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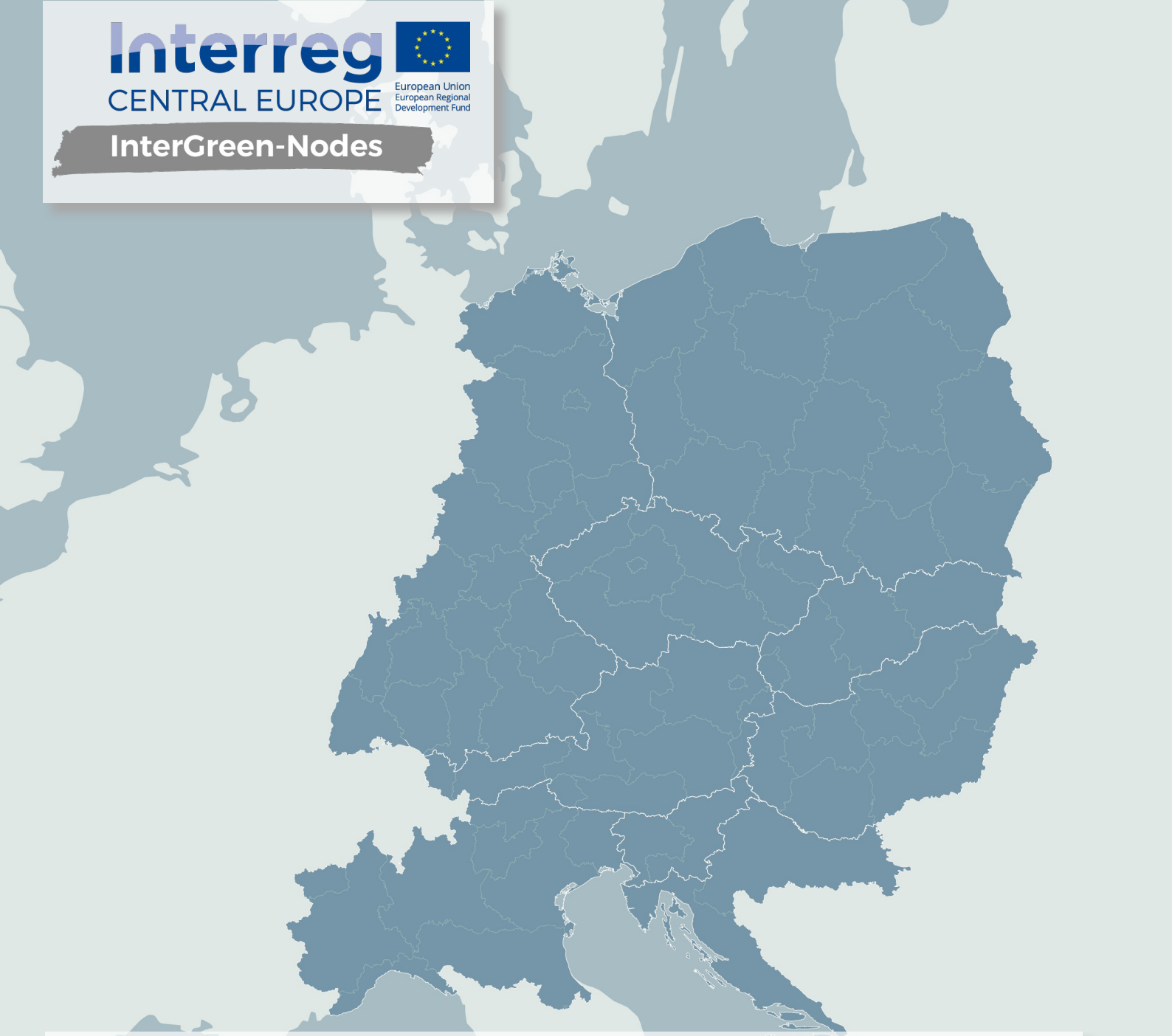
InterGreen-Nodes



CE1444: InterGreen-Nodes

FINAL MODULAR CATALOGUE OF THE OUTCOMES FROM INTERGREEN-NODES

TAKING
COOPERATION
FORWARD

InterGreen-Nodes Final modular catalogue

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Interreg Central Europe Region Project #CE1444: “Intermodal Green Alliance - Fostering Nodes”

TAKING COOPERATION FORWARD

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Abbreviations

BEHALA	Berliner Hafen- und Lagerhausgesellschaft mbH
BREEAM	Building Research Establishment Environmental Assessment Methodology
KPI	Key Performance Indicators
LEED	Leadership in Energy and Environmental Design
SOP	Standard Operating Procedure
TCO	Total-Costs-of-Ownership

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1 Introduction

The InterGreen-Nodes project brings together regions along the Central European sector of the Scandinavian-Mediterranean Core Network Corridor (ScanMed) and aims to develop environmentally friendly, intermodal last-mile freight transport in urban nodes. Nodes are the most logical spatial/ geographical level for improving the coordination of freight transport actors. On the one hand, nodes have the critical mass to achieve change in support of green transport. On the other hand, those responsible at this level have the necessary regional and practical knowledge to implement effective and sustainable solutions. However, as they operate mainly at the regional level, they lack exchange with other actors, which limits their ideas and solutions to their respective region. InterGreen-Nodes describes a transnational research project. The consortium consists of 13 partners from Germany, Italy, Hungary and Slovenia. The focus of the cooperation is to use the development potential of the Southern Scandria®Corridor on a political, spatial and technical level to increase the efficiency and sustainability of transport systems.
In this context, InterGreen-Nodes demonstrates highly innovative solutions in a practical and tangible way with ports that have solid environmental management and disseminates them throughout the CE programme region. Accompanying strategic measures at spatial planning and political level ensure a strategic basis for the project.
InterGreen-Nodes has connected the actors from practice and politics and will continue this beyond the project duration. This brochure provides an overview of the project results achieved.

