WORKING PAPER: CLEAN AIR IN PORTS

This working paper of the NABU LIFE+ Project *Clean Air in Ports* aims at to collect and discuss measures that can be undertaken to reduce the air pollution from ports. Please note that at this point the paper is under construction and will be supplemented piece by piece. This paper by no means claims to cover all subjects completely, but instead asks for the input and thoughts of the reader.

INTRODUCTION

In September 2012, the German Nature and Biodiversity Conservation Union (NABU) and eight environmental organizations from six European countries started the EU-LIFE+ project "Clean Air", campaigning for better air quality throughout Europe. With its project *Clean Air in Ports* NABU contributes to this EU LIFE+ project. Cleaning up the air in European ports will help the environment, the climate and the health of local residents.

This paper aims to give an introduction to the problem and challenges of air pollution in ports and to collect possible measures for different stakeholders:

Which emissions pollute the air in ports?
Who are the emitters?
Which measures can be taken?
Are there best practices so far?

Over the three year period of the project, measures, best practices and examples for clean air in ports shall be collected, discussed and then integrated into this paper. One resource for this paper are the six workshops in European Port cities that NABU holds as part of its project:

2013 in Hamburg (Germany) and Antwerp (Belgium)
2014 in London (Great Britain), the European Green Capital Copenhagen (Denmark) and Barcelona (Spain) (tbc)
2015 in Gdansk (Poland)

As a result at the end of the project, this paper will be turned into a brochure Clean Air in Ports.

1. AIR POLLUTION IN PORTS – WHAT ARE THE HARMFUL POLLUTANTS?

In Europe, more than 500.00 people die each year prematurely because of air pollution. Especially in cities the air is often very much contaminated. In port cities the ports contribute massively to air pollution. But it is not only the ships that pollute the air with emissions from fuels that are up to a thousand times dirtier than road fuels. In the operating range of ports shunting locomotives, wharfage cranes or heavy truck traffic from the logistics sector are additional significant emitters.
Air pollution is a problem of many different pollutants. The project *Clean Air in Ports* focuses on three of them that are dangerous for human health, the environment and the climate: ***sulfur dioxide (SO_2), nitrogen oxides (NO_x)* and *Particulate Matter (PM)*, with its subcomponents *PM10, PM2,5* and *Black Carbon (BC*).**
Carbon dioxide (CO_2) is not a 'traditional' air pollutant, but of course a polluting gas, especially for the climate (*greenhouse gas*). The NABU project and this paper focus are dealing with 'traditional' air pollutants and will not take CO_2 into account. Still, CO_2 emissions from ports and ships are enormous and must be reduced. Although it should be noted that there is a big overlap: Many measures aiming to reduce air-polluting emissions in ports also reduce CO_2 and vice versa. Actually, most measures aiming to improve energy efficiency, thus reducing energy consumption, will have benefits in terms of air pollution. Although emission factors may depend on combustion conditions etc., pollution in this case is often related one way or the other to the use of energy or fuel.

1.1 Sulfur oxides

SO_x emissions can be blown very far distances by the wind. That's how coastal regions get polluted with emissions from shipping and ports. When SO and SO_2 are oxidised in SO_4, they form sulphate aerosols which are so small that they belong to the group of Particulate Matter.
The 2008 Air Quality Directive 2008/50/EC (article 22) sets the one-hour limit for sulfur dioxide at 350 $\mu g/m^3$ which may be exceeded 24 times a year tops. The daily limit of 125$\mu g/m^3$ may not be exceeded more than three times a year.

1.2 Nitrogen oxides

NO_x arises during fuel combustion in engines of ships, construction machinery, locomotives and trucks. If combustion time and temperature increase, NO_x emissions also rise. Having passed a certain temperature threshold, the increase grows rapidly.
The 2008 Air Quality Directive 2008/50/EC (article 22) sets a European-wide one-hour limit for NO_2: 200 $\mu g/m^3$ which may not be exceeded more than 18times a year. Accompanying this, the limit per year is a daily average of 40 $\mu g/m^3$.areas (river mouths). In Hamburg, for example, ships alone account for 38% of the NO_x emissions.

