chainPORT

DIGITAL & SUSTAINABILITY

HOW CAN THE DIGITAL TRANSITION SUPPORT ZERO-EMISSION PORTS?

2021

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Climate change and its effects are becoming increasingly relevant to ports. The effects can be, for example, strong weather phenomena such as storm, floods or heavy snow. As a result, port infrastructure and operations are affected and, in some cases, can only operate to a limited extent, which also has a financial impact. In addition, there is the rising sea level that ports have to deal with. Therefore, it is in the interest of ports to deal with the issue of sustainability and work toward a zero-emission port. Digitalisation can support this transition. This Playbook presents various best practices from chainPORT ports to show how digital processes and applications can help reduce emissions in the port area or detect the sources of emissions.

This Playbook, written for environmental port experts of port authorities, was created to share our experiences working toward zero-emission ports. It provides selected examples of digital solution best practices from participating chainPORT members that port authorities can apply to their operations.

> We are being confronted with the biggest challenge of our time – to sustain this planet. We hope, the best practices illustrated in this playbook could ignite more ideas and measures among port communities around the world.
>
> Phanthian Zuesongdham, Hamburg Port Authority

INTRODUCTION TO CHAINPORT PLAYBOOK SERIES (REFERENCE TO VOLUME 1)

After six years in existence, it was with much pride that chainPORT launched its first official publication in October of 2020 entitled Leveraging Digital Solutions for Crisis Management. Fully digital, the document truly captured the essence and values of the chainPORT collective as a group of forward-looking ports aiming to spearhead the digital transformation of the industry: highly relevant, collaborative, interactive and democratic in its approach to knowledge diffusion. The first edition was a compendium of smart solutions destined to port managers and strategists that allowed ports to weather the pandemic while building resilience for the next disruptions to come. The timing could not have been better as ports were in an unprecedented struggle to protect, maintain and keep global supply chains running under a truly dramatic context.

The collective effort was well received by the global community. So much so that chainPORT is happy to introduce a second edition under a topic arguably just as relevant: Digital and Climate Change. While carbon reduction strategies are without a doubt topping the list of topics benefiting most from exposure these days, the link between environmental and digital strategies is not necessarily intuitive nor given. The key questions that concern us here are: 1) how can digital solutions advance a port's zero-emission agenda? 2) How can ports harness the power of digital for the benefit of the environment? The contents of this Playbook therefore aim at 'putting a digital twist' to decarbonization strategies and the like. It can be easily argued that this second edition is just as timely, as the clock is ticking for an industry that needs to do more collectively to achieve zero-emission goals.

> "Very few, if not any, publications have explored and made explicit the link between digitalization and our industry's net-zero agenda. It is hoped that this hands-on compendium of best practices will lead the way in this direction.
>
> Daniel Olivier, Port of Montreal

WHY AND FOR WHOM SHOULD THIS PLAYBOOK BE USEFUL?

This digital document will likely be a critical read for environmental port experts and decision makers, but is certainly not limited to such experts and should also compel any maritime industry stakeholder driven by a serious environmental agenda. It should appeal to any human being who is deeply concerned about contributing to a better future for the planet … period!

These chainPORT playbook series are designed as a handbook of best practices, inspired by the world's leading ports who excel in this field and are generous enough to share lessons learned. Sharing success is easy. Sharing pitfalls, mistakes, challenges and lessons learned requires more humility, even for the best-in-class. But it is exponentially more rewarding and pedagogical.

Port of Hamburg – © Westend61

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CLIMATE CHANGE MATTERS TO PORTS

The physical and economic effects of climate change are already being felt by ports all over the world. Extreme weather events attributed to climate change such as severe hurricanes and snowstorms have led to port closures. Wind and storm surges from these extreme weather events have cost ports a considerable amount of time and money to repair. Rising sea levels from melting ice pose a major threat to existing port infrastructure. Many ports do not have current policies or planning documents to guide them in how to incorporate sea level changes into their infrastructure designs.

