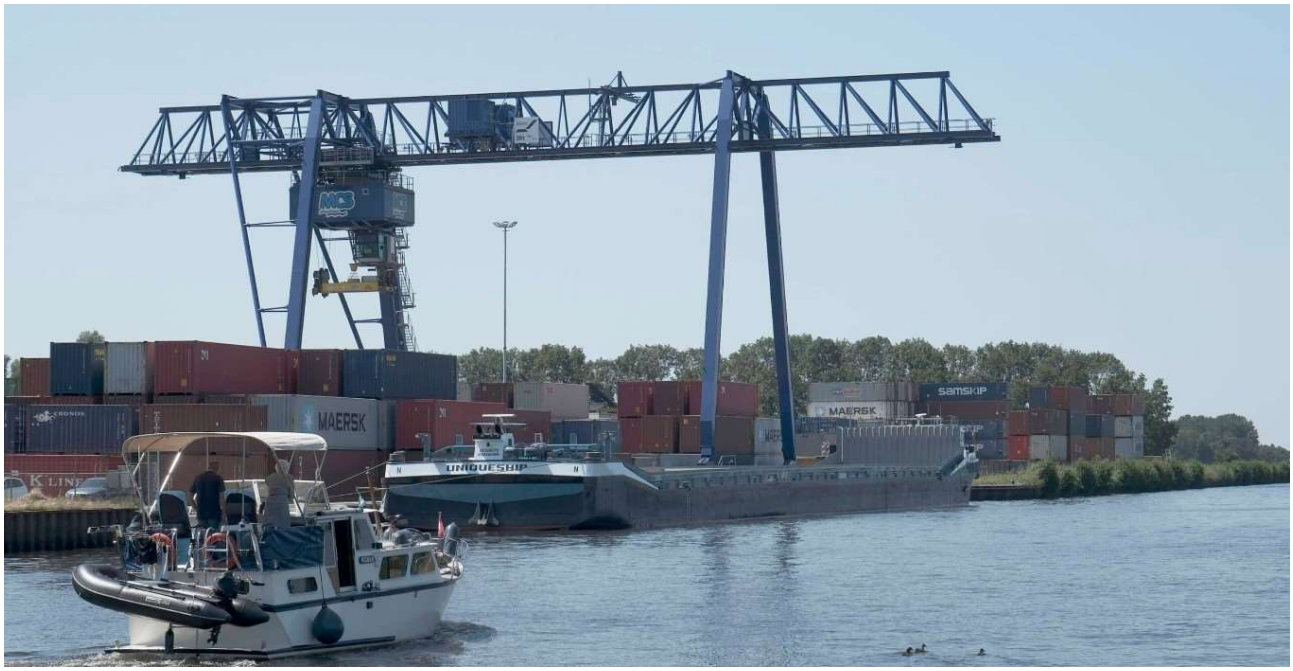
Report:

Reduction in CO_2, energy and time savings achieved by the NON-STOP Project



Interreg
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This report is conducted for the Port of Zwolle by GEMBA Seafood Consulting as a part of North Sea Interreg project NON-STOP.

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1 Executive summary:

In an era where seaports and inland ports are crucial for global trade but face significant challenges in ecological impact and logistical efficiency, the NON-STOP (New Smart Digital Operations Needed for a Sustainable Transition of Ports) project got initiated.

NON-STOP was co-funded by the Interreg North Sea Region Programme 2014–2020.

NON-STOP set out with ambitious goals:

- *to reduce port operation times by 10% while concurrently reducing CO_2 by 2% and ensuring an energy saving of 8%*

These objectives have not only been met but surpassed, marking a successful achievement in the project's mission.

The project highlights the power of green investments and collective action, offering a path to digitisation, sustainability, and efficiency in maritime operations.

It underscores that ecological responsibility and economic growth can coexist.

NON-STOP´s main contributions in relation to CO_2 reduction, energy and time savings:

<u>CO_2 emission reduction:</u>

- Eco-friendly infrastructure: Adoption of onshore power supply (OPS) and renewable energy sources significantly reduced carbon emissions during ship operations.
- Energy-efficient technologies: Integration of advanced harbour management systems and sensor-based networks decreased CO_2 emissions.