1.3 PM and soot emissions

PM are small particles, that are – depending on their size – classified as PM10, PM2,5 or PM0,1. PM not only develops when diesel is burnt, but also when certain pollutants meet other substances. This form of PM is called "secondary particulate matter".
When it comes to legislation and limits, only PM10 is regimented today: the average value is limited at 40 $\mu g/m^3$ (per year) and the daily average value of 50 $\mu g/m^3$ may not be exceeded on more than 35 days per year.
In Hamburg, for example, ships account for 17% of the PM10 emissions, including secondary PM. Black Carbon (BC) is a component of PM..

2. Effects of Air Pollution: Health, Environment and Climate

2.1 Health effects of air pollution

The emissions from diesel engines contribute widely to the big number of people who die each year prematurely because of air pollution:

- In June 2012 the World Health Organization (WHO) published a report that confirmed diesel exhausts as **carcinogenic**.
- Emissions of sulfur dioxides(SO_2) are respiratory irritants and co-responsible for increased mortality rates, for example in the coastal areas of North America and Europe.
- **NO_x** emissions diminish the function of the lungs and increases the risk of of cardiovascular diseases. It also is a precursor of O_3 (ground level ozone) which is very dangerous for human health. It can cause an irritation, impairment and inflammation of the respiratory system, headaches, an impairment of physical ability and an increase in the frequency of asthma attacks.
- PM emissions cause more frequent asthma attacks, chronic bronchitis, lung cancer. They worsen heart- and lung diseases. It is assumed that children get more infections of the middle ear. In general, morbidity and mortality increase with more PM. The smaller the particles are, the deeper they get into the lungs where they cause the more serious consequences. It is likely, but not scientifically proofed that PM ends up in the blood stream, too.
- Respiratory problems, heart attacks, lung cancer and low birth weights are health effects associated with **Black Carbon**[i]

Latest scientific work of the virtual Helmholtz-Institute on the effects of high emission concentrations in breathing air, presented at the first workshop Clean Air in Ports workshop in Hamburg, used for the first time a new method for exposing human lung cells directly to emissions. Results show that the risks of NO_x and soot emissions are way higher than estimated before.

2.2 Environmental damage of air pollution

Emissions of sulfur oxides (SO_x) respectively sulfur dioxide **(SO_2)** are harmful to plant vegetation and cause acid rain. High concentrations of nitrogen oxides **(NO_x)** cause eutrophication of lakes, soils and coastal areas (river mouths) and acidification of soils. Ground level ozone (**O_3**), that develops from NOx, is very dangerous for plant vegetation. Recent research found that **PM** emissions contribute to forest decline[ii].

2.3 Global Warming and air pollution

Especially Black Carbon particles are harmful for the climate: Some of them get carried to the Arctic, where they settle on the white snow surfaces. This leads to a warming of the surrounding areas and a minimization of the reflection of the sunlight, thus also increasing the warming. Black Carbon is made responsible for 40% of Arctic warming.

NOx is also contributing to climate change, since it is the precursor of **O_3** that is very harmful for the climate.

3. REGULATIONS

When it comes to laws and regulations regarding air pollution in ports, the following directives are relevant:
→ The Council Directive 2012/33/EC as regards the sulfur content of marine fuels, limiting the sulfur content of marine fuels in ports to 0,1% (when at berth for two or more hours)
Two major European directives are dealing with air pollutants:
→ The European Ambient Air Quality Directive (2008/50/EC) defines limit values for the three emissions (and some more) that are valid from 2012 onward.
→ The European NEC Directive (2001/81/EC), which defines National Emission Ceilings (NEC). Member states of the European Union have to adopt programs to comply with these ceilings.

4. WHAT ARE EMITTERS IN PORTS?

There are several sources for air pollution in ports and in every port the different emitters have different shares on the air pollution. The *Clean Air in Ports* project limit its scope to emitters of PM, SO_2 and NO_x that belong to immediate port-business: Non-road-mobile-machinery (NRMM) such as construction machineries and van carriers, ships (high sea and inland), barges, lorries, trains, conveyor vehicles, cars. Their engines are mostly diesel powered and the burning of diesel causes a lot of PM, SO_2 and NO_x emissions.
In this context it is important to know that the dirtiest fuel burnt is ship fuel with a maximum allowed sulfur content of up to 3,5% (heavy fuel oil, HFO), when sailing outside Emissions Control Areas. This is up to 3.500times dirtier than fuel allowed for cars and trucks.
The *Clean Air in Ports* project will not deal with other emission sources such as turnover business. The following passages present possible measures for cleaning up the emissions from the different sources, followed by overall port- strategies and policy instruments.