Goods movement is a major contributor to greenhouse gas emissions. About 2.5% of the global greenhouse gas emissions are generated by maritime transport, according to the European Commission (2014). The International Maritime Organization (IMO) has set out to reduce carbon intensity from shipping. IMO has a goal to reduce the total annual greenhouse gas emissions from international shipping by at least 50% by 2050 as compared to 2008. In addition, many companies in the logistics sector are already analyzing their operational carbon footprint and going beyond the IMO goals. For example, Maersk and CMA CGM have decarbonization plans to reduce greenhouse gas emissions to net zero from their operations by 2050. However, customer companies such as Amazon and Ikea are already demanding zero carbon shipping by 2040 (Reuters, 2021).

While ports only make up a portion of the Goods Movement sector, they have an obligation to decarbonize their operations to ensure their own sustainability and meet their customers' demands, all while experiencing continued growth. Utilization of zero-emission technologies to move cargo in and out of the ports can provide the benefit of combating climate change, as well as reducing other harmful pollutants such as diesel particulate matter and nitrogen oxides. According to IMO-IAPH Port Emission Toolkit Guide 1 (2018), these pollutants are known to be harmful to health. Therefore, the move to zero-emission cargo moving technologies not only battles climate change, but it also improves the health and safety of port workers and the surrounding port communities.

> By working together, ports and supply chain partners can successfully achieve important sustainability goals.
>
> Lance Kaneshiro, Port of Los Angeles

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WHAT IS A ZERO-EMISSION PORT

COMMON UNDERSTANDING FOR ZERO EMISSION OF THE PORTS

A zero-emission port aims to reduce its emissions to zero or at least to a minimum.
This includes the following emissions:

Greenhouse gas | Air pollution | Plastic pollution | Noise emission | Odor emission | Water pollution

COMMON VISION & APPROACHES

Ports worldwide have identified their potential to contribute to the reduction of emissions in the shipping industry and have taken measures to realize becoming a “zero-emission port”. In ports, emissions are produced from different sources, e.g. industry in the port, chemical industry, shipping industry, traffic or waste.

Whereas each port defines individual approaches towards a zero-emission port, there are common approaches to realize the vision. A major driver to reduce emissions is the use of alternative energies such as onshore power and fuels from renewable energies (e.g. hydrogen) in the port operations. Even though all participating ports have ongoing projects and investments in alternative energies, it will not be the focus of this paper. Instead, we concentrate on digitalization and how it can contribute to reach the zero-emission port.

> “Ports are large innovation platforms where new products towards zero emissions solutions can be faster developed and scaled up to an operational level. Innovation-with-a-purpose has to be the focus in the years to come.
>
> Piet Opstaele, Port of Antwerp

INDIVIDUAL APPROACHES IN EVERY PORT

Every port defined specific goals and time frames to reach the vision of the zero-emission port:

Hamburg

65% CO_2 Reduction by 2030 below 1990 levels as part of the German climate laws

100% CO_2 reduction by 2040 below 1990 levels - Climate neutral port in 2040

All new buildings in the port are planned and built climate neutral and fossil free

ZeroEmission@Berth by 2030

Barcelona

By 2025, 50% of the container & ro-ro docks will have an onshore power system. Reduce 50% of CO_2 emissions in port operations by 2030 and become a carbon neutral port by 2050

Los Angeles

By 2023, reduce port-related emissions by 59% for NOx, 93% for SOx and 77% for DPM below 2005 levels

By 2030, reduce GHGs from port-related sources by 40% below 1990 levels

By 2050, reduce GHGs from port-related sources by 80% below 1990 levels

Montreal

MPA has commited through the Montreal Climate Partnership to reduce its GHGs emissions by 55% by 2030 and achieve carbon neutrality by 2050

Antwerp

50% CO_2 Reduction by 2030

Climate neutral port in 2050

3 objectives: Sustainable energy, sustainable shipping, sustainable industry

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TRAFFIC MANAGEMENT

Thousands of cars and, in comparison to municipal roads, a high amount of heavy freight traffic pass through the port every day. Traffic jams, stop-and-go traffic and waiting times at the terminal cause greenhouse gas, air pollution, noise and odor emissions. In addition, stop-and-go traffic produces micro plastic from tyre abrasion. With the digitalization of traffic management, capacities on the road can be optimally utilized. Guaranteeing a smooth traffic flow means that fewer emissions are produced.