Innovations and perspectives on three levels:

At political level

- Coordinated guidelines for the development of environmentally friendly, last mile intermodal freight transport in urban areas,
- Regional action plans to launch and establish a mechanism for policy dialogue to compare positioning, development of a joint report on TEN-T policy and
- Training on the technical results and financing possibilities of the projects.

At spatial level

- Development of regional action plans for all participating regions and
- Creation of a toolbox for spatial planning.

At technical level

- Creation of a toolbox with step-by-step instructions and
- Elaboration of a Leader follow-up model Solutions in nodes.

This project is supported by the Interreg CENTRAL EUROPE programme, financed by the European Regional Development Fund.

2 Fostering impact by policy involvement

Challenges for intermodal transport nodes in the CENTRAL EUROPE programme are communication deficits between different actors and stakeholders as well as a lack of harmonisation, especially with regard to integration into TEN-T networks.
The involvement of policy and operational actors aims to reduce the gap between the communication of relevant information on the evolving green, intermodal and last-mile freight transport in urban areas and its wider impacts.
The broad network of partners involved was used and coordinated to present a common position to the EU on TEN-T policy issues for urban nodes/transport hubs.

2.1 Coordinated guidelines

The project developed coordinated guidelines for the development of environmentally friendly, intermodal last mile freight transport in urban nodes.
The partial results of these task activities provided evidence on three main factors.
In the first step, a survey of policy initiatives was carried out to describe how project partners exploit the opportunities associated with Ten-T policies and related funding programmes at different territorial levels.
In the course of this, an analysis of funding opportunities was carried out to show how actors interested in promoting green hubs can promote and fund their projects within the EU framework.
Based on this, twelve best practices were collected to further explore the relationship between funding opportunities, governance solutions and implemented partnerships; best practices specifically focused on the implementation of innovative forms for the management and funding of last mile green logistics were identified.

Best Practice Overview on political level

The result is an easy-to-use guide for the definition of regional action plans for the future development of InterGreen Nodes, with particular attention to three aspects:

- Coherence with European, national and regional planning documents;
- Strategies for accessing funding opportunities; and
- Identification of the overall administrative framework to support investment.

Despite the complexity of regulations and funding systems, these guidelines were suggested as a "checklist" to assist decision-makers in project implementation with a step-by-step approach. The result

of the following step-by-step approach is a matrix that provides a synoptic overview of all project steps:

Coordinated Guidelines

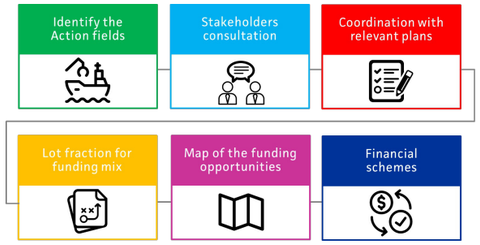
There are various benefits of the strategy for a smooth development of green nodes expected. A first group of benefits for the target groups (especially public institutions, logistics and business operators) refers to the possibility of speeding up the process of identifying financial opportunities to support the identified actions.
A second group of benefits refers to the improvement of the coordination process that should be carried out to achieve the objectives and an effective management framework to follow. A third group of benefits relates to the comparability of measures at European level. The proposed strategy draws on international best practice and the use of knowledge from other territories and from actors operating in other institutional contexts. This increases the validity of the measures to be pursued and brings benefits in terms of reliability.
The benefits depend mainly on the effectiveness of the investments in intermodal infrastructure. The strategy will indeed support authorities and organisations in getting the process right for their investments, with innovative solutions in public and private partnership, through a set of case studies and good practices that can be transferred in any local context.

2.2 Fundings? Yes, but how?

Through stakeholder engagement on key corridor developments in the CE region (project-based and external), regional action plans were developed based on the coordinated guidelines for the development of environmentally friendly, intermodal last mile freight transport in urban nodes to ensure applicable implementation of the results.
For this purpose, a tool was developed that lists the conditions to access funding and the involvement of local actors for identifying thematic areas of interaction. The tool includes a common transnational checklist/questionnaire to explore the transferability and scalability of developed pilot actions ("demonstrators") to other areas of the ports beyond the end of the InterGreen-Nodes project. The questions asked define how this scalability could be included in an "action plan". The focus was on the following points:

(1) Stakeholder consultation,
(2) Coordination with relevant plans,
(3) Funding mix, and
(4) Funding plan.

It should be emphasised that the checklist/ questionnaire is intended to support the port's "action plan", so in principle it refers to the strategic planning level of the interested ports. For this reason, the checklist consist of a simple methodology. As the nature of the proposed actions may differ significantly and in many ways from port to port, the guidelines propose a rather flexible methodology that can be applied in different local contexts, while ensuring the adoption of a common approach.
The checklist/questionnaire consists of six blocks that are closely linked to the outcomes of the coordinated guidelines. They are the main reference points for filling in the questions, especially for funds and funding schemes:



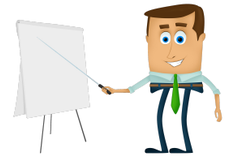
Checklist for adaptive action plans

Again, the expected benefits of the strategy for smooth development of green nodes are manifold and in line with the target groups of the coordinated guidelines.

