



Hamburg

Behörde für Wirtschaft,
Verkehr und Innovation



Hamburg Port Authority

TAKING ACTION

CREATING VALUES

TAKING ACTION. CREATING VALUES.

Sustainability 2018 at the Port of Hamburg.



€12.7BN
VALUE CREATION IN
METROPOLITAN REGION

26.2%
LOCAL RATIO

-8%
NO_x/TEU
CONTAINER
SHIPS

INVESTMENTS IN
INFRASTRUCTURE OF
€123.4M

83%
OF TRUCKS WITH
EURO 5 + 6

4 TONNES
OF HEAVY METAL REMOVED
FROM WATER SYSTEM

GOOD CONDITION
OF BRIDGES, ROADS,
FLOOD PROTECTION
AVERAGE RATING
1.9-2.4

64%
SHORESIDE SEDIMENT
USAGE

>80%
FIXED
SALARY
SCHEME

19,000
SHIP CALLS

42 MW
WIND POWER
GENERATED

**5 CONSERVATION
PROJECTS**

5.1
ACCIDENTS
PER MILLION
VEHICLE KM

156,000
JOBS IN THE
METROPOLITAN REGION

48.4%
OF TONNAGE
BY RAIL

Table of contents

About this report	4		
Foreword by the BWVI	5		
Foreword by the HPA	7		
Scope of reporting	9		
01 The Port of Hamburg	11		
Project group report	12		
Guiding principles: sustainable development at the Port of Hamburg	13		
Doing business at the port	15		
Working at the port	20		
Traffic at the port	23		
Neighbourly relationship between the city and the port	29		
Climate protection and conservation at the port	31		
Our contribution to the SDGs	34		
		02 Port is what the HPA does	36
		Digitalisation	37
		03 Infrastructure and traffic management	40
		Space-use strategy	41
		Introduction infrastructure and traffic management	46
		Waterway infrastructure	47
		Shipping traffic	53
		Flotte Hamburg	55
		Cruise shipping	57
		Rail infrastructure	59
		Rail traffic	62
		Road infrastructure	65
		Land traffic	70
		04 Facts and figures	73
		Imprint	76

Joint report for the Port of Hamburg

At the request of Hamburg City Parliament, the Hamburg Port Authority (HPA) started reporting on its sustainability activities in 2011 and publishing a biennial sustainability report. The Hamburg Senate's 2015 coalition agreement pledged to expand this sustainability reporting to the whole of the Port of Hamburg. Subsequently, Hamburg City Parliament asked the Ministry of Economy, Transport and Innovation (BWVI) in 2017 to produce a corresponding sustainability report in conjunction with associations and institutions at the port. Consequently, in May 2018, it established a → *port sustainability project group* overseen by the HPA, which identified the key issues and aspects for sustainable development at the Port of Hamburg.

This report for the Port of Hamburg provides information about the project group's activities and sustainability achievements. It covers the period from 1 January 2017 to 31 December 2018. The copy deadline for the report was the end of June 2019. The content generated by the project group was supplemented by comprehensive information on additional topics which fall within the HPA's sole responsibility. This includes content relating to digitalisation and IT infrastructure and the whole "Infrastructure and traffic management" chapter. In addition to the space-use strategy, this part of the report contains

information about the three modes of transport – waterways, rail and road. This content serves to round out the reporting on issues which are relevant at the port.

To show clearly which parts of the report were produced by the project group, the respective pages have a red bar along the lower edge. The parts of the report for which the HPA alone was responsible have a blue bar at the bottom.

The project group's contributions to the report are based on the sustainability process of the Global Reporting Initiative (GRI). Both the content selected for inclusion and the chapter structure are based on a materiality analysis and the sustainability strategies derived as a result, which make a positive contribution to the Sustainable Development Goals (SDGs), Hamburg's 2030 Agenda and the World Ports Sustainability Program (WPSP).

Further information on the scope of the report can be found in the → *section "Scope of reporting"*.

Foreword by Senator Michael Westhagemann

Dear readers,

The Port of Hamburg is on a growth trajectory. That is good news. However, it is not just about the latest figures and opportunities for short-term profits. Going forward, we want the Port of Hamburg to be managed in a sustainable and resilient fashion. The port should generate value added without increasing its carbon footprint. In our view, using resources sustainably, choosing alternative, renewable energies as sources of power, and taking a responsible approach to the environment and nature are key factors for the logistics of the future. The objective is to provide the port with energy from sustainable sources, such as wind power, via a new supply infrastructure. Some of this can be used directly while some can be converted into green hydrogen, which is then available as a source of energy for mobility and production and forms part of a testing ground for innovation, transportation and active climate protection in Hamburg. This turns the port – which made Hamburg wealthy by virtue of trade and international links – into a forerunner in the symbiosis of climate protection and prosperity.

To achieve the climate targets, we need to decarbonise all business sectors by doing without fossil fuels. This applies to everything from transport and mobility to industry and properties. We want our port to serve as a blueprint for this, which is why our approach centres on technology and innovation, not bans. In my opinion, hydrogen is the power of the future. Here in the North, we are ideally

placed to generate green hydrogen. That is the next logical step for the energy transition. In Hamburg and northern Germany as a whole, we have everything needed to take this step: industry, wind power, universities, innovativeness. Together, we are developing a hydrogen strategy for northern Germany. I firmly believe that the energy transition will not succeed without northern Germany – and that we will be unable to meet the climate targets without the energy transition. At present, hydrogen is expensive. However, policymakers can show that they back this technology and make substantial investments. As quantities increase, hydrogen will also become more cost-effective. The Port of Hamburg is the largest interconnected industrial area in Germany, making Hamburg an ideal location for a large-scale electrolysis plant. It is crucial that the generation of renewables is ramped up further so that they can make an effective contribution to decarbonising the various sectors – industry, heat and transport.

It goes without saying that all players at the port have a shared responsibility to establish a forward-looking approach to business and mobility at the port. Sustainable development therefore includes a trusting, neighbourly relationship between the city and the port, consistently reducing emissions and consumption, strengthening the port as an attractive employer that offers high-quality jobs, and acting prudently with regard to the future development of the tidal Elbe as both a natural habitat and a business hub.

These are precisely the topics which are dealt with in the first sustainability report for the Port of Hamburg. At the request of Hamburg City Parliament, the Hamburg Port Authority's ongoing sustainability reporting has been broadened into a report for the whole port which addresses key questions for sustainable development. The main focus of the reporting is on the activities of companies at the port during 2017 and 2018. These activities help to enable the port to operate in a forward-looking manner – with economic strength, ecological awareness and social responsibility.

There is no doubt that this report and the development process which preceded it should be viewed as a considerable success. Developing this report for the Port of Hamburg in conjunction with various stakeholders within a project group and linking it with content produced by the Hamburg Port Authority is a tremendous achievement. I would therefore like to take this opportunity to express my heartfelt thanks to all those who were involved in this new process for their dedication in the interests of sustainable port development.

We have made a start – now we need to build on that. This is why I warmly welcome the project group's wish to gradually expand this voluntary reporting over the coming reporting cycles.



I would particularly like to draw your attention to the guiding principles for sustainable development at the Port of Hamburg, which can be found at the beginning of the chapter about the port. They were jointly developed and approved by the project group and set out the approach we need to take in order to ensure that a growing Port of Hamburg has an environmentally friendly, sustainable and secure future.

I hope that you will gain valuable insights from reading this report, which also highlights how much potential for innovation exists at this port.

Yours,

A handwritten signature in blue ink, appearing to read 'M. Westhagemann'.

Michael Westhagemann
Senator for Economy, Transport and Innovation

Foreword by the CEO of the HPA, Jens Meier

Dear readers,

Our port has linked Hamburg with the world for over 830 years, during which time it has gone through many developments. We have a tradition of change, and adapting to future needs is a necessity. Today, too, we must find new answers in the light of huge technological and societal shifts and actively help shape megatrends such as urbanisation, climate change and digitalisation. To achieve this, everyone involved needs to willingly embrace change.

At the HPA, our answer is to safeguard the future by acting sustainably. As well as being a strongly held belief, this offers us a great opportunity to considerably enhance our competitiveness at national and international level. That is why we consider social, ecological and economic aspects in equal measure throughout our decision-making.

Every day, we work hard to guarantee the port's accessibility and availability, maintain a resilient, functioning infrastructure, and use foresight in our planning. For us, deepening the navigation channel is just as much a means of actively safeguarding the future as digitalising our processes and developing innovative business models which are geared towards sustainability.

At the same time, it is our job to efficiently manage traffic on the water, rails and roads. In doing so, we aim to minimise our environmental and climate impact by choosing greener mobility solutions with low-emission drive technologies and attractive public-transport offerings. We are particularly interested in switching from road to rail as this is the most environmentally friendly mode of transport.

For us, sustainability also means making our own organisation adaptable and efficient. A key part of this is ensuring our staff are well prepared for change, for example by training them for digitalisation. Our work in this area will also help us to prevent shortages of skilled staff from becoming a business risk.

Isolationism in world trade creates uncertainty for everyone involved in the value chain. We are consciously taking a different approach and wholeheartedly promoting partnership, cooperation and network links – with all players at the Port of Hamburg, other ports and our neighbouring federal states. My motto is: you can only win as a team. We want to learn from one another and work together to develop innovative solutions which bring benefits both for the players in global goods flows and for the ports.

We look forward to shaping the sustainable future of the port in conjunction with the project group and its members. This report offers a transparent account of the consequences and risks of our actions. It also shows the dichotomies between the various expectations and objectives which we seek to balance. At the same time, we can proudly show where the HPA is creating value added for society and making its contribution towards achieving the Sustainable Development Goals of the United Nations.



Together with our partners at the port and beyond, we also want to ensure that sustainability remains the benchmark for our future actions. With that in mind, I look forward to engaging in dialogue with you and hope this report will be an important catalyst in that regard.

Yours,

A handwritten signature in black ink, consisting of a large, stylized 'J' followed by a horizontal line and a small flourish.

Jens Meier
Chief Executive Officer of the HPA

Scope of reporting

The Port of Hamburg is a complex organisation and an interconnected space where different operators can achieve economic success. Its geographic boundaries are clearly defined, but the port's operational boundaries are extremely dynamic and embedded in international goods flows and supply chains.

Below is an explanation of what falls within the responsibility of port operators and the HPA. The boundaries of the respective reporting are also described.

The reporting concentrates primarily on the area of the Port of Hamburg and the surrounding region. In some cases, a broader view is taken. Examples are:

- The Port of Hamburg's hinterland connections, which comprise road, rail and waterway links to northern, central and eastern Europe;
- Value creation at the Port of Hamburg, which has an impact on the whole metropolitan region;
- Deposition possibilities for sediment at the E3 buoy site in the North Sea.

Furthermore, information is provided on which other parties share responsibility for the functionality of the port ecosystem and the supply chain. The HPA's operating respon-

sibility goes beyond the Port of Hamburg. Its day-to-day work is closely linked with the region, the neighbouring federal states of Schleswig-Holstein and Lower Saxony, the Federal Waterways and Shipping Administration (WSV) [Wasser- und Schifffahrtsverwaltung des Bundes] and developments throughout the River Elbe's catchment area. Integrating additional responsible parties at the port changes the boundaries of the reporting organisation's business model.

- The organisational boundary comprises the organisations which perform the tasks involved in ensuring safe, cost-effective operations at the Port of Hamburg.
- The operational boundary refers to the activities which are necessary for port operations, including the construction and maintenance of infrastructure at the Port of Hamburg.
- The geographic boundary depends on the business model of the reporting organisation.
- The dynamic boundaries can have an impact on supply and logistics chains. These are subject to the geometry of the infrastructure (such as water depths) and aspects that influence the accessibility, availability and capacity of the port, such as weather conditions or the effects of climate change.

The diagram below shows which corporate responsibility each party bears in relation to the port and the level of influence they have as a result. Responsibility and influence vary within individual activities:

- Proprietor or has complete responsibility
- Contractor or adviser
- Partner with scope for influence

Fig. 1: Overview of responsible parties and their scope for influence

Activities	German Bight	Lower Elbe	Port area (HPAG legislation applies)	Upper Elbe
Infrastructure of the federal waterways and waters belonging to federal states (locks, barrages, etc.)	Cuxhaven Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Cuxhaven]	Hamburg Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Hamburg]	HPA	Lauenburg Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Lauenburg]
Safety of shipping traffic	Cuxhaven Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Cuxhaven] HPA	Hamburg Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Hamburg] HPA	HPA	Lauenburg Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Lauenburg] HPA
Traffic management for vessels (navigation), Cuxhaven	Cuxhaven Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Cuxhaven] HPA	Hamburg Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Hamburg] HPA	HPA HVCC	Lauenburg Waterways and Shipping Authority [Wasserstraßen- und Schifffahrtsamt Lauenburg] HPA
Road/bridge infrastructure			LSBG HPA	
Traffic management on land			Police HPA	
Operating public flood defences			HPA	
Infrastructure of public flood defences			BUE HPA	

Activities	German Bight	Lower Elbe	Port area (HPAG legislation applies)	Upper Elbe
Infrastructure of private flood defences			Private entities HPA BUE	
Operating private flood defences			Private entities HPA	
Rail infrastructure			HPA	
Traffic management for the port railway			HPA	
Port railway user fee			BWVI HPA	
Land owner			Private entities HPA	
Letting and leasing HPA land and water areas			BWVI HPA	
Port user fee			BWVI HPA	
Port development			BWVI HPA	
Services – tugs, mooring, boatmen			Private entities HPA	
Services – pilots			HPA	
Vessel disposal			BUE	

BUE = Ministry for the Environment and Energy, BWVI = Ministry of Economy, Transport and Innovation, HVCC = Hamburg Vessel Coordination Center, LSBG = Hamburg State Office for Roads, Bridges and Water Bodies



01

The Port
of Hamburg

Project group report



The Hamburg Senate’s 2015 coalition agreement pledged to expand sustainability reporting by the Hamburg Port Authority (HPA) to the whole of the Port of Hamburg. In 2017, Hamburg City Parliament subsequently asked the Ministry of Economy, Transport and Innovation (BWVI) to produce a corresponding sustainability report in conjunction with associations and institutions at the port.

Port sustainability project group

In May 2018, a port sustainability project group was therefore established. Overseen by the HPA (see Figure 1), it identified the material issues and aspects for sustainability reporting. Its work was founded on a joint agreement that content and data would be ascertained and reported on a voluntary basis because the Port of Hamburg is not a company. It does not have clearly defined organisational boundaries. Instead, it is the sum of all the activities conducted by a large number of people, groups and companies. It is not currently possible to fully incorporate all of its sustainability activities in a report. However, the project group intends to gradually expand the port community’s reporting on a voluntary basis over coming reporting cycles.

The project group’s task was to start by formulating overarching guiding principles for the sustainable development of the Port of Hamburg and then define the material content for reporting covering the years 2017 and 2018. It did this by holding a total of three workshops, at which it identified the areas city/port, value creation/work and traffic/infrastructure.

The material aspects of these areas were then examined in conjunction with an extended group of stakeholders via an online survey. The results of the survey supported the project group’s assessments, but gave slightly greater importance to the aspect of climate protection and nature conservation. The project group reacted to this and incorporated a separate section on this subject into the report.

The sustainability reporting process is based on the Global Reporting Initiative (GRI) Standards, which are also used by many other ports around the world.

Fig. 1: Project group participants

- Ministry for the Environment and Energy (BUE)**
- Ministry of Economy, Transport and Innovation (BWVI)**
- Hamburg Federation of Trade Unions (DGB HH)**
- Hafen Hamburg Marketing (HHM)**
- Hamburg Port Authority (HPA)**
- Hamburg Chamber of Commerce**
- Industry Association of Hamburg (IVH)**
- Logistik-Initiative Hamburg (LIHH)**
- Association of Hamburg Port Operators (UVHH)**
- Verein Hamburger Spediteure (VHSp)**
- Zentralverband Deutscher Schiffsmakler (ZVDS)**

Guiding principles: sustainable development at the Port of Hamburg



The port connects Hamburg with the world – and has done so reliably for over 830 years as part of the city’s Hanseatic tradition. During this time, the port has constantly evolved – its markets, infrastructures and value creation for the city are subject to perpetual change. Today, with parameters changing at an ever-increasing pace, the Port of Hamburg remains committed to upholding this tradition of confronting fundamental questions concerning its future viability. For it to succeed, all those who operate and work at the port must be willing to embrace change.

Megatrends such as urbanisation, climate change and digitalisation are impacting on the configuration of infrastructures and the intensity of land use. Haulage routes, the goods transported and their cargo flows will all change. Climate-related resource shortages, failed harvests and the planned phase-out of coal will prompt port operators to make their business models and lines of business more flexible and more adaptable.

Whether the Port of Hamburg remains viable in the future will not only depend on trade flow trends, new technologies or the consequences of climate change. Its future will depend heavily on decisions made by companies, government agencies and local people today. At the heart of this change is the task of developing the port in line with a strong economic, social and ecological ethos. Addressing this task can give rise to valuable innovations. For that reason, the project group sees the issue of sustainability as a competitive factor which can generate a substantial advantage for the Port of Hamburg – and therefore future-proof prosperity for people in the surrounding region.

With this in mind, the project group has formulated key tenets which should serve as guidance for the Port of Hamburg as it moves towards a sustainable future.

Tenet 1: Further develop Hamburg as a universal port

The Port of Hamburg’s sustainable development rests on its diverse economic structure spanning logistics, trade and industry. The notion of a universal port should be upheld as a guiding principle and further developed.

Tenet 2: Safeguard the port’s accessibility

Ensuring that the Port of Hamburg can be accessed reliably by land and by water and in line with users’ needs is key to its future viability.

Tenet 3: Increase the proportion of cargo destined for the metropolitan region

The proportion of cargo arriving at the Port of Hamburg which remains within the metropolitan region should be increased if possible. The Port of Hamburg should further boost its real net output in the metropolitan region. This will help enhance the port’s attractiveness as a destination for goods and commodities.

Tenet 4: Expand Hamburg as a hub for eco-friendly modes of transport

To ensure the Port of Hamburg's accessibility over the long term, the underlying conditions for eco-friendly modes of transport – including rail freight transport in particular, which is already well represented at the Port of Hamburg – should be further optimised. Traffic in Hamburg must also be managed and coordinated safely and reliably. The objective is to make intermodal links even more efficient. This reduces traffic and emissions while saving money and time.

Tenet 5: Position the Port of Hamburg as an attractive employer

Companies at the Port of Hamburg should keep making it a high-quality, attractive place to work in the future. This will enable the Port of Hamburg to remain a popular employer in the local region, which attracts and retains skilled workers.

Tenet 6: Actively transform the working world

Digitalisation and automation at the Port of Hamburg are an important means of making logistics processes and workflows more efficient and reducing the associated emissions. However, it should be ensured that the digital future of the port takes shape in an economically viable and socially ethical way. Special attention should be paid to adequate training and continuing professional development for workers.

Tenet 7: Reduce emissions

Emissions of air pollutants, odours, light and noise should be consistently reduced using sound economic judgement. Steps to do this have already been set out – for example in the second update of the Clean Air Plan in Hamburg.

Tenet 8: Keep conserving energy and resources consistently

Steps to improve energy and resource efficiency at the Port of Hamburg (for example in the form of existing initiatives such as UmweltPartnerschaft) can be further developed in a meaningful fashion. They make an important contribution towards achieving the climate targets in Hamburg.

Tenet 9: Actively shape the relationship between the city and the port

It is impossible to imagine the City of Hamburg without its port. The Port of Hamburg is one of the largest city ports in the world. This means that the city and the port are closely interlinked. In Hamburg, they can only develop hand in hand with one another – and ideally strengthen each other in the process.

Alignment with the World Ports Sustainability Program

The International Association of Ports and Harbors (IAPH) adopted the World Ports Sustainability Program (WPSP) in 2017.¹ This global programme aims to highlight how ports can contribute towards achieving the Sustainable Development Goals of the United Nations (2030 Agenda). The WPSP sets out concrete areas of action for ports which would like to grow sustainably. Steps include:

- Endorsing the United Nations Paris Climate Agreement (COP21), which aims to limit global warming to less than two degrees Celsius;
- Making the ports' infrastructure more resilient to both climate change and attacks on IT or traffic systems;
- Seeking active dialogue with the local community, i.e. maintaining an open and transparent exchange between the city's population and the port.

The project group supports these areas of action set out in the WPSP.²

¹ www.sustainableworldports.org

² The WPSP charter dated 14 March 2018 lists the areas of action as potential topics in section 2 ("Scope").



Goods and value creation – doing business at the Port of Hamburg

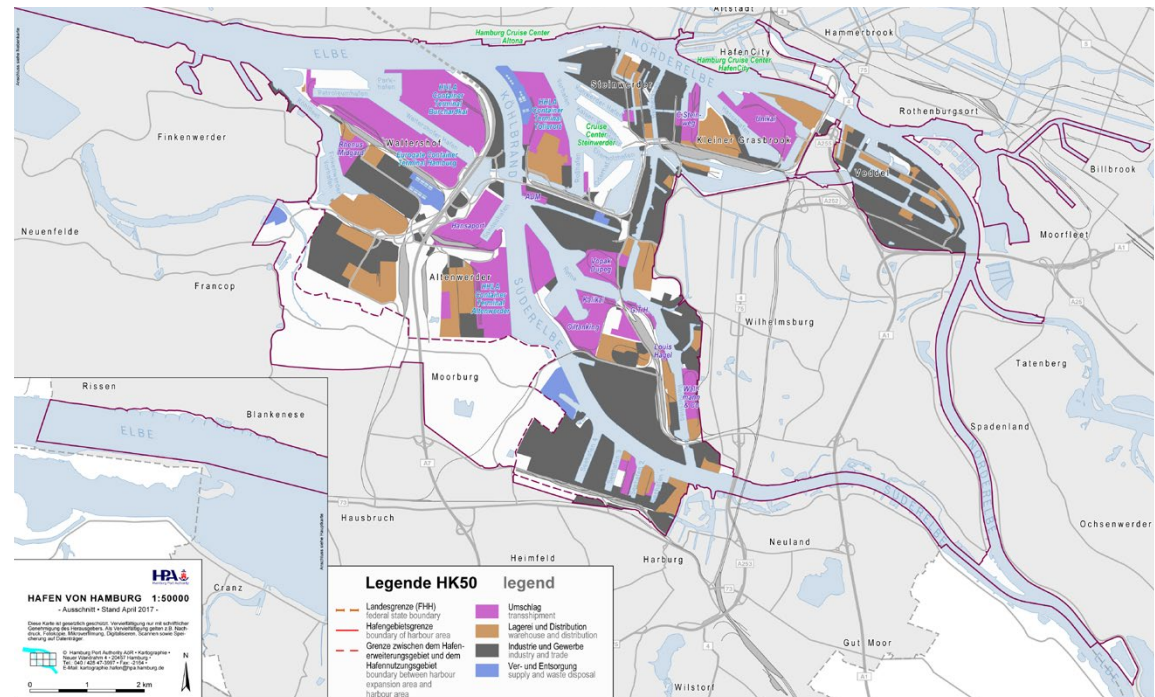
Hamburg is Germany’s largest port and logistics hub. Spanning an area of 6,288 hectares, the dedicated port area is home to a wide range of value creation – with large cargo handling companies, innovative industrial firms and start-ups for whom the link to the waterways is a locational advantage. In total, more than 16 different sectors are based on the publicly owned land in the port – from container and bulk cargo handling to the mineral oil industry and from logistics and metal production to cruise operators (see Figure 1).

Creating value for the people in Hamburg, the surrounding region and Germany

The Port of Hamburg creates lasting value at multiple different levels. Key among these is its economic benefit. The port’s overall gross value creation stands at around € 12.7 billion (metropolitan region) per annum. Each year, the Free and Hanseatic City of Hamburg collects taxes in excess of € 800 million (figures from 2014) on business activities at the port.

The incoming goods and commodities which remain in the metropolitan region (local cargo³) are extremely valuable for Hamburg and the metropolitan region because they enable raw materials such as cereals, oleaginous fruits, mineral oils or ores to be processed and refined. The volume of local cargo transported between Hamburg and the metropolitan region was estimated at 1.5 million TEU for 2017, putting it on a par with the figure from 2013. As it was simultaneously possible to increase the volume and

Fig. 1: Land use at the Port of Hamburg – by industry (for larger view → see “Facts and figures” section)



market share in a large number of hinterland regions, the local cargo ratio in relation to hinterland traffic as a whole fell from 28.1 per cent to 26.2 per cent. Nevertheless, Hamburg is unique among the German seaports in having such a local volume concentration in the port’s immediate environs.

³ The local cargo ratio is the percentage of goods which remain in the metropolitan region of the respective port instead of being transported to the hinterland.

