Port of Hamburg

Impact on Shipping Emissions on the Port and the City of Hamburg

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Since 2004 Clean Air Action Planning

- NOx
- SOx
- PM$_{10}$
- CO$_2$

Cities in Germany (2016)

Annual average NO$_2$ µg/m$^3$

Since 2004 Clean Air Action Planning

- Hamburg City:
  - Total area: 755.3 km$^2$
  - Port area: 71.5 km$^2$

Photo: HPA, Bernd-Rainer Albers
Long-Term Air Quality Measuring Net

- 15 AQ measuring stations for background and local air pollution measuring
- 4 traffic stations show exceedances of the legal NO\textsubscript{x} threshold value of 40 µg/m\textsuperscript{3}

![Map of AQ measuring stations](image)

- Traffic station (exceeded)
- Background station

![Diagram showing AQ levels](image)

- NO\textsubscript{x} threshold level
- Local pollution (road traffic)
- City load
- Regional background
Emission Inventory Port of Hamburg

**Ship traffic**
- Input data?
- Ship movements/engine specific data („Elbsimulation“)

**Port railway traffic**
- Input data?
- Train passages and shunting movements & engine power classes

**Road traffic**
- Input data?
- Vehicle detection on port main route/
  Calculation of average daily traffic rates

**Industry**
- Input data?
- Emission reporting according to 11. BImSchV

**Domestic coal & small businesses**
- Input data?
- Estimation of heated room volume

**Cargo handling equipment**
- Input data?
- Throughput & calls per terminal
- Estimation of equipment type based on U.S. emission inventories

Emission inventory PoH
- $\text{PM}_{10}$
- $\text{PM}_{2.5}$
- $\text{SO}_x$
- $\text{NO}_x$
- $\text{CO}_2$
Results Clean Air Action Plan 2017

Shares of NOₓ emitter groups during baseline year 2013/2014:

- **Ship traffic**: 39%
- **Road traffic**: 29%
- **Domestic coal**: 5%
- **Off-road traffic**: 3%
- **Aircraft traffic**: 2%
- **Rail traffic**: 1%
- **Port railway**: 1%
- **Industry**: 16%
- **Cargo handling equipment (CHE)**: 4%

### Emission group t NOₓ

<table>
<thead>
<tr>
<th>Emission group</th>
<th>t NOₓ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship traffic</td>
<td>7.944</td>
</tr>
<tr>
<td>Road traffic</td>
<td>5.949</td>
</tr>
<tr>
<td>Industry</td>
<td>3.286</td>
</tr>
<tr>
<td>Domestic coal</td>
<td>1.080</td>
</tr>
<tr>
<td>Cargo handling equipment (CHE)</td>
<td>797</td>
</tr>
<tr>
<td>Off-road traffic</td>
<td>585</td>
</tr>
<tr>
<td>Aircraft traffic</td>
<td>442</td>
</tr>
<tr>
<td>Rail traffic</td>
<td>131</td>
</tr>
<tr>
<td>Port railway</td>
<td>257</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20.471</strong></td>
</tr>
</tbody>
</table>

- Approximately 50% of the city’s NOₓ emissions are related to port activities (*blue groups*).

Source: CAAP BUE, 2017
Ship Traffic Emission Calculations

Methods?
- Seagoing vessels: ship and berthing site exactly calculation
- Inland and port vessels: traffic simulation via distribution functions

Reference years?
- Baseline year 2013/2014
- Prognosis 2020 & 2025
We detected hot spots at the berthing sites of the large container terminal facilities!
Results Clean Air Action Plan 2017

• Analysis based on modelling and real time measurements (calibrated with 4 AQ traffic stations)
• Threshold level exceeded at main traffic roads and close to port areas

Baseline year 2013/2014
Results Clean Air Action Plan 2017

- Traffic pollution decreases (due to car fleet transition), but shipping pollution stays!

Prognosis year 2025
Conflicting Situation: Air Quality vs. Economic Growth

NO\textsubscript{x} emissions increase despite better efficiency!

Based on ISL throughput prognosis for the PoH 2020, 2025 and 2030; ISL May 2015
### Ship Traffic Emissions

<table>
<thead>
<tr>
<th>Ship class</th>
<th>Port calls</th>
<th>t NOₓ</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container ships</td>
<td>4.807</td>
<td>5.422</td>
<td>68</td>
</tr>
<tr>
<td>Tankers</td>
<td>1.721</td>
<td>832</td>
<td>10</td>
</tr>
<tr>
<td>Dry bulk</td>
<td>408</td>
<td>132</td>
<td>2</td>
</tr>
<tr>
<td>Multi-purpose ships</td>
<td>2.777</td>
<td>458</td>
<td>5</td>
</tr>
<tr>
<td>Cruise ships</td>
<td>177</td>
<td>200</td>
<td>3</td>
</tr>
<tr>
<td>Other seagoing ships</td>
<td>21</td>
<td>3</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Inland vessels</td>
<td>ca.10.000</td>
<td>175</td>
<td>6</td>
</tr>
<tr>
<td>Tug boats</td>
<td>n.s.</td>
<td>264</td>
<td>3</td>
</tr>
<tr>
<td>Inner port vessels</td>
<td>n.s.</td>
<td>458</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7.944</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Oceangoing ships cause approx. 90% of total NOₓ emissions.
- 65% of NOₓ emissions are emitted at berth.
- 0.6 kg NOₓ are emitted per TEU.
- 0.05 kg NOₓ are emitted per t cargo.
- 0.4 kg NOₓ are emitted per pax.

Seaborne cargo throughput in 2013:
- Total throughput: 139.0 Mio t
- Containers: 9.3 Mio TEU
- Cruise passengers: 552,459 pax
What we already do: External Energy Supply for Cruise Vessels

Three cruise terminals with three alternative external energy solutions:

1. Landside power by stationary onshore power supply
2. Landside power by LNG Hybrid Barge
3. Landside power by LNG truck
What we plan to do: External Energy Supply for Container Vessels

1. Stationary Onshore Supply Station
   - Development is pushed by the city’s coalition agreement 2015
   - Currently: Identification of technical feasibility, costs, time schedules
   - Identification of possible berthing sites, terminals

2. LNG PowerPac by BMS
   - 2 x 40 ft Container
   - 1,5 MW (up to 3 MW) Gas Gen Set
   - 1 x 8,2 t LNG Tank Container
   - Frequency 60 Hz / 50 Hz
   - Voltage 6,6 kV
   - CE certified
   - Pilot starts in 2018!

Next steps!

Photo: Becker Marine Systems
The Port of Hamburg in 2025

Installation of external energy supply at large scale:

- Stationary OPS container
- LNG PowerPac container
- Stationary OPS cruise
- LNG Truck fueling cruise
The Port of Hamburg in 2025

Port Fee System: Graduation of port fees according to Tier-Level (start in 2018)

Tier levels of ship classes PoH

- Container vessel
- Tanker
- Multi-purpose ship
- Cruise ship
- Dry bulk

Data source: 2015
Thank you!

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