5 MEASURES FOR SINGLE EMITTERS

5.1 Trains

Technical measures

5.1.1 Emulsified diesel for trains

Emulsified diesel reduces the fuel consumption. Fuel and air get mixed better and therefore burn more efficient. The advantage is that there are almost no changes on board necessary.

5.1.2 Locomotives with idling control

If a locomotive has an idle control built in, the main engine can be shut down when not in use, and a smaller, more efficient diesel engine operates instead. It ensures that oil and fuel are available and that the water temperature is proper. This technique safes fuel and minimizes noise.

5.1.3 (Diesel-) Electric Locomotives

Diesel-electric locomotives consume less fuel whereas electric locomotives do not need fuel at all – they are powered by electricity. Only if it is electricity from renewable sources, it reduces air pollution.
Example: The inland *port of Magdeburg* has the first diesel-electric locomotive that is supposed to save up to 40 percent fuel (and by that refinances its own investment costs). The energy comes from a windmill build on the site of the port.

5.1.4 Light freight wagons

If wagons are built lighter, they need less energy to be moved.
Example: *The Hamburg Hafen und Logistics AG (HHLA),* together with a company, developed a lighter train carrier that can carry 10% more load and by that saves 10 % CO_2 and other emissions.

5.2 Trucks

Organisational measures

5.2.1 Efficient coordination of the arrival and departure

If arrival and departure of trucks is coordinated so that trucks drive the shortest ways and don't drive empty when not necessary, a lot of fuel and thereby emissions can be saved.

Technical measures

5.2.2. After-treatment systems for exhaust fumes for trucks

Most trucks have a diesel engine that causes a lot of soot emissions. Due to their bigger size and the bigger size of their engine, their soot emissions are up to 30 percent higher (per km) than those from cars. Trucks can be retrofitted with particulate filters, and the technology for this is on the market, but the current EU-regulations do not require the (retro)fitting so far. From 2013 onwards, at least new built trucks have to have a particulate filter.
Trucks also cause a lot of NO_x emissions. In ports the emissions are especially high because slow driving causes more NO_x emissions - and trucks cannot drive very fast in ports. The EU regulation for NO_x from trucks has not been ambitious in the last years – again, from 2013 on and only new built trucks have to follow a stricter emission standard.
One measure could be that the port authority allows only "clean trucks" in the harbour area: For example it would only allow trucks with the EURO V standard and a particulate filter and an SCR or alternative drive technologies enter. Dirtier trucks are either not allowed to enter the port or have to pay a pollution fee.
Example: The *Port of Los Angeles* started a program in 2008 that successively banned trucks who did not meet certain standards.

5.2.3. Alternative drive technologies

An alternative to diesel-powered trucks are LNG-powered trucks.

5.2.4 Electric Cars and Trucks

The use of electric cars and trucks saves a lot of air emissions, since those automotives don't cause fumes. Those vehicles are good for the air only if the energy is produced from renewable sources– if it is produced by coal power plants the air pollution problem is only relocated to a different place. Another way to charge the batteries of electric vehicles is to use fuel cells (s. 5.3.4.). They don't serve as a gear but for charging the batteries of the electric vehicles.

Examples: The *port of Magdeburg* uses electric vehicles with exchangeable batteries, so charging the batteries does not use time.
The *HHLA* has the biggest fleet of electronic cars of the northrange ports.

5.3.5. Fuel switch for cars and trucks

Cars and trucks can either switch to a cleaner diesel fuel mixed with sustainable bio fuels. Or the fleet in a port can switch from gasoline to compressed natural gas-powered vehicles.

5.3 CRANES, VAN CARRIER AND OTHER NRMM

Organisational measures

5.3.1 Efficient coordination of the processes of loading and deloading of ships

By optimizing the processes of loading and deloading ships, a lot of fuel can be saved.
Example: The *HHLA* saves through that measure, mostly transporting by more containers on one voyage of a carrier, fuel in a six-digit number.