<u>Energy savings:</u>

- Automation and optimization: Automation of administrative tasks and real-time monitoring systems streamlined energy usage.
- Renewable energy integration: Adoption of renewable energy sources, such as solar power, improved energy efficiency.

<u>Time savings:</u>

- Real-time data utilization: Integration of real-time data analysis tools enhanced decision-making processes and operational efficiency.
- Technological advancements: Adoption of cutting-edge technologies, including Private 5G networks and sensor-based camera networks, optimized processes and minimized disruptions.

2 Introduction

Seaports and inland ports are vital for global trade and face challenges of ecological impact and logistical efficiency. NON-STOP addresses these issues.

NON-STOP's objective is to reduce port operation times by 10% while reducing CO2 by 2% and ensuring an energy saving of 8%. Achieving this ambitious goal involves a collaborative effort from partners across the North Sea region. In this report, we explore their achievements in reducing co_2 emissions, conserving energy, and optimizing time management.

The project demonstrates the power of green investments and collective action, offering a path to sustainability and efficiency in maritime operations.

NON-STOP signifies transformative change in the maritime industry, proving that ecological responsibility and economic growth can coexist.

While all partners have been actively participating in NON-STOP, it is not all partners that has made a direct contribution towards reducing CO_2, energy and time. Some partners have conducted desk work only and while achieving interesting and relevant results that may lead to reductions in the future, this has not been possible to measure here at the end of the project.

The following report thereby focus on the achievements made by the following partners:

- Port of Zwolle, the Netherlands
- Port of Oostende, Belgium
- Niedersachsen Ports GmbH & co. Kg, Germany
- Port of Korsør, Denmark
- Port of Antwerp-Bruges/Citymesh, Belgium
- Berg-Packhäuser & Kollegen (BPK), Germany

3 Achievements and activities of project partners

3.1 Ports of Zwolle, the Netherlands

In the dynamic environment of ports of Zwolle, digitalization has emerged as a pivotal theme in its harbour development. NON-STOP has been a great steppingstone in achieving this and has resulted in the adoption of a cutting-edge harbour management system.

CO_2 emissions reduction:

Apart from the ShipLogic initiative, the Ports of Zwolle have implemented an onshore power supply (OPS) to receive vessels in an environmentally friendly manner. This infrastructure allows ships to dock and operate without emitting CO_2 or generating noise pollution, benefiting both the environment and local communities. By eliminating the need for onboard generators and diesel engines during berthing, the OPS reduces emissions and promotes cleaner, quieter port operations.

The Ports of Zwolle has installed OPS in Meppel, Zwolle, and Kampen where vessels now have access green power when at quay. Kampen, a burgeoning tourist destination, has witnessed a surge in cruise ship arrivals, with over 300 ships docking annually. By eliminating the need for onboard electricity generation via generators and enabling the shutdown of diesel engines, the OPS has significantly reduced CO_2 emissions.

Furthermore, the real-time quay availability information provided by ShipLogic offers vessels a crucial advantage. Vessels can easily identify vacant quay locations, eliminating the need for extended periods of searching and manoeuvring. This improved docking efficiency reduces vessel idling time, which is a significant contributor to emissions. Therefore, the utilization of ShipLogic not only enhances operational efficiency but also translates into tangible CO_2 emissions reduction.

The three port areas, Zwolle, Meppel and Kampen has assessed its CO_2 reduction to the following:

- Municipality of Zwolle: 15 tons reduction.
- Municipality of Kampen: 114 tons reduction (76 tons in 2022 and 38 tons in 23).
- Municipality of Meppel: 631 tons reduction in the project period (421 tons in 2022 and 210 tons in 23). The OPS is expected to maintain an annual reduction of 421 tons.

Energy savings:

The ShipLogic system automates invoice generation and payment processing, reducing the need for manual intervention in administrative tasks, including harbour master interactions with ship owners. Furthermore, ShipLogic's real-time quay availability information reduces vessel idling time. By swiftly locating vacant quays, vessels minimize the need to keep engines running during idle periods, leading to significant energy savings.

The introduction of shore power at the Port of Zwolle optimizes vessel energy use. When ships connect to shore power, they can idle main engines, eliminating excess energy production on auxiliary systems. This approach ensures vessels draw only essential energy, resulting in substantial energy savings, with potential efficiencies of up to 30%, benefiting both vessel operators and the port.

