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## Abstract

*Ports and port cities play a pivotal role towards the sustainable development of coastal ecosystems. These ecosystems provide their natural capital by offering favourable locations for industry and accessibility to world markets. While port industrial activities have been reactive to pressure from stakeholders, in more recent years ports have adopted inclusive strategies and seek to align their strategic intentions with stakeholders. Around the world port authorities are aligning their ambitions towards their contribution to the Sustainable Development Goals, such as the World Port Sustainability Program for port authorities and AIVP2030 for port-cities. The aim of this paper is to assess to what extent ports have contributed to the implementation of the SDGs. The analysis is based on a content analysis on project portfolios in which port authorities demonstrate leadership in sustainable development. The results indicate that the contribution of port and port city authorities are generally motivated to 'do no harm', although they also have intentions to 'do good' for their ecosystems. Furthermore, the findings show the linkages between projects with the Goals is rather ambiguous. Directions are given towards a methodology for a stronger link between (monitoring) business strategies with the implementation of inclusive strategies in order to contribute to the SDG goals and targets.*

## 1 Introduction

Ports and port cities play a pivotal role in the sustainable development of regions. While governments have committed to the United Nations Framework Convention on Climate Change ('Paris Agreement'), port authorities and city governments across the world are feeling the pressure to act. In 2018, leading port authorities of Hamburg, Barcelona, Antwerp, Los Angeles, Long Beach, Vancouver and Rotterdam have embarked on a joint international initiative and work together on reducing emissions and tackle the issues of global warming coming from GHG emissions from industries and shipping activities. In that same year, over a 1,000 ports signed off for the declaration of the World Port Sustainability Programme, under the leadership of the International Association of Ports and Harbors, and co-founded by Association of American Port Authorities (AAPA), European Sea Port Association (ESPO), Permanent International Association of Navigation Congresses (PIANC) and the International Association of Port Cities (AIVP). Ports are at the heart of international trade, while providing millions of people access to jobs and international markets, significant contributions can be made in ports and their neighbouring port cities. 2019 marked the year of climate action when the younger generations impersonalised by

Greta Thunberg have stepped up for their future rights and demand stronger actions to mitigate the consequences of climate change. With these urgencies in our minds, the question arises to what extent ports and their authorising bodies have been motivated towards their commitments to realise the Sustainable Development Goals and what actions have been taken?

## 1.1 Ports as ecosystems

For long ports, its functions and evolution have been investigated from the perspective of the spatial demarcation between land and sea ( Bird, 1963), (Hayuth, 1982), (Hoyle, 1989). (Hoyle, 2000) . As ports have expanded and separated from their host cities, not only scale has led to an increasing role of the port as an economic engine (Kuipers, 2018), but also as an area where the externalities have impacted a larger region, both in terms of economic wealth as well as its effect on the environmental in terms of noise, pollution, and other nuisances, which is affecting neighbouring communities and societies at large. The port city interface is being redefined (Wiegmans & Louw, 2011). It is not only the geographical meaning which has changed, but also the issues surrounding the port city and the region have become more complex and can therefore no longer be approached from a port planning perspective alone. The interests which are at play between port city actors have multiplied, become more diverse, and has also fuelled various scientific debates and has led to various conceptualizations. Governments on various levels have embraced green policies, formulated inclusive growth agendas and have turned to action modus, evidenced by European Green Deal (European Commission, 2019) and United Nations Act Now campaign (United Nations, n.d.). Inclusive growth is not only about economic facets of development, but also its social and cultural dimensions. Port authorities and city governments form the pivot between economic development and inclusive growth. Through the inclusion of employment opportunities for all citizens, governments can proactively ensure the widespread benefits of economic growth (VanSandt and Sud 2012). To advance towards sustainable development goals including the goal to make cities inclusive, safe, resilient and sustainable by 2030, Pittman (2019) argues that cities must enhance all aspects of their unique natural and social capital, including adjacent marine spaces.

Megacities are not only important drivers for socio-economic development but also sources of environmental challenges (Atmosphere et al. 2012). Port-cities are concentrations of both human population, resource consumption and results in a variety of ecological impacts, at the same time this concentration gives the authorities an opportunity to leverage on the concentration of people and businesses for sustainable innovation, re-use and recycle materials, using economies of scale, co-siting of industrial installations and for lower costs per capita for fresh water treatment, waste water treatment and urban housing (Rees & Wackernagel, 2008). One of the major challenges and sources for conflict is how ports can grow while maintaining a balance with the societies they serve, while sustaining the ecosystems of which they are part of. United Nations posits an integrated ecosystems approach across land and seascapes is required to reconcile conflicting interests in densely populated coastal ecosystems (United Nations Environment Programme, 2020). The port-city ecosystem lives by the well-being of its inhabitants and is based on the premise that prosperity flows from the stocks of tangible and intangible capital which the ecosystem provides: natural capital, industrial (working) capital, human capital, social capital, cultural capital and creative capital (Jansen, 2020). The invisibility of ecosystems as global public goods – oceans, air, land, forests – has led to ecosystem degradation, biodiversity loss, and negative impacts on human liveability. It is for this reason why ecosystems have to be at the core of any approach to achieve the ambitions of the Sustainable Development Goals. (TEEB, 2010).

