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Stakeholder's Policy Paper
Carbon-Neutral Überseehafen 2035 Project

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Abbreviations

CHPP	Combined heat and power plant
CCF	Climate Cooperation Fischereihafen
CNÜH	Carbon-Neutral Überseehafen project
CO_2	Carbon dioxide
DT	Digital twin
EGTS	Eurogate Technical Services
EnWG	German Energy Industry Act
GWh	Gigawatt hour
H_2	Hydrogen
kV	Kilovolt
kW	Kilowatt
MW	Megawatt
MW_{el}	Megawatt electric
MW_p	Megawatt peak
MWh	Megawatt hour
PV	Photovoltaics
SHARC	Smart Port Application Concept for the Integration of Renewable Energy

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1 Introduction

The Carbon-Neutral Überseehafen project was launched in 2023. In this project, bremenports GmbH & Co. KG (bremenports), acting on behalf of the Special Asset Port, works in close cooperation with the local port industry (hereinafter referred to as the "port stakeholders" or simply "stakeholders"). The aim of the project is to develop and implement a decarbonization strategy for the City of Bremen's overseas port in Bremerhaven – the Überseehafen – that ties in with the Port Development Concept 2035 and provides the stakeholders with practical implementation guidelines.

One core element of the project was to create a digital representation of the energy systems and energy flows at Überseehafen. This "digital twin" (DT) includes the present energy consumption data of the individual port stakeholders as well as the data forecast for the future. By adapting highly divergent framework conditions and technologies, the DT also enables the derivation of future development pathways. An optimisation model permitted the simulation of a wide range of decarbonization scenarios and their evaluation in terms of efficacy, cost-effectiveness and feasibility. These models were based on the policy target of "zero" carbon emissions by 2035.

The results of the simulations were unequivocal: if zero carbon emissions are to be achieved by 2035, there will have to be a significant change in energy supply to the port, which currently still depends largely on fossil fuels. The digital twin proposes a predominantly electric energy system based on sustainable energy generation, with the preference on local energy generation, produced directly in the port area if possible, and the resulting energy used primarily by the port stakeholders themselves.

The CNÜH project also included evaluation of the opportunities for joint action by the port stakeholders in decarbonization of the port. However, this analysis revealed that the establishment and development of a shared energy system for the port area is faced with numerous regulatory obstacles: the current legal framework offers financial benefits primarily for the self-supply of renewable energy to individual port stakeholders rather than a joint supply system. As a result, under the present circumstances decarbonization would essentially have to be promoted in the form of measures implemented by individual companies.

Despite that situation, in the interest of exploiting cross-company synergies, the project participants have agreed to continue their cooperation in the Carbon-Neutral Überseehafen project in the following four areas:

- continuing and expanding their cooperation directed at the common target of a climate-friendly, carbon-neutral Überseehafen
- identifying the funding requirements from the specific transformation pathways of the individual stakeholders and the total investments required
- identifying and supporting the necessary regulatory adjustments to achieve the decarbonization targets
- learning from similar activities by other parties in order to analyse and integrate successful practices from other regions, countries and logistics sectors

The stakeholders have agreed on the wording of this Policy Paper that presents the status and background of the Carbon-Neutral Überseehafen project. The Policy Paper also outlines a blueprint for the next central steps that have to be taken and how responsibilities for the implementation of appropriate practical decarbonization measures can be derived for the various private and public actors.

2 Objectives of this Policy Paper

This Policy Paper

- outlines the history, status quo and key figures of the CNÜH project,
- describes the four subject areas of the agreed future cooperation within the CNÜH, and
- derives the central measures to be taken and compiles them into a list as a basis for discussion.

The Policy Paper further states the necessary contributions or support that is required from parties other than the Überseehafen stakeholders to promote successful implementation of the decarbonization strategies.

3 Status quo and background of the CNÜH project

3.1 Background

In December 2019, the European Commission announced the European Green Deal, which is aimed at making Europe climate-neutral by 2050. The Green Deal provides a roadmap that includes comprehensive measures that are intended to ensure that this ambitious goal is achieved and refers to all sectors of the economy. In the transport sector, it also addresses the ports, which are called upon to make their own contribution towards decarbonizing the economy.

Bremen adopted a clear position on this topic at an early stage with its Climate Action and Energy Programme. 2020. This was adopted by Bremen's Senate in December 2009[1] and stipulated the objectives and strategies of Bremen's climate protection and energy policies up to the year 2020. The overall programme focussed on the binding target of reducing Bremen's carbon emissions by a minimum of 40 % by the year 2020, relative to 1990. This target was unfortunately not achieved and when the programme was updated and evaluated in 2018, a reduction of only 16% was forecast for the year 2020[2], amongst other things because end energy consumption was significantly higher than originally assumed as a result of higher economic growth and higher population figures.

The current discussion in Bremen is also influenced by the work of the Select Committee that published its Final Report in December 2021 and stated an ambitious climate target for the Federal Land of Bremen: Bremen is to become climate-neutral by the year 2038.[3]

The major milestones for climate-neutral port development are as follows:

- The port management company bremenports has been carbon-free since 2013, partly by the purchase of credits.
- The target was to make the port infrastructure, i.e. activities of the public purse handled by bremenports/the Special Asset, carbon-free by 2023. By the end of 2023, a reduction of approx. 75% had already been achieved; the remainder was offset by certified emission reduction credits.

[1] Climate Action and Energy Programme/Fourth update of Bremen's Energy Programme (Bremen Parliament, State Parliament, 17th legislative term, Parliamentary Paper 17/1112, 15.12.2009) (text only available in German)
[2] Cf. Update of Climate Action and Energy Programme (Bremen Parliament, Parliamentary Paper 19/1974, State Parliament, 19. legislative term, 18.12.18) (text only available in German)
[3] Cf. Bremen's Climate Action and Energy Act (BremKEG) of 19.04.2023. (text only available in German)

- The ports of Bremen as an industrial location are scheduled to be decarbonized by 2035.[4]

Pursuant to the aforesaid Senate resolution, the term "port" within the meaning of the CNÜH project is geographically defined as the City of Bremen's Überseehafen district in Bremerhaven.

The decarbonization of energy supply helps to safeguard the port stakeholders' competitiveness. Moreover, the expansion of decentralised energy generation options promotes independence from market volatility and raises resilience.

