), Ashrafi et al. (2019), Zis (2019), Schrobback and Meath (2020)
Regulatory	Ensure compliance with regulation at national and international levels and develop stringent policies and measures at the port level	Acciaro et al. (2014a), Hiranandani (2014), Lam and Notteboom (2014), Le et al. (2014), Puente-Rodríguez et al. (2016), Kang and Kim (2017), Poulsen et al. (2018), Woo et al. (2018)
Social	Legitimacy from local communities, social license to operate, public image enhancement, protection of human health, and development of social initiatives	Hiranandani (2014), Acciaro (2015), López-Navarro et al. (2015), Notteboom et al. (2015), Puente-Rodríguez et al. (2016), Kang and Kim (2017), Poulsen et al. (2018). Ashrafi et al. (2020), Stein and Acciaro (2020)

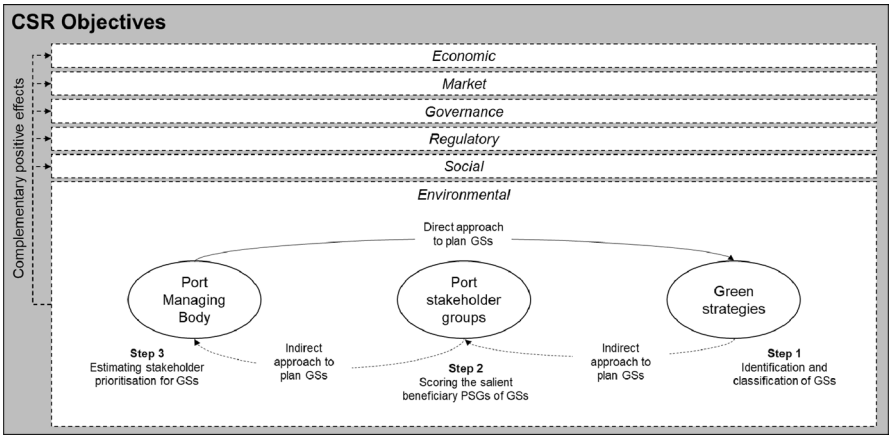

Fig. 1 Conceptual framework

To address the research questions, the conceptual framework adopted in this study highlights the complementary effects of environmental interventions in achieving economic, market, governance, regulatory, and social objectives. Two direct and indirect approaches are employed to identify salient PSGs of GSs based on stakeholder management theory and the pioneering contribution from Notteboom et al. (2015).

In line with the direct approach, PMBs evaluate PSGs based on their strategic objectives, assess the benefits of potential GSs for each PSG, and select the GSs that offer more significant benefits to the salient PSGs. However, due to the predominantly public nature of PMBs, the direct approach may be subject to limitations and biases and may prioritise certain PSGs based on politically driven considerations that may align differently from the actual strategic goals of the PMBs.

Instead, the indirect approach proposed by Notteboom et al. (2015) can arguably overcome the above limitations. This empirical methodology involves three main steps. First, identifying and classifying GSs inductively performed by selected PMBs. Second, evaluating of the environmental benefits and CSR spillovers of each GS, considering social, economic, market, regulatory, and governance objectives. This allows for scoring the relevance of each GS typology for different PSGs. Third, developing a GSs/PSGs matrix that highlights the beneficiary PSGs for each GS. By combining the outcomes of these empirical phases, indirect estimation of stakeholder prioritisation by PMBs in developing effective GSs can be achieved. The subsequent methodological section presents a detailed explanation of the indirect approach.

3 Methodology

3.1 The Italian case

The conceptual framework used in this study is rooted in the European regulatory and institutional context, as it specifically applies to Italian ports. Several factors justify this choice, driven by economic, environmental, and regulatory considerations.

From the economic viewpoint, Italian ports hold strategic locations along major transportation routes, handling significant cargo and passenger volumes. In 2022, Italian ports handled 490 million tons of cargo and served 61 million passengers (Assoporti 2022). Italy is a key player in Mediterranean short-sea shipping, with a 39% market share, and ranks first in Europe for cruise passenger numbers (Brewer 2020). From an environmental perspective, the port industry contributes significantly to Italy's air pollution and greenhouse gas (GHG) emissions. Italy has consistently exceeded the EU average for PM2.5 levels, as reported by Brewer (2020).

Furthermore, the transportation sector was responsible for over 24% of Italy's total GHG emissions in 2019 (European Commission 2020). Italy's extensive coastline of 7,600 km, with approximately one-third of the population residing within 5 km of the coast, magnifies the environmental impact of the maritime industry. As an EU member state, Italy must align with the European Commission's pollution reduction targets (e.g., strategy 2018/773/EC). This necessitates the adoption of GSs by PMBs, requiring comprehensive insights into the green initiatives of Italian ports. Additionally, Italy's legal and institutional framework underwent significant changes following the 2016 reform of the Italian port system. The reform introduced substantial alterations in administrative procedures and port management practices. The Port System Environmental and Energy Plan (DEASP) became mandatory for Italian PMBs, assessing energy demands and outlining crucial GSs to reduce the environmental impact of ports. Despite the strides made by Italian PMBs in enhancing sustainability, considerable variation exists in the types of GS initiatives and their geographical coverage, warranting further examination, in order to understand the primary drivers, which shape both the type and the magnitude of GS actions and interventions implemented by the Italian PMBs.

This study encompasses all sixteen Italian PMBs as the research domain, ensuring a comprehensive understanding of the Italian context. We map, analyse, report and discuss 344 GS actions. Including all PMBs allows for a robust analysis of green strategies and stakeholder prioritisation practices in the Italian port industry. This approach facilitates the identification of common trends, patterns, and variations across different PMBs, offering valuable insights and a holistic understanding of the Italian context. The extensive coverage enhances the reliability and validity of the findings, contributing to the academic literature on stakeholder prioritisation and green strategies in port management.

3.2 Taxonomy of green strategies

The first step of the proposed indirect methodological approach involves identifying and classifying GSs. Desk research thoroughly examined vital documents such as the Port System Environmental and Energy Plan (DEASP), Strategic Planning Document of Port Systems (DPSS), and other strategic planning documents and reports on environmental and energy management released by the sixteen Italian PMBs. Furthermore, we conducted comprehensive interviews with managers from 7 Italian PMBs, which represent approximately 50% of the sample. The interviews aimed to gather more in-depth information about the environmental advantages of GSs and their associated objectives.[1] The in-depth interviews consisted of two parts: the first focused on the PMB's CSR strategy and the related GSs to meet stakeholders' expectations, while the second aimed to gain deeper insights into each GS's achieved or anticipated environmental benefits.