Time savings:

In ports of Zwolle, a continuous flow of ships necessitates efficient registration processes. The harbour authorities searched for a system that aligns seamlessly with their daily operations. Together with the software company ShipLogic, solutions were constructed so an interactive map for real-time harbour monitoring and automatic ship detection now is running. With a simple click on a vessel, owner or payer information becomes readily accessible, streamlining the invoicing process. A function with a time reducing impact for both shipowners and port administration.

The Ports of Zwolle experience significant time savings through digitalization and ShipLogic software adoption. Harbor masters no longer need to manually register vessels and collect duties, optimizing their time. Moreover, real-time quay availability information helps vessels find berths quickly, eliminating time-consuming searches and reducing idling. This benefits both harbour authorities and visiting vessels, enhancing operational efficiency, and reducing congestion.

The time reduction is assessed to be more than 10 percent compared to the previous manual registration process.

3.2 Port of Oostende, Belgium

The Port of Oostende advanced in NON-STOP by focusing on the development of a digital twin component – a high-performance sensor-based camera network within the harbor. This network streamlined data transmission under marine conditions, replacing traditional optic fibers. The innovative system not only enhanced security and supervision but also led to tangible benefits in terms of efficiency, time savings, and resource optimization.

The focus of the Port of Oostende's digital twin pilot has inspired similar initiatives in other ports, including Zeebrugge and Antwerp.

CO_2 Emissions Reduction:

While exact quantification of CO_2 emissions reduction remains challenging in the case of Oostende, the transition from optic fibers to sensor-equipped cameras contributed to energy efficiency improvements, aligning with sustainability goals. A precise estimation can not be given at this point – but a reduction of CO_2 emission has been an impact.

Energy savings:

The replacement of optic fibers with the sensor-based camera network reduced energy consumption, although precise figures are challenging to ascertain due to the complex nature of bandwidth comparisons.

Time savings:

The adoption of this advanced system facilitated real-time data analysis for various port operations and environmental factors. This capability enabled remote monitoring and data access, enhancing decision-making processes, optimizing resource allocation, and ultimately increasing efficiency.

The development of a digital twin component in the Port of Oostende has from a more holistic point of view had a positive impact on the three parameter's CO_2 , energy and time - but difficult and to complex to estimate in details. Seen in combination it is evident the effort done will reduce in accordance with the ideas of the NON-STOP project.

3.3 Citymesh and the Port of Antwerp Bruges, Belgium

Citymesh, a provider of wireless communication solutions, has been advancing port environments through Private 5G networks. In NON-STOP they deployed a network in the Bruges-Antwerp Port (PoAB) that integrates air quality sensors for real-time environmental monitoring. The data-driven approach of Citymesh optimize operational efficiency, identifying inefficiencies in areas such as energy consumption and logistics, leading to targeted CO_2 reduction measures. Citymesh actively fosters sustainability initiatives, collaborating with port stakeholders to share best practices and promote collective efforts in reducing CO_2 emissions. Due to the Programme´s ERDF saving request and uncertainty in the last months of the project, Citymesh reduced its budget and did not do complete the emission reduction calculation

CO_2 emissions reduction:

Citymesh in collaboration with the Port of Antwerp Bruges (PoAB) has deployed a groundbreaking Private 5G network equipped with air quality sensors. These sensors enable real-time, precise air quality monitoring, offering deep insights into the port's environmental conditions. By analysing data with advanced inference algorithms, vital insights into air quality and environmental factors were gained, empowering proactive measures to improve the environment and reduce CO_2 emissions. Citymesh's Private 5G network ensures reliable, high-speed communication critical for collecting and analysing this data.

Energy savings:

Citymesh employs data analytics to identify inefficiencies and implement targeted CO_2 reduction measures. By analysing energy consumption patterns and traffic flow, among other data, Citymesh optimizes logistics, reduces energy-intensive processes, and enhances overall operational efficiency, thus reducing CO_2 emissions.

Additionally, 5G technology, as part of NON-STOP's vision, has the potential to decrease energy consumption in ports.