135.1

million tonnes total throughput
by seagoing vessels

The Port of Hamburg is in

3rd place

in Europe (based on container
throughput)

As Germany's largest universal port, Hamburg has a policy of diversification. The range of industries represented and the handling facilities available for all types of cargo lend stability to the complex port system. Consistently strengthening the local cargo volume – for instance by attracting more manufacturing companies and industry – could make adaptive port space development a success factor (for usage and siting concept → see the "Space-use strategy" section).

In addition to the two major container handling companies, some 700 companies are based at the Port of Hamburg. Well-known industrial firms from the energy sector, the raw materials industry, drive technology, shipbuilding, mechanical engineering and the fertiliser industry are also an important part of the business landscape at the port. The port's production industry and port-related companies offer a particularly high percentage of commercial and industrial jobs.

It should be borne in mind that many of the firms based at the port are structurally very different from the companies in the city itself, which is clearly demonstrated by the ways in which land is used. This applies, for example, to the large-scale storage of ores and coal, the handling of containers or the storage of mineral oils in tanks. For this reason, a container terminal will in-

evitably have lower productivity per unit area than a sizeable business centre, although the number of employees may be virtually the same.

More than 150,000 people in gainful employment in the metropolitan region of Hamburg have direct or indirect links with the Port of Hamburg. The majority of them are well-qualified, skilled workers on fixed salaries who work in highly specialised spheres at the port. It is notable that, at € 97,000 p.a., the productivity of employees at the port is considerably higher than that of workers in Hamburg as a whole, where the figure is € 77,250 p.a.⁴

However, there is even more to the port than that: it is part of the city which residents call home and a source of cultural identity. The port plays an important role as a local recreational destination and a tourist attraction in the city. The biennial Cruise Days, ship christenings and the Harbour Anniversary celebration are tourist magnets which also illustrate the close, positive links which people within Hamburg and beyond have with the port.

Hamburg as a goods hub: throughput and cargo groups

In 2018, approximately 10,000 inland waterway vessels called at the Port of Hamburg along with 8,522 throughput-generating seagoing vessels with a total throughput

of 135.1 million tonnes. This was 1 per cent lower than the benchmark figure from 2017. Container throughput in Hamburg – in both tonnes and TEU – also fell by 1 per cent in 2018 and totalled 89.4 million tonnes or 8.7 million TEU. This was primarily due to a decrease of 87,000 TEU in lower-value empty container shipments and to transshipment losses. A growing number of ships headed straight for the Baltic Sea without calling at Hamburg. However, an upwards trend emerged in the fourth quarter of 2018. The Port of Hamburg once again recorded growth in the bulk cargo and break bulk cargo handling segments.

The Port of Hamburg ranks 16th for container throughput globally and third within Europe. This position should be maintained. Hamburg could achieve this by taking steps such as extending its knowledge of the imported goods, their destinations, senders and recipients. This knowledge could provide valuable information about future markets for the Port of Hamburg.

⁴ Throughput has stagnated since this data was collected in 2014. It can therefore be assumed that the number of associated employees at the Port of Hamburg has remained stable. No new data will be collected before the end of 2020.

In 2018, the cargo transported via the Port of Hamburg could be split into three groups (see Figure 2). Container handling dominated overall at 89.4 million tonnes, followed by 44.1 million tonnes of liquid and dry bulk cargo and 1.5 million tonnes of conventional break bulk cargo. Bulk cargo handling therefore remains a mainstay of the universal port.

Import volumes grew by 2 per cent compared with export volumes in 2018. Based on tonnage, a total of 59 per cent of goods in Hamburg were imported while 41 per cent of goods were exported. Table 1 shows a selection of goods with a clear trend. There was a particularly marked increase in coal imports, while the volume of liquid bulk cargo exported was halved. Handing of cereals – a suction material – was down by a third. Among cereals and rapeseed,⁵ climate-induced stress factors such as dryness and drought caused substantial crop failures.

Hamburg’s advantage: eco-friendly transport links to the hinterland

A universal port’s success rests on a large number of factors. One of them is the quality of its combination of sea and hinterland links. The Port of Hamburg is much further inland than many of the world’s other ports which are deep enough for seagoing vessels. Although this location makes the 120-kilometre approach along the estuary more complex, it means that large ships can call directly in the heart of the metropolitan region. As a result, goods and commodities do not need to be loaded onto trucks or trains on the coast and transported to the economic area of Hamburg

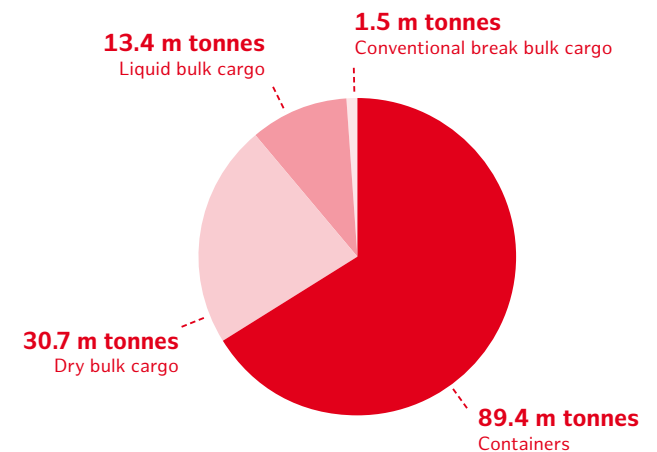
in small quantities. This makes Hamburg well placed to link ships and trains – both eco-friendly modes of transport – with one another optimally, well into the port’s hinterland.

In the period from 2005 to 2018, the proportion of containers transported to the hinterland by rail (modal split) grew significantly, from 31 to almost 45.2 per cent (see Table 2). During the reporting period, an average of 204 freight trains were handled on the port railway network each day.

Inland waterway vessels accounted for 2 per cent of the transport volume. Developments in shipping on inland waterways in Hamburg do not just depend on the infrastructural provisions within the port: they are also shaped by a large number of external factors in the hinterland transportation of containers. Other influencing factors include the end-to-end navigability of the Elbe (overall concept for the Elbe) and the transport capacity of the Elbe Lateral Canal (new construction of a replacement boat lift in Scharnebeck near Lüneburg).

At 52.4 per cent, trucks accounted for the majority of hinterland transport. Trucks remain the main means of transporting goods to the metropolitan region. In 2018, forwarding companies delivered approximately 1.5 million TEU to Hamburg’s metropolitan region. According to data from the Verein Hamburger Spediteure (VHSp), they generally travelled a radius of up to 300 kilometres. 900,000 TEU of cargo originated from or was destined for the city of Hamburg itself.

Fig. 2: Cargo groups at the Port of Hamburg, 2018



Tab. 1: Import/export data for 2017 and 2018 in millions of tonnes

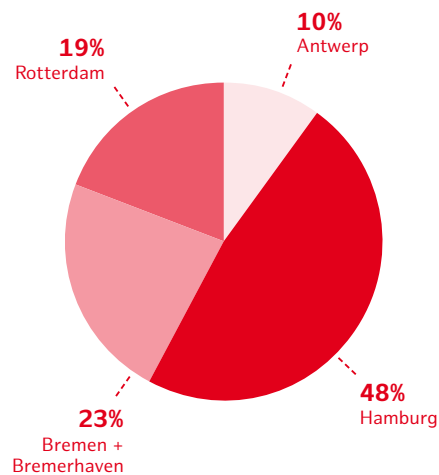
Imports	2017	2018	Exports	2017	2018
Coal	7.8	8.1	Suction materials ⁶	3.5	2.2
Ores	10.1	10.2	Liquid bulk cargo	4.2	1.7

Tab. 2: Seaborne cargo throughput by mode of transport

Modal split	2018 in millions of tonnes	2018 in millions of TEU
Seaborne cargo throughput	135.1	8,730
Transshipment, mega-ship	19.2	1,661
Transshipment, feeder	19.2	1,661
Hinterland, train	46.8	2,443
Hinterland, inland waterway vessel	9.9	128
Hinterland, truck	40	2,834

⁵ 2018 harvest report by the German Federal Ministry of Food and Agriculture.
⁶ Suction materials: feed, cereals, fertiliser.

Fig. 3: Percentage share of rail traffic held by major North Range ports, 2018 (4.90 m TEU in total)



Hamburg expands its position as Europe’s largest railway port

In the reporting period, the Port of Hamburg succeeded in expanding its position as Europe’s largest railway port (see Figure 3). In 2018, the number of trains running to and from the Port of Hamburg exceeded 60,000 for the first time. This meant that the Port of Hamburg was the point of departure or destination for 38.5 per cent of all containers transported by rail in Germany.

Growth in the volume transported was even stronger. A total of 46.78 million tonnes and 2.44 million TEU were transported via Hamburg’s port railway in 2018. That is an increase of 2.7 per cent and 4.7 per cent respectively on 2017. The figures marked a new record high.

Hamburg has also succeeded in gaining market share in Germany’s hinterland regions recently – especially North Rhine-Westphalia, Baden-Württemberg and Bavaria – by virtue of its rail links. It is striving for further growth here. A prime example of these activities is the “Hamburg-NRW plus” project, which was developed and implemented in conjunction with the Ministry of Transport in North Rhine-Westphalia. The volume of containers transported to and from North Rhine-Westphalia currently stands at around 500,000 TEU per annum. This figure is forecast to double by 2030. The partnership set out to reduce the above-average levels of truck traffic to and from North Rhine-Westphalia by shifting it

onto the rails – with new freight train links serving areas such as the industrial zones in the Ruhr district and the Sauerland. As a result, container traffic between Hamburg and Dortmund rose by 12 per cent while the route to and from Warstein experienced growth of 40 per cent.

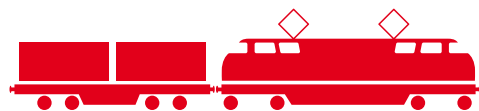
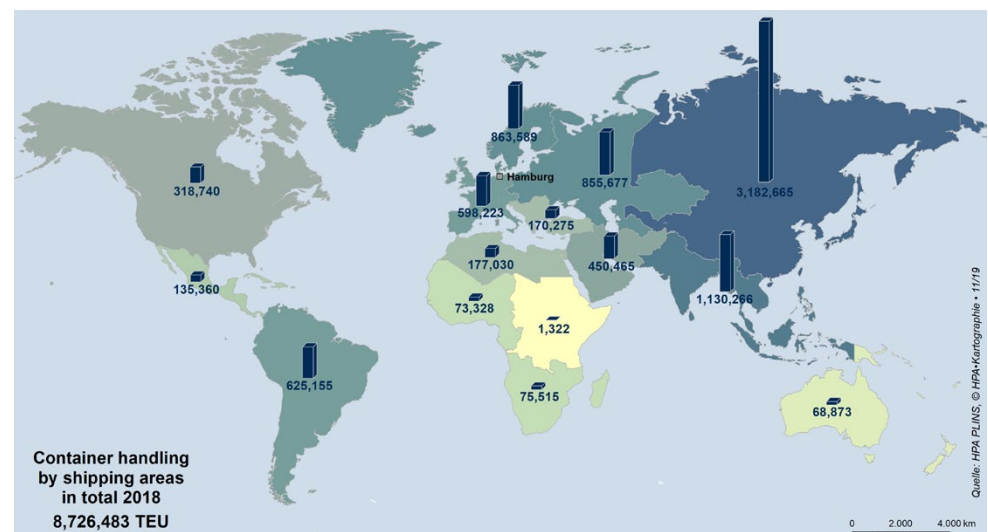
At present, there are 235 rail links per week between Germany and China. Expanding the rail network between China and western Europe could create new potential here. The People’s Republic of China is developing the infrastructure along this old trade route with its “New Silk Road” project (Belt and Road Initiative). As a strong business partner to China, the Port of Hamburg could also

benefit from this expansion and facilitate new goods flows by rail from and to the Far East.

Integration into world trade: Asia dominates, South America catches up

Almost a quarter of Germany’s seaborne foreign trade in goods operates via Hamburg (www.hafen-hamburg.de). The Port of Hamburg is part of global supply and logistics chains and has cargo handling links with all markets on all continents (see Figure 4). Trade areas and volumes of goods fluctuate considerably from year to year. However, the large number of trade zones and the variety of markets served compensates for this.

Fig. 4: Breakdown of the Port of Hamburg’s trade areas, 2018



North and South-East Asia dominated the port’s trade areas. Despite a decrease, they remain by far the most important trade area, accounting for a total share of almost 60 per cent in 2018. Meanwhile, container handling for Europe fell by 2.1 per cent to total 27 per cent. This was primarily due to substantial decreases in freight traffic with Great Britain and Russia. By contrast, transport flows to the northern, central and eastern European hinterland remained strong.

Marked growth was reported for South America in the period under review. This was driven by a very strong increase in container throughput with Brazil. Container traffic with North Africa fell by a tenth in 2018, triggered by substantial reductions in throughput with the USA and Mexico. Hapag-Lloyd and ONE decided in 2018 to shift four important line hauls from Bremerhaven to the Port of Hamburg. As a consequence, traffic to North America can be expected to grow measurably in the coming years.

All in all, the trend towards concentration in container shipping has continued. Operators such as Hanjin exited the market during the reporting period. The market has changed fundamentally as the highest-revenue shipping companies have joined forces in just three alliances.⁷ This has far-reaching consequences for shipping companies’ schedules and for the frequency of departures and the number of vessels calling at the Port of Hamburg. This development shows that locational advantages are increasingly important in the competitive environment. These include the volume of cargo arising locally and in the port’s hinterland. The large proportion of local cargo and the high frequency of train departures in Hamburg exert a positive influence in this regard.

Trends in ship sizes present a challenge for the Port of Hamburg

Ever-larger ships remain an ongoing trend. New orders in 2017 and 2018 included an above-average proportion of ultra large freighters. There were 51 orders of mega-ships alone, each with a capacity of over 22,000 TEU. Some of these units are expected to be integrated into the market in late 2019, with the majority commencing operations in 2020.

In 2018, the CMA CGM mega-ship *Antoine de Saint Exupéry* became the largest ship to call at the Port of Hamburg to date. It has a length of 400 metres, a 59-metre beam and a capacity of 20,775 TEU. 531 ships of this size moored at the terminals in Hamburg in 2017, rising to 566 in 2018 (see Table 3).

The HPA is responding to the more demanding requirements with technical and organisational steps to ensure that ships can call at the port safely and easily (→ see the “Shipping traffic” section).

Both the suprastructure and infrastructure at the Port of Hamburg also need to be adjusted to this trend. Work here includes a HHLA project initiated in 2017, for instance, to put three additional state-of-the-art container gantry cranes into operation for mega-ships over 20,000 TEU at the Container Terminal Burchardkai (CTB) with eight twin-forty container gantry cranes allowing ships to be loaded and unloaded in tandem. The Container Terminal Tollerort (CTT) has been equipped with five new container gantry cranes on this scale. Similarly, EUROGATE has installed four new container gantry cranes at the Container Terminal Hamburg (CTH) to enable an additional berth at the CTH to handle the new generation of mega-ships.

Cruises: Hamburg’s attraction
 Hamburg is one of the fastest-growing cruise bases in the world (→ see the “Cruise shipping” section). Cruise shipping grew at the Port of Hamburg in 2018: 212 port calls were received with almost 900,000 passengers on board. In 2017, 197 calls were made in Hamburg, bringing 810,000 cruise tourists to the city.

Tab. 3: Number of calls by container ships of various sizes at the Port of Hamburg, 2017 and 2018

Ship classes	Maximum dimensions in m			2017	2018
	Draught	Beam	Length		
Mega-ship	> 15.50	> 49.00	> 370.00	531	566
Fleet max.	15.50	49.00	370.00	378	371
Reference ship	14.55	46.00	350.00	118	148
Post-Panamax	14.55	42.00	318.00	241	219
Panamax	13.50	32.40	295.00	825	781
Kielmax	9.50	27.00	210.00	660	715
Feeder	8.00	28.00	170.00	897	704
Total				3,650	3,504



⁷ Hapag-Lloyd, UASC and CSAV, COSCO / China Shipping, Maersk and Hamburg Süd / NYK, “K” Line and MOL.

Quality and attractiveness – working at the port



More than 150,000 people in gainful employment in the metropolitan region of Hamburg have direct or indirect links with the Port of Hamburg. The skills, sound training and continuing professional development of workers at the port play a key role in its economic success. Good working conditions, intercultural openness and a healthy, safe working environment are critical success factors in the competition for skilled workers and in efforts to enhance the attractiveness of sectors and professions.

The social partnership between employers and employees at the port makes an important contribution towards this success. The relevant master agreements and collective wage agreements are supplemented at the Port of Hamburg by collectively agreed special arrangements (covering, for example, breaks, overtime and annual bonuses).

The project group's shared objective is to ensure that the Port of Hamburg continues to provide high-quality, attractive jobs in the future by upholding a good social partnership.



Recruiting the next generation: ensuring sufficient skilled workers for the port

Companies at the Port of Hamburg need skilled new recruits. Although the various sectors are affected by a shortage of workers and skilled employees in very different ways, many firms at the port have stepped up their efforts to attract new recruits by showcasing and promoting the professions and workplace more actively than they did previously. These wide-ranging measures will not be listed individually here. However, a number of focus areas for 2017/2018 will be mentioned along with concrete projects:

■ *Strengthening vocational colleges – protecting professions*

Many jobs at the shipping companies with a presence in Hamburg require staff who have trained as shipping agents. This skilled occupation also enjoys a good reputation internationally because of the quality of training provided. The training course for prospective shipping agents at the Staatliche Handelsschule Berliner Tor (H18) – the vocational college for shipping – therefore represents an invaluable locational advantage which must be retained. A ready supply of well-trained

employees is also good news for foreign shipping companies, many of whom have their European headquarters in Hamburg or manage their agencies in other ports, such as Rotterdam, from their base by the Elbe. With this in mind, the Zentralverband Deutscher Schiffsmakler e. V. has always supported retaining this distinct profession and associated vocational training which is as discrete as possible.

■ *Information and education at schools and universities*

The activities focused on working with young people to show them how varied and attractive the various port professions are at the earliest possible age. A number of initiatives were established for this purpose, including "Logistik Lernen Hamburg". With its portal www.logistiklernen-hamburg.de, this project offers a point of access for schoolchildren, teachers and students who are interested in jobs at the port. The portal presents a range of professions and career profiles, showcases opportunities for training and continuing professional development, and provides resources for teachers.



Junior staff ensure the future viability of the Port of Hamburg.

During the reporting period, the Verein Hamburger Spediteure also played an active role in providing information about professions relating to logistics and the port by attending a number of school events in the greater Hamburg area.

- **Transition from school to work**
 Since 2018, the Logistik-Initiative Hamburg (LIHH) has been organising a flagship project for older school pupils who are making the transition from school to work. This takes the form of a special class called “Logistics Youngsters”. The three-year pilot project is currently running in a ninth-grade class at Stadtteilschule Wilhelmsburg and integrates logistics content into lessons. Ten logistics companies are supporting this project with hands-on opportunities and work experience placements. The LIHH and other partner companies also attend job fairs such as “Einstieg” and “vocationium”, which are aimed at school pupils, or the “Hanseatische Lehrstellenbörse” event. Since 2016, the Verein Hamburger Spediteure has even been organising its own training fair (“Just in Time”) in conjunction with the Federal Employment Agency in Hamburg. The Zentralverband Deutscher Schiffsmakler put on a special tour of the port for school pupils interested in training as shipping agents.

- **Programmes for students who discontinue their courses**
 More and more students are considering discontinuing their studies or have already abandoned their course. Working with numerous partners from the city and the port, Hamburg has established the “shift” initiative – an effective guidance scheme which operates directly at higher-education institutions and helps vacillating students to plan their future and transfer to a suitable vocational training course.

Retaining junior staff: training and continuing professional development at the port

Junior staff ensure the future viability of the Port of Hamburg. Retaining them at firms is just as important as recruiting them. Companies at the port benefit from a very well-developed infrastructure for training and continuing professional development in Hamburg. This includes, for instance, the colleges Berufliche Schule für Spedition, Logistik & Verkehr, Berufliche Schule gewerbliche Logistik und Sicherheit, and the HHLA-Fachschule am Burchardkai. Hamburg is unique throughout Germany in offering a bachelor’s programme in logistics, which provides an innovative combination of vocational training and a business management degree course with a strong practical focus. Students who complete this course receive two qualifications: they graduate as fully trained agents for haul-

age and logistics services and are also awarded a bachelor of arts (BA) in business management.

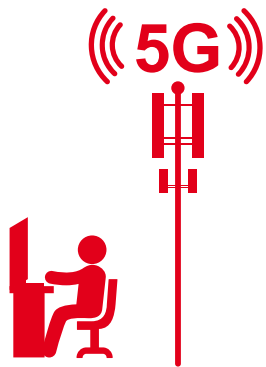
The work of ma-co GmbH is also particularly important for companies at the Port of Hamburg. This non-profit is funded by firms and trade unions at the Port of Hamburg, Bremen and Bremerhaven. One of the primary objectives of ma-co GmbH is to facilitate the continuing professional development of skilled workers at the Port of Hamburg. As part of these activities, it runs seminars on port handling, logistics, maritime shipping, and hazardous goods handling.

A new development programme, “Wir machen den Hamburger Hafen fit”, has recently been launched which is supported by the German Federal Ministry of Labour and Social Affairs and funded by the European Social Fund. The project started in September 2016 and is aimed at all companies which are members of the Unternehmensverband Hafen Hamburg. Its objective is to give small and medium-sized enterprises at the Port of Hamburg the opportunity to deliver new training to their employees.

However, ma-co GmbH also helps job seekers in Hamburg to enter the labour market and highlights ways in which they can gain a vocational qualification.

Idea: study of job quality at the Port of Hamburg

The German Trade Union Confederation (DGB) and its member unions have adopted “Good work” as their guiding principle for the development of the world of work. Since 2007, the DGB has conducted nationwide studies of employees each year, asking them to rate their working conditions. The project group has suggested to the DGB that job quality at the companies based at the Port of Hamburg should be reviewed by an independent institute. It envisages a study which captures data about current working conditions and pay structures – based on details provided by both staff and employers.



One of its projects is “FALOG Hamburg”, which trains job seekers as warehouse logistics specialists. In 2017, ma-co GmbH also started integrating refugees into the labour market at the port. It aims to test and document migrants’ existing practical skills and potential in the field of logistics. As it proved so successful, the project was repeated several times in 2017 and 2018. Five additional courses will start in 2019.

A glimpse of the future: the evolving working world at the port

In the 2017/2018 reporting period, it was clear that the working world at the Port of Hamburg is undergoing extensive change. This development is primarily being driven by the digitalisation of workflows and logistics processes and the automation of operating processes. In the light of this, it seems prudent to revise and reconfigure the specifications for jobs and professions at the port – perhaps as part of an updated “4.0” system of vocational training.

Two recent studies by the Hamburg Chamber of Commerce⁸ and the Institute for Employment Research (IAB)⁹ show what form the change prompted by digitalisation and automation could take.

The studies’ core message is that there is currently no reason to fear job losses. However, the digital reform will bring with it a

fundamental structural shift on the labour market in Hamburg and at the port, which – along with demographic change – will result in a number of radical changes. The impact on different professions varies. Digitalisation will lead to wide-ranging changes, depending on the level of workers’ qualifications, the sector and the field of work.

Assistant jobs in the logistics and transport industry are among the main occupational groups in which the demand for workers is likely to decrease markedly due to rapid digitalisation and automation. The substitution potential has risen by approximately 20 percentage points here and now stands at almost 59 per cent. Almost all tasks relating to the flow of materials and goods in the field of logistics can now be performed fully automatically by robots. However, this effect is not making itself felt yet. As a result, although the substitution potential is currently high, the number of skilled workers has in fact seen an above-average increase due the constant growth in warehouse logistics in recent years.

⁸ https://www.hk24.de/blob/hhik24/produktmarken/interessenvertretung/positionen_stellungnahmen/4083280/ec89a29e2b0ac157a79a4f7886585bc6/Analyse_Handelskammer_Fachkraeftemonitor_Hamburg_2018-data.pdf

⁹ http://doku.iab.de/regional/N/2018/regional_n_0318.pdf

Reducing environmental impact – traffic at the port



Forward-looking port planning aims to make transport infrastructure available to all users on an equal footing and to ensure that the port can be accessed safely and reliably in the best possible way. The ability to adapt continuously to shifting environmental conditions (such as climate change), new digital value chains and requirements associated with the growing city is very important in connection with this. As part of the global supply and logistics chain, the availability of the infrastructure consisting of high-performance multimodal means of transport and an interconnected, central traffic management system is essential.

