Lutz M. / Department for Health, Environment and Consumer Protection, Berlin, D

Berlin's Low Emission Zone – rationale and resumee after 100 days in force

Despite considerable improvement of Berlin's air quality over the last decade current EU limit values for particulate matter (PM10) and NO2 are still exceeded in years with normal weather conditions along more than 100 kilometres of Berlin's main road network. So, Berlin drew up an air pollution abatement plan in 2005. Given that road traffic is the predominant source for PM10 and NO2-pollution, the plan focused on transport sector measures, among them a low emission zone (LEZ) aimed at accelerating the turn-over of the vehicle fleet towards cleaner traffic with less emissions.
The LEZ, which is yet the first and most ambitious LEZ scheme stipulated in Germany, has been introduced in two stages covering a central city area of 85 km^2 with more than 1.1 Mio residents, delimited by the local railway ring. Since January 2008, after a transitional phase of two years since the adoption of the scheme, vehicles not meeting certain emission criteria are banned from driving within the zone. The traffic restriction covers both passenger cars and commercial vehicles, because, following our impact assessment study, such an approach leads to substantially higher emission reduction than a concept limited to heavy-duty vehicles.

As a precondition for the practical implementation of LEZ in Germany the Federal government adopted in 2007 a national vehicle labelling scheme together with technical specifications for particle filter retrofit. The scheme introduced 4 pollution classes, according to the following emission criteria:

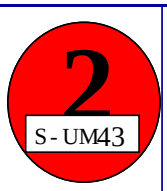
sticker:			
minumum criteria for Diesel vehicles **ban for Diesel veh. older than …**	**Euro 2, or Euro1 plus particle filter** **1992**	**Euro 3, or Euro 2 plus particle filter** **1996**	**Euro 4, Euro 3 plus particle filter** **2000**
minimum citeria for petrol cars			**Euro 1 plus catalytic converter**

Figure 1: German vehicle labelling scheme

Vehicles not meeting any of these criteria belong to pollution class 1. They cannot be exempted from any traffic ban.
An amendment to the national vehicle registration ordinance set out the minimum efficiency a particle filter needs to fulfil so that any retrofitted diesel vehicle can be upgraded into a higher pollution class. The minimum filter efficiency criterion for passenger cars and LGVs needs to be at least 30%, a particle trap for HGVs needs to remove between 30 and 50% of the particle load for unregulated systems and at least 90% for regulated CRT systems.
Foreign vehicles are classified according to their age, if the Euro standards cannot be clearly identified in the vehicle registration.

Environmental criteria in Berlin's LEZ

Environmental criteria for Berlin's low emission zone All vehicles (passenger cars, LGVs and HGVs) willing to enter the low emission zone …	
in stage I **as from 1.1.2008**	need a red, yellow or green label,  i.e. at least pollution class **2** of the national labelling scheme This corresponds as a minimum: • **for Diesel-vehicles to** Euro 2 or Euro 1 + particle filter • **for petrol vehicles**. Euro 1 with a catalytic converter
in stage II **as from 1.1.2010**	need a green label,  i.e. at least pollution class **4** of the national labelling scheme This corresponds as a minimum • **for Diesel-vehicles to** Euro 4 or Euro 3 + particle filter • **for petrol vehicles**. Euro 1 with a catalytic converter

Of a total of 1.4 Mio registered vehicles, around 80.000 vehicles, among them about 30.000 commercial vehicles, will be affected by the traffic ban in stage I. In addition, 22.000 cars will be banned by stage II in 2010, while another 60.000 diesel cars and 33.000 commercial vehicles need to be retrofitted with a particle trap, so that they can drive in the LEZ. No general exemption for residents or commercial traffic is foreseen. However, in case of lacking retrofit options temporary exemptions can be granted for businesses with special vehicles or to whom replacing their vehicle would constitute an disproportionate financial burden. Exemptions for private cars users are limited to disabled people and commuters with working hours during night, when public transport services are scarce.

According to an extensive impact assessment study stage 2 of the LEZ should result by 2010 in around 10,000 fewer residents living in PM10 non-attainment areas in the LEZ area. The restrictions on high-emission diesel vehicles and old gasoline cars should mean a similar amelioration for 6000 to 4000 residents concerning NO2. Days in excess of the 24h PM10 limit value should fall by about 10-15 per year, with annual PM10 mean concentration decreasing by up to 10% averaged over all main roads in the central city area.

Concerning the real impact of LEZ on the current pollution levels since its introduction beginning of 2008 the number of days exceeding the 24h PM10 limit value since 1 January 2008 have fallen by half (from 19 to 9) compared with the same time period a year ago, when the LEZ was not yet in force. However, given the strong dependency of pollution levels on weather conditions no robust conclusion can yet be drawn unless at least one year of pollution data will have been recorded since the launch of the LEZ. A more detailed impact assessment study has been commissioned, which looks into the real-world change of the vehicle stock in terms of emission categories and on traffic flows within the LEZ, so as to generate the input needed for calculating the vehicle emissions and eventually the pollution levels in all road section within and outside of the LEZ. Results are expected not before beginning of 2009.

However, a comparison of the vehicle registration data before and after the launch of the LEZ reveals that the aim of replacing older, more polluting vehicles by newer ones has actually been achieved. Figure 2 compares the number of registered vehicles before (BAU) and after (LEZ) the start of the LEZ, classified according to their emission standard. The pre-Euro1 segment has shrunk by 60% for cars and 32% for goods vehicles as an effect of the LEZ.

In conclusion, the LEZ is the most effective single measure in Berlin, provided that ambitious emission criteria (i.e. particle emissions of Euro 4) are required within a reasonably short time scale (i.e. by 2010), which won't be watered down by extensive granting of exemptions for residents and business. Nevertheless, in order to be proportionate, a transition period is need between the adoption and practical implementation of a LEZ so that business and car drivers can adapt. Furthermore, a LEZ area needs to be large enough in order to generate the expected effect on the renewal rate of the vehicle fleet and in order to avoid detrimental affects in adjacent areas by undesired traffic re-routing generated by the LEZ.

However, implementation of the LEZ and all the additional measures stipulated by Berlin's Clean Air Plan still leaves a **compliance gap**, even if we take advantage of the prolongation of the attainment period offered by the revised EU air quality legislation. So, the LEZ needs to be supplemented by further action, like traffic planning measures on the local level and stricter vehicle emission standards by the EU. Current standards and even the future Euro 5 emission limits will not bring about tangible reductions of NO2 pollution, because of rising direct emissions of NO2, in particular by Euro 4 Diesel vehicles and retrofitted CRT systems. So, unless stricter emission standards (Euro 6/VI) will be introduced within the given attainment period of the air quality standards (for NO2 by 2015 at the latest) the benefits of LEZ concept on NO2 will remain fairly limited.