After conducting a thorough analysis and reviewing relevant documents obtained from desk research and interviews with expert personnel from the PMBs, a database comprising 344 GSs was created. These GSs serve as our unit of analysis and are categorised based on their project title and timeframe. The breakdown of GSs per sample PMBs is presented in Table 2. By this approach, the study aims to gain comprehensive knowledge about the GSs implemented by the sixteen Italian PMBs, their alignment with stakeholders' expectations, and the environmental outcomes they have generated or are expected to generate.

A systematic approach was taken to organise and classify the GSs using two classification schemes: GS typology and GS objective. The typologies of GSs were developed through an inductive process based on the analysis of the examined documents. This involved iteratively constructing, testing, and revising categories while continuously comparing data and information. The outcome of this process gave a set of eight comprehensive and internally coherent types, which can be seen in Table 3. To ensure the accuracy and reliability of the categorisation, all the GS actions included in the analysis have been reviewed and evaluated at least three times before the final labelling, involving different researchers and assessing intercoder reliability. This collaborative review confirmed that the categories accurately represented the characteristics of the GSs and were consistent with the research findings.

In addition, a brief survey was administered to academic colleagues and to the port managers who were previously interviewed to validate the identified categories.

[1] We scheduled several meetings with key figures of these PMBs. These included meetings with the directors of the Technical and Environmental Management Department of the Western and Ligurian Sea Port Network Authority, the head of Special Projects, Innovation, and Institutional Relations of the Eastern Ligurian Sea Port Network Authority, a manager from the board of the Major Projects Office of the Central Tyrrhenian Sea Port Network Authority, and a manager from the Planning and Development Department of the Ionian Sea Port Network Authority. We also conducted three online meetings with a manager from the Planning and Development Department of the Sardinian Sea Port Network Authority, a manager from the Development and Innovation Department of the North Tyrrhenian Sea Port Network Authority, and a manager from the Southern Tyrrhenian Ionian Sea Port Network Authority.

Table 2 Sample green strategies

PMB	No. of green strategies	% of the sample (%)
North Tyrrhenian Sea (Ports of Livorno, Capraia, Piombino, Rio Marina, Portoferraio, and Cavo)	44	13
Northern Adriatic Sea (Ports of Venice and Chioggia)	35	10
Sardenian Sea (Ports of Cagliari, Olbia, Golfo Aranci, Porto Torres, Oristano, Portovesme, Santa Teresa Gallura)	33	10
Western Ligurian Sea (Ports of Genoa, Prà, Savona and Vado)	32	9
Eastern Ligurian Sea (Ports of La Spezia and Marina di Carrara)	31	9
Northern Central Tyrrhenian Sea (Ports of Civitavecchia, Fiumicino and Gaeta)	30	9
Eastern Adriatic Sea (Port of Trieste and Monfalcone)	22	6
Western Sicily Sea (Ports of Palermo, Termini Imerese, Porto Empedocle and Trapani)	20	6
Southern Adriatic Sea (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli)	20	6
Ionian Sea Port (Ports of Taranto)	19	6
Eastern Sicily Sea (Ports of Augusta and Catania)	15	4
Central Adriatic Sea (Ports of Ancona, Falconara, Pescara, Pesaro, San Benedetto del Tronto and Ortona)	12	3
Central Tyrrhenian Sea (Ports of Naples, Castellammare di Stabia and Salerno)	8	2
Northern Central Adriatic Sea (Port of Ravenna)	8	2
Southern Tyrrhenian and Ionian Sea (Ports of Gioia Tauro, Corigliano, Crotone, and Palmi)	8	2
Messina Strait (Ports of Messina and Milazzo)	7	2
Overall	344	

Table 3 Green strategies typology

Green strategies typology	Description
Digitalisation and ICT platforms	Digital innovations (e.g., IoT[a], digital platforms for data exchange, smartphone applications, etc.) are being used to mitigate the environmental concerns of maritime logistics operations within the port domain. The focus is on improving operational efficiency by using ICT platforms, smart sensors, and other technological tools to monitor emissions and environmental externalities stemming from port activities
Energy efficiency	Strategies for enhancing the energy efficiency of maritime logistics activities in the port. These strategies encompass substituting lighting systems and other technical and technological solutions to decrease energy consumption, related GHGs, and harmful emissions
Renewable energy production	Development and installation of renewable energy production systems in the port domain. These strategies include installing solar panels, wind turbines and wave energy technologies to produce energy
Policies and measures	Policy frameworks and incentive schemes to drive the adoption of eco-friendly practices and behaviours. These initiatives include green energy procurement, establishment of technical committees specializing in environmental monitoring and promotion within the maritime cluster, and network collaboration agreements facilitating the port's transition to the green initiative
Bunkering and storage facilities for alternative fuels	Bunkering and storage facilities construction for providing alternative fuels in the port domain, including liquefied natural gas, hydrogen, ammonia, biofuels, etc.
Facilities and infrastructure for electric energy supply	Construction of facilities and infrastructure for electric energy supply in the port domain. These strategies comprise shore power (i.e., cold ironing) and electric vehicles charging facilities
Land-use conversion	Strategies to convert specific port areas into new neighbourhoods, parks, museums, and edutainment centres related to the maritime logistics industry and touristic attractions
Research and development	Research initiatives and investigations to improve port sustainability, undertaken by the port authority/port management body (individually or in collaboration with scientific/industrial partners)

[a]The Internet of Things (IoT) denotes the transformative technology facilitating the seamless integration of interconnected devices, sensors, and systems within the maritime sector. This interconnected network collects and transmits real-time data, revolutionizing fleet management, enhancing cargo tracking, and refining supply chain processes. By harmonizing these elements, this integration endeavours to elevate efficiency, safety, and sustainability standards in maritime operations

This step was undertaken to obtain feedback and insights from experts in the field, ensuring the reliability and suitability of the classification scheme.

The second classification scheme is based on five categories of CSR-related objectives: economic, market, governance, regulatory, and social. These categories, encompassing environmental and non-environmental objectives, were derived deductively from the existing CSR literature on port management, as presented in the conceptual framework.

