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# Selective Adoption: How Port Authorities in Europe and West Africa Engage with the Globalizing ‘Green Port’ Idea

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**Abstract:** The scholarly debate on ‘green ports’ since it emerged in the policy discourse of international maritime organizations has largely focused on exploring the economic benefits associated with implementing related policies and developing green guides and codes of conduct for port authorities. In contrast, it has received little attention how the green port idea and according measures are taken up and what role is played by contextual factors in places of such uptake. By engaging with the expanding literature on policy mobilities and drawing on empirical information collected through interviews with port officials from four ports in Europe and West Africa, we argue that context-specific factors strongly influence what we call the selective adoption of green port tools and measures for transitioning ports towards sustainability. They include environmental priorities, regulatory requirements, financial resources and the immediate areas of competence of port authorities, which all vary widely across regions and specific ports.

**Keywords:** sustainable ports; policy mobilities; translation; sustainability fix; port infrastructure

## 1. Introduction

While ports are regarded as critical national infrastructures and important for economic development, port authorities are experiencing increased pressure to address the negative environmental and social impacts associated with port operations and development [1,2]. Recently the green port concept emerged in the policy discourse of international maritime organizations as a way to address environmental and social sustainability concerns related to ports (see [3,4]).

Since then, various norm setting maritime organizations and port environmental networks have created and promoted green technologies, guides and different management tools to enable ports’ transition towards sustainability [5–10]. In Europe, the European Sea Ports Organisation (ESPO) has developed green guides and codes of conduct for its ports [11]. In North America, the Association of American Port Authorities (AAPA) provides a sustainability guide for its ports [12], and in West Africa, a joint initiative between the regional port association (PMAWCA), the regional secretariat of United Nations Environment Programme (UNEP) and the non-governmental Ports Environmental Network Africa (PENAf) has recently initiated an ambitious effort to devise a common environmental or ‘green port’ policy for the region [13]. Aside from these, a new transnational body, the GreenPort network, with support from technology companies such as Siemens, Kalmar and academic institutions has emerged, devising and circulating various environmental best practices and market based tools and technologies for the greening of ports [6].

Consequently, in the course of the last few years, many ports across the globe have either implemented a green port policy or adopted ideas akin to the concept, with the ports of Bremen being

among the first ports globally to implement a green port strategy in 2009 [14,15]. Some ports in Europe and North America have since been either certified, labeled or conceived as green ports [16–19]. Being conceived as a green port or acquiring a green port status or label is said to be positively linked with higher port performance and economic benefits, and has the potential of attracting climate and green funds and trading partners [3,20,21].

The green port idea as we refer to it in this paper has as such attracted a lot of attention from scholars, particularly from maritime economists, engineers, social scientists and others from interdisciplinary backgrounds. The scientific literature on green ports has thereby largely focused on evaluating the benefits associated with implementing a green port policy [22–25]; identifying managerial and policy tools for the greening of ports [3,17,26–32]; determining priority green port tools and indicators for evaluating the green performance of ports [20,33–35] and transnational networks or initiatives of ports and port cities for improving environmental performance, both at ports and along the value chain [36–38]. Few authors have engaged critically with the green port concept, especially referring to concerns about greenwashing and the social justice of green transformations at ports [39–42].

We argue that the strong economic focus of research on green ports so far has not yet taken adequate account of the disparate economic and political contexts in which port authorities engage with or adapt the green port idea. Hence in this article, we aim at exploring how port authorities in Europe and West Africa engage with the green port idea. Specifically, we provide insights into how contextual factors lead to what we call the selective adoption of green port tools and measures. We argue that the green port concept is adapted in ways that are meaningful in specific political, regulatory and social contexts. To do this, we draw on insights from a policy mobilities scholarship in human geography to structure and interpret our empirical research.

As general background to this development, it should be noted that the role and governance of port management has become more diverse within and across regions over the last two decades [43]. This is also true for the regions we will look at. Akin to the Asian model, West African ports have seen some degree of involvement of private actors (e.g. global terminal operators); nevertheless, some port authorities like the Ghana Ports and Harbors Authority do not follow a strict landlord model and are also involved in providing operational services [44]. They have thus fused two management systems in a hybrid form differing from most European ports (like the ports of Bremen), which are organized in accordance with the landlord model [15]. While the new governance arrangements are not the focus of this paper, it is important to bear in mind that, in all instances, port authorities have re-positioned themselves and are playing a managerial role in environmental and sustainability issues related to all aspects of port operations and activities. In the studied West African and European ports, port authorities implement green port policies both individually and in collaboration with private terminal operators. They also play a role as landlords and regulators.

The paper proceeds as follows: In Section 2, we briefly introduce green port as a concept and a label and we outline tools and technologies for green ports based on reviews of the existing literature. In Section 3, we present the theoretical background we used in framing the paper and we follow this with the research methodology in Section 4. In Section 5, the results and discussion are presented with the final discussion and concluding remarks in Section 6.

## 2. Background and Rationale

### 2.1. Green Port as a Concept and a Label

Although ports are the backbone to the global economy; increased shipping through ports, new port infrastructure development projects and functional activities at ports can be associated with adverse environmental and social impacts on coastal locations and neighboring communities [2,45–47]. Consequently, stricter environmental legislations as well as social and environmental performance standards and requirements have emerged from various quarters in recent years [48–50]. Ports have therefore become important entry points for addressing the environmental and social externalities

caused by maritime activities and are important nodes for improving the sustainability performance of global value chains.

According to Pavlic et al. [4], the term 'green port' evolved from joint research activities between academia and industry related to sustainability in the maritime sector. The term green port and the concept underlying it has been used since the early 1990s (see [51]). Between the 1990s and the late 2000s, it was perceived as a "new ideology to realize sustainable development (at ports) through coordinating the balance between environmental effect and economic benefit" [52] (p. 1873; see also [53]). The label 'green port' was consequently used loosely in referring to ports that are proactive in addressing their negative environmental externalities. Wooldridge et al. [54] noted that in the early periods, priority environmental issues that were being addressed by European and North American ports included water quality, dredging and noise. Wooldridge and his colleagues, therefore, argue that port managers may use existing laws that apply to them as a baseline in devising their green strategies.