While De Boer et al. (2019) introduced the ecosystem-based port design framework which moves away from offsetting environmental impact to avoiding and reducing environmental impact, the Building with Nature approach to integrated coastal policy and coastal engineering gives directions to move even beyond ‘doing no harm’. The essence is flexible integration of land-in-sea and water-in-the-new-land, coastal engineering while making use of materials, forces and interactions present in nature, taking into account existing and potential nature values, and the bio-geomorphology geo-hydrology of the coast and seabed (Waterman, 2010).

## 1.2 An ecosystems services approach

Most of the sustainability challenges in a port-city context are closely intertwined. This complexity calls for a deeper understanding of the relations between the human use of the space in interaction with the transformation of the ecosystem, which are supporting human life (Liu et al. 2015). The impact of human activity in coastal regions is clear, present and potentially dangerous: overfishing of the oceans, degradation of land, air and water pollution, acidification of the oceans, global warming because of GHG emissions, acceleration of extinction of species, plastic soup in rivers and oceans. The carrying capacity of the ecosystem is central to sustainability, and economists have now started to consider species, habitats, and ecosystems as forms of natural capital (Rees & Wackernagel, 2008) and provide a service to human societies. They posit that ecosystems provide for basically all human activities directly or indirectly. For both basic needs and the production of food, energy and materials, humans extract resources from nature, and are eventually returned in degraded form or as waste to the ecosystem. The services these ecosystems provide have value for the society and allow for economic activities to emerge. For instance, marine ecosystems sustain fishing communities along the coast. Most ports have also evolved using the natural resources as a stock of capital to grow, using the favourable location on the interface between sea and land for human settlement, trade and development.

Ecosystem services can be categorized in four main types (TEEB, 2010). Provisioning services are the products obtained from ecosystems, such as food, fresh water, fibre, genetic resources and medicines. Secondly, ecosystems regulate ecosystem processes such as climate regulation, water regulation and purification, biodiversity regulation or pollination. Cultural services include the non-material benefits that people obtain from the ecosystem, such as a sense of place, aesthetic values, spiritual values, recreational values and educational values. Lastly there are the supporting ecosystems services. Supporting ecosystems refer to habitats for species which maintain a diversity of complex processes that underpin the other ecosystem services, such as coral reefs. Coral reefs are habitats and provide for rich biodiversity of species, and even provide a natural protection against storm surges. Recent advancements in research have worked out the ecosystem services for a variety of ecosystems: marine, coastal, forests, wetlands, alpine ecosystems. Each are essential for human activities and provide for quality of life and wellbeing.

Provisioning	Regulating	Cultural	Supporting
Raw materials, food, water supply, fiber, energy supply, route of transportation, medicinal resources, carrying capacity for human settlement.	Climate regulation, disease regulation, erosion control, natural hazard regulation, biological control, water purification, water regulation, storm protection, carbon sequestration, waste water treatment, pollination, air quality maintenance, maintenance of genetic diversity	Cultural diversity, social relations, sense of place, aesthetic values, educational values, recreational values, spiritual values, conservation values, cultural heritage values, inspiration	Habitat, maintenance of genetic diversity.

Table 1: Ecosystems services per type. Source: FAO, Deltares.

Especially in coastal regions, the ecosystem is under pressure from population growth, urban and industrial activities. Due to the valuation issue, ecosystem as stocks of natural capital has largely been ignored, undervalued, kept largely outside the market, and therefore lead to errors in construction projects (Costanza et al. 1997). The problem with ecosystem services valuation lies partly in its public nature. They are considered public goods, which makes it difficult to apply the concept of supply and demand and sell the ecosystem services to individual customers. Enjoying the tranquillity of a park or enjoy free time on the beach are positive externalities, but people would not be willing paying to pay for this outdoor time unless the consumer gets something of material value in return. Another issue is that ecosystems can be irreplaceable, such as the bleaching of the Great Barrier Reef. Because of the irreversibility of the loss this makes it even harder to add a price tag to coral reefs. The third reason is the temporal dimension. There is no immediate loss, when ecosystems are deteriorating, therefore the value is not lost until the loss is complete and it's too late. This is what happens with overfishing or reclaiming agricultural land from the Amazon rain forest. Chen (2020) present a framework on ecosystems accounting which tracks the temporal and spatial change in ecosystem's contribution to society. They argue that such knowledge would add to the acceptance decision-making and allow for building ecosystems into new institutions (policies, plans, laws). Results from ecosystem accounting would support the implementation from knowledge-to-policy and from policy-to-practice. Apart from the economic motivations, valuing ecosystem services is not only about economic motivations, it is also about fairness and sustainable wellbeing (Costanza et al. 2017).