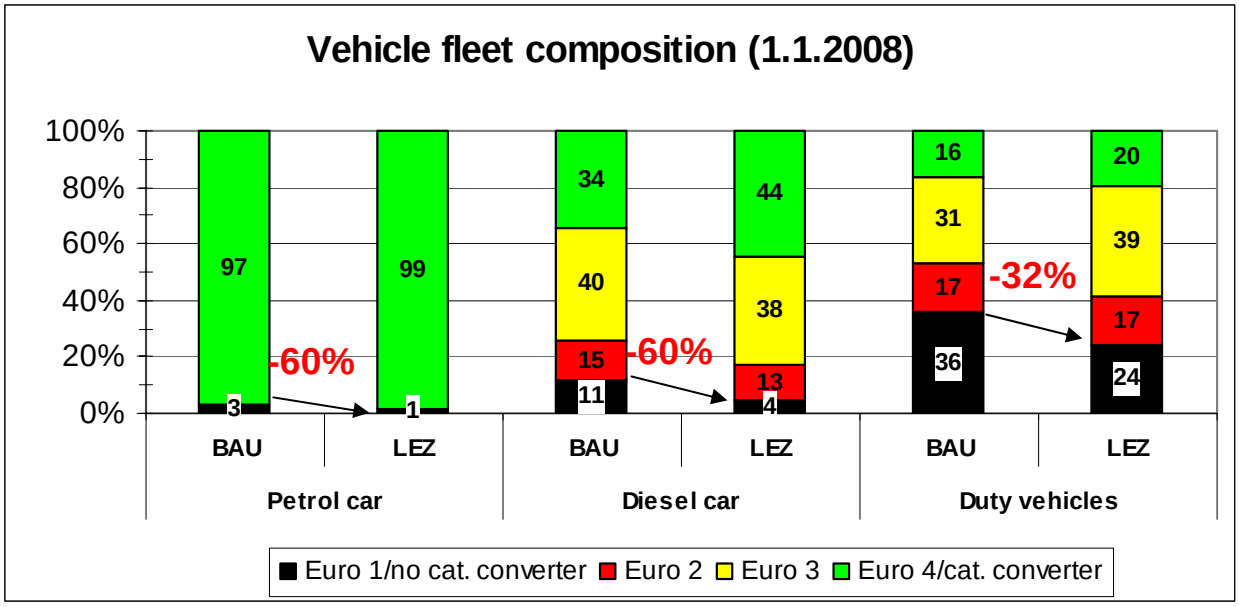


Figure 2: Impact of stage 1 of the LEZ on the registered number of vehicles; BAU: business as usual case without LEZ, extrapolated from 1 Jan 2007 data, LEZ: new statistic of 1 Jan. 2008 when the LEZ started

Tel. +49(30)9025-2338
Martin.lutz@senguv.berlin.de

Berlin's low emission zone

rationale & résumé after 100 days in force

Martin Lutz

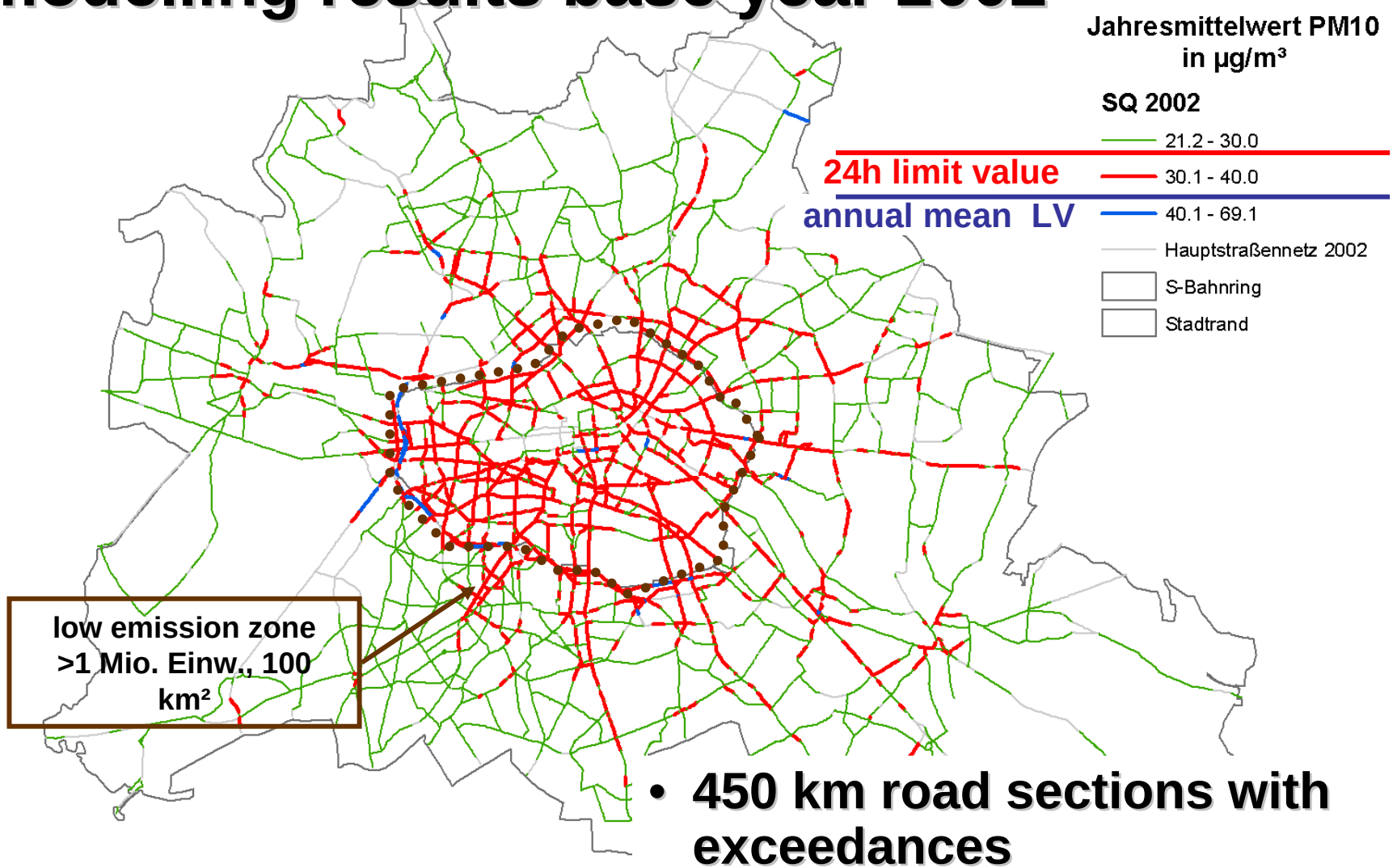
Senate Department for Health, Environment and Consumer Protection, Berlin

