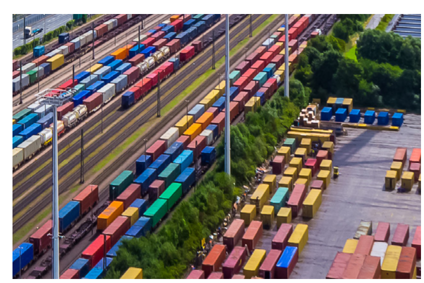
International Transport Forum

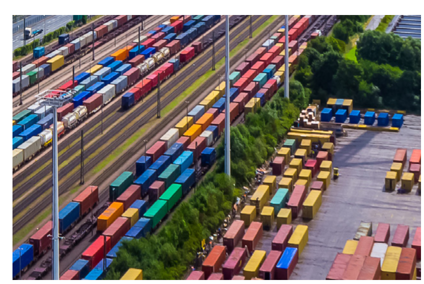
Zero Carbon Supply Chains

The Case of Hamburg



Case-Specific Policy Analysis

Zero Carbon Supply Chains
The Case of Hamburg



Case-Specific Policy Analysis

The International Transport Forum

The International Transport Forum is an intergovernmental organisation with 63 member countries. It acts as a think tank for transport policy and organises the Annual Summit of transport ministers. ITF is the only global body that covers all transport modes. The ITF is politically autonomous and administratively integrated with the OECD.

The ITF works for transport policies that improve peoples' lives. Our mission is to foster a deeper understanding of the role of transport in economic growth, environmental sustainability and social inclusion and to raise the public profile of transport policy.

The ITF organises global dialogue for better transport. We act as a platform for discussion and pre-negotiation of policy issues across all transport modes. We analyse trends, share knowledge and promote exchange among transport decision-makers and civil society. The ITF's Annual Summit is the world's largest gathering of transport ministers and the leading global platform for dialogue on transport policy.

The Members of the Forum are: Albania, Armenia, Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Chile, China (People's Republic of), Colombia, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Mexico, Republic of Moldova, Mongolia, Montenegro, Morocco, the Netherlands, New Zealand, North Macedonia, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Tunisia, Turkey, Ukraine, the United Arab Emirates, the United Kingdom, the United States and Uzbekistan.

International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
contact@itf-oecd.org
www.itf-oecd.org

Case Specific Policy Analysis Reports

Cite this work as: ITF (2021), "Zero Carbon Supply Chains: The Case of Hamburg", *International Transport Forum Policy Papers*, No. 91, OECD Publishing, Paris

Acknowledgements

This report was written by Olaf Merk of the ITF. It was informed by interviews and exchanges with a variety of stakeholders, including Dr. Andreia Thiel, Ingrid Boqué and Dorita Hermes (Hamburg Port Authority), Jan Hendrik Pietsch (HHLA and Metrans), Andreas Schruth (Eurogate), Jörg Erdmann, Ulf Schawohl and Pyers Tucker (Hapag Lloyd), Edgar Uribe (Kühne + Nagel), Holger Schneebeck (DHL), Björn Tiemann (Konrad Zippel), Martin Aden and Malte Lübbers (Otto).

The author would like to thank Steve Perkins of the ITF for his review of a draft version of the report and Richard Venturi for editorial support.

Table of contents

Tables

Executive summary

What we did

This report assesses the potential of zero carbon supply chains by way of a case study of the freight transport chain linked to the port of Hamburg. It maps the initiatives to decarbonise freight transport, as undertaken by select main stakeholders connected to the port. What's more, it analyses how these initiatives are inter-related and offers recommendations on how the move towards zero carbon supply chains could be accelerated. The analysis is based on desk research and interviews with the relevant stakeholders.

What we found

The Hamburg port and container terminals have developed relatively ambitious emission reduction targets, which is less the case for other parts of the chain. On the maritime side, only a few carriers have developed ambitious long-term targets. On the landside, most transport operators have not formulated long-term emission reduction targets, the exception being large logistics operators, although they are dependent on transport operators to realise the most substantial emission reductions.

Hamburg can be commended for a range of measures it is taking to reduce the carbon emissions of freight transport. It has managed to achieve a high share of rail in transport serving the port, the legacy of decades of investment in rail tracks within the port and a policy to facilitate port rail transport. Hamburg's main terminal operators have proactively invested in low-emission yard equipment and cranes. All this has made it possible for certain forwarders to offer practically zero carbon transport chains from the port of Hamburg to its hinterland destinations, something that is not yet possible in many other places.

In maritime and road freight transport, Hamburg (and Germany as a whole) has developed policies to stimulate the use of natural gas via incentive programmes and roll-out of infrastructure. Although more or less consistently and coherently pursued, this strategy cannot be considered a long-term – or even a medium-term – zero carbon solution. More generally, Hamburg could be considered reactive rather than proactive with regard to alternative fuels and energy sources. It is not a frontrunner when it comes to charging facilities for electric ships.

Many stakeholders in the freight transport chain are inter-related: most companies are either suppliers or customers of other companies in freight transport. In practice, these linkages are currently not being used to push for decarbonisation. Neither does any level of government fully exploit its potential leverage over shipping companies. The city-state of Hamburg has an ambitious GHG emission reduction strategy and is one of the main shareholders of the container shipping line Hapag Lloyd. Yet it does not appear to use this position to pressure Hapag Lloyd to develop a more ambitious and proactive stance on GHG emission reductions. Hamburg and other local, regional and national governments could use the leverage they have over the shipping industry via maritime state aid to incentivise the companies they support to engage in ambitious GHG emission reduction measures.

The higher costs of zero carbon transport is a challenge for the whole freight transport chain. Zero carbon freight transport is generally more expensive than conventional transport because the negative external costs of transport – such as emissions – are not charged for. Fossil fuel subsidies also make high-carbon options even less expensive than zero-carbon options. The end result is companies are effectively encouraged to use fossil fuels. An overhaul of the system of incentives in freight transport is therefore needed to stimulate the transition towards zero carbon power sources.

Reforms often take time because of concerns of maintaining a level playing field. The argument is that unilateral action – say, by Hamburg or Germany – would be ineffective because it would lead to a substantial part of freight transport activity simply relocating to other places. In order to avoid this, co-ordination between the jurisdictions that could be considered competitors in terms of freight transport flows is important if decarbonisation measures are not to be delayed. At the same time, bold action by certain port authorities can also drive change by others.

What we recommend

A more proactive strategy from the port authority

The Hamburg Port Authority (HPA) could play a more proactive role in driving the decarbonisation of the freight transport companies using the port of Hamburg. This would require a strategic reorientation: instead of focusing almost exclusively on its own emissions, it could leverage its position as a key node where a multitude of freight transport flows come together. Moreover, it could develop a clear strategy aimed at stimulating zero carbon road, rail and maritime freight transport. As part of this strategy, it could change its focus to possible long-term solutions instead of stimulating transition fuels like LNG. A proactive port strategy could benefit from stronger incentive schemes: not only deductions for good performers but also surcharges for bad performers.

Stronger involvement of the city administration in zero carbon freight

The city-state of Hamburg could more actively drive the decarbonisation of container shipping. As one of the shareholders in the shipping firm Hapag Lloyd, it could use its leverage to get commitment to a more active GHG emission reduction strategy. The city-state of Hamburg could also initiate a co-ordination group for port cities in Europe and across the world to develop common policies. Co-ordination of decarbonisation policies is desirable to avoid potential leakage effects of measures taken in isolation. Co-ordination could take place with regard to port city measures to stimulate zero carbon freight transport, incentive schemes, charging and refuelling infrastructure, and mitigation of the GHG impacts of ships, trucks, trains and barges coming to the port city.

Facilitation of zero carbon freight transport by the federal government

The federal government could help the transition to zero carbon supply chains by phasing out the fossil fuel subsidies for shipping and terminal operators, subsidies and toll exemptions for gas-powered trucks, and maritime state aid without strings attached. Such support measures should be transformed to facilitate the transition to zero carbon operations. Certain EU initiatives, such as changes to the EU Energy Taxation directive and inclusion of shipping in the EU-Emission Trading System, could help such a transformation. Finally, Germany's support for these measures could facilitate the transition towards zero carbon supply chains.

Introduction

The need to mitigate greenhouse gas (GHG) emissions is urgent. Global temperatures have already risen by an average of 1°C relative to pre-industrial levels. Ice sheets are melting; sea levels are rising. And extreme weather events exacerbated by climate change are fast taking their toll across the globe and will only become more frequent and more intense as a result of inaction. To limit global warming to 1.5°C above pre-industrial levels – a key aim of the 2015 Paris Agreement – will require a significant scaling-up and acceleration of action by governments and other stakeholders (OECD, 2021).