The CNÜH project breaks down into various port-related strategy papers on both a local (Bremen) and national level

- It is one module in the "Environment and Sustainability Management" area of action of the Port Development Concept 2035.
- The Smartport Strategy of the Ports of Bremen appeals for a joint understanding of sustainability and for designing joint activities en route to becoming a sustainable port industry.
- The National Port Strategy[5] underlines the role played by the ports in the transition to green energy and promotes measures taken by the ports to reduce air pollutants, promote defossilization / greenhouse-gas-neutrality by 2045.

The project endorses industrial transformation initiatives, particularly in iron and steel production (amongst other things, the decarbonization of steelworks and the concomitant hyBit research project).

The CNÜH project is also continuing the round tables organised by the port stakeholders in 2022/23:

- At the first round table in May 2022, the participants discussed and resolved a joint target for the future energy system in the Überseehafen district.
- At the second round table, the parties adopted a "Joint resolution of the targets to be pursued":
    i. economically compatible and resilient/safe decarbonization with maximum independence from surrounding grids.
    ii. generation of wind power and photovoltaics (PV); surplus energy can be distributed or stored (batteries, hydrogen, e-fuels).
    iii. climate neutrality as soon as possible, investigation of potential financial backing.
    iv. transition period requires the use of e-fuels (storage and handling)
    v. investigation of an operating/cooperation company to enable faster and more effective utilisation of financial resources.
    vi. considering the integration of shore power facilities, also whether alternative fuels can cover the shipowners' requirements.

[4] Cf. The Senator for Economic Affairs and Ports (Publisher.): Port Development Concept 2035. The CNÜH project, however, initially focusses on the Überseehafen as part of the City of Bremen's port area in Bremerhaven.

[5] Cf. National Port Strategy of the Federal Government for Sea and Inland Ports. Federal German Parliament, Parliamentary Paper 20/10900, 25.03.2024

The technical implementation of CNÜH essentially follows on from the preceding SHARC project (Smart Harbour Application Concept for the Integration of Renewable Energy):

- The project ran from 2019 to 2022 and created a digital twin to establish the main energy consumption categories (electricity, heating/cooling, fuels) at Überseehafen on the basis of reference year 2018 (approx. 350 GWh/a) and simulated options for climate-neutral processes by 2030.
- A digital twin for the energy system at Überseehafen was created for reference year 2018 and used to simulate the development of energy consumption up to the year 2030 and draw up a comparison of various options for achieving climate neutrality.
- 10 stakeholders, under the leadership of bremenports, worked together with Siemens and Berlin Technical University. Eurogate Technical Services (EGTS) and BLG Autoterminal Bremerhaven were involved in the SHARC project as subcontractors.

3.2 Status quo of the Carbon-Neutral Überseehafen project

3.2.1 Task

In order to support the political objective of achieving genuine (as opposed to offset) carbon neutrality at Überseehafen by 2035, bremenports initiated the Carbon-Neutral Überseehafen project, thus continuing the knowledge-sharing process of the round tables and combining these findings with the approaches proposed by the SHARC project.

The core element was to update the energy requirement figures from 2018 to the year 2022 and to include the planned shore power supply and further stakeholders in the simulation scope. A digital twin was created to map the stakeholders' energy flows and presented suggestions for achieving the decarbonization target. The digital twin forecast requirement profiles for scenarios in the years 2022, 2026, 2030 and 2035 on the basis of these figures. At the same time, it simulated technical transformation pathways, taking into account the potential for generating renewable energy at the Überseehafen district, and also assessed potential operating models for implementation.

This culminates in an energy development concept for Überseehafen that, in the next stage, will enable detailed planning, implementation and operation of the future energy systems while also assessing the cost effectiveness of the individual systems.

The following stakeholders were involved in the DT modelling (cf. Table 1):

Terminals	Logistics service provider	Shipyards, other organisations
- North Sea Terminals GmbH - Eurogate Container Terminal Bremerhaven GmbH - MSC Gate GmbH & Co. KG	- Atlantik Hafenbetriebe Geuther & Schnitger GmbH & Co. KG - BLG Autoterminal Bremerhaven GmbH & Co. KG - EKB Container Logistik GmbH & Co. KG - DS energy s Holding GmbH/ UTG-Tanklogistik - D. Heinrichs Logistic GmbH - Heuer Logistics GmbH	- Lloyd Werft GmbH - Eurogate Technical Services GmbH - swb AG

Table 1: Stakeholders participating in the Carbon-Neutral Überseehafen project. Source: bremenports

Other participants included the Free Hanseatic City of Bremen, represented by the Senator for Economic Affairs, Ports and Transformation, and bremenports GmbH & Co. KG, acting on behalf of the Special Asset Port, as infrastructure operator and future provider of shore power.

3.2.2 Key findings from the digital twin

3.2.2.1 Simulation results and decarbonization pathways

Based on the expectations of the participating stakeholders for their business performance up to 2035 and the future strategies of the business enterprises, simulations were carried out to identify how the present energy system at Überseehafen can be developed towards carbon neutrality at minimum cost.

The results of the DT simulations – driven above all by the assumption that container handling will have become fully automated by the year 2035 – proposed comprehensive electrification of the entire port handling activities and heat generation. They also advise the significant expansion of PV and wind power plant to generate renewable electricity on the port premises for use by the port stakeholders themselves.

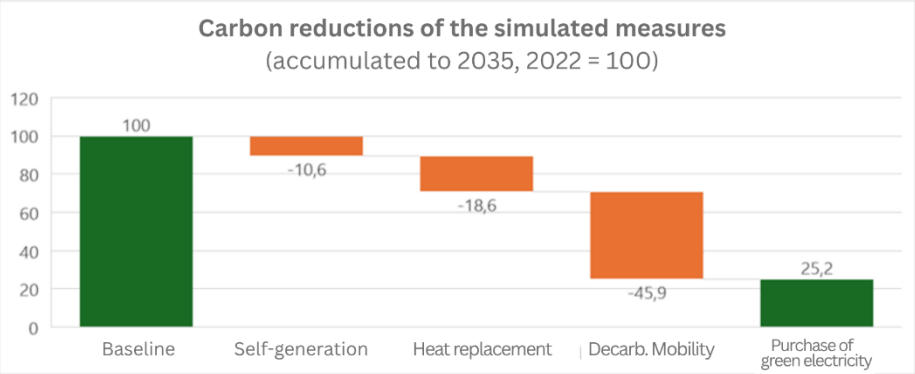

Fig 1: Carbon reduction resulting from the measures proposed by the DT. Source: Siemens, own calculations

The driver of decarbonization – in terms of carbon emission savings – is the decarbonization of mobility, followed by the replacement of heating systems and the self-generation of electric energy. This would lead to a remainder of approx. 25 % carbon emissions that would have to be defossilized by the appropriate procurement of green electricity (cf. Fig 1).