Directorate Environment Policy

- **why a low emission zone (LEZ) ?**
- **the LEZ concept**
- **predicted impact**
- **real effects**
- **problems, pros & cons**

„current“ situation ☞PM10

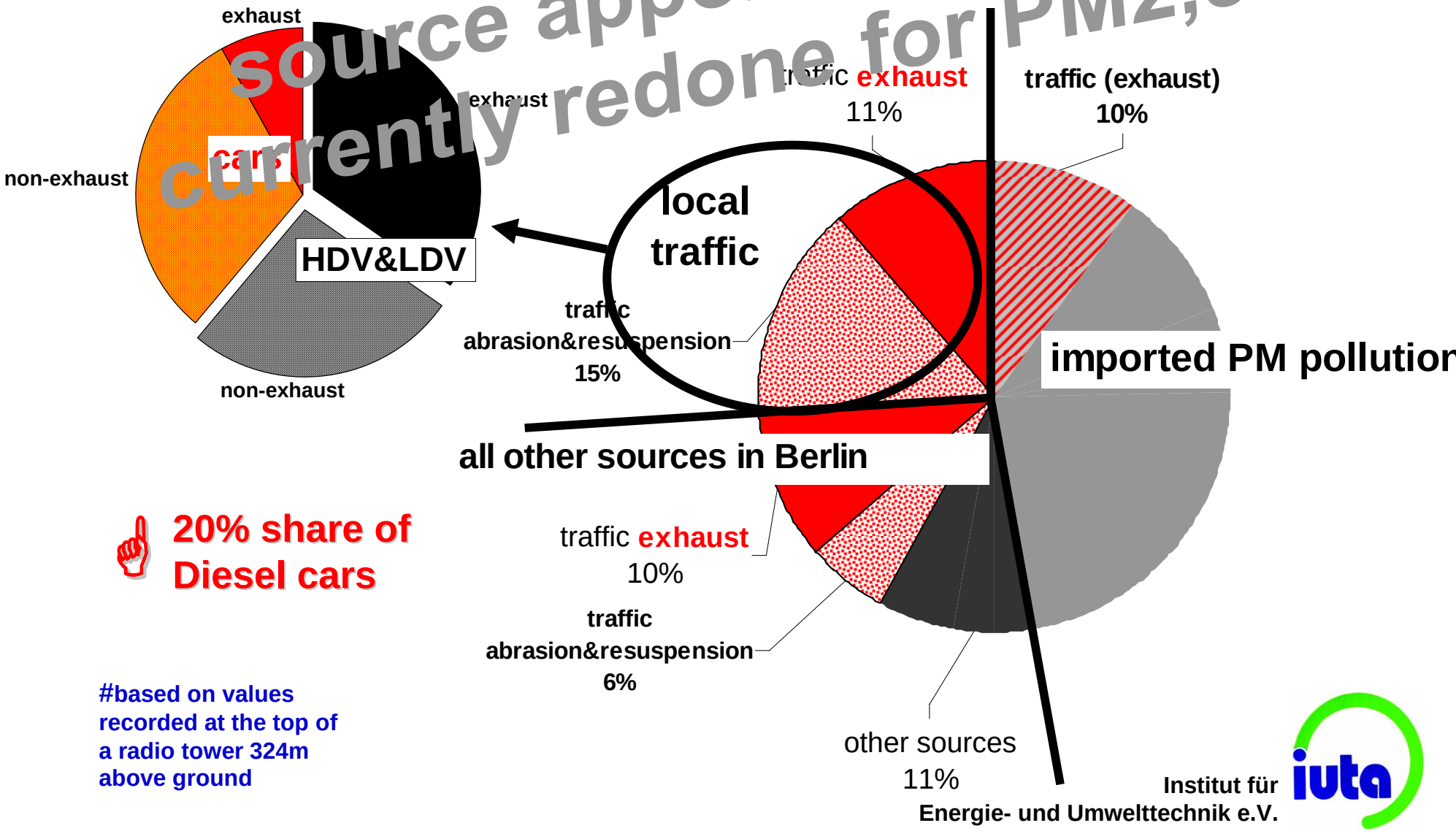
modelling results base year 2002



- 450 km road sections with exceedances
- 190.000 affected residents

why LEZ? ☞source analysis PM10

source apportionment currently redone for PM2,5



☝ **20% share of Diesel cars**

#based on values recorded at the top of a radio tower 324m above ground

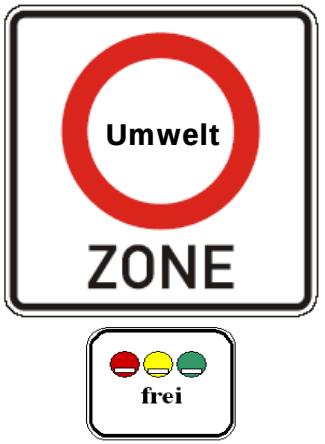
Institut für iuta Energie- und Umwelttechnik e.V.

LEZ Berlin ☞ reasons

low emission zone Berlin – why?

- exceedances mostly in main roads
  - ↳ road traffic is main contributor
    - ☞ ~40% of total PM10 pollution
    - ☞ ~80% of total NO2-pollution
- previous measures insufficient
  - ☞ modernisation of municipal fleet,
  - ☞ funding scheme for CNG-vehicles
- large-scale non-attainment concentrated in central city areas („S-Bahn ring“)
- need for accerelated improvement of the total Diesel vehicle fleet
  - ↳ replacing older by new vehicles with less emission
  - ↳ retrofitting existing vehicles with particle traps
- local scale traffic restrictions merely shift problem in other roads
- short-term temporary traffic restrictions barely effective during pollution episodes
  - ↳ alarm management of adhoc traffic bans too complicated
  - ↳ exemptions for commercial traffic needed

„Zeichen 270.1



LEZ Berlin ☞ reasons

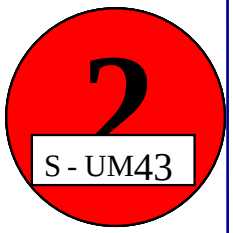
conclusion....