3.3 Evaluation of the salient beneficiary port stakeholder groups of green strategies

According to Freeman's (1984) stakeholder definition, port stakeholders can be described as individuals or groups with a legitimate interest in or impacted by the actions or inactions of the port (Notteboom & Winkelmans 2003). This broad definition allows for various interpretations and classifications of significant stakeholders, both those who can contribute to achieving port objectives and those who can be affected by port operations. Building upon significant scholarly contributions (e.g., Notteboom and Winkelmans 2003; Notteboom et al. 2015; Ashrafi et al. 2020), this study identifies ten distinct groups of port stakeholders, which are presented in summarised form in Table 4.

A structured questionnaire was administered to a panel of international experts with extensive expertise in ports to evaluate the prioritisation of crucial beneficiary PSGs about GSs (i.e., the second step of the indirect approach). The questionnaire was distributed online using Survey Monkey and it was sent to 75 experts. The survey was open for response from October 18, 2021, to December 18, 2021. Out of the 65 received responses, 50 were deemed complete and suitable for analysis, resulting in a response rate of 67%. The final panel's composition demonstrated consistency in dimension, heterogeneity, and respondents' experience. Notably, 70% of the participants had over 10 years of experience in the maritime industry, with 36% having more than 20 years of experience. The responses were obtained from experts residing in 23 different countries (Fig. 2), ensuring a comprehensive evaluation of salient beneficiary PSGs.

Furthermore, among the respondents, 38% were affiliated with universities or research centres, while 30% were associated with PMBs (Fig. 3). The remaining panel members held positions in private companies such as shipping companies, transport and logistics firms, terminal operators, and financial operators. Additionally, some respondents held key positions within public entities, including municipalities, regions, transport-related ministries, national or international regulatory agencies, and other organisations involved in the port industry. This diverse representation within the panel ensured a comprehensive perspective from various sectors and institutions relevant to the field.

The questionnaire, administered to the international experts, requested them to assess the expected benefits for each PSG resulting from the implementation of GSs, using a 7-point Likert scale. The scale ranged from 1, indicating "no benefits," to 7, representing "maximum benefits." The responses were used to populate the "salient

Table 4 Port stakeholder groups (PSGs)

Group	Description
Shareholders/owners	Public entities or private organisations/firms which hold the ownership or at least a stake in the Port Authority (PA) or Port Managing Body (PMB), empowered to appoint the PA/PMB board of directors or executive directors (e.g., central government, regional governments, municipalities, and other public entities)
Financial community	Credit and financial institutions that provide funding to support PA/PMB investment decisions and port development
Employees and labour unions	Labour unions, executive and operational employees in the port domain
Terminal operators	Companies owning or operating a terminal under concession
Other concessionaires	Firms operating at least a concession related to warehouses, industrial sites, logistics platforms, malls, or commercial areas in the port area
Carriers	Shipping lines (container, ro-ro, cruise companies, etc.) and tramp operators (liquid bulk, dry bulk, etc.)
Port users	Freight forwarders, ship agents, brokers, road hauliers, railway companies, logistics providers, etc.
Passengers	Ferry or cruise ship travellers who pass through the port for embarking/disembarking
Local community and societal groups of interests	People and organisations located close to the port areas and directly or indirectly impacted by port operations and business
Regulatory agencies	Policymakers and public institutions that set the institutional framework and governance mechanisms

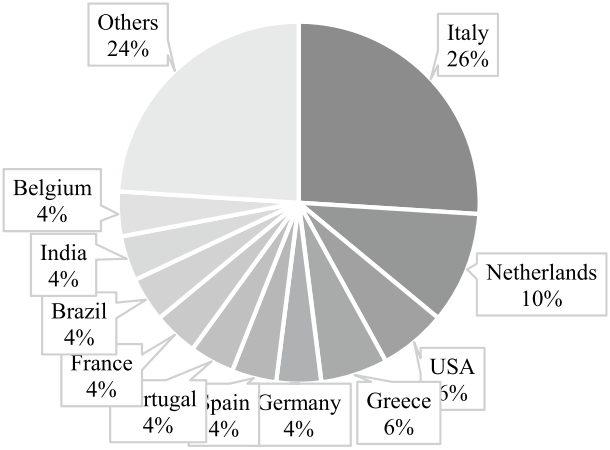

Fig. 2 Descriptive statistics of the survey respondents: country of employment

beneficiary stakeholders' matrix" in Table 5. This matrix captures the perspectives and experiences of the experts, mapping the 8 identified typologies of GSs in the rows and the 10 PSGs in the columns. The average scores assigned to each of the 80 combinations within the matrix were utilised as coefficients to estimate PMBs'

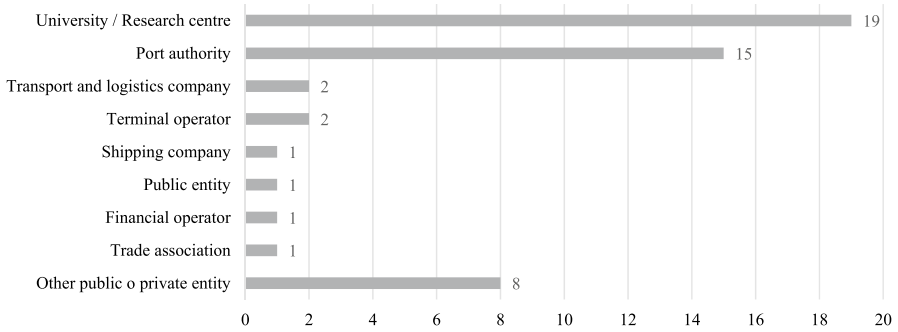

Fig. 3 Descriptive statistics of the survey respondents: type of company or public entity

prioritisation of stakeholders for GSs. The estimation follows the procedure outlined in Table 5: the average scores were used as coefficients (c_i where $i = 1, 2, \ldots 0.80$), multiplied by the number of GSs of each typology performed by the Italian PMBs of the sample (n_j where $j = 1,2,\ldots 0.8$). The sum of the results of each column ($\sum c_i * n_j$) constitutes the total score achieved by each PSG. The relative scores (i.e., $\sum c_i * n_j / \sum\sum c_i * n_j$) represent the estimation of stakeholder prioritisation for GSs performed by the Italian PMBs of the sample.

Finally, the matrix was tested on the Italian case, to carry out the last step of the indirect approach. The theoretical and empirical findings are reported and discussed in Sect. 5. The salient beneficiary stakeholders' matrix scores were normalised to understand the results better.