Freight transport has an important role to play in reducing GHG emissions. The carbon emissions from worldwide freight transport were approximately 3 billion tonnes of CO_2 in 2020, representing roughly 9% of total global carbon emissions (ITF, 2021). The emissions from freight transport are expected to increase over the coming decades in most scenarios. According to the business-as-usual scenario for freight transport, emissions from it will continue to grow until 2050 (ITF, 2021). And sea freight emissions are projected to increase by up to 50% by 2050, compared to 2008 levels (IMO, 2020).

Freight transport chains consist of many stakeholders, and their efficiency is dependent on the interconnections between these stakeholders. Door-to-door freight transport involves different transport modes connected by various nodes, and each transition risks generating friction, waiting times and transaction costs. Focusing on the interactions between transport modes and nodes can not only increase their efficiency but also reduce emissions, hence the relevance of assessing whole freight transport chains.

Policy frameworks for freight transport are fragmented. Many policies are developed per transport mode without much reflection on how these policies relate to other modes or possible synergies. Relevant high-level ambitions have been formulated in different settings, resulting in targets that are only loosely connected. The Paris Agreement, negotiated within the United Nations Framework for Climate Change Convention (UNFCCC), sets forth the ambition of "…holding the increase in the global average temperature to well below 2°C above preindustrial levels...". However, it does not explicitly mention global aviation and maritime shipping. Since the Kyoto Agreement, the responsibility for GHG emissions from aviation and shipping has been delegated to the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO), respectively. In 2016, the ICAO developed its own emission reduction strategy. The IMO, for its part, formulated its Initial GHG Strategy in 2018, with relative and absolute emission targets, including the target to reduce shipping emissions by at least 50% by 2050. Both the ICAO and IMO emission reduction targets are only in line with the ambitions of the Paris Agreement if they lead to substantial immediate emission reductions. This is just one example of the multitude of different jurisdictions with regard to climate policy for transport and the lack of a holistic vision on freight transport emissions.

Most of the different parts of the freight transport chain are connected to ports. At least four-fifths of global trade volumes are transported by sea and handled in ports. Significant shares of truck, train and barge transport come from or are destined for ports. Only air freight is somewhat independent of ports, and even then there are some connections in places that act as combined sea-air freight hubs (e.g. Dubai). Seaports are therefore unique nodes where many trade flows come together. This characteristic of ports gives them potential leverage over decarbonisation of the whole freight transport sector. Ports could play an essential role in stimulating emission reductions in the whole freight transport chain. And this report seeks to shed light on this potential, based on a case study of the port of Hamburg.

The port of Hamburg is an interesting case. Owned by the city-state of Hamburg, it is one of the largest ports in Europe and has both a large carbon footprint and a significant ecological constituency. Contrary to most other ports throughout the world, Hamburg has a close-knit and interconnected community of locally-based stakeholders, including terminal operators, shipping companies, freight forwarders, and trading and industrial companies. These local interconnections could well encourage stakeholders to co-ordinate their GHG reduction strategies.

This case study assesses the GHG reduction strategies of the different local stakeholders, including the port authority, terminal operators, shipping companies, trucking and train operators, freight forwarders, logistics operators and shippers. The focus is on the containerised transport chain, in particular in its relation to the retail sector. The report assesses for each stakeholder the amount of emissions, emission targets, the main measures to reduce emissions, the drivers of emission reductions and the obstacles.

Based on this mapping of the different stakeholders' initiatives, an analysis of the coherence of these different initiatives is conducted to identify policy recommendations that could help accelerate the movement towards zero carbon supply chains. These recommendations target policy makers in Hamburg, but the case study also aims to inform policy makers throughout the world by pointing to the main lessons that could be learnt from the case of Hamburg. The analysis for this case study is based on desk research of strategic documents and studies, as well as interviews with the main stakeholders based in Hamburg.

The port of Hamburg

The port of Hamburg is one of Europe's largest ports. It handled 137 million tonnes of goods in 2019, 69% of which were containerised goods, representing 9.3 million standard containers (twenty-foot equivalent units [TEUs]), making it the third largest container port in Europe. It rose to prominence in the 13th century, when it was one of the main ports of the Hanseatic League, a confederation of merchant communities in northern Europe. Hamburg and Bremerhaven are the main German ports, serving a hinterland that consists of Germany and Eastern Europe. Their main competitors for containerised German cargo are the ports of Rotterdam and Antwerp. One of the specificities of the port of Hamburg is that is about 100 km from the North Sea: ships access it via the river Elbe.

The Hamburg Port Authority (HPA) administers the port. Its role could be described as infrastructure manager: it is responsible for development and maintenance of port land, quay walls, access channels, roads and bridges in the port area. The HPA has a marketing organisation, Hamburg Port Marketing, in charge of promoting the port of Hamburg nationally and abroad. Like many port authorities throughout the world, the HPA does not actually perform operations, rather it grants concessions to private terminal operators.

The main clients of the ports are terminal operators and other firms that occupy port land. These companies pay concession fees or rents to the port. Shipping companies that use the port are not the direct clients of the port authority but of terminal operators. However, they pay port dues that are in effect fees to cover the use of port infrastructure. Like with most seaports, the HPA's main revenue sources are concession fees and port dues.

The HPA procures the construction and maintenance of significant pieces of infrastructure. Recent large infrastructure investments include the transformation of the Steinwerder terminal into a cruise terminal. Other important investments include dredging access channels in the port and deepening the Elbe River, necessary to be able to attract the companies with the largest container vessels.

The City of Hamburg is a city-state, with similar responsibilities as the other German regional states (*Länder*). As such it is the sole shareholder of the HPA, appointing its director, who reports to the city-state's government. Prior to the foundation of the HPA in 2005, the port was administered directly by the city administration. Both the city-state and the federal government consider Hamburg to be a real-life test bed of innovations in a variety of fields, including urban development and logistics.

A considerable part of Hamburg's economy is connected to its port and the logistics of its operations, generating considerable economic value added (Merk and Hesse, 2012). The flipside of the economic impact is its spatial footprint. The port of Hamburg occupies a land area of 43 km^2, which represents approximately 5% of the land area of the city-state of Hamburg. The largest part of the port area is dedicated to handling containers.

As a consequence, the city administration has multiple, sometimes conflicting, perspectives on its port. It wants to promote it, but it also competes with the port for space. Case in point is Hamburg's leading urban redevelopment project, Hafencity, developed on former port land. The proximity of the port to urban areas means the city-state administration is highly sensitive to the port's impacts. In short, the HPA has no choice but to take citizens' concerns with regard to the port seriously.

Carbon emissions

The HPA was responsible for emitting around 7 000 tonnes of CO_2 in 2019. More than half of these emissions come from the harbour vessel fleet, and around one-third are generated by the natural gas used for energy consumption in port buildings. More than half of the HPA's energy consumption comes from electricity, but this represents only a marginal share of the carbon emissions due to the use of renewable energy. The emissions from the harbour car park are also relatively small.

These calculations are based on the energy consumption of the HPA in seven different categories: heating oil, natural gas, liquefied gas, electricity, vessel fleet and car park. For each category an emission factor is used to calculate the CO_2 emissions related to the energy use. A similar calculation model is used by the city-state of Hamburg. The HPA deserves credit for monitoring emissions on an annual basis. These emission data are communicated periodically in its sustainability report, the most recent of which is from 2017-18.

Targets

The HPA has formulated various emission reduction targets for its own activities, most recently in the document "*Klimastrategie 2.0 – Klimaschutz und Klimaanpassung*" [Climate strategy 2.0 – Climate mitigation and adaptation] (HPA, 2020). This covers energy use from its buildings and car and vessel fleet, but it does not cover terminals and transport by other actors, as the port is not directly responsible for these emissions. The HPA's latest emission reduction and energy use targets are the following:

- a 50% reduction of direct CO_2 emissions by 2025 from 2012 levels
- a 5% reduction of energy use by 2025 from 2015 levels in increments of 0.5% each year
- zero carbon emissions by 2050.

This last target is likely to be adjusted to zero carbon emissions by 2040, in line with Hamburg's goal to be carbon-neutral by that date. These targets follow up on earlier emission reduction targets aiming at a 40% carbon emission reduction by 2020 and an 80% reduction by 2050, compared to 1990.

These medium- and long-term targets are translated into annual targets. According to the HPA's emission calculation modal, a yearly reduction of 311 tonnes of CO_2 per year would be necessary to reach carbon neutrality by 2050. Its climate action plan for 2021 has assigned the 311 tonnes to its different departments, with each bearing the responsibility to reach its target.

Reducing levels 40% by 2020 from 1990 levels has been achieved, but there was considerable fluctuation in emissions from 2010-20, with a clearly distinguishable downward trend only in the last four years.

Measures to reduce emissions of the port authority

Emissions have decreased since 2010 because the use of heating oil has gone down and the harbour vessel fleet has been reduced. In addition, the HPA gradually increased its share of clean electricity to 100% in 2020. Moreover, it bought carbon offsets prior to 2010 to reduce its emissions, but they have not been used since then. Energy use via electricity has decreased slightly since 2010, and the use of natural gas has remained stable.