Moving towards digital, integrated traffic management

Multimodal traffic management supports the objective of speeding up goods transportation sustainably and reducing traffic. For this reason, Hamburg strives to optimally coordinate both land and water traffic – and link them with one another – with the support of digital solutions. Four projects at the Port of Hamburg, which started to bear fruit in the 2017/2018 reporting period, are presented below by way of example.

- *“Fuhre 4.0” – a slot booking process for truck handling:* Trucks continue to play an important role at the interface between land and sea traffic – especially for transportation within the metropolitan region. Until 2017,



they were handled at the terminals without prior registration, which led to lengthy waiting times. The handling processes were only digitalised to a limited extent.

Based on a field study comprising a survey of 14,000 drivers and an analysis of the pre-carriage and onward carriage of up to 10,000 trucks a day, HHLA put in place a raft of measures to speed up truck handling at its container terminals and distribute incoming and outgoing traffic evenly throughout the day and night.

The slot booking process (SBV) was introduced in November 2017. Since then, each truck has been assigned a fixed, pre-bookable timeslot for handling at all of Hamburg’s container terminals. The SBV process applies to the collection and delivery of both full and empty containers. This initiative succeeded in staggering the truck traffic arriving at and departing from the terminals in 2018. Despite the new control system, hauliers say there is still a lack of plannability. Although the terminals stipulate the time frame in which a truck must arrive for handling, the terminals are not always able to comply with these slots.



- *PRISE and NIVE – improved information sharing for shipping traffic:* Ever-larger vessels need to be handled in a shorter space of time, both at the Port of Hamburg and on the River Elbe. Information must be shared between all port users faster to overcome this growing complexity. For this reason, Hamburg has set up the joint information platform PRISE (Port River Information System Elbe), which is overseen by DAKOSY. The system was initiated and funded by HHLA and EUROGATE.

A wide range of data is integrated into the information platform – including details needed for the terminals’ berth planning and booking, status information concerning vessels’ positions on the Elbe, pilots’ ship registration details, and water level forecasts published by the Federal Maritime and Hydrographic Agency (BSH).

PRISE enables arrivals and departures of large container ships to be managed in a more forward-looking way and with greater efficiency. This time-saving approach is particularly good news for customers of the Port of Hamburg. Over the next few years, the aim is to link PRISE with the new Nautischer Informationsverbund Elbe (NIVE) system which is currently under development. NIVE would then be responsible for the information processes with vessels and pilots at the port and on the Lower Elbe.

- *HVCC – coordination centre linking terminal information with details of vessels’ arrivals:* In 2015, the Feeder Logistik Zentrale (FLZ) and the Nautische Terminal Koordination (NTK) came together to form the new Hamburg Vessel Coordination Center (HVCC). Since 2017, the HVCC has been offering terminals and shipping companies at the Port of Hamburg coordination services for arrivals and departures in line with the stipulations of the HPA’s Vessel Traffic Service Centre.

The number of quay operators which use the service provided by the HVCC was successfully increased from ten to 72 in the reporting period. Customers and partners are constantly being integrated into the HVCC’s situation mapping. This enables it to optimise its planning processes and reduce shipping emissions by making arrivals and departures more efficient.

ELBA – new booking system for inland waterway vessels

With the new online portal ELBA, the HPA has created a new, efficient and time-saving booking process for inland waterway vessels at the port. This marks a further digitalisation milestone. Following completion of a pilot phase, the portal has been available for all inland waterway vessels at the Port of Hamburg since June 2018. Around 10,000 inland waterway vessels call at the port each year, all of which are required to formally register their arrival and departure accordingly. Both this and the selection of charges for inland waterway vessels introduced in March 2018 can now be completed entirely online. The portal can be accessed easily from a smartphone, tablet or desktop computer.

Reducing emissions: the impact of port traffic on health and the environment

The project group advocates consistent reductions in emissions of air pollutants, light and noise. Essential steps to improve air quality are set out in the second update of the Clean Air Plan in Hamburg. This was approved by the Hamburg Senate on 30 June 2017. It serves to ensure compliance with the limit for average annual levels of NO₂ as quickly as possible.

72

quay operators use the HVCC’s service to make arrivals and departures more efficient.

10,000

registrations of incoming and outgoing inland waterway vessels have been processed online since June 2018.

In the 2017/2018 reporting period, industry and shipping in the port area were once again responsible for emissions of nitrogen oxides and particulate matter which led to an increase in background pollution in the city. For several years now, the HPA has been producing an emission inventory for various groups of emitters at the Port of Hamburg. It covers the following air pollutants: nitrogen oxides (NO_x), sulphur dioxide (SO₂) and particulate matter (PM₁₀). This data is incorporated into the statistics for the whole of the city (see Figure 1). It

shows that passenger car traffic in Hamburg was responsible for the largest proportion of NO_x emissions at 31 per cent, followed by container shipping at 24 per cent and industry, which made up 23 per cent. The data in Figure 1 stems from various survey years (2014 to 2018); however, it is unlikely there were significant differences during this period.

Since 2013, the HPA has been using a model developed specially for the Port of Hamburg by the Institute of Shipping Economics and

Logistics (Institut für Seeverkehrswirtschaft und Logistik, ISL) to determine emissions of air pollutants and CO₂ in past and future years. This model – known as the Elbe simulation – maps shipping movements at the Port of Hamburg berth by berth, which allows emissions generated by maritime shipping, inland waterway vessels and intra-port traffic to be calculated (see Figure 2). The data in the emission inventory is updated annually if possible and the calculation method is constantly enhanced.

Fig. 1: Causes of NO_x emissions in Hamburg by percentage share

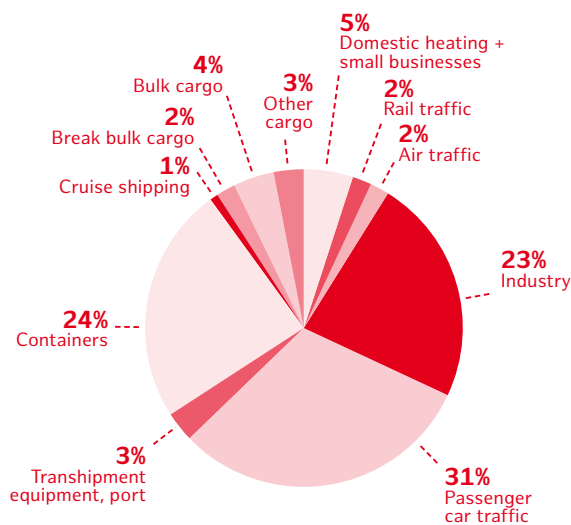
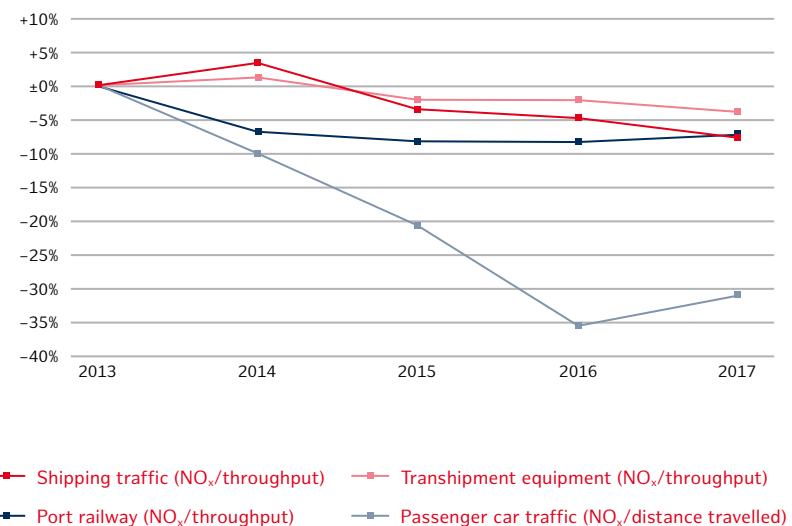


Fig. 2: Development in relative NO_x emissions by traffic at the port (distance travelled in km, throughput = tonnage)



Measures: reducing the impact of ships

Emissions: Container shipping accounts for the majority of arrivals and departures at the Port of Hamburg. As a result, it was responsible for 70.4 per cent of NO_x shipping-related emissions in 2018, while tankers accounted for 10.6 per cent and cruise ships made up 4.1 per cent.

Due to fleet renewals and steps to boost efficiency, total NO_x emissions by container ships at the Port of Hamburg have fallen steadily since 2014 (see Figure 3). For the first time, 18 vessels with Tier III compliance called at the Port of Hamburg in 2018. The slight rise in 2018 was attributable to various factors, including the reduced loading of mega-ships because dry weather made for a low water level in the River Elbe and longer dwell times at the port.

Generally speaking, climate and environmental protection have become a greater priority for the International Maritime Organization (IMO), which is responsible for setting binding standards in maritime shipping. As a consequence, the IMO has put a large number of requirements in place over recent years to reduce vessel-related emissions. For instance, ships around the world will only be allowed to use fuels with a sulphur content of up to 0.5 per cent as of 1 January 2020. The

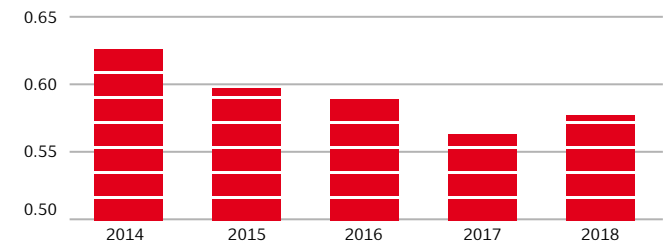
current standard permits fuels containing up to 3.5 per cent sulphur. Implementing this regulation will further improve the ecological footprint of shipping.

Alternative fuels and propulsion: The number of ships in the fleet which can be powered by liquefied natural gas (LNG) is expected to rise. To prepare the Port of Hamburg for the future demand for bunkering, the HPA is currently producing risk analyses for selected berths.

During the period under review, a number of vessels from Flotte Hamburg GmbH tested synthetically produced fuels to great success. The Flotte Hamburg fleet is involved in international research projects such as the development of a seagoing vessel with methanol fuel cell propulsion (HyMethShip) (→ see the “Flotte Hamburg” section).

In order to reduce emissions by inland waterway vessels, there are plans to enable more ships with electric propulsion to use the Port of Hamburg. To achieve this, the existing power supply facilities need to be redimensioned.

Fig. 3: NO_x emissions generated by container shipping at the port in kilograms per TEU



Incentive systems: The Environmental Ship Index (ESI) has established itself as the largest programme of its kind. Since the index was rolled out in 2011, more than 7,000 vessels with a score of more than zero have been registered. That means they exceed the legally required standards.

Over 50 ports – including the Port of Hamburg – are helping to drive these developments forward by means of additional incentives (→ see the “Shipping traffic” section).

Onshore power: Reduced-emission power supply services have been offered at Hamburg's three cruise terminals since 2015 (→ see the "Cruise shipping" section). Concepts are currently being developed for the installation of additional onshore power facilities to supply container ships as well. Steps must be taken to make the use of onshore power attractive. In 2018, Hamburg supported an initiative by the upper house of the German parliament (Bundesrat) to further reduce the cost of onshore power by capping the levy payable under the Renewable Energy Sources Act (EEG) and reducing grid charges, especially at peak times.

Disposal of ship-generated waste and bilge water: Protecting the marine environment is immensely important to the responsible Free and Hanseatic City of Hamburg. The correct disposal of ship-generated waste and cargo residues from seagoing vessels calling at the port is central to its endeavours in this field (www.hamburg.de/marpol). The EU Directive on port reception facilities for waste from ships and cargo residues (last amended on 17 April 2019) and its enactment via the Hamburg Act on Ship-Generated Waste and Cargo Residues (Hamburgisches Gesetz über Schiffsabfälle und Ladungsrückstände) are the key pieces of legislation pertaining to the disposal of waste from seagoing vessels at the Port of Hamburg.

The Directive is based on precautions and prevention along with the "polluter pays" principle. Firstly, this means that the operators of seagoing vessels must bear the cost of unloading and disposing of their ship-generated waste and cargo residues at the Port of Hamburg. Secondly, it requires Hamburg to ensure that an adequate system consisting of stationary and mobile unloading and disposal facilities for ship-generated waste and cargo residues is available sustainably at the Port of Hamburg. A total of twelve firms are currently active in the disposal of ship-generated waste at the Port of Hamburg. The Ministry for the Environment and Energy (BUE) has signed long-term disposal agreements with these service providers.

Oily residues and mixtures made up a considerable proportion of the waste volume at the Port of Hamburg, accounting for 45,000 cubic metres in 2017 and 41,000 cubic metres in 2018. Solid waste – such as rubbish similar to domestic waste – stood at 12,000 cubic metres in 2017 and 14,000 cubic metres in 2018. It is striking that the amount of ship-generated waste similar to domestic rubbish which is disposed of correctly onshore in Hamburg has almost doubled since 2012. A further rise in these volumes of waste is to be anticipated due to ongoing growth in the cruise sector.

Measures: reducing the impact of road traffic

Trucks are the main mode of transport for goods bound for the metropolitan region. It is notable that local hauliers have a very modern fleet: over 83 per cent of diesel vehicles meet Euro 5 and 6 standards. This is because most forwarding companies lease trucks which are less than three years old.

Between 2013 and 2018, road traffic emissions at the port saw the sharpest overall decrease of just under 25 per cent. The substantial initial reductions had to be recalculated in 2017 following a reassessment prompted by the revelation of diesel manipulations. Emissions rose slightly year on year again in 2017 due to a change in the method used.

Much like in shipping, progressive forwarding companies are increasingly using alternative fuels and drive technologies. An internal survey of members of the Verein Hamburger Spediteure (VHSp) in 2018 showed that 35 per cent can imagine using hydrogen to power their trucks, 28 per cent can envisage using liquefied natural gas (LNG) and 25 per cent can imagine running electric trucks. The hauliers believe that the port's infrastructure for alternative fuel filling stations requires expanding.

83%

of diesel vehicles used by local hauliers comply with the **Euro 5 and 6** standards.

-25%

NO_x emissions caused by road traffic at the port

The first LNG filling station at the Port of Hamburg opened in 2018. There are plans to extend the filling station network for LNG within the port area over the coming years. The port has a hydrogen filling station in Aluminiumstraße.

Modal shift: A substantial proportion of emissions generated by truck traffic is caused by intra-port transfer movements and empty trips. In the period under review, a total of 61 per cent of intra-port traffic crossed the Köhlbrand. Meanwhile, the highest volume of traffic at the port – 945,000 TEU per annum per truck – was recorded in the Waltershof/Dradenau area (→ see the “Land traffic” section). With this in mind, the operators and companies at the port aim to shift a greater proportion of intra-port traffic onto the water – ideally using inland waterway vessels and pushed barge trains. In the period from 2013 to 2018, the firms Container-Transport-Dienst GmbH and the Eckelmann Group reduced road traffic by growing their volume of waterborne transport from 60,000 TEU in 2013 to 108,200 TEU in 2018. This accounted for a 6 per cent share of intra-port transfer. However, increasing these figures is dependent on creating more favourable business conditions – such as a minimum volume per trip, a suitable route for groupage transport, effective congestion planning for barges and free time slots at the terminals.

108,200

TEU less on the road thanks to internal waterborne transfer

Measures: reducing the impact of rail traffic

The port railway increased its throughput by almost 10 per cent between 2013 and 2017. Relative emissions were reduced by 7 per cent. This is testament to the port railway’s efficiency improvements, achieved by optimising shunting movements, which currently account for up to 95 per cent of emissions. The system of charges for infrastructure usage – known as INES – is an important set of incentives for the reduction of emissions. It enables the port railway to encourage efficient infrastructure usage and the use of modern vehicles which emit less noise and fewer harmful emissions (→ see the “Rail traffic” section).

Measures: reducing the impact of terminal traffic

Transshipment: Emissions generated by transshipment equipment developed broadly in line with those caused by shipping traffic. Between 2013 and 2017, absolute emissions fell by 6 per cent.



Noise generated by terminal traffic: Because the city and the port are so close to one another, a number of residential areas in Hamburg are affected by noise emissions caused by terminal operations or ship movements on the Elbe. One of the areas affected by noise is Övelgönne. Founded in 1998, the Neumühlen/Övelgönne committee on port noise enables residents of the riverside suburb to discuss ship noise issues with the HPA, the BUE (emissions control and waste management) and HHLA, and to work together to find solutions. In the 2017/2018 reporting period, the HPA organised twice-yearly meetings of the committee. As well as moderating these meetings, the HPA gave the attendees progress reports on the latest noise studies and technical projects with the potential to reduce noise. The economically viable measures agreed to date include insulating metal boxes, electrifying cranes and fork-lift trucks, and raising workers’ awareness of noise by means of training courses.



Planning together – the city and the port

The Port of Hamburg is one of the largest city ports in the world. Its location in the heart of the city and the centre of the metropolitan region make it an integral part of Hamburg's culture and history. However, operating the port also presents specific challenges for the city. These encompass the port's effects on the surrounding neighbourhoods along with space and land-use planning.

Conflicts of aims at the interface between the port and the city

As part of its urban development, Hamburg is striving to bring living and working closer together while simultaneously maintaining the city as a base for industry. To achieve both objectives, it is necessary to take fresh approaches to conflict reduction and resolution so as to ensure that home building, high standards of environmental protection and security of corporate investments continue to be promoted in equal measure. One focus area is that of striking a balance when conflicts of aims arise in the field of emissions control.

For instance, there are currently 37 establishments in Hamburg's port area where dangerous substances may be present. To gauge the consequences of a major accident

at one of these sites, six safety reports were produced at the port in 2018 as part of the Hamburg project on home building and establishments where dangerous substances may be present. Additional reports are currently being compiled in connection with other infrastructure projects. The aim of the project is to identify conflicts between establishments where dangerous substances may be present and infrastructure considered worthy of protection (such as residential areas or major transport routes) and develop solutions.

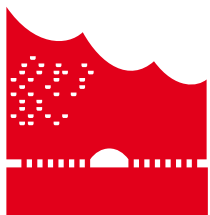
In 2016, IBA Hamburg GmbH also completed an expert report on the ambient odour situation in several project areas – the neighbourhoods surrounding the city hall, the Elbinsel and the Spreehafen. This identified relative odour-hour frequencies exceeding the limit of 0.10 stipulated in the German Odour Emissions Guideline (GIRL) for residential and mixed-use areas. The BUE considers it necessary to draw up a concept for the medium to long-term reduction of unpleasant odours to ensure that healthy living and working conditions are taken into account when development plans are produced.

The companies which operate at the port believe it is important for the economic and technical viability of both siting regulations and emission limits to be examined. Industrial companies based there should be actively integrated into planning for the city as a whole – without risking their existence or their development.

With this in mind, the project group advocates viewing these challenges as an opportunity. The aim must be to continue to enable urban development in Hamburg at sites which are deemed suitable under planning legislation, without restricting the attractiveness and functionality of the port as an existing business hub.

Hamburg city port: space for innovation

If this balancing act succeeds, there is the potential to develop innovative use concepts for the port and residential building in Hamburg which could serve as a blueprint for other ports in Europe and around the world. The project group believes that this could be facilitated, for example, by a city-port laboratory enabling companies, public authorities, associations, organisations, residents, city planners and environmental conservationists to actively contribute their views.



The HPA tries to develop port areas in the most forward-looking and efficient way possible. This includes making use of the current concept of economic entities and regional areas at the port. At the heart of this concept is a property master plan ("Immo-plan"). In the future, this should show how optimum use can be made of areas at the port and contribute towards better managing investments and ideally linking different uses with one another via the economic entities (→ see the "Space-use strategy" section).

Two concrete projects in the 2017/2018 reporting period illustrated how space development at the port could take shape while taking into account wide-ranging interests pertaining to city and port planning and the associated expectations.



- **Kleiner Grasbrook/Überseezentrum:** The Kleiner Grasbrook area is earmarked for urban development. This project represents a further development of the Hafencity district to the East and enables it to spread to the other side of the Northern Elbe. The Hamburg Senate plans to develop a new neighbourhood on this site encompassing residential development, green spaces and office/commercial space.

To ensure that port operations and urban development are compatible, a letter of intent (LOI) was signed on 1 August 2017 concerning the further development of the former Überseezentrum site and the adjacent areas for commercial, port-related use. This letter of intent is an agreement between the UVHH, the Industry Association of Hamburg (IVH) and the Hamburg Senate. At its heart is a commitment to balance urban development and port-related use in such a way as to ensure that the port companies based in Kleiner Grasbrook can remain there long-term.

- **Steinwerder Süd and westward expansion:** Port development projects (→ see the "Space-use strategy" section)

The port as an integral part of the city's culture

The Port of Hamburg is a fixed part of the city's identity. According to a study conducted as part of the EU INTERREG project "TIDE" by Prof. Beate Ratter from the Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research (HZG),¹⁰ 68 per cent of Hamburg residents associate the Elbe with shipping and the port. This shows that Hamburg and its port are closely linked in the public's eyes. The project group views this acceptance of the port as an important locational advantage.

However, the Port of Hamburg cannot take this acceptance for granted. Prof. Ratter's study also showed that people in the local region increasingly associate the port and the River Elbe with conflicts of use between conservation, recreation and shipping. If the port is to remain embedded in the city's culture and enjoy social acceptance over the long term, the project group believes it is important to raise public awareness of work and business operations at the port. The aim should be to present the port as a lively, dynamic place which creates values for the city.

68%

of Hamburg residents associate the Elbe with shipping and the port.

¹⁰ <https://www.forum-tideelbe.de/files/download/die-elbe-aus-sicht-ihrer-anwohner-vortrag-prof-dr-ratter.pdf>

Climate protection and conservation at the port



The Port of Hamburg is a hub for business and industry and a link in global supply and transport chains. However, it is also part of the tidal Elbe habitat, which covers a variety of conservation and recreation areas. This coexistence of nature and the port resulted in a wide range of climate protection and conservation activities in the period under review, but it also engendered discernible conflicts of aims.

For instance, the Special Report by the Intergovernmental Panel on Climate Change (IPCC) highlighted the urgent need to reduce CO₂ emissions completely to zero by 2050 at the latest. Limiting global warming to a maximum of 1.5 °C requires everyone to take action, including the Port of Hamburg, which therefore needs a concept for achieving carbon neutrality. This includes generating economic growth which has a reduced environmental footprint and does not give rise to any additional ecological impacts.

In the reporting period, steps taken by project group members alone succeeded in saving approximately 100,000 tonnes of CO₂. It is not yet possible to reliably calculate the level of CO₂ emissions originating at the Port of Hamburg. The project group

suggests capturing this data in a validated form in the future and making it available on a platform where it can be accessed in a transparent fashion.

Cooperation for environmental and climate protection in Hamburg: the contribution made by companies at the port

A large number of companies at the port are involved in the city's UmweltPartnerschaft and Luftgütepartnerschaft alliances and became climate partners in 2018.

- 25 per cent of UVHH member companies have signed up to the UmweltPartnerschaft. Members of this environmental partnership at the Port of Hamburg include port handling firms such as EURO-GATE, HHLA, UNIKAI (warehousing and haulage company), various importers and the HPA itself. Shipping companies and a large number of partners from the raw materials industry who are based in the port area are also active in the UmweltPartnerschaft scheme. In recent years, these firms have invested in energy efficiency, CHP plants, renewables (wind power in the port area) and eco-friendly mobility.

- 64 IVH member companies have already made a commitment to the environment as UmweltPartner.

Climate protection and resource preservation at the port

The project group advocates developing further measures to make meaningful improvements to energy and resource efficiency at the Port of Hamburg. These steps make an important contribution towards achieving the climate targets in Hamburg.

A large number of firms at the port have also set themselves the goal of using energy as efficiently as possible and choosing renewables wherever possible. In 2016, the UVHH determined that individual companies saved around 60 megawatt-hours per annum, thereby avoiding emissions of 76,000 tonnes of CO₂ each year by proactively improving efficiency.

Additionally, the Industry Association of Hamburg has overseen the founding of four energy efficiency networks since 2015. The Hamburg industry network succeeded in saving a total of 75,000 tonnes of CO₂ by the end of 2018 alone. Under the patronage of Senator for the Environment Jens Kerstan, this network has been extended for a further term.

Approx.

100,000

tonnes of CO₂ were saved in the reporting period via action taken by project group members alone.



Altogether, the IVH's four energy efficiency networks have set themselves the target of saving almost 500,000 tonnes of CO₂. A number of IVH member firms which have joined the energy efficiency networks are based at the port. They are: ADM Hamburg AG, ArcelorMittal Hamburg GmbH, Aurubis AG, H&R Ölwerke Schindler GmbH, HHLA Hamburger Hafen und Logistik AG, HOLBORN Europa Raffinerie GmbH, Nynas GmbH & Co. KG (refinery), Sasol Wax GmbH, TRIMET Aluminium SE and Vattenfall Wärme Hamburg GmbH.

