Progress towards attainment of EU limit values in Berlin

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- AQ assessment & current compliance situation
- actions in the pipeline
- impact analysis of LEZ & other measures
- compliance gap – how to deal with it
- problems, outlook
nitrogen dioxide pollution in Berlin in 2009

levels above 40 µg/m3 exceed annual NO2 AQ standard
long-term trend of nitrogen dioxide in Berlin: no improvement despite decreasing NOx-emissions
compliance with the PM10 air quality standard in Europe

source: City of Linz
compliance situation PM10

number of days in excess of the 24h-limit value of 50 μg/m³ for PM10 in Berlin

*mean May09-April10
backward trajectory statistics Jan-April 2010
receptor point Berlin

Source: E. Reimer, IfM
Free University Berlin
Source apportionment

PM2.5-speciation

Chemical composition of PM2.5 at a busy city centre traffic spot in 2007 split up into different source areas

local traffic

urban background

regional background
Introduction

Source analysis

Origin of kerbside PM2.5 and NO2 in Berlin

Sources of roadside PM2.5 pollution

- Local traffic
  - Road transport: 9%
  - Resuspension + abrasion by traffic: 4%
- Urban background
  - Non-industrial combustion: 3%
  - Combustion in energy and transformation industries: 1%
- Other sources
  - 4%
- Homemade vehicle tailpipe contribution

Sources of roadside NO2 pollution

- Local traffic
  - Road transport: 7%
  - Resuspension + abrasion by traffic: 2%
- Regional background
  - Ca 7%
- Other sources
  - 7%
- Traffic
  - 32%
- Basis: NOx modelling

Berlin, 2007

Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz, Referat III D, M. Lutz
Clean Air Plan Berlin

### List of Actions

#### Large Stationary sources:
- Best Available Technology; already largely exhausted

#### Domestic heating:
- Cleaner fuels (nat. gas), heat & power cogeneration
- Promotion of energy saving measures
- Renewables (but strict emission limit values for wood fired burners)
  - Option: stricter emissions standards for wood heating systems (< 10 mg/m³)
- Synergies with new Berlin energy program
  - Aim: 25% less CO2-emission by 2010 (relative to 1990)
- Only few single coal fired stoves left (<2% of all flats);

#### Construction:
- Guidelines & information about dust abatement measures
- Agreement with construction business for voluntary application
  - Ultimate option: regulation
- DPF as criteria for construction machinery for public tenders

#### Transport:
- Cleaner vehicles and fuels (CRT retrofit & CNG)
  - Municipal vehicle fleet (CRT retrofit & CNG)
  - Filter retrofit of passenger cruising ships
  - LEZ (low emission zone)
- Less traffic through sustainable transport- and city planning
  - Master plan transport, “StEP”
- Optimized traffic management
  - Speed limits (30 km/h)
- Ban of heavy duty vehicles in single streets
  - ...
Area:

about 88 km²
(Berlin total area: 892 km²)

Inhabitants:

about 1 Million
(Berlin total: 3.4 Mio)

Stage 1: since 1.1.2008

- Diesel vehicles: at least Euro 2 or Euro 1 & retrofit
- Gasoline vehicles: at least Euro 1
- 7% of vehicle fleet affected

Stage 2: since 1.1.2010

- Diesel: Particle emission Euro 4:
  - cars: Euro 3 + particle filter or better
  - goods vehicles: also retrofit of Euro 1-3 towards Euro 4
- 10% of the vehicle fleet affected

More than 40 LEZ planned/in force in Germany, but with different emission criteria.
Stage 2: Free entry only with green sticker
affected vehicles 2010:
(according to registration data base of 1. January 2010)

- Diesel Passenger cars:
  - 14,000 PC (7%) with red sticker → can barely be retrofitted to
  - 60,000 PC (30%) with yellow sticker → can be retrofitted to