Fact sheet for Regional action plans to future develop InterGreen-Nodes themes

2.3 Trainings on technical project results and funding opportunities

The trainings focused on identifying the project results that are of main interest to other regions and operators in order to generate interest and inspire the development of action plans, alternative fuels for last mile logistics and spatial planning taking into account renewable energies.
With this objective in mind, three training topics have been identified to correspond to the specific results and to present the experience of one of the pilot sites. In this way, participants are familiarised with the main content needed for decision-making and the experiences of those who have applied these concepts.
The trainings proved to be an effective way to provide technical information and stimulate discussions that go beyond the project partners. The participation of more actors and stakeholders would have been welcomed, and further opportunities to share these materials will be supported by the dissemination of the materials and the availability of partners to answer specific questions.



Documents of InterGreen-Nodes trainings sessions

3 Spatial issues of urban nodes

Terminals and ports are struggling to handle the rapidly growing volume of freight transport. This is due to conflicts in land use. This is particularly evident for terminals and seaports near or within urban areas.

Due to the technical concrete pilot projects developed in the project on the technical level, the spatial planning part of the integration of a green last mile in nodes is addressed. The spatial requirements of urban nodes or ports and terminals for the implementation of the green last mile and its impact on urban nodes will be elaborated in the form of regional action plans for all participating regions. By developing a transnational strategy for all nodes in Central Europe, along the Scandria®Corridor and beyond, the main common needs and challenges for greening nodes will be consolidated to create tools for spatial planning.

The regional action plans were developed from different stakeholder of nodes like regional authorities, ports or business development bodies. Therefore, the results are very well transferable as other stakeholder in Central Europe but also beyond will have equal regional activities and challenges. The described measures and fields of activities have the potential to influence further nodes in their own activities. Together with the transnational summary report, the strategy on greening nodes and the spatial planning toolbox for implementing green solutions in nodes other region will get guidance for their own development activities.

3.1 The Action Plans for spatial needs

The regional action plans were developed based on the specific objective of identifying relevant measures for greener transport in the nodes and regions of the InterGreen-Nodes project. This was done in the form of action sheets, which were elaborated by the partner regions. From This, a total of twenty-four action sheets from eight regions and nodes were identified as fields of action and compiled as the most relevant measures.

The actions are specified in the field of action, the time horizon, their priority, important partners for the implementation process and CO_2 savings, among others.

The range of needs and activities gives a broad picture of the diversity of measures to achieve the ambitious goals for climate-neutral transport. Some examples are measures in the fields of:

- land use to install renewable energy solution;
- shifting traffic to environmentally-friendly transport modi;
- communication, but also coordination;
- clean fueling stations and clean vehicles;
- green industrial areas;
- water protection and sustainable planning.

One of the main outcome is that all developed measures and actions are of high regional added value and transferable to other European hubs and nodes. Further the action plans summarizes also the measures, which will be part of the regional follow-up process.

The regional action plans describe the actions and steps which have to be taken to reach the goals of greening nodes incl. partly the expected CO_2 savings after implementation. The regional action plans give therefore an overview of the concrete field of activities like spatial planning issues, energy supply, alternatives fuels or overarching action fields like communication. Furthermore, the plans address the involved stakeholder, but also financing options for the implementation in their own territory.

In sum twenty-four regional actions were developed by the involved partners und described in regional action sheets. Sixteen of the actions could be implemented in short-tern under three years. Fourteen of the actions will reach a high or very high regional added value. Finally, more than a half of the defined actions will generate a high rank in CO_2 saving.

3.2 Proposal for a Transnational strategy on greening nodes

This strategy provides European, national and regional policy-makers with key recommendations to improve the conditions for greening freight transport. It summarises the status quo of technical and societal interconnections and suggests policy guidelines such as regulations and funding sources.

Freight transport still largely depends on social structures that move by car. Road transport is the dominant mode to move both goods and passengers while reflecting the political economy of socio-historical industry, the societal provisions of infrastructure and the way of land use. The transition towards a decarbonised freight transport is impacted by four challenges:

Challenge A: The different levels of decision-making in spatial planning regimes cannot be coordinated from a single point of view.

Challenge B: It is impossible to assume certain tools, knowledge or equipment between several planning regimes, as there is a high level of diversity.

Challenge C: Urban areas are seeing an increasing competition for scarce spaces.

Challenge D: The creation of acceptance at stakeholder level to safeguard long-lasting support for changes is becoming increasingly harder to achieve and maintain.

Policy-makers can refer to a set of actions to tackle these challenges. The challenges are embedded in a social construct, making them well suited for application across Europe. Firstl, EU policies should explicitly try to leverage green development and decarbonisation throughout all levels of decision-making. Funding sources should incorporate the requirements to decarbonise the freight sector. Second, in order to meet the divergence of different levels of knowledge and spatial planning instruments, policy-makers should promote the development of bottom-up processes and policy-learning between relevant actors of all levels. EU-funding should create opportunities for regional planning authorities to develop planning tools to foster the transition towards a green freight transport. Third, in urban areas, the competition for spatial use will potentially increase in the next decades. Therefore, those areas already used for transport