Like many organisations, the HPA has a climate strategy, which it adopted in 2011. The latest update specifies climate protection targets and describes initial steps to assess the opportunities and risks presented by the consequences of climate change. In this context, the HPA has taken various steps, including expanding wind power at the port. An in-depth assessment of potential new locations for wind turbines identified four suitable sites for concrete wind projects. There are currently 14 turbines with an installed output of 42 megawatts at the port.

The port as a habitat: practical conservation

Building projects and other infrastructure investments by the HPA inevitably involve vegetation structures and stretches of water which are home to various animals and plants. Particular attention is paid to the wide range of pioneer habitats at the port, such as dry grasslands. These biotopes are considered to warrant special protection. Measures to mitigate the impact on habitats are usually implemented outside of the port. Since the Eco-Account Directive (Öko-konto-Verordnung) was enacted in 2012, the HPA has made use of the option of using precautionary mitigation measures and restoring land to its natural state. Means of enhancing such sites in Hamburg and the surrounding area are developed by conservation experts initially without a connection to concrete demand. During the period under review, the BUE and Niedersächsische Landesforste – which manages Lower Saxony's state forests – implemented a number of renaturalisation measures on behalf of the HPA.

■ *Kirchwerder Wiesen:* Kirchwerder Wiesen is a conservation area in the Bergedorf district of south-east Hamburg. Rare species of birds which need damp, open areas of lowland use this as a habitat. The ditches criss-crossing the ancient

farmland, which is now primarily used as pasture, are also home to many rare underwater and floating plants. The HPA has funded work to restore 16.2 hectares of land in Kirchwerder Wiesen to its natural state as part of its mitigation efforts.

■ *Alter Moorburger Hafen:* In 2016, the HPA started work to restore an area of land on the old, disused port site to its natural state in order to provide a habitat for Elbe water dropwort – a strictly protected species of plant which only lives by the tidal Elbe. This area should serve as a stepping stone between sites where the plant already grows. The Alter Moorburger Hafen has now been restored to its natural state. A three-year survey of the plants found that major losses were experienced every winter, but fruit-bearing specimens of Elbe water dropwort were present in each year of the study. The plant is therefore reproducing successfully at the Alter Moorburger Hafen site. In the light of this, the plant's colonisation should be viewed as a success.

■ *Kreetsand shallow water zone and pilot projects for revetment greening:*
→ see the "Waterways" section

Various threatened species on the Red List were once again found at the Port of Hamburg in the 2017/2018 reporting period. Several mapping projects reached corresponding findings. In such cases, the HPA carefully tried to resettle threatened species, such as fish, insects and birds, or to adapt its construction projects to the needs of these species.

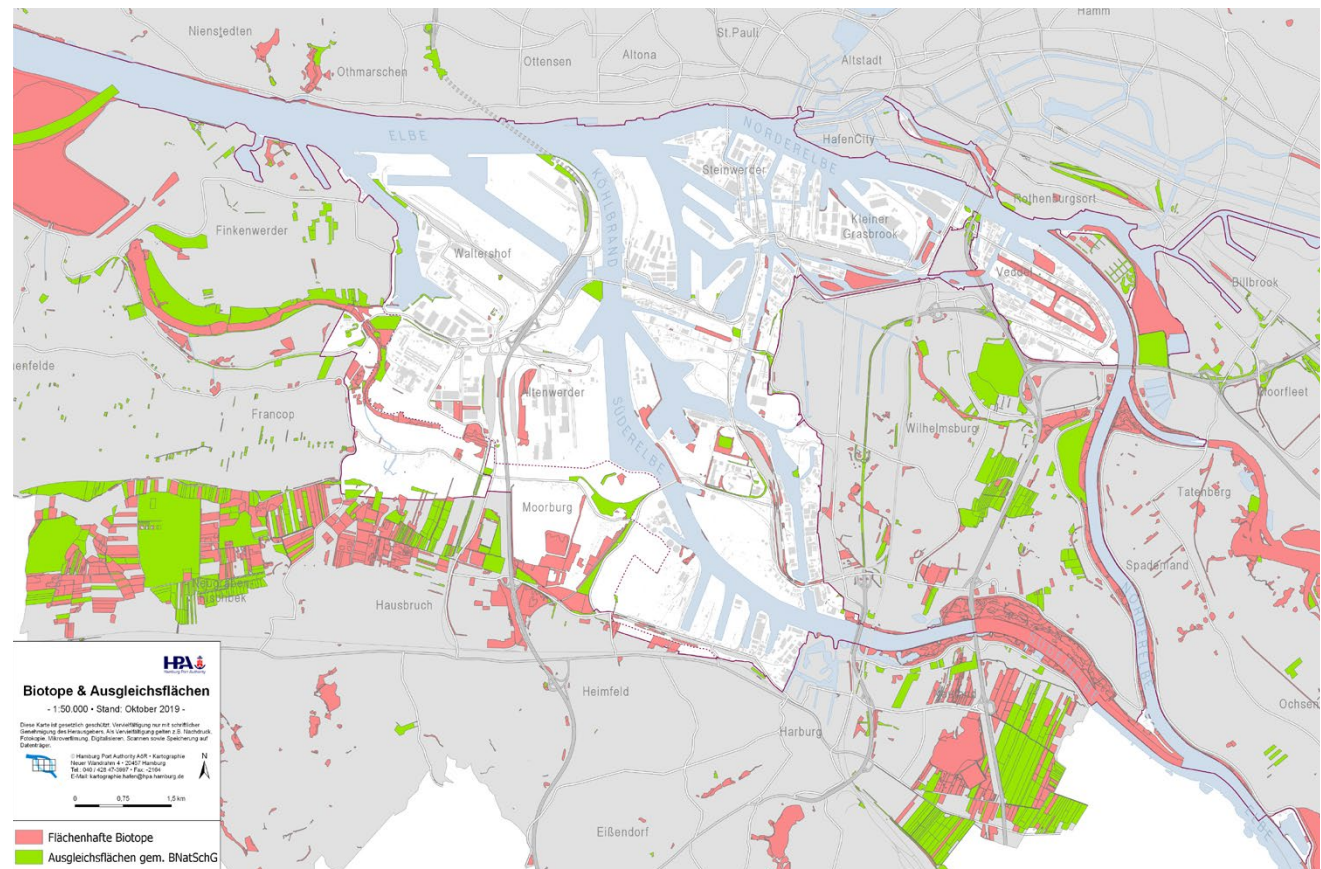
Biotope network: the biotope network also encompasses the port

By changing its Landscape Programme, Hamburg has paved the way to make an interstate network of interlinked biotopes a reality. The required sites and development targets for establishing the biotope network have been incorporated into the Landscape Programme following a resolution by Hamburg City Parliament. With this move, the Hamburg Senate delivered on a pledge made in the coalition agreement to establish a network of interconnected biotopes to safeguard and link the habitats of rare species in Hamburg (see Figure 1).

The sites earmarked in the Landscape Programme for the biotope network also include land within the Port of Hamburg which warrants protection – such as the biotope network encompassing the Moorgürtel and Alte Süderelbe/Westerweiden conservation areas. During the period under review, it became clear just how complex it is to

balance use of the port with the protection of natural sites. The HPA plans to develop the Altenwerder West area – a 45-hectare site near the Alte Süderelbe (Altenwerder) – for commercial use. The conservation organisations NABU and BUND have filed an appeal against the Altenwerder West port planning regulation adopted for this purpose because they believe the proposals jeopardise the site’s ecologically valuable willow stands.

Fig. 1: Biotopes and mitigation sites (for larger view → see section “Facts and figures”)



Our contribution to the SDGs

The project group acknowledges the SDGs and endorses the principles of the World Ports Sustainability Program (WPSP).



Moving towards a sustainable future at the Port of Hamburg

Sustainable development is seen as a competitive factor which can give rise to a substantial advantage for the Port of Hamburg and the city. The project group has jointly agreed on important strategic goals (tenets) concerning the identification of material issues and areas of action. These centre on making a contribution towards developing the port in line with a strong economic, social and ecological ethos.



Goods and value creation – doing business at the Port of Hamburg

The Port of Hamburg creates lasting value at multiple different levels. Key among these is its economic benefit. As Germany’s largest universal port, Hamburg has a policy of diversification. The range of industries represented and the handling facilities for all types of cargo lend stability to the complex port system. Consistently strengthening the local cargo volume – for instance by attracting more manufacturing companies and industry – could make adaptive port space development a success factor.



Quality and attractiveness – working at the port

Good working conditions, intercultural openness and a healthy, safe working environment are critical success factors in the competition for skilled workers and in efforts to enhance the attractiveness of sectors and professions. The project group’s shared objective is to ensure that the Port of Hamburg continues to provide high-quality, attractive jobs in the future by upholding a good social partnership.



Reducing environmental impact – traffic at the port

Forward-looking port planning aims to make transport infrastructure available to all users on an equal footing and to ensure that the port can be accessed safely and reliably in the best possible way. Hamburg strives to further enhance optimal coordination of both land and water traffic – and link them with one another – with the support of digital solutions. The project group advocates consistent reductions in emissions of air pollutants, light and noise.



Planning together – the city and the port

As part of its urban development, Hamburg is striving to bring living and working closer together while simultaneously maintaining the city as a base for industry. The aim must be to continue to enable urban development in Hamburg, without restricting the attractiveness and functionality of the port as an existing business hub.



Climate protection and conservation at the port

Limiting global warming to a maximum of 1.5 °C requires everyone to take action, including the Port of Hamburg, which therefore needs a concept for achieving carbon neutrality. This includes generating economic growth which has a reduced environmental footprint and does not give rise to any additional negative impacts.

A photograph of a ship's deck. The hull is painted red, and the upper part is dark grey. A white metal railing runs along the edge of the deck. A wooden ladder with rope rungs is attached to the hull. In the foreground, a white structure, possibly part of a crane or hoist, is visible. The sky is overcast.

02

**Port is what
the HPA does**



Digitally and reliably connected into the future

Digitalisation is no longer a vision of the future, it has now become an integral part of daily life. It has made its way into the private, professional and political spheres and is resulting in new forms of interaction. Communication not only among people, but also between humans and machines in a digital, networked world (for example with the Internet of Things [IoT]) is being changed by new media, artificial intelligence and technologies that work at an incredible pace and which have a far-reaching impact on living environments and day-to-day work. Digitalisation will change not only business models, but also business fields, supply chains and value chains. One of the greatest challenges will be to make this transformation environmentally and climate-friendly as well as socially responsible.

Because of this, thinking in terms of scenarios is becoming increasingly important for the HPA, as it has to assume that there is a wide array of different development paths. It is easier to identify these paths than it is to forecast what impact they will have. Considering the digital transformation trends, there are opportunities to be generated and risks to be avoided. Since 2012, the HPA has been making intelligent use

of IT and innovative technological solutions to develop digital approaches and projects (Industry 4.0) with the aim of improving the reliability and safety of port logistics business processes and of boosting efficiency in terms of both energy and infrastructure usage and traffic and property management. This so-called smartPORT philosophy is being further developed all the time.

Success hinges among other things on there being secure and available physical and virtual communication and data networks which can resist cyber attacks and which run with a high degree of failure safety and the appropriate redundancies. Resilient IT infrastructures and communication networks are therefore crucial for the provision of information for productive workflows, an uninterrupted data flow and reliable availability for everyone involved.

Digitalisation offers potential especially in terms of the connectivity of port players in the areas of the maritime and logistics industries. Their requirements are focused in particular on supply chain visibility.

Making responsible and future-oriented use of digitalisation

Digitalisation changes stakeholders' demand behaviour as well as their expectations of the HPA. The executive position of Chief Digital Officer (CDO) was foresightedly created in 2016. In the first half of 2017, the CDO developed a digitalisation strategy highlighting how digital product strategies could be devised with the various departments in addition to the implementation of traditional IT processes. Three of the focal areas are:

1. Corporate responsibility: the focus here is on customer benefits and on the HPA exploiting business opportunities
2. Innovations as part of the smartPORT philosophy
3. The HPA's global responsibility as a port operator and as part of the global supply chain

The smartPORT programme is the centralised management of innovative projects across all of the HPA's divisions.

Internal and port logistics processes are to be monitored and measures are to be identified on the basis of various megatrends such as the Internet of Things (interconnected and intelligent sensor technology, for example), digital device networking and workflow automation. The HPA's digital strategy is being continuously further developed together with higher education institutions and universities, companies, start-ups and innovation hubs. These partnerships boost project completion levels.

Project examples:

Augmented reality (AR) and virtual reality (VR)

The pilot project "Virtuelle und erweiterte Realität (VR/AR) für Hafenanwendung" (Virtual and Augmented Reality [VR/AR] for Port Use) tested the technical implementation of VR/AR in the area of construction in order to improve stakeholder communication. As a result, building stages can be planned and realised virtually on the basis of building information modelling (BIM).

Building information modelling (BIM)

BIM virtually maps out a building project's entire life cycle, from drafting and planning a building to its construction and use and even through to its demolition. BIM gives everyone involved access to virtual plans, process management, extensive databases and 3D to 5D building models. It is a centralised digital engineering method designed to gradually pool all the relevant building data from throughout a project life cycle within an intelligent building model (= digital twin). In other words, it is the digitalisation of the HPA's core business.

Connected autonomous underwater vehicles (AUVs)

Together with the Hamburg University of Technology (TUHH) and other partners, autonomous underwater vehicles are being developed as part of the Robotic Vessels as a Service (RoboVaaS) project which can see to automated environmental monitoring tasks on demand. These include water quality analysis and inspecting quay walls, dams and locks, as well as providing assistance in the event of a disaster such as shipping accidents or flooding. Additionally, innovative business services can be established that, for example, scan a container ship's hull while it is being unloaded in order to identify and subsequently rectify any defects.

CyberPort: the cyber-physical port of the future

With the assistance of the HPA, the Institute smartPORT at the Hamburg University of Technology (TUHH) is conducting research into improving the efficiency and safety of port areas. It is investigating aspects of miniature, low-power sensing and actuating devices regarding energy supply from the environment (solar, wind, water flow, vibrations) as well as low-power network protocols and control algorithms for a reliable access to the devices and a steady data flow.

smartPORT monitor and port traffic centre:

→ see the "Shipping traffic" section

smartBridge: → see the "Infrastructure/Land traffic" section

Smart Area Parking and Green4TransPORT:

→ see the "Land traffic" section

Digitalisation Day – informing and raising awareness among the employees

Digitalisation Day was first held in November 2018. Its aim was to introduce the employees to digital solutions and technologies which were already being used by the HPA or which offered huge potential for future use. Under the motto of "Hands-on digitalisation", the employees were able to observe and try out various technologies at a total of twelve stands, much like at a trade fair. With around 150 participants, the first Digitalisation Day was very well received and the day has now been set as an annual event.

Future-proof communication networks

Internal cloud technologies and fibre-optic networks are continuously being optimised and cooperation with European cloud service providers is being expanded. The solutions are based on a scalable, resource-conserving and resilient IT infrastructure. The HPA's own fibre-optic network covers a distance of more than 300 kilometres and in the interests of failure safety has a ring structure. It therefore boasts almost 100 per cent availability. All the relevant processes including the stored data are integrated into two fully redundant data centres.

5G

testbed in the port area measuring 8,000 hectares

High IT standards are applied to protect the intellectual property of the HPA and of its customers from theft, loss, unauthorised disclosure, unlawful access or misuse. No tally is currently kept of the cyber attacks averted. Greater detailing is to be achieved in the future with the creation of a security operations centre (SOC).

5G – the port area as a test site

The future of mobile communication is called 5G. This gigantic network was officially tested in the Hanseatic city of Hamburg with the 5G Mobile Network Architecture (5G-MoNArch) research project funded by the European Commission as part of its Horizon 2020 framework programme. A transmitter attached to Hamburg’s TV tower at a height of 150 metres covers the 8,000-hectare test site within the port area.

The 5G Smart Sea Port testbed project consortium consists of Nokia, Deutsche Telekom, Samsung and the HPA.

5G offers mobile connectivity at a level of reliability, security and speed which was not possible with earlier generations of mobile telecommunications networks and which allows for entirely new fields of application and service. 5G is up to ten times faster than LTE with a maximum bandwidth of 10 gigabits per second. Because of this and also with the introduction of isolated virtual networks – so-called network slices – 5G

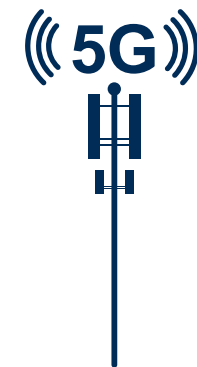
is able to handle the extensive demands of the Smart Sea Port. The network slices can be flexibly and dynamically adapted to changing requirements or new applications, allowing the communication infrastructure to be brought into line with new business requirements quickly. The Port of Hamburg is testing the implementation and realisation of 5G and network slicing in a real operating environment in order to gather practical experience of the capabilities of this new communication system and then make the most of the opportunities this offers to improve the port’s operations and processes. The applications implemented focus on the improvement of traffic and infrastructure control.

Exploiting the opportunities offered by digitalisation for a networked port

The HPA has set its sights on turning the Port of Hamburg into one of the world’s smartest ports by 2030 with its smartPORT projects. Digitalisation will serve as a key instrument here for innovations and business opportunities. The expansion of sensor technology and the evaluation of data allow for the early detection of the infrastructure’s critical loads. The IT-based networking of the physical infrastructure with data regarding the weather, water levels or construction sites will allow for optimised traffic flow management and an accelerated flow of goods as a networked data flow and intelligent IT solutions enable

all the players to make more efficient use of the infrastructure. This significantly reduces emissions, saves time and boosts profitability.

The implementation of hotspots, cloud computing and 5G will allow traffic flows at strategically relevant sites within the port to be logged automatically, meaning users can be provided with traffic information such as bottlenecks, closures and bridge openings as well as details about available parking spaces, all in real time. The aim is to perfectly coordinate the management of all means of transport, from containers to road and rail traffic.





03

Infrastructure and
traffic management



Value creation and environmental responsibility within the space-use strategy

The HPA has set itself the goal of sustainably developing the port and of exploiting and strengthening the success factors related to its location in order to safeguard its future. Innovative and intelligent usage and settlement concepts are needed precisely because of the limited space available (land and water), various usage conflicts and competition for space as the city continues to expand and due to the impact that the port activities have on people and the environment.

Infrastructure configuration and space-use intensity are influenced by the megatrends of urbanisation, climate change and digitalisation. Climate-related resource shortages and the decision taken to phase out coal mining are forcing tenants and port players to make their business models and lines of business more flexible and more adaptable.

With the port being the region's biggest employer, its social added value for the people in the city is highly significant. Mutual acceptance and the joint reduction of disruptions, including on the periphery of the port, are two of a number of factors which will be crucial to the port's future development. One of the success factors will be the coordinated reconciliation of interests related to the sensitive and increasingly permeable interface between the city and the port. In this regard, joint solution models could be developed with regard to housing development, which is drawing

ever closer, and the impacts of port-related goods shipment and cargo handling activities such as noise, light and emissions. This approach prevents potential usage restrictions and space devaluation as well as competitive disadvantages for the companies based there.

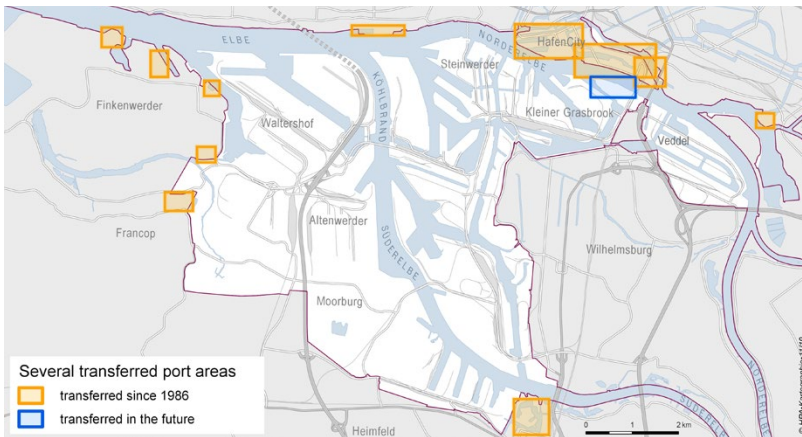
With a universal port in mind, the HPA is pursuing a market-driven and customer-oriented space-use strategy that takes profitability and value creation into account. For the port to grow healthily on both a national and international scale and boost its economic significance for Hamburg, the aim is for land and water as resources to be used very carefully and consciously.

The Port of Hamburg is at the heart of a city with urban development which is drawing ever closer to the Elbe and therefore also to the port as its maritime industrial space; the port has already ceded more than 325 hectares of space since 1986. Because of this and in view of the finite space which is available in the city state of Hamburg, the HPA as the owner of the majority of port space is absolutely focusing its activities on intensifying the use of the space available within the port. This forward-looking and proactive approach is contributing to an increase in rental revenues and means the HPA is still able to make offers when enquiries are made about space for new companies to set up on or for existing businesses' expansion.

7,083
hectares of port area



Fig. 1: Port space released in 2019



Changes are intermittently made to the geography of the port area. Space is transferred from the port expansion area to the dedicated port area, while existing space is also released from the port area. In 2017, for example, a further approximately 22 hectares near the Baaken dock were released from the dedicated port area for urban development use in the HafenCity development.

The port area currently comprises 7,083 hectares. This consists of the dedicated port area and space which is reserved for possible future port development (port expansion area). The ratio of water to land space is 40 to 60.

Hamburg’s dedicated port area contains approximately 3,250 hectares of land. Setting aside the land under private ownership and the land used for infrastructure, flood control, green space and the HPA’s own facilities, there remain approximately 1,945 hectares of lettable land.

The lettable HPA land is used as follows: around 190 hectares are currently not let, approximately 164 hectares of which due to redevelopment requirements that cannot currently be financed, restructuring/renovation preparatory measures and current marketing or planning matters, for example due to westward expansion or soil interim storage at Kuhwerder. It therefore has a utilisation factor of a good 90 per cent. Fallow land which is unsurfaced and with

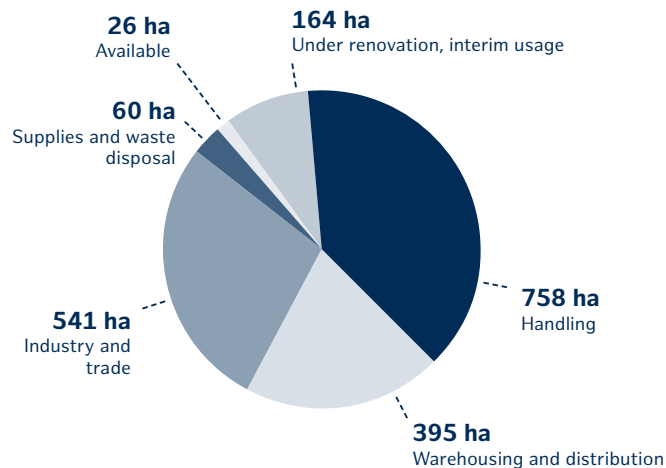
no superstructures is often sites that have not yet been put to use by the tenants or owners.

The water space available for maritime cargo handling totals 2,839 hectares. Productivity is to be increased without any additional water space being used.

Efficient space management boosts profitability

The HPA is pursuing a business settlement strategy that features sustainable space allocation criteria for Hamburg as a universal port. This focuses in particular on systematically boosting local cargo volumes and maintaining sector diversity, among other things by stepping up the local settlement of manufacturing companies and industry and by focusing on high value creation and work-intensive sectors. The diversification that this entails reduces economic vulnerability and generates additional stability. Adaptive port space development takes into account the consequences of climate change in order to limit usage interruptions/restrictions (→ see section on the port).

Fig. 2: Space utilisation (lettable HPA space: approx. 1,945 ha)



The crucial aspects
when it comes
to space allocation
are the rent, the
contribution made to
value added and
the strategic benefit
for the port.

Space allocation criteria oriented on sustainability

Large, economically attractive plots of land are usually let on the basis of transparent, non-discriminatory and Europe-wide bidding processes. The aspects crucial to the HPA when it comes to space allocation are the rent, the contribution made to value added and the strategic benefit for the port. Other criteria are additionally taken into account such as the number of jobs created both directly and indirectly, the additional traffic volume and the tenant's commitment to environmental and climate protection. The HPA thus selects its tenants on the basis of a stipulated set of sustainability criteria. The lease agreements require the tenants to grass or plant 10 per cent of the leased space. In 2017 and 2018, space was let to eight companies from the sectors urban logistics (2 hectares), logistics and warehousing (0.5 hectares), empty container storage and repair (7 hectares), port vehicle parking and container business, service repairs in the area of maritime industry (4.4 hectares) and building material handling.