The largest emission reductions in the future could be achieved by reducing emissions from the harbour vessel fleet. The HPA considers this to be one of the largest challenges, as it does not currently how this could be realised before 2050, considering the immaturity of existing technologies. Continued phasing out of heating oil could realise emission reductions in the short term. The HPA considers that ongoing digitalisation could lead to rationalisation in the number of port buildings, resulting in less energy use.

A large procurement item for the HPA is the dredging of the Elbe River. It indicates it would be interested in procuring low-emission dredgers, but these are much less affordable than conventional dredgers.

Measures to reduce emissions from ships

The HPA provides discounts on port dues related to environmental criteria. One of the possible discounts is a reduction of a maximum of 15% in port dues for ships powered solely by liquefied natural gas (LNG). In addition, ships can get a discount based on their score on the environmental ship index (ESI). This index contains a variety of environmental indicators, part of which relate to GHG emissions. The maximum environmental discount per ship in Hamburg is EUR 3 000.

The port of Hamburg has operated an onshore power facility at the Altona cruise terminal since 2017 and plans to expand the number of such facilities. Shore power facilities make it possible for ships to shut off their engines at berth by connecting to the electricity grid. This can substantially reduce the emissions from ships in port. Shore power facilities are planned to be installed in the coming years at 20 to 25 locations in some of the main container terminals (e.g. Predöhlkai, Burchardkai and Tollerort) and cruise terminals (Steinwerder and Hafencity). Discussions are ongoing on a possible LNG terminal in Brünsbuttel, near Hamburg, which would help the HPA provide LNG bunkering in the port of Hamburg.

Measures to reduce emissions from rail transport

Hamburg is one of the few ports in the world that has managed to achieve a relatively high rail share in its transport to and from the hinterland. Rail transport accounted for 42% of the modal split of the port's hinterland transport in 2019, and it generally emits less CO_2 emissions than truck transport, as well as less local air pollutants such as NO_x and particulate matter. This high rail share is the result of a sustained strategy to promote rail transport to the port, associated with a high density of railway tracks in the port area. The proportion of containers transported by rail to the port's hinterland has increased by over 25 % in the past ten years.

In recent years, the HPA has aimed at increasing the proportion of rail-based container traffic by an average of 0.5 percentage points a year up to 2020, when port railway throughput was projected to increase to 47.4 million tonnes. The port authority also formulated a target of train capacity utilisation of 75 TEUs per train by 2020.

The HPA has put an incentive scheme in place to increase the environmental performance of rail transport in the port. These incentives take the form of discounts on the port railway's infrastructure user charge system, known as INES. Locomotives equipped with black carbon particle filters can get a 50% discount on this charge. Similar discounts are applied for hybrid locomotives or electric shunting locomotives. In 2018, 61 locomotives were registered as having black carbon particle filters or as being hybrid locomotives, which represents approximately 35% of the shunting locomotives. Other incentives include a bonus for every passage by wagons equipped with modern, low-noise brakes that cause approximately 10 decibels less noise than conventional systems.

Drivers

The main driver of HPA's environmental strategy is the city-state of Hamburg, which requires the companies it owns to formulate ambitious climate targets in line its own. The HPA has to also take account of the concerns of various environmental non-governmental organisations (NGOs), which are often vocal about the port's ecological footprint. NGOs have been particularly focused on the environmental impacts of dredging the Elbe River, justified by the HPA's desire to attract the largest container vessels to Hamburg.

Container terminals in Hamburg

The port of Hamburg has four main container terminals. These are terminals that exclusively handle containerised goods transported in containerships. Three of these terminals (Buchardkai, Tollerort and Altenwerder) are operated by Hamburger Hafen und Logistik AG (HHLA) and one by Eurogate, part of the Eurokai Group (there are other smaller terminals [e.g. Hansa] that handle containers, but their share is minor). In 2019, approximately 75% of the port's container volumes were handled by HHLA and 22% by Eurogate. Terminal operators have acquired the right to operate the terminals via concession contracts with the Hamburg Port Authority (HPA); these are often long-term contracts, with an average life span of 20-30 years.

The main responsibilities of terminal operators are the handling of cargo (terminal operations) and developing their terminals, in particular by investing and maintaining the equipment needed for cargo handling (i.e. the superstructure of a terminal). Cargo handling involves transferring cargo from ship to shore, storing it in yards and then loading it onto trucks, trains, barges or ships to be transported to the hinterland.

The main clients of container terminals are container-shipping companies, also called carriers. They have contracts with terminal operators, often for a period of one to three years. Terminal operators are generally paid per effective move they perform; their contracts with carriers might include incentives related to performance, e.g. the number of effective moves per hour. The payments from shipping companies present the main source of income for terminal operators.

Terminal operators regularly invest in terminal equipment, considering that their terminal lease or concession almost often exceeds the typical lifetime of ship-to-shore cranes and yard equipment, such as straddle carriers, reach stackers, automated guided vehicles (AGVs) and rail-mounted gantry cranes. Terminal operators procure these from equipment manufacturers, such as ZPMC, Liebherr, Kalmar and Konecranes.

HHLA is listed on the Frankfurt stock exchange. As of 2019, its main shareholder was the city-state of Hamburg, which owned 68.4% of its shares; the rest were flee-floating shares, 23.2% of which were in the hands of institutional investors and 8.4% private investors (HHLA, 2020). Shipping company Hapag Lloyd owns a 25.0% share of HHLA's Container Terminal Altenwerder in Hamburg, .

Eurokai, a financial holding company, owns 50% of the Eurogate group, and BLG Logistics, which is fully owned by the city-state of Bremen, owns 50%. Eurokai is a majority shareholder of Contship, which operates terminals in Italy. More than 75% of Eurokai's voting share capital is held by the Thomas H. Eckelmann family.

Eurokai has terminals in the other German container ports Bremerhaven and Wilhelmshaven, as well as in ports in Italy, Morocco and Cyprus. HHLA has terminals in Tallinn and Odessa, and it also has a freight rail subsidiary, METRANS.

Carbon emissions

The emissions from container terminal operations in Hamburg amounted to 150 thousand tonnes of CO_2 in 2019, according to data from the terminal operators. This includes emissions generated directly at the terminals and indirect emissions, i.e. from the use of energy that is generated somewhere else, such as electricity.

HHLA and Eurogate deploy similar technologies for calculating emissions, in compliance with international reporting standards. HHLA calculates its CO_2 emissions on the basis of the Greenhouse Gas Protocol Corporate Standard (revised edition), a global standard for recording GHG emissions. Eurogate uses the Guidance for Greenhouse Gas Emission Footprinting for Container Terminals. HHLA has regularly reported is carbon footprint since 2008. Its website has provided annual sustainability reports since 2012, with sections on carbon emissions. These reports are written in accordance with the international guidelines of the Global Reporting Initiative (GRI). Eurogate also releases its emissions estimates in sustainability reports, but these do not appear every year.

Around three-quarters of the Hamburg container terminals' emissions comes from yard equipment, such as straddle carriers or AGVs in the automated CTA terminal. Considerably smaller emission sources are container cranes, buildings and lighting and electricity for reefer containers that contain refrigerated cargo.

Targets

HHLA and Eurogate have formulated targets for relative emissions (i.e. per container handled), consisting of reductions of 30% (HHLA) and 25% (Eurogate) by 2020, compared to 2008. In addition, HHLA has set itself two absolute emission targets: a reduction of 50% by 2030, compared to 2018, and being carbon-neutral by 2040. Eurogate, for its part, aimed to reduce energy consumption 20% by 2020, compared to 2008, and is currently developing a new medium-term emission target.

A three-year average trend of HHLA's CO_2 targets is taken into account in executive board remuneration: achieving the agreed target range triggers the payment of a bonus.

HHLA and Eurogate have both achieved their emission targets to be met by 2020, with the former reporting a relative emission reduction of 39% in 2019 and the latter 27% in 2018.

Measures

The absolute emissions from all container terminal operations in Hamburg increased 25% from 2010 to 2019, but there are considerable variations among terminals. One of the container terminals managed to reduce its emissions by 35% over the same period. Another, the Container Terminal Altenwerder (CTA), was certified by the certification company TÜV Nord to be climate-neutral in 2019, which meant that all unavoidable CO_2 emissions resulting from container throughput were offset.

The largest emission reductions in the Hamburg container terminals were realised by reducing the carbon intensity of the terminal equipment. The container cranes (ship-to-shore) were gradually electrified in various terminals. In the CTA, the electrification rate of container cranes is 100%, and 50% of the AGVs are electrified (AGVs transfer containers from under STS cranes to container stacks in the terminal yard). By 2022, all AGVs will have been converted to fast-charging lithium-ion batteries. The carbon intensity of other pieces of yard equipment has also decreased via regular multi-year investments in low-emission or hybrid straddle carriers. What's more, HHLA's truck trailers – now diesel-powered – will be electrified this year. HHLA also reduced energy use by filtering diesel residues in straddle carriers.