4 Findings

4.1 The main typologies of green strategies and related CSR objectives

Figure 4 reports the main typologies of GSs implemented by the Italian PMBs and related CSR objectives. As to be expected, the majority of GSs consist of actions and interventions for improving port energy efficiency (29% of the sample), followed by facilities and infrastructure for shore energy supply (19%) and renewable energy production (18%). Then, 10% of the sample concerns "policies and measure" interventions and 9% refer to "digitalisation and ICT platforms" (e.g., the integration of IoT systems to streamline port operations and monitor environmental impact; the establishment of a digital port community platform for seamless management of import and export processes; the deployment of unmanned robots for monitoring carrier activities and port infrastructure; and the implementation of a smart traffic tool and mobile application to enhance gate management efficiency and access). Research and development" accounts for 8%, "bunkering and storage facilities for alternative fuels" for 5% and only 3% of interventions concern "land use conversion".

Table 5 The salient beneficiary stakeholders' matrix

Green strategy	Shareholders/ owners	Financial community	Employees and labour unions	Terminal operators	Other concessionaires	Carriers	Port users	Passengers	Local community and societal groups of interests	Regulatory agencies	Total score
Digitalisation and ICT platforms	$c_1 * n_1$	$c_2 * n_1$	…	…	…	…	…	…	…	$c_{10} * n_1$	$\sum \mathbf{c_i * n_1}$
Energy efficiency	…	…	…	…	…	…	…	…	…	…	…
Renewable energy production	…	…	…	…	…	…	…	…	…	…	…
Policies and measures	$c_i * n_4$	$c_i * n_4$	…	…	…	…	…	…	…	$c_i * n_4$	$\sum \mathbf{c_i * n_4}$
Bunkering and storage facilities for alternative fuels	…	…	…	…	…	…	…	…	…	…	…
Facilities and infrastructure for electric energy supply	…	…	…	…	…	…	…	…	…	…	…
Land-use conversion	…	…	…	…	…	…	…	…	…	…	…
Research and Development	$C_{71} * n_8$	$c_{72} * n_8$	…	…	…	…	…	…	…	$C_{80} * n_8$	$\sum \mathbf{c_i \times n_8}$
Total score	$\sum \mathbf{c_i * n_j}$	…	…	…	…	…	…	…	…	$\sum \mathbf{c_i * n_j}$	$\sum\sum \mathbf{c_i \times n_j}$
Relative score	$\sum \mathbf{c_i * n_j} / \sum\sum \mathbf{c_i * n_j}$	…	…	…	…	…	…	…	…	$\sum \mathbf{c_i * n_j} / \sum\sum \mathbf{c_i * n_j}$	**1**

Regarding CSR-related objectives, "market" and "economic" objectives (see Table 1 for details) emerge as the most diffused ones within the sample GSs (39% and 37% of the sample, respectively). Social objectives rank third (13%), followed by governance (8%) and regulatory objectives (3%).

The findings per single PMB are reported in Figs. 5 and 6. The North Tyrrhenian Sea Port Network Authority, consisting of the ports of Livorno, Piombino, Capraia, Portoferraio and Rio Marina, exhibits the most significant number of interventions (44), representing the lead Italian PMB for GSs regarding digitalisation and ICT platforms (9), and research and development (9).

Regarding energy efficiency and alternative fuels bunkering and storage facilities, the Northern Adriatic Sea Port Network Authority is the leader, with 16 and 4 GSs, respectively. As energy hubs, ports consume different types of energy in substantial volumes. Thus, energy efficiency measures are crucial in making port activities more sustainable. The most prevalent interventions implemented by sample PMBs revolve primarily around three core areas: replacing conventional lighting fixtures with LED lighting systems, retrofitting the fleet of handling equipment (e.g., forklifts, reach stackers, straddle carriers), and enhancing port buildings' energy efficiency.

Conversely, bunkering and storage facilities for alternative fuels are almost neglected by Italian PMBs, except for the Eastern Adriatic Sea (Ports of Trieste and Monfalcone) and North Tyrrhenian Sea Port Network Authorities (Ports of Livorno, Piombino, Capraia, Portoferraio and Rio Marina) that have carried out two interventions primarily focused on LNG.

The Western Ligurian Sea Port Network Authority (Ports of Genoa, Prà, Savona and Vado) shows the most comprehensive and diversified array of GSs. It is by far the Italian PMB with the most interventions regarding land use conversion (44% of the sample). Two specific projects named "Dune di Prà" have been initiated in this respect. The projects aim to establish a "green zone" between the operational area of the port of Genoa Prà and the adjacent urban regions to mitigate the acoustic impact of port operations and provide citizens with a new open-air space near the sea. Despite being a marginal investment, only the Southern Tyrrhenian and Ionian Sea (2) (Ports of Gioia Tauro, Corigliano, Crotone, and Palmi), Eastern Ligurian Sea (1) (Ports of La Spezia and Marina di Carrara), Northern Central Tyrrhenian Sea (1) (Ports of Civitavecchia, Fiumicino and Gaeta), and Western Sicily Sea (1) (Ports of Palermo, Termini Imerese, Porto Empedocle and Trapani) Port Network Authorities have shown participation in this particular category of interventions.

The Eastern Ligurian Sea Port Network Authority (ports of La Spezia and Marina di Carrara) is the most active in GSs related to policies and measures (29% of the sample). It has devised a range of incentives aimed at facilitating the adoption of renewable energy sources by shipowners and terminal operators. The measures also include tariff changes, offering different prices to port stakeholders; market-based measures aiming at creating funds to promote the adoption of greener technologies, improve port management and offset greenhouse gas emissions; and voluntary agreements, which rely on the CSR behaviour of port stakeholders.