Effective strategic management of space development

The HPA initiated development of the concept of economic entities and regional areas and began to implement this concept with its property master plan. The aim of the property master plan is to determine the optimum future use of port space at the economic entity level and to therefore

serve as a guide for space efficiency, investments, revenues, and management and maintenance costs. Over the long term, space potential is to be leveraged for new users, investments are to be managed based on needs, revenues are to be increased and costs optimised.

Planning on the basis of economic entities and regional areas

Implementation of the strategic concept of economic entities and regional areas is essential for a future-oriented port policy. This assigns specific development focuses to different port areas. The primary strategic goals for the regional areas are maritime accessibility and water depths and also dynamic and structural engineering limitations. Investments and business settlement are based on the sectors assigned to an area and focus on port-compatible industry. Efficiency is then increased in the long term because of more intensive usage – vertical growth, dual use – as an increasing number of tenants with similar space and infrastructure needs can be settled within a port area (for example, the use of car parks at Cruise Center Steinwerder when no cruise ships are scheduled to dock → see the “Cruise shipping” section). This process simultaneously provides the basis for the master plan that prioritises the more in-depth analysis of specific port areas. Feasibility studies are used to precisely identify restructuring potential and measures.

The modal shift aimed at increasing freight traffic by rail and ship and relieve the roads remains an important goal, in particular with regard to the settlement of traffic-heavy businesses. Priority is to be given here to sites with bi- and trimodal traffic connection options.

Balancing economic, social and environmental sustainability

In view of the space limitations and the urban development parameters, the HPA's port development is inward-looking. If new space is needed, the dedicated port area either has to be expanded on its peripheries or older port areas have to be restructured if they no longer live up to the requirements of modern port logistics. At the same time, it is Hamburg's declared objective to conserve nature and to keep the loss of water space within the port area to a minimum (→ see the “Waterway infrastructure” section). This is a conflict of goals that the HPA has to handle responsibly: our actions are based on the efficient use of land and water as valuable resources.

If we adhere to the principles of sustainability, the environmental impacts of our actions as a result of space usage remain within view too. For example, we already focus on avoiding or at least minimising harmful environmental impacts at the project planning stage. Adverse impacts which are unavoidable due to the nature of a project are offset. Own space within the port and also space outside of the port is used for this (→ see section on the port). We are especially careful with how we use the port's water space, because losing this worsens the hydrological conditions and ultimately hampers water depth maintenance, as the result tends to be greater sedimentation in other areas of the port.

We also act responsibly with regard to biodiversity: if especially protected or strictly protected species are involved, species protection legislation must be observed. The aim is to enhance the importance of species which are worthy of protection as well as their functions within the ecosystem (→ see section on the port for more measures).

Dialogue on urban development and port expansion

The topic of space development has an important social dimension too: 740 residents of the Moorburg neighbourhood have been affected by port area development plans since Hamburg's Port Development Act entered into force in 1982, and there has been no urban development in the village since then. The Moorburg Discussion Group was then created in 1998. Together with various Hamburg authorities and organisations, the HPA promotes dialogue with the residents regarding life in Moorburg and the plans for the port expansion area through this discussion group.

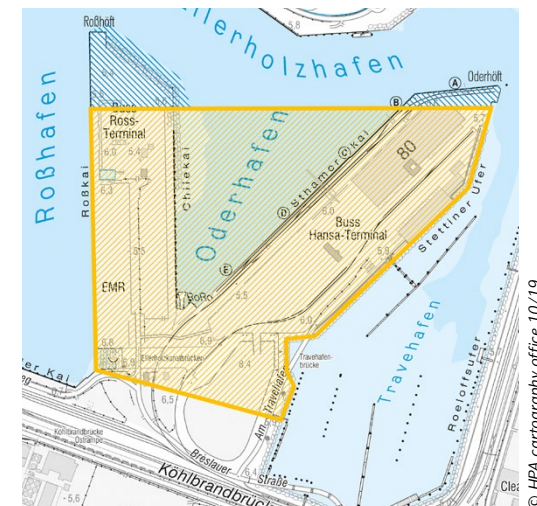
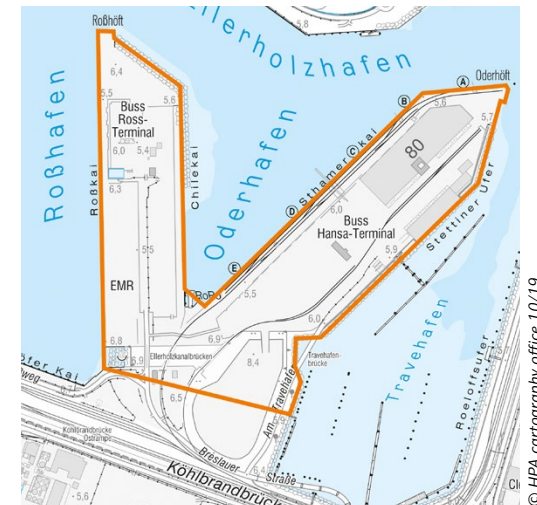
Port development projects

Westward expansion: The westward expansion project of EUROGATE Container Terminal Hamburg (CTH) comprises expansion of the existing CTH following fundamental restructuring of the space at the petroleum terminal. The plan is to boost capacity by 2 million TEU at the approximately 38-hectare terminal and to create berths for two container mega-ships and a feeder vessel (quay wall length of approximately 1,050 metres). To guarantee mega-ships safe docking conditions, the existing turning circle is to be increased from 480 metres to 600 metres. While approximately 13 hectares of water will be backfilled, around 7.5 hectares of the headland will be removed – the measure will therefore result in an approximately 5.5-hectare reduction in water space.

Planning permission for the project (applied for jointly by the HPA and EUROGATE) was granted in November 2016, after which a complaint was lodged with Hamburg Administrative Court.

Steinwerder Süd: The HPA resolved to resource-efficiently revitalise the Hansa Terminal and Ross Terminal sites in the Steinwerder neighbourhood, which are in need of renovation and are partially also derelict, in a multi-stage process. The preparatory work will involve the creation of an efficient and flexible space structure measuring approximately 33 hectares and featuring quayside embankments. The port space newly created by this boundary realignment measure will be devised and structurally engineered in such a way that it can be developed for the various port usages that are currently anticipated based on concrete market demand at the time of completion. Its usage will be determined in 2020. The loss of 2 hectares of water space will be offset outside of the port area.

Fig. 3: Project-based changes in the land and water space (inventory above, planned changes below)



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© HPA cartography office 10/19

Dyke height brought into line with

8.10 m

above sea level

Strategically embedded public and private flood control

With its low-lying marshland in the Elbe river's bifurcation area, much of Hamburg is at risk of flooding in the event of a storm surge. More than 325,000 people live in this area and valuable goods and freight are stored there too. Protection from flooding and storm surges is therefore indispensable for Hamburg and is a sustainability priority.

The port area is protected by both public and private flood controls (polders).

In the area of flood control, the HPA is officially responsible for approximately 26 kilometres of the public main dyke line within the port and also serves as the overarching port authority responsible for dyke and polder supervision. The HPA is also responsible for the planning, drafting, execution, maintenance and operation of special flood control structures: three locks, four barrages, pumping stations and floodgates.

As the owner and lessor of port space, the HPA also engages in flood control in accordance with private law and is involved in or heads 16 private polder communities. The HPA guarantees long-term preservation on the basis of a sustainable maintenance concept. The aim of maintaining the polders and modifying them in accordance with future design flood levels along a dyke length of 97 kilometres is to guarantee flood control for the entire port area, avert risks and keep port operations running as

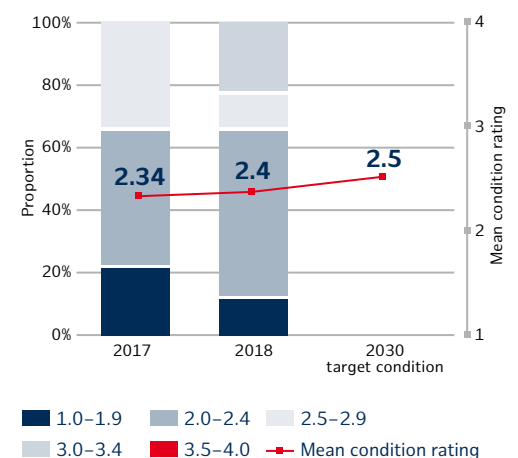
smoothly as possible even during storm surges. The new, 80-centimetre higher design flood level will be taken into account gradually during any relevant measures and in the course of the necessary creation or replacement of private polders.

The plan is for the dyke lines of the public flood protection systems to have been brought into line with the new design flood level of 8.10 metres above sea level (Hamburg-St. Pauli as the reference level) by 2042. A climate-based addition of 20 centimetres and a reserve of 60 centimetres have also been factored in.

The maintenance plans are based on the city's principles of preservation management. The aim is to have a safe and functioning public infrastructure. The guidelines set out a systematic approach that guarantees value retention and aims to extend the useful life. There are regular inspections throughout the life cycle, taking into account aspects such as the degree of wear, weathering, age, material and load. The target is for everything to be in "good condition", as represented by a mean condition rating of between 2 and 2.4 (German system of school marks). The aim is to keep the number of facilities with a condition rating of 3.5 to 4 that are at risk of failure to an absolute minimum. The HPA determines the classification of the special structures for public flood control on an annual basis, thereby effecting regular modernisation of the relevant structures. The adaptability

that this allows for and the consideration of future climate changes guarantee the high resilience and the high availability of the facilities. The mean target condition rating for 2030 is 2.5 because it can be assumed that the condition of certain structures will deteriorate due to old age.

Fig. 4: Development in the condition of barrages and locks (public flood protection systems)



An efficient infrastructure and effective traffic management

250

million euros invested in the future viability and resilience of the traffic infrastructure

An efficiently run port is founded first and foremost on a resilient infrastructure. With the help of smart management, this should be geared to allow all the stakeholders access to it and for optimum traffic flows within the port. The focus of the activities here is therefore on the one hand on the preservation, maintenance and operability of the infrastructure and, on the other, on efficient and flexible traffic management. This is the case for all the relevant modes of transport, be it water, rail or road.

Making the infrastructure resilient and sustainable

A modern and functioning infrastructure is crucial to Hamburg as the heart of a growing metropolitan region with strong national and international appeal. The reliable availability of this infrastructure and guaranteed port accessibility are ensured on the basis of forward-looking port planning. The vision is for the Port of Hamburg to be accessible at all times.

The HPA made targeted investments of over 250 million euros in the future viability and resilience of the traffic infrastructure within the Port of Hamburg during the reporting period. All three dimensions of sustainability are equally important, as the infrastructure does not only have to be able to adapt to changing climate and environmental conditions – it also has to be in a position to respond to changing digital value creation and logistics processes as well as to new work and residential needs within a port city.

Giving efficient traffic management the right of way

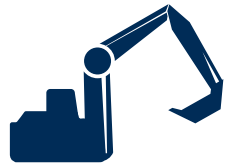
The interruption-free handling of traffic is incredibly important to the Port of Hamburg as a shipping, rail transport and truck transport hub. The more efficiently the existing infrastructure can be used, the lower the traffic-related emissions and the less additional infrastructure needs to be created anew as the traffic volumes increase. This reduces the port's space utilisation and boosts the HPA's profitability thanks to lower investment needs.

In addition to efficiency, the appeal and competitiveness of the individual modes of transport also depend on high operating quality, as manifested first and foremost in punctuality, plannability and reliability. The HPA's overarching objective is ongoing improvement in traffic flow management. It achieves this with an interruption-free and reliable traffic flow to accelerate goods transportation and by switching to environmentally friendly means of transport such as rail and inland waterway.

Intermodal management

With the HPA's smartPORT project Port Traffic Monitor (→ see the "Digitalisation" section), there are additionally plans to network port traffic forms even more efficiently and to link them up with movable infrastructure such as locks and bridges as well as to data on water and wind levels. This will entail what are currently four separate control centres – the Vessel Traffic Service Centre for shipping, the rail control centre, the Port Road Management Center for road traffic and a control centre for movable infrastructure – being merged to create one single traffic management system. The IT architectures of the current control centres are already structured such that future integration of this kind will be possible.

Using and expanding waterways sustainably



The HPA is responsible for the development and maintenance of the section of the federal waterway delegated by the federal government to Hamburg and also of the port waterways belonging to the state of Hamburg (approaches, turning circles, harbour basins). It provides the shipping industry and the associated maritime industry with a reliable infrastructure based on the industries' needs. This is key to the port being competitive and future-proof.

Ever-changing parameters require the infrastructure to be incredibly adaptable to, for example, ever larger and wider vessels, water level and current conditions and the consequences of climate change. Within the bounds of what is currently possible, the customers' need for high infrastructure availability coupled with low waiting and dwell times for efficient goods handling is optimally met.

25 years. Even so, the possibilities of storing and making good use of the materials dredged during maintenance are factually still limited due to the pollution which is typical for the Elbe river. Endeavours on the part of the river basin community within the whole of the Elbe catchment area will be needed to achieve future improvements.

Goal:

Comprehensive sediment management across administrative borders

The Port of Hamburg is a tidal seaport in which ecological passability has been maintained. It is located within the Elbe river's bifurcation area where the current slows due to the greater width, resulting in the port's increasing sedimentation. The amount of sedimentation is dependent on a large number of natural influences and, in particular, on what flows down from the upper Elbe catchment area: the less it rains there, the greater the volume of sediment that settles in the Port of Hamburg. As with all tidal ports, the waterways and berths therefore have to be kept suitably deep for the port's customers by means of regular dredging.

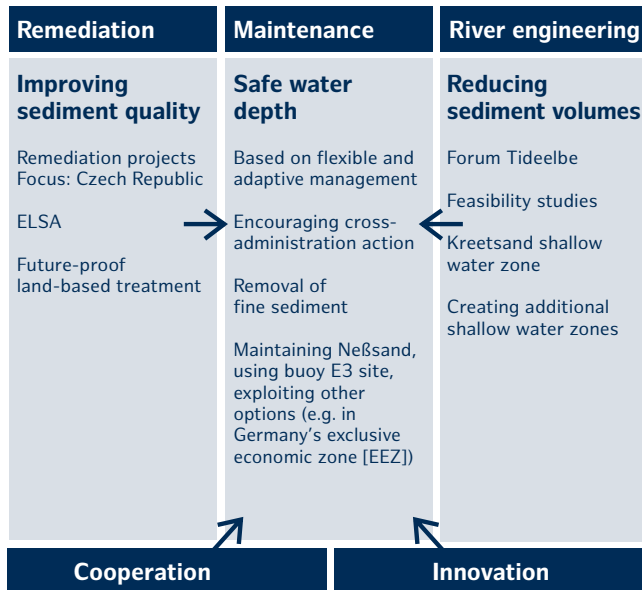
Joint ongoing development of sediment management strategies

The development and maintenance of quay-side infrastructure have to take into account the possible effects that a habitat characterised by complex hydromorphological conditions will have on the environment and nature. Successful sediment management consequently has to consider all the key influencing factors.

The HPA's Elbe remediation activities within its jurisdiction and the sustainable development of the Elbe estuary by means of river engineering measures that can have a positive influence on tidal dynamics are to be judged with comprehensive sediment management in mind. The HPA also champions the cleaning up of contamination sources outside of Hamburg's city limits in the Upper Elbe catchment area and supports the Elbe sediment pollutant remediation project Schadstoffsanierung Elbsedimente (ELSA) to this end. Both approaches serve to improve the ecological state of the tidal Elbe and therefore have a positive influence on maintenance.

Water depth maintenance is influenced by two factors: the quantity of sediment to be dredged and the sediment's quality. While the quantity can fluctuate greatly due to natural constraints which are difficult to influence, the quality of the sediment has improved considerably over the past

Fig. 1: Sediment management fields of activity for the Port of Hamburg



For many years, the HPA has been cooperating closely with Germany's Federal Waterways and Shipping Administration (WSV) and the neighbouring federal states on the development and realisation of comprehensive tidal Elbe sediment management that extends across administrative borders. This calls for an overall view of the natural processes within the tidal Elbe and beyond. Other focuses include sediment quality improvement and the promotion of river engineering measures such as the creation of shallow water zones. This should reduce the volume of dredged materials in the future and improve sediment quality.

Sediment quality improvement (Elbe remediation) is ecologically prudent and increases the scope of what can be done with sediment and how it can be used (a balance between areas with excess sediment and those with a sediment deficit):

- Cross-administration, flexible and adaptive maintenance that follows the principle that objective quality alone is what matters is suitable for breaking through sediment cycles in the short term, thereby generally reducing dredging volumes and conserving resources.
- River engineering measures such as the creation of shallow water zones lend themselves well to the long-term improvement of hydromorphological conditions

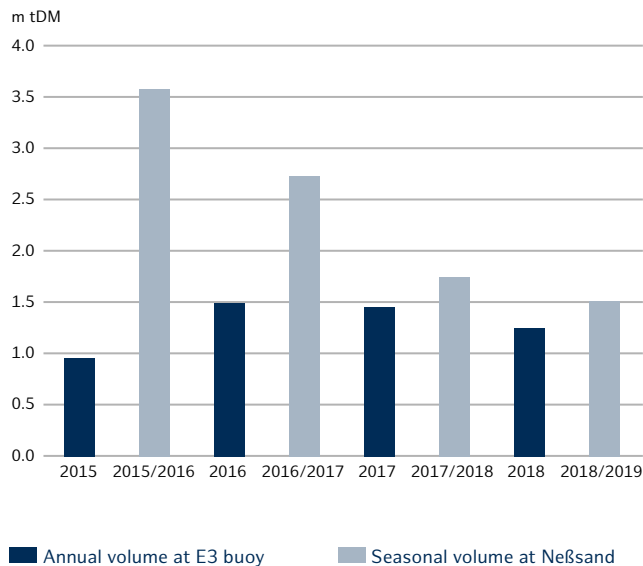
and to reducing sediment volumes in synergy with nature and water protection goals.

The challenge for Hamburg is that the solutions (remediation, relocation to ebb stream-dominated areas) cannot be effected within Hamburg's jurisdiction alone. Hamburg is therefore reliant on the support of all the states/countries through which the Elbe runs as well as of the federal government and is focusing on dialogue with all the interest groups, while also looking into legal requirements in relation to, for example, Water Framework Directive implementation shortcomings in the Upper Elbe catchment area. A detailed concept is to be presented in 2020 together with the WSV regarding the implementation of jointly optimised maintenance across administrative borders.

Efficient and transparent management

The development and maintenance of water-side infrastructure within the port area are managed centrally and efficiently by the HPA. This allows for the necessary linking of the operating activities such as the sounding, dredging, storage and treatment of contaminated sediment with long-term strategic tasks such as Elbe remediation and river engineering. Requirements and work are scheduled in close dialogue with the customers and the HPA's Harbour Master's Office, which is responsible for swift and smooth traffic processing and for all nautical matters.

Fig. 2: Neßsand volume development



Environmental monitoring: All the affected port zones are thoroughly tested and analysed before there is any sediment deposition. Sediment may only be deposited if it is clean enough. A comprehensive monitoring programme at the E3 buoy deposit site with more than 300 analyses per field campaign ensures that the environmental impacts are monitored incredibly closely and are accompanied by measures with the aim of creating an early recognition mechanism.

The stakeholders are involved by means of customer events, targeted civic information, topic-specific working groups and major engagement processes such as Forum Tideelbe (Tidal Elbe Forum). The HPA wishes to provide information transparently and engage in open dialogue between equals by means of wide-ranging public relations work via websites, explanatory videos, brochures, newsletters, articles and expert presentations.

Water depth maintenance and the depositing of dredged materials

In April 2016, the state of Schleswig-Holstein granted its approval for a total of 5 million tonnes of dry matter (tDM) sediment (a maximum of 1.5 million tDM a year) to be taken to the silt deposit site at the E3 buoy in the North Sea. This arrangement is expected to be extended in October 2019. The depositing of sediment at the E3 buoy site is subject to strict requirements. The fact that a systematic discharge strategy is needed in the interests of everyone and is sustainable is demonstrated by how the volumes have developed at the Neßsand river island: the depositing of sediment at the E3 buoy in the North Sea has resulted in the volumes relocated to Neßsand being more than halved in a matter of years.

The relocation of dredged materials to Hamburg territory (at Neßsand) is limited to the winter months (November to March). This takes into account nature and water protection requirements (such as fish spawning seasons and low oxygen levels in the water during warmer months) based on an action plan drawn up together with Hamburg’s Ministry for the Environment and Energy (BUE).

Climate change impacts: The effects of climate change will make water depth maintenance in Hamburg more difficult. The forecast rise in sea levels will further intensify the

dominant flood tide and therefore also the tidal pumping effect (in other words, the transportation of sediment upstream). A lower low tide also means fewer areas with sufficient water depth for use berthing ships. More frequent storms mean an increase in the remobilisation of sediment in the North Sea/in the Elbe estuary, with the sediment being transported in the direction of the port by the flood tide, where it then needs to be dredged. An increase in dry periods in the Elbe catchment area reduces freshwater flow, which likewise increases sedimentation and makes maintenance in Hamburg more difficult. Extreme occurrences such as flooding in the Upper and Middle Elbe can transport contaminated sediment from these regions to the port and can further impede sediment management, for example when values recommended by existing permits are exceeded.

Additionally, a rise in the temperature can lead to more frequent anoxia situations, which then prevent maintenance measures from being implemented due to environmental protection reasons. Changes in the environmental conditions could result in a change in species composition, which would entail more stringent nature conservation requirements being introduced. The pillars of sediment management outlined above take these scenarios into account and, if implemented accordingly, are suitable for counteracting these developments. Sediment management is especially important at a time when sea levels are rising as it can contribute to surplus sediment being used in the future to offset coastal sediment deficits caused by climate change. Here too, the efficient implementation of remediation measures within the Elbe catchment area would be a significant step in the right direction.

4 tonnes

of heavy metals permanently extracted from the waterway system

Making material flows resource-friendly

These days, the majority of sediment can be relocated or deposited within the waterways. More heavily contaminated old sediment is processed and disposed of on land at the METHA treatment facility and on drainage fields. Disposal encompasses both the use and removal of waste. If required, the sand accumulated during maintenance can be put to use to reduce the need for external resources, for example in construction work. This takes the strain off the existing waste disposal capacities for contaminated dredged materials. Its utilisation rate should continue to be kept as high as possible while taking into account the use of resources this necessitates. If necessary, port areas with more heavily contaminated old sediment should be dredged in such a

way that fresh sediment can be relocated within the waters during subsequent dredging. On the one hand, this allows tidal volumes which were lost due to silting up and also environmentally valuable shallow water zones to be restored, including above and beyond the direct nautical needs and, on the other, land-based waste disposal capacities (space) and lengthy treatment (energy) to be saved.

Around 1.5 million and approximately 1.25 million tDM were discharged into the North Sea in 2017 and 2018 respectively. A systematically high level of discharge allowed the volumes relocated to Neßsand to be further reduced: while 2.7 million tDM were relocated during the 2016/17 relocation season (November to March), this figure was reduced by approximately 1 million tonnes in 2017/2018. This volume of dry matter was further reduced by approximately 0.2 million tonnes in 2018/2019. Hamburg has permanently extracted more than 4 tonnes of heavy metals from the waterway system since the METHA land-based treatment facility was created.

Utilisation rate: Approximately 226,500 tDM and around 203,020 tDM were treated and disposed off on land in 2017 and 2018 respectively. The utilisation rates were 67 per cent and 64 per cent respectively. This rate is dependent upon the HPA's internal utilisation opportunities. METHA silt, which has good sealing properties, was used at the HPA's Francop and Feld-

hofe mono dumps to create sealing layers, while METHA sand was used for the construction of drainage layers. Other forms of utilisation are to be developed in order to take the strain off waste disposal capacities in the long term.

Waterside sediment transport: Water depth maintenance is of fundamental interest to the port and is therefore an indispensable responsibility of the HPA. The HPA is giving increasing consideration to climate protection and resource efficiency when transporting dredged volumes and when applying its chosen dredging techniques. Its aim is to reduce the emissions caused. Different levels of air pollutants and carbon emissions are caused depending on the fuel used, the transportation distance and the transport weight. Dredging equipment is hired on the basis of Europe-wide tender procedures coupled with a bonus-malus system which already rewards efficient dredging, thereby serving as an incentive for the resource-efficient use of the equipment. In this context, the HPA assumes responsibility within the supply chain and reached an agreement with the contractors in 2016 to make transportation energy consumption transparent.

Fig. 3: Sediment deposition paths and volumes in 2018



The data available since 2017 confirms that transparency is both important and necessary. Sediment transport accounts for around two thirds of the HPA's entire energy consumption.