> We are seeking to reduce our carbon footprint for transportation within the port as part of global efforts to address the climate emergency. Optimization is the logical way to address the challenges.
>
> Hermann Grünfeld, Hamburg Port Authority

PORT OF HAMBURG

The goal of Green4TransPORT is to make the best possible use of the existing road transport infrastructure, to network and digitize it in order to enable sustainable traffic management. The introduction of V2X technology enables real-time communication between trucks and the traffic light system. The system detects approaching trucks and truck convoys with V2X, can extend the green phase of the traffic lights accordingly and thus optimizes the traffic flow. By reducing stop-and-go traffic in front of traffic lights, fuel consumption and greenhouse gas emissions in particular, but also material wear and tear, are reduced.

MOZART stands for “Mobility OptimiZation and Analysis in Real Time” and provides a traffic management through traffic signal control by quantum-inspired optimization. It achieves an overall network analysis and network-wide coordinated traffic signal control to steady the flow of traffic. The quantum-inspired technology “digital annealer” provides a solution approach to play through the extremely high number of possible traffic light circuits in a matter of seconds and find the optimal one. As a basis, the current traffic situation is determined from the sensors in the network and mapped in a traffic model. If, for example, a long truck platoon is detected in the sensor network, the result of optimal traffic control is not only to prioritise the platoon at one traffic light, but also to prioritise it in advance at the following traffic lights. The flexible traffic light control makes it possible to route the trucks through the port network without delays.

With Smart Area Parking, the detection of inflows and outflows, the current parking space occupancies and the remaining capacities are all determined. Subsequently, this information can be made available to users in parallel via the DIVA boards in the street network and to the B2B service providers via Mobility Data Marketplace. This reduces parking search traffic and optimizes the utilization of existing parking space capacities. The reduction in parking search traffic also means less environmental pollution for the port.

Green4TransPORT – © Chris Callaghan

MOZART – © Port of Hamburg & Fujitsu

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☑	☑	☐	☐	☐	☐

TRAFFIC MANAGEMENT

PORT OF LOS ANGELES – ECO-FRATIS

The Port of Los Angeles in conjunction with the project partners will demonstrate near-zero and zero emission cargo handling equipment as well as an intelligent transportation system technology. The Advanced Yard Tractor Deployment component will demonstrate 5 BYD Motors electric yard tractors and 20 Capacity Trucks near-zero emission natural gas yard tractors, fueled with renewable natural gas provided by Clean Energy Fuels. The Eco-FRATIS component will demonstrate the integration of ITS technologies with 100 drayage trucks in order to enhance drayage operations and improve onroad truck efficiency.

The technologies that will be integrated for the Eco-FRATIS component include: Freight Advanced Information System (FRATIS) deployment, Harbor Trucking Association and InfoMagnus' Geostamp application, which provides real-time truck travel and terminal turn times via an automated mobile smart device application; and UCR's Eco-Drive application, which uses traffic signal timing information to optimize acceleration and deceleration of trucks. This project will enhance market acceptance of advanced vehicle and information technology in yard tractors and drayage truck applications that will reduce greenhouse gas emissions, reduce petroleum use, improve energy cost savings, and benefit disadvantaged communities.

Eco-FRATIS – © Port of Los Angeles

PORT OF BARCELONA – ACCESS TIME PORTAL

The project running and having a virtual doors system that digitizes customs procedures has been in place for a while. Following this direction, the port is also implementing two systems. The Access Time portal allows to check the average entry time to the container terminals once the truck has entered the port. Currently, we are developing a project with T-Systems that goes one step further, as it will anticipate the volume of traffic two hours in advance. The system combines artificial intelligence with cloud solutions from Amazon Web Services and video analytics technologies to observe the passage of trucks through different points of the enclosure. The information provided by the different cameras will automatically establish the time it takes the same truck to travel between different points. It also takes into account the time of the day and the port capacity. Another benefit is traceability because it allows us to minimize operational risks, eliminate the use of paper and link the work chain in a reliable and automated way.