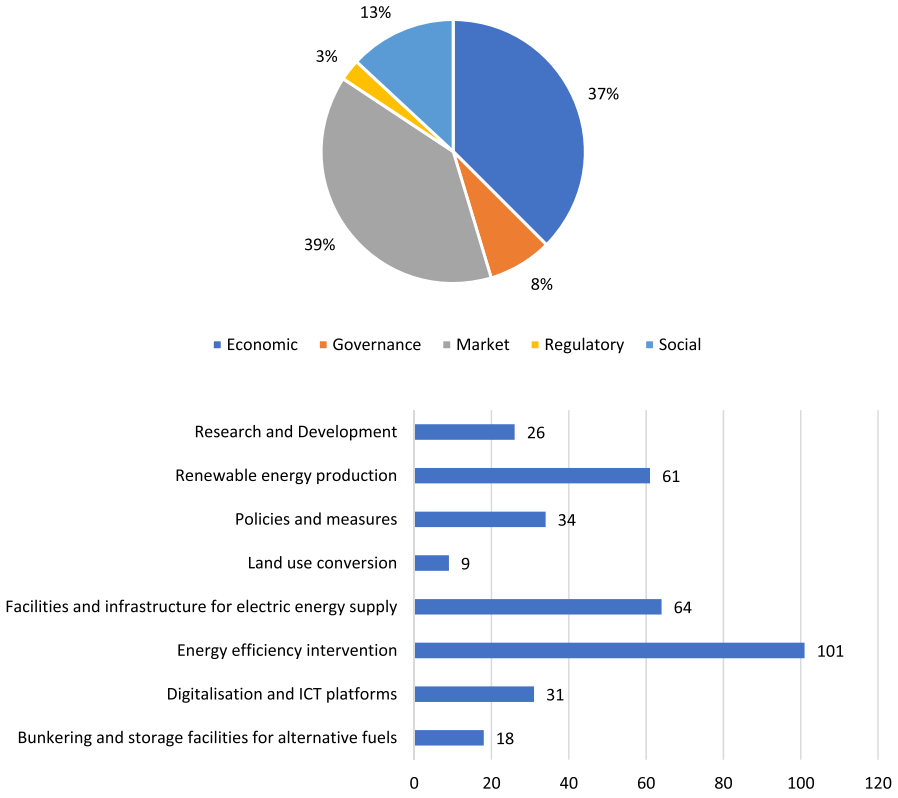

Fig. 4 Green strategies typologies and related CSR objectives: The Italian port case

Regarding renewable energy production, the first-ranked Italian PMB is the Northern Central Tyrrhenian Sea Port Network Authority (accounting for 18% of the sample interventions). Most interventions primarily focus on installing photovoltaic plants due to their high technology readiness level (TRL), affordability, operating and maintenance costs. Unlike bunkering facilities, installing solar panels on building roofs eliminates the space constraint issue, making their implementation feasible. Consequently, it is unsurprising that photovoltaic plants rank as the third most frequently implemented green solution in Italian ports.

Concerning the "facilities and infrastructure for electric energy supply" category, the North Tyrrhenian, the Central Adriatic and the Eastern Adriatic Sea Port Network Authorities are the leaders in implementing these GSs (10% of the sample each). The main interventions are cold ironing and electricity recharge columns for vehicles. Supported by the National Recovery and Resilience Plan fund, all the Italian Sea Port Network Authorities will install at least one cold ironing plant for supplying electricity to ships; this justifies its position as the second most implemented GS in Italian ports.

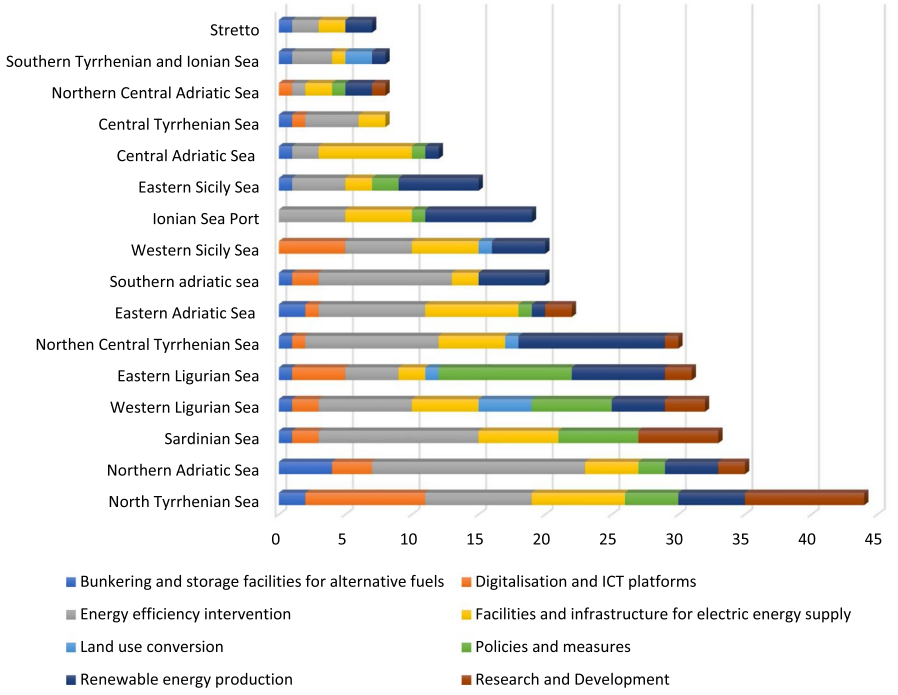

Fig. 5 The main findings from the Italian case: the most diffused green strategies

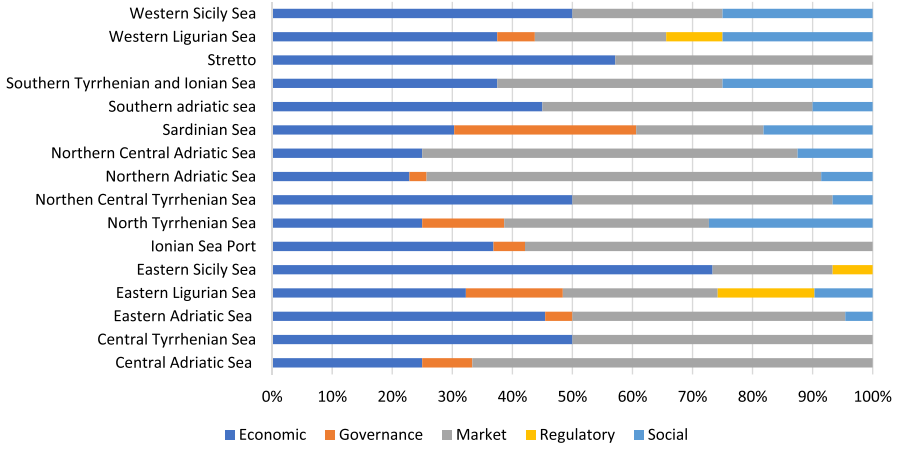

Fig. 6 The main findings from the Italian case: primary objectives of Italian PMBs

4.2 Stakeholder prioritisation for green strategies

The results from the questionnaire, administered to the panel of international experts, are presented in Table 6. The average scores highlight the salient beneficiary

PSGs for each typology of GSs.