Transformation towards carbon neutrality at Überseehafen would involve widespread electrification across the sectors of electric current, mobility and heat (cf. Fig. 2): the largest carbon emitter at present, viz. diesel consumption for container handling by straddle carriers, will be completely electrified over the long term. The second-largest carbon emitter today – the procurement of grey electricity – will be replaced by the local generation and procurement of green electricity. The largest energy consumer at Überseehafen in future – shore power supply – is per se electrified; additional requirements of electricity should be generated locally or purchased in the form of green electricity.

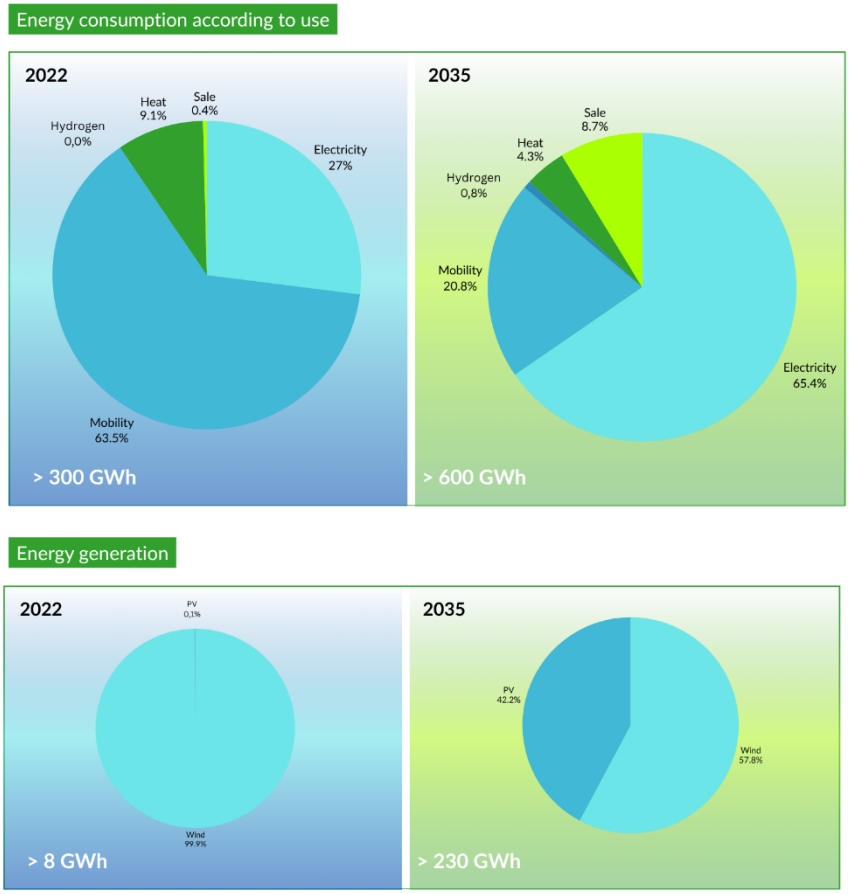

Fig. 2: Energy consumption and generation at Überseehafen (2022 and 2035). Source: bremenports

In addition to electrification, other technologies as well as low-carbon fuels could serve as interim solutions or to cover peak loads in marginal areas and as energy storage. With regard to interim solutions in particular, in view of the required investments, lack of experience and potential operating risks, it should be investigated whether it is advisable to adopt in new technologies, such as hydrogen, which are intended to be used for only a few years.[6]

For the period 2022 to 2035, the DT calculates an increase in the local production of renewable energy from approx. 7.6 GWh to 237 GWh. This will be achieved by the use of wind energy (the DT optimisation proposes 10 wind turbines with a total capacity of 61.5 MW_{el}, in line with the optimisation algorithm proposed by Siemens) and photovoltaics (PV, the DT model states 96.,5 MW_p) (cf. Fig. 3). This generation capacity on the grid side compares with a connection capacity to the higher-level 110 kV grid of 3 x 63 MVA.

[6] Hydrogen generation for use in the grid could be one option for storing local surplus energy. Whether this technology – and its use at Überseehafen – is chosen by the stakeholders depends on its technological availability and cost effectiveness.

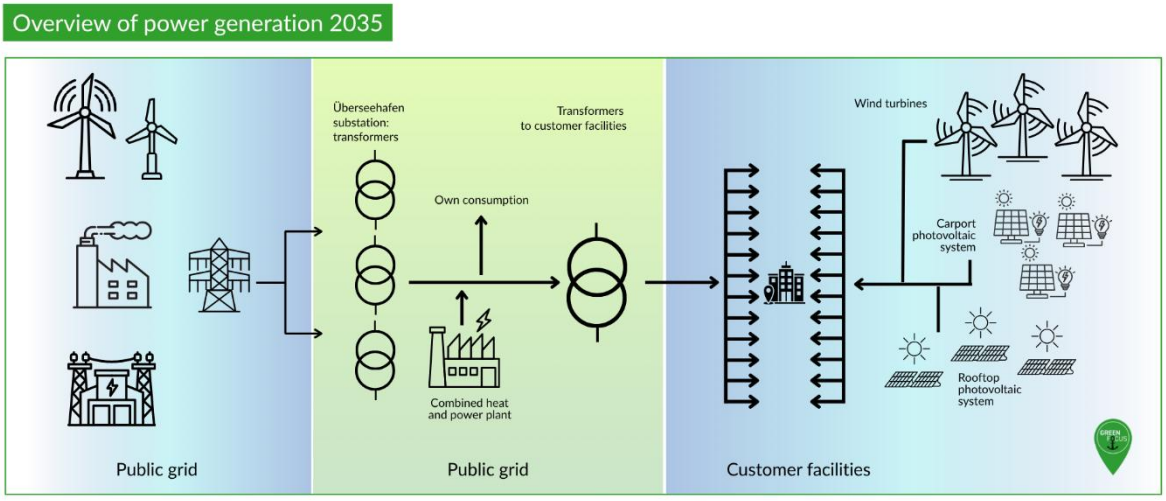

Fig. 3: Overview of power supply in 2035 (DT proposal). Source: bremenports

In the DT, the decarbonization of vehicles and vessels is achieved primarily through

- climate-neutral e-fuels for port handling equipment and shunting locomotives; electric and hydrogen propulsion systems could also be an economically attractive option in some individual cases. The in-depth project sH2unter@ports concluded that changing shunting locomotives over to hydrogen would be feasible, as would a transition to overhead line battery hybrid locomotives,
- electrification of cars & other motor vehicles; in individual cases, supplemented by combustion engines using e-fuels.
- using climate-neutral e-fuels or H_2 for the vessels at Überseehafen

The DT achieves the decarbonization of heat supply (cf. Fig. 4) by means of

- decentralised heat pumps in combination with electric heating to cover peak loads.
- in a few individual cases, alternative technologies (e.g. hydrogen-powered combined heat and power plant) could supplement the heating system at Überseehafen.