The ecosystems services perspective provides a holistic perspective on challenges ports are facing in reconciling opposite objectives. For ports to balance economic growth with wellbeing of the community and restore the ecosystem values, ports will have to consider the natural capital of the ecosystem is critical. The question is whether such paradigm shift is acceptable for stakeholders.

### 1.3 Motivations and actionability of stakeholders

In the port development discourse, initial communication with stakeholders regarding socio-economic impacts serves the purpose of social acceptance. Stakeholder interests, conflict accommodation and collaboration between stakeholders have been subject for extensive port research. The inclusive growth discourse starts from the identification of local issues considered by local stakeholders and considers

ports as links between the macro and micro determinants of economic growth. Ports contribute to the sustainable development goals by focusing on inclusive ambitions, such as ‘accessibility through transportation and connectivity, with a priority on people’s quality of life, safety and social equity’ (United Nations, 2016). Port developmental studies have often considered ports as battlegrounds for conflicts and trade-offs between positive and negative effects, often ending in unresolved issues (de Langen 2006; Vining and Boardman 2008; Galvao, Wang, and Mileski 2016; Parola and Maugeri 2013). Lam & Van de Voorde (2012) witness that port authorities are embracing green and sustainable port strategies which build on the key constructs of stakeholder involvement, green market development, cost effective green policy and sustainable port operations and developments. Acciaro (2015) observed a renewed interest in the environmental and societal impacts of ports. Others have emphasized the importance to include the socio-economic impact of a broader group of stakeholders for the social acceptance of port infrastructure development (Dooms, Haezendonck, and Verbeke 2015). The traditional issues such as congestion, labour conflicts and land use dominate the debate (Galvao, Wang, and Mileski 2016) but in recent years there is a shift towards environmental sustainability and energy efficiency are growing in importance (Davarzani et al. 2016). Xiao and Lam (2017) take a systems-oriented view on port city development and the dynamics between port economic development, while minimising the negative relationships environmentally. Port authorities can significantly contribute to transform government policies into practical measures and action plans (Di Vaio, Varriale, and Alvino 2018).

Inclusiveness port development places ports – particularly in remote regions and islands - in the centre in between governments, business and society. It requires ports to collaborate and search for new complementary governance constellations that would benefit the directly and indirectly involved and even new stakeholders (Jansen, van Tulder, and Afrianto 2018). Having an inclusive strategy contributes to the Sustainable Development Goals, which ultimately has the ultimate ambition seeks to balance the ecosystems, enabling human prosperity while conserving the ecosystem. Partnering with an informed, engaged local community is considered as crucial in advancing sustainable transportation for ‘both and’ solutions rather than a trade-off between positive and negative effects (Van Tulder and Pfisterer 2013).

Van Zanten and van Tulder (2018) assessed to what extent multinational enterprises (MNEs) are engaged with the SDGs. The engagement towards contributing to the SDGs can be distinguished by looking at motives and actionability of these MNEs. The SDGs have various targets which can be labelled by using the targets its motive and actionability. For companies to act, it starts with the intention to do something. Motivation is a core concept of sustainable development strategy. Motivation refers to the force that initiates, guides and maintains goal-oriented behaviour of people and organisations. These motives are hardly shaped in isolation, they are set under pressure from outside and are either primary or secondary motives (Van Tulder, 2018). Primary motives relate to the either intrinsic or extrinsic motivation. Intrinsic motivation is associated with passion, ambition and linked to the development of ‘own’ capabilities, whereas extrinsic motivation is driven by external influences and require external stimuli (penalties, grades, rewards). Secondary motivations define the aim or goals of the motivation, long term or short term, strategic or tactical. Fundamental in this line of argument is the goal-seeking behaviour of companies: is profit maximisation a goal or is profit a means to reach for higher aims, such as continuity, employability, or sustaining a long-lasting relationship with the community? The interaction between primary and secondary motives determines four actual attitudes towards strategy: inactive, reactive, active and proactive. An important concept to consider is the ‘sphere of influence’.