Table 6 presents the normalised relative scores of the salient beneficiary stakeholders' matrix for each PMB in Italy. The rows in the table represent the hierarchy of PSGs for the Italian PMBs. Each cell value indicates the percentage level of prioritisation for each PSG.

Figure 7 presents the most important stakeholders target by Italian PMBs when implementing GSs. As expected, terminal operators represent the primary beneficiaries of GSs, with an average prioritisation of 15.6%. The results align with expectations. Given that terminal operators cater to the primary clients of PMBs, it is essential for the latter to strategically align with their expectations to achieve optimal outcomes. The focus on meeting the needs and goals of terminal operators reflects the significance of catering to their requirements for fostering productive and mutually beneficial relationships. The local community and societal interest groups are prominent beneficiaries at 15.5%, with shareholders/owners following closely in the third position at 14.0%. Interestingly, passengers, employees, and labour unions receive lower rankings in prioritisation, suggesting comparatively less focus on their concerns and needs.

While there are no substantial variations among the scores achieved by each PSG, essential distinctions emerge among the PMBs included in the sample. The Southern Tyrrhenian Ionian Sea (ports of Gioia Tauro, Corigliano, Crotone, and Palmi), Northern Central Tyrrhenian Sea (ports of Civitavecchia, Fiumicino and Gaeta), and Ionian Sea (Port of Taranto) Port Network Authorities demonstrate a higher priority for the local community and societal interest groups, with respective scores of 17.6, 16.6, and 16.6%. In contrast, terminal operators take precedence in the Central Tyrrhenian Sea (ports of Naples, Castellammare di Stabia and Salerno), Southern Adriatic Sea (ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), and Western Sicily Sea (ports of Palermo, Termini Imerese, Porto Empedocle and Trapani); Port Network Authorities, that reported scores of 16.7, 16.7, and 16.6%, respectively. Compared to other PMBs in the sample, the Central Adriatic Sea Port Network Authority (ports of Ancona, Falconara, Pescara, Pesaro, San Benedetto del Tronto and Ortona) pays significant attention to carriers and port users, evidenced by 14.0 and 12.9%, respectively. The Port Network Authorities of the Ligurian Sea, i.e. Western Ligurian Sea (ports of Genoa, Prà, Savona and Vado) and Eastern Ligurian Sea (ports of La Spezia and Marina di Carrara), while prioritising terminal operators and local communities as the most relevant stakeholders, also assign notable significance to shareholders/owners, with scores of 14.1% for the Eastern Ligurian Sea and 14.0% for the Western Ligurian Sea. These variations reflect the contexts and dynamics within each PMB, underscoring the diverse stakeholder priorities across different regions.

5 Discussion

In response to RQ1, which focuses on identifying the primary typologies of GSs adopted by PMBs and their corresponding CSR objectives, our findings reveal three main typologies of GSs. These include energy efficiency, accounting for

29% of the sample; facilities and infrastructure for shore supply (19%); and renewable energy production, representing 18% of the sample. The findings are unsurprising and validate the observation that Italian ports are actively implementing GSs that align with the core objectives of the European Green Deal, which are geared toward advancing the industry's transition to environmentally sustainable energy practices. To date, the Environmental and Energy Plans of the Italian Port System (DEASP) show that investments in green strategies amount to more than €200 million in the 2022–2023 period, considering only of completed projects with reported figures. Green investments in the Italian port industry are expected to increase significantly in the next years. In this vein, for example, the first round of the "Green Ports" project, i.e., the recent national bidding procedure (deadline expired in November 2021), which provided public incentives for both PMBs and private operators investing in green port projects located in the Northern and Central Italy, has guaranteed over 270 million euros for green projects (not included in the previously reported figures) planned in the next years (to be accomplished by December 2027). In addition, a similar amount of financial resources will be earmarked for ports located in Southern Italy in the next two years. Furthermore, these findings align with the principal goals outlined in the Italian National Recovery and Resilience Plan which foresees funding for port modernisation and efficiency measures of more than EUR 2.8 billion for the years 2021 to 2026, including the ambitious plan to electrify the quays of 34 Italian ports[2] before 2026. Finally, our analysis reveals that only 3% of the interventions are related to land use conversion. This finding emphasises the need for increased efforts in transforming port areas by altering their usage to generate value for the local community. This perspective is also supported by authors such as Felício et al. (2023), who have demonstrated how sustainable port practices can influence the perception of ports by local communities. This implies that more attention and action are required to convert and repurpose port areas, ensuring they align with sustainable development goals and positively impact the surrounding communities.

Our results show that market and economic objectives take precedence within the sampled Italian PMBs, represented 39 and 37% of the total CRS-related objectives. Economic objectives revolve around creating value within the port system, enhancing competitiveness, and optimising operational efficiency (e.g., construction of a new branch line to supply power to towers T18 and T19, as well as lighting systems with LED lights in the Port of Olbia). On the other hand, market objectives focus on meeting the expectations of firms within the maritime cluster, effectively responding to market pressures and competition (e.g., implementation of cold ironing in the Port

[2] Port of La Spezia, Port of Leghorn, Port of Piombino, Port of Portoferraio, Port of Civitavecchia, Port of Naples, Port of Salerno, Port of Goia Tauro, Port of Cagliari, Port of Olbia, Port of Golfo Aranci, Port of Torres, Port of S. Teresa di Gallura, Port of Portovesme, Port of Palermo, Port of Trapani, Port of Termini Imerese, Port of Empedocle, Port of Catania, Port of Augusta, Port of Taranto, Port of Ancona, Port of Pesaro, Port of San Benedetto di Tronto, Port of Ortona, Port of Pescara, Port of Ravenna, Port of Venezia, Port of Trieste, Port of Porto di Monfalcone, Port of Rovigo, Port of Nogaro, Port of Siracusa, Port of Gela.