Technical measures

5.3.2. Ultra-low-sulfur diesel only together with particulate filter in NRMM

(Retro)fitting with a particulate filter is possible for most of the construction machineries and inland ships. The prerequisite, the use of a cleaner fuel, is already mandatory.

5.3.3. Gas-fuelled forklifts

Forklifts can be fuelled with liquefied petroleum gas (LPG), propane gas or natural gas. The advantage of this is not only that it causes almost no air pollutant emissions, but that it is very quiet, too. Within buildings, this way of cargo handling is done since quite some time in order to protect the workers from poisonous emissions.

5.3.4. Fuel Cells

Fuel cells generate energy through an electrochemical reaction between hydrogen and oxygen that causes just water and heat. Fuel cells meet or even exceed environmental standards set for example by the US Environmental Protection Agency (EPA) for emissions, efficiency, and noise. At ports, they can be used instead of diesel generators (s. 5.2.4. and 5.4.8., too). Fuel cells have efficiencies up to 53 percent, little noise, and zero emissions of sulfur dioxide, nitrogen oxide and particulates.

53.5. Diesel/Electric Machinery

Several electronic machineries can be equipped with electronically drives: Container bridges, cranes for storage and trains, Automated Guided Vehicles (AGV- for container) and diesel-electric van carrier (VC- Add Blue Technology). It is important that the energy for those electric devices needs to come from renewable energies.
Example: The *HHLA* has all this equipment in place.

5.4 TUG BOATS, HIGH SEA- AND INLAND SHIPS

Organisational measures

5.4.1. Slow Steaming (high sea ships)

In general, slowing down can save a relevant quantity of fuel and avoid costs and emissions. A port can require ships to slow down when entering the port waters.

Examples: *The Port of Long Beach (California)* set up an incentive program for ships to slow down when entering a zone 40nm around the port. The Californian Air Ressources Board (CARB) estimated in a study that if all ships were to reduce their speed to 12 knots starting 40nm outside the port, the air pollution would be decreased: PM by 31%, NO_x by 36%, SO_x by 29%. It has to be taken into consideration that most ship owners stated in a survey that they would speed up once they left the 40nm zone, which would diminish or even undo the effects on air quality. This leads to considerations of having a general speed reduction and/or combining speed reduction in ports with Virtual Arrival (below).

5.4.2 Virtual Arrvial(high sea ships)

So far, ships just head for a port and when reaching it, often have to wait outside the port until there is a slot for them to berth The new concept of *Virtual Arrival* uses weather analysis and algorithms to calculate and agree a notional vessel arrival time, so that the ship will arrive 'just in time'. By introducing this slot system, ships can optimize operations: they plan their journey and book a slot in advance. This means they can save waiting time and in addition use less fuel. This may lead to a radical reduction in (bunker) fuel consumption and emissions On the other hand, this management can lead to less congestion and more safety in a port.

5.4.3 ECAs

Emission Control Areas (ECAs) are sea areas, where the amount of a kind of emissions is limited. ECAs are introduced by the IMO. In Europe there are three SECAs (SO_2 Emission Control Area) so far: in the Baltic- and the North Sea and the English channel. They were as well introduced by the IMO and put into European law by the directive 2012/32/EC, that also regulates the sulfur content of ships berthing at a port for more than two hours. It is necessary to have SECAs all around Europe and also to introduce NECAS (NO_x Emission Control Areas) in all European waters.

	IMO			EU		
	2012	**2015**	**2020**	**2012**	**2015**	**2020**
Non-SECAs	**3,5%**	3,5%	0,5%[1]	**3,5%**	3,5%	0,5%[2]
SECAs	1,0%	**0,1%**	0,1%	1,5%	**0,1%****	0,1%[2]
Passenger Ships[3]	-	-	-	1,5%	1,5%	**0,1%**[2]
At berth				0,1%	0,1%	0,1%

Technical measures

The dirtiest fuel in ports is burnt by ships with a maximum allowed sulfur content of up to 3,5% (heavy fuel oil, HFO), when sailing outside Emission Control Areas. At berth (in Europe), ships can use fuels with a maximum of 0,1% sulfur – compared the sulfur content of diesel for vehicles is limited to 0,001%. It is estimated that all ships worldwide burn 250m. tons of HFO.