Container terminals in Hamburg use green electricity and produce part of their energy needs via solar panels. Certain emission reductions were also achieved by replacing the existing lightning with LED lightning. In the CTA, the share of yard cranes with LED lightning was increased from 46% in 2014 to 100% in 2016. And all of the lights at Eurogate's terminal were replaced by LEDs in 2019. The latter also produces electricity by a wind turbine, representing 7.8 milion kWh electricity produced in 2019.

Operational measures that were applied in the Hamburg container terminals were related to the optimisation of container storage, dual cycling at the Altenwerter terminal and twin operations at the Tollerort-terminal. HHLA has also created a joint venture with the company HyperloopTT to focus on using hyperloop technology for port and inland shipping container operations.

HHLA's CTA has managed to be certified by the certification company TÜV Nord as a climate-neutral terminal in part thanks to carbon offsetting. In its offsetting activities, HHLA supports climate-friendly projects that are certified according to the highest standard (the Gold Standard) of Voluntary Emission Reductions (VERs), a type of carbon offset exchanged in the voluntary market for carbon credits. These projects include wind farms in India, low-friction anti-fouling paint for ship hulls and the reforestation of depleted rainforests in Panama.

Drivers

A significant driver of the emission reductions is reduced operational costs. Electric AGVs reduce operational costs because of the efficiency of their engines: combustion engines waste of a lot of energy via heat, which is not the case for electric engines. The traditional straddle carrier needs 30 litres of diesel per hour; a diesel-electric straddle carrier needs 20 litres; and a hybrid straddle carrier – deployed in Hamburg since 2019 – only requires 15 litres per hour thanks to its battery packs. The electrification of AGVs and the hybridisation of straddle carriers have not only reduced emissions but also significantly reduced fuel costs.

Terminal operators are also under pressure from society and government to reduce emissions. HHLA's goal of climate neutrality by 2040 is aligned to the ambition of its main shareholder, the city-state of Hamburg.

Clients drive the environmental agenda of terminal operators to some extent. This is not so much the carriers but rather the freight forwarders on behalf of some of their customers. HHLA has developed its "HHLA Pure" product at the request of a freight forwarder for the car industry. This product offers customers certified, climate-neutral container transport and handling, with all the CO_2 emissions resulting from handling and transportation within the HHLA network offset via compensation projects. Terminal operators expect the pressure of certain shippers (e.g. IKEA) on carriers to become carbon-neutral will at some point also trickle down to terminals. For the moment, the zero carbon push from their customers has not led carriers to pressure terminals to decarbonise.

Obstacles

It is currently uncertain what the technologies will be that will allow terminal operations to become fully carbon-neutral. Various options are considered likely for powering terminal equipment, such as electricity from renewable energy sources, hydrogen and hydro-treated vegetable oil (HVO). Fully-electric yard equipment, like straddle carriers, would require further advances in battery development, for example, with regard to the speed of re-charging. The current hybrid straddle carriers in Hamburg need to be recharged every hour, which takes a few minutes per hour. Shifting to full electric mode would also be more expensive, considering that electricity is at the moment more expensive than diesel. Straddle carriers powered by hydrogen would also be a possibility, and there is strong political interest within Hamburg and the federal government for developing hydrogen as an energy source, but it is not commercially viable for the moment. The same is true for HVO, which has been tested at APM Terminals Gothenburg.

Commercial viability would be increased if the cost differential between current and cleaner energy sources would decrease. This is challenging in times of falling oil prices, like 2020. In addition, terminal operators benefit from a tax exemption of 25%-50% for the fuel used in their terminals, which makes it more difficult to bridge the cost gap between diesel and alternative power sources, such as electricity from renewable energy sources, not covered by the tax exemption. The background of this tax exemption is that 50% of the regular fuel tax is used to finance infrastructure. As terminal operators finance their own infrastructure they do not benefit from this earmarked infrastructure funding, hence the partial tax exemption, which can be justified but risks locking in fossil fuel use in terminals. A zero carbon transport chain would be helped by focusing the tax exemption on low- or zero-carbon fuels. At the same time, terminals are covered by the German CO_2 tax, which will increase each year. Another relevant element with regard to commercial viability is the scale of renewable energy production. Synthetic fuel production would need sufficient scale for it to become commercially viable.

Environmental indicators do not form part of lease and concession agreements between the port and the terminal operators. These agreements date back and are generally not updated. In the event new terminals are developed in the port of Hamburg, new terminal concessions could include environmental criteria along the lines of the concessions for the container terminals in Rotterdam’s Maasvlakte 2.

Container shipping

All major container lines provide services to Hamburg. Container carriers provide the long-haul ocean transport, either in their own ships or in ships that they charter from non-operating ship owners. They provide these transport services for shippers (cargo-owners) or for freight forwarders, which act as intermediaries for shippers.

Not surprisingly, shipping companies' most important investments are in their ships, which they either buy from other ship owners or order in shipyards. Container ships are constructed in a fairly select group of shipyards, mostly based in South Korea and China. Many of the investments in ships are financed via loans or other forms of external finance. Providers of external finance, such as shipping banks, have committed to decarbonise maritime transport by launching the Poseidon Principles, an initiative to incentivise shipping's decarbonisation in line with the climate goals of the UN's International Maritime Organization (IMO).

There are considerable differences in the corporate governance of the major container carriers. There are publicly listed companies, non-listed private companies, state-owned companies and companies that are hybrids. This means that these companies have a huge diversity of shareholders, ranging from families, states, and institutional and private investors.

Among the container carriers, Hapag Lloyd is particularly relevant for this study: it is headquartered in Hamburg and partly owned by the city-state of Hamburg. Moreover, the city-state of Hamburg formed the core of a group of Hamburg-based stakeholders (the Albert Ballin consortium) that protected Hapag Lloyd in 2008 from a foreign takeover (Hesse, 2018). Hapag Lloyd also receives annual subsidies from the German government (EUR 10 million in 2019) and US government (EUR 25 million in 2019). Its main shareholders include Kühne Holding AG (29.6%), the Chilean carrier CSAV (27.8%), the city-state of Hamburg (13.9%) and the investment funds of Qatar (14.5%) and Saudi Arabia (10.2%). Rounding this off, 4% of the shares were free floating in 2019.

Carbon emissions

In 2018, the global container shipping fleet emitted around 232 million tonnes of carbon emissions. This represents 22% of total CO_2 emissions from global shipping. Between 2012 and 2018 the CO_2-equivalent emissions of container shipping grew by around 5%, and the average GHG intensity (average CO_2-equivalent emissions per vessel) remained stable (IMO, 2020). These calculations are from the Fourth IMO GHG Study, which appears every few years (the Third IMO GHG Study was published 2014).

An annual overview of GHG emissions from shipping is provided by BSR's Clean Cargo, based on data provided by 17 major container carriers. These data are also available per trade lane. For example, the average CO_2-equivalent emissions on the Asia-North Europe trade lane were 42.3 grammes of CO_2 per TEU kilometre in 2019 (BSR Clean Cargo, 2020). These are emissions on a Well-to-Wheel-basis (it also calculates data on a Tank-to-Wheel-basis). In addition, various large container carriers detail their CO_2 emissions in their annual reports or sustainability reports. For example, Hapag Lloyd reported that it emitted 13.7 million tonnes of CO_2 in 2019 (Hapag Lloyd, 2020).

Targets

The International Maritime Organization formulated GHG emission reduction targets for the shipping sector as a whole in its 2018 Initial GHG Strategy (IMO, 2018). These targets include two relative medium-term targets and one absolute long-term target, namely reducing GHG emissions from shipping by at least 50% by 2050, compared to 2008. Container shipping companies have also formulated targets themselves. Twelve out of eighteen container shipping companies disclosed emission reduction targets in 2019 (CDP, 2019). Of these companies, Maersk and CMA CGM have formulated the target to be carbon neutral by 2050. Hapag-Lloyd aimed to reduce its CO_2 emissions per TEU-kilometre by 20% by 2020, compared to 2016.

Measures

Main measures taken by container shipping companies have been speed reduction after the economic crisis of 2008 and the ordering of larger, more energy efficient vessels. Some carriers have focused on LNG-powered ships as a short-term measure to reduce carbon emissions from shipping. This is notably the case of CMA CGM, which ordered a series of nine LNG-powered container ships, operational in 2020 and 2021. Hapag Lloyd has carried out pilot projects with LNG-powered vessels. Maersk and CMA CGM both offer the possibility to their customers of shipments powered by biofuels. Various container carriers have carried out pilot projects related to alternative fuels and renewable energies, e.g. rotor sails. Container carriers that call at Californian ports have equipped their vessels with the possibility to connect to onshore power, as this is mandatory in California. For example, of the 168 container ships that Hapag Lloyd operated in 2019, 19 were equipped for connection to onshore power.