purposes shall be converted towards a higher efficiency and multimodal use to work under the premises of a decarbonised transport. In addition to that, transportation will need to develop and deploy modern technologies to unlock new potentials for green transport.
Furthermore, the key to a broad and long-lasting acceptance within civil society is in actions that promote working solutions and deliver a positive impact for the people. In this context, small-scale solutions for the transport sector, which replace a status quo with visible negative effects for the society, should be implemented.
The aim of this strategy was to collect the results of the analysis and to survey the spatial needs of urban nodes. For European and national policy-makers, the strategy presents guidelines on how to design funding mechanisms for investments and pilots and regulations for green freight transport. Moreover, regional and local public authorities may find guidelines and orientation points to implement solutions based on the cooperative development of spatial tools together with the citizens. In this context, the strategy offers a toolkit on how to initiate a comprehensive stakeholder participation. For infrastructure and public service providers (such as ports) as well as private actors, the strategy illustrates so-called “spotlights” of good practice examples. Stakeholders may benefit from technical descriptions as well as “handbooks” of how to deal with challenges and apply for funding. The strategy’s framework itself is aligned with the project approach of InterGreen-Nodes: It combines the deployment of technical pilots with fostering the exchange of knowledge and experience of different stakeholder groups. This strategy was developed to provide decision-makers of all political levels and territories with key recommendations to understand the interdependence of societal trends and needs and the climate targets set in the Paris Agreement. This complexity was considered in the design of strategic actions that build upon a combination of harmonised top-down spatial planning tools and funding opportunities and a strong bottom-up process. EU-policy-makers and national governments may use this strategy to define the political framework for grants and other funding sources. Furthermore, regions and local authorities can use these guidelines to implement solutions and develop tools together with the citizens.
The strategy is made available on the project platform and has been disseminated among a central group of stakeholders/other nodes. It is relevant for all levels and has been promoted as an important input for the development of regulations and concepts.
The top-down processes of spatial planning regimes are confronted with complex societal struc-tures and systems characterised by transregional and transnational divergences. Therefore, the aim of this strategy was to shed light on the status quo of spatial planning tools, dynamics in urban areas and societal trends that define challenges as well as prospects for a green freight transition. The dominance of car and road transports and car land-use patterns present a major challenge for this transition.
Based on the cooperation internally with the project partners, but also by the involvement of additional project results from other projects like SULPiTER this strategy could give an outline on how to deal with the complexity of top-down policy implementations and the requirements for bottom-up acceptance and small-scale (technological) solutions. While it is good to have a strategic idea what to do, the gap between that and the actual actions and outcomes are to be bridged. Current policies such as the European Green Deal make this complexity a topic of high politics by taking into consideration all governance as well as societal aspects that are affected by climate and decarbonisation issues.

Transnational summary report on spatial needs - implementing green solutions

3.3 Spatial Planning toolbox for implementing green solutions

As intermodal hubs, ports and intermodal terminals are faced with the societal expectation to contribute to decarbonisa-tion of the transport system. Thus, they are putting a lot of efforts to decarbonise their operations and to supply alternative energy for long-haul transport as well as for the first and the last mile. This implies a change in strategic port development: production, bunkering and distribution of renewable energy for transport as well as port-affine industry becomes more and more important. To address development comprehensively, including spatial planning, land-use conflicts as well as business development in a dynamically developing technological environment, innovative, collaborative processes are needed that involve relevant stakeholders from different levels and sectors.

The toolbox presents “green” solutions developed at eight different multimodal nodes in Central Europe and the Baltic Sea Region. Each solution is marked by the action fields it mostly contributes to. Thus, the toolbox shall help planners, intermodal node operators to identify useful experiences. By giving further reference to contact persons, the transfer of knowledge shall be enhanced. The key ambitions of the toolbox are:

- Easy access to knowledge transfer and solutions developed
- Combination of EU instruments with existing solution as starting point for further development
- Avoiding double work by giving the status quo in CE
- Supporting cooperation between intermodal hubs facing the same challenges and working on equal solutions future common projects also as invest)

In addition, the toolbox provides useful information on European instruments supporting the transition to green nodes, referencing to relevant European legislation as well as financial support schemes. The toolbox function as an interactive tool and guides the user through the document by selecting the single intermodal hubs or action fields like.

Spatial Planning Toolbox

4 Technical and processual solutions for terminals

Especially in the last mile, transport and handling are less environmentally friendly than they could be.
However, new technical solutions that make intermodal terminals more environmentally friendly and improve their performance are expensive to develop as well as implement and are not yet established.
On a technical level, the terminals will test different innovations and share them first with other project partners, then with terminals and ports. This will be achieved through seven highly visible demonstrators.
The demonstrator activities include innovative vehicle technology, new processes and innovative transport chains.
The Demonstrator Partners of the InterGreen Nodes project, Berliner Hafen- und Lagerhausgesellschaft mbH (BEHALA), Rostock Port GmbH, Port of Venice, Freight Village Bologna, Freeport of Budapest Logistics Ltd. and Luka Koper, port and logistic system, PLC are aware of the impact of ports on the environment and have committed to a solid environmental management in their policies to preserve the environment for future generations.
The processes to monitor and reduce environmental impacts have become part of regular activities.
These project partners are constantly focusing on implementing measures that not only meet legal requirements but also reduce negative impacts with the best available technology to protect the environment and enable growth. They are among the port systems that can be classified among the most advanced ports in terms of green thinking and the development of socially sustainable measures.
In a 3-step workflow, the technical solutions are developed together with the partnership:

- standardised, through a KPI system and a technical performance scoreboard,
- tested via pilot actions documented with a toolbox of step-by-step instructions and
- linked to the policy and spatial level in a leader-follower model, where follower partner terminals copy successful demonstrations of leader-partner terminals.

