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PORT INDUSTRY

EU Project DUAL Ports: Cost- and emission-saving opportunities for ports through "green" investments

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With the ambitious targets of the European Union to reach their climate goals for 2030 and 2050, more attention is being directed towards the maritime sector and its role in emission reductions. Since current estimations suggest a 25 percent growth of inner-European maritime traffic until 2030, a greater need arises to transform the sea traffic sustainably.

Ports must be an integral part of that transformation. Ports represent the interfaces in the (international) trade of goods. This is where the various modes of transport merge so that these hubs can have a decisive influence on future traffic developments. Without the inclusion of ports into the long-term ecological restructuring, the economic development of regional economies can only succeed with an integrated port approach.

EU Project "DUAL Ports" research opportunities for a "green" transformation

DUAL Ports (Developing Low ca (einzelseiten-special-edition-spring-2022/dual-ports-cbacfa.html#mainTop) n Utilities, Abilities and potential of regional entrepreneurial Ports) is a currently

ongoing EU research project funded by the EU-Interreg North Sea Region Program that spans over seven years (2015-2022) and addresses the impact of sustainable port infrastructure. The project investigates how th encumbrance of port operations in the North Sea region can be reduced economically. Hence, the goal is to improve the organizational and operational energy efficiency and productivity of the ports. This is supposed to be achieved through the comparison of "green" and "onventional" investments, that is, to invest in port infrastructure or supra-infrastructure "as it has always been made". The "green" investment follows new, non-standardized technological and infrastructural investments designed to increase ports' efficiency and utility. By reducing emissions, the social (marginal) costs of production are internalized. In the course of this project, those investments – so-called "pilots" – are tested and evaluated. The evaluation is orientated at how high the emissions reduction (measured in CO2 equivalents[1] but referred to as CO2 in this text) and monetary costs develop compared between the "green" and "conventional" investments.

The project is organized on an interregional level and includes the cooperation of 17 different project partners of seven North Sea countries. Among those, the port of Oostende takes the role of the Lead Project Partner. Within the framework of the project, 15 different "green" pilot investments have been carried out to date. For example, conventional lighting systems have been replaced with smart LED systems, roads have been built with "green asphalt" that binds nitrogen oxides instead of conventional asphalt, and residual energy from wind, solar and marine energy systems has been reintegrated into local heating systems.

The HWWI's CBA/CFA shows potential for "green" ports

As part of the DUAL Ports project, HWWI developed a CBA/CFA tool (cost-benefit- & carbon footprint analysis) in coordination with the project partners, which compares the direct and indirect effects of the "conventional" with the "green" business cases. This allows a quantification of potential cost and CO2 savings if the "green" alternative is implemented. In greater detail, the tool breaks down the complexity of comparing various forms of investments that range from a simple renovation to the construction of bigger infrastructure projects. Depending on the specific business case, the tool can work with different levels of information, making it possible to also evaluate initiatives when some information is still missing or not applicable. Evaluated investments can be the renewal of old equipment and infrastructure, the implementation of new technologies and services, as well as change in business operations and management.

The tool considers, on one hand, the monetary dimension, total investment costs, implementation externalities, operating results, operation externalities, and indirect externalities. On the other hand, the tool enables a distinction between different levels of externalities such as those created during the implementation, operation, and possible indirect externalities. Through the detailed differentiation of the various cost aspects and levels of emissions, it is possible to evaluate projects in various ways making it possible to calculate projects pragmatically and practically without having to dispense the scientific foundation.

Seven pilot projects were assessed for the evaluation of the project: HEAT, LED, LNG, Sail cargo, Sediment[2], SOIL, and Surface. A more thorough description of the pilots can be found at the end of this article. It is important to note that the observed pilots can be considered best practices and that the transferability of the results in savings varies depending on a port's general conditions. For further consultation, the HWWI's CBA/CFA tool can be used to examine the possible cost and emission savings, according to specifications.

DUAL Ports' pilots offer great leverage in reducing emissions

Based on the results of the seven pilots, the overall research outcome of the port investments is positive. Table 1 below emphasizes the results by showing that CO2 emission reductions have been achieved in all of the "green" investment pilots. Additionally, in five of the seven proposed investments, a cost reduction can be realized (on average

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25 percent of the total costs). Especially, the port pilots Sediment and HEAT offer great leverage in reducing emissions with high percental savings of total costs.