Table 6 The salient beneficiary stakeholders' matrix: coefficients

Green strategy	Shareholders/ owners	Financial community	Employees and labour unions	Terminal operators	Other concessionaires	Carriers	Port users	Passengers	Local community and societal groups of interests	Regulatory agencies
Digitalisation and ICT platforms	5.1	4.7	4.4	5.8	4.9	5.5	5.5	4.9	4.9	5.3
Energy efficiency	5.4	4.9	4.4	5.6	5.2	4.9	5.0	4.3	5.6	4.9
Renewable energy production	5.4	5.1	4.1	5.3	5.1	4.6	4.7	4.1	5.5	5.0
Policies and measures	5.4	5.0	4.4	5.4	5.1	5.1	5.2	4.2	5.3	5.3
Bunkering and storage facilities for alternative fuels	5.2	4.7	4.2	5.3	4.9	5.6	5.0	3.7	4.7	4.8
Facilities and infrastructure for electric energy supply	5.2	4.8	4.3	5.5	5.1	5.6	5.4	4.4	5.5	5.0
Land-use conversion	4.8	4.4	4.4	3.9	4.1	3.5	4.1	5.0	6.1	4.7
Research and Development	5.4	5.1	4.7	5.2	5.1	5.0	5.2	4.3	5.4	5.3

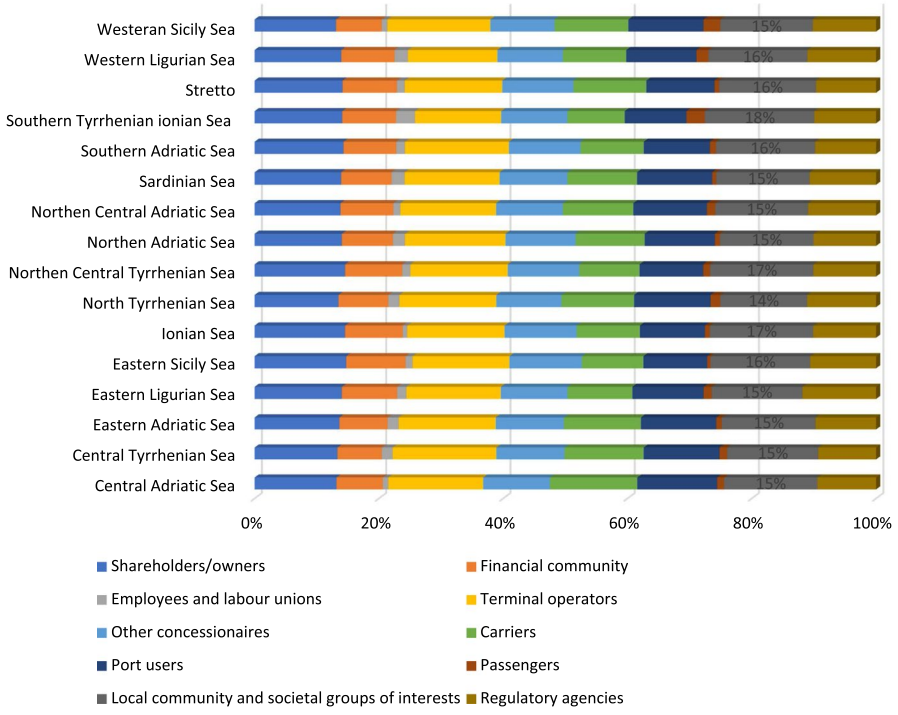

Fig. 7 Stakeholder prioritisation for green strategies by Italian port managing bodies

of La Spezia). These findings underscore the paramount importance of GSs in not only reducing the environmental impact of port activities but also in bolstering the overall competitiveness of the Italian port system. Social objectives constitute 13% of the identified GSs, reflecting the increasing interest of Italian PMBs in obtaining the social license to operate and enhancing their public image. The recognition of social objectives signifies a shift in the mindset of port managers towards assuming greater social responsibility and engaging meaningfully with local communities. Though rooted in the nuances of the Italian context, our study's methodology holds potential for broader generalisation. Our survey questions transcend specific national boundaries by employing an indirect approach facilitated by input from a panel of international experts. Consequently, the resultant matrix offers a versatile tool for investigating ports in various countries. Furthermore, our ongoing research aims to provide valuable benchmarks for assessing the evolving prioritisation strategies of PMBs concerning emerging stakeholder categories.

Regarding RQ2, which focuses on identifying the key beneficiaries of GSs implemented by PMBs, we have utilised an indirect empirical approach to estimate stakeholder prioritisation. The findings unveil three prominent PSGs for PMBs: terminal operators (15.6%), the local community and societal interest groups (15.5%), and shareholders/owners (14.0%). These findings align with the resulting CSR-related objectives. Terminal operators and shareholders prioritise economic and market objectives, while the local community and social interest groups focus on social

objectives. Notably, the local community and social interest groups rank second, ahead of shareholders, and nearly on par with terminal operators. This underscores the importance of GSs in achieving social approval and emphasises the necessity of considering the perspectives of local communities in port decision-making processes. This is a consequence of the growing recognition of the substantial impact of port activities on air quality, especially in coastal regions, as substantiated by studies like that of Gilbert et al. (2018). This research reveals that approximately 70% of ship emissions occur within 400 km off the coast, with severe implications for local communities. Given the well-known high emissions associated with port operations, an ongoing dialogue with the surrounding community is crucial.

This emerging inclusive approach of PMBs aims to jointly address the challenges of maintaining business continuity while effectively managing both short-term and long-term environmental concerns. Through proactive collaboration, port managers can foster shared responsibility and pursue sustainable solutions that balance economic and ecological considerations. For example, the Blueconnect project, conducted by the Eastern Ligurian Sea Port Network Authority aims to establish a collaborative network among companies, institutions, and industry operators to implement initiatives and policies supporting the transition of the port of La Spezia into a smarter and more environmentally sustainable port. Another noteworthy initiative is the Aer Nostrum project, which not only engages terminal operators and shipping companies but also fosters collaboration among various Italian Port Managing Bodies (PMBs) to enhance air quality in ports and surrounding areas. This project engages Port Network Authorities of the North Tyrrhenian Sea (ports of Livorno, Capraia, Piombino, Rio Marina, Portoferraio, and Cavo), the Sardinian Sea (ports of Cagliari, Olbia, Golfo Aranci, Porto Torres, Oristano, Portovesme, and Santa Teresa Gallura), and the Western Ligurian Sea (ports of Genoa, Prà, Savona, and Vado) that have collaborated to implement an innovative model for monitoring and forecasting emissions within ports. This model not only facilitates the collection of crucial data but it also empowers ports to strategically plan and share sustainable actions, taking into account both environmental and economic factors. The literature on green business typically distinguishes between firms that adhere to compliance-driven approaches, which focus primarily on meeting legal mandates, and those that embrace proactive environmental strategies, considering a range of factors beyond government regulation (Aragòn-Correa et al. 2020). Specifically, incorporating environmental considerations into corporate strategy beyond what is mandated by government regulations can be seen as a means of enhancing a company's alignment with the increasing environmental concerns and expectations of its stakeholders. The findings of this study show that the GSs implemented by PMBs reflect an endeavour to meet the expectations of emerging PSGs (i.e., local community and societal interest groups) that go beyond what is required by the regulations. These PSGs are, therefore, recognised as crucial participants in the development of port corporate strategies, signifying a noteworthy transformation in the management of the conservative port industry.