The DT calculations recommend the construction of individual heat storage units with a capacity range of several days. The construction of a large-scale seasonal storage unit is not recommended.

The findings for up to 2035 further include the gradual establishment of wind turbines as well as rooftop and carport photovoltaic systems with a total capacity of ~150 MW, essentially to supply the port stakeholders with self-generated green electricity.

Owing to the less attractive conditions for the use of green electricity in constellations in which the operator of the renewable energy plant and the power consumer are not identical and / or the power is purchased via the public grid, the DT does not recommend the erection of further renewable energy plant over and above the quantity intended for self-consumption.

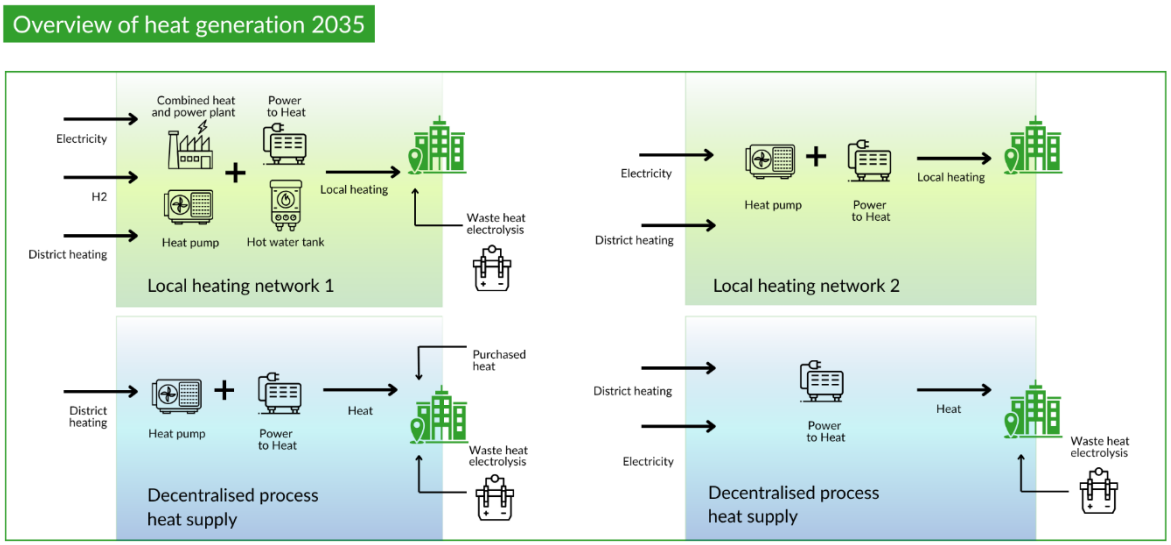

Fig. 4: Overview of heat supply in 2035 (DT proposal). Source: bremenports

The DT calculations also recommend the construction of "mini-electrolysers" with a total output of approx. 3 MW for selected port stakeholders to raise the self-consumption share of energy from renewable energy plant (cf. above) and the production of green H_2 (e.g. for further processing into e-fuels); this effect is even stronger as it is assumed that hydrogen and e-fuel prices will continue to rise; in view of the options for scaling up, which are not yet foreseeable, the implementation of such projects has to undergo further investigation.

Another element recommended by the DT is the construction of decentralised battery storage systems for the interim storage of self-generated green electricity with a total capacity of up to 17.5 MWh.

Fig. 5 illustrates the large number of energy system technologies at Überseehafen proposed by the DT

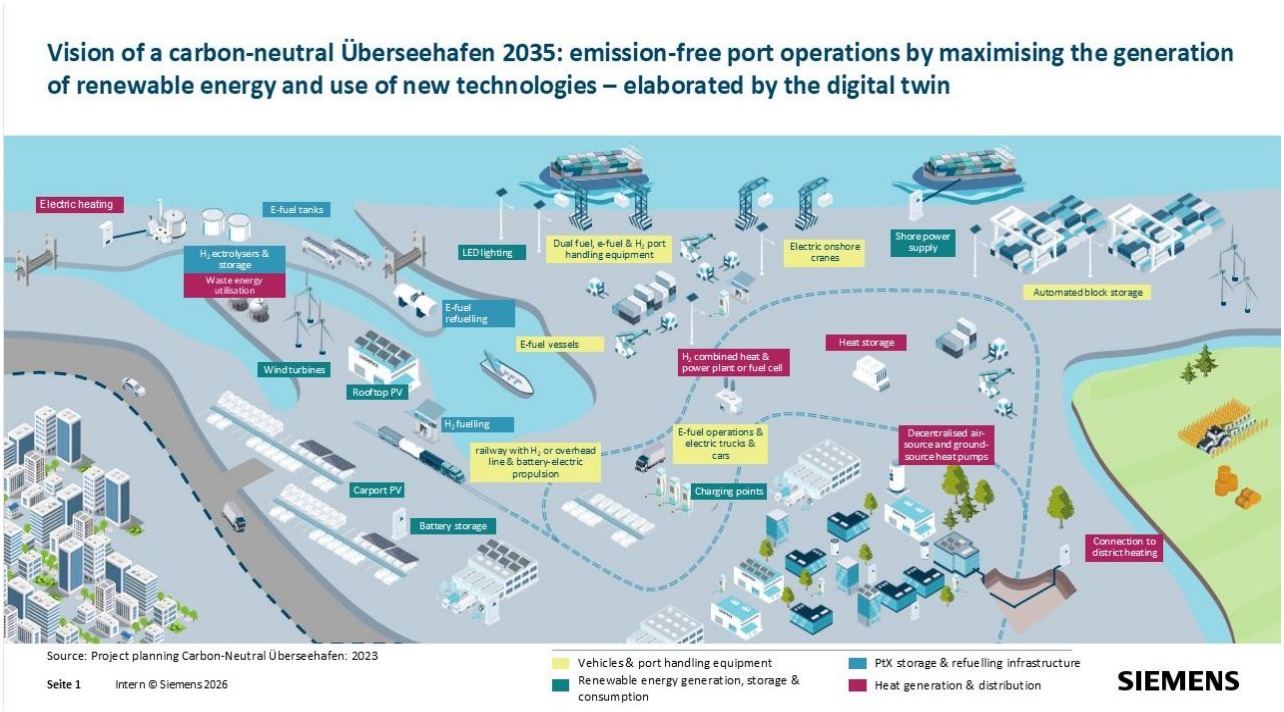

Fig. 5: Overview of measures for carbon-neutral port operations in 2035. Source: Siemens