Looking in particular at the LED pilot, one can see how the CBA/CFA tool works. The LED pilot was a renewal of an old lighting system that needed to be replaced and aimed at optimizing the outside lighting efficiency of the port area. The main objectives were to reduce the energy consumption of the lighting system and, thus, minimize externalities and overall costs. By using a smart LED system, the lights automatically turned themselves on and off when needed and reduced the energy consumption through their high energy efficiency. While the total costs of the LED lighting systems are reduced by 3 percent, savings of yearly emissions of 80 percent were realized. The results of the LED pilot emphasize that even with realized total cost savings under the project goal of 20 percent of all DUAL-ports pilots, "green" investments still can achieve a significant reduction in carbon dioxide emissions.[3]

These results become even more relevant by the prospect that, on the one hand, the ports are expected to be more involved in achieving sustainability goals – e.g., by being included step-by-step in the EU Emissions Trading System (EU ETS) with effect from January 1, 2023 – and, on the other hand, the CO2 price will continue to increase in the coming years. With estimations of a future price of carbon dioxide emissions of up to 200 EUR per ton, the overall economic viability of the green investments improves through a shorter amortization period and a drastic reduction in expenditures for carbon emission rights.

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Table 1: Summary* of HWWI's Cost-Benefit-Analysis results (Total Costs and CO_2 emissions) of seven "green" *DUAL Ports* Pilots

Pilot	Total cost reduction in %*	Potential of proportional total costs reduction in %	Total CO_2 reduction in %*	Potential of proportional CO_2 reduction in %	Saved (per) additional costs (Euro) for every saved ton of CO_2
HEAT	28 %	High	92 %	Very High	74 €/t CO_2
LED	3 %	Low	80 %	Very High	4,041 €/t CO_2
LNG**	-13 %	Nothing	27 %	High	-1,460 €/t CO_2
Sail cargo	12 %	Middle	98 %	Very High	470 €/t CO_2
Sediment***	62 %	Very high	75 %	Very High	8,767 €/t CO_2
SOIL	10 %	Middle	4 %	Low	14,704 €/t CO_2
Surface	-11 %	Nothing	12 %	High	-1,506 €/t CO_2

Source: Jahn & Wiedemeier (2019), Jahn & Wiedemeier (2021)

* Positive numbers are reductions in emissions and costs while negative values are increases in costs and emissions.

** The according results of the LNG pilot must be seen in a larger scope since the bunkering of LNG does not just constitute an opportunity for the reduction of carbon emissions but also acts as a guarantor for energy provision and as a variable in geopolitical ambitions.

*** The sediment pilot is not finished yet. The current data is as of 21/01/2022.

Total cost reduction (DUAL-Ports goal: -30 %)	Total CO_2 emissions reduction (DUAL-Ports goal: -50 %)	The ratio of the saved total cost (Euro) and CO_2 emissions (tons)
Nothing: ≤ 0 Low: > 0 and < 10 % Middle: ≥ 10 % and < 30 % High: ≥ 30 % and < 50 % Very High: ≥ 50 %	Low: ≤ 5 % Middle: > 5 % and ≤ 10 % High: > 10 % and ≤ 50 % Very High: > 50 %	The absolute value of total cost saved divided by the absolute value of saved tons of CO_2

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Of the seven pilots, in both dimensions HEAT offers the highest absolute saving potential: a reduction of 5.3 million EUR in total costs and 72,619 tons of CO2 between the "conventional" and “green" investment. Each ton of saved CO2 came with cost savings of 74 EUR (see Table 1). Hence, 95 percent of the combined CO2 emission savings of the seven pilots originate from the HEAT pilot, followed by the LNG pilot with a share of 4 percent of total CO2 emission savings (2,811 tons) (see Figures 1). Nevertheless, the LNG pilot is the only one that is associated with a high increase in total costs (+4.1 million EUR) compared to the conventional investment. Each ton of CO2 saved brings additional costs of 1,460 EUR (see Table 1).[4]