Since 2010, while the green port concept is applied as a new paradigm that seeks to harmonize port activities with environmental and social considerations without jeopardizing economic growth, and has as such become synonymous with sustainable ports [5], the label 'green port' has been largely associated with ports that have implemented projects and initiatives that address air quality, climate change and/or those that use renewable energy or clean fuels for port operations [17,18].

However, it has been little studied so far how political, economic and institutional conditions may shape how port authorities engage with the green port idea and the tools, technologies or measures that they may adopt. Davarzani et al.'s [39] comprehensive review on green ports found that knowledge on green ports has been dominated by research on European and North American ports. This does not come as a surprise as the green port idea originated from European and North American contexts [19]. Pioneering ports in Europe including Bremen (Bremerhaven), Rotterdam and Antwerp are already labeled or conceived as green ports based on the implementation of measures geared mainly towards low carbon operations or improving air quality [1,9,55–57], energy efficiency or the use of renewable energy and eco-friendly mobility at ports [8,17,29,58,59] or reducing impacts on climate change [5,60], which are considered to be priority green port measures. It is in this regard that Di Vaio et al. [61] (p. 229) for example remarked that "(today) those ports that tend to assume ( . . . ) energy efficient behaviours ( . . . ) have been broadly defined as green ports". To the best of our knowledge however, there is no formal institution that certifies or confers the label 'green port' on ports, except for ESPO's EcoPort network, which confers the 'EcoPorts' label on ports that have gone through the certification process for its Ports Environmental Review System (PERS) standard or ports that are certified to the ISO 14001 standard. Many ports that use the label 'green port' therefore either registered it as a trademark on their own and promote it in the form of a green marketing strategy or are conceived as such by scholars based on some so-called priority green port indicators for ports sustainability [20,34,35].

However, taking green ports along its environmental sustainability leg, addressing environmental issues such as dredging, port and ship-generated waste are equally important areas for green ports [27,62–64] especially as ports may have varying environmental priorities. While the port of Hamburg for example, is considered a green port due to its initiatives in energy management and climate change mitigation [17,18,65], controversies about the dredging of the Elbe river remain [66,67]. On the other hand, ports that have created innovative approaches for waste management, e.g., in West Africa, are rarely considered to be green ports even as they engage with the globalizing green port idea [63]. However, as ports differ in size, energy demand, legislation and environmental priorities and are located in countries at different levels of economic development [2,68] it may be impossible for one port to adopt all green port tools or measures at the same time. By turning towards the differing ways in which port authorities in disparate contexts engage with the green port idea, we argue in this paper that in engaging with the globalizing green port idea, port authorities are likely to select tools or measures that make sense in the disparate geographical, political and economic contexts within which ports are located. We argue that, rather than a standardized practice with a clearly defined set of technologies, a green port is better understood as a 'travelling idea' or a rather vague vision, with a

loose (but not arbitrary) ensemble of different practices and measures aimed at transitioning ports towards sustainability. Seen in this way, engaging with the green port idea becomes a local practice that is embedded in specific times and places.

## 2.2. Green Port Tools, Technologies and Measures

As outlined above, there are multiple measures that have been discussed under the term green ports. Over recent years, the focus of debates has shifted substantially: While in the early 2000s, a strong emphasis has been put on relatively narrow fields such as waste management, water quality or noise reduction, the focus currently is on broader mainstreaming tools like management protocols, etc. The main approaches that have been discussed over the years can broadly be grouped under three categories: (1) Technical infrastructures; (2) pricing and access and (3) integrated management approaches.

First, a number of technical infrastructures have been proposed that often deal with specific problem areas such as air quality, ship waste or energy efficiency and transitions.

**Cold ironing:** Otherwise also known as onshore power supply (OPS), cold ironing is a land-to-ship technology that provides shore-side electricity connection derived mainly from renewable sources like wind, hydro and solar so that ships can switch off their on-board diesel-powered generators and auxiliary engines while they are docked at the port [59]. Several reviews of case studies and meta-analyses summarize the empirical research on cold ironing and its benefits [30,31,58,59,69,70], which ports are more likely to implement this tool based on prevailing political and economic conditions [58,59,71] and the challenges associated with adopting cold ironing [31,72]. Its main objective is to help port authorities to remove greenhouse gas emissions from ships in port areas [32] and to contribute to reducing the impacts of port activities and shipping on climate [36].

**Waste reception infrastructure:** Marine litter and pollution is a major environmental problem and as such the provision of a port reception facility has been identified as a green port measure [1,73,74]. The development of a port waste reception facility enables port operators to receive or collect all forms of ship waste, including garbage, its oily sludge and all other forms of waste generated on board the ship so that it does not end up in the oceans and seas as has been the case for centuries. It also allows port authorities to collect ship wastewater (ballast water) so that ports do not directly discharge it into the port waters with the risk of the introduction of invasive species.

**Cargo handling and transport:** Measures involve switching or converting from carriers, hybrid vehicles, trailers, tractors and forklift trucks and cranes that use diesel fuels to those that use bio-fuels or are powered by electricity generated from renewable sources. This can also include a shift towards automation and paperless systems of port operation and management. Port authorities like in Rotterdam set a strict standard for cargo handling trucks. In other ports, trucks and vehicles are required to meet sulphur fuel limits in order to reduce emissions and ports procure only sustainable logistics [29]. Under this category also is the use of a more sustainable modal split as a green port measure. In order to lower the dependence on trucks for conveying goods from the port to the hinterlands and its associated emissions and traffic congestions, many ports, especially in Europe are going towards intermodal solutions that are based on a combination between barges and trucks or rail transport and trucks [29].

**Greenhouse gas emission inventory:** This tool requires the development of a structured inventory of energy and fuel use and other activities that produce greenhouse gas emissions at the port. It is argued that by monitoring and measuring, an emission inventory can help port authorities to identify trends and areas for further improvements, in the form of energy efficiency or improved port operations [9,55,75,76]. Poulsen et al. [77] however noted that many ports would probably not develop a greenhouse gas inventory because of what they call the 'complexity of tool implementation'—to wit the fact that implementing these tools requires specialized skills. Port authorities need existing baseline data, which are non-existent in most ports. Aside from this, identifying the geographic boundaries or scope e.g., of emissions caused by direct and indirect port activities or emissions from port tenants and determining the emission categories to be covered requires highly skilled personnel [77]. It is,

however, to be noted that a greenhouse gas emission inventory in itself does not reduce environmental impacts but is only a means of developing reduction measures and monitoring their effects and may be used mainly as a tool in supporting political claims of port authorities.