4.1 KPI-System and technical performance scoreboard

Against the backdrop of climate change, reducing emissions is also becoming increasingly important in the transport sector. To reduce the environmental impact, companies and organisations in the multimodal freight transport sector are looking for new, more environmentally friendly technologies that they can integrate into their processes.
However, it is not yet clear how to quantify the environmental impact without forgetting the economic aspect and the additional costs that could be caused by a greener alternative. The InterGreen-Nodes project has developed a scoreboard that allows monitoring of both environmental impacts and economic performance.
Suitable Key Performance Indicators (KPIs) were selected following an analysis of the performance monitoring requirements at the InterGreen-Nodes demonstrators ot the ports mentioned above (Berlin, Rostock, Venice, Bologna, Budapest and Koper). The result is a KPI system divided into two parts. Part one includes KPIs on energy consumption and greenhouse gas emissions, with a focus on environmental impact.
Part two covers economic performance with Total Cost of Ownership (TCO) and reported variable and fixed costs.
Calculations based on best practice examples have shown that clearly defined processes and targets are necessary to achieve appropriate results. However, if these definitions are done correctly, the results can help in monitoring already implemented technologies or in finding a suitable solution for future implementation. The attached Standard Operating Procedure (SOP) and Excel file Barcode provides guidance on the implementation of the scoreboard for monitoring as well as decision making for future process changes.

SOP for application of KPI-system

KPI System Excel file

4.2 Pilot Applications of Greening Solutions

Developing innovative solutions for transhipment nodes is risky and resource-intensive.
As part of the InterGreen-Nodes project, a number of possible solutions were tested, demonstrated and evaluated.
Together with the ports and terminals of Berlin Port and Warehouse Company (BEHALA), Rostock Port GmbH, Port of Venice, Freight Village Bologna, Freeport of Budapest Logistics Ltd. and Luka Koper, port and logistic system, pilot actions were discussed, tested as well as implemented.
The ports and terminals demonstrated the following actions:

- Cargobike-Rail Pilot in Berlin,
- Full electric Terminal Pilot in Berlin,
- Electric Ship Pilot in Berlin,
- BREEAM and LEED ratings in Budapest,
- Solar Energy Demonstratotor in Berlin and Koper,
- LNG use in freight transport in the Emilia Romagna Region and
- Possibilities of energy storage systems in ports.

These pilot actions of the project are easily transferable to any city with a transhipment hub in or near the city. The transnational value is enhanced by the joint de-elopment and discussion of demonstrators, so that ports in other countries can easily adapt the demonstrator.
This brochure summarises the pilot actions in their essential components.

Cargobike-Rail Pilot in Berlin

Environmentally friendly transport on the last mile requires not only environmentally friendly vehicles, but also transhipment points in the city. The space requirement is often the biggest challenge here.
One parcel service provider uses an inner-city transhipment hub with microdepots operated by a neutral provider, the "Berliner Hafen- und Lagerhausgesellschaft mbH" (BEHALA), at the Westhafen. The microhub consists of shipping containers for reasons of simplicity and low cost. The containers serve as short-term storage and transhipment point for the last transport kilometres and for delivery with the company's own cargo bikes.
This solution represents a transnational transfer character. Like all pilot actions of the project, the demonstrator is easily transferable to any city with a transhipment point in or near the city. The transnational value is enhanced by the joint development and discussion of demonstrators, so that ports in other countries can easily adapt the demonstrator. For example, small and low-cost transfer stations could be set up at an existing transfer hub for the transport of consumer goods and transferred and distributed directly from other environmentally friendly modes of transport, such as rail, to cargo bikes.

© BEHALA

The emission effects as well as the costs, correlate very strongly with the operational boundary conditions, but also with the design of the logistics system. However, the vehicles and their emissions per kg payload can be calculated and compared as follows:

	Typical 3.5t vehicle	Cargobike
Diesel consumption per 100 km (l):	11	0
Electricity consumption per 100 km (kwh):	0	2,5
kg CO_2-emission per 100 km*:	29	1
Maximum payload (kg):	1,400	250
kg CO2-emission per 100 km and 100 kg payload:	2.06	0.40

*at an emission factor of 3.165 for Diesel and 0.4kg per kWh electricity (based on the electricity mix for Germany in 2020).

The demonstrator is already fully operational, but adoption by other ports is possible, which could mobilise additional resources.

Report of Intermodal Cargobike-Rail Pilot in Berlin

Electric Ship Pilot in Berlin

How can inland navigation within sensitive regions become CO2-neutral? InterGreen-Nodes partner BEHALA has been working on this question for years. The idea involved developing an emission-free hybrid-electric powered canal push boat for use in the Berlin-Brandenburg region and between Berlin and Hamburg. In the lighthouse project ELEKTRA, BEHALA created a significant milestone in the context of the climate policy targets of the Federal Republic of Germany.
The InterGreen-Nodes project focused on environmentally friendly last-mile transport on inland waterways.

© BEHALA

The ELEKTRA is a hybrid-electric test vessel, with electrical energy provided by both batteries and hydrogen fuel cells. This will test the feasibility of hydrogen and electricity for local transport on inland waterways.
The use of electric batteries and hydrogen is a novel and innovative approach.
A lot has happened since the keel-laying of the world's first zero-emission push boat in November 2019. The extensive work involved in assembling and installing the relevant components to the point of floatability was successfully completed and BEHALA celebrated the successful launch of the "ELEKTRA" at the Hermann Barthel shipyard in Derben on 27th of May 2021. After months of inspections and acceptance by experts, surveyors and the inspection commission of the Waterways and Shipping Administration, the construction and commissioning process was completed and the ELEKTRA was able to be transferred to its home port of Berlin Westhafen. Here, the testing of the mode of transport was started and the resulting findings were evaluated within the framework of InterGreen-Nodes with regard to their technical performance and environmental impact in cooperation with the Technical University of Wildau.
As far as the environmental impact is concerned, initial estimates can be made and KPIs calculated.