The concept of sphere of influence seeks to establish the scope of corporate responsibility [...]. It consists of a set of concentric circles, mapping the stakeholders in a company’s value chain, with the workplace as the most inner circle, then moving outward to suppliers, the marketplace, the community, and governments (Ruggie 2008). Companies tend to be more motivated to act responsibly when the interests of other stakeholders fall in their sphere of influence. Even when a company knowingly providing a substantial contribution or takes benefit from a malpractices by another stakeholder, this could result in accountability and could lead to a legal liability (Ruggie, 2008). Therefore, it is important to distinguish “doing no harm” from “doing good,” motives. The motive “doing no harm” relates to the targets which aim to avoid the negative externalities of various operations and the motive “doing good” aims towards the targets that are proactively improving sustainable development (Van Tulder, 2018). Examples of ‘doing no harm’ in a port context could refer to investing in technical installation to reduce carbon footprint or reducing the emissions of NOx by implementing on-shore supply facilities for ships during their stay in port. ‘Doing good; motives could refer to investment in facilities for renewable energy, such as hydrogen installations.

## 2 Methodology

In answer to the question to what extent ports and their authorising bodies have been motivated towards their commitments to realise the Sustainable Development Goals and what actions they have taken, we have analysed the project portfolio of the World Port Sustainability Platform, which documented 121 projects from ports across the world. The projects are categorised under five themes: community outreach, governance and ethics, climate action, resilient infrastructure and safety and security. For each of the projects, the project sheet provides reference to specific SDGs to which the project contributed. Not knowing the underlying reasoning of the WPSM for linking the project sheets to the SDGs goals we have chosen to make our own classification by means of a content analysis and doing the following:

We assessed to what extent an ecosystem service relates to each project in the portfolio. The ecosystems approach is embedded in the SDG framework and distinguishes three hierarchical layers. The economy is built upon the society, where the society is built on the biosphere (Stockholm Resilience Centre, 2020). Using this framework, we then retrieved the list of SDG targets from the SDG knowledge platform (United Nations, 2020).

Figure 1: SDG layered framework (Stockholm Resilience Centre)

Ecosystem layer	Sustainable Development Goals
<b>Economy</b>	
<b>Society</b>	
<b>Biosphere</b>	

The next step was the risk assessment for ecosystems value loss ('doing no harm') or ecosystem value recovery ('doing good'). Using the project sheet, we assessed the strategic intent of the port authorities' engagement with stakeholders and linked this to three SDG targets. When a project falls within the sphere of influence of the port authority, e.g. a port engineering project or the implementation of an information system, we have considered this as internally actionable because the action can be done within the company's workplace, using the company's own capabilities. When the company has engaged with other port users or with the community to contribute to the SDGs, we have considered this to be externally action driven.

### 3 Research findings

This section covers an overview of port authorities' contribution to the SDGs. First, it shows the number of projects relating to ecosystem values. Secondly, the findings show the engagement of port authorities with the SDGs, per goal and per target. Engagement is expressed in motivation and actionability. Lastly, the findings show what specific activities port authorities have taken and whether these activities have been done from the 'heart', from the 'head' and/or from the 'hands'.

#### 3.1 General findings

For all 121 projects we were able to categorize the projects and link these projects to ecosystems values. 60 projects have been indicated to use the ecosystem for provisioning services: such as air quality, carbon storage, energy provision, a physical environment for human activities and provision of raw materials. The most important ecosystem service provided is the route of transportation. Being a port, there were quite a number of projects which addressed the energy efficiency and emission monitoring of shipping activities. 31 projects address cultural services, which relate to conservation values, cultural heritage, educational values and recreational values. Also, the ecosystem value of sense of place and spiritual values were mentioned. These values seem particularly important for ports who seek to live in harmony with communities of indigenous people.

Table 1: WPSP project impact on ecosystems services

Ecosystems	Ecosystem value	Biosphere	Economy	Society
<b>Provisioning services (60)</b>	Air quality maintenance		3	13
	Carbon sequestration (storage)	1		
	Energy provision	2	4	7
	Physical environment for human activities		1	2
	Raw materials		2	
	Route of transportation		25	
<b>Regulating services (30)</b>	Climate regulation	2	6	4
	Erosion control	1		1
	Natural hazard regulation			1
	Waste water treatment	1		
	Water purification	3		1
	Water regulation		1	1
<b>Supporting services (1)</b>	Habitat for species	8		

Ecosystems	Ecosystem value	Biosphere	Economy	Society
<b>Cultural services (31)</b>	Conservation values	2	2	2
	Cultural heritage values			1
	Educational values			11
	Recreational values	1	2	5
	Sense of place			2
	Social relations			2
	Spiritual values			1
	<b>Total</b>	<b>21</b>	<b>46</b>	<b>54</b>

### 3.2 Port Authorities' engagement with the SDGs

Table 2 provides an overview of the 10 SDG targets to which port authorities are contributing in 60% of the projects analysed. It shows which issues are top of mind for port authorities.