Second, a number of tools for pricing and access have been proposed, mainly geared towards the access of ships and shipping lines to port terminals, and companies operating at the port.

Environmental shipping index (ESI): It is a market based tool that was originally designed by port authorities in the so-called 'World Port Climate Initiative' network including the ports of Le Havre, Antwerp, Rotterdam, Bremerhaven and Hamburg to help improve the environmental performance of seagoing vessels visiting ports [7,78,79]. ESI is a web-based tool that asks ports to lay out their incentives for ships with lower air emissions while asking ship owners for their fuel receipts. It is argued that this could help ports and ships to reduce their greenhouse gas emissions [78].

Concession agreements [29,80]: Here, environmental sustainability is made a requirement for granting concessions to companies that want to operate at the port. Concession agreement as a tool can be used to address various issues ranging from the issue of waste and energy to emission reduction [29,63]. Notteboom and Lam [29] suggests when port authorities impose for example, a cap on CO<sub>2</sub> emissions during terminal lease agreements, it can encourage terminal operators to embrace innovation and to meet the environmental objectives of the port authority.

Port dues: As ships, trucks and carriers pay several fees for using port infrastructure, port dues involve the use of incentives and punitive measures to promote environmental protection following the polluter pays principle [17,18,77,81–83]. Sustainability is used as a condition to gain access to certain services or to determine the fees to pay for using a port infrastructure or service [84]. Port authorities use either "penalty pricing as the 'stick' approach or incentive pricing as 'carrot' or both approaches to reduce pollution and improve the environmental performance of port users and developers" [81] (p. 175). Port authorities issue surcharges on docking fees and fines on oil and waste spills. The aim of this tool is thus to facilitate the conservation, protection, efficient use of resources and promote sustainability using incentives or punitive measures in the form of fees or port charges [85].

Third, a number of tools can be classified as integrated management approaches. For example, environmental management systems (EMS) based on an internationally recognized environmental management standard have been promoted as a priority green port tool [53,81,86,87]. With this tool, port authorities prepare a plan that details their environmental policy objectives, environmental aspects of their operations, legal requirements that regulate their operations and their mitigating programs and initiatives [88]. It is thus a systematic plan for port authorities to manage their environmental programs for pollution prevention, protection and control. The Ports Environmental Review System (PERS) of ESPOS's EcoPorts network, ISO 14001 EMS and the Eco-Management and Audit Scheme (EMAS) are examples of environmental standards that are used by ports to guide effective and systematic environmental management.

Another integrated management tool is the creation of nature compensatory mitigation sites in the port or at another location to give to nature what has been taken elsewhere in the case of unavoidable impacts of port construction [11]. These sites are designed to compensate for lost ecosystems and accommodating flora and fauna. As such they serve as a 'green infrastructure' for biotopes [15], enabling port authorities to counterbalance negative environmental impacts of port developments by contributing towards nature conservation, and not against it [89].

Other management tools include the establishment of a department responsible for handling environmental issues, skills training for staff to equip them with the capacity to handle new trends in environmental management, and adopting collaborative mechanisms with port stakeholders in implementing environmental policy [15]. Di Vaio and Varriale [90] argued that a major challenge facing the implementation of environmental policy at ports is the lack of technical capacity of the staff and the non-involvement of relevant stakeholders such as transport operators, terminal operators and shippers in adopting policies that respect the environment. In this regard, a designated department with a well skilled staff is an important measure for the greening ports.

Given this broad range of measures, instruments, tools and programs, it is hardly surprising that the ways ports implement green port policies are also diverging substantially, geographically and in time. For instance, fifteen years ago, port waste (garbage) and dredging were seen as the most important environmental challenges for EU ports—today port waste (garbage) is rated as the least important problem, the top three environmental priorities of EU ports being air quality, energy consumption and climate impacts [91]. West African ports, on the other hand, are currently prioritizing measures for efficient handling of hazardous or port and ship generated waste and reducing ocean litter or pollution from waste and ballast water [63]. This suggests that, among other things, the bundle of measures that may be adopted by ports changes as environmental priorities change. Today, green port measures such as providing ships with renewable energy at ports, ESI and carbon foot printing have been particularly promoted by maritime organization including the International Association of Ports and Harbors, ESPO and port environmental networks like the World Ports Climate Initiative [7–9,11,92], and these measures are now also primarily associated with green ports. As ports operate within unique business, political, environmental and social contexts, green practices of ports may be diverse, reflecting for example, the different economic contexts, the major issues on the country's regulatory agenda, availability of financial resources, and major environmental priorities. The definition of common criteria for labeling or describing a port as a green port is therefore a highly political and sensitive task, which can maintain or establish new hierarchies between ports, creating disadvantages for the latecomers despite their endeavors.

### 3. Theoretical Framework: Green Ports as a Travelling Idea

For analyzing the circulation of ideas, best practices, concepts and policies in a narrower sense, the literature on policy mobilities (PM) offers valuable insights into conditions, actor networks, processes of translation and re-interpretation of circulated ideas and policies, and other aspects of such circulations. Building upon earlier accounts on the transfer of policies, mainly arising from research in political sciences, the PM approach has been adopted in various disciplines and has also been widely cited and co-produced in human geography.

In face of an observed extension and acceleration of the mobility of policies in the contexts of growing neoliberal globalization, Lovell [93] has identified three recent lines of debate within the broad research field of policy mobilities. First, the traditional focus on government-to-government policy transfer is increasingly replaced by recognition of the role of non-state actors (especially the private sector) in mobilizing policies, which also means a turn towards urban and transnational actors rather than nation state institutions. Second, the introduction of assemblage theory has given rise to the relevance of heterogeneous networks that comprise actors and technologies alike, and to relational geographies of policy mobilities. Finally, a focus on the materiality of the policies that are mobilized has also reinforced the interest in “how policies change or mutate as they move” [93] (p. 48).

This third focus has been applied to the study of models [94,95], ideas [96], concepts [97] and technology [98] by particularly focusing on what happens in the process of transfer and/or adaptation, also allowing for the understanding of mobile policies and ideas as being “socially produced and circulated forms of knowledge (. . . ) that develop in, are conditioned by, travel through, connect, and shape various spatial scales, networks, policy communities, and institutional contexts” [99] (p. 109). This approach can help in understanding the links between spatially diverse but yet conceptually similar activities.