- **LEZ: selective traffic ban for high polluting vehicles**
  - **durable:** not only on days in excess of 24h-limit value
  - **large-scale:** not only in single roads but covering the whole (potential) non-attainment area
- **transition period** (> 2 ½ years) prior to the start & staged concept 2008/10
  - ensures **proportionality**
  - **no** general exemptions for residents and commercial traffic
  - **individual** temporal exemptions possible
    - ☞ if retrofit impossible
    - ☞ restrictive for private vehicle use
    - ☞ limited to cases of hardship
    - ☞ charges 20-1000€, depending on vehicle and duration

☞ **LEZ is the most effective single measure**

LEZ ☞ precondition

national vehicle labelling scheme:

sticker:			
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minimum citeria for petrol cars			Euro 1 with catalytic converter

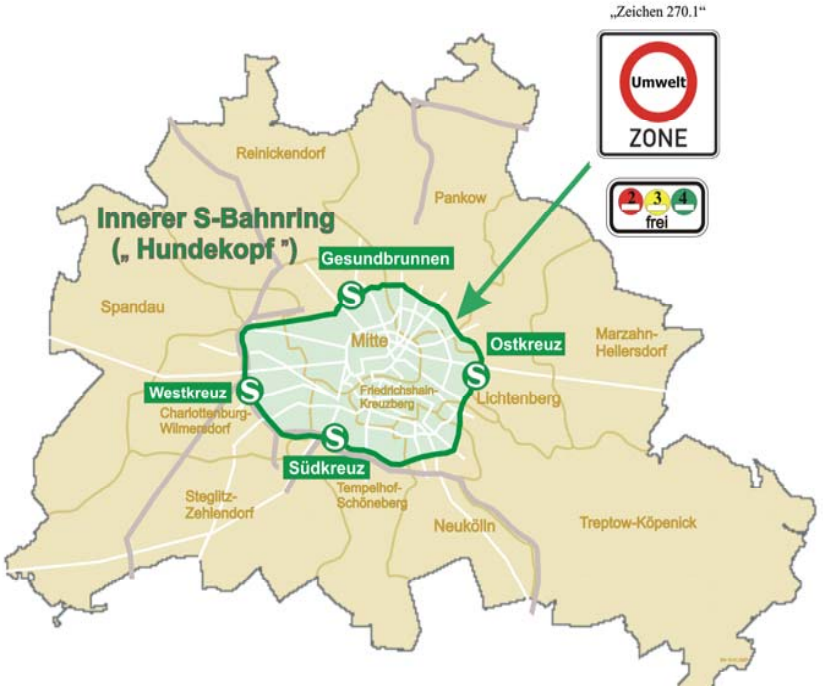
general exemptions for

- police, fire brigade, military, ambulance, etc
- two wheelers, mobile machinery, vintage cars

technical criteria for DPF retrofit kits

☹ no EU-wide harmonisation

Berlin LEZ ☞ emission citeria



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**

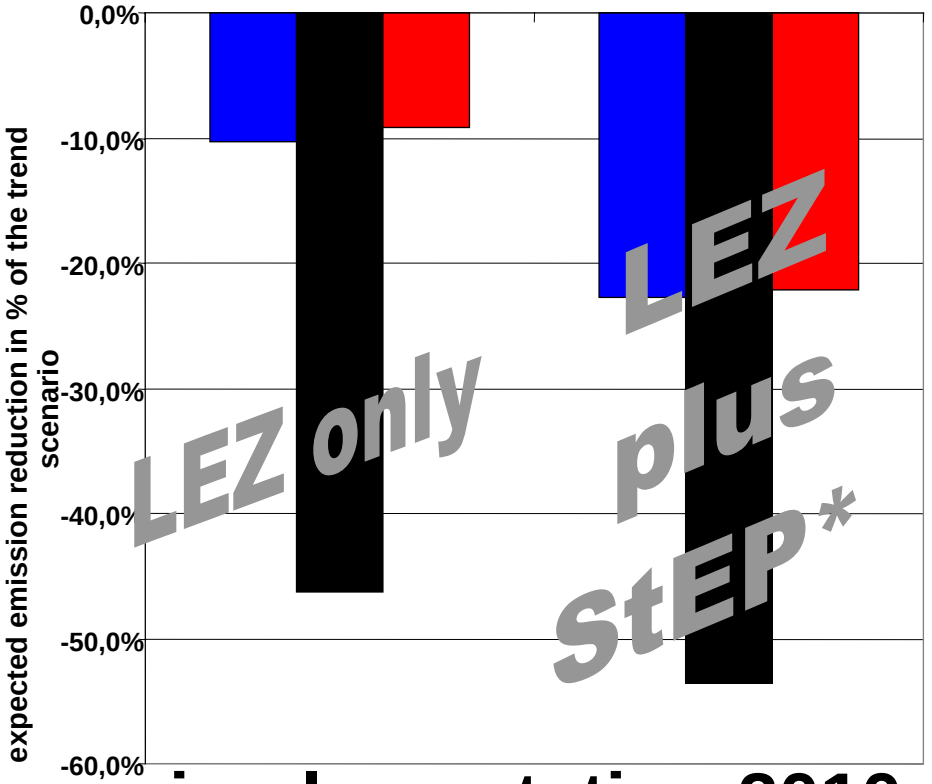
- **Stage 2:**
  from 1.1.2010

  Diesel: Particle emission Euro 4:
  - ☞ **cars: Euro 3 + particle filter or better**
  - ☞ **goods vehicles: also retrofitting of Euro 1 to Euro 4$_{Particle}$**

LEZ ☞ predicted impact

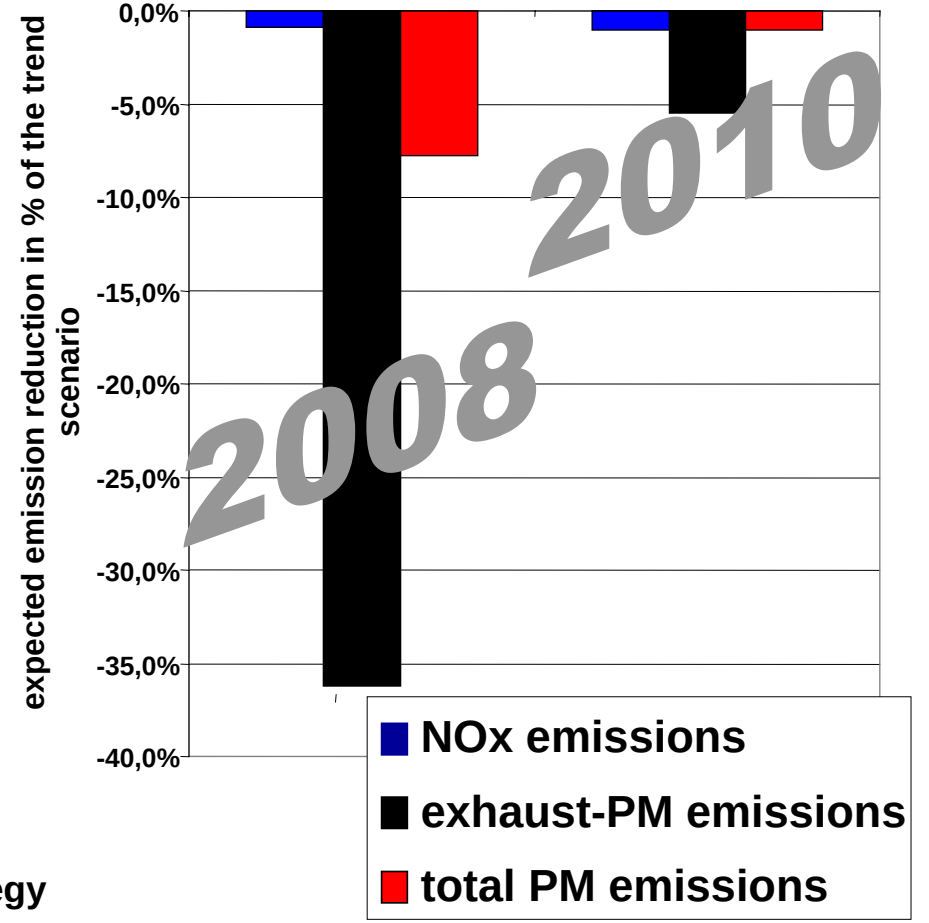
LEZ-generated reduction of traffic emissions on top of a trend scenario