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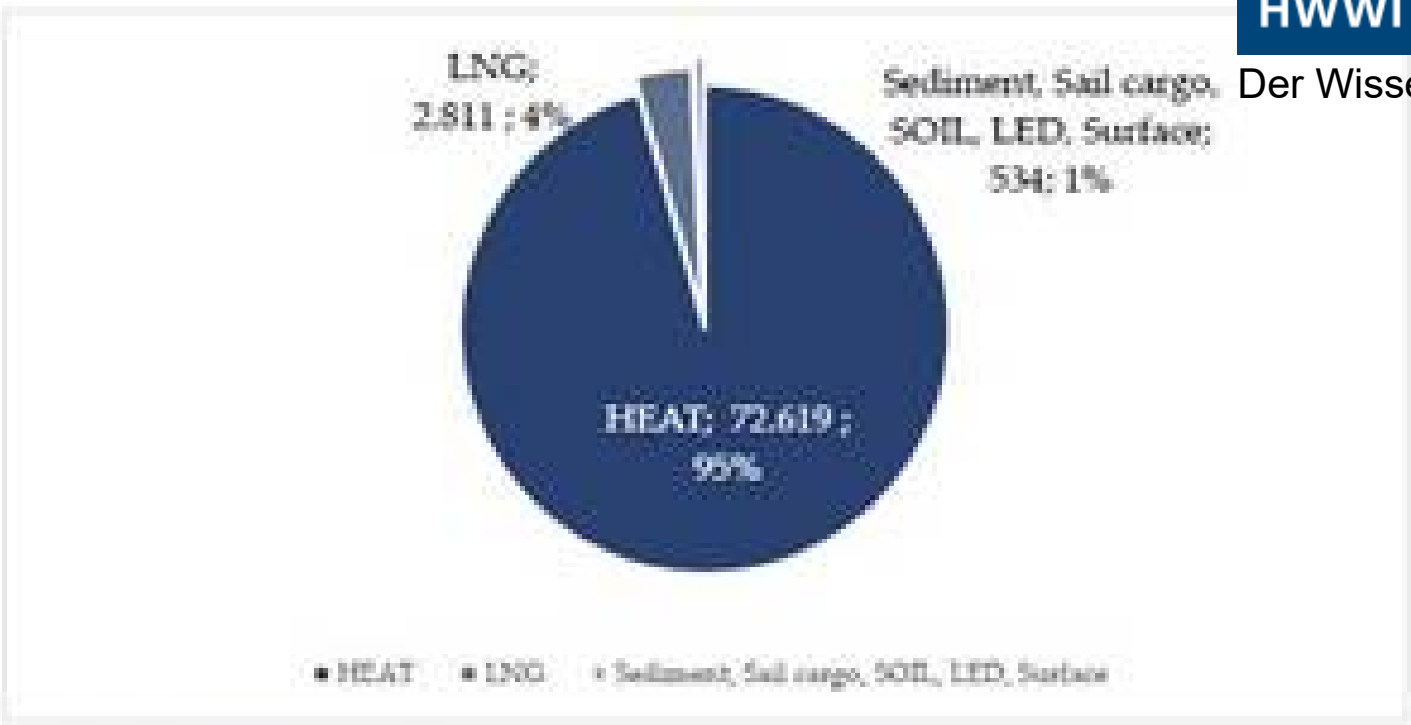
Figure 1: Saved CO_2 emissions in tons for all seven "green" pilots



[Pilot(s) name; absolute value of CO_2 in tons; percentage of total reductions]
Source: Jahn & Wedemeier (2019), Jahn & Wedemeier (2021).

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The remaining five pilots make up around 1 percent of the total CO2 emission savings of which the total cost savings (compared to the conventional investment) range from 5.3 million EUR (Sediment, with the same amount as HEAT) to 88,000 EUR (SAIL cargo). Of these, only Surface had a small increase in total costs (9,000 EUR) (see Figures 2). Additionally, the comparison of the five pilots reveals that the pilot Sediment shows the highest potential in reduced carbon emissions combined with the highest cost savings. Costs saved per reduced ton of CO2 amount to 8,767 EUR per ton (see Table 1).