Behrends et al. [94] writing on travelling models for example, argue that, as a model travels from one place to another, some embodied knowledge, institutions and conventions associated with the objectivized model do stay immobile and hence need to be re-invented at the sites where the model arrives through practice and experience. Defining a model as “an analytical representation of particular aspects of reality, created as an apparatus or protocol for interventions in order to shape reality for certain purposes” [94] (p. 2), they explain why certain issues that are important at one place may be

taken up in another while others may not. It is then important to consider and treat the process of the travel, adaptation or appropriation as a process of 'translation'.

In this paper, we argued that this focus on the processes of translation of a model, an idea or a concept also brings up the question of selectivity: Here, we connected the PM literature to work that has, for example, been carried out by Martin et al. [100], Jokinen et al. [101] or Walker [102] who stress how in wider sustainability policies and approaches of cities, the "selective uptake of certain aspects of sustainability discourse, policy and planning" [102] (p. 167) can be a key strategy of cities in the face of neoliberal globalization and contribute to ambivalent "sustainability fixes" in those cities. Drawing on Jessop [103] and his understanding of "strategic selectivity" of local governments, Walker demonstrates how sustainability policies are employed to "position cities favorably in competitive place-marketing and to address the material political economic circumstances structuring urban development" [102] (p. 165). So far, little has been said about how the selectivity unfolds. As we will show, the example of the green ports discourse offers a way of understanding how selectivity plays important roles in two ways: First, selectivity plays a key role in the dynamic definition of a globally circulated idea or model, by way of deciding which tools, technologies and practices are part of the agenda and which ones are not. These decisions are largely made by the frontrunning actors in global networks. Second, during the implementation of the globally circulated models and ideas, local actors strategically select practices and tools that fit both, the institutional as well as material contexts of their ports. Selectivity thus becomes a decisive part of translation, revealing a close relationship between the two, influencing each other in the continuous process of sense-making and in the wider practice of sustainability fixes.

The green port concept originated from European contexts and is associated with particular practices and technologies, often framed around particular environmental issues [31,58,81] but has now become a global phenomenon and been implemented worldwide including at West African ports [63]. Yet, as we will see in more detail below, the material technologies, tools, infrastructures and practices ascribed to 'green ports' are diverse. Selectivity in both, setting the agenda of greening ports and adopting measures and technologies out of a larger bundle of potential solutions for greening ports, plays out in highly specific constellations at particular ports. They are shaped, among other things, by the competencies and capacities to implement certain technologies, by the priorities on the agenda of governments, as well as the needs and pressure of national and international private actors.

#### 4. Research Methodology

The research presented in this paper was part of a larger research endeavor to explore the sustainability transitioning of ports in Europe and West Africa. In this paper, we combined data collected from 29 in-depth key informant interviews with port environmental officers, terminal operators and related maritime stakeholders from four ports in Europe and West Africa with information gathered through literature reviews and document analysis. The ports included in this study are: Tema (Ghana), Lagos (Nigeria), Abidjan (Côte d'Ivoire) in West Africa and the twin ports of Bremen/Bremerhaven (Germany). This enabled us to learn between disparate sites and practices [104]. We used a semi-structured interview guide in conducting all our interviews. A semi-structured interview allows for some degree of flexibility in terms of questioning [105]. Thus, while the main topics and questions we asked were the same in all interview cases, semi-structured interviews allowed us to ask follow-up questions where necessary, to clarify certain issues, which also allows new themes to emerge. Through this method, we were able to obtain an overall picture of how the studied ports (authorities) engage with the globalizing green port idea and the rationalities underlying their choice of measures, tools and technologies. The interviews were conducted between May 2016 and July 2018 with experts of different status that are responsible for environmental and sustainability issues at ports. Relevant data to analyze the influence of contextual factors on the selective adoption of green port measures were collected from journal articles and policy documents available on the websites of the ports.

A content analysis was performed on the data to identify common and divergent themes [106,107]. Content analysis is a systematic process of ordering (coding and building themes) from interview

transcripts, notes from participatory observations, focus group discussions, documents and reports [108]. We repeatedly read through the interview transcripts together with the recorded audio-visual tapes to get a sense of the data and identify major themes. These themes were then analyzed in light of key variables identified in our theoretical framework. This allowed us to situate our finding in the frame of existing literature on green ports and to draw overarching conclusions. Triangulation of methods and data sources was used to enhance the credibility and validity of the results.

## 5. Results and Discussion

In this section, we present the greening practices of the studied ports, showing how context specific factors shape or influence the measures and tools that port authorities adopt over time.

### 5.1. The Ports of Bremen

The ports of Bremen are located in Bremen and Bremerhaven. They are managed by Bremenports GmbH and Co. KG on behalf of the Free Hanseatic City of Bremen as a single entity (twin-ports). Whereas Bremerhaven is closer to the open sea (North Sea) and specializes in handling container ships, car carriers and specialized ships, the terminals in Bremen are 60 kilometers further south and handles mainly general cargo and bulk commodities [109]. The port authority is active in taking initiatives and implementing programs to protect the environment, improve public health and reduce impacts of its operations and development on climate change [15].

#### 5.1.1. Engaging with the Green Port Idea at the Ports of Bremen and Bremerhaven

As one of the pioneering ports globally to have implemented a green port policy, the ports of Bremen's case provides insights into how it both co-sets the pace when it comes to green port practices, but also how its choice of tools or measures at different time periods from a (potential) ensemble of tools available for port authorities to transition towards sustainability reflects some form of selectivity. The measures they adopt, we argue, are influenced by contextual factors including the priority environmental aspects of the port and major issues on the regulatory agenda of the EU and the German state.