- commercial Diesel vehicles:
  - 10,000 LDV/HDV (12%) with red sticker → can be partly retrofitted to
  - 25,000 LDV/HDV (30%) with yellow sticker → can be retrofitted to

affected vehicles in total: ca. 124,000
by mid 2010: 25% Diesel PC & 18% LGV/HGV retrofitted!
40% of Diesel PC have a DPF with 60% closed systems
Berlin LEZ – real impact analysis

Impact on fleet composition

Share of registered vehicles with

Positive impact of Berlin’s LEZ on the registered vehicle fleet

<table>
<thead>
<tr>
<th>Year</th>
<th>All Cars</th>
<th>Diesel Cars</th>
<th>Goods Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2006</td>
<td>85%</td>
<td>19%</td>
<td>1%</td>
</tr>
<tr>
<td>Jan 2008</td>
<td>90%</td>
<td>39%</td>
<td>20%</td>
</tr>
<tr>
<td>Jan 2009</td>
<td>92%</td>
<td>49%</td>
<td>37%</td>
</tr>
<tr>
<td>Jan 2010</td>
<td>96%</td>
<td>59%</td>
<td>54%</td>
</tr>
</tbody>
</table>

LEZ stage 1

LEZ stage 2

Share of registered vehicles with green sticker

Trend
# Berlin LEZ – real impact analysis

## Impact on Fleet Composition

### Before-after Comparison of the Fleet Composition at Frankfurter Allee

Fleet characteristic at Frankfurter Allee based on number plate recognition before and after introduction of Berlin’s LEZ in 2008/9

<table>
<thead>
<tr>
<th>Category</th>
<th>Feb 07 before LEZ</th>
<th>Sep 08</th>
<th>Sep 09</th>
<th>Trend 09 no LEZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass. Cars Diesel</td>
<td>4%</td>
<td>8%</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td>LGV Diesel</td>
<td>28%</td>
<td>20%</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>HGV 3,5 - 7,5 t</td>
<td>37%</td>
<td>31%</td>
<td>30%</td>
<td>28%</td>
</tr>
<tr>
<td>HGV &gt; 7,5</td>
<td>26%</td>
<td>24%</td>
<td>23%</td>
<td>22%</td>
</tr>
</tbody>
</table>

- **4 - green**
- **3 - yellow**
- **2 - red**
- **1 - no sticker**
LEZ impact: change of NOx emissions from road traffic*

based on fleet composition at Frankfurter Allee (new emission factor data base HBEFa 3.1)

*NO2 direct emissions included, but no NO2 accumulation by retrofitted DPF for HGV
LEZ impact: change of particle exhaust emissions

based on fleet composition at Frankfurter Allee (new emission factor data base HBEFa 3.1)

emissions extrapolated to the entire main road network based on the fleet composition at Frankfurter Allee (without DPF retrofit, only warm emissions, no cold start impact)
based on the results of the PM2.5-source apportionment in a main road in Berlin’s city centre

applying the emission reduction of the LEZ

of -35% EC & OC

→ - 4.9% PM2,5

of -19% NOx

→ - 1.5% PM2,5

Σ = - 6.4 % PM2,5

related to PM10:
- 4.5 % PM10
(70% PM2,5 in PM10)

largely independent from traffic and meteo changes

LEZ – real impact analysis

pollution concentration

can be controlled by LEZ

soot + organic material from vehicle exhaust in Berlin
14%

secondary particles from NOx-emissionen from traffic in Berlin
8%

resuspension + abrasion from traffic in Berlin
7%

other sources in Berlin
15%

other sources outside Berlin
47%

traffic outside Berlin
9%

Σ = - 6.4 % PM2,5

related to PM10:
- 4.5 % PM10
(70% PM2,5 in PM10)

largely independent from traffic and meteo changes
traffic-adjusted trend of the local traffic increment of total carbon concentrations in main roads in and outside of the LEZ

- LEZ in force
- -28% dispersion-related parameters, 2007=100%
**traffic adjusted** trend of Berlin's contribution to NO₂ levels in main roads in and outside of the low emission zone