Drivers

The measures taken so far by the container shipping industry have been partly driven by the need to comply to the IMO sulphur regulation, which has led some shipping companies to acquire LNG-powered vessels. The 2008 economic crisis has generally resulted in slower vessel speeds, first as reaction to deal with lower transport demand and then as a way to keep maritime transport costs low. Reducing unit costs primarily motivated the tendency of ever-larger container ships, but it has also resulted in more energy efficient container transport. Some customers of container carriers are interested in zero carbon maritime transport, but there are only few of them that would be willing to pay significantly more for such a service. Financial institutions active in shipping, such as shipping banks, have in large majority signed up to the Poseidon Principles, which, as mentioned, aim to decarbonise shipping, but this has yet to have much practical impact.

Obstacles

The main challenge for zero carbon shipping is higher costs, which for the moment hinder the commercial viability of zero carbon ships and zero carbon fuels. These are generally more expensive than conventional ships and fuels because negative external costs – such as emissions – are not taken into account, but fossil fuel subsidies are another factor. Examples include the fuel tax exemptions for shipping and the exemption of carbon taxation almost everywhere in the world. Another relevant element with regard to commercial viability is the scale of renewable energy production. Synthetic fuel production would need sufficient scale for it to become commercially viable.

Hinterland transport

The main hinterland transport modes related to the port of Hamburg are road and rail transport. More than 50% of the containers are transported to and from the port by truck, about 42% by train. Around 200 freight trains, carrying approximately 5000 rail cars, reach or leave the port on every working day. With rail freight volumes to and from the port equivalent to 2.3 million TEUs, Hamburg is the most important rail port in Europe, much more so than the ports of Rotterdam and Antwerp, which generate considerably lower volumes and shares of port hinterland rail transport.

Various types of companies provide these transport services. There are specialised trucking companies and freight rail operators that operate on partly complementary markets. In general, the market for road freight transport is fragmented, whereas the market for rail freight is more concentrated but nevertheless competitive.

There are also combined transport operators that offer intermodal rail and road services. An example is the Hamburg-based Zippel Group, which has a fleet of 200 trucks and operated 2000 block trains a year in 2019.

Some of the rail freight operators, such as DB Cargo, have become active as third party logistics companies and freight forwarders. There are also other forms of vertical integration. As mentioned before, the terminal operator HHLA has a rail transport subsidiary, Metrans, linking the HHLA terminals to inland rail terminals in Germany, Poland, Hungary, Slovakia and the Czech Republic.

In public areas within the port of Hamburg, the port railway is owned and operated by the Hamburg Port Authority (HPA), extending to 300 kilometres of rail track. An additional 160 kilometres of track are located in 130 private sites, owned by industrial, cargo handling and logistics companies.

The clients of hinterland transport companies are shippers (cargo-owners) or freight forwarders acting as intermediaries for shippers. The main investments for trucking companies are their trucks, in a fairly concentrated market. The main investments for rail operators are locomotives and wagons, produced in an even more concentrated market.

Carbon emissions

The ITF has not found any calculations or estimations of the total carbon emissions related to the port hinterland transport of Hamburg. Although not impossible to collect, it would involve a considerable data collection effort, as it would require information on the exact origin and destination of all shipments, the vehicles involved and fuel type. Some individual companies that provide hinterland transport to and from Hamburg monitor their emissions (e.g. Metrans), but most logistics operators, even large ones, do not systematically monitor the emissions of their transport activities. Sustainable last-mile freight transport has been the focus of initiatives of the Logistics Initiative Hamburg (LiHH), a network organisation of the main stakeholders in the freight transport chain in Hamburg.

Rail freight measures

Most of the rail tracks in Germany are electrified, which means that direct carbon emissions from freight rail transport are limited. The main emissions come from the so-called last mile, both in ports and the inland rail terminals. The locomotives used for long-range transport are not able to operate on the non-electrified last mile, and they have to be separated from the wagons after arrival within the port area. In the port, shunting locomotives with separate drivers take over, couple to wagons and push them into the port terminals. Most shunting locomotives are diesel electric or diesel hydraulic locomotives as they have to be able to operate independently from the overhead voltage or on non-electrified tracks (Girard, Oostra and Neubauer, 2008). They are typically provided by dedicated port shunting companies. Depending on the size of the port, there are different companies active in the shunting business (Krämer, 2019). In Hamburg, shunting operations are carried out by the HPA and rail operators, such as Metrans.

There are currently four hybrid shunting locomotives in the port of Hamburg, two of which Alstom manufactured and Metrans operated. Depending on their assignment, these hybrid shunting locomotives can run on battery power for between 50% and 70% of their operational time, which reduces fuel consumption up to 50%. The operation of hybrid shunting locomotives is facilitated by the 50% exemption of rail infrastructure charges on the port railway network for hybrid and electric shunting locomotives.

Road freight measures

The reduction of carbon emissions from road freight transport has so far come mostly from reductions made over short distances. An example is Zippel Group reducing emissions for last-mile truck transport at the request of its customer BMW. In 2018, it started to provide bio-fuel-powered truck transport between the BMW production plant in Leipzig and the intermodal terminal Schkopau, which is connected via rail to the port of Hamburg. The trucks used run on compressed natural gas (CNG), using 100% bio-methanol made from straw. Scania manufactured the CNG trucks; the bio-fuel comes from Verbio. The fuelling station is located between the BMW factory in Leipzig and the combined terminal Schkopau. The Zippel Group currently owns 12 CNG trucks that are also deployed in the BEHALA inland port near Berlin, also connected by rail to the port of Hamburg. It intends to order 10 more CNG trucks in 2021, which will represent around 15% of their fleet. According to Zippel, CNG trucks powered by their type of bio-fuel have 90% less CO_2 emissions than diesel trucks, and it estimates that thanks to its CNG trucks it emitted 18 000 less tonnes of CO_2 from 2018 to 2020.

This project was facilitated by a federal subsidy scheme and an exemption from the German truck toll system, which equates to a substantial operating subsidy. The investment subsidy scheme consists of a subsidy of EUR 8 000 for the acquisition of each CNG truck and EUR 16 000 for each LNG truck. LNG and CNG differ in the way in which they are stored and delivered: LNG is frozen in order to turn it into liquid form, whereas CNG is pressurised to the point where it is highly compact. CNG also generally has lower production costs than LNG. In addition to being subsidised, CNG and LNG trucks are exempted from the German toll system for trucks (known as LKW-Maut), the logic being to internalise the external costs of truck transport. This toll exemption was put in place in 2019 and was recently extended to 2023.

These measures form part of a broader policy to stimulate gas-powered truck transport. Since 2018, a network of LNG refuelling stations for trucks has been put in place in Germany. The first of these stations was located just south Hamburg at Georgswerder Bogen, near the Hamburg Süd motorway interchange and not far from the Hamburg Süd motorway triangle, an important axis for freight transport near the Hamburg port.

Hamburg's Ministry of Economy and Innovation is also the lead partner in an EU Interreg programme, called Smooth Ports aims to reduce CO2 emissions from port-related road traffic by improving regional policy instruments in a holistic manner. Key themes in the project, undertaken with stakeholders in administrations, ports and logistics business, are: finding optimal procedures for the clearance of the goods, ICT solutions for port-related traffic flows and alternative fuels for future port activities.

Drivers

An important driver for low-carbon truck transport is the customer (e.g. BMW in the case cited above). A few other shippers, notably in the food industry, are also interested in such transport options, but for most companies zero carbon truck transport is not considered a priority. Transport companies willing to do this are driven by the strong motivation of their management and company boards and are currently able to provide such options thanks to government-funded incentive schemes. The same applies to rail transport operators.

It is not certain that hybrid-shunting locomotives would have been acquired in Hamburg without the incentive of the partial exemption of the rail infrastructure charge. These incentives take the form of discounts on the port railway's infrastructure user-charge system, known as INES. Locomotives equipped with black carbon particle filters can get a 50% discount on this railway user charge. Similar discounts are applied for hybrid locomotives or electric shunting locomotives. In 2018, 61 locomotives were registered as having black carbon particle filters or hybrid locomotives, which represents approximately 35% of the shunting locomotives. Other incentives include a bonus for every passage by wagons equipped with modern, low-noise brakes, which cause approximately 10 decibels less noise than conventional systems.

Obstacles

The main obstacle related to zero carbon shunting locomotives is the market size. For the moment, manufacturers can only realise limited economies of scale, as the market for hybrid-shunting locomotives is fairly small. There are generally no limitations related to technology: the most recently acquired shunting locomotive in Hamburg already has more battery autonomy than the one acquired in 2016. Fully electric shunting locomotives are also possible, as illustrated in the rail terminal in Warstein (Germany). This is despite the fact these are for the moment most appropriate for extremely short distances (50-100 metres) and less for the longer distances travelled by shunting locomotives in the port of Hamburg.