In 2008, the port authority established the office of environment and sustainability affairs, ascribing the office and its director a key role on the management board of the port. Since 2009, the port authority developed and published what it calls its "greenports" sustainability strategy aimed at implementing the green port idea. The adoption of this strategy marked the first time that sustainability issues associated with Bremen's ports were being looked at in a comprehensive way, linking economic, ecological and social concerns:

"( . . . ) We started with environmental topics in 1991 but since 2009, it was necessary to change this view to open it to all kinds of sustainability topics. So it was a strategic change to design and own a sustainability strategy to work it out and to follow it.". (Interview (hereafter: Iv), Bremerhaven, 25.08.16)

While a green port may mean different things to port managers in other contexts, for the ports of Bremen, it means cementing into their policies, management plans and into the fabric of new port investment plans the philosophy that operating and developing ports can be done sustainably in a win-win manner. In developing its green port strategy, the port aimed at not only delivering sustainable development, but also improving the competitive position of the port and the entire port region by combining the implementation of green programs with green marketing:

"( . . . ) when we wanted to develop and own a sustainability strategy, it was clear that we must have and own a trade mark protected by law ( . . . ). The trademark is for the port and we sell it to the local maritime companies who believe it is a good label and now ( . . . ) the politicians accept it to be a good strategy for the region ( . . . ). We want to focus on

managing the port well and to be a front runner not only in Germany because it is a field of international competition (...). By implementing the greenports strategy, we wish to promote sustainability both in port management and in the port area, and, if possible, also in the port industry and logistics.” (Iv, Bremerhaven, 25.08.16)

The port authority linked the green port idea to the concept of sustainable development and produced this idea as a business strategy by registering its “greenport” label at the European Consortium for Trademarks in Belgium. This allowed the port authority not only to have an official green port sustainability strategy, but also to sell it as a global brand to companies that want to use similar tools and technologies to promote sustainability upgrading in the logistic chain. Other than a proper certification scheme, this trademark label has up to date not been connected to transparent conditions and clear standards, or external evaluations.

It is important to point out that the port authority developed its green port strategy in line with the main operational activities of the port that required regulation, either at the level of the EU, federal government or at the state and local level, as well as the key issues that were connected to the political aims of the port. From the beginning, the ‘greenport’ strategy of the port focused on nature conservation and improving water quality:

“When you look through the port, then we have the world heritage area (Wadden Sea) directly near the port, north and west of the port, we have the European Habitat sites (... ) directly inside the port and we have German nature protection sites in the port so for us, biodiversity is so important as (for) no other port in Germany (...). This means that we needed to comply with comparatively high standards in this respect (...). When you look at other European ports like Antwerp and Le Havre, then there are some similar conditions.” (Iv Bremerhaven, 25.08.16)

The port authority was consequently more concerned with nature protection and managing waste and dredged materials to prevent marine pollution at the initial stages, but soon energy efficiency developed into an important issue. Between 2009 and 2014, the port authority declared its intention of operating a carbon neutral port infrastructure in-line with the increasing and new stringent legislation on air quality, energy and sulphur content of fuels for ports in the European Union:

“At the time (2009), we had no view of becoming a CO<sub>2</sub> neutral port. (... ) (When) the environmental situation became characterised by society challenges in connection with climate change and protection, climate protection became one of the biggest topics we had to address at the port.” (Iv Bremerhaven, 25.08.16)

Implementing the green port idea at the ports of Bremen was therefore done in line with addressing its major environmental priorities and meeting the high standards expected of the port with respect to nature protection (by virtue of its sensitive location) and air quality requirements of the EU [14,110–113]. In the following, we present the measures or tools the port implemented over the years.

### 5.1.2. Green Port Practices at the Ports of Bremen and Bremerhaven

Pursuant to the objective of transitioning towards sustainability, Bremen ports have implemented various policies, technologies and measures, and have provided several green services to ships calling at its ports. The port authority has strategically developed measures and incorporated environmental goals into its planning and operational structures. We outline this below:

**Technical Infrastructures:** In line with a EU Directive on ship waste i.e., Directive 2000/59/EU [114], the port in the early 2000s has put in place the needed waste reception infrastructure to receive and process all kinds of waste from ships and vessels that call at the port under Bremen law on port reception facilities for ship waste and cargo residue (BremHSLG) dated 19 November 2002 [15]. Since 2010, the port authority has implemented measures to reduce air emissions, improve air quality, improve energy efficiency and reduce impacts on climate change. The port has provided electricity

generated from renewable sources for inland vessels that berth at the port and related port operations. A total of 18 shore power connectors have been installed to ensure that inland vessels berthed at the port are powered by clean energy, which allows them to shut down their auxiliary engines that would have run on diesel generators, while on-shore power supply options for maritime shipping are currently being evaluated [115] (p. 50).

Since 2012, the port has doubled the percentage of energy it draws from renewable sources and has the objective of introducing new technologies like green hydrogen by the year 2024 [109]; this is in line with the broader greenhouse gas reduction efforts on European and national levels, as well as growing air quality regulations [88,113]. Recently, EU directive 2014/94 on the deployment of alternative fuels infrastructure further required all EU ports to prioritize the use of renewable energy, cold ironing and Liquefied natural gas [116], which has placed pressure on EU ports to implement measures in this regard. Aside from the above, Bremerhaven together with other German ports like Hamburg have also moved towards the use of rail shuttles for moving goods to the hinterlands in order to reduce emissions and congestion of traffic flows in and around the ports, whereas Rotterdam, Antwerp and Amsterdam are said to heavily rely on barges to reach hinterland regions [29]. In 2012, the Bremen port authority conducted the first carbon footprint analysis for its ports, which has since helped to monitor their effects on climate and air quality and to device measures for further improvement [15].

Pricing and access: Since 2012, the port authority has implemented the environmental ship index (ESI) tool and has announced its bonus scheme for seagoing vessels that uses low sulphur fuels. Since the beginning of the year 2016, 25 vessels with the best ESI scores greater than or equal to 40 points are granted a 15% discount on each call at the port every quarter. This formula is also applied to LNG-powered ships. This serves as an incentive for behavioral change of vessel owners to reduce their emissions further than what is legally required and is said to have culminated in a reduction in greenhouse gas emission in the port areas in the course of the past few years. For example, carbon dioxide (CO<sub>2</sub>) emission at Bremen's ports is said to have dropped from 7000 tonnes in 2011 to 2065 tonnes in 2016 [109]. It is estimated that since the year 2012, the number of ship arrivals with ESI score in relation to the total number of ship arrivals has increased from about 10% in 2012 to nearly 40% in 2017 [109]. In 2017, 101 ships that have called at the ports of Bremen about 185 times are said to have benefited from the ESI port (dues) discount [109] (p. 41). The use of the ESI as an incentive pricing green port tool has also been observed in other European ports like Rotterdam and Antwerp [81].