The advantage is less waiting time for lorries and optimization of vehicles, with the corresponding savings on direct costs for the carriers: increased number of moves per vehicle, optimizing carrier's fleets; improved mobility, at the port and its surroundings by limiting queues lowers CO_2 emissions, which is key to ensuring sustainable growth of ports; improved competitiveness of land transport, which may find booking systems to be a clear driver of change. After booking systems, the next step to ensure maximum efficiency and productivity is to expand terminal hours. Depending on market demand, ports can even consider moving towards a 24/7 model in the future.

Access Time Portal – © Port of Barcelona

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WASTE MANAGEMENT

Normally, waste disposal is a closed loop, but unintentional pollution within the port is a possibility. Among other things, this can lead to odor emissions and water pollution. Next to waste separation and recycling the circular economy gets more popular. Waste is to be further processed and is seen as a new resource. It is not just important to prevent waste, but also to detect it. Smart sensors simplify this process.

> The project will allow the Port of Barcelona to optimize the management of solid waste through a system of sensors that calculates its volume with high precision remotely and in real time, without having to have the presence of supervisors.
>
> Felix Gonzalez, Port of Barcelona

PORT OF BARCELONA - MEASUREMENT OF THE VOLUME OF SHIP WASTE

In 2019 a challenge was set by the port authority in order to check how to industrialize the reading of the volume and weight of containers or tanks. The solid waste from the boats is collected in containers that are managed by the port service providers. In the maritime sector, waste is measured by volume and not by weight as it is on land. For this reason, the result is not as precise as it could be. We were seeking to measure the volume of the waste in an automated and reliable way and that this measurement reaches the Port Information System in real time. A laser measuring the volume, cameras identifying the MARPOL class, and infrared technology to detect the temperature help the system to be reliable and not assisted. With this system, 24 hours release of waste is permitted. It ensures the confidence of the operators and avoids pricing issues.

Measurement of the volume of ship waste – © goClever

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☐	☐	☑	☐	☐	☐

ADVANCED PORT INFORMATION MANAGEMENT

With more information about the handling in the port/terminal (ship, truck, rail), the processes can be planned more precisely and coordinated. This results in reducing waiting time, optimizing resource utilization, avoiding unnecessary container movements and at the same time reducing greenhouse gas and noise emissions.

PORT OF LOS ANGELES – PORT OPTIMIZER

Port Optimizer is a cloud-based software solution that enhances supply chain performance and predictability by delivering real time data driven insights through a single portal to partners across the supply chain. Integrating data from across the port ecosystem, combining machine learning and deep domain expertise, it helps the supply chain monitor and respond to dynamic conditions, align people and resources, and proactively communicate across functions – enabling maximum port throughput and delivery performance. Knowing a vessel's expected arrival time and what cargo will need to be offloaded/loaded increases terminal operation efficiency which in turn reduces emissions. A vessel can preschedule the use of shore power or arrange for use of an emission capture control system. Containers with less dwell time on dock reduces the number of container moves/lifts which in turn decreases emissions from the cargo handling equipment performing the moves. Reduced truck turn times decreases truck idling at the terminals.

Port Optimizer – © Wabtec

PORT OF MONTREAL – PREDICTING TRUCK TURNAROUND TIMES FOR IMPROVED ROUTE OPTIMIZATION

The platform was introduced in 2016 as an open desktop and mobile app to obtain real-time truck turn times at the 4 container terminals. The app also uses an algorithm that translates processing times into greenhouse gas emissions and reports on real-time truck-borne carbon emissions at the port. The app has been used by truckers and dispatchers to optimize their routings and dispatches by making optimal use of uncongested time windows and night gates so as to maximize the number of truck turns in a single day. In 2019, an AI layer was added to create truck turn time predictions up to 24 hours out. The predictions provide further visibility to inform planning of port visits and dispatches for the 2,500 trucks that visit the port daily. Combined with the introduction of a night gate program, the app has allowed increased fluidity of trucks at the gate. Since its introduction, the port has been able to decrease truck processing times by 5% despite a 30% increase of truck volumes. This efficiency gain translates into better environmental performance per transaction.