Transport operators currently have little certainty on what the truck of the future will look like. At the moment, electric trucks are being developed in the smaller segments (up to 7.5 tonnes), but the expectation is that in a few years 44-tonne trucks will also be electrified. Tesla has announced the production of electric long-haul trucks, but these are not commercially available yet. Some operators also expect to see hydrogen-powered trucks, whereas bio-fuels and gas are considered to be transition fuels. A common challenge is the need for recharging or refuelling infrastructure. CNG trucks currently seem most appropriate for smaller distances (up to 100 km) considering the recurrent need for refuelling. In terms of costs, CNG trucks are 10%-15% more expensive than conventional trucks, and electric trucks are many times more expensive. The creation of a market for zero carbon trucks seems difficult without bridging this cost differential, either by providing positive incentives for the acquisition of zero carbon trucks or by increasing taxation on diesel trucks.

Logistics service providers

Logistics service providers offer transport logistics solutions to their customers. This can be either isolated activities, such as storage, packaging and customs brokerage, or a whole range of door-to-door freight transport services, such as acting as a freight forwarder or an intermediary for shippers (cargo owners). In the latter case, they procure transport services from transport operators, such as trucking companies and ocean or air freight carriers. Various container lines, including Maersk, CMA CGM, Cosco and NYK, have their own freight forwarding subsidiaries. Some owners of freight forwarders (Kühne) hold shares in shipping companies (Hapag Lloyd).

Carbon emissions

Large logistics service providers, like DHL and Kühne + Nagel, monitor carbon emissions and report on them in regular sustainability reports. Their emissions monitoring includes both the emissions for which they are directly responsible and the indirect emissions generated by the transport operators with which they work.

Targets

The large logistics service providers have all formulated carbon emission reduction targets. For example, Kühne + Nagel had a global target to reduce relative carbon emissions by 15% by 2020 (compared to 2010 levels), carbon neutrality of scope 1 and 2 emissions by 2020 and carbon neutrality of scope 3 emissions by 2030. Such global targets are generally translated into regional and national targets.

Measures

The main measures to reduce emissions in warehouses include electrification of equipment and installing LED lighting. All of the forklifts operated in Kühne + Nagel warehouses are electrified, and 75% of its lighting is LED lighting. Last-mile deliveries in urban centres are increasingly electrified. Other measures include changes in the layouts of logistical processes to reduce the movements of forklifts and trucks.

A few customers have asked freight forwarders for zero carbon supply chains. Freight forwarders have so far made arrangements with transport operators for premium zero-emission services, but some intend in the future to deal directly with producers of bio-fuels. The target of carbon neutrality of some logistics service providers is partly achieved by offsetting. Kühne + Nagel, for its part, will move towards what is known as carbon insetting: developing its own projects that compensate for carbon emissions.

Drivers

The main driver of zero carbon strategies for logistics service operators in Hamburg is the motivation of the owners and management of the logistics companies to be more sustainable. Although their clients pay more lip service to environmental sustainability, few of them demand zero carbon freight transport. Freight forwarders are able to accommodate zero carbon transport and expect to do more of this in the future, but the number of clients that are willing to pay for the additional costs that come with zero carbon supply chains is quite small.

Obstacles

The main obstacle for most logistics service providers is not so much their own emissions but the ones of the transport operators on which they are dependent. In ocean transport, there are a few possibilities for low-carbon shipping, but this is generally more difficult in road transport, where such options for the moment hardly exist. Few customers are willing to pay for premium zero carbon transport services, but there is an expanding potential interest.

Shippers

Shippers are at the origin of freight transport chains; it is their desire to ship goods throughout the world that creates the demand for freight transport. There is a wide variety of shippers, ranging from small enterprises to huge multinationals. The port of Hamburg is focused on containerised transport, which is the predominant way of transporting consumer goods. The industry at the origin of a substantial part of containerised transport – and therefore making up a large portion of shippers – is retail, an example of which would be the Hamburg-based retailer the Otto Group. As one of the world's largest e-commerce companies, it operates in more than 20 countries. Companies like Otto procure considerable amounts of freight transport services either directly or via freight forwarders to get goods to their warehouses and then on to customers (Otto Group has its own freight forwarding company, Hermes).

Carbon emission targets

Several large shippers have carbon emission reduction targets. Otto Group, for instance, had a target of reducing emissions by 50% by 2020, compared to 2006. Its new target is to be carbon-neutral by 2030. Main emission sources for retailers are inbound transport (whether by sea, air, rail or road), warehouses and last-mile transport. They have most leverage over the latter two, as they own both warehouses and vehicles for last-mile transport. Groups like Otto calculate carbon emissions per transported article and report on this through their purchasing departments every month.

Measures

The factor that has the highest impact on the retail sector's emissions is the share of goods transported by plane. Otto Group, for example, has managed to reduce its emissions on inbound transport by 75% since 2006 in essence by reducing the share of goods transported by plane from 25% in 2006 to 5% in 2019. This was possible because the composition of transported goods changed over time, from predominantly fashion goods, often transported by plane, to mostly furniture, which is generally transported by ship. In addition, Otto Group worked on improving its internal planning processes to shorten the time between production and delivery to customer. This made it possible to shift more goods to ocean transport, even seasonal goods. However, disruptions or sudden promotions require the flexibility and speed of aviation. E-commerce has also made demand for goods less predictable and thus transport-planning more challenging.

Drivers

The drivers of the emission reduction strategies of shippers are diverse. Shippers in direct contact with end customers will generally be confronted by the increased awareness and concern of customers with regard to climate change. But even in these companies it is usually the motivation of the company owners – or managers – that drives zero carbon strategies and the company culture necessary to achieve it.

Obstacles

The main obstacle for shippers appears to be the lack of zero carbon transport solutions offered by transport operators. Hardly any operator in road, ocean or air transport is currently able to offer a premium zero carbon transport chain. The only zero carbon freight transport chain that exists in practice would be a combination of rail transport with sustainable last-mile transport powered by bio-fuel or electricity. Shippers interested in zero carbon maritime transport can subscribe to the GoodFuels programme or an occasional service provided by two carriers (Maersk and CMA CGM), but there is little choice.

The interlinkages

It is a challenging task to estimate the carbon emissions of the whole freight transport chain connected to the port of Hamburg. Methodologies for calculating and monitoring the carbon emissions of the different stakeholders vary, so a fully consistent comparison is not possible. This is not surprising considering that carbon emissions monitoring within the different industries themselves is often already problematic. For example, the container shipping industry has widely diverging practices in this respect (Sea Intelligence, 2020). Harmonisation of GHG emissions reporting along the chain would help to increase coherence, but this requires increased collaboration and co-ordination of different groups of stakeholders.

Ports are the nodes where the different transport flows come together, but their share of the carbon emissions of the whole freight transport chain are negligible. For example, only an estimated 1% of the emissions from transporting containers from Shanghai to Prague via the port Hamburg would be generated by terminal handling in Hamburg (Table 1). In this example the largest share of emissions comes from container shipping (84%), despite the fact that it is relatively energy efficient per TEU-kilometre. Hinterland transport via train would generate 6% of the emissions of the container transport chain (HHLA, 2020b).

Table 1. Estimated carbon emissions of container transport from Shanghai to Prague

From/to	Transport leg	Share of GHG emissions
Inland to Shanghai	35 km by truck	3%
Shanghai	Port handling	2%
Shanghai to Hamburg	Ocean shipping	84%
Hamburg	Port handling	1%
Hamburg to Prague	Train	6%
Prague	Inland port handling	1%
Last mile to customer	35 km by truck	3%

Source: HHLA (2020)b.

Targets

The Hamburg port and container terminals have developed ambitious emission reduction targets, which is less the case for other parts of the chain. The port authority and HHLA terminal operator have aligned their targets to the carbon emission reduction target of the city-state of Hamburg: zero carbon emissions by 2040, a target likely to be adopted by Eurogate as well. On the maritime side, only a few carriers have developed a long-term target, the most ambitious of which is zero carbon emissions by 2050 (adopted by Maersk and CMA CGM). The global target, as formulated by the International Maritime Organization, is a reduction of at least 50% by 2050, which falls well short of ambitions as formulated by the Hamburg Port

Authority (HPA). On the landside, most transport operators have not formulated long-term emission reduction targets, the exception being large logistics operators that are dependent on transport companies to realise the most substantial emission reductions (Table 2).