3.2.2.2 Regulatory framework

The present legal framework of the German Energy Industry Act (EnWG) favours primarily the self-supply of green electricity for customer installations that do not rely on public grid infrastructure. The legally prescribed tax and other levy components of grid fees means that a "self-consumption" solution is by far the most attractive model. The cost difference resulting from tax and other levy components currently amounts to EUR 0.06 per kWh; Siemens estimates the typical grid fees for transmission of the electricity at EUR 0.07 per kWh.[7]

A prerequisite for the recognition of a self-consumption model is that the operator of the renewable energy power plant and the consumer of the generated electricity are identical. For the Überseehafen district, this means that the stakeholders would erect PV and / or wind turbines on their premises, or at least operate these at their own risk, and use the generated power in their own customer grid. Any surplus generated electricity that was not consumed there could be sold to third parties, including other stakeholders, taking into account the grid fees as stated above[8].

Because of the volatile current production by wind turbines and PV systems, connection to the public electricity grid is necessary to ensure an uninterrupted supply of electricity 24/7. Any surplus electricity generated by a wind turbine and / or PV system could then be fed into the public grid.

[7] Cf. Siemens (2024), Final Presentation/7th Workshop
[8] As alternative, the DT recommends the construction of "mini-electrolysers" with a total output of approx. 3 MW.

Concrete regulatory problems will have to be identified on the basis of the actual projects within the decarbonization strategies of the stakeholders (cf. Chapter 4.3).

3.2.2.3 Coordination / orchestration

The currently valid legal provisions for the use of public electricity grids, in addition to allocation of the grid costs to the transported current quantity, also provides for charging taxes and levies. This favours optimisation schemes that refer to individual enterprises, rather than solutions that involve groups or associations of highly different port stakeholders. Nevertheless, a coordinated approach means advantages for the entire Überseehafen district.

One central finding of the analysis of potential operating models for the energy system at Überseehafen is that the transformation towards carbon neutrality should be accompanied by an "orchestrator", i.e. the provision of support for the stakeholders in implementing their individual decarbonization strategies and raising their own potential for generating renewable energy.

Waiving the foundation of a joint enterprise could potentially eliminate ongoing discussions as regards the organisation and strategy of such an entity. Instead, the orchestrator could devote its capacities to one overriding task, which consists amongst other things of coordinating fast exploitation of the potential for renewable energy development at Überseehafen and enabling the best possible utilisation within the framework of decentralised self-consumption solutions by the port stakeholders. This would not only accelerate the transformation to green energy at Überseehafen but simultaneously lead to lower electricity costs compared with today and thus directly improve the competitiveness of the local port handling companies (and – of macroeconomic relevance – help to safeguard jobs in this area).

3.2.2.4 Impact on upstream networks

Fig. 3 clearly shows that the public distribution grid operated with 20 kV at the port (grid operator EGTS) is supplied by further upstream grids. Electrification of the terminal and logistics operations proposed both by the DT and also pursued by various stakeholders, as well as the potential of local renewable energy generation and operation and ongoing expansion of the shore power facilities, will impact on the upstream distribution grid, in particular changes in current quantity, in (peak) output consumption as well as the load profile of this district. This is clearly evident from the change in the annual load duration curve for 2022 to 2035 and the daily load curve for a sample day in 2022 to 2035 (cf. Fig. 6).

The annual load duration curve shows the power requirements of a supplied object on the basis of the individual period of use. The annual load duration curve shows the demand for a certain output for how many hours a year. This is calculated by entering the maximum annual number of hours (8760 hours) on the abscissa (x-axis) and the output (here in kW) on the ordinate (y-axis). The more horizontal the line, the more even the distribution of demand.

The figures now clearly show that

- the peak load of approx. 12 MW in 2022 rises to approx. 72 MW in 2035, whereas

- the base load of approx. 4 MW in 2022 declines significantly in 2035.[9]

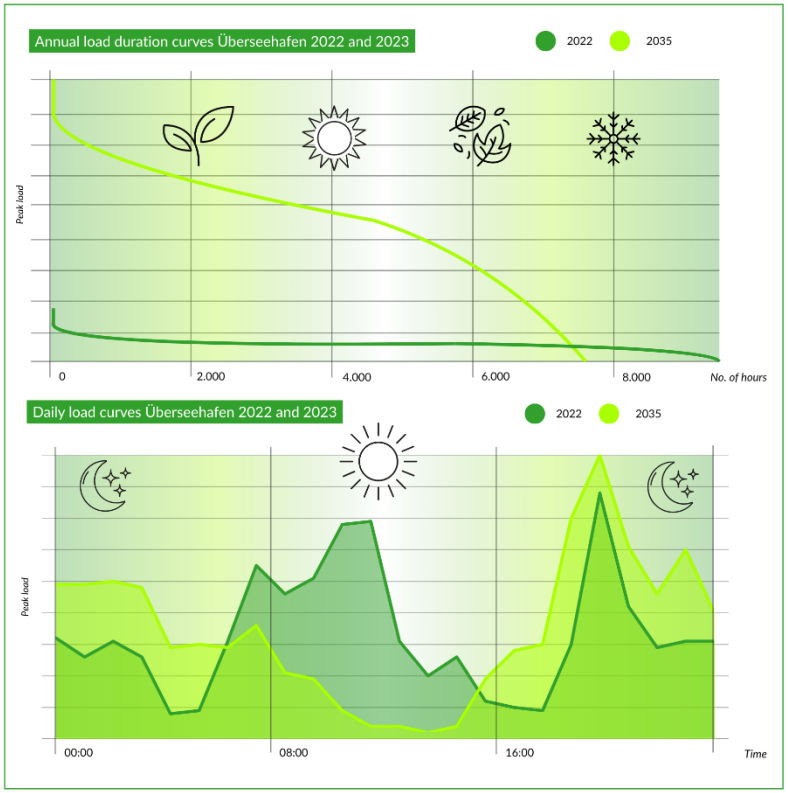

Fig. 6: Annual load duration curves and daily load curves for the district in 2022 and 2035. Source: bremenports

A typical daily load curve looks similar. A daily load curve shows the load consumption per hour of the day. In 2022, two peak loads in the late morning and early evening hours are noticeable. In 2035, a peak load in the early evening is dominant.