Time savings:

5G technology transforms time savings in ports. With significantly higher data transmission speeds, real-time monitoring and control systems, and efficient collaboration among stakeholders, it enables faster decision-making, quicker response times, and streamlined operations.

Automation, augmented reality (AR), and virtual reality (VR) technologies further expedite processes, while enhanced security and safety protocols minimize disruptions and delays. 5G's low latency and reliability support automation and robotics, leading to significant time savings. The introduction og 5G technology in the Port of Antwerp has given a positive impact on the three parameter's CO_2, energy, and time. Like in the case of Oostende it is difficult and complex to estimate in detail. Seen in combination it is evident the effort done will reduce in accordance with the ideas of the NON-STOP project and summing up in a holistic view the impacts is over the estimated targets.

3.4 Niedersachsen Ports GmbH & co. Kg, Germany

Niedersachsen ports GmbH & co. Kg has played an important role in developing a smart sediment and water management system at the port of Emden. This pilot project has been committed to achieving several project goals:

Reduction of influx of materials from the river Ems into the port:

Niedersachsen ports GmbH & co. Kg has developed its knowledge in microbiology and sedimentology to develop a concept aimed at significantly reducing the influx of materials from the river Ems into the port of Emden.

Improvement of drainage in the hinterland of Emden:

The project also addressed the improvement of drainage in the hinterland of Emden. By integrating data from smart measurement systems and creating an accessible dashboard, Niedersachsen ports has contributed to streamlining the drainage process. This approach has reduced the time required for inland drainage, improving efficiency and responsiveness.

Long-term support of maintenance dredging:

Maintenance dredging is a critical aspect of port management. Niedersachsen ports has worked towards long-term support for maintenance dredging by developing self-sustaining measurement systems that eliminate the need for frequent ship deployments, thus reducing energy consumption and emissions from ship diesel.

As a result of these efforts, Niedersachsen ports has achieved significant savings in terms of CO_2 emissions, energy usage, and time:

CO_2 emissions reduction:

The integration of self-sustaining measurement systems and the reduction of ship deployments for manual measurements have led to a reduction in CO_2 emissions. By relying on solar power and batteries for continuous operation, conventional energy sources have been replaced with renewable energy, further contributing to lower emissions.

Calculations and assessments suggest that a reduction of approx. 10% has been achieved.

Energy savings:

Implementing self-sufficient measurement systems and a smart water management system has reduced energy consumption. The use of clear insights provided by the dashboard enables more informed decisions on pump operations, ensuring pumps are utilized only when necessary.

Calculations and assessments suggest that a reduction of approx. 10% has been achieved.

Time savings:

Niedersachsen ports' efforts have resulted in a reduction in the time required for various port-related processes. The use of sensor data, data aggregation, and visualization through a dashboard has streamlined inland drainage processes, making them more efficient and reducing the need for manual measurements.

Calculations and assessments suggest that a reduction of approx. 8% has been achieved.

This pilot shows how the involvement of digitalization can help not only on the three targeted parameter's but also helping other relevant challenges in port operation as reducing influx, drainage and dredging.

Seen in combination with the three NON-STOP targets and the challenges in port operation meet in this pilot the impacts are counting above the expected level outlined in the NON-STOP project.

3.5 Port of Korsør, Denmark

The Port of Korsør has advanced the goals of the NON-STOP project by investing in an OPS, a move that aligns with both environmental sustainability and business objectives. The installation of this shore power system represents a major commitment to reducing carbon emissions associated with ship arrivals.

The OPS has been implemented at Amerikakajen, the section of the port where the largest vessels dock, and where crane operations are most intensive. This calculated placement ensures that the greatest impact is achieved in terms of CO_2 reduction during ship arrivals and departures. The total cost of the shore power system project amounts to seven million Danish kroner and the completion of the system is anticipated in 2023.

CO_2 emissions reduction:

The OPS are expected to reduce the port's overall CO_2 emissions during ship operations. This achievement not only contributes significantly to the project's environmental goals but also positions the port of korsør as an eco-conscious and responsible port facility.

Estimates suggest a reduction of 60 to 70 percent in CO_2 emissions during ship calls when fully operational and when all vessels use the opportunity.