A rating system will be developed in the future that will allow emission-reducing components to already be taken into account during the tender procedure without improperly limiting competition.

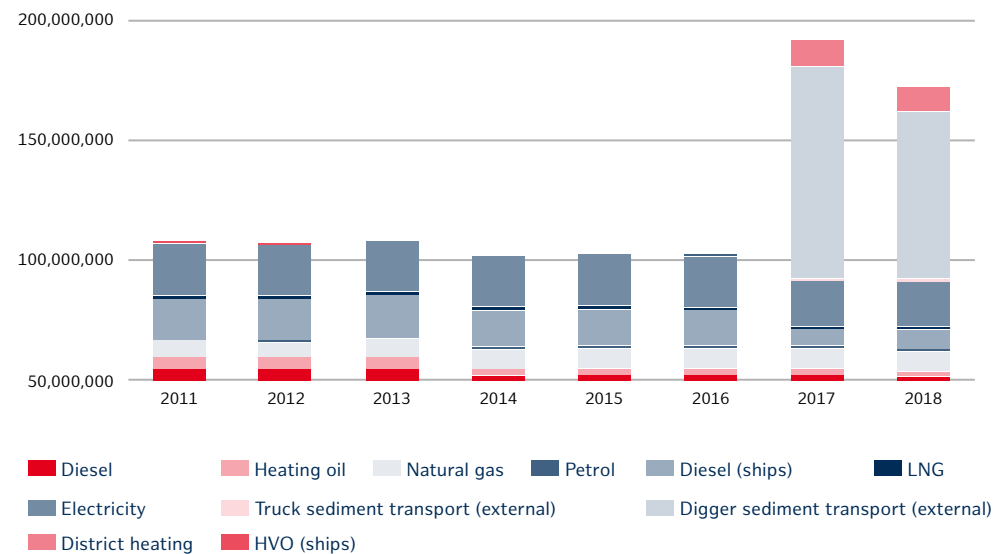
Projects:

Lower and Outer Elbe navigation channel adjustment

The adjustment of the Lower and Outer Elbe navigation channel that began in 2019 is incredibly urgent considering the capacity increases which have already occurred in global container shipping and the related nautical challenges of navigating the tidal Elbe. Growing draught problems mean the container mega-ships currently in use are increasingly having to put up with cargo reductions and/or waiting times. The project is therefore to be completed within 36 months by autumn 2021. To offer the shipping industry some initial nautical improvements as early as possible, the dredging work will get under way with the so-called passing box, a section of the Elbe navigation channel between Wedel and Blankenese which will be widened to 385 metres to significantly improve the simultaneous passing of especially wide container ships and bulk carriers. Construction of the passing box will modify the routing of the navigation channel, resulting in the old Blankenese leading light line having to be replaced.

Based on extensive planning and with the broad involvement of the stakeholders, the project has been developed in such a way that hydrological and ecological changes have been largely kept to a minimum.

Fig. 4: Energy consumption of the HPA in kilowatt-hours



Affording the river more space

Changes in the water space and the concomitant loss of tidal volumes are increasingly the focus of political and societal attention and are detrimental to many processes within the tidal Elbe, not least water depth maintenance. This is because the loss of tidal volumes goes hand in hand with accentuation of the hydromorphological conditions, resulting in increased upstream sediment transport into the Port of Hamburg. However, port development and urban development plans repeatedly call for a reduction in water space and tidal volumes at the local level.

90

measures to improve the condition of the tidal Elbe

The HPA is therefore counteracting this elsewhere with the creation of the Kreetsand tidal shallow water zone and with the Billwerder Island measure, resulting in the creation of approximately 30 hectares of tidal water space by 2021. Kreetsand alone will generate tidal volumes of approximately 1 million cubic metres. The creation of additional shallow water zones and tidal capacity is currently being discussed and their implementation being examined within Forum Tideelbe in cooperation with the stakeholders and the administrators of the states bordering the Elbe. Within its own jurisdiction, the HPA has so far successfully pursued the goal of having a positive or at least balanced ratio of water space to land space. This approach is also heavily backed by the Elbe Habitat Foundation, which the HPA supports. The foundation has already initiated or executed more than 90 measures designed to improve the ecological condition of the tidal Elbe.

Upon completion, the area should evolve into a very precious habitat which will be protected together with the Auenlandschaft Norderelbe nature reserve. For example, the shallow water zone serves as a place of refuge for a variety of fish, while its banks offer optimum conditions for the Elbe water dropwort, which is found nowhere else in the world.

Pilot projects for revetment greening

Ten EConcrete tide pools made of bioactive concrete are to be incorporated into the riprap revetments within the tidal zone in 2019/20. The first five will be incorporated during current bank remediation work along the Bubendey bank of the main Elbe channel, followed by five along the Gent bank at Finkenwerder outer harbour. Each pool measures 1.2 x 1.2 x 0.7 metres and they are arranged in such a way that they fall dry for a certain period when the tidal water level drops. The surface of the pools is highly structured and porous and is made of special concrete, the composition of which has so far demonstrated excellent colonisation potential for flora and fauna, in particular in marine water environments. The company EConcrete currently lacks experience in fresh water environments. The colonisation success will be tracked by means of a multi-year monitoring programme.

Another pilot project is testing the use of pre-planted mats along Elbe embankment areas affected by shipping and the tides. This involves a chamber revetment (netting) filled with armour stones first being put in place within the tidal zone at the Gent bank during bank remediation work, after which ready-grown plant mats will be firmly attached to these elements. The ready-grown plants should then firmly bond with

the substrate over the summer. Three different plant schemes are planned depending on tidal conditions ranging from 1 metre below sea level to approximately 5.30 metres above sea level and also on the time during which the plants are submersed in water. The plants likely to be used include grassweed, rushes, reeds and bulrushes. Here, too, the plants' growing success and ability to survive the substrate, tidal and wave conditions will be tracked by means of multi-year monitoring.





Efficient and careful shipping traffic management

Reliable and straightforward shipping traffic is essential for uninterrupted and punctual goods handling. The key to efficient shipping traffic management lies in the precise coordination of all the parties that have a bearing on how long a ship remains within the port. These include handling companies, tugboat companies, Elbe and harbour pilots, moorers and shipbrokers.

Traffic on the Elbe is diverse, comprising seagoing vessels, inland waterway vessels and traditional ships as well as sports and harbour vessels. With approximately 19,000 seagoing and inland waterway vessels putting into harbour, the Vessel Traffic Service Centre faces an immense traffic flow management challenge, in particular in view of the dynamic limitations. These include ship size developments (→ see section on the port), varying water levels, the Köhlbrand Bridge's clearance and also current, draught and weather factors.

The challenges faced currently also include the construction work planned for adjustment of the navigation channel, which began in summer 2019. For safety reasons, a speed limit is being introduced throughout

the Port of Hamburg, with its observance monitored by the Vessel Traffic Service Centre.

Digitally managing uninterrupted traffic flows

The HPA is legally responsible for water-side traffic flow management in all of the Elbe arms and harbour basins as well as within the waterways connected to these between a line that crosses the Elbe at Oortkaten and Hamburg's state boundary that runs across the Elbe from Tinsdal to Cranz. There is also close coordination with the waterway and shipping authorities all the way from the Elbe estuary down to Lauenburg.

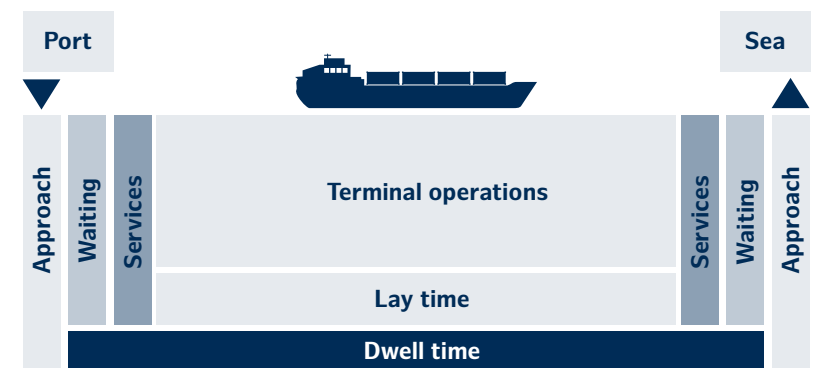
Traffic flows within the Port of Hamburg are managed by the Vessel Traffic Service Centre, which is one of the most state-of-the-art traffic control centres in the world. Here, control centre software developed specifically for the Port of Hamburg – the mobile PortMonitor – is used. All the data relevant to management is incorporated into this in real time, such as ship, tide and weather data, the current water depths, information about berths, bridge heights and widths, and up-to-date details of construction sites or dives.

As part of the preventive fulfilment of duties, the aim is to identify disruptions early on and take forward-looking action. Nautical calling conditions such as wind restrictions and simultaneous passing bans have to be taken into account in traffic flow management, as do dangerous goods transport, customs and clearance matters, port handling and waste disposal from and supplies to seagoing vessels. A port information guide developed together with other ports is available to give port customers a better overview of traffic management.

21%

increase in the number of port calls made by mega-ships between 2015 and 2018.

Fig. 1: Aspects influencing congestion and waiting times



The Vessel Traffic Service Centre is assisted by the Hamburg Vessel Coordination Center (HVCC), the private coordination point for mega-ship, feeder ship and inland waterway vessel traffic (→ see chapter “The Port of Hamburg”).

Safe approach and calling conditions for mega-ships

The shipping companies MSC, CMA CGM and HMM notified the HPA that ships in a new 22,000–23,000 TEU class would be going into operation from July 2019. This is a class of container ships with a cargo capacity of 22,000–23,000 TEU. It can be assumed that these ships will be processed at the Container Terminal Burchardkai (CTB) and the EUROGATE Container Terminal Hamburg at Waltershofer Hafen/Parkhafen, and also at the Container Terminal Tollerort (CTT) within the outer harbour. As this class of ship has not yet called at the Port of Hamburg, simulations are to be used to determine whether the port calling conditions for the largest container ships that currently call at the Port of Hamburg can be applied to this class of ship too. The simulations will work through manoeuvring strategies to consider the tidal and wind conditions under which these ships can approach and depart safely.

In view of an approximately 18 per cent increase in the number of port calls made by mega-ships between 2012 and 2017, it became necessary for the two berths at

the Finkenwerder pilings to be renovated to allow the latest generations of ships to likewise moor there safely and in any weather on occasions when, for example, the berth at the terminal cannot be called at, the berth needs to be vacated for other approaching mega-ships or technical problems mean a mega-ship needs an alternative berth. The waiting berths at the Finkenwerder pilings are scheduled for completion at the end of 2019.

Following completion of the turning circle within the Northern Elbe waterway, it has been possible since 2018 for mega-ships to be safely cleared at the Container Terminal Tollerort. The ease and safety of port traffic flow management will increase considerably once the passing box has been completed (→ see the “Waterways” section).

Following demolition of the old Rethe Bridge and the peripheral facilities, there will be an even greater width available to shipping traffic from 2020 (64 metres instead of 44); the height limitations for passing will also be eliminated.

Financial incentives for low-emission vessels

In 2012, Hamburg incorporated the Environmental Ship Index (ESI), an initiative of the International Association of Ports and Harbors (IAPH), into its port dues as an incentivising scheme and to reward low-emission vessels. Since then, the number of ships

calling at the port that have more than 20 ESI points has risen from 543 to 2,225, which suggests there has been global ship fleet renewal. For 2018, this equated to 26.5 per cent of all calls at the port. There was a threefold increase in the number of port calls made by especially low-emission ships with more than 50 ESI points. A considerable proportion of these is attributable to the *AIDAperla* (53.3 points), which called at the port multiple times.

In 2017, the HPA was the first port in the world to incorporate an additional environmental component for nitrogen oxide (NO_x) into its port dues.

Transparent information for inland waterway transport

The HPA wishes to improve the Port of Hamburg’s connections with the inland waterway network by digitalising information, communication and navigation processes. Among other things, this entails the transparent presentation of the infrastructural information which is relevant to safe travel to and within the port. Up-to-date traffic information regarding construction sites and closures, Elbe water levels, and berth and waiting berth occupancy is to be shared with the public in a user-friendly way in the future. The Port of Hamburg’s smartPORT concept will therefore breathe new life into inland waterway vessels as a mode of transport too.

Tab. 1: Number of calls at the Port of Hamburg made by ships with ESI classification

ESI classification	Number of calls 2017	Number of calls 2018
20 < 25	409	365
25 < 35	748	828
35 < 50	688	922
≥ 50	37	110
Total	1,882	2,225

Ships of up to

23,000 TEU

cargo capacity can be cleared in Hamburg.



Flotte Hamburg: added value for the city under a single flag

Flotte Hamburg commenced work in July 2017. The company was founded in accordance with a resolution of the Senate of Hamburg. In 2016, the Senate commissioned the HPA with consolidating the fleets of the HPA, the fire department, the water police and the Hamburg State Office for Roads, Bridges and Water Bodies (LSBG) into an overarching municipal fleet management company.

This division's key responsibility is to generate synergies by means of overarching fleet management. Ships can be serviced, repaired and newly procured in a standardised manner. Intelligent pooling ensures that the vessels are used cost-effectively and to their optimum capacity.

To guarantee that the division's activities are as independent and as business-minded as possible, the HPA established the fleet management division as a wholly owned subsidiary with the business form GmbH & Co. KG. Flotte Hamburg refinances its costs by means of long-term charter rates which remain stable for the customers. Flotte Hamburg has reported a positive operating result since being founded.

Vessels: a programme of gradual modernisation

Flotte Hamburg's municipal fleet consisted of 46 vessels at the end of 2018. The majority of these are inland waterway vessels with very different functions ranging from firefighting and police boats to testing and sounding vessels, transport vessels and icebreakers. The fleet also operates dredgers, a barge-mounted slurry elevator station and 40 barges. The fleet management challenge lies in the fact that the vessels vary in terms of their technical condition due to the different ages and years of service. Flotte Hamburg has therefore decided to systematically modernise the fleet of municipal vessels by updating the existing vessels and introducing new replacement vessels.

Flotte Hamburg put three new vessels into service in the reporting period:

- Icebreaker *Hugo Lentz* (2017)
- Icebreaker *Johannes Dalmann* (2017)
- LB 40 firefighting boat *Branddirektor Westphal* (2018)

An important criterion for the construction of new vessels is that they be multifunctional. For example, the icebreakers can also serve as tugboats and transport vessels.

Five-pillar strategy: the fleet as an environmental protection pioneer

At the same time as the municipal fleet management division was founded, the Hamburg Parliament formulated the goal of making the fleet environmentally friendly, among other things by means of low-emission ship propulsion technology and filter technology. Flotte Hamburg is rising to this challenge with an innovative five-pillar concept developed together with DNV GL. They jointly defined five areas of action to serve Flotte Hamburg as a guiding structure for its environmental strategy. Flotte Hamburg is therefore making an important contribution to the HPA's climate strategy

The concrete objective of the five-pillar strategy is to reduce emissions of CO₂ (carbon dioxide), of the air pollutants NO_x (nitrogen oxide) and SO_x (sulphur oxide) and of black carbon particles (PM_{2.5-10}). Ongoing and sizeable reductions were achieved quickly by using low-emission fuels such as GTL (gas to liquids) and, to a lesser extent, HVO (hydrotreated vegetable oil). At the end of 2018, synthetic fuels already accounted for 50 per cent of the fuel used.



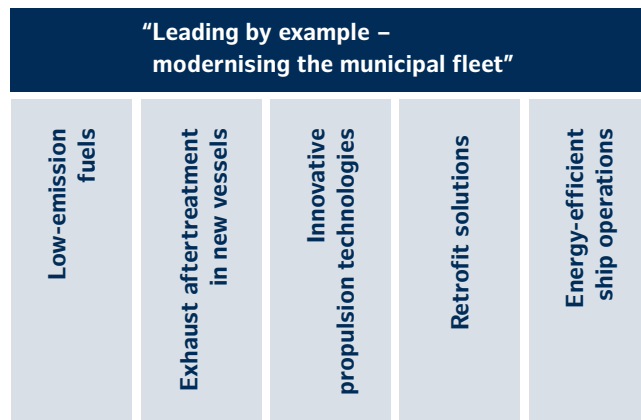
13%

NO_x reduction
within the fleet since 2015

Tab. 1: Emissions in relation to fuel consumption

	2015	2016	2017	2018
Nitrogen oxide NO _x in kg/m ³	31.70	31.13	28.54	27.47
Particulate matter PM ₁₀ in kg/m ³	0.022	0.021	0.019	0.018
Carbon dioxide CO ₂ in t/m ³	2.4	2.4	2.3	2.3

Fig. 1: Flotte Hamburg’s five-pillar strategy



Newbuild Branddirektor Westphal

The *Branddirektor Westphal* is one of the world’s most state-of-the-art fireboats. The LB 40 fireboat was christened in Hamburg on 26 November 2018. All of its engines are equipped with a modern exhaust aftertreatment system with black carbon particle filters and nitrogen oxide catalytic converters (selective catalytic reduction, SCR). Investments in exhaust emission control alone totalled 1.2 million euros. The *Branddirektor Westphal* is therefore playing an important part in keeping Hamburg’s air clean. The extinguisher pumps can pump a total of 120,000 litres of extinguishing water a minute. With a throwing height of 120 metres, the *Branddirektor Westphal* can also extinguish the largest container and cruise ships.

The figures are to be steadily reduced further. From 2016 to 2018, ship emissions of NO_x fell by 12 per cent and those of PM₁₀ by 14 per cent. The results were determined using a tool created by DNV GL for the calculation of ship emissions.

- *Pillar 1 – low-emission fuels:* Following a trial period, a substantial proportion of the fleet was switched to synthetic fuels. These fuels emit less nitrogen oxide than diesel (approximately 10–35 per cent) and significantly less particulate matter (approximately 30–60 per cent) depending on the engine configuration and the exhaust emission control system used. The disadvantage is that the ships’ operating costs are approximately 10 per cent higher than with diesel.
- *Pillars 2 and 3 – exhaust aftertreatment in newly acquired vessels and as a retrofit solution:* If technically feasible, Flotte Hamburg endeavours to fit its vessels with exhaust aftertreatment systems such as black carbon particle filters and nitrogen oxide catalytic converters. This applies both to newbuilds and the retrofitting of existing vessels. In 2018, the first six vessels were selected for the retrofitting of exhaust aftertreatment systems and implementation was initiated. Three more ships are set to follow each year in the years to come. It is also worth noting that the savings effects of using gas to liquids (GTL) and exhaust aftertreatment systems are multiplied.
- *Pillar 4 – innovative propulsion technologies:* Flotte Hamburg sees itself as a test environment for maritime innovations in the area of new propulsion concepts and it therefore promotes these technologies. Specifically, the new fireboats scheduled for completion at the end of 2020 will be fitted with battery-backed diesel-electric hybrid propulsion (plug-in hybrids). Flotte Hamburg is

also involved in international research projects such as the development of a seagoing vessel with methanol fuel cell propulsion (HyMethShip).

- *Pillar 5 – energy-efficient ship operations:* Emissions can also be reduced by operating the municipal fleet vessels in a more environmentally friendly way. In the reporting period, Flotte Hamburg had 90 per cent of its skippers undergo training in energy-efficient ship operations with DNV GL. Judicious ship operation (for example, a less intensive throttle in the start-up phase) can lead to emission reductions of 3 to 7 per cent per journey.

Focus on the employees: a start-up culture with experience

Flotte Hamburg is a start-up with a wealth of nautical experience. The company is sustained by approximately 140 committed and circumspect HPA employees. The majority of these employees make up the crews, i.e. are either skippers or ship mechanics.

The Flotte Hamburg management supports its employees in remaining healthy. Occupational health management is especially important for shift workers. Flotte Hamburg therefore developed its own health education programme for its pilot transfer employees as a test measure in the reporting period, which will serve as an example to other Flotte Hamburg teams.



Cruise Gate Hamburg: making cruises possible in Hamburg

Hamburg is one of the fastest-growing cruise bases in the world. In 2018, cruise shipping in the Port of Hamburg increased to 212 calls with almost 900,000 passengers. This compares with 810,000 cruise tourists who visited Hamburg in 2017 on the basis of 197 calls at the port. Hamburg benefits from this growth, but also has to keep a keen eye on the impact that cruise tourism has on the city.



Cruise Gate Hamburg GmbH (CGH) oversees this growth. As the operator of the three cruise terminals in Altona, the Hafencity and Steinwerder, CGH is the central point of contact for all the cruise shipping companies based in Hamburg. As a wholly owned subsidiary of the HPA, CGH operates with a small yet efficient and motivated team of eleven employees. CGH's declared goal is to serve as a one-stop shop for cruise shipping at all of Hamburg's terminals – with high-quality terminal clearance guaranteed through a demanding accreditation process for all of CGH's service providers.

Pioneering work for fewer cruise shipping emissions

Hamburg has decided to focus on environmentally sustainable growth in its development of cruise shipping. The Port of Hamburg is one of only a handful of ports around the world to offer cruise shipping companies alternative, low-emission energy supply options during ship lay times.

Since 2016, cruise ships at the terminal in Altona have had the option of sourcing electricity from the first environmentally friendly onshore power system. It is unique in Europe in terms of its size and is the first step in the direction of making Hamburg a low-emission cruise shipping location. However, the only voluntary buyer of this green electricity to date has been the cruise ship *AIDAso!*. During its twelve calls at the port in 2017, the ship bought onshore power seven times; this compares with 21 purchases during 21 calls in 2018 (periodically). In 2018 alone, this equated to a 458-tonne reduction in CO₂¹¹ compared with onboard power generation via diesel

engines. In 2018, the delivery of onshore power was tested with the EUROPA 2 and this testing was a success. First put into operation in 2015, the infrastructure for the shoreside supply of power to cruise ships by the *Hummel*, an LNG power barge, at the Hafencity terminal could not be used in 2017 and 2018 because of construction work. The HPA has also trialled supplying cruise ships with low-emission liquefied natural gas (LNG). In 2017, the *AIDAprima* and the *AIDAperla* were periodically supplied with LNG from a truck at Cruise Center Steinwerder during lay times. Using LNG means it will be possible to all but avoid emissions of particulate matter and sulphur dioxide during lay times, while nitrogen oxide emissions can be significantly reduced.

¹¹ Calculation of the CO₂ reduction is based on the volume of electricity supplied and an assumed efficiency of the *AIDAso!* engines as the actual fuel consumption was not known during the lay time. The carbon emission reductions are not included in the HPA's balance sheet.

900,000

passengers from 212 cruise ship calls in 2018

CGH endeavours to apply its knowledge in the area of emission-lowering measures to international networks and research projects. Together with the HPA, CGH jointly initiated the European partner project Green Cruise Port. Working with 20 partners primarily based around the Baltic Sea, the initiative looked at how cruise shipping could be made sustainable at ports. Among the partners were the ports of Rostock, Riga, Tallinn, Helsinki and Bergen and the shipping companies AIDA Cruises and TUI Cruises. The project assessed a total of 100 individual measures for the reduction of air pollutant and noise emissions. The results were summarised in the Green Cruise Port Action Plan 2030 (www.greencruiseport.eu).

This coordination with other ports is extremely relevant to cruise shipping. This is because only once a reliable network of ports has been established that guarantees shoreside supplies of alternative fuels will it become attractive for cruise shipping companies to transition entirely to onshore power supplies during lay times. Hamburg can and must play a pioneering role here. However, an attractive overall package for the sector can only be put together when all the ports along the cruise ships' routes cooperate.

Outlook: sustainable growth for cruise shipping in Hamburg

Growth in cruise shipping business will continue at a moderate level in Hamburg. To cope with the increasing clearance capacity needs in the Port of Hamburg, among other things, the cruise terminal in the HafenCity is being built anew. The cruise terminal is to be made an integral part of a complex of buildings together with a shopping centre and a hotel in the south of Überseequartier and will feature an additional onshore power facility. The inauguration date currently being communicated is the end of 2023.

CGH will also step up its endeavours within the International Association of Ports and Harbors (IAPH) in the next few months to establish even greater transparency regarding cruise ship emissions in ports around the world. CGH is organising various projects relating to emissions data, the topic of overcrowding and sustainable growth together with the ports belonging to the IAPH and Cruise Europe. A new reporting standard needs to be put to the test here.

Efficient use of space

CGH wishes to go one step further with the efficient use of its space. For example, the parking lot at Cruise Center Steinwerder is increasingly to be used by trucks at times when no cruise ships are scheduled to call. The aim of the Bosch Secure Truck Parking project is for optimum use to be made of the space available for parking within the port of Hamburg. This offers a variety of benefits: freight forwarders lower their emissions because unnecessary parking space searches are eliminated. The truckers can park safely and do not hold up traffic due to hazardous parking. At the same time, CGH boosts its space capacity utilisation.