Aside from ESI, the ports of Bremen have also enforced the sulphur cap EU legislation (see [117]), which obliges ships and vessels to use fuels with a maximum sulphur content of 0.1% in the so-called sulphur emission control areas (SECA) since 2016. As the ports of Bremen are located in the North Sea range, which is part of the so-called SECA regions, they had to put in place measures that would enforce the cap placed on the use of sulphur fuels [117]. It is estimated that particulate matter emitted by all vessels calling at Bremerhaven reduced from about 180 mg/BRZ in 2012 to 21 mg/BRZ in 2015 while SO<sub>x</sub> has reduced from 1.74 g/BRZ to 0.22 g/BRZ during the same period [109].

Integrated management approaches: Given the major port expansion works in the period up to 2010, the port authority knew that only ambitious and persuasive compensation measures can get the local community and regulatory stakeholders to support the port and its new projects. The EU Habitats Directive, a binding legal framework for protecting flora and fauna [112] sets the general background for according measures. In-line with this, the port authority from the early stage of engaging with the green port idea, created so-called compensation sites in situations where the adverse impacts of port development and operational activities on nature became unavoidable. Nearly 50 such compensation sites have been created since then, with the 'Luneplate' located in the Weser estuary south of Bremerhaven as the flagship nature compensation site for the ports of Bremen. Covering an area of about 1.400 hectares, it provides a habitat for various bird species, plants and wildlife and has been declared a national nature reserve. In November 2016, the European Sea Port Organization (ESPO) gave the port an award in recognition of the benefits of the Luneplate to safeguarding ecosystems in the port area and have declared the Luneplate a best practice example for

other ports to emulate for demonstrating that “biodiversity and the realization of port infrastructure do not need to contradict” [89] (p. 17). The port authority can now use the (legally binding) creation of nature compensation sites as a tool to advertise sustainable port development.

In the field of integrated management tools, the ports of Bremen have also been certified to the European Sea Ports Organization’s EcoPorts Ports Environmental Review System (PERS) [109].

The results so far suggest that over time the ports of Bremen have implemented a combination of tools and measures to green its operations. In the early stages, they used measures like the provision of port waste reception facilities and creation of nature compensation sites. In recent years they have prioritized measures geared towards improving air quality, energy conservation and reducing their impacts on climate change with tools such as the ESI and use of renewable energy for port operations. The bundle of measures the port has adopted in recent years can be linked to new and tight legislation by the EU especially the comprehensive Directive 2008/50/EC on ambient air quality and cleaner air for Europe where the several Member States have already either been brought to the European Court of Justice or have been convicted for violating air quality levels [11]. According to ESPO, the European Commission has given priority to the implementation and enforcement of European air quality and climate-related legislation and non-compliance to these legislations could attract negative publicity and could be injurious to the image of ports.

Being among the first ports worldwide to implement a greening strategy, and owning the trademark “green port”, the Bremen port authorities have been in a position that the successive shifts and the selective prioritizing of certain measures at different points in time have had impacts on the global development of the discourse. Together with other European ports, Bremen ports have actively contributed to the institutional design of the global green port initiatives, as well as on the contents that have been successively prioritized in those institutions. Being selective in the kinds of measures to be taken under their own sustainability strategy has therefore had wider impacts on what bundles of measures have been prioritized at different times.

## 5.2. *The Ports of Abidjan, Lagos and Tema*

The ports of Tema, Lagos and Abidjan are the most important ports in the West African sub-region, accounting for nearly half of the region’s total maritime trade in terms of volume [118]. The increasing recognition of transboundary environmental issues has led to increased and strict legislation in recent years in the West and Central African sub-region [44,119], also affecting the development and operation of port facilities. In the next sub-section, we discuss how these ports are engaging with the globalizing green port idea and their associated greening practices.

### 5.2.1. Engaging with the Green Port Idea at West African Ports

Although not all ports have a concrete green port policy, some have started implementing tools akin to the green port idea. In general terms, the studied ports understand a green port as a catchphrase that promotes the idea of developing and operating ports with environmental and social considerations. In the absence of a clearly defined green port policy for some ports, officials of the understudied ports nonetheless stated that they are engaging with the green port idea, which according to them is of European origins:

“When I took over the position (head of the environment department) of the port ( . . . ), I wanted to know what other ports in Europe do for environmental protection. I saw it (green ports) on the internet and by just typing the request I saw links that gave me names of some people working in leading ports in Europe. When I contacted them, they told me about green ports ( . . . ) and then I started following them and try to learn also what they do.”. (Iv Abidjan, 9.02.17)

“The (idea of) green port I believe is to reduce the environmental impacts that emerge from port operations. Talking about waste reduction, greenhouse gases reduction and making

sure your port becomes compliant to national and international law. (...). In order to go green, we have made every effort to reduce waste generated from port operations (...). Furthermore, facilities have been provided in the port for the reception and treatment of ship waste.”. (Iv Tema, 10.01.17)

“It (green port) is an idea that re-echoes the possibility to develop and manage a port and do business without damaging the environment.”. (Iv Lagos, 23.11.16)

The above extracts reveal how the West African ports considered in this study encounter, understand and engage with the travelling green port idea: A first encounter with the green port idea often happened through the internet, with subsequent contacts to European port authorities and to coordinators of port networks during networking events [13]. It became also clear from all the interviews with port officials in West Africa that the green port idea was also encountered following efforts by national governments to mainstream principles of green economy and sustainable development goals in different sectors of their economies as being promoted by international development institutions. In Ghana, for example, efforts are being made to mainstream elements and principles of green economy and green growth into medium-term development plans of district, municipal and metropolitan assemblies and in different sectors of the economy including at ports [120]. The studied West African ports have since then been engaging with this idea and have adopted measures, tools and technologies to address their most pressing environmental aspects, meet legal requirements and improve their competitiveness amidst their unique constraints as further discussed below.

### 5.2.2. Green Port Practices of the Studied West African Ports

Officials from all three ports considered in the study have indicated that during the past few years, environmental issues have become important to them and they have introduced several measures and programs to protect the environment, thereby not following a standard recipe or a coherent policy. Rather, its elements have been implemented over time, the choice often influenced by environmental priorities, financial capacity and the level of expertise of port authorities.