Interestingly, our findings underscore that employees and labour unions hold a lower position in the PSG hierarchy. Despite Italian PMBs' high sensitivity to social issues concerning port labour, as reflected in the DPSS and related initiatives,

GSs do not substantially benefit port workers. Workplace safety and labour rights are prominent concerns within the port domain but have limited connection with GSs. As discussed in the literature, organisations with a track record of inadequate quality management concerning environmental and social concerns related to their employees may encounter difficulties in attracting or retaining highly skilled personnel. These employees are often strongly inclined toward organisations with proactive environmental management practices (Buysse & Verbeke 2003; Klefsjö et al. 2008). In this context, the effectiveness of PMBs can be significantly enhanced through the cultivation of green competencies, a process heavily reliant on the participation and engagement of their employees.

This discussion underscores that Italian ports primarily embrace environmental sustainability initiatives in alignment with the objectives set forth in the European Green Deal. This is in line with previous literature that suggests that policies aimed at further investments in these areas could significantly contribute to improving port competitiveness (Woo et al. 2018). Moreover, such policies can align with the expectations of PSGs, ultimately enhancing the competitiveness of ports. The findings also indicate that Italian PMBs prioritise economic and market objectives. Consequently, it is imperative for policies to seek a delicate equilibrium between these objectives and environmental aspirations. By doing so, policies can encourage businesses to adopt sustainable practices while safeguarding their competitiveness. Continuing to prioritise and actively promote the engagement of local communities in port decision-making processes through communication about upcoming port authority meetings, newly proposed infrastructure projects, notices of environmental impact documents, port commission meeting minutes and monitoring of environmental performance remains of paramount importance (Rodrigues & Ensslin 2023). For example, in 2021, the Western Ligurian Sea Port Network Authority organised the first Italian public debate regarding the construction of the new outer breakwater for the Port of Genoa. Introducing this procedure was pivotal in planning a significant port infrastructure project of national importance, aimed at facilitating the development of the port area and enhancing economic benefits. Given the potential environmental and social impact, the project underwent community evaluation through four meetings to gather feedback and proposals to enrich the design, as well as to address any potential disagreements and achieve a consensus-approved project. This demonstrates local communities are gaining ever more influence in shaping the trajectory and success of port businesses, especially in urban areas closely tied to port infrastructure where the environmental impact is felt more. Therefore, policies should persist in fostering strong community involvement. However, it is noteworthy that employees and labour unions appear to hold a comparatively lower position within PMBs' stakeholder hierarchy. To rectify this, policies could be instrumental in encouraging port businesses to establish and implement GSs with a focus on encouraging green behaviours (e.g., reducing resource consumption, waste generation, and overall environmental impacts), improving workplace safety, thereby enhancing the well-being of employees of the port business.

6 Conclusion

The study delves into the emerging and significant domain of green strategies within the conservative port industry, employing a strategic management lens. It introduces a robust conceptual framework integrating the foundational principles of stakeholder management and, more specifically, of CSR to comprehensively unveil and categorise the primary types of GS activities carried out by PMBs. To validate empirically the effectiveness of the conceptual framework, the study conducts an extensive investigation of all sixteen Italian PMBs to answer two distinct and compelling research questions.

This paper contributes substantially to the academic debate regarding the interplay between environmental initiatives and stakeholder management in the port sector, by introducing an indirect empirical approach for stakeholder prioritisation. It also offers valuable insights to aid port managers in enhancing their decision-making processes regarding GSs. This approach allows managers to effectively assess and prioritise the diverse PSGs based on their specific needs and preferences. Consequently, ports can optimise their portfolio of GSs, tailoring strategies to maximise the benefits for targeted PSGs. Additionally, the findings provide policymakers with valuable insights that can serve as a cornerstone for nurturing the ongoing development of GSs in ports. These insights can potentially advance the environmental sustainability efforts of ports, striking a harmonious balance between economic, market and environmental objectives, fostering the involvement of local communities and diverse stakeholders in decision-making processes, and encouraging employee engagement in sustainability initiatives.

Nevertheless, it is crucial to recognise specific limitations in this paper, which provide opportunities for future research. Firstly, since many of the GSs discussed in this study are yet to be implemented, assessing their impact becomes challenging. The analysis primarily relies on projections and expert opinions, which may introduce uncertainty in evaluating benefits. Secondly, the assessment of the benefits of PSGs is based on the perspective of international experts who participated in the survey panel. This may introduce a certain degree of bias to the empirical analysis. To enhance the robustness of the coefficients associated with the GSs-PSGs matrix, future studies could incorporate the perspectives of the PSGs themselves. A more comprehensive and balanced understanding can be obtained by directly evaluating their own perceptions of the benefits derived from each typology of GSs. Addressing these limitations will strengthen the empirical analysis and provide a more nuanced understanding of the potential impact and benefits of GSs for different PSGs. It is recommended that future research endeavours consider PSG perspectives as an integral part of the evaluation process, ensuring a more holistic assessment of the benefits arising from various GSs.

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Data availability The dataset generated and analysed during the current study is available from the corresponding author on reasonable request.

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Authors and Affiliations

Giovanni Satta[1] · Francesco Vitellaro[1] · Abdel Ganir Njikatoufon[1] · Marcello Risitano[2]

✉ Giovanni Satta
giovanni.satta@economia.unige.it

Francesco Vitellaro
francesco.vitellaro@unige.it

Abdel Ganir Njikatoufon
abdelganir.njikatoufon@cieli.unige.it

Marcello Risitano
marcello.risitano@uniparthenope.it

[1] Department of Economics and Business Studies, University of Genoa, Via Vivaldi 5, 16126 Genoa, Italy

[2] Department of Business and Quantitative Studies, University of Naples Parthenope, Via Generale Parisi 13, 80132 Naples, Italy