all Diesel vehicles
Euro III + particle filter(PF)



implementation 2010

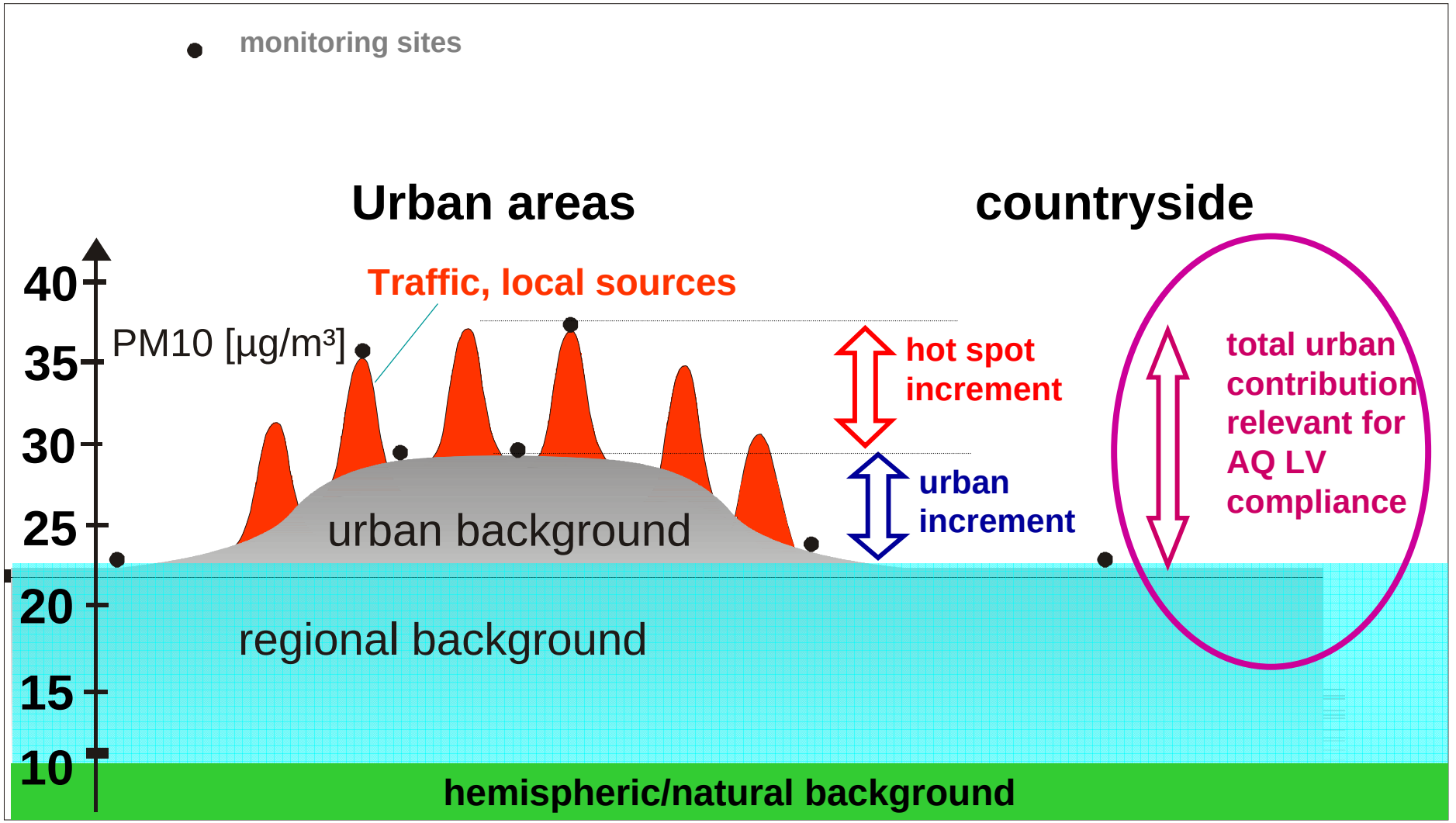
„London“
lorries, busses, taxis
Euro II + PM filter



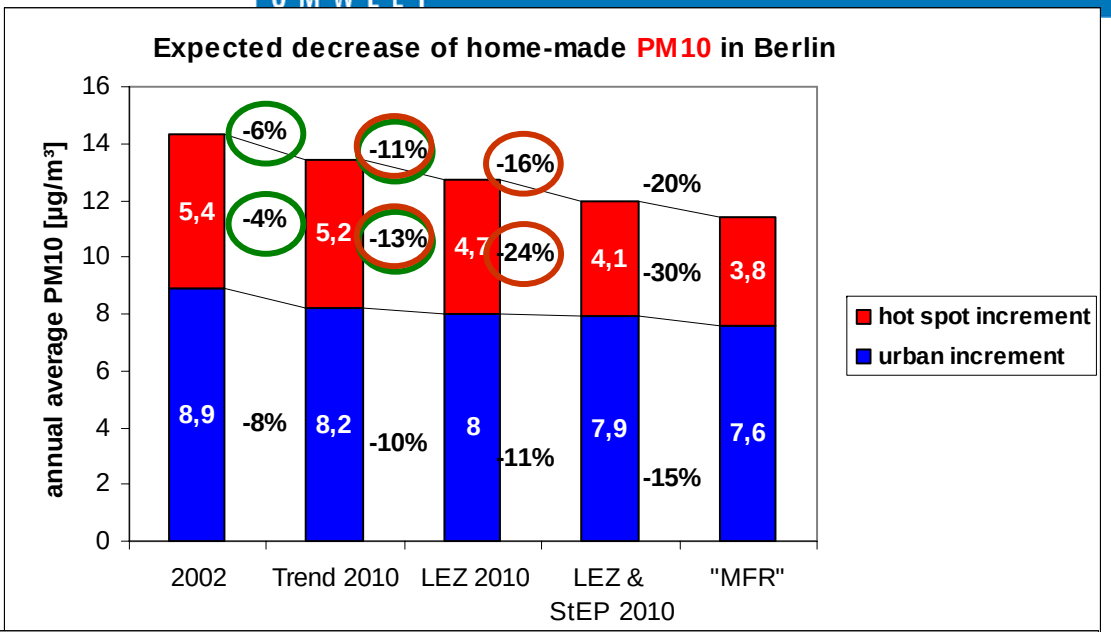
*StEP: assuming 10% less traffic due to transport strategy