These figures refer to net quantities and peak loads, as the DT considers local renewable energy generation (cf. Chapter 3.2.2.1) from the viewpoint of the stakeholders who use the grid, but not from the viewpoint of the grid operator.

3.2.2.5 Shore power

In June 2020, Bremen's Senate resolved the construction of eight shore power facilities for seagoing vessels and two for barges. The total funding volume is currently estimated at EUR 51 million[10]. These facilities will in

[9] This is important in that, for reasons of predictability, the base load is cheapest and the peak load, because it is unpredictable, has to be purchased at the highest price on the electricity exchange

[10] Cf. Senate Notification of the Climate Action Strategy 2038, Annex 2a, Factsheets on the Climate Action Plan – Federal Land of Bremen, p. 83, Bremen Parliament, Parliamentary Paper 20/1838, State Parliament, 20. legislative term 28 March, 2023 (text only available in German)

future enable the first seagoing vessels to be supplied with green electricity at the quay and thus save carbon emissions and air pollutants for the ship operators.

As from 2030 it will be compulsory for certain shipping segments and vessel sizes (as from 5000 gt) in the EU to use shore power. In the Überseehafen at Bremerhaven, this shore power obligation will affect in particular container vessels and cruise ships. The following infrastructure is currently under construction or is necessary in Bremerhaven:

- early 2026: completion of 1 facility for carriers
- by early 2027: completion of 3 facilities for container vessels and 1 facility for cruise ships;
- as from 2030: ideally completion of 10 facilities for container vessels and 2 facilities for cruise ships.

The first five facilities stated above will be erected by bremenports/Special Asset Port and also operated by bremenports during the test phase. The operational details of future facility operations are currently being finalised. Additional requirements at the quay in Bremerhaven will be reviewed in 2026, taking into account the refurbishment of the southern section of the riverside quay (Stromkaje, 2027 – 2035) and depending on the possible ongoing development of further EU requirements, as will the construction of additional facilities for RoRo vessels.

The medium-term target is to supply the shore power facilities with regionally generated energy from sustainable production. Green electricity will be purchased on the market as a short-term solution.

Accounts for the consumed power quantities will be settled between the shipowners and the operators of the shore power facilities, based on the actual quantities of electric energy consumed.

The shoreside technology behind the transfer equipment has been in use worldwide for many years and is generally accepted as successful in practical operations. Nevertheless, the technical solutions for the supply of shore power involve facilities that are adapted to the individual customer and location.

3.2.3 Potential analyses

The assumptions made in the DT for the generation / supply of renewable energy have to be reviewed before planning the carbon-neutral energy systems and the opportunities for local / regional coverage identified. The focus is on wind and solar power and thermal energy stored in the water of the River Weser / of the port.

Based on the geographical, meteorological and climatic location conditions and taking into account operating and approval restrictions, three analyses were performed to identify the potential of the location concepts for the potential design and utilisation of the aforesaid renewable energy sources in the Überseehafen district. These analyses are also intended to identify possible opportunities in the surrounding region for compensating the generation capacities that cannot be achieved in the Überseehafen district and to propose options for the development and use of such facilities.

The renewable energy generation capacities of 61.5 MW_{el} (wind) and 96,5 MW_p (solar) assumed in the DT were confirmed by the potential analyses. There is additional potential of 0.012 MW aquathermal energy for the potential coverage of heat requirements at the cruise terminal as well as a share of the BLG buildings.

Source	Digital twin assumptions		Potential analyses (Contractor)
	2022	2035	
Wind	3.4 MW_{el}	61.5 MW_{el}	60.0 MW_{el} (DWG)
Solar	0.015 MW_p	96.5 MW_p	205.0 MW_p (UTEC)
Aquathermal	--	--	0.019 MW_p (ZAI)
Other	2.5 MW_{el} CHPP	0.28 MW_{el} CHPP 0.04 MW pellet boiler	

Table 2: Potential for the generation of renewable energy (DWG: Deutsche WindGuard GmbH; UTEC: Ingenieurbüro für Entwicklung und Anwendung umweltfreundlicher Technologien GmbH; ZAI: Ziegler-Aulbach Ingenieurgesellschaft mbH). Source: bremenports

DT results in respect of the wind potential analysis:

> The surveyor confirmed the locations of 10 wind turbines that could be erected near the container/auto terminals (seven + one) and the Lloyd shipyard (two). Assuming an average output of 6 MW per turbine, 60 MW renewable energy could potentially be generated, which essentially corresponds to the DT assumption of 61.5 MW_{el}.

DT results in respect of the photovoltaics potential analysis:

> The surveyor calculated a total potential of 205 MW_p for Überseehafen, compared with the DT assumption of 96.5 MW_p. Owing to the availability curve of the PV electricity taken into account in the DT, the DT selected a lower output than could fundamentally be installed.

DT results in respect of the aquathermal potential analysis:

> The ZAI surveyors calculated a potential capacity of 0.019 MW_p that could be generated from the River Weser or port water for heating the cruise terminal and operating buildings at Nordhafen, whereas the DT did not consider this option of energy conversion. However, the calculated potential appears relatively small compared with the overall heating energy requirements, so that we assume that this technology would be used only selectively.

3.2.4 Joint declaration for future cooperation

In September 2024, the participating stakeholders adopted a "Joint Declaration" for their future cooperation[11]. This includes the orchestration proposed by Siemens and defines four subject areas that provide a framework for the content of future cooperation by the stakeholders. During the simulation project phase, Siemens assumed the role of orchestrator; this function has been handled by bremenports since summer 2024, a development that was explicitly approved by the stakeholders.