Contrary to the impression one might have, ships are sailing close to shore most of the time. Their emissions get carried up to 400 km inland. The transport of this pollution is done by the wind and may vary according to climatic conditions. Emissions from ships are estimated to cause up to 50,000

premature deaths in Europe every year. Ports that can only be reached through one single river, like the ports of Hamburg, Rotterdam and to some extent Antwerp, are more incriminating for the people living in that area.

5.4.4. Use of low sulfur-diesel (high sea ships)

Even though high-sea-ships at berth in Europe can use fuel with "only" a maximum sulfur content of 0,1% this still is a problem because this fuel is still very dirty compared to road diesel (0,001% sulfur) and ships can switch to HFO as soon as they leave a port – unless they are in a SECA where the limit is 1,0%, but that is still dirty enough. Although cleaner fuels lead to reductions in harmful emissions, this is not sufficient. BC and NO_x emissions are still too high.

5.4.5. Soot particulate filter

The installation of a soot particulate filter can reduce soot emissions from a ship almost completely. A prerequisite for the installation of such a filter is the use of distillate fuel. For ocean going vessels soot particulate filter are ready to use, but no ship has ever built one in. Some smaller ships as those in ports (fire brigades, tugs) and inland ships already sail with soot particulate filters.

5.4.6. Selective catalytic reduction systems (SCRs)

SCRs eliminate most of the NO_x emissions from the ship`s exhaust fumes. The fumes need to have a certain temperature for the SCR to function. Soot particulate filters and SCRs can be combined. About 300 ocean-going vessels already have an SCR built in.

5.4.7. Seawater scrubbing

So called "scrubbers" wash the ship's exhaust gases in a subsequent treatment process and thus clean it from harmful particles and residues. Ships can be retrofitted with scrubbers, but not many shipbuilders invest into that at the moment. Scrubbers can reduce the sulfur emissions by 70 to 95 percent and even PM and NO_x emissions to some extent.
Wet scrubbers need a lot of sea water that is discharged back to sea after the treatment. *Dry scrubbers* filter the fumes and by that produce some sort of waste that needs to be disposed of in a harbour. Not many harbours have facilities for this kind of waste.
Since scrubbers lower the temperature of the exhaust fumes, they cannot be combined with an SCR, the abatement technology for NO_x (see 5.4.6.). Scrubbers produce the left-over substance "sludge" that has to be carried onboard until it can be disposed of on shore.

5.3.8. Fuel Cells

S. 5.3.4.: Fuel cells generate energyand may be used them for for bringing in ships where they have to steam slow.

5.4.9. Liquefied natural gas (LNG) as ship fuel

Liquefied Natural Gas (LNG) can be used as a fuel for ships. It reduces the emissions of the three air pollutants focused in this project: there are no sulfur emissions and the emissions of PM and NO_x can be reduced up to 90%. But the effect on the climate is discussed controversial, because the so called "methane slip" may be as bad as CO_2 emissions from HFO: Methane is a greenhouse gas gas that gets emitted to some extent when LNG is used and handled. It is about 25more times harmful for the climate than CO_2 (timeframe: 100years). So if a lot of Methane gets emitted, LNG is more harmful for the climate than CO_2. A study by the IMO (2009) says that the methane slip reduces the net global warming benefit from 25% to 15%.
Further, security matters are currently under discussion, not only for the ships but also for the handling in the supply chain.

A study by Llyod Registry[1] predicts that by 2025 there could be 653 deep sea, LNG-fuelled ships in service, consuming 24m tones of LNG annually. These ships are most likely to be containerships, cruise vessels or oil tankers. But LNG is another fossil fuel which will be exploited at some point. Other forms of producing gas in order to cover the supply (shale gas,fracking) have many downturns for the environment and are discussed very controversial.