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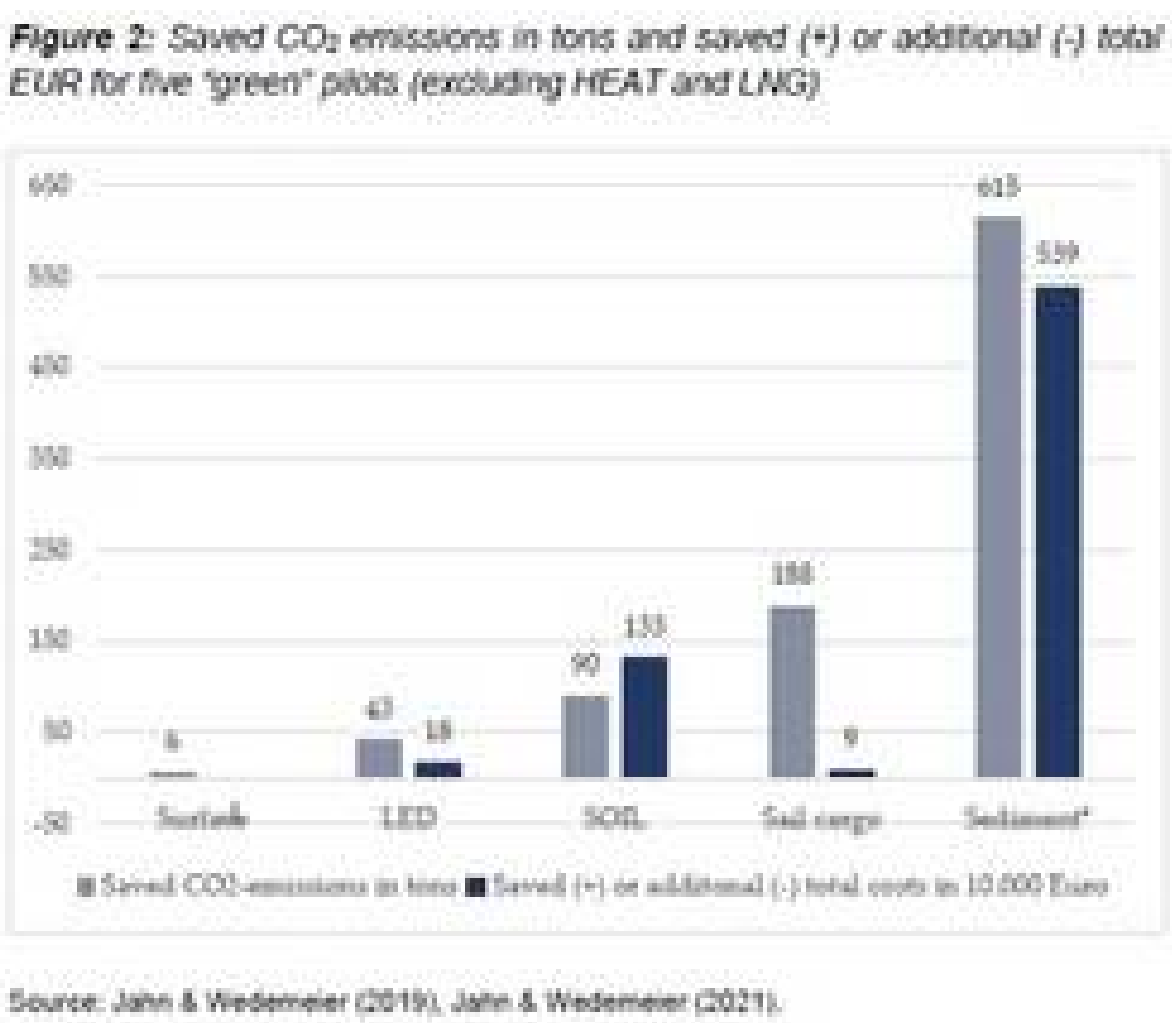

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The pilot SOIL is associated with savings in absolute CO2 and total costs as well. In combination with the amount of CO2 saved, it has the highest costs saved to emissions saved ratio with 14,704 EUR/ton CO2.. The pilot Sail cargo, on the other hand, saved 12 percent in total costs while achieving the highest cost reduction of the five pilots (98 percent). Each ton of saved CO2 came with cost savings of 470 EUR. (see Table 1).