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☑	☑	☐	☐	☐	☐

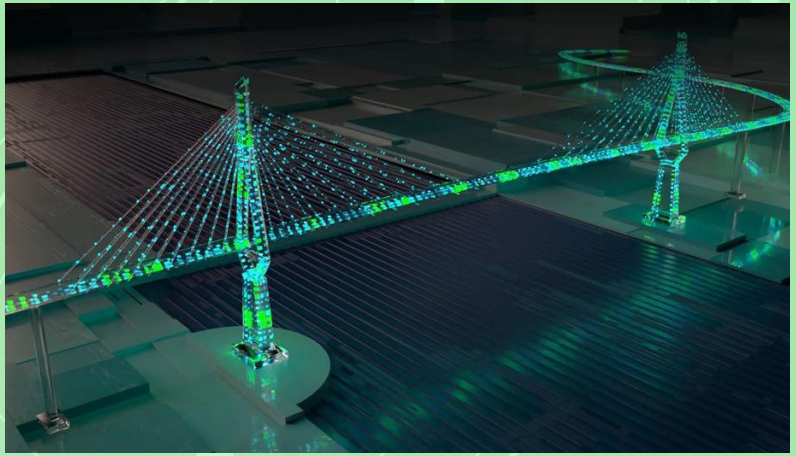
ADVANCED PORT INFORMATION MANAGEMENT

PORT OF ANTWERP - APICA

APICA (Antwerp port information and control Assistant) is a virtual assistant that leverages the input of smart cameras, drones, sensors for air and water quality and combining all this data into a virtual model (digital twin) of the port. APICA is used to improve the safety & security and operations in the port by having a faster and real-time view on what's happening in the port but also as an important driver to reduce the carbon emissions in the port. The usage of shore tension for barges is now monitored remotely (in the past port staff needed to go on-site) and the tugboats are monitored in real time on their emissions and potential mechanical issues. Applying data science on the data in APICA will allow it to become a port with more predictive operations, with a higher level of safety and security.

PORT OF HAMBURG - SMARTBRIDGE

smartBRIDGE Hamburg is part of the smartPORT-Hamburg-Portfolio. SmartBRIDGE Hamburg is a digital twin of one of Hamburg's most important landmarks – the Köhlbrandbrücke. The bridge is equipped with more than 500 sensors, which measure the condition of the bridge in real time. These condition indicators are merged with a 3D Model of the bridge and transformed into the digital twin. The smartBRIDGE Hamburg software enables the engineers to get a better overview of their objects. Furthermore, it enables the engineers to perform predictive maintenance, whereas traditional maintenance work is mostly reactive. The software immediately detects minor damage, so that technicians can perform small maintenance measures to prevent big construction measures, which results in a longer lifetime, increased safety and availability of the bridge. Thus, measurement costs can be reduced and less interruptions in the traffic flow due to constructions leads to a reduction of emissions. All in all, smartBRIDGE Hamburg is a very good maintenance management tool with an outstanding visualization that provides an intuitive software experience.



smartBRIDGE – © Große Liebe

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SMART SHIPPING INCLUDING HINTERLAND

The port comprises various traffic and transport networks. In addition to optimizing the fuel consumption of these, alternative fuels are also a way of reducing emissions in the port. IoT sensors, for example, can help to generate the best possible sustainable benefit. Sustainability initiatives should not be limited to the port, but also include the hinterland.