5.4.10. Power supply from land

Many ships, in particular cruise ships, have to keep their engines running when in port in order to supply on board equipment with energy. When they get connected to power supply from land or a barge (LNG), ships can shut down their engines and by that reduce their emissions of air pollutants at least for the time berthing. But soon as they lift the anchor, ships have to use fuel again and often can use HFO.

a) Cold ironing/Onshoe PowerSupply (OPS)

Cold ironing provides ships with electricity at berth so they can shut down their engines. For example, one cruise ship needs as much power as one ICE train (high speed train). For one OPS it is not necessary to build an additional power plant. But the power for an OPS must be produced by renewable energies, otherwise the air pollution is just shifted to the location of the power plant. After many years of negotiations, an international standard for cold ironing was adopted in 2012, making it more attractive for ports and ship owners to invest. Still, the energy management is crucial but difficult when running an OPS

Example: The municipal energy supplier „*Stadtwerke Lübeck*“ developed an OPS in the port of Lübeck, even though there was no standardization at that time.. Recently they are trying –together with the port of Hamburg- to get an exemptde from energy taxes for the energy used at the OPS. It’s a good example for the collaboration of ports. Lübeck is planning to install more OPS sites.

The *port of Stockholm*, who was represented at the workshop in Hamburg, had their first OPS up and already running in 1985.

b) Shore-side/barge-side electricity-supply with “liquefied natural gas” (LNG)

Energy is produced from LNG on shore or on a barge and then delivered to a ship, so it can shut down its engines while at berth and by that reduce its emission of air pollutants. The same concerns for methane slip and security account for such electricity supply as mentioned above (LNG as ship fuel). The technical infrastructure for this energy supply is simpler compared to shore-side electrical power (below) and already implemented in some places.

At the workshop in Hamburg in February 2013, the company *Future Ship* presented its concept of LNG barges for the port of Hamburg, which shall be implemented within the next years.

5.4.11. Ships with kites (high sea ships)

There are some projects going on to drive ships, also container ships, by wind . In combination with an engine, this can be quite successful.

5.5 MEASURES FOR THE WHOLE PORT

Organisational measures

5.5.1. Energy efficiency

Most forms of energy efficiency also reduce air pollution. When less fuel is burnt, fewer emissions are set free. Further, if electric energy is managed in an intelligent way, it is possible to restore parts of the energy for example while lowering heavy charges.

5.5.2. Awareness raising and training of employees

One relevant measure to enhance environmental changes –for air pollution and others- is to raise the awareness of all people working in a port (for companies doing business in the port, the port authority or for shipping companies) about the topic. Each person can contribute and make a change, for example by saving energy or by bringing up ideas for cleaning up the air. Building up on this, employees should be trained about air pollution measures in their specific field of work.
Examples: The *HHLA* and *Eurogate* do such trainings.

5.5.3 Include ports into Low Emission Zones (LEZs)

A political measure would be to include ports into Low Emission Zones (LEZs). This could mean stricter regulations for diesel engines, for example only EURO V trucks are allowed in the port or NRMM have to have a particulate filter. It also would imply a reduction commitment and monitoring stations.

Technical measures

5.5.4. Electric equipment wherever feasible (energy from renewables)

This measure eliminates all harmful air pollutants, but only if the energy comes from renewable sources.

5.5.5 Passive –houses

Even for buildings measures can be undertaken to save energy and thereby reduce harmful air pollutants. A passive house does not use energy at all.
Example: The *Hamburg Port Authority (HPA)* built such as house with offices in 2013.

5.5.6.. General Power supply from alternative sources

As ports implement cold ironing and successively power machinery, trucks and trains with electricity, it is very important that this energy comes from renewable sources such as solar, wind and water power and not from coal fired power plants (s. 5.4.10.a). Some ports already have windmills or solar panels on their ground. Ideally all energy used in a port comes from renewable sources.

Examples: The inland *port of Magdeburg* has a windmill that directly supplies the new electric locomotive (below), the excess energy is delivered into the general net. *The HHLA* has solar panels on industry buildings that supplied more than 10.000kwh in 2012. By that, HHLA has the third biggest solar panel in the city of Hamburg

Port Policy

5.5.7. Incentives for a modal shift

The port authority can set incentives to transport more goods on trains instead of lorries. Again, this is only an advantage if locomotives are cleaner (see 5.1.). Also, if the inland ships run on clean(er) fuel and are equipped with an SCR and a DPF, the port authority can set incentives to transport more goods on inland navigation ships instead of lorries.