GHG-emissions in kgCO2e/km			
Before		After	
2020	15,32	2020	14,95
Difference 1:		-0,36 kgCO2e/km	
Difference 2:		-2%	

The following insights were gained from this first test phase:

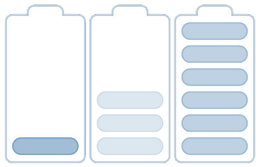
- After some adjustments, ELEKTRA shows excellent handling in solo operation;
- Interaction of energy sources basically functions very well and stably;
- Battery-only operation has largely been tested to full satisfaction;
- The energy consumption for the drive in solo operation is so far below the forecast, i.e. greater ranges are currently possible;
- Very extensive on-board sensors have recorded a large amount of data - extensive data is still being analysed with new tools developed in-house and
- Pier (standby) operation can still be significantly improved in terms of energy consumption.

The demonstrator will go into regular service in the Westhafen by 2023.

Report of Electric Ship Demonstrator in Berlin

Full electric Terminal Pilot in Berlin

In this pilot action, the feasibility of electrifying numerous processes along the entire value chain was demonstrated. In the process, the CO_2 emissions of port operations were to be achieved through the introduction of electric vehicles. In the Intergreen Nodes project, the following elements were demonstrated for this purpose in Berlin's Westhafen, which is operated by BEHALA.
Electric rail shunting vehicle,
electric crane,
electric terminal tractor, which also serves as a 40-tonne road vehicle,
Electric all-purpose wagon and
Electric van (for maintenance staff, equipped with maintenance tools).
All vehicles used in this demonstrator are battery electric. Unlike other propulsion and energy storage solutions, it is not necessary to install a large meta-infrastructure for the operation of battery electric vehicles, as the electricity grid for charging electric vehicles is already in place. Under these conditions, emissions are expected to decrease by up to 90%, depending on the specific use case.
HIGH EFFICIENCY in urban areas: Electric motors provide their maximum torque over the entire power spectrum, enabling rapid acceleration at any speed, whereas conventional motors only provide maximum torque over a certain speed. In practice, this means that an electric motor can accelerate with less energy input than a conventional motor. This results in lower energy requirements, especially in urban environments where vehicles need to slow down and accelerate frequently.
Lower noise emissions could enable new logistics concepts, e.g. night-time deliveries in urban areas, for example to shops. It also enables direct deliveries to buildings, e.g. transporting trailers with production material directly to the production/assembly lines without additional reloading at a loading ramp. Noise may be generated during loading and unloading, but this can be minimised by technical solutions (rubber wheels on transport trolleys, rubber buffers, etc.). The relative silence of electric vehicles can make them a hazard if other road users (especially pedestrians and cyclists) cannot hear the electric vehicle. Technical solutions, such as noise detectors, are currently being discussed.
Like all pilot actions of the project, the demonstrator is easily transferable to any city with an interchange in or near the city. The transnational value is enhanced by the joint development and discussion of demonstrators, so that ports in other countries can easily adapt the demonstrator.
The demonstrator is already fully operational, but adoption by other ports is possible, which could mobilise additional funding.



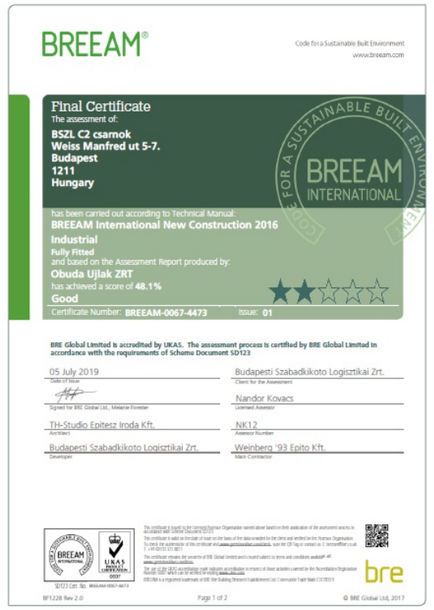
Report of Full electric Terminal in Berlin

BREEAM and LEED ratings in Budapest

A major challenge is how the construction and operation of new buildings or the renovation of existing buildings (both office and warehouse buildings) can be part of the efforts to green port operations.
This pilot action consists of presenting the BREEAM and LEED rating systems and examples of certified buildings in the operation of the Budapest Freeport, as it is currently a requirement to design, construct and accredit new buildings according to a green certification system. More and more businesses (renters) are specifically looking for certified buildings for various reasons, and as energy prices are rising, it is of primary importance to minimise the costs of running a business. BREEAM and LEED are globally recognised programmes which indicate that a building has been designed and constructed to a certain level of environmental responsibility.

About BREEAM

BREEAM means Building Research Establishment Environmental Assessment Methodology and measures sustainable value in a number of categories ranging from energy to ecology. Each of these categories addresses the most influential factors, including eco-friendly design and carbon emissions reduction, design longevity and resilience, climate change adaptation, and ecological value and biodiversity protection. Each category is divided into a number of assessment aspects, each with its own target and benchmarks. When a target or benchmark set by the BREEAM assessment officer is met, the development or asset is awarded points, known as credits. The category score is then calculated according to the number of points achieved and the weighting of the category. Once the development has been fully assessed, the final performance score is determined by the sum of the weighted category points. The pilot project demonstrated the assessment process and the final product (certified buildings). The Port has 2 buildings (C2 warehouse and B9 office/lab) that have been certified as part of the Port's efforts to become more environmentally friendly. This pilot project has thus shown how such an accreditation process can become part of the general greening of nodes, which also meets the needs of customers.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About LEED

LEED stands for Leadership in Energy and Environmental Design. It is a certification

programme of the non-profit U.S. Green Building Council (USGBC) that includes rating systems for everything from design and construction to operation and maintenance of homes, buildings and even entire neighbourhoods.
LEED certification provides independent verification of a building or neighbourhood's green characteristics and enables the design, construction, operation and maintenance of resource-efficient, high-performance, healthy and cost-effective buildings. LEED is the triple bottom line in action, benefiting people, the planet and the bottom line.
LEED's thresholds are based on percentages, while BREEAM uses quantitative standards. LEED is considered simpler in its approach, while BREEAM is more academic and rigorous.
LEED projects receive points in nine basic areas that address important aspects of green buildings. Depending on the number of points achieved, a project receives one of four LEED rating levels (certified, silver, gold, platinum).
The pilot project demonstrated the rating process and the end product (certified buildings). There are two buildings in the port (warehouse/office buildings C1 and E2) that are certified LEED Silver as part of the port's greening efforts.