Technical infrastructures: All three ports have put in place the infrastructure needed to receive and process the waste generated on-board of ships that call at their ports. The port of Tema, for example, has concessioned environmental service companies to receive ship waste and process it in an environmentally friendly manner in compliance with Annexes 1 and 5 of MARPOL 73/78. After processing of the ships’ oily waste, the by-product is sold as fuel for industrial and manufacturing companies in the industrial enclave. This has led to efficient handling of ship waste, which at the same time brings direct economic benefits to the port authority and the companies:

“(...) the port is required to develop a port reception facility so that ships that come can discharge their waste at the port, to avoid the ship from dumping waste at sea or offshore on the high sea. We have concessioned this business to a number of companies who come around whenever a vessel has landed here to collect their waste. We have shared it among five companies based on percentages that they can handle. We make sure no ship goes away with the waste it comes with and you know we have an environmental fee which the vessel has to pay whether you discharge the waste or not. So this is to make sure that they deposit it before they leave.”. (Iv Tema, 12.05.16)

Similarly, the Nigerian Port Authority (NPA) has a public-private partnership agreement with African Circles Ltd., an environmental service provider that manages its ship waste. It has also an agreement with Sea View Properties Ltd., which manages its port generated waste (personal communication, port of Lagos, Apapa). The port of Abidjan has also put in place the needed port reception facilities in compliance with Annexes 1 and 5 of MARPOL 73/78 to receive and process ship waste (Personal communication, Port of Abidjan). In Ghana, the Ghana Ports and Harbors Authority (GPHA) and Meridian Ports Services (MPS)—the main container terminal operator at the port—have

also implemented a waste management policy called the ‘waste segregation policy’ based on the principle of the 3-R’s (reduce, recycle and reuse). This is one of the major tools the port authority has implemented with regards to its objective of ‘going green’, where they see no waste, but only resources. Based on this flagship green port initiative, differently colored and well-labeled waste bins have been procured and placed at designated points at the port to segregate different types of waste while punitive measures have been outlined. According to the port, it has received enormous economic and environmental benefits since then:

“The biggest challenge we have here is waste. Therefore, in order to green the port, we have ensured that there is an effective segregation of waste. ( . . . ) We segregate waste and make sure the right waste goes to the right place where it can be reused or recycled. We also try to reduce waste generated in general. (We) have paper, plastic, wood, domestic waste etc. My own analysis shows that at first in a month, we pay a truck twice a week to convey our waste. Twice a week means that it comes eight to ten times in a month. It was cost. But now with the segregation, people come to pick specific wastes as resources and even pay us something back. In the bigger picture too, you will see that we have cut down the cost. Since the truck now comes fewer times, it also means it will burn less fuel. So this single initiative even has linkages to the intermodal and it is a very sustainable practice. It gives us economic benefits as well as helps to reduce pollution.”. (Iv MPS, Tema, 17.02.17)

In another course of action, the port of Tema in a bid to boost the efficiency, reduce port-generated waste, reduce waiting time of vessels and congestion has introduced the paperless port policy as a green port tool since September 2017. Fraught with some initial agitations from a section of port workers (especially the revenue collection unit) who feared that this policy initiative could make them redundant, the initiative has taken shape after authorities allayed their fears. According to the GPHA, this has helped to reduce the amount of waste generated and resource use and has also led to an improvement in revenue collection. They argue that it is a policy that has both economic and environmental goals (personal communication, port of Tema, 05.06.18). Aside from this, all three ports use electrified rubber-tired gantry cranes (ERTG) for terminal operations to reduce emissions.

**Pricing and access:** The study shows that all three ports use indirect fees (port dues) as well as fines to promote environmental consciousness and improve the environmental performance of terminal operators, concessionaires, truckers, logistics providers and vessels.

All three ports have instituted heavy fines based on the polluter pays principle for marine oil spills and other forms of pollution in the port area. This serves as a punitive measure and seeks to discourage pollution of any kind by companies operating in the port area. All three ports have also put in place indirect fees to discourage the disposal of waste at sea. At the port of Tema, the estate and environment department have implemented a compulsory fee for the discharge of waste at the ports reception facilities for all vessels regardless of whether the vessel has any waste to discharge or not. In Abidjan, the port authority through the environment department has instituted a ship waste fee, which serves as an economic incentive for controlling pollution from ships that call at the port. Aside from this, port managers at these three ports have inserted environmental clauses into concession agreements. At the port of Tema, it is currently impossible for concessionaires to operate without first presenting an environmental permit from the Environmental Protection Agency (EPA) detailing the potential impacts of the company’s activities on the environment and how these issues would be addressed through a detailed environmental impact assessment:

“We have deliberately included environmental components in lease agreements. By law, no company can start operations on the port lands without an environmental permit from the EPA. So these environmental permits, environmental statements indicating the possible impacts of your operation and measures that you are going to adopt to prevent or reduce them, we make sure you implement it or sometimes not allowed to operate at all if the environmental impacts are too grave. So environmental issues and permit plays a major role.

This department is the eye of the port. We look at your environmental permits before we allocate land to you.”. (Iv Tema, 12.05.16)

Integrated management approaches: All three ports have designated officers in charge of environmental management. The port of Abidjan created its environment department in 2004 and has since been responsible for developing yearly environmental targets and management procedures although the head of the environment department remains a junior management portfolio and at times faces challenges with getting its initiatives and programs approved. At the port of Tema, an environmental department has been established since 2002 and is responsible for managing environmental issues at the port. In the last five years in specific, the department has become very influential in decision-making regarding new port extension projects, land use and port operations. Similarly, the port of Lagos, Apapa has a designated department for handling environmental issues. This marked the first attempt to make the care of the environment a normal process in port development, operations and management at these ports.