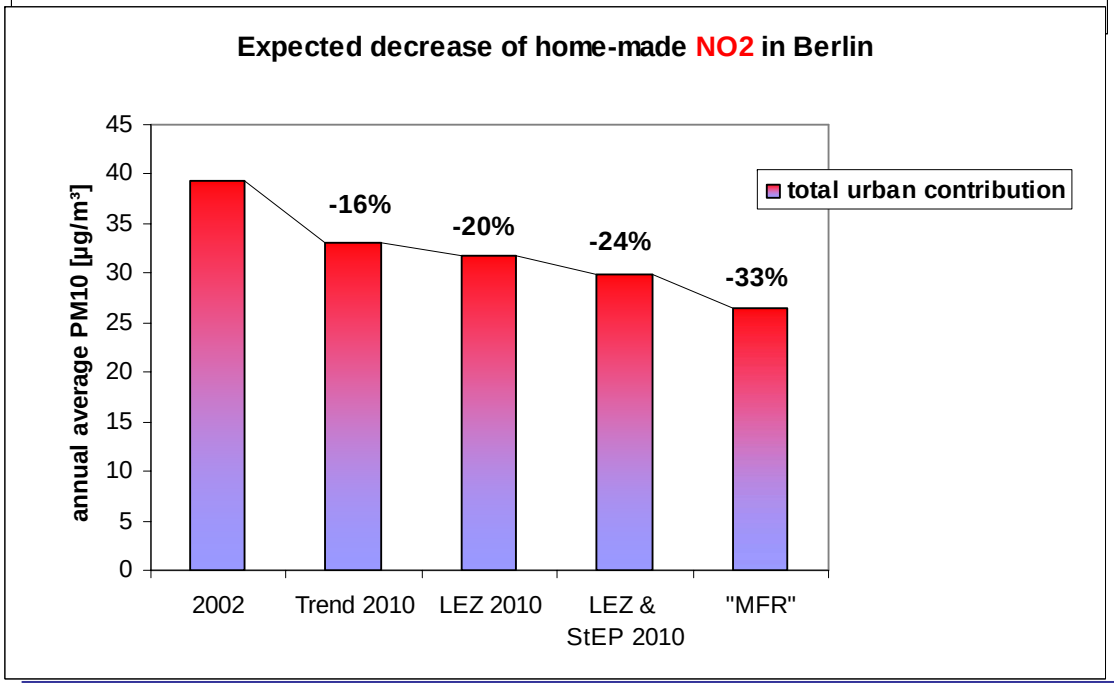
PM source analysis

Simplified schematic of the PM pollution



LEZ ☞ predicted impact





predicted impact of LEZ & other measures on the home-made PM & NO2 pollution in 2010

% figures related to 2002

no exemptions from traffic ban assumed

total decrease includes a modelled 10% decline of regional background levels

LEZ = Low Emission Zone

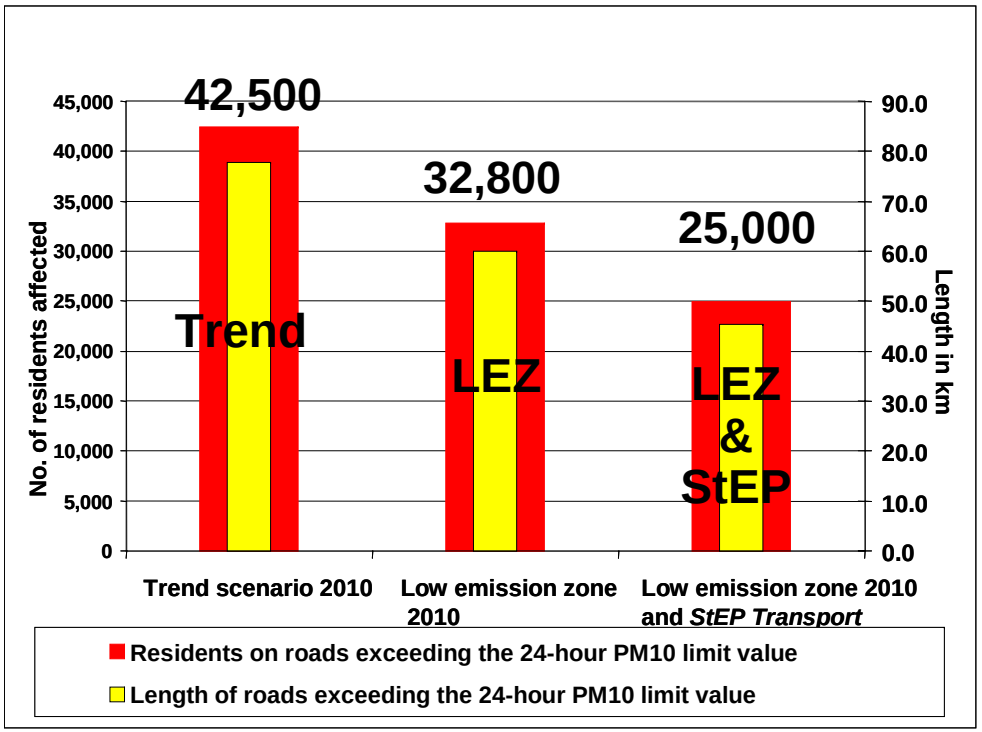
StEP = transport planning measures assuming 10% less traffic in the central city area

MFR=maximum feasible reduction scenario (all vehicles Euro 4/IV or 5/V)