Urban contribution = kerbside levels-upwind levels at city periphery (ca 10 - 12 µg/m³)
no visible shift of traffic into surrounding areas

significant change in the vehicle fleet composition:
- fewer "dirty" vehicles (<E1):
  - LGV/HGV: only 4-7% instead of 30%
- more clean vehicles (E4):
  - cars 73% instead of 44%,
  - lorries 50% instead of 17-23%

decrease of traffic emissions on top of trend:
- exhaust particles: - 35 %; NOx: - 19 % (probably less)

LEZ is most effective single measure, if
- based on ambitious emission criteria
- covering a larger area
- introduced not too late
- exemptions are limited

possible benefit for the air quality
- 5-10% reduction of PM10/2.5 & NO2,
- traffic related decrease of black carbon ~30%
- ~10 less excess days > 50 µg/m³ PM10
particle filter in passenger cruise ships

pilot project 2008-2010:

- retrofit of 3 vessels with different filter systems
- monitoring of filter efficiency, performance and handling during routine operation
Berlin transport strategy
portfolio of measures

- Promotion of sustainable transport modes & car sharing
- Speed limits
- Traffic light synchronisation
- Optimising vehicle flow
- Re-routing through traffic
- Extra bus lanes
- Traffic light priority for bus
- Re-allocation of road space in favour of cyclists & pedestrians
- Parking management
- Traffic bans
- Promotion of sustainable transport modes & car sharing

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traffic management measures

Potential impact on air quality

- Shift modal split from motor traffic to clean transport modes
  - Berlin’s planning objective: -10% less motor traffic in 10-15 years results in 5-10% less NO2, 3-4% less total PM10

- Optimizing traffic flows (progressive signal systems):
  - Impact difficult to quantify
    - Local effect, traffic signal coordination works only in one direction, potentially negative effects on cross-roads
      - Conflict with acceleration of bus/tram
      - Risk that gained road capacities will attract more traffic
      - Small net gain in pollution control

- Speed limit 30km/h:
  - Example Schildhornstraße Berlin: 10% less NO2, -6% PM
    - If traffic light coordination with 30 km/h works well speed limit is enforced
    - Also less noise and traffic accidents

- Truck ban:
  - Example HEAVEN project: up to 20% less NO2, -7% PM
    - Only local effect in single roads, merely shift to other roads, no net reduction
long-term trend of nitrogen dioxide in Berlin: no improvement despite decreasing NOx-emissions
Closing the NO2-gap in Berlin

max NO2-level

mean NO2-level

gap -50%

-15% fleet renewal, incl LEZ
-3% modal shift
-5% speed limit 30 km/h
-x% Euro 6/VI incentives
-x% SCRT retrofit buses & HGVs
-x% ????????

EU limit value

modelled NO2- levels at traffic site Stuttgart Neckartor

IFEU 2010 im Auftrag des UM Baden-Württemberg

LV excess even in 2020 and even if all vehicles were Euro 6/VI

source: Udo Lambrecht
IFEU Institute 2010
NO2 attainment 2015:
- full impact of LEZ stage 2 (fading away by 2015)
- SCRT retrofit program buses & perhaps for some HGVs
- speed limits, traffic light coordination, etc
- modal split change due to transport strategy
- local (HGV) traffic bans (barely feasible in Berlin)
- Euro 6/VI incentives (need to wait for the Federal Gov.)
- realistic scope for improvement up to 30%
- full compliance unlikely

PM10 attainment by 2011: short notification end of 2010
- full impact of LEZ stage 2
- tightening LEZ exemptions
- optional: stricter emission limits for small combustion units
- long-range (transboundary) PM transport is not Berlin’s fault
  (>50% of excess day 2010)
- compliance in 2011 is a lottery game depending on meteo
Result: Better Balance between City, Transport and Environment

Conclusions

Thanks for listening!

For more information on

- Berlin’s LEZ see www.berlin.de/umweltzone (also in EN & FR)
- LEZ in Germany see http://www.umweltbundesamt.de/umweltzonen/index.htm
- LEZ-cities in Europe visit www.lowemissionzones.eu, the website of the European Network of LEZ-cities (LEEZEN)
- transport related measures in EU cities visit www.civitas.eu