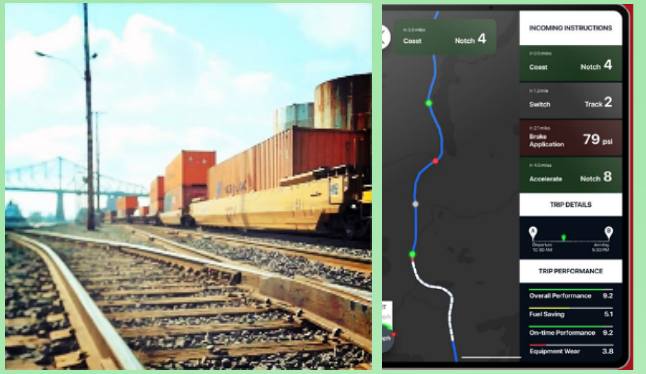
PORT OF ANTWERP - ECHODRONE

Sounding the depth of the water in the port is one of the key tasks of a port authority. This is to ensure safe and smooth ship traffic and to detect the areas where dredging is required. In the Port of Antwerp an autonomous zero emission sounding boat – the Echodrone - has been developed to perform these measurements in a faster, cleaner and cheaper way. Connected to a cloud platform the small boat is sending continuous depth measurement data while receiving information to support its autonomous sailing. The Echodrone is continuously measuring depths of ground levels during dredging activities, also at places that are difficult to be reached by larger vessels (e.g. taluds). In the meantime, it also became a sensor and data platform for inspection of infrastructure, detection of waste on the water and measurement of air quality. Challenges which still need to be overcome are sustaining over 8 hours of operation time and resistance to rough weather conditions.

Echodrone – © Port of Antwerp

PORT OF MONTREAL – SMART LOCOMOTIVE DRIVER ASSISTANCE

With over 100 km of rail lines and four locomotives, the Port of Montreal is a unique model in North America in that the port authority operates its own railway and offers on-dock shunting services to its Class1 railway partners. Since over 60% of greenhouse gas emissions generated by port authority activities are generated by its rail activities, the MPA began replacing its fleet of locomotives with next generation low-emission GenSet locomotives since 2010. To fully optimize the environmental benefits from these engines, the MPA is introducing and testing in 2021 an on-board dashboard that will make real-time recommendations to the conductor with the aim to optimize driving behavior and further save on fuel consumption. Locomotives are being equipped with sensors that capture a full range of data on train specifications and parameters, feeding the AI optimization algorithm. Recommendations on speed, acceleration, tractive power output and distribution will assist drivers in lowering fuel consumption. The project could reduce MPA's greenhouse gas emissions by 7 % and fuel consumption by 11 % annually.



Smart Locomotive Driver Assistance – © Port of Montreal © RailVision Analytics

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☑	☑	☐	☐	☐	☐

CLEAN AIR INITIATIVES

Sources of air pollution come from ships, locomotives, industries with chemical and combustion processes, and domestic fuel emissions, among others. The most relevant air pollution is the greenhouse gas. It is the main reason for the climate change and has therefore a global impact. Further air pollutions are for example particulate matter. It harms our health and has a more local impact. The wind circulates the particulate matter to the cities. Sensors help to detect the amount of air pollution and can initiate countermeasures. Digital applications can also help to detect and prevent the amount of air pollution. Sustainability initiatives should not be limited to the port, but also include the hinterland.

PORT OF HAMBURG – I2PANEMA

The goal of the research project I2PANEMA is to develop IoT demonstrators based on different application scenarios. In addition, an IoT reference architecture for increasing the efficiency of ports and shipping is being derived. In the Port of Hamburg, among other projects, a forecasting model for the purchase of onshore power supply is being developed. The ship data required for this will be collected automatically on board and transmitted to the Port Authority. Based on the forecast, the required amount of electricity can be purchased before the ship's stay in the port.

PORT OF ANTWERP - INOSES

Being one of the largest chemical hubs, about 50 different volatile organic components (VOC) are produced in the Port of Antwerp. Besides the exceptional occurrence of incidents an important attention point is illegal degassing of tanker barges. To achieve a port wide monitoring Port of Antwerp has built a network of more than 70 Inoses which are measuring the air quality in real time, but especially the presence of VOC's. Based on specific sensors and advanced AI algorithms there is a continuous air measurement, where in case of detection of high concentrations an immediate alarm is given to a central dispatching who can take further action towards the cause of the source of the incident. Samples can also be collected remotely with canisters present on the Inoses.