Table 2. Carbon emission reduction targets of companies in the Hamburg transport chain

Organisation	Relative target	Absolute target
HPA		-50% by 2025, compared to 2012 Zero carbon by 2050
HHLA	-30% by 2020, compared to 2008	-50% by 2030, compared to 2018 Carbon-neutral by 2040
Eurogate	-25% by 2020, compared to 2008	
K+N	-15% by 2020, compared to 2010	Carbon neutrality of scope 1&2 by 2020 Carbon neutrality of scope 3 by 2030
Hapag Lloyd	-20% by 2020, compared to 2016	
Otto		-50% by 2020, compared to 2006 Climate-neutral by 2030

Measures

Hamburg can be commended for a range of measures undertaken to reduce the carbon emissions of freight transport. It has managed to ensure a high share of the transport to and from the port is by rail, the legacy of decades of investment in rail tracks within the port and a policy to facilitate port rail transport. The environmentally-motivated exemptions of the port rail infrastructure charges have helped to create demand for hybrid shunting locomotives, and Hamburg's main terminal operators have proactively invested in low-emission yard equipment and cranes. All this has made it possible for certain forwarders to offer practically zero carbon transport chains from the port of Hamburg to its hinterland destinations, something that cannot be realised in many places.

Hamburg – and Germany as a whole – have developed policies to stimulate the use of natural gas in maritime and road freight transport. At the port level, this takes the form of deductions of port dues for LNG-powered vessels. An LNG bunker barge has been acquired for refuelling cruise vessels, and there are plans to develop LNG bunkering facilities in Brünsbuttel, near Hamburg. At the federal level, support takes the form of subsidies and toll exemptions for LNG-powered trucks, and a roll out of LNG refuelling stations for trucks. Although more or less consistently and coherently pursued, this strategy cannot be considered a long-term or even a medium-term solution to mitigate the GHG emissions from transport. Using LNG as a fuel could limit carbon emissions to some extent, but it increases methane emissions, which creates more long-lasting damage to the climate. LNG vessels or trucks could use biofuels, but there will generally not be enough waste or residual products to generate biofuels for a large share of the truck or vessel fleets.

Hamburg could be considered reactive rather than proactive with regard to alternative fuels and energy sources. It is no frontrunner when it comes to onshore power facilities in port terminals or charging facilities for electric ships. It could become a testing ground for a variety of projects related to alternative fuels in shipping, in particular with regards to the port-side infrastructure and facilities needed to facilitate the transition towards zero carbon shipping.

Potential drivers

Many stakeholders in the freight transport chain are interrelated: most companies are either suppliers or customers of companies in freight transport. It is through these linkages that companies could potentially influence the behaviour of other companies. In practice, these linkages are currently not being used to push for decarbonisation. Carbon emission reduction potential is at best considered a secondary criterion in the shipper's choice of transport operators. Carriers do not take carbon emissions into account in their contracts with terminals. Emissions hardly play a role in the concession contracts between ports and terminal operators. And the level of emissions is just one of many indicators in the demand that transport companies articulate to manufacturers of vessels, trains, trucks, terminal equipment, dredgers and pilot boats. Due the strong interlinkages of all stakeholders, the clear articulation of concerns on carbon emissions by one group of stakeholders could rapidly trickle down to the other stakeholders.

There are differences in the regulatory approaches of the different freight transport sectors. In road freight transport, regulation is developed with vehicle manufacturers in mind, whereas regulation in shipping is developed in co-operation with the ship owners and operators rather than with the ship-builders. One can wonder if the transition towards zero carbon shipping is most effectively driven by the demand or supply of zero carbon vessels. It is possible that the International Maritime Organization's practice of co-creating regulation in close consultation with the shipping industry is creating a lock-in into existing solutions rather than a dynamic interaction with vessel or engine manufacturers that have greater interest in innovative solutions.

Compounding this, governments do not use their leverage over shipping companies. The case of Hamburg is a good illustration. The city-state has an ambitious GHG emission reduction strategy and is one of the main shareholders of Hapag Lloyd, yet it does not appear to use this position to push Hapag Lloyd to a more ambitious and proactive stance on GHG emission reductions. A similar remark could be made with regard to the federal government: it provides a specific subsidy to Hapag Lloyd and a variety of support measures to the shipping industry in Hamburg – such as a generous tonnage tax scheme and exemptions of social security payments – without asking for anything substantial in terms of public value in return. Governments should use the leverage they have on the shipping industry via maritime state aid to force the companies they support to engage in ambitious GHG emission reduction measures.

Obstacles

A common challenge for the whole freight transport chain is the higher costs of zero carbon transport activities. Zero carbon freight transport is generally more expensive than the conventional freight transport because negative external costs – such as emissions – are not taken into account but also because of fossil fuel subsidies. Examples include the fuel tax exemptions for the shipping and terminal industry in Hamburg. Such tax exemptions create a lock-in to fossil fuels. An overhaul of the system of incentives in freight transport is needed in order to stimulate the transition towards zero carbon power sources.

Reforms often take time because of considerations about ensuring a level playing field. The idea is that unilateral action, say, by Hamburg or Germany, would be ineffective because it would a substantial number of the freight transport businesses to relocate to other places. Although there is some merit to this argument, it also often leads to institutional lock-in and stagnation. Co-ordination makes sense between the jurisdictions that could realistically be considered competitors in terms of freight transport flows. In the case of the containerised trade flows that pass through the port of Hamburg, competitors are other container ports in north-western Europe (and to a much lesser extent those in southern Europe). Co-ordination at this level would help avoid carbon leakage effects, as it could make sure that the conditions for zero carbon freight transport are similar, e.g. with regard to incentives, taxation, regulations and deployed technologies.

Policy implications

Three major players could make Hamburg more effective in directing the transition towards zero carbon supply chains: the port authority, the city administration and the federal government.

A proactive strategy from the port authority

The Hamburg Port Authority (HPA) could play a more pro-active role in driving the decarbonisation of the freight transport companies using the port of Hamburg. This would require a strategic orientation: instead of focusing almost exclusively on its own emissions, it could leverage its position as a key node where a multitude of freight transport flows come together. It could develop a clear strategy aimed at stimulating zero carbon road, rail and maritime freight transport. This could take several forms. The HPA could systematically measure and monitor airborne emissions – including GHG emissions – from ships, trucks and trains using the port – and report about it regularly, like the Port of Los Angeles. HPA could encourage major port users to develop targets in line with its own target of zero carbon emissions by 2040. It could develop a multitude of measures that stimulate zero carbon freight transport. This could include pilot projects to stimulate innovations, technology transfer programmes, roll out of relevant supporting infrastructure and coherent incentive schemes, properly evaluated for effectiveness.

The HPA should focus on possible long-term solutions instead of stimulating transition fuels. It is unclear how its current focus on facilitating LNG will help to achieve its ambitious zero carbon target by 2040, as the potential to reach this goal via LNG is limited. Its projected installation of onshore power facilities should be considered in a longer-term context of battery-powered ships: could these investments be used as a catalyst for electrification of certain categories of ships calling at Hamburg, for example, short-haul shipping in the North Sea and Baltic region? An example of an ambitious roll-out of electric charging systems in ports is the case of Norway (Box 1).

Box 1. Roll-out of electric charging systems for electric ships in Norway

In Norway, batteries, electrification and shore power projects in ports are all funded with the goal of greening maritime transport. The agency Enova, whose allocations from 2017-19 were NOK 10.4 billion (EUR 1.0 billion), of which NOK 2.7 billion (EUR 270.0 million) was for the transport sector. By the end of 2019, Enova had allocated more than NOK 500 million (EUR 49.6 million) for battery installation and other energy efficiency measures in about 75 vessels, along with a small number of fully electric vessels. In terms of funding commitments, Enova has awarded more than NOK 900 million (EUR 89.2 million) for the electrification of 39 ferry connections with 52 associated ferries. Between 2015 and 2019, it supported 89 onshore power projects in more than 60 Norwegian ports with more than NOK 600 million (EUR 59.5 million).

Source: ITF (2020).

A proactive port strategy could benefit from an incentive scheme with stronger positive and negative incentives. Existing schemes provide deductions from port fees (for ships) or infrastructure charges (for rail operators). These incentives are often relatively small, begging the question if they have any effect at all (ITF, 2018). Incentive schemes could have larger effects if there are substantial differences in price to pay. This could be by not only using bonuses but also so-called maluses to dissuade undesirable behaviour, along the lines of the incentive scheme in Bergen (Box 2).

Box 2. Environmentally differentiated port fees

Various ports throughout the world have introduced environmental discounts on port fees. The impact of most of these schemes is marginal, as the difference for the best and worst performing ships is too small: most schemes only provide incentives for a few vessels and no penalties for the ships that have poor environmental performance (ITF 2018).

Truly environmentally differentiated port fees are relatively new and for the moment restricted to cruise ships calling at Norwegian ports. This practice is based on an index developed by Norwegian ports, called the Environmental Port Index (EPI). Unlike previous indexes such as the Environmental Ship Index (ESI) and the Clean Shipping Index (CSI), the EPI measures the actual operational efficiency of a ship at port. Moreover, various Norwegian ports have developed a pricing structure that allows for a wide spread between the best and worst performing ships. For example, in the ports of Bergen and Stavanger, the best performing ships get a 17.5% rebate and the worst performing ships a 150.0% surcharge on the general port tariff.