Eco-friendly and safe rail traffic

290

kilometres of track within the port area's public track network

The ability of railway undertakings to offer attractive transport services is dependent upon there being an efficient rail infrastructure at the port. With this, the HPA boosts the competitiveness of rail freight traffic and the environmentally necessary transfer of traffic from the road to rail. The high safety of rail freight traffic plays a key part in dangerous goods carriage.

The HPA is the owner and operator of the public track network within the port area. The network has a total track length of 290 kilometres, with approximately 780 points and 61 other facilities and structures such as railway bridges and passages, together with eight signal boxes and a wagon repair workshop. 73 private railway siding companies with an approximate total track length of 130 kilometres and 540 points are also connected to the network.

Increasing freight volumes mean the maintenance of expansion options is especially important for the port railway as the political goal of transferring goods carriage to rail as an environmentally friendly mode of transport cannot be achieved without additional infrastructure capacities. The

existing infrastructure from and to the port needs to be maintained and continuously further developed in the interests of attractive rail traffic.

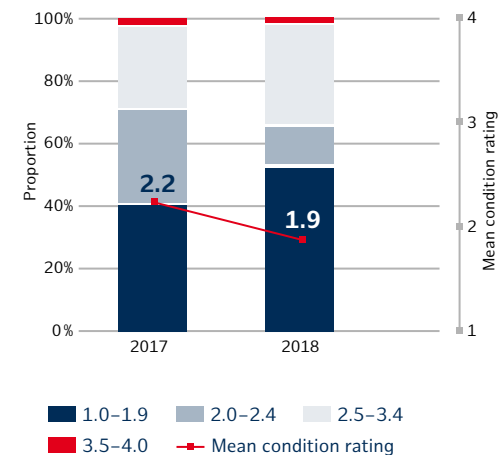
Foresighted planning to strengthen the rail infrastructure

With its maintenance strategy, the HPA focuses on high availability of the track systems and safe rail operations. Service limitation is to be kept to a minimum for the customers through coordinated scheduling of the measures. Much like roads, the condition of the infrastructural facilities is assessed with ratings ranging from 1.0 (very good) to 4.0 (poor). The HPA has set itself the goal of an ongoing positive development and monitors the attainment of its targets for tracks and railway bridges. All the railway bridges where their condition was not classified as being very good, good or satisfactory are already scheduled for renewal, decommissioning or demolition.

The HPA also wishes to put the infrastructural prerequisites in place within the port for the needs-based extension of the existing platforms to a working length of 740 metres.



Fig. 1: Forward-looking assessment of the condition of the rail infrastructure



Tab. 1: Development in the efficiency of train despatches per day

	2015	2016	2017	2018	2030
Target value					260
Actual value	196	200	198	204	

204

trains are despatched within the track network every day.

Since 2016, freight trains with a total length of 835 metres have been able to stop at the Hohe Schaar station part. Longer trains boost the competitiveness of rail over road traffic. The company is also pushing ahead with modernising the control and safety systems. The European Train Control System (ETCS) is set to be introduced, making cross-border traffic considerably easier thanks to standardised control systems. The aim is to be able to process up to 260 trains a day within the track network by 2030. The port railway development measures are based on the city of Hamburg’s Port Development Plan.

The HPA is also working to reduce its consumption of energy for operation of the infrastructure, for example for point heating and lighting. Traffic-related noise and air pollutant emissions are also to be reduced. The company will additionally develop a concept for the management of green spaces along the tracks. The aim here is to help prevent the occurrence of dangerous events and damage and to ensure high availability of the tracks even in the event of more frequent/stronger climate-related storm incidents.

The HPA believes strongly in the close incorporation of the stakeholders with regard to its rail infrastructure too. In this vein, customers such as railway undertakings and railway siding companies are kept abreast of major construction measures resulting in limited operations regularly and in good time by means of engineering information dialogue. Residents are sent information letters announcing engineering work and explaining the necessity and the objectives of such projects.

The HPA is also involved in a variety of associations and committees, such as experts’ workshops to analyse Hamburg as a railway node and regarding the Deutschland-Takt timetable, which is part of Germany’s Federal Transport Infrastructure Plan. The company also comments on the framework regulatory conditions, for example within the ESPO’s Rail Expert Group, Germany’s Pro-Rail Alliance and the Association of German Transport Companies (VDV).

Numerous new builds and modernisations

The HPA has now equipped more than half of its railway tracks with overhead lines. All of the six port stations’ entrances and exits and the majority of the tracks used for train arrivals and departures at the station parts have already been electrified. As the remaining tracks are used almost exclusively for shunting operations or for wagon parking, electrification is not currently needed here for operational reasons.

The locomotive service point in the west of the port with a locomotive repair shop, filling station and sandbox filling facility went into operation in 2018. The provision of new services and expanded locomotive parking capacities will further increase the appeal of rail traffic in the port of Hamburg, while routes and journey times will be reduced.

Inventory renewal with a focus on noise prevention and energy efficiency

The HPA continues to systematically work on the tracks in the vicinity of Hausbruch in order to reduce noise emissions. This involves the surface of tracks in noise-sensitive areas being processed twice a year. The port railway seeks to achieve a high level of acceptance of engineering work by using modern construction machinery and by notifying the residents of work in good time.

The HPA gives especially careful consideration to noise reduction when repairing existing and building new bridges too: for steel railway bridges, it uses a special anti-corrosion procedure in which a thick layer of permanently elastic rubber is applied to the steel superstructure. This reliably protects the steel from corrosion and also absorbs the transfer of vibrations from the track ballast to the steel construction, meaning the sound pressure level can be reduced by approximately 10 decibels. All 21 of the structures to which this system is suited have been equipped with it since 2017.

The point heating system at the Hausbruch station part was fully upgraded in 2018. Weather-based switching coupled with optimised heating times has resulted in increased point availability. Based on sensor data and weather forecasts, the heating system is switched on when temperatures are low only if precipitation is forecast, thus resulting in energy savings of up to 30 per cent. This reduces the burden for the atmosphere by 4 tonnes of CO₂/a.

Bridge projects realised on schedule

As part of the project to improve transport connections to Burchardkai, which will continue until the end of 2020, the existing Waltershof railway bridges will be replaced and a third track will be completed to the south of Mühlenwerder station. This will improve the flow of operations between Mühlenwerder station and the CTB and EUROKOMBI terminals and will reduce train waiting times. The construction costs will total 30.7 million euros.

In the case of the new Kattwyk railway bridge being constructed, the river piers were sunk to the right depth in the reporting period and a culvert was created between the two piers. Pre-assembly of the bridge superstructures commenced at the end of 2018, with on-site assembly beginning in May 2019. Three bridges for shoreside development have already been completed. When the new bridge is inaugurated, this will establish a double-track encounter section on what was previously a single-track connection between the Hohe Schaar and Hausbruch station parts, thus making additional rail traffic capacities available here.

10

decibel reduction in the sound pressure level was achieved in the area of railway bridge construction and bridge maintenance.

Attractive rail traffic thanks to efficient management



60,427

trains were despatched and transported in 2018.

A third of all the tonnage that arrives at the Port of Hamburg on seagoing vessels is subsequently transported further by rail. In 2018, 60,427 trains with 1,610,636 wagons and 2,443,068 TEU were despatched and transported. The HPA is responsible for the efficient management of rail traffic, which involves coordinating a large number of different traffic flows between the hinterland and the various loading points within the port.

Efficient traffic management with minimal waiting and idle times helps the railway undertakings to operate economically. This boosts the competitiveness of rail traffic in general. The more efficiently cargo carriage within the port is managed, the lower the traffic-related emissions such as noise and air pollutants. In addition to efficiency and environmental protection, a factor which is very important for the attractiveness of rail services is high operational quality, comprising the criteria of punctuality, plannability and reliability.

A large number of industry players are involved in managing rail traffic in the Port of Hamburg. In addition to the HPA, these include approximately 150 railway undertakings, various operators, customs, the

water police and DB Netz AG. In all, more than 70 loading/unloading points are operated. It is especially important that there be a smooth exchange of information among the various industry players.

The large number of active users of the HPA infrastructure results on the one hand in strong competition, with attractive offers for the forwarders. On the other hand, however, it also represents a major challenge for the HPA in terms of coordinating all the traffic. The HPA is obliged to guarantee non-discriminatory access to the infrastructure and has to develop workable solutions for the users' sometimes competing requirements.

Traffic management based on data exchange

The HPA operates the world's most state-of-the-art information system for port railway logistics, called trans-PORT rail. This regulates all of the train journeys and track occupancy, assists with loading procedures and allows for the transparent exchange of data among everyone involved in the transport chain – among others,

the railway undertakings and loading points, operators and the water police are connected to the system, meaning they can engage in essentially automated communication with one another via data interfaces.

Incentive system to reduce environmental impacts

The port railway's infrastructure user charge system called INES is another means with which it promotes efficient infrastructure usage. INES offers the users targeted incentives with staggered parking fees for stationary traffic, with tracks being categorised according to their function and importance. INES also boosts ecological traffic behaviour by specifically promoting the use of modern vehicles with reduced noise and pollutant emissions. In this context, Hamburg's port railway was the first in Europe to introduce a noise-dependent fee component for use of the railway infrastructure. It offers a bonus for every passage by wagons equipped with modern, low-noise brakes that cause approximately 10 decibels less noise than conventional systems.

The number of registered wagons equipped with such brakes increased significantly in the reporting period, to 205,703 at the end of 2018 (2016: 106,157). In the same year, these wagons passed the port boundary 1,025,372 times. They therefore already accounted for approximately 64 per cent of rail traffic from and to the port at the end of 2018. It can be assumed that this will be close to 100 per cent by 2020 because of national statutory requirements.

The HPA also incentivises the use of shunting locomotives with black carbon particle filters. Locomotives equipped with such filters were afforded a 50 per cent fee discount in the reporting period. In 2018, 61 locomotives were registered as having black carbon particle filters or as being hybrid locomotives. This is approximately 35 per cent of the locomotives involved in shunting.

The HPA served as a partner in the Ortung Hafen project run by the IHATEC initiative for innovative port technologies in the reporting period, a project looking into the feasibility of the track-specific locating of locomotives. Equipping shunting locomotives with a location system promises to simplify the management of shunting processes at the port and to allow the efficiency-oriented incentive components within the charging system to be further developed.

Throughput and proportion of rail traffic being systematically increased

The HPA aims to increase goods handling speeds and the reliability of the transport chains. An improved information flow will allow flexibility and plannability to be further optimised and buffer times to be reduced. It is also a question of guaranteeing an uninterrupted, reliable traffic flow and of curbing delays. The HPA will continue to work on simplifying data exchange and on the targeted collection of additional data which is important for port operations.

The idea is to enable those involved to boost their efficiency themselves and to expand the HPA’s management capacities in the interests of overall optimisation.

The HPA also intends to continue to promote more environmentally friendly traffic behaviour by means of incentives. This includes increasing the proportion of locomotives equipped with environmentally friendly technologies that are used for shunting services at the port. These are locomotives equipped with exhaust gas cleaning systems such as black carbon particle filters or SCR catalytic converters and innovative drive technologies, such as hybrid locomotives or electric shunting locomotives. This should reduce emissions per tonne of rail traffic cargo.

Overall, the HPA is seeking to increase the proportion of rail-based container traffic by an average of 0.5 percentage points a year up to 2020. Similarly, port railway throughput is to increase to 47.4 million tonnes by the same date. Train capacity utilisation is to increase to 75 TEU per train by 2020. A record was already achieved in 2018 with an average of 74 TEU per train.

Active involvement of stakeholders

The HPA gives its customers such as railway undertakings regular notification of planned modifications to the fee system and explains how the incentive systems offered work. All customers can consult the Port Railway Service Centre around the clock for assistance or to report issues or make suggestions. The port’s Railway Sidings Service unit is available for advice and assistance for anyone interested in creating new railway sidings within the port. The HPA is also involved in Logistik-Initiative Hamburg’s rail working group.

Tab. 1: Development of port railway throughput in millions of tonnes

	2015	2016	2017	2018	2020
Target value					47.4
Actual value	45.8	46.4	45.5	45.2	

74 TEU
of capacity utilisation
per train on average

Just
0.01
kilograms of
NO_x emissions
per tonne of cargo
transported by the
port railway

HPA measures to boost the efficiency of rail traffic

Rail is the most environmentally friendly mode of transport. A container train with up to 108 TEU can replace approximately 70 trucks (with 1.5 TEU per truck). If we compare the nitrogen oxide emissions of the different modes of transport, rail is the means of transport in Hamburg with the lowest level of emissions. The emissions per transported tonne are as follows:

- By truck (Euro 5–6):
0.15 kilograms of NO_x emissions
- By ship (marine diesel oil):
0.05 kilograms of NO_x emissions
- By port railway:
0.01 kilograms of NO_x emissions
(→ see *emission inventory*)

A further reduction in handling times was achieved by means of operations optimisation. Throughput on the track network had risen to 8,424 TEU per kilometre of track length by the end of 2018 – an increase of 3.5 per cent – and to 161,313 tonnes per kilometre. This allowed infrastructural measures with environmental impacts to be limited in terms of both time and spatially.

To make economical use of the existing facilities and to boost the port railway's proportion of the modal split, the HPA is focusing on further developing the services it offers and on new customer acquisition. The letting of construction material handling space used internally to third parties as well for external construction measures within the port or in the Hamburg metropolitan region helps here and strengthens rail-based construction site logistics. The HPA is also expanding the services of the Port Railway Service Centre and is involved in cooperative projects to transfer hinterland traffic to rail (→ see *section on the port*).

Assuming responsibility for environmental impacts

In 2017, a number of camera towers were erected along the approach to the west of the port as part of the Rail Data Gate (RDG) project to automatically record train and cargo information and to share this with the port railway's IT systems. This has improved data availability and quality and has reduced the manual workload. The RDG project also includes a wheel flat detection system operated by the HPA, which uses sensors in the tracks to analyse the individual wheels' running characteristics as the trains pass. This allows wheels that are not running true, among other things causing greater noise emission, to be identified. Wagon owners/operators can thus have damage repaired early on.

In 2017 and 2018, the HPA performed conceptual groundwork for the introduction of systematic locomotive parking scheduling in mid-2019. The aim is to guarantee short distances from and to the various sidings within the port and to avoid mutual obstruction because of locomotives parked temporarily. This can minimise infrastructural bottlenecks and can also optimise the railway undertakings' preparation times.

Prioritisation of low-emission locomotive technologies

A study was conducted in 2018 to determine how the incentive system for the use of shunting locomotives equipped with black carbon particle filters could be further developed. The introduction of staggered pricing of shunting movements within the port based on the locomotives' emission classes was identified as an effective means. With effect from the beginning of 2019, discounts for using SCR catalytic converters and electric/hybrid shunting locomotives were incorporated into the fee system. Hybrid locomotives use diesel generators if necessary in addition to their electric motors to recharge their batteries. As well as lower pollutant and carbon emissions, this hybrid technology is associated with reduced noise emissions.

High land traffic availability and quality



The industry and the port industry players need an intact and fully usable road network in order to process their traffic. There is otherwise a risk of companies drifting away or of choosing to settle elsewhere. Citizens likewise expect a high-quality road network which is suitable for all the user groups.

In this area, the HPA faces the conflicting priorities of ideally maintaining full infrastructure availability but also effecting the necessary maintenance work in the form of engineering measures. In accordance with the Hamburg Roads Act (HWG), the HPA is responsible for the approximately 142-kilometre network of roads within the port area. This relates not only to the roads' surfaces, but also to 105 bridge structures, tunnels, passages, dams, ditches, 70 kilometres of drainage systems, embankments, ramps, retaining walls, safety strips, roadside verges, lighting, traffic signal systems and road signs.

Approx.

63,500

passenger vehicles and
16,400 trucks on an average
work day

Road network efficiency

Approximately 23.8 million motor vehicles entered Hamburg's main port network in 2017, approximately 19.5 million of which were passenger vehicles and 4.3 million were trucks. Based on an average work day, this equates to approximately 63,500 passenger vehicles and 16,400 trucks. The number of port area entries increased by 6.7 per cent compared with 2016. There were significant increases in both truck volumes (3.7 per cent) and passenger vehicle volumes (7.4 per cent). As there was once again full availability of the Köhlbrand Bridge unlike in the previous years, it is likely that there was more through traffic via the main port route.

The port network is used by other road users too. Approximately 2,000 cyclists were counted on one day in September 2017. Bicycles accounted for around 2 to 3 per cent of all the vehicles using the road network, which is significantly less than the proportion of bikes in Hamburg's city area.

The road network works as well as the weakest link in the chain. It has been common knowledge for years that the Köhlbrand Bridge had reached the limits of its load capacity. The many meters which have been installed provide speed and traffic volume data, which is used to determine efficiency. A day on which there was a high volume of traffic was chosen for data analysis purposes, with readings being taken on the easterly approach to the bridge, on the right-hand two-lane carriageway, with trucks only being allowed to use the right-hand lane.



There is a clear relationship between traffic volumes and average speeds, as demonstrated in Figure 1. In spite of the high traffic volumes, the average speed is generally above 50 kilometres an hour. This theoretical high availability is often limited by, for example, congestion on the autobahn or an increase in truck traffic. Reserve capacity is still available on the left-hand lane and overnight.

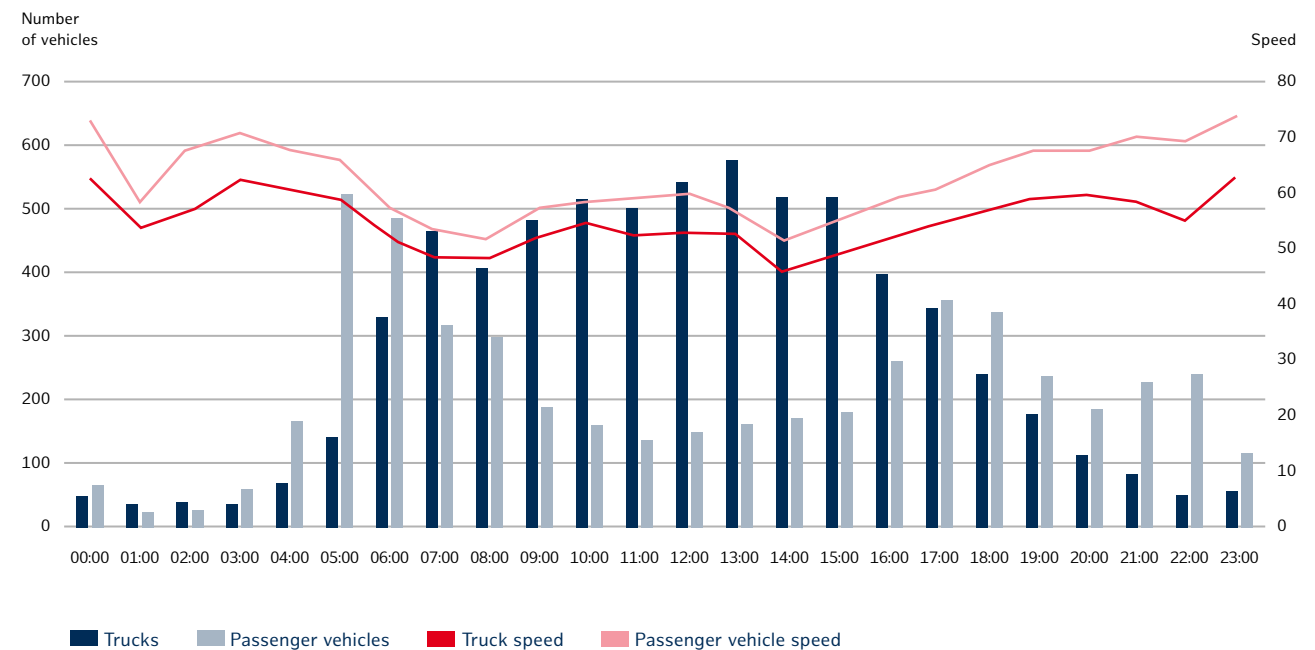
The challenge is to maintain this good situation until 2030. The preventative maintenance programme is working and will need to be adapted to changing parameters such as climate change and Mobility 4.0.

Systematic planning and implementation of maintenance measures

The HPA pursues the goal of maintaining the safety, longevity and availability of the road infrastructure on the basis of a preventative maintenance strategy. Existing renovation-related congestion is to be systematically and sustainably reduced.

The HPA follows fixed principles in its maintenance strategy. The company handles its infrastructure management with the goal of establishing cost-efficiency for the duration of the infrastructure’s useful life. This calls for long-term forecasts of the maintenance measures and means needed. This is illustrated by, for example, the fact that a bridge’s utilisation costs can sometimes

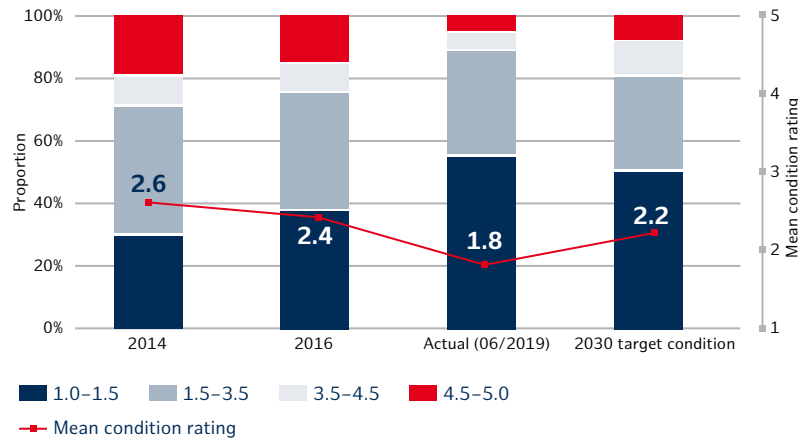
Fig. 1: Flow of traffic on a day with a high traffic volume (Köhlbrand Bridge heading west – right-hand carriageway)



be considerably higher than its construction costs. The age of structures and the increasing traffic loads call for targeted investment in structural maintenance. At the same time, economic maintenance strategies can minimise the utilisation costs.

Maintenance of the flood control systems (→ see the “Space-use strategy” section) is managed in accordance with the specifications of the Senate of Hamburg. The aim is to stop the further loss of the infrastructure’s value and to make the thoroughfares available in a user-oriented and safe condition.

Fig. 2: Condition ratings of the major roads in 2018



A universal “school marks” system is used to determine individual conditions, comprising four standardised limits.

- Mark ≤ 1.5 : Reference figure following construction
- Mark 1.5–3.49: No specific observation required
- Warning rating ≥ 3.5 : Observation and possibly also action required
- Threshold rating ≥ 4.5 : Individual examination needed, action is required

As the mean condition ratings demonstrate, maintenance management can be successful with a small number of facilities which are in the critical zone (red).

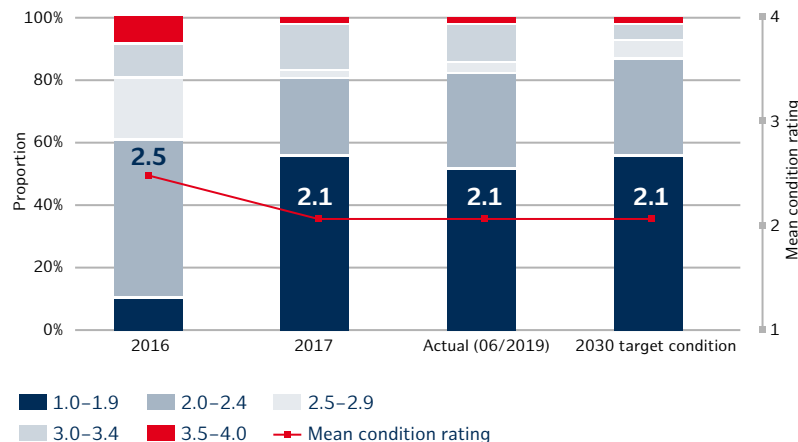
smartBridge: digital analysis of bridge structures

As its main task, smartBridge is piloting the sensor-assisted condition evaluation of existing bridge structures, essentially in real time. The project’s key innovation is its adaptation of the concept of the “digital twin” to the area of structural maintenance. It essentially complements cyclical, primarily physical inspection (DIN 1076) with elements of digital inspection, resulting in continuous condition feedback.

A mark consists of a user-oriented rating that represents a road’s practicability and traffic safety and a structural rating that stands for the current quality of the structure including, for example, cracks and weather-related changes.

The project is being run on the Köhlbrand Bridge as its demonstration object. The bridge’s component and material diversity, with steel, reinforced concrete and prestressed concrete in use, offers all sorts of application opportunities. The readings and vital signs (KPIs) derived from them are then made available via a cloud-based information system and are dynamically visualised. The HPA wishes to give third parties and business partners the opportunity to play a part in the project’s expansion and to test their own concepts in the field.