Conclusion

The EU Project DUAL Ports is intended to demonstrate whether and to what extent investments in sustainable port infrastructure can lead to increased efficiency in operation. It provides information on the pilot projects that could be successfully transferred to other locations. The knowledge gained through the evaluation of the pilots can also give an incentive to other ports. They can gain comparative competitive advantages through increasing efficiency, which goes beyond the intrinsically motivated pursuit of sustainability goals. They have at their disposal the Cost-Analysis Tool developed by HWWI, which can be used to compare "green" investments with "conventional" investments in terms of environmental impact and costs. Furthermore, HWWI has developed an Action Plan for the transformation towards low emission ports as part of DUAL-Ports. Experiences of the port of Emden show that initiating "Green Management practices" help improve a port's overall economic and ecological performance. In greater detail, in 2019 yearly carbon emissions of standard port operations at the port of Emden were reduced by 15 percent compared to 2015. With the supervision and support of the implementation, a Greenport Officer can act as a catalyst in the decarbonization effort. Nevertheless, even with the provided CBA tool and the support of a green management system, a proper carbon accounting system acts as a general prerequisite for the success of decarbonization measures.

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In conclusion, ports can operate in an environmentally friendly and cost-conscious manner at the same time. Whilst the overall reduction in total costs can initially vary in magnitude, with an expected increase in CO2 emi greater focus on sustainability in the maritime sector, the economic relevance of decarbonization becom makes investments even more viable. Overall higher energy efficiency, shorter transport routes, and innovative technologies make it possible to achieve comparative competitive advantages that can secure the long-term competitiveness of the ports and the regions in which they are located.

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[1] For future information on the calculation of CO2 equivalent please refer to the attached source of the United States Environmental Protection Agency.

[2] This pilot is not completed yet. Saving potentials are yet estimated and no final results are available to this date.

[3] The green investment projects are supposed to reach the target of 20 percent operational cost reduction, 20 percent total cost reduction, and 10 percent CO2 emission reduction. These targets are externally given by the INTERREG North Sea Region Programme of the European Union (in the framework of the European Regional Development Fund).

[4] The according results of the LNG pilot must be seen in a larger scope since the bunkering of LNG does not just constitute an opportunity for the reduction of carbon emissions but also acts as a guarantor for energy provision and as a variable in geopolitical ambitions.

Pilot description

HEAT (Port of Hvide Sande)
The pilot seeks to optimize the production of rest-energy from wind, solar and sea-based power systems by integrating it into the local heating system, thus greatly reducing the carbon footprint by introducing an intelligent heat pump system combining smart heat exchangers technology.

LED (Port of Emden)
The investment ought to optimize the use of port area lighting. Through the installation of a smart LED lighting system the needed amount of energy is to be reduced by requiring less operating energy and second through sensors which automatically regulate the light quantity.

LNG (Port of Skagen)
The goal of the LNG terminal and bunkering system pilot is to reduce carbon emissions by offering an alternative to heavy fuel-driven vessels. LNG is a cleaner fuel than heavy fuel, with an expected reduction of CO2 emissions of 40 percent.

SAIL cargo (Port of Oostende)
The SAIL cargo pilot aims to transport goods with a zero-emissions low-impact cargo sailing ship that can access goods where they are produced. In greater detail, in entrails the operation of a 50-tonne sailing cargo vessel between Oostende, Belgium, and Ramsgate, UK.

Sediment (Port of Emden)
To protect the sediment of the port of Emden an innovative and sustainable concept for the removal of pollutants in the port’s sediments ought to be developed. The current problem lies in the fact that the recirculation dredging procedures can only be carried out in areas where no pollutants are present in the sediment to be treated. Any pollutants mustn't be distributed to other port areas

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SOIL (Port of Vordingborg)
The main objective is to expand and develop the port of Vordingborg by using recycled products, such a
contaminated soil, concrete, and excessive soil from building projects in the municipality.

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Surface (Port of Skagen)
To combat increasing amounts of CO2, NOx, and SOx, the Surface pilot aims at testing absorbing pollution-absorbing asphalt. The asphalt contains titanium dioxide which can absorb NOx while also reducing the overall CO2 footprint.

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The HWWI estimated the costs of PLA (a type of bioplastic polymer) when using different feedstocks in production.
MORE (einzelseiten-special-edition-spring-2022/bioplastics-pla.html)

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The HWWI commodity price index rose by an average of 32 % in March compared with the previous month. Russia's invasion of Ukraine led to price surges in almost all commodity segments.
MORE (einzelseiten-special-edition-spring-2022/commodity-markets-april-2022.html)

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SCIENTIFIC STRENGTHENING

Michael Berlemann new Scientific Director of HWWI

Prof. Dr. Michael Berlemann has been the new scientific director of the HWWI since March 2022. In addition, the cooperation with the The Helmut Schmidt University/University of the Federal Armed Forces Hamburg is being expanded.

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