5.5.8 Develop a general emission reduction strategy or an environmental policy for the port

There are some ports that have given themselves their own air quality strategy. As a first step it is important to calculate the emissions of a port and attribute it to different sources. Than a plan must be developed, how much emissions should be reduced until when, where and possibly how. It is crucial to have a valid monitoring system for such a project.
Examples: The *Port of New York/New Jersey*, *the Port of Long Beach (Los Angeles)*, together the *Port of Seattle*, *Port of Tacoma* and *Port Metro Vancouver* (Northwest Ports Clean Air Strategy). The *HHLA* aims to develop a zero emission terminal.

5.5.9. Economic Instruments: Ecological Port Fees for Ships

The idea of an environmental port fee is that ships get a reduction in their port fee if they fulfil certain ecological requirements.
Example: The *Port of Turku (Finland*K grants a reduction in the port fee if the sulfur content of the fuel used is <0,5% or if the nitrogen content is below 10g/kWh.

6. Port Policy between Ports

One general problem is that most ports are competitors about ships calling. But for cleaning up the air, it is necessary that they network and tune measures.

6.1. Environmental Port Index

Within the "*Clean Baltic Sea Shipping*", the "*Environmental Port Index*" will be developed until the end of 2013. Until then it collects best practices and identifies *Key Performance Indicators* (KPIs). Amongst other goals, it aims at "creating a joint strategy for differentiated port dues and reducing ship-borne air pollution at sea, in ports and in cities"[iii]. So far, nine ports are participating in the project and more are to come.

6.2. The World Port Climate Initiative (WPCI)

The "*World Port Climate Initiative" (WPCI)* was founded in 2008 out of the "*International Association of Ports and Harbors" (IAPH)*. It provides best practice in monitoring greenhouse-gas-emissions in ports. Many measures to reduce greenhouse-gas-emissions from all kind of engines also reduce the emissions of NO_x and soot particles, such as slow steaming, saving fuel and OPS.

6.3. Environmental/clean/green Ship Indices

Worldwide, there are about 50 different indices on clean(er) ships, for example the *Environmental Ship Index (ESI)*, which is a project of the above WPCI. Some ports tune their port fees relating to one clean/green ship index, for example *the port of Hamburg with the port of Rostock*.

6.4. Voluntarily measures

Some ports agree on certain environmental measures or regulations between ports or with ship owners. Example: The *port of Stockholm* made a trilateral agreement in 1990 with two ferry lines between Sweden and Finland, not to exceed the sulfur content of the fuel used over 0,5%.

Links:

Project Website „Clean Air in Ports“: www.NABU.de/ports with subpage to the Hamburg Workshop.

Glossary

BC	Black Carbon
EPA	Environmental Protection Agency (US)
EPI	Environmental Port Index
ESI	Environmental Ship Index
HFO	Heavy Fuel Oil
HHLA	Hamburger Hafen & Logistik AG
IMO	International Maritime Organization of the UN
LEZ	Low Emission Zones
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
NECA	Nitrogen Emission Control Area
NO_x	Nitrogen Oxide
NRMM	Non-Road-Mobile-Machinery
OPS	Onshore Power Supply
OGV	Ocean Going Vessels
PM	Particulate Matter, classified by size of particulates (PM10, PM2,5, PM0,1 and BC)
SECA	Sulfur Emission Control Area
SO_2	Sulfur Dioxide
WHO	World Health Organization
WPCI	The World Port Climate Initiative

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The EU-Project Clean

Each year approximately 500,000 people die prematurely from the direct consequences of poor air quality throughout the European Union. That is one of the reasons why in September 2012, the German Nature and Biodiversity Conservation Union (NABU) and eight environmental organizations from six European countries started the EU-LIFE+ project Clean Air, campaigning for better air quality throughout Europe. The project is supported by the EU-Commission. Please find further Information on the project at www.cleanair-europe.org

[i] http://www.epa.gov/airscience/air-blackcarbon.htm
[ii] http://www.juraforum.de/wissenschaft/wie-feinstaeube-zum-waldsterben-beitragen-443420
[iii] http://www.clean-baltic-sea-shipping.com/uploads/files/Clean_Baltic_Sea_Shipping_Position_Document.pdf