© Example of LEED Certificate of Port Budapest

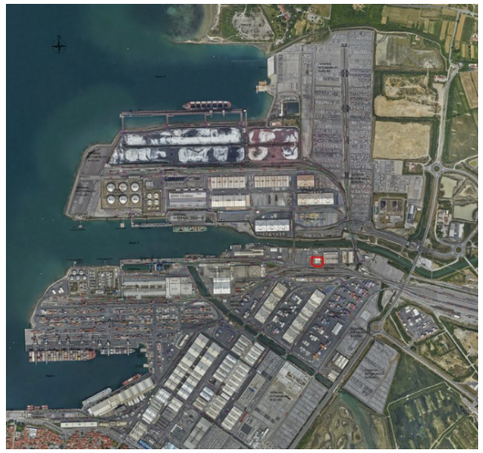
Report of BREEAM and LEED ratings in Budapest

Solar Energy Demonstrator

One of the greening solutions tested in the InterGreen-Nodes project was the installation and testing of solar panels at ports. This was done by the partners in Berlin (Germany) and Koper (Slovenia).

In Port of Koper

The Port of Koper installed a microsolar power plant during the project period. It was set up to generate electricity from


© Microsolar power plant in Port of Koper

renewable sources, promote the green port and provide energy for future self-sufficiency in electricity.
The objective of setting up a microsolar power plant is to provide some of the electricity needed to light the main road connecting the port.
The photovoltaic power plant was realised with photovoltaic modules installed on the roof of the existing substation in the port of Koper. It was assumed that 24 photovoltaic modules with a capacity of 330 Wp would be installed, resulting in a maximum peak power of 7.92 kWp and an estimated annual amount of generated electrical energy of 9000 kWh.
The actual results after implementation: The micro solar power plant on TP Tropes produces 9,850 kWh of electricity per year, which means 3,575 kgCO2eq (CO2 reduction). The factor used to calculate CO2eq emissions for the Slovenian electricity system is 0.363 kgCO2eq/kWh. The solar power plant is connected to the internal electricity grid behind the existing metering point of the plant. In addition, charging stations for electric vehicles were also installed at the site of the microsolar power plant (co-financed by the CLEAN BERTH - Interreg Ita-Slo project).
The results of the production analysis of the microsolar power plant led to the decision of the Luka Koper company to conduct a study (also developed within the InterGreen Nodes project) to find suitable locations on the roofs of the warehouses in the general cargo terminal for further installation of solar power plants. The study was carried out as an extension of the solar demonstrator in the port of Koper. The results of the static evaluation of the roofs were very promising, as about 50% of the roofs are suitable for the installation of solar power plants in terms of static evaluation.
Furthermore, the results showed that up to 10 MW of additional solar power plants can be installed in the port in the coming years. The investigated sites/warehouses are marked in yellow and red. Yellow sites are suitable in terms of carrying capacity, red sites are not suitable in terms of carrying capacity for solar power plants.


© Future plans with solar energy in Port of Koper

The study served to estimate the total capacity of the harbour roofs without additional investments in structural upgrading. The results will be used for further planning of the installation of solar power plants in the port.

At BEHALA

EnTerra Solar Holding GmbH has installed two photovoltaic systems with a total output of 268 kWp on the roofs of BEHALA. The entire system produces 253 MWh of clean electricity per year. This saves around 224 tonnes of carbon dioxide.
The electricity generated by the plants can supply up to 60 four-person households. The total of 604 polycrystalline modules with an output of 127 kWp generate around 114 MWh of electricity per year, saving 74 tonnes of carbon dioxide. The electricity generated is fed into the grid and

remunerated accordingly.
Both companies are thus making a valuable contribution to environmental and climate protection.

Report of Solar Energy Demonstrator

LNG use in freight transport in Emilia Romagna Region Pilot

The main objective of the demonstration project was the construction of a new LNG refuelling station for trucks in the most important and largest freight transport centre of the Emilia Romagna region (Italy). The action is part of the infrastructure decarbonisation strategy and includes several other actions and investments in the medium and long term, such as the construction of new rail and intermodal facilities and the modernisation of existing ones, the digitalisation of intermodal terminal operations, the implementation of different energy sources within the infrastructure and the creation of an energy community.
The whole strategy is in turn part of the Emilia Romagna Region's Green Transition Plan, which is part of the European Green Deal to achieve climate neutrality by 2050. The installation of an LNG refuelling station promotes the use of sustainable fuels by freight operators, as transport is responsible for a quarter of greenhouse gas emissions in Europe (source: The European Green Deal [COM (2019) 640 final]), with an ever-increasing impact. Indeed, natural gas has become increasingly important in the international energy scene, especially in freight transport, with prospects for further growth in the coming decades.