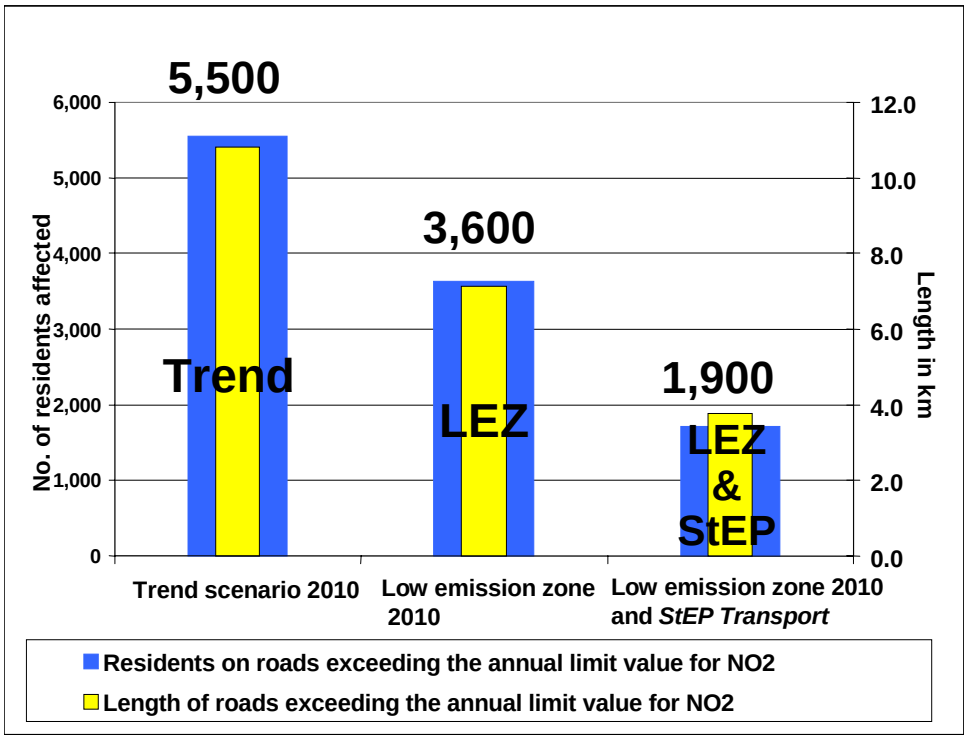
LEZ ☞ predicted impact

Impact of LEZ and transport planning („StEP“) on resident‘s exposure to PM & NO2 within the LEZ

non-attainment PM10



non-attainment NO2



LEZ Berlin ☞ real impact

➢ vehicles affected by the traffic ban

- **2008 affected vehicles by stage 1...**
  - ca. **21.000** Diesel-cars (Euro 1 and worse)
  - ca. **29.000** Diesel commercial vehicles (Euro 1 and worse)
  - ca. **26.000** petrol cars (with 3-way-catalytic converter)

☝ only about **7 %** of ca. **1,26 Mio. registered vehicles** in Berlin

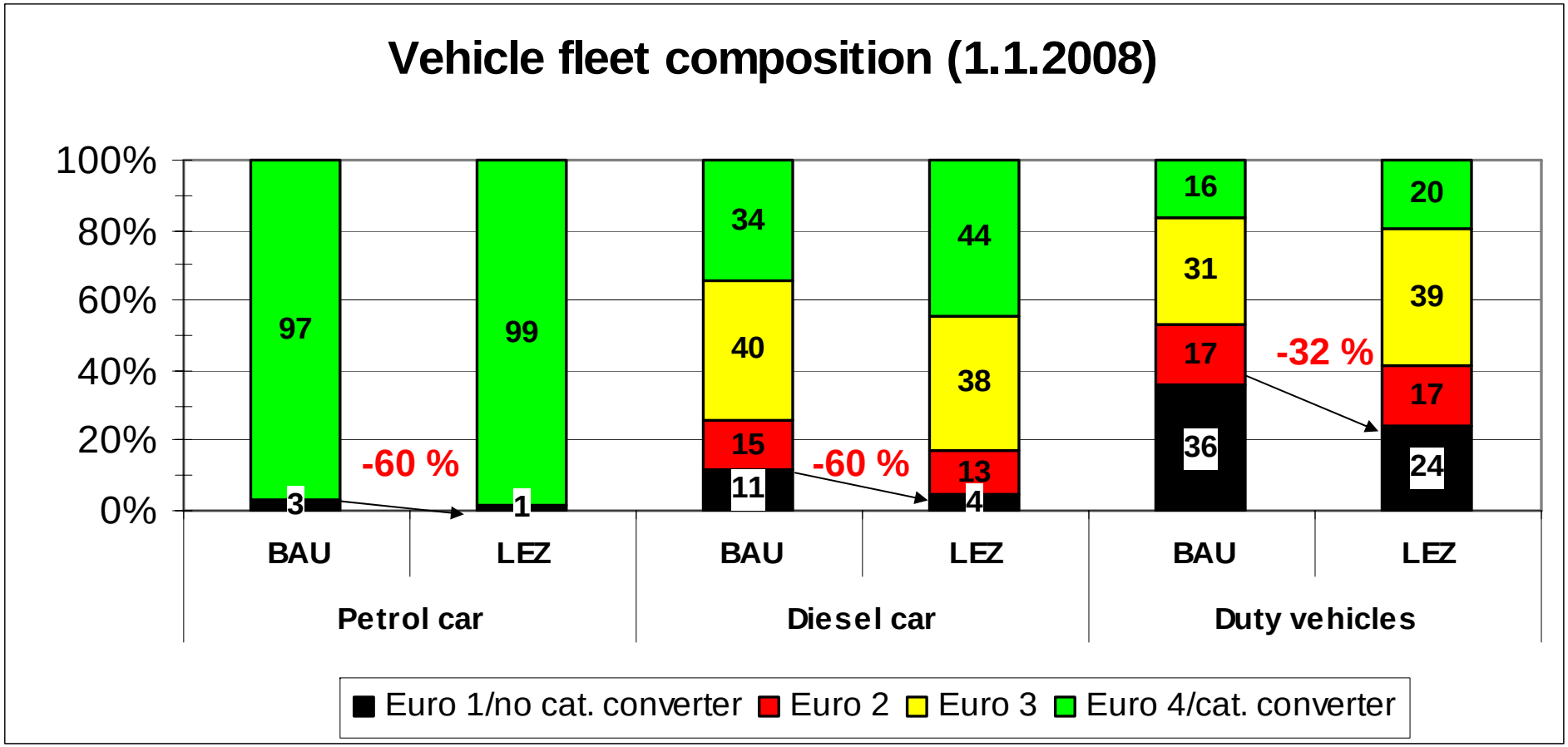
- **2010 affected Diesel - vehicles by stage 2...** 4 S - UM43
  - **strongly affected,** because no retrofit possible
    22.ooo Diesel cars with 2 S - UM43
  - less **strongly affected,** because retrofit possible towards 4 S - UM43
    52.ooo Diesel cars 3 S- UM43
    32.ooo commercial vehicles with 2 S - UM43 or 3 S- UM43

☝ **significant need for retrofit**, in particular for commercial vehicles

- number of individual exemptions still below 8.ooo (10% of total)
- effective enforcement
  - 15.000 sanctions issued
    (**40€** charge, plus **1 score** in national traffic penalty register