Table 2: Projects related to SDG targets (preliminary findings)

SDG target	Short description	Ecosystem layer
9.1	Reliable, resilient and sustainable infrastructure	Economy
14.1	Manage and protect marine and coastal ecosystems	Biosphere
13.1	Resilience and adaptive capacity to climate related hazards and natural disasters	Biosphere
4.7	Promote sustainable development through knowledge and skills	Society
11.6	Reduce per capita environmental impact of cities	Society
8.5	Decent jobs and equal pay	Economy
3.9	Reduce hazardous chemicals and air, water and soil pollution and contamination	Society
8.9	Promote sustainable tourism	Economy
11.7	Promote access to safe, inclusive, accessible green and public spaces	Society
15.5	Reduce degradation of natural habitats, halt loss of biodiversity	Biosphere

As mentioned in the methodology, it is more interesting to reflect on the nexus of SDGs. One of the major challenges for ports is how to co-exist with their societies while preserving the natural ecosystem. In the ecosystem perspective, we should not be looking at the SDGs separately, but as intertwined sets of targets. Such a nexus approach aims to enhance the resilience by inducing companies to pursue a portfolio of activities which are aimed to contribute to multiple SDGs through the creation of co-benefits, while minimising trade-offs between the SDGs (Van Zanten & Van Tulder, forthcoming). The nexus approach is applied to a selection of projects<sup>1</sup>, which are listed in the Appendix.

<sup>1</sup> The full analysis is work in progress

What appears from this list is the coherence between the ecosystem layers. The projects address each ecosystem layer, which evidences the dilemmas port authorities are facing in the approach to inclusive port development. For comprehending their motives, we have examined the specific actions and motives for their engagement with the SDGs. This is covered in the next paragraph on actions and motivations.

### 3.3 Activities and motivations of PAs

Considering the engagement of Port Authorities with stakeholders and the way PAs have exerted their influence towards their environment, we have clustered the projects in three groups, one relating to projects that have an influence on the biosphere, one relating to society and one relating to economy.

Table 3: Projects relating to economy

	Do no harm	Do good
<b>internal</b>	<ul style="list-style-type: none"> <li>• Information system environmental impact</li> <li>• Low energy lighting system installation</li> <li>• Emergency management system</li> <li>• Relocation of communities</li> <li>• Vision on responsible supply chains</li> <li>• Monitoring system for environmental pollutants</li> <li>• On-shore power supply</li> </ul>	<ul style="list-style-type: none"> <li>• Information system connectivity</li> <li>• Single window systems</li> <li>• Robust Information system cyber security</li> <li>• Resilient port infrastructure</li> <li>• Information system to fight criminality in port</li> <li>• Green zones for recreation</li> <li>• Cruise port terminal infrastructure</li> <li>• Upgrading communication network</li> <li>• Regional impact assessment cruise activities</li> </ul>
<b>external</b>	<ul style="list-style-type: none"> <li>• LNG bunkering facility</li> <li>• Information system port community system</li> <li>• Port call optimization platform for shipping companies, reducing CO2</li> <li>• Truck parking platform</li> <li>• Environmental condition forecast system</li> <li>• Incentive scheme for energy efficiency</li> <li>• Vessel performance monitor</li> <li>• Blockchain solution for multimodal transport</li> <li>• Trailer reservation system</li> </ul>	<ul style="list-style-type: none"> <li>• International partnership for Port Facility Security Officers</li> <li>• Technical installation for circularity of plastics waste</li> <li>• Hydrogen renewable energy installation</li> <li>• Blue Economy incubator program</li> </ul>

Table 2 shows the projects (46) categorised in four groups. These projects have been classified as a contribution to the economy. In the top left corner, these projects relate to activities which are inherent to the workplace of the port authority and have the aim to reduce the impact on the environment, however, are economically driven. The bottom left corner are projects which are aimed to stimulate, promote or facilitate direct stakeholders in optimising their efficiencies, and improve their environmental performance, such as a truck parking platform for trucking companies and vessel performance monitoring for shipping companies. The top right corner lists projects which aim to enhance the economic performance for the port, or to contribute to a safe and secure environment. Examples here are single window systems to facilitate trade, the construction of resilient port infrastructure, such as cruise terminals, green zones for recreation purposes and upgrading of communication networks. The strategic intention of PAs is to contribute to the economic growth, which is in the direct interest of the PA as well as for direct customers of the port authority. The bottom right corner lists the projects which have involved or are aimed at positively contributing to society