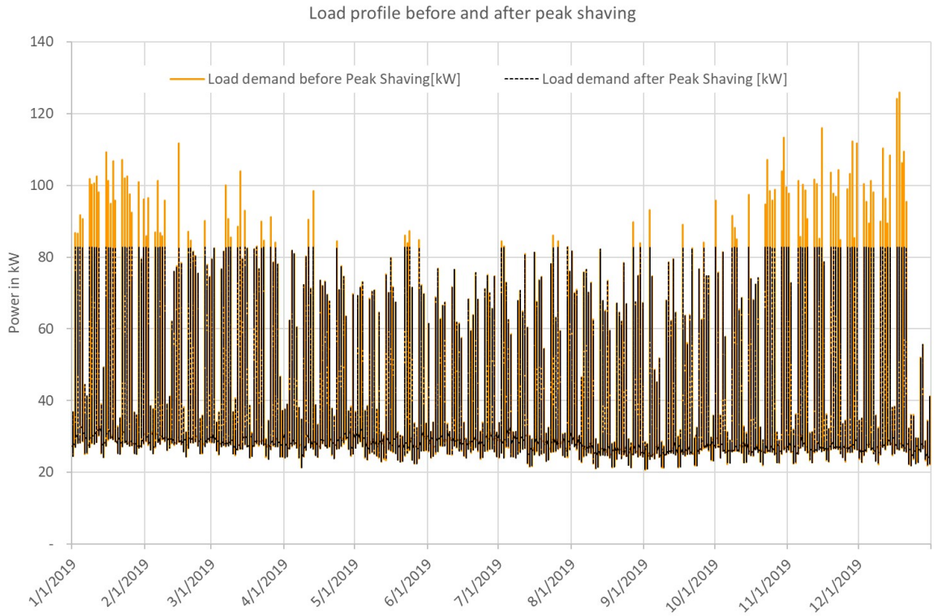
© Interport Bologna

The results of the demonstration project will be used as a reference in the Emilia Romagna region to transfer them to other similar locations and create a network of LNG plants for freight transport. The regional model can also be transferred to other regions, especially those with high productivity and density.

Report of NG use in freight transport in Emilia Romagna Region Pilot

Energy storage systems in ports

Reducing peak demand at the grid connection point is a valuable application today. There are several ways to reduce peak demand. The first and usually most cost-efficient option is on-site load/ demand management, the second is to use locally already existing "storage systems" (e.g. production flexibility through product tanks) or heat/cold storage units. A battery storage system can be considered as an additional add-on to reduce further costs. These costs can be either costs for the grid connection point itself (grid expansion costs) or grid fees during operation.
In the future, transport (ships, boats, trucks, cars, trains, cargo carriers) will become more and more electrified, which in turn will have an impact on the energy supply structure in the ports.
This is assumed because in logistical peak times with battery-electric equipment, the vehicles have to be charged at the port at the same time. In particular, the last mile to the ports will be electrified and equipped with batteries.
The project did not carry out a full pilot project in this case. The pilot project was not planned at the beginning of the project funding. Instead, the idea to describe the elements of such a pilot project was introduced by an associated partner one year after the project started. Thus, the elements of the pilot project and various measurements were brought into the project, which were derived from various existing plants of the associated partner ABO Wind.
The question of when and whether a battery storage system or on-site hydrogen generation with renewable energies is



© ABOWind: Example load profile of an exemplary office building demonstrating the analysis and the outcome for peak shaving

suitable for a port depends heavily on the individual load profile of current and future planning. For ports with a critical emissions reduction plan that are considering converting vehicle and vessel production to electric propulsion, it is beneficial to study their current load early on and begin planning for an integrative behind-the-meter microgrid with battery storage systems, renewables and electrolysers. ABO Wind can assist in understanding the impact of these changes and developing a suitable system to ensure economic operation in the future.

Report of Energy storage systems in ports

ABO WIND

4.3 Toolbox with step-by-step instructions

To help other ports and transhipment facilities implement similar solutions, the project has bundled the pilot actions in their characteristics and published them in three Handbooks:

HANDBOOK 1: Buildings and Built Infrastructure Requiring Buildings,

HANDBOOK 2: Use of clean, mainly electric vehicles and

HANDBOOK 3: Deployment of clean energy systems and energy storage systems.

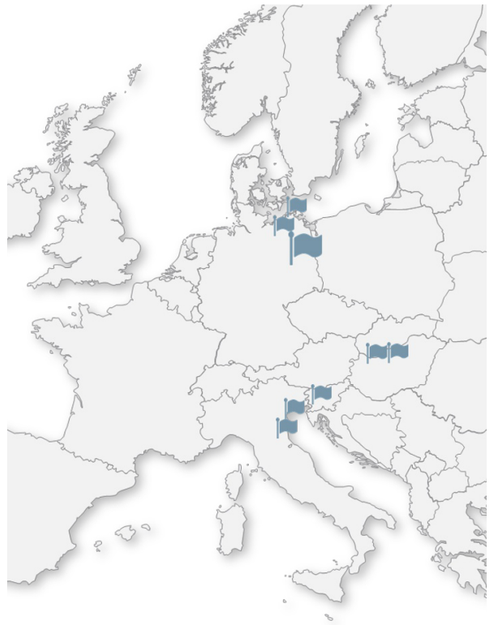
By applying the Handbooks, significant reductions in CO_2 emissions can be achieved to implement CO_2 saving measures, and they can be used by any transhipment centre and additionally operators of commercial vehicles or building operators.

Handbook 1: Buildings

Handbook 2: Vehicles

Handbook 3: energy systems

Contributing partners



Interreg
CENTRAL EUROPE
European Union
European Regional
Development Fund

InterGreen-Nodes