In another step, two of the ports have adopted and are certified to international environmental management systems (EMS) as their environmental management standard. The ports of Tema and Abidjan are currently certified to ISO 14001 EMS. This standard is used as a guide and provides the framework for a systematic environmental management at the ports, according to their respective environmental objectives, environmental aspects and legal requirements. While they have both developed a comprehensive approach to care for the environment in the space of the port lands and port waters with measures mainly geared towards sustainable management of waste in the port and ship interface, water pollution, oil spills, effluent discharges from the port and the city and preventing the dumping of hazardous waste (mainly electronic waste) through the ports, little measures have been taken towards improving air quality or reducing impacts on climate change. The quote below from one port manager, which resonates with all the other port officials that were interviewed, provides insights into the reasons behind this selectivity in adopting or implementing green port measures:

“If I have to be frank, we have not developed the consciousness in investigating the type of energy that we or the terminal operators use. We have not developed to that height yet. We still depend on the national grid and fossil based fuels even though we have been considering various options and we have been receiving proposals from companies regarding the development of solar energy but we have not yet implemented them. They remain plans and proposals that are still under discussion. We hear about the need to use renewable energy from European based ports in line with becoming a green port, but here in Tema, we don’t even have the space, the resources and the capacity to implement such infrastructure.”. (Iv Tema, 12.05.16)

The ports in the first place lack the capacity and equipment to monitor energy-related emissions. Thus, the tools and technologies they adopt in engaging with the green port idea are influenced by their environmental priorities, availability of financial resources and their immediate areas of competence. For example, in-port electrical connections (cold ironing) require reliable electrical supply, which is often not available. In general, access to clean and affordable energy remains poor and irregular in Africa [121] and efforts towards reducing impacts on climate change are constrained by technical and financial factors [122,123]. On the other hand, since a major incident with the dumping of toxic waste in Probo Koala, Côte d’Ivoire in 2006, sustainable waste management has become a topical issue for ports in the sub-region to address. The analyzed West African ports hence do not consider implementing emission reduction technologies or providing cold ironing technology as an immediate priority in the face of the law, financial capacity and or an issue that falls under their immediate area of competence.

While it has become clear that the analyzed West African ports to a certain extent have taken over some of the basic assumptions and main arguments of the debates around greening of port operations and infrastructures, a general focus on ‘softer’ policies and initiatives can be noted. Whereas many European ports (like the ports in Bremen and Bremerhaven) have started investing in alternative power

sources and providing vessels with an on-shore power supply, the ports in Ghana, Cote d'Ivoire and Nigeria show only few signs of larger technical innovations. Instead, their 'greening' stories mainly rely on the introduction of integrated management tools like the creation of environmental management offices or ISO certifications. Disregarding the construction of waste management facilities, all three ports have not reported larger investments in technical infrastructures. Additionally, a major difference has been observed how ports in West Africa implement pricing and access regulations: While the ports of Bremen mainly rely on incentive pricing for attracting vessels with reduced emissions, the analyzed West African ports use punitive measures. All three ports have not adopted the ESI index for differentiated pricing, also with regards to the relative high entry costs for participating in the global system for access regulation.

## 6. Final Discussion and Conclusions

The paper investigated how port authorities in Europe and West Africa engage with the green port idea highlighting how contextual factors shape the adoption of green port measures. This explains the varied green port practices of ports in European and West African contexts. Although green ports have received considerable attention from scholars [3,27,51,81], very little attention has been given to understanding the role contextual factors may play in the adoption of green port measures from a potential bundle of tools and technologies. This is particularly important in appreciating the measures that are taken by port authorities in African countries, where resource and infrastructure constraints pose enormous challenges to the transition towards sustainability. The findings also put into question the fact that some ports in Europe use the label 'green ports', which most West African ports do not have.

Our findings show that whereas the ports of Bremen in Europe have implemented measures that are geared mainly towards addressing air quality, energy and climate change mitigation, the West African ports adopt measures that are geared mainly towards sustainable waste management, oil spills and ballast water management. It is also evident that port authorities adopt different combinations of measures at different time periods based on their environmental priorities, major issues on the regulatory agenda of governments, financial capacity and immediate area of competence of port authorities. Whereas the twin ports of Bremen have a comparably strong focus on technical infrastructures, integrated management approaches are more prevalent in West African ports.

In a broad perspective, the findings corroborate a report by PIANC [5] (p. 4), which noted that "in a green growth strategy, sustainability is an economic choice based on a proactive long-term vision". How ports engage with the green port idea and translate it into a business reality, the tools, technologies and measures they adopt from a potential bundle of measures available only make sense in time and place. This finding concurs with Barnes-Dabban et al.'s [63] general argument that environmental reforms relating to the green port idea are influenced by institutional and situational factors and are implemented through processes of sense-making. It also supports Wooldridge et al. [54] and Acciaro et al.'s [18] view that existing legislation and financial capacity may influence green port strategies. Our results further confirm Innes and Monios's [31] more specific assertion that contextual factors such as financial capacity and total energy requirement levels of ports influence the decision to adopt the cold ironing technology and Poulsen et al.'s [77] finding that complexity of a green tool implementation may constrain implementation and upgrade along the value chain.

Theoretically, our study shows that as ideas and concepts move across space, they are translated based on local conditions, priorities and interests. During their implementation, port managers strategically select or adopt measures and practices that fit both institutional and material contexts of the ports and the countries or the regions in which they are installed [99]. Thus the issue of selective adoption unfolds as part of the translation process and is embedded in specific socio-political contexts. Seen in this way, selective adoption becomes an important strategy ports use to pursue a local sustainability fix [102,124]. For further research on the decision-making processes, the application of a method or framework that deals with complex decision-making processes, like the analytic hierarchy

process (AHP), may also contribute to the topic, as it has been applied to sustainable urban transport in general (see [125,126]).

For West African ports to implement measures towards improving air quality or energy transitioning, for example, may be challenging in terms of funding and technical support. The selective adoption of green port measures or tools is further conditioned by the international debates on sustainable development in which air quality, energy and climate change are the key concerns that, currently, receive the most attention by the media, funding agencies and governments, especially in industrialized countries. West African ports, with limited financial capacities and relatively little public pressure regarding climate change mitigation, are strategically adopting certain tools that address their priority environmental issues like waste management; their choices may also be influenced by requests of transnational private actors in the logistics business. The definition of the globally circulated ideas of green port, especially with regards to the tools, measures and technologies that become standard parts of the agenda, is still largely shaped by a few influential ports in Europe and North America. The question which measures and tools are made a pre-requisite for labeling or certifying a port as a green port, remains an important and a highly political one. Agendas developed in a global setting, that are at the same time competitive and oligopolistic, are likely to deepen existing economic inequalities. Their environmental effects await further investigation.

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