LEZ Berlin ☞ real impact

LEZ stage 1: effects on Berlin‘s vehicle fleet



BAU: business as usual, extrapolated from Jan 2007 data prior to LEZ

LEZ Berlin ☞ real impact

➢ real impact of stage 1 of the LEZ

- **decrease** of the registered vehicles without sticker
  - Diesel-cars from **21.000** to **8.500 – by 60%**
  - Diesel commercial veh. from **29.000** to **20.000 – by 1/3**
- **more new** registrations in Berlin than elsewhere in Germany:
  - 2 % more cars
  - 16 % more commercial vehicles
  - 50 % more buses, coaches
- on traffic volumes, characteristics of vehicle fleet and **emissions**
  - investigations running: results end of 2008
- on the **pollution levels**
  - evaluation of pollution data not useful before end of the year
  - 50% less excess days, but strong weather dependency

LEZ ☞ pros & cons

- **Objective:**
  - ☞ faster modernisation of vehicle fleet
- **Criteria: When should a LEZ be considered?**
  - ☑ high contribution of urban traffic-related air pollutants
  - ☑ air quality limit values exceeded in many urban streets
  - ☑ low proportion of through traffic or no alternative routes
- **Advantages:**
  - ☺ aims specifically at the highest emitting vehicles
  - ☺ rewards vehicle owners who invested in clean vehicles
  - ☺ reduces the emission of the overall vehicle fleet all over the LEZ → decrease in all streets → decrease of urban background concentrations → decreasing urban population exposure
- **Disadvantages:**
  - ☹ financial burden for owners of high emitting vehicles
    - ☞ in particular for small business
  - ☹ in Germany: every car owner has to buy a sticker to facilitate control
  - ☹ considerable administrative effort, e.g. for granting single exemptions

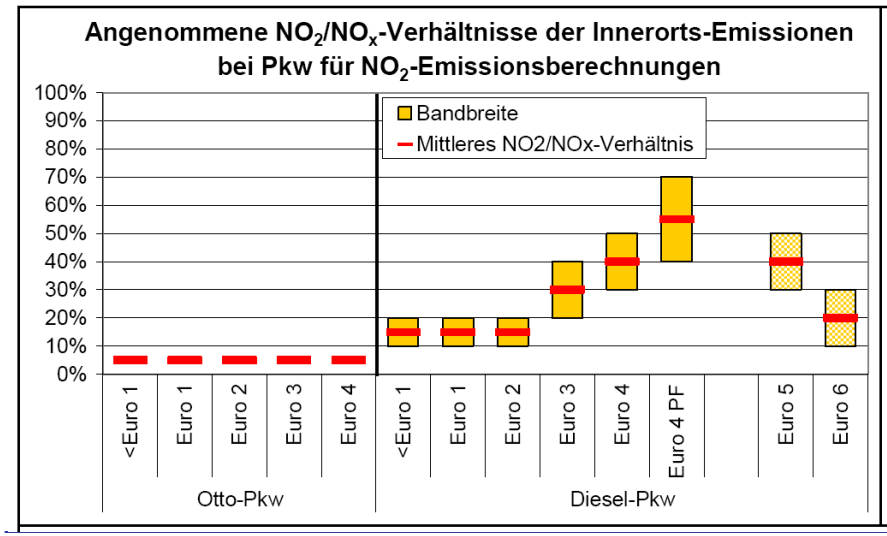
LEZ ☞ what's needed

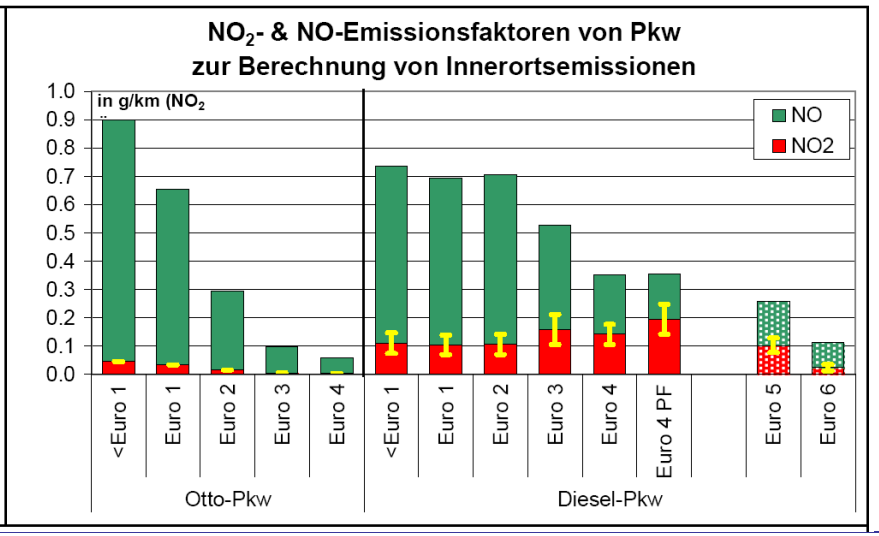
- ☑ (national) vehicle classification scheme in force in time
  (☝ EU-wide regulation !?)
- ☑ technical criteria for retrofit systems to be set early
  (☝ EU-wide regulation, at least cross-border compatibility!!)
- ☑ sufficient market coverage for retrofit kits, in particular for commercial vehicles
- ☑ economic incentives
  - ☞ tax discounts, funding for cleaner/retrofitted vehicles (with particle trap, CNG)
- ☑ sufficiently long transition period
- ☑ few exemptions from traffic ban
- ☑ intensive public information
- ☑ effective enforcement & sanctions
- ☑ stricter vehicle emission standards
  (☝ EU-wide regulation !!)
- ☑ traffic planning promoting clean transport modes

☞ résumé (i)

- **environment zone most effective single measure, provided**
  - ↳ **ambitious environment criteria** ☞ 4 S-UM43
  - ↳ **implementation not too late** ☞ **~2010**
  - ↳ **limited exemptions, LEZ sufficiently large**

  possible benefit: ☞ 10% reduction of total PM10 pollution
  ☞ 10-15 less PM10 – exceedance days
- **NO2-impact limited, because criteria = emission standards**
  - ☹ **retrofit deNOx-systems very limited or not yet available**
  - ☹ **higher share of direct NO2-emissions of modern veh. inkl. Euro 5**





source: IFEU (2007)

LEZ ☞ résumé (ii)

- **LEZ alone not sufficient, needs to be supplemented by…**
  - **transport planning aimed at less motor traffic**
  - **optimzed traffic management**
  - **….**
- **compliance with PM und NO2-standards, hardly possible, even if one takes advantage of prolongation of attainment periods, inter alia because**
  - ☹ **Revision NEC-Directive too late**
  - ☹ **apdate Euro-standards E5/6 und E VI too late**
- **all appropriate & proportionate measures need to be exhausted, including LEZ**

The LEZ: Berlin‘s marathon race towards cleaner air

Thanks for listening!