Inoses – © Port of Antwerp

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☑	☑	☐	☐	☐	☐

CLEAN WATER MANAGEMENT INITIATIVES

Today's oceans contain 26-66 million tons of waste, with approximately 94% located on the seafloor. So far, collection efforts have focused mostly on surface waste, with only a few local efforts to gather underwater waste, always using human divers. No existing solution exploits autonomous sensors or robots for underwater litter detection and collection. With respect to port waters, they can be polluted by oil spill, plastic washed in from the ocean and microplastic. Microplastic on land, for example, produced by tire abrasion, ends up easily in the water when it is raining. In some countries, scrubbers are allowed to release the polluted water into the port waters. With the help of digital applications and sensors, water pollution can be detected so that countermeasures can be initiated.

PORT OF ANTWERP – SMART WATER SENSOR

Being a large bunkering port, there are yearly about 150 oil spills in Antwerp. Most of them are small overspills but from time-to-time there are bigger incidents having significant impact on the environment and operations of the port. There are clean up costs of over 1 million € annually linked to this. By using systematic drone surveys with (remote controlled) drones – covering the water areas in the port 8-10 hours a day – and equipped with computer vision software to detect oil spills, the port of Antwerp is able to have a much faster detection of spills and better identification of the root cause and involved parties. Currently, an AI model is developed to detect the concentration of waste at the docks during the drone flights. This way, more targeted clean-ups by the special equipped waste vessels can be executed. Besides this initiative, a continuous and systematic monitoring of the water quality in the port is being rolled out by using **'smart water sensors'**. These connected sensors are measuring multiple parameters such as acidity (pH), oxygen, turbidity and conductivity. This allows the port to have a much better view on the overall quality and supports faster intervention in case of incidents or emergencies.

smart water sensor – © Port of Antwerp

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☐	☐	☑	☐	☐	☑

CLEAN WATER MANAGEMENT INITIATIVES

PORT OF HAMBURG – SEACLEAR

SeaClear — short for SEarch, identificAtion and Collection of marine Litter with Autonomous Robots — is a Horizon 2020 funded project that aims at automating the process of searching, identifying, and collecting marine litter, using a team of autonomous robots that work collaboratively. A surface vessel scans the sea bottom detecting large debris already at this stage. An observation underwater robot, whose main job is to find litter of any size, adds more details to the scan with close-up targeted scans of the bottom. When in clear water, a drone also searches for litter from the air. Identified litter is registered on a map.

All underwater and aerial vehicles communicate with a surface ship that acts as a hub for the robots working together. With the help of Artificial Intelligence litter is recognized and classified to avoid the collection of plants or sea creatures by mistake. An underwater robot manoeuvres to each piece of litter on the map and grabs it with a custom-made gripper. The litter is then collected in a basket for transportation to the shore.

SeaClear – © SeaClear

Greenhouse gas	Air pollution	Plastic pollution	Noise emission	Odor emission	Water pollution
☐	☐	☑	☐	☐	☑

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FUTURE POTENTIAL AND OUTLOOK

The role of ports and their managing authorities is changing fast, being challenged by, among others, climate change and fast technology developments. It's good to see that the sustainability agenda is now a strategic priority for most ports (a recent study by Deloitte-ESPO showed that 70% of the European ports take climate change in consideration for the development of new infrastructure projects).

New and forthcoming governmental directives and legislation (on different levels) are key drivers to support this fundamental transition (eg. EU Green deal) where many more innovations on climate resilience, sustainable energy, and digital transition are required.

It's promising to note that leading ports started with the implementation of concrete projects and actions to execute on the sustainability agenda:

> Ports are asset intensive businesses where the availability of smart infrastructure is a key driver for sustainable operations, as demonstrated by the different traffic and information management systems active today.
>
> Monitoring of the environmental parameters in and around the port area is present in most ports. Today, we see new solutions coming up to react much faster in case of incidents (eg by using drones).
>
> User orientation and convenience are key drivers for successful implementation and take-up, for instance being able to dispose of waste 24/7 makes a big difference.

Ports need many more such solutions in the coming 3 to 5 years to further accelerate concrete remedies for the necessary sustainability transition. Digitalization and technology developments are means to achieve this, but above all, ports will need a close cooperation between the different stakeholders in and linked to the wonderful Port of the Future.

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