Table 4: Projects related to biosphere

	Do no harm	Do good
<b>internal</b>	<ul style="list-style-type: none"> <li>• Cleaning installations for waste water treatment</li> <li>• Coastal engineering, e.g. erosion control, coral reef protection</li> <li>• Management system on water quality</li> <li>• Technical installation for water quality improvement</li> </ul>	<ul style="list-style-type: none"> <li>• Green vision</li> <li>• Research projects, e.g. on circularity</li> <li>• Develop resilient infrastructure</li> </ul>
<b>external</b>	<ul style="list-style-type: none"> <li>• Carbon sequestration (storage)</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat for species</li> <li>• Ecological conservation</li> <li>• Knowledge sharing platform</li> </ul>

The database contains 21 projects which are relating to the biosphere of the port. Table 4 shows the project groups. Some projects are related to technical installations for water quality improvement and waste-water treatment. There are also coastal engineering projects in which the port authority constructed new port infrastructure but has taken measures to protect the coral reef. We have clustered these under ‘do no harm’ because these measures relate to the core capabilities of the port authority (i.e. port development, port construction). There are also examples where the ports are using these core engineering capabilities to build resilient infrastructure. There is one project which uses the ecosystem for carbon storage. Then, there are projects which execute the ‘good’ intentions of the Port Authority. The Green vision, research projects on circular economy are both aimed for internal alignment. For three project groups, the contribution to the ecosystem is driven by external values: ecological conservation and habitat restoration, and a national knowledge sharing platform for SDG achievements.

Table 5: Project relating to society

	Do no harm	Do good
<b>internal</b>	<ul style="list-style-type: none"> <li>• Air quality improvement plan</li> <li>• Sustainability reporting</li> <li>• Green policy and program</li> <li>• Water bank system for air pollution reduction</li> <li>• Management system zero emissions</li> <li>• Research on sustainable fleet operations</li> <li>• Electric mobility plan</li> </ul>	<ul style="list-style-type: none"> <li>• Inclusive port vision</li> <li>• Sustainable governance model</li> <li>• Community dialogues</li> <li>• Conservation engineering projects</li> <li>• Local employment at cruise terminals</li> <li>• Apps for tourism</li> <li>• Tidal energy installation</li> <li>• Hydrogen installation</li> </ul>
<b>external</b>	<ul style="list-style-type: none"> <li>• On-shore power supply (reduce NOx)</li> <li>• Air quality information system</li> <li>• Ship emission management system</li> </ul>	<ul style="list-style-type: none"> <li>• Community awareness program</li> <li>• Employee outreach programme</li> <li>• Port festival</li> <li>• Education and capacity building</li> <li>• Recreation for local community</li> <li>• Cruise port development inclusive to local community</li> <li>• Cadet programme for women</li> </ul>

The WPSP portfolio contains 54 projects which we have classified as contribution to society, which are listed in the Table 5. In the top left corner, there are several projects which concern internal management systems, policies and programmes on sustainability and green operations. Furthermore, some projects aim to reduce the nuisance of local air pollution caused by shipping operations by implementation of emission reduction installations and management systems. Then, there are a range of projects which aim to reach out to the community, by means of festivals, education and capacity building, recreation for the local community, as well as fostering local community involvement in design and development of large-scale infrastructure projects. Lastly, we identified one project which is specifically aimed to get more women into a maritime career.

## 4 Discussion

This section discusses the question to what extent ports and their authorising bodies have added value to the ecosystem and what were their strategic intents and actions to contribute to the realisation of the Sustainable Development Goals?

### 4.1 Ecosystems services and SDG engagement

The ecosystems services perspective provides a holistic perspective on challenges ports are facing in reconciling opposite objectives. For ports to balance economic growth with wellbeing of the community and restore the ecosystem values, ports must consider the natural capital of the ecosystem which is critical for their license towards society to grow. For port authorities the notion of ecosystems services is at the core of their existence and long-term sustainability.

An inclusive approach to port development starts with the ports inherited resources, the stocks of capital, which is the favourable location for human activities, whether it be a location for settlement, for clusters of industry or a gateway for trade and transport. The extent to which port authorities engage with the SDGs must therefore be rooted in the ecosystem. Building resilient and robust port infrastructure is the core capability of Port Authorities. The portfolio of projects show evidence that Port Authorities are starting to realize that long lasting relationships with society go hand-in-hand with protection of the biosphere.