Energy savings:

The introduction of shore power at the port of korsør enhances energy efficiency during vessel operations. When vessels are docked and connected to shore power, they can shut down their main engines, avoiding the unnecessary production of excess energy on auxiliary or unused engines. This practice allows vessels to draw only the energy needed for essential onboard operations, reducing energy consumption significantly.

The adoption of shore power has, in other ports, led to energy savings of up to 30%, offering substantial cost savings for vessel owners and the port.

Time savings:

While the primary focus has been on CO_2 reduction and energy savings, the shore power system may also bring time savings. Although this aspect is not of great relevance in this case, it is worth noting that shore power can streamline vessel operations, reducing downtime associated with fuelling or maintenance.

3.6 Berg-Packhäuser & Kollegen (BPK), Germany

Antara is a digital platform developed by Berg-Packhäuser & Kollegen (BPK) designed to enhance the efficiency, transparency, and sustainability of port area management in European ports. It provides an online system that stores and retrieves data, including land records, building information, environmental data, infrastructure details, contracts, and permits. Antara simplifies decision-making for port authorities and facilitates tendering processes, ensuring compliance with European public procurement laws.

CO2 Emissions reduction

Towards becoming environmentally responsible ports, Antara, can play an important role. By digitizing operations, it minimizes the need for paperwork and manual data processing, by allowing users to access necessary data for concession tenders seamlessly. This not only streamlines our processes but also promotes sustainability.

Energy savings

While Antara's most significant achievement lies in time savings, its commitment to environmental sustainability and energy efficiency highlights an approach to port management. This digital tool positions port authorities as pioneers in the maritime industry, achieving efficiency without compromising sustainability.

Time savings

Antara acts as a centralized repository for important port data, reducing the need for manual searches and ensuring real-time access to information. The platform has a user-friendly interface, streamlining administrative tasks and allowing port staff to allocate their time more effectively. Automation is a key feature, with Antara automating data retrieval and tender management, thus freeing up staff for strategic endeavors. It also promotes efficient collaboration among port stakeholders, ensuring quick responses to operational needs.

3.7 Summary of project partner achievements

In this section, a summary of the achievements and contributions made by the project partners is provided. These partners have played a role in various aspects of the project, and here the CO2 reduction, energy savings, and time savings are briefly listed.

Below is a table summarizing the accomplishments of each partner in these key areas.

Also, other relevant impacts have been uplisted in the table below showing - seen from a holistic point of view – the components indirectly increasing the common effect from the NON-STOP project.

Partner/Target and other impacts	CO2 reduction	Energy savings	Time savings	Other relevant impacts
Ports of Zwolle, the Netherlands	Zwolle: 15 tons reduction	Automation reduces manual tasks, 30% due to shore power	Realtime quay availability, +10% time savings	Increased awareness of potential benefits from digitalization.
	Kampen: 76 tons (2022)	Onshore power supply, 30% due to shore power	Streamlines vessel berthing, +10% time savings	
	Meppel: 421 tons (2022)	Shore power optimizes energy, 30% due to shore power	Optimizes harbour master's time, +10% time savings	
Port of Oostende, Belgium	Not specified – calculation to complex	Reduced energy consumption	Realtime data analysis	Replaced optic fibres and remote monitoring
Citymesh and the Port of Antwerp Bruges, Belgium	Not specified due to ERDF saving request	Data analytics for efficiency – increasing energy savings	Faster decision making	Automation, AR/VR technologies. 5G potential. Proactive CO2 reduction. Deep air quality monitoring
Niedersachsen Ports GmbH & CO. Kg, Germany	More than 10% reduction	More than 10% reduction.	More than 8% reduction	Streamlined drainage process. Increased use of renewable energy. Reduced need for manual measurements. Self-sustaining measurement
Port of Korsør, Denmark	60-70% reduction (Estimate)	Enhances energy efficiency and air quality.	Potential time savings	Increased awareness of potential benefits from digitalization at staff level.
Berg-Packhäuser & Kollegen	Supports emission reduction	Supports energy savings	Supports digitalisation and secures time savings	Eases the concession process and contracting of port managers.

4 CO_2 reduction, energy savings, and time savings

In the pursuit of sustainable and efficient port operations, the NON-STOP project partners have achieved several landmarks.

These accomplishments underscore the industry's commitment to environmental responsibility, innovative technology adoption, and enhanced operational efficiency.