Fig. 3: Condition ratings of the road bridges (not including moving bridges in 2016 and 2017)



The HPA examined and assessed 73.1 kilometres of major roads, 162.5 kilometres of minor roads, 63 road bridges, 37 other bridges and five moving bridges. The target is a good mean condition rating (2–2.4).

One of the HPA’s main approaches is to group maintenance measures within large sections (measure areas) in order to minimise substantial traffic interruptions in terms of both time and space and to maintain availability at as high a level as possible.

Predictive maintenance results in fewer surprises and therefore also in fewer costly, unscheduled and possibly also unbudgeted emergency measures. Better availability can be achieved on the basis of improved schedulability of the measures needed. As a specialist application, the project supports facility management with regard to monitoring vulnerabilities and forecasting a structure's residual life. It is also gathering best practice experience which can then be applied to new build projects.

Intelligent models to protect infrastructure

There are traffic-limiting factors within the port area such as load limits when crossing bridges, speed limits, bans on overtaking and minimum vehicle distance rules. The Köhlbrand Bridge, which connects the eastern and western parts of the port, is affected in particular by load limits. The HPA is effecting various measures in this area to preserve the bridge's useful life and increase its resilience. For example, trucks are only authorised to use one lane and a weigh station has been installed under the carriageway to record the vehicles' total loads and axle loads. Readings confirm that many trucks are too heavily loaded, putting the bridge's critical load unnecessarily under strain. Anonymous recording and analysis of the data serve as the basis for structural conservation and for strategic planning regarding the infrastructure. In addition, DIVA boards providing dynamic information on traffic volumes notify the drivers if they are exceeding the speed or load limits, thereby raising awareness among the road users.

However, as these two measures are not sufficient, a minimum driving distance of 50 metres was introduced in early 2019 for trucks in the area of the bridge pylons. Road markings used in Germany for the first time and a corresponding sign are employed to keep the traffic flowing. This so-called minimum distance funnel reduces sudden braking and the build-ups of traffic that this can cause. The minimum distance requirement will then be lifted once reinforcement of the bridge has been completed, which is scheduled for 2020/21.

Close contact with those who use the traffic infrastructure is especially important to the HPA. It therefore has in place firmly established communication channels such as resident notification, information events, online notifications and the DIVA boards installed in the port that provide traffic information.

Modal shift to bicycle traffic

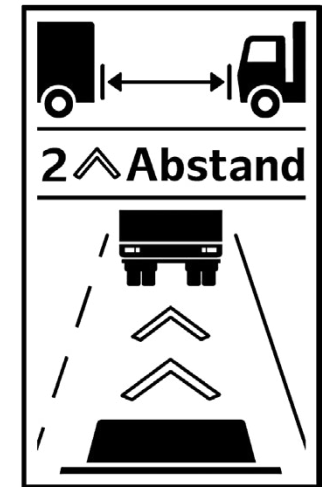
The HPA has set itself the goal of making the port experienceable and is supporting the Senate's objective of having bicycles account for 25 per cent of traffic by 2030 with measures promoting a modal shift to bicycle traffic.

Once construction of the new Kattwyk railway bridge has been completed, the cycle track and footpath, which have already been finished, will be opened over a distance of 900 metres. Between now and 2020, cycle paths will be created on both sides of further sections of road that make up Veloroute 11.

The HPA is engaging in talks with Hamburg's State Ministry of Economy, Transport and Innovation (BWVI) and the Hamburg Mitte district office regarding the creation of an approximately 1,300-metre cycle track in Finkenwerder along the old railway line running between Finkenwerder Norderdeich and Osterfeldeich.

Focus on bridge building and road maintenance

The Rethe Bridge connects the port areas of Altenwerder/Moorburg and Harburg with the central port and also takes the strain off the main port route that crosses the Köhlbrand Bridge. Road and rail have been separated with the reconstruction of the bridge as a double-leaf bascule bridge as well as the new construction of the Hohe Schaar Bridge. This has eliminated closure of the road because of trains passing – something which occurred up to 40 times a day before the new bridge was built – allowing around 7,000 vehicles to pass freely every day and also increasing the channel width that can be used by ships. It was cleared for road traffic use in summer 2016, followed by rail traffic at the end of 2017. This construction project won the 2018 German Steel Construction Award, which is presented by the association bauforumstahl e.V.



The HPA is also exploring new avenues technically speaking with its rebuilding of the Reiherstieg Lock. In the future, the lock gates will be moved by a toothed belt, as opposed to the previous solutions that used ropes, chains or racks. The toothed belt does not require any lubricant, which means there is no longer the extra work involved of collecting this and disposing of it separately – a good example of an environmentally friendly product choice to protect the waterways.

**A key future project:
a new Köhlbrand crossing**

Keeping the Köhlbrand Bridge operational beyond the year 2030 will not be economical. Additionally, with a clearance height of 53 metres, the bridge, which was inaugurated in 1974, is no longer suitable for the forecast sizes of future container ships. In 2017, the HPA therefore began first considerations for creating a new Köhlbrand crossing.

The new Rethe bascule bridge won the **2018 German Steel Construction Award**, which is presented by the association **bauforumstahl e.V.**

This consideration process is intentionally being kept very open, with a multi-stage feasibility study fundamentally weighing up the arguments for and against either a tunnel or a bridge solution. An initial interim finding suggests that both solutions would be technically feasible. There is also external analysis of the extent to which climate change over the next 100 years needs to be taken into account in the project. The concluded surveys are serving as the basis for the development of concepts

regarding, among other things, the dimensions and the infrastructure route taken. Reliable results allowing for a fundamental evaluation are due at the end of 2019.

Köhlbrand Bridge rainwater treatment systems

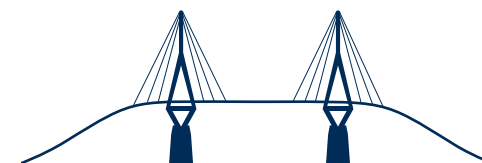
In accordance with the Federal Water Act (WHG) in conjunction with the Water Framework Directive, rainwater to be fed into the waterways must be cleaned by law. The Köhlbrand Bridge’s existing drainage system currently directs precipitation into the Köhlbrand without it first being treated. Cleaning systems will be installed by the end of 2019 as part of a project to introduce rainwater treatment systems to the Köhlbrand Bridge in order to significantly reduce the pollutants which are channelled into the waterways, thereby making an important contribution to environmental protection.

Accelerated and resource-conserving road construction processes

The majority of the roads within the port can only be maintained at the weekends in order to avoid traffic hold-ups. Together with a road construction company, the HPA has developed a solution that allows crossings and stretches of road to be renewed within 48 hours. It involves asphalt being produced and used at lower temperatures than usual. One way in which reduced-temperature asphalt can be used is as foamed bitumen. This has mixing temperatures of 130 to 140 degrees Celsius, which is 30 to

40 degrees lower than the mixing temperatures usually found in an asphalt mixer. In addition, using foamed bitumen allows the compression temperature to be reduced by 30 to 40 degrees Celsius to 110 degrees without detrimentally affecting its processability or its usage characteristics. Its quicker cooling behaviour saves not only time, but also energy.

The HPA is also endeavouring to reduce its consumption of resources for road construction. Since 2013, for example, it has been using a resource-conserving process for the renewal of road surfaces which boasts a recycling proportion of 50 to 70 per cent. This has been used on space of 87,000 square metres every year since 2014. The shorter transport routes needed for the asphalt have resulted in a 24-tonne reduction in carbon emissions since then, while the use of recycled materials has conserved stones and bitumen as resources.





Making road traffic safe and efficient

10%

increase in the traffic load

52.4 per cent of all containers and 41.4 per cent of the total tonnage enter the port then leave it again by road. Entries into the Port of Hamburg's traffic network increased by approximately 10 per cent between 2016 and 2018. There were similar increases in the number of entries of both trucks and passenger vehicles. Vehicle distance travelled, in other words the kilometres clocked up by vehicles within the port network, likewise increased over this period. There was a rise of approximately 8.5 per cent in truck network entries, while truck distance travelled rose by around 9 per cent.

A factor which affects truck traffic volumes in particular is construction sites both within and outside of the port area. Other reasons for an increase in traffic are new logistics companies setting up business in the port and changes in the flow of traffic within the port. In view of the ever greater traffic volumes, the objective remains to ensure the availability of the road infrastructure, with minimal waiting times and congestion. At the same time, the HPA is endeavouring to increase traffic safety and reduce the accident rate.

Due to the limited scope for expansion of the traffic space within the port area, optimum use has to be made of the traffic infrastructure. Construction works, accidents and capacity bottlenecks at the critical traffic nodes likewise result in lost time, as does the scheduled closure of the lift and bascule bridges. Needs-based maintenance and modification of the road network, a reduction in the traffic load and acceleration of the flow of traffic are thus required.

Innovative traffic management: reducing congestion, preventing accidents

Reducing the restrictions caused by accidents, closures, congestion and engineering works is key to maintaining and improving the efficiency of the road network. As a metric, average speed is an important indicator of the availability and efficiency of the road network. A large number of sensors throughout the port are used to record traffic volumes and motor vehicle speeds.

Introduction of the Roadwork Administration and Decision System (ROADS) software by the Hamburg State Office for Roads, Bridges and Water Bodies (LSBG) will improve communication among the industry players in the area of road infrastructure. This is used to centrally record and spatially visualise

scheduled roadworks with the aim of being able to better forecast the duration and impact of traffic hold-ups and of boosting the efficiency of the traffic network throughout the city. This can reduce not only congestion, but also the associated emissions.

Information about the frequency, location and types of accidents is relayed by the Hamburg police and is then evaluated by the HPA to serve as the basis for traffic planning. The goal is to further reduce the accident rate.

Top priority: availability and safety of the road network

The moving bridges within the Port of Hamburg are not fully available to road traffic due to the way they intersect with shipping and rail traffic. Details of the full availability of the moving bridges relate to times at which they are down and can therefore be used by road traffic and to their closure for road traffic.

High bridge availability in 2017 meant that the hours of congestion within Hamburg's main port network fell by approximately 35 per cent compared with the previous year. The knock-on effect of this was a greater volume of traffic.

Traffic congestion reduced

To reduce tailbacks, the 13 DIVA boards installed around the port are used to notify road users of bridge closures, major road-works and congestion. Journey times will likewise be displayed in the future. This allows drivers to adjust their route choices when there are restrictions, thereby reducing the time spent in congestion. Additional data will be needed and new detectors will need to be installed throughout the port area in order to improve the evaluation abilities.

The smartPORT project Green4TransPORT was initiated to create a test environment for V2X communication. This entails roadside units being installed at two traffic signal systems and on-board units being installed in approximately 150 trucks to allow for communication between the vehicles and the infrastructure. The test site is near Kattwykdamm. Within the test site, truck drivers will be sent information about the next traffic light cycle via a smartphone app, allowing them to adapt their vehicle speed accordingly. The system also makes it possible for groups of trucks to be prioritised with extended green traffic light cycles. The project is therefore playing a part in making the flow of traffic steadier and concurrently reducing emissions.

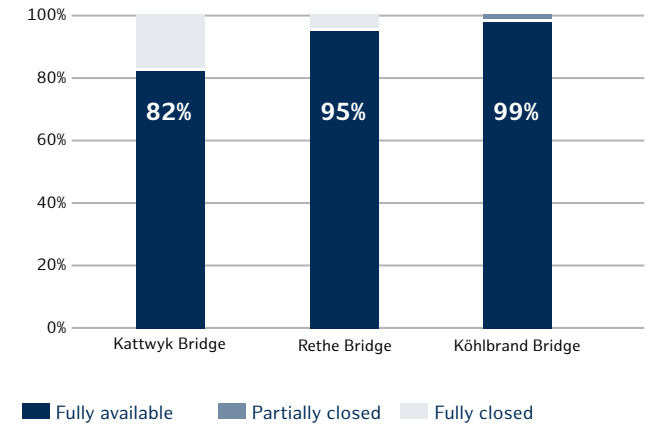
Approx.
35%
drop in hours
of congestion
year-on-year

Further lowering the accident rate

The accident rate is the ratio of distance travelled within the Port of Hamburg’s road network to the number of accidents occurring there. This has been declining since 2015. The number of accidents in 2017 remained essentially unchanged year-on-year at 782, in spite of greater distance travelled. Approximately 94 per cent of the accidents in 2017 occurred on a work day. 90 per cent of the accidents are accidents involving damage to property.

Finkenwerder Ring is an accident hotspot – 182 accidents occurred there in 2017. Measures to reduce accident frequency were therefore developed for this stretch of road on the basis of extensive testing, such as changes in the road markings, road sign changes and lane reductions, and these are now at the realisation stage.

Fig. 1: Bridge availability



Tab. 1: Accident rate for the major road network in accidents per million motor vehicle kilometres

	2015	2016	2017	2018	2025
Actual value	6.5	5.2	4.9	5.1	
Target value					3.9

Parking space management to free up the roads

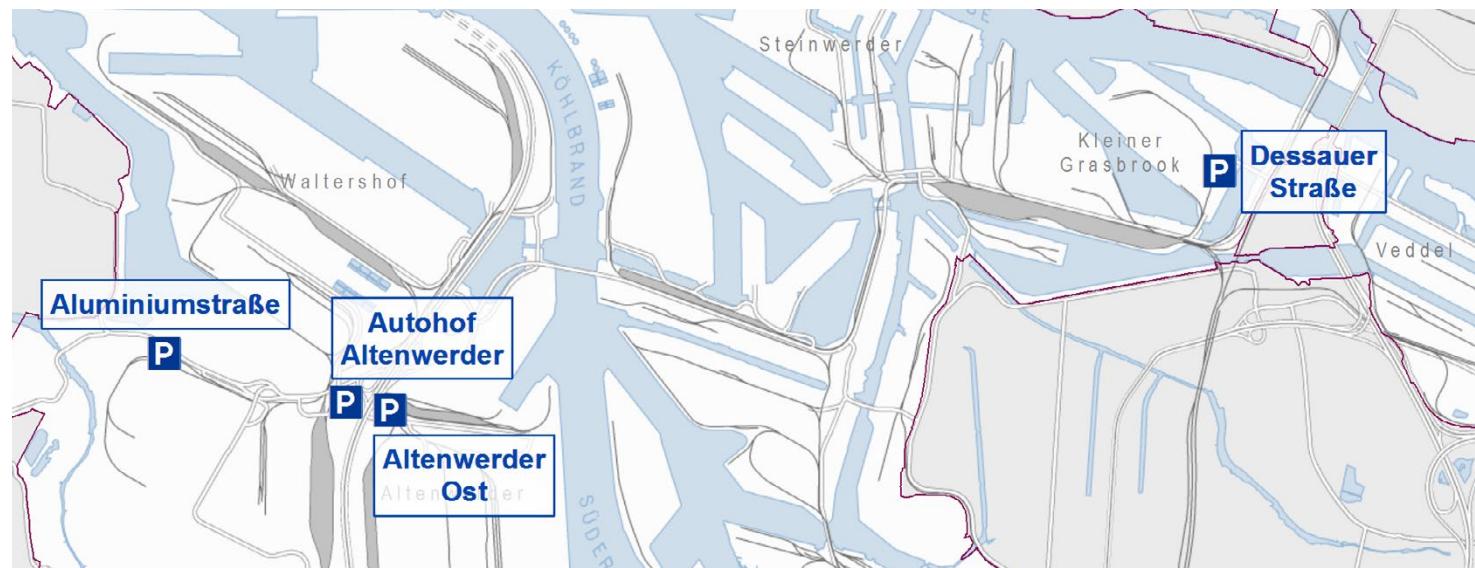
In the smartPORT project called Smart Area Parking initiated by the HPA, four truck parks in the port were equipped with parking space detection systems (see Figure 2) that monitor arrivals at and departures from the truck parks. Since August 2016, this information has been made available to road users via the DIVA boards installed around the port. This makes it easier for drivers and managing clerks at the port to locate or be specifically directed to vacant parking spaces, thus bringing down the volume of traffic searching for a parking

space. At the same time, the number of trucks parking on roads is being reduced, with the result that the traffic load, emissions and traffic safety risks are likewise being lowered. It can be assumed that an increase in the number of people using truck parks is also leading to an increase in utilisation of the services offered at these parks – having a positive impact on street cleanliness and on the burden placed on street residents.

The truck parks have mean capacity utilisation of approximately 76 per cent. There is average capacity utilisation of

79 per cent on work days and 71 per cent on weekends. The nighttime figures are significantly higher than those for during the day. Capacity utilisation of the truck parks increased considerably year-on-year in 2017. The HPA assumes that particularly in the western part of the port additional parking space will be needed for trucks in order for overnight capacity bottlenecks to be catered for. It is pursuing the goal of creating more truck parks and of therefore reducing the traffic searching for parking spaces.

Fig. 2: Overview of the truck parks in the Port of Hamburg equipped with parking space detection



04

Facts and figures



Fig. 1: Land use at the Port of Hamburg – by industry

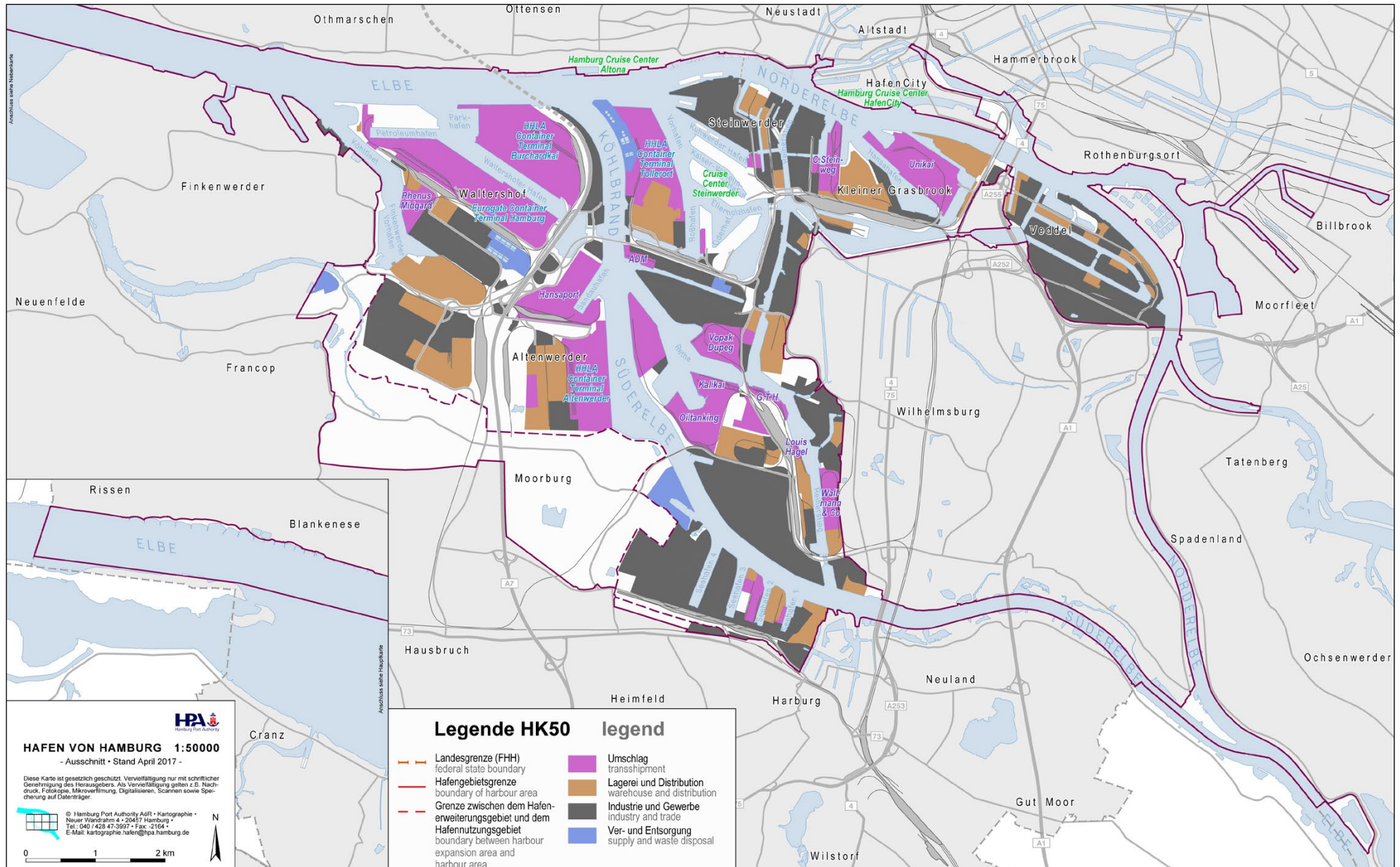
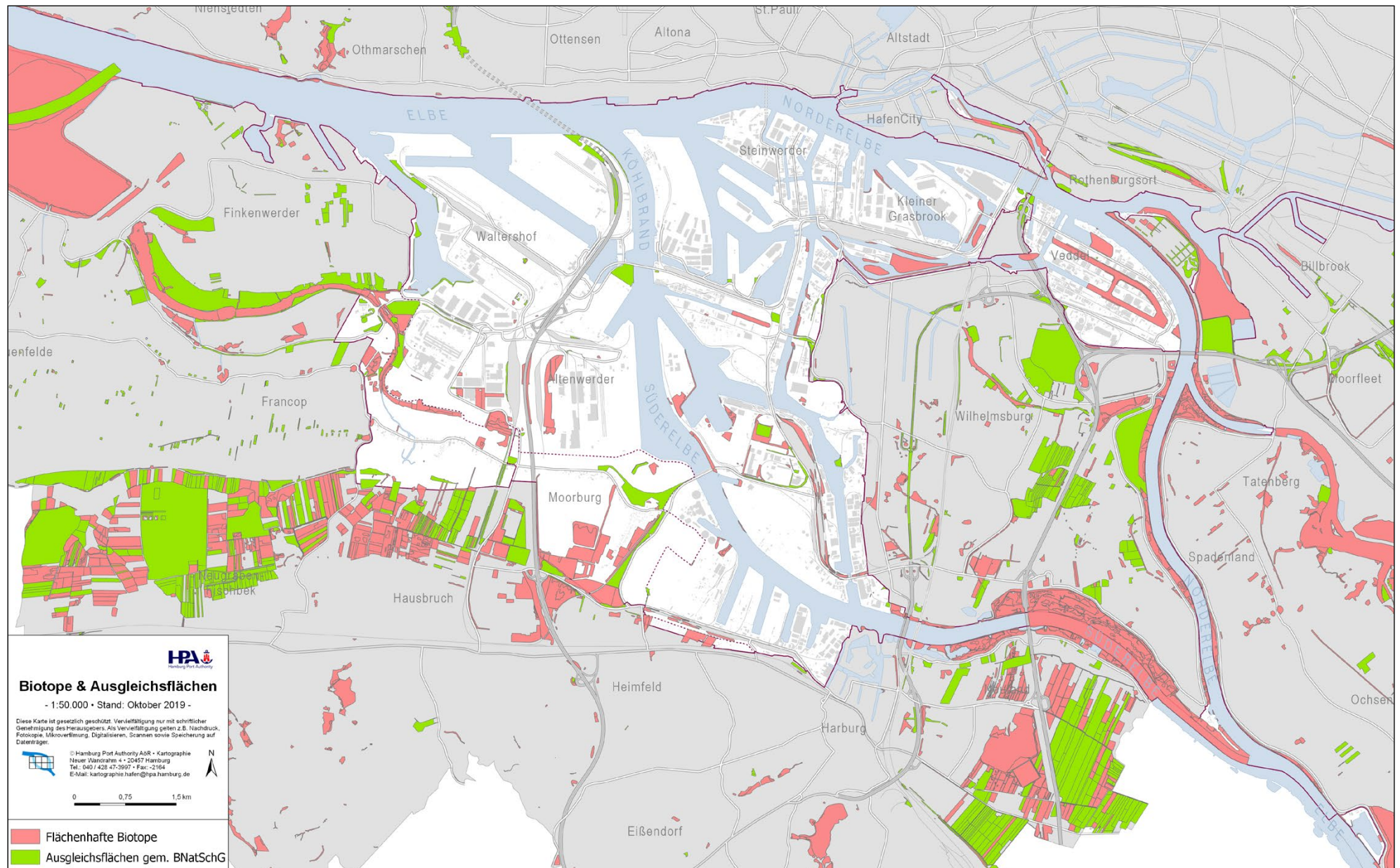


Fig. 1: Biotopes and mitigation sites



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Contact details

If you have any questions or suggestions relating to the topic of sustainability and the HPA, please do not hesitate to contact us. To do so, please use the following email address: nachhaltigkeit@hpa-hamburg.de

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