The initial findings are based on a WPSP project portfolio which is a worldwide programme that has only started two years ago as a knowledge platform to share good practices. Reflection on the learnings as well as conceptualizing the findings have not been done to the full extent. Based on currently listed projects, we expect Port Authorities to be in an awareness stage concerning their engagement with the SDGs. The green and zero emission visions as well as the plans and programmes which were launched very recently underscored this initial conclusion.

Furthermore, our initial findings show that Port Authorities are primarily engaged in SDGs which are contributing to the economy layer of their ecosystem. Positive to see is the portfolio of initiative, which cover both 'do no harm' and 'do good' practices. As expected, there is a considerable number of projects with internally actionable 'do no harm' engagement to the SDGs. These are projects which they have capabilities 'in house'. Additionally, PAs also engage in externally actionable 'do no harm' projects, which are aimed to push their direct stakeholders in the right direction. In those projects, PAs exert their role as facilitator. By doing so they are transferring their license to operate to the execution level. On the positive side, there are also considerable number of projects which show PAs are taking

responsibility for restoring the relationship with their coastal ecosystems: habitat restoration, coral reef conservation, wetland conservation, but also inclusive partnerships with indigenous communities.

#### 4.2 Methodology considerations

We must however be careful with these conclusions for methodological reasons. Although the analysis is based on 121 projects, there may be a selection bias in this dataset. Port Authorities may have done a selection of projects for submission to the WPSP knowledge platform. There could be other motives at play for this selection such as promotion of the sustainable image of the port. There could also be an omission bias. Our findings are based on 82 ports, including a handful of port consortia, but large ports in important countries, such as China, Japan and Europe are missing in the database.

Thirdly, there could be a measurement bias in our findings. There is not a methodology for linking SDGs and SDG targets to the projects, and the project leaders at PAs have labelled the SDGs – on a goal level – to the projects. We have created a methodology ourselves, using the ecosystems layers as the basis, but this methodology will have to be calibrated. The solution to these research biases could be to collect more data via a survey among the project leaders, and by more profound case studies.

### 5 Conclusions

This paper presents the preliminary findings of a study into the contribution of port authorities to the SDGs, by taking a holistic view on ports and the ecosystems. These coastal ecosystems are inherently providing a home to ports, who use the natural capital from the ecosystem for human society and economic activity. The ecosystems view on inclusive port development is fundamental for stakeholders who seek to collaborate and take on the challenge of creating value for themselves while also considering the value provided by the ecosystem. The carrying capacity of the coastal ecosystem is already under severe pressure which is not sustainable and neglecting the ecosystem values will eventually lead to severe risks for coastal communities, (metropolitan) port cities and ports.

The World Port Sustainability Program is a promising initiative which – through knowledge exchange – supports and promotes the sustainable development agenda by the United Nations, while at the same time raises the awareness for collaborative action. Having an inclusive strategy to port development is essential for port authorities to contribute to the Sustainable Development Goals, which ultimately has the ambition to sustain the ecosystems, while enabling human prosperity.

There are still limitations to the study. First, the findings presented in this paper are not complete. The nexus approach – the interlinkages between the SDGs – requires further study, particularly to assess the links between the three ecosystem layers: biosphere, society and economy. Furthermore, the methodology to link a port project to an SDG requires further calibration, for instance by comparing this study with similar studies where SDGs have been linked to contributions by multinationals or city governments. A third research avenue could be to explore specific case studies. Motivations and actionability have now been assessed for a large quantity of projects, but the underlying mechanisms at play from project initiation to valorisation may provide a better understanding on stakeholder engagement and partnerships. Some port authorities are already working on strategic monitors in which they link their corporate objectives to the SDGs, including a set of SMART performance indicators on project level.

Ports are in a pivotal position towards sustainable development for various reasons: 1) their physical locations in coastal ecosystems, 2) their institutional position in between governments making policies on a macro-level and companies acting on the micro-level, 3) the direct impact of port construction on the ecosystem. Port authorities are making steps to move from conflict to collaboration with their stakeholders. More research is needed to understand the interdependencies, the partnership mechanisms and preferred approach to inclusive port development.