Source: ITF (2020).

Stronger involvement of the city administration in zero carbon freight

The city-state of Hamburg could be one of the driving forces in the decarbonisation process of container shipping. Its ownership of the HPA and the majority of shares in HHLA has resulted in an alignment of the emission reduction targets of the city, the port and the HHLA port operator, driving change towards zero carbon port activities. Moreover, as one of the shareholders in the shipping firm Hapag Lloyd, the city-state of Hamburg could use its leverage to make the company to commit to a more active GHG reduction strategy.

The city-state of Hamburg could also initiate a co-ordination group of port-cities to develop common policies. Such a network could include port-cities that own ports that can be considered competitors, such as Rotterdam, Antwerp, Amsterdam, Zeebrugge, Bremerhaven and Gothenburg. Co-ordination on decarbonisation policies would be needed to avoid potential leakage effects of measures taken in isolation. Co-ordination could take place with regard to port-city measures to stimulate zero carbon freight transport, such as developing incentive schemes, charging and refuelling infrastructure, and regulation of ships, trucks, trains and barges.

Facilitation of zero carbon freight transport by the federal government

The federal government could help the transition to zero carbon supply chains by phasing out fossil fuel subsidies. The shipping industry benefits from an exemption from the fuel tax. Yet as this tax exemption does not apply to renewable energies or electricity, it locks the shipping industry in a fossil-fuel energy trajectory. Terminal operators are also exempted from a fuel tax, which runs counter to efforts to decarbonise the sector. In addition, the federal government provides subsidies and toll exemptions for gas-powered trucks. It also provides maritime state aid without strings attached. All these support measures require an overhaul to make sure that they facilitate the transition to zero carbon operations. What this could mean is: abolishing fuel tax exemptions and subsidies or transforming them into support for zero carbon power sources. An example could be to attach carbon emission reduction criteria to the tonnage tax, a shipping-specific tax regime (Box 3).

Box 3. Greening tonnage taxes

A tonnage tax is a specific tax for the shipping sector that replaces a regular corporate income tax. The tax base is the net tonnage of the ships that a shipping company operates (hence the name of the tax) rather than corporate income or profit. The tonnage tax is favourable to the shipping sector as it results in lower tax burdens than those incurred by a regular corporate income tax. As such, it has become one of the main mechanisms to subsidise the maritime sector in recent decades. While Greece has had a tonnage tax since 1957, many European countries only started to introduce a tonnage tax after the Netherlands put one in place in 1996. Currently, more than twenty EU countries have introduced a tonnage tax, and certain non-EU countries have done so as well (e.g. Japan, the Republic of Korea and India).

The tonnage tax schemes of some countries are differentiated according to the environmental performance of ships. In Norway, a shipping company can obtain a reduction of the standard tonnage tax of up to 25%, dependent on the environmental rating of their ships. This incentive aims to reward companies for exceeding the mandatory requirements with regard to the environmental performance of their ships. In Portugal, in the case of ships with a tonnage of more than 50 000 net tonnes that use mechanisms for preservation of the marine environment and climate change mitigation, a reduction of up to 20% of the amount of the tax base can be granted. Other tonnage tax schemes provide incentives for younger ships, which could facilitate GHG emission reductions if new ships are more energy efficient than existing ones. For example, the tonnage tax scheme in Malta provides a reduction from the standard tonnage tax rate when the ship is less than 10 years old and increases the tonnage tax when then ship is 15 years old or more.

Source: ITF.

Certain EU initiatives could help such an overhaul. The European Commission is currently reviewing its energy taxation regulation, including the requirement that ship fuel should be exempted from taxation. Abolishing the ship fuel tax exemption would help the costs of zero carbon and conventional fuels to converge. Another measure that could help is the announced insertion of shipping into the EU emissions trading system (EU ETS). Germany’s support for such measures could facilitate the transition towards zero carbon supply chains.

References

BSR Clean Cargo (2020), "2019 Global Container Shipping Trade Lane Emission Factors", Clean Cargo.

Camuzeaux, J. et al. (2015), "Influence of Methane Emissions and Vehicle Efficiency on the Climate Implications of Heavy-Duty Natural Gas Trucks", Environmental Science & Technology, Vol. 49, pp. 6402-6410.

CDP (2019), "A Sea Change: Which shipping companies are ready for the low-carbon transition?", London.

Eurogate (2017), "Sustainability Report 2016. Consciously into the future", Eurogate Group, Bremen.

Eurogate (2018), "Consciously into the future. Update 2017. Sustainability at Eurogate", Eurogate Group, Bremen.

Eurogate (2019), "Consciously into the future. Update 2018. Sustainability at Eurogate", Eurogate Group, Bremen.

Girard, H., Oostra, J. and J. Neubauer (2008), "Hybrid shunter locomotive", Proceedings of the 8th World Congress on Railway Research, Seoul, Korea.

Hapag Lloyd (2018), "Sustainability Report 2017", Hamburg.

Hapag Lloyd (2019), "Sustainability Report 2018", Hamburg.

Hapag Lloyd (2020), "Sustainability Report 2019", Hamburg.

Hesse, M. (2018), "Focal firms, grand coalitions or global city makers? Globalization vs. new localism in Hamburg's maritime network", in Hoyler, M., Parnreiter, C. and A. Watson (eds.) (2018), Global City Makers. Economic Actors and Practices in the World City Network, Edward Elgar Publishing.

HHLA (2013), "Sustainability Report 2012", Hamburger Hafen und Logistik AG.

HHLA (2014), "Sustainability Report 2013", Hamburger Hafen und Logistik AG.

HHLA (2015), "Sustainability Report 2014", Hamburger Hafen und Logistik AG.

HHLA (2016), "Sustainability Report 2015", Hamburger Hafen und Logistik AG.

HHLA (2017), "Sustainability Report 2016", Hamburger Hafen und Logistik AG.

HHLA (2018), "Sustainability Report 2017", Hamburger Hafen und Logistik AG.

HHLA (2019), "Sustainability Report 2018", Hamburger Hafen und Logistik AG.

HHLA (2020), "Sustainability Report 2019", Hamburger Hafen und Logistik AG.

HHLA (2020b), "HHLA Terminals as Part of the Transport Chain", presentation, Hamburger Hafen und Logistik AG.

HPA (2018), “Taking Action, Creating Values; Sustainability Report 2017-18”, Hamburg Port Authority, Hamburg.

HPA (2020), “*Klimastrategie 2.0 – Klimaschutz und Klimaanpassung*”, Hamburg Port Authority, Hamburg.

IMO (2018), “Initial IMO Strategy on the reduction of GHG emissions from ships”, International Maritime Organization, London.

IMO (2020), “Fourth IMO GHG Study. Final Report”, International Maritime Organization, London.

ITF (2018), “Reducing Shipping Greenhouse Gas Emissions. Lessons from Port-Based Incentives”, International Transport Forum, Paris.

ITF (2020), “Navigating towards Cleaner Maritime Transport. Lessons from the Nordic Region”, International Transport Forum, Paris.

ITF (forthcoming), *Transport Outlook 2021*, International Transport Forum, Paris.

Krämer, I. (2019), “Shunt-E 4.0 – Autonomous Zero Emission Shunting Processes in Port and Hinterland Railway Operations”, Journal of Traffic and Transportation Engineering, Vol. 7, pp. 157-164.

Mazzone, A., Schönbacher, M. and X. Larrea (2018), “Future Freight Locomotives in Shift2Rail – Development of Full Electric Last Mile Propulsion System”, Proceedings of 7th Transport Research Arena TRA 2018, April 16-19, Vienna.

Merk, O. and M. Hesse (2012), “The competitiveness of global port-cities: The case of Hamburg”, OECD Regional Development Working Papers, 2012/06. Paris: OECD Publishing.

Mottschall, M., Kasten, P. and F. Rodriguez (2020), “Decarbonization of on-road freight and the role of LNG from a German perspective”, Öko-Institut Institute of Applied Ecology, The International Council on Clean Transportation (ICCT), Berlin.

OECD (2021), “Accelerating Climate Action: Refocusing Policies through a Well-being Lens”, OECD Publishing, Paris, https://doi.org/10.1787/2f4c8c9a-en.

Zero Carbon Supply Chains

This report assesses the potential of zero carbon supply chains via a case study of the freight transport chain linked to the port of Hamburg. It analyses the initiatives taken by selected main stakeholders to decarbonise freight transport. In addition, it offers recommendations on how the move towards zero carbon supply chains could be accelerated.

International Transport Forum
2 rue André Pascal
F-75775 Paris Cedex 16
+33 (0)1 73 31 25 00
contact@itf-oecd.org
www.itf-oecd.org

Published: 06/2021 | Photo credit: TimSiegert-batcam | Shutterstock