NON-STOP in this way explore how eco-friendly infrastructure, energy-efficient technologies, renewable energy integration, automation, and real-time data utilization have collectively transformed the maritime landscape, ushering in a new era of sustainable and efficient port operations.

4.1 CO_2 emission reduction

The NON-STOP project partners have reduced CO_2 emissions, demonstrating the industry's commitment to environmental sustainability. Several strategies have been employed to achieve this goal:

Eco-friendly infrastructure:

The adoption of eco-friendly infrastructure such as onshore power supply (OPS) and renewable energy sources has significantly reduced carbon emissions during ship operations. These efforts align with broader sustainability objectives and contribute to lower environmental impact.

Energy-efficient technologies:

The integration of energy-efficient technologies, like advanced harbor management systems and sensor-based networks, has led to decreased CO_2 emissions. Ports have optimized energy consumption, reducing the ecological footprint of their operations.

4.2 Energy savings:

Efforts to reduce energy consumption have been another central component in NON-STOP project, with the implementation of innovative solutions across various ports:

Automation and optimization:

Automation of administrative tasks and the adoption of real-time monitoring systems have reduced the need for manual intervention and streamlined energy usage. These efficiency gains have translated into energy savings, benefitting both port operations and the environment.

Renewable energy integration:

The use of renewable energy sources, such as solar power, has emerged as a sustainable way to power port facilities. By relying on clean energy alternatives, ports have achieved energy efficiency gains while contributing to a greener future.

4.3 Time savings:

Improving time management and operational efficiency has been a shared objective among project partners:

Real-time data utilization:

The integration of real-time data analysis tools has advanced decision-making processes and enhanced operational efficiency. Ports can make more informed decisions, allocate resources effectively, and reduce idle times, leading to improved overall performance.

Technological advancements:

The adoption of cutting-edge technologies, including Private 5G networks and sensor-based camera networks, has optimized processes, minimized disruptions, and led to significant time savings in port operations. These advancements have streamlined operations and improved productivity.

5 Conclusion

The NON-STOP project has not only met its ambitious goals but surpassed them, delivering substantial reductions in CO_2 emissions, energy consumption, and operational time.

The initial objective of a 10% reduction time and reducing CO_2 by 2% and ensuring an energy saving of 8% has been exceeded, illustrating the project's resounding success.

Embracing digitalization for efficiency: The project partners' collective experience underscores the transformative power of digitalization in the maritime industry. Adopting cutting-edge technologies and systems, such as the harbour management system and sensor-based networks, can significantly enhance operational efficiency across various port activities.

Environmental responsibility for sustainability: A recurring theme among the partners is the commitment to environmental responsibility. Implementing eco-friendly solutions like OPS and renewable energy sources not only reduces carbon emissions but also aligns with broader sustainability goals. Ports can play a vital role in minimizing their ecological impact.

Data-driven decision-making: The utilization of real-time data and advanced analytics tools is instrumental in improving decision-making processes. Access to accurate information, as demonstrated by the availability of quay data and sensor network insights, empowers ports to optimize resource allocation, reduce idle times, and enhance overall efficiency.

Collaboration and collective efforts: The NON-STOP project emphasizes the value of collaboration and collective action. Partners worked together to address common challenges, such as reducing CO_2 and improving operations. Sharing best practices and fostering sustainability has led to industry-wide improvements.

Innovation and technology adoption: Innovations like Private 5G networks and sensor-based camera networks have the potential to update port operations. Ports that embrace technological advancements can not only improve security but also achieve tangible benefits in terms of efficiency, time savings, and resource optimization.

Renewable energy integration: The integration of renewable energy sources, such as solar power, in port operations is a viable strategy for reducing both CO_2 emissions and energy consumption. By harnessing clean energy, ports can contribute to a greener future while achieving cost savings.

Efficiency through shore power: The adoption of shore power systems, as seen in the case of OPS, offers dual benefits of reducing emissions and improving energy efficiency during vessel operations. This approach not only aligns with environmental goals but also enhances operational effectiveness.

The NON-STOP project has been a success for the port industry, proving that digitalization, sustainability and economic growth can coexist. The project's achievements in CO_2 reduction, energy savings, and time management highlight the dedication to a greener, more efficient port operation.