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## Appendix: List of projects and SDG targets

Country	Title	Ecosystem value	Ecosystem	SDG Target 1st	SDG Target 2nd	SDG Target 3rd
Australia	Ports Australia – Ports and a Sustainable Australia	Conservation values	Biosphere	17.14	4.7	9.1
Australia	Port Coogee - Maritime Trail	Recreational values	Biosphere	14.5	4.7	11.7
Australia	Port of Brisbane – Offsite Stormwater management	Erosion control	Biosphere	9.1	6.3	15.5
Australia	Port of Brisbane – Migratory Shorebird Monitoring	Habitat for species	Biosphere	15.5	14.2	17.9
Germany	JadeWeserPort – The Seabin Project	Water purification	Biosphere	8.4	6.6	14.2
Spain	Port of Vigo – Sunset Dock Project	Carbon sequestration (storage)	Biosphere	14.2	4.7	13.1
Spain	Port of Huelva – Ecological recovery project	Habitat for species	Biosphere	11.7	13.1	15.9
United Arab Emirates	Abu Dhabi Ports – Protecting the Coral Reefs	Habitat for species	Biosphere	9.1	14.5	8.1
United Kingdom	Port of London – Expanding wetland fringes along the estuary	Habitat for species	Biosphere	14.2	9.1	15.9
United Kingdom	Port of London – Expanding Passive Litter Collection on the Thames	Waste water treatment	Biosphere	14.1	6.6	15.1
Canada	Northwest Seaport Alliance – Clean Truck Program	Air quality maintenance	Economy	11.6	3.9	4.7
France, Greece, Italy	Collaborative project - PIXEL	Climate regulation	Economy	9.c	8.2	11.b
Germany	Port of Hamburg – Secure Truck Parking	Air quality maintenance	Economy	3.9	11.2	9.1
Germany, Greece, Italy, Spain	Collaborative project – Green and Connected Ports	Route of transportation	Economy	9.1	13.1	

Country	Title	Ecosystem value	Ecosystem	SDG Target 1st	SDG Target 2nd	SDG Target 3rd
Italy	Port of Bari – Artificial intelligence for environmental monitoring and prediction	Conservation values	Economy	14.1	11.6	9.5
Japan	Port of Yokohama – LNG bunkering	Air quality maintenance	Economy	7.1	9.1	11.6
Panama	Panama Maritime Authority – Cruise Terminal Development	Recreational values	Economy	9.1	8.9	
Singapore	Maritime and Port Authority of Singapore - Singapore's Next Generation Tuas Port Project	Route of transportation	Economy	9.1	8.5	14.2
United States	Port of San Diego – Environmental Innovation through Blue Economy Incubator Program	Conservation values	Economy	8.3	14.2	14.a
Australia	Gladstone Ports Corporation – Sustainable Sediment Management Project	Erosion control	Society	9.1	17.7	14.2
Australia	Gladstone Ports Corporation – Sustainable Sediment Management Project	Educational values	Society	4.3	8.5	10.2
Brazil	Port of Açú – AbraÇU Volunteer Project	Educational values	Society	11.3	8.8	17.7
Canada	Port of Montreal – Grand Quay development project	Recreational values	Society	8.9	9.1	7.2
France	Port of Marseille – Provision of Onshore Power Supply	Air quality maintenance	Society	3.9	7.2	13.1
France	Port of Marseille – GuideMeMarseille	Recreational values	Society	8.9	9.1	9.4
Germany	Port of Hamburg – Hamburg Sustainable Fleet	Climate regulation	Society	7.3	8.2	13.1

Country	Title	Ecosystem value	Ecosystem	SDG Target 1st	SDG Target 2nd	SDG Target 3rd
Italy	Port of Genoa – Onshore Power Supply to vessels	Air quality maintenance	Society	13.1	11.6	3.9
Japan	Port of Tokyo – Addressing Port congestion during the 2020 Tokyo Olympics	Air quality maintenance	Society	11.6	9.1	13.2
Kenya	Kenya Ports Authority – Tunahusika Corporate Social Investment program	Educational values	Society	3.8	4.1	5.1
Philippines	Port of Batangas – Greening Project	Energy provision	Society	11.6	13.1	3.9
South Korea	Busan Port – Reinventing unused port space	Recreational values	Society	8.5	11.7	17.17
South Korea	Yeosu Gwangyang Port – Community Outreach Program	Recreational values	Society	8.3	11.a	4.7
South Korea	Busan Port Pop-Up Cruise Market	Recreational values	Society	8.5	8.9	9.1
Sri Lanka	Sri Lanka Ports Authority – Community awareness programs	Educational values	Society	4.7	14.2	17.17
United Kingdom	Port of London – Thames Vision 2035	Conservation values	Society	9.1	11.4	14.2
United States	Port of Seattle – Duwamish Valley Community Benefits Commitment	Cultural heritage values	Society	8.5	11.4	16.7