[11] https://www.bremenports.de/presse/co2-neutraler-hafen-unternehmen-vereinbaren-weitere-zusammenarbeit

The orchestration encompasses:

- the organisation of regular port stakeholder meetings
- preparing the agenda of these meetings, implementation and follow-up

At a joint workshop in November 2024, the stakeholders elaborated the four areas of cooperation stipulated in their "Joint Declaration".

4 Identification and description of measures from the four subject areas

In the Joint Declaration of September 2024, the stakeholders agreed to cooperate in future in four subject areas

- Network and platform / joint communications and public image
- Calculation of the financial requirements for the planned decarbonization pathways
- Regulatory optimisation, and
- Looking beyond the horizon.

Following structured brainstorming sessions, the stakeholders elaborated these areas as follows:

4.1 Network and platform / joint communications and public image

In the subject area "Network and platform", the focus is on continuing and expanding cooperation with the shared target of achieving a climate-friendly, carbon-neutral port, and the establishment of a network for sharing technological knowledge and experience. Another central aspect is to identify potential funding options for such projects.

On signing the Joint Declaration and publishing that statement in a press release on 20.09.2024, the members of the Carbon-Neutral Überseehafen project committed themselves to targeted cooperation to promote the decarbonization of Überseehafen. While implementation of the measures takes place at the individual enterprises concerned, the foundation of this alliance and development of this Policy Paper mark a significant first step towards a joint communication and networking strategy.

It is clearly evident from the conception of the Policy Paper and the regular meetings of the project participants that communication does not begin only with the first external announcements, but is actually an integral part of the project work. The ongoing dialogue within the alliance creates a sound basis for specific demands and measures, whether vis-à-vis policymakers, funding sources or other stakeholders.

One central element of this process is to bundle and prioritise measures, followed by the evaluation of specific contents and requirements. This internal consultation is essential to create a clear and solid basis for external communications. Publication of the Policy Paper will conclude this internal process and enable coordinated external communications.

The ideas and questions regarding communications discussed at the joint workshop have already been put into practice by drawing up and publishing this Policy Paper. This unequivocal commitment and specific content demonstrate that the stakeholders have overcome the typical "Bremen understatement" and adopted a more proactive position vis-à-vis third parties. On publishing their Joint Declaration under the *Green Focus* seal and adopting the title "Carbon-Neutral Überseehafen", the stakeholders have already ensured uniform project branding, inclusive of a distinctive name.

The aim of Green Focus is to bundle the joint sustainability activities of the ports of Bremen and ensure a positive public image with the help of a clearly defined and consistent communication strategy. Specific benefits are to be made available to defined target groups, new developments communicated transparently and close links created with the stakeholders. These objectives are fully consistent with the project participants' endeavours to achieve a "Carbon-Neutral Überseehafen". It consequently makes sense to integrate the activities of the alliance into the overriding communication strategy of the port location, especially in view of efficient networking and consistent public image. On the other hand, creating a separate branding only for those activities that are related to the topic of "Carbon-Neutral Überseehafen" would not be advisable, as integration into the Green Focus creates synergies, raises visibility and avoids fragmentation of the messages to be communicated.

The agreed core contents will be published on the website of the ports of Bremen, bremenports.de. Communications on the social media channels of the ports of Bremen will continue as before under the hashtags #greenfocus and #portsofsustainability. All publications will be prioritised according to their news value and their added value for stakeholders. At the same time, all project participants should continue to use their own communication channels, such as LinkedIn, to publicise successful project achievements.

Additional issues and ideas can be considered after publication of the Policy Paper, such as extension of the project to cover Bremen as a location, closer links with similar projects such as the "Climate Cooperation Fischereihafen" (CCF) led by the Fischereihafen operating company FBG, or networking with science institutes and relevant research institutions.

With the aim of strengthening cooperation, regular dialogue formats should also be established between port stakeholders, public authorities and other stakeholders. These formats could help to identify common challenges and solutions and raise commitment within the cooperation. Accordingly, after the project members have jointly drafted the Policy Paper, they should continue to hold regular meetings to evaluate, elaborate and develop new measures relating to "Network and platform".

4.2 Identifying financial requirements

The identification of financial requirements depends on the existence of specific projects to promote decarbonization. These projects can then serve as a basis for the identification of specific financial requirements and suitable funding programmes and also address regulatory problems. In that respect, the stakeholders proposed:

- decarbonization of shunting operations, e.g. by electrification of the terminal railway and retrofitting existing shunting locomotives with hydrogen drive systems
- self-generation of electricity using wind and photovoltaics

- self-generation of heat from water / thermally activated sheet piling
- replacement of heating systems, primarily with heat pumps and geothermal systems
- mitigation pf diesel consumption, e.g. by using HVO in Bremerhaven

The estimated investment volume for infrastructure amounts to approx. EUR 200 million, an additional sum of several hundred million euros for superstructure, as well as investments of approx. EUR 115 million in renewable energy generation, first and foremost wind energy and PV. Further investments of an unknown quantity will also be necessary for measures in the heating sector, for instance.

However, the identification and documentation of decarbonization measures have to be considered within the context of the following fundamental premises:

- Problem: low-carbon solutions are expensive/more expensive -> customers are frequently unwilling to pay for this
- HVO: in addition to the high purchase price, the situation is aggravated by unfavourable regulatory conditions
- DT provides ideas, the stakeholders themselves are responsible for project planning / calculation.

The stakeholders see the following starting points for jointly addressing funding issues:

- identification and presentation (e.g. at workshops) of relevant funding programmes
- identifying the stakeholders' requirements; aggregation of requirements for potential bundling / structuring of applicant coalitions
- potentially preparing "stand-by applications" to enable prompt reaction to tenders, and
- potential collaboration with partners outside the group of stakeholders, e.g. customers who could potentially help with / participate in applications / projects. This would create an interface, for instance, to the "Green Corridors".

With regard to lobbying activities, the brainstorming focussed on:

- obtaining the support of policymakers / political party representatives for relevant topics
- potentially with the emphasis on taxes on HVO, funding programmes

4.3 Regulatory optimisation

The legal framework rewards optimisation by individual parties. The DT, however, identified potential for joint energy management measures, which currently could not be implemented cost effectively owing to the provisions of the Energy Industrial Act. It therefore appears advisable to identify such obstacles and encourage the necessary regulatory adjustments to achieve decarbonization targets, whilst simultaneously maintaining the competitiveness of the location and the individual actors.

The stakeholders propose drawing up a list of those rules and regulations that constitute the major obstacles to decarbonization and/or where the interpretation of such provisions, e.g. by the Federal Network Agency, requires more flexibility. The interaction between the regulatory provisions has to be taken into account, particularly as regards operation of the distribution grid, the burden of taxes and duties and the specification of feed-in tariffs.

The stakeholders could envisage commissioning expert opinions, involving the relevant professional associations such as the Central Association of German Seaport Operators and seeking the support of the federal government as "endorsers". With regard to the proposed drafting of a position paper, the divergent structures of the stakeholders have to be taken into account, as does the focus on certain aspects of energy law, such as Section 110 EnWG, which governs the energy grids for supplying customers in a defined geographical industrial or trade park.

4.4 Looking beyond the horizon

In addition to cooperation to promote the location, the stakeholders also endorse regional and potentially also international cooperation between relevant players, with the objective of analysing and integrating the experience and successful practices from other regions, countries and logistics sectors.

Other ideas include comparisons with other seaports such as Antwerp, Rotterdam and Amsterdam, as well as some inland ports which have assumed a pioneering role in terms of energy, such as Duisport, or other locations of the Eurogate Group.

Other conceivable targets for looking beyond the stakeholders' own horizons could also include comparable vertically integrated infrastructures, such as chemical parks (in particular methanol terminals) and airports. Other professional associations, such as the Federal Association of Energy and Water Industries, relevant business initiatives such as Cleanports Logistics Initiative Hamburg or the E4ports-Netzwerk, could also be consulted.

Looking beyond the horizon means not only looking at selected technical solutions of competitors, but also the use of public-private models for generating additional funding. This also includes dealing with joint applications for financial support and / or funding at other locations, as well as joint Power Purchase Agreements (PPA) and questions of the use of carbon capture and storage or utilisation (CCS/CCU).

Other aspects worth mentioning include potential initiatives for raising awareness and providing training for the staff at port companies about the benefits and potential of decarbonization to achieve widespread acceptance and encourage participation.

5 Outlining contributions / support from parties other than Überseehafen stakeholders

To achieve a successful definition and implementation of decarbonization strategies, further discussion of the necessary framework conditions is essential:

- dimensioning the upstream electricity grid
- investigating the need for regulatory adjustments, in particular the calculation of grid fees
- investigating the availability of green electricity through power purchase agreements
- identifying "lessons learnt" from other network groups, such as the CCF or NOW
- examining and evaluating funding programmes

6 Summary and next steps

Following presentation of the simulation results by Siemens in March 2024, the DT has provided a database which can provide a basis for the decarbonization strategies of the individual business enterprises. Even if no specific measures can be derived directly from the DT, the simulation results nevertheless provide starting points for such decisions.

This Policy Paper presents the foreseeable measures planned by the stakeholders as a basis for addressing joint specific activities by the stakeholders in the following subject areas: internal and external networking, procuring funds and financing, regulatory optimisation and ideas that go beyond their own environment.

These measures involve primarily, but not only, the development of wind and solar systems by many stakeholders as well as substantial investments in the electrification of logistics processes, first and foremost at the container terminals. The expansion of generation capacities for renewable electricity will reduce the quantity of green electricity that has to be purchased; electrification goes hand in hand with the automation of container handling. Moreover, investments in new buildings will lead to a reduction in heat requirements and consequently of carbon emissions. At the same time, investments in two new intermodal terminals (CT terminals) will raise the logistic efficiency of these processes and thus also lower carbon emissions.

7 Annex: Overview of planned measures

Stakeholders	Title of measure	Objective of the measure	Description	Implementation period (from/to month/ year])	Implementation status
bremenports/ Special Asset Port	Shore power supply	Direct carbon reduction by the connection and installation of shore power facilities	i) 1 facility for car carriers (6.6 / 11.0 kV; 60 Hz; 4 MVA) ii) 3 facilities for container vessels (6.6 kV; 60 Hz; 7.5 MVA), 1 facility for cruise ships (6.6 / 11,0 kV; 50 / 60 Hz; 16 MVA) and iii) 10 facilities for container vessels (6.6 kV; 60 Hz; 7,5 MVA) 2 facilities for cruise ships (6.6 / 11,0 kV; 50 / 60 Hz; 16 MVA) Investigation of further facilities	Early 2026 By early 2027 Necessary by 2030	First connection was commissioned at the RoRo section of Überseehafen in January 2026
BLG AutoTerminal Bremerhaven GmbH & Co. KG / BLG AutoTec GmbH & Co KG	Decarbonization of heat supply Expansion of renewable energy	Direct CO_2 savings	i) Replacement of existing heating systems (oil & gas) by heat pumps (approx. 845 kW) and ii) Installation of power-to-heat systems (730 kW) for the redundancy and coverage of peak loads. iii) Investigation of development plans for renewable energy: the calculated max. capacity of the terminal area for PV is approx. 89 MWp.	By the end of 2027 2025 - 2029	Clarification of contractual framework conditions, addressing limiting factors imposed by building structure

DS Energie Holding GmbH/ UTG-Tanklogistik	Heating replacement		i) Replacement of oil-fired steam boiler by electric boilers for tank heating ii) Investigating whether the above electric boiler can be used for the connection of a second heating circuit.		
Container Terminals: EUROGATE CTB, NTB	Replacement of straddle carriers (SC)	Direct carbon reduction through reduced use of diesel.	Conventional straddle carriers are to be replaced by hybrid SC as necessary	2027 - 2030	Planning stage / in implementation
Container Terminal: EUROGATE CTB	Expansion of CT facility	Reducing mileage	Investigation of expansion of CT facility	By 2030	Planning stage
As above	New terminal building	Increasing energy efficiency	Construction of a new terminal building with a modern heating system; demolition of the existing building	By 2030	Planning stage
Container Terminals: EUROGATE CTB, MSC Gate, NTB	Expansion of renewable energy	Replacing grey electricity with green electricity	Purchase and erection of further wind turbines for container terminals that will be largely electrified in future. Installation of further PV systems	As from 2027	Planning stage
EUROGATE Technical Services	Renewal of heat supply system CHPP	Direct carbon reduction	Replacing the present CHPP by lower-carbon heat supply systems.	By 2030	Planning stage

Container Terminals: EUROGATE CTB, MSC Gate, NTB	Automation of terminal logistics	Direct carbon reduction through reduced use of diesel	Conventional handling equipment is to be replaced by automated and electrified equipment.	By 2040	Planning stage

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