Air quality management in Berlin: tools, challenges and solutions

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- Berlin's past actions to combat winter smog
- Current challenges and need for additional action
- Example: the low emission zone
- Portfolio of extra measures
- Estimation of their likely impact on the AQ
- Link to other planning activities
- résumé

Framework for Air Quality Management in the EU

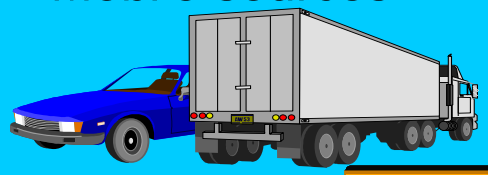
7th Environment Action Program

....to safeguard EU citizens from environment-related pressures and risks to health and wellbeing, like air pollution, and further reduce its impact on ecosystems and biodiversity

Controlling Emissions

National Emission Ceilings

Mobile sources



EU-Standards for vehicle emission and fuel quality (EURO 5/V – 6/VI)

Product standards, e.g. solvents in varnishes, Eco-Design

additional **national strategies**, e.g.
Economic measures
Road pricing
Fiscal incentives for BAT
Energy taxes
Scrappage schemes….

Air Quality Plans: additional measures on a **local** level, e.g.
- green public procurement
- traffic planning & management,
- small combustion units
- building sites, etc…….
short-term action plans if useful

Stationary sources

EU-Directive to control industrial emissions (LCP, waste incineration, industrial plants)

achieve Air Quality standards

trigger for further measures

Improving Air Quality

AQ Directive 2008/50

- sets **air quality standards** for
  - SO_2, PM, NO_2, lead
  - Benzene, CO
  - Ozone
  - *PAH*, heavy metals**
- requires **Air Quality Plans** in non-attainment areas
- sets common **criteria for air quality assessment**
- sets minimum **require-ments** to **inform the public** about air quality

Critical loads for Acidification & Eutrophication

*seperate Directive 2004/107

AQ assessment Berlin

☞ need for action

- **Drivers:**
  - **air quality standards for fine particles (PM10) and nitrogen dioxide (NO2) still exceeded**
    - ☞ **need for city strategy to reduce air pollution**
  - **obligation for noise actions planning**
    - ☞ **Berlin‘s target levels: 70 dB(A) day/60 dB(A) night**
    - ☞ **long-term goal: 65 dB(A) day/55 dB(A) night**
  - **ambitious goals to curb greenhouse gas emissions**
    - ☞ **-40% CO2 emissions by 2020 compared to 1990**
    - ☞ **control soot particle emissions as a driver for climate change**
- **Focus on road transport:**
  - **road traffic is main contributor to PM10 and NO2**
  - **transport is the only sector with rising CO2 emissions**
    - ☞ **+7% from transport since 1990, -10 to -40% other sectors**
  - **urban noise pollution is mainly generated by road traffic**

☞ **need for action to make road transport more sustainable**

New air quality plan 2011-17

☞ Stipulated type of measures

- **Regional-, urban- and landscape planning**
- **Traffic on road, rail and inland waterways**
  - ☞ Vehicle technology
  - ☞ Traffic management
  - ☞ Avoiding & shifting traffic to more sustainable transport modes
  - ☞ Transport infrastructure improvement
- **Domestic heating**
  - ☞ study on PM contribution from wood combustion
  - ☞ potentially regulate small combustion sector
- **Construction sector**
  - ☞ DPF for construction machinery
- **Industry und commerce**
- **Measures not pursued**
  - ↳ no tightening/extending of the LEZ
    - ☞ But exemptions will largely end in 2015
  - ↳ no road pricing/city toll/congestion charge
    - ☞ lacking legal ground
    - ☞ might generate traffic or push it in city areas without road pricing

New air quality plan 2011-17

☞ Clean vehicle technology & fuels

- **Funding and benefits for Euro 6/VI vehicles**
  - Vehicle tax discount, labelling ☞national government
  - reduced parking fees
- **Promoting natural gas for vehicles and domestic use**
  - Programme for gas taxis & garbage collection vehicles
- **Promoting electro mobility**
  - The Berlin Capital Region as one of 4 national showcases for electromobility
    - ☞ Focus on practical implementation of electromobility in concert with intelligent energy and transportation concepts
    - ☞ 74 projects will be implemented
  - Underpinned by Berlin's Energy Strategy aimed at boosting renewable power production

PV panels on roof of Berlin's new main railway station

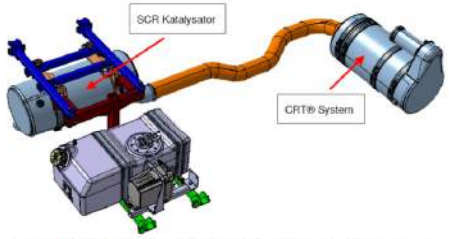
Berlin eTukTuks at the Brandenburg Gate

New air quality plan 2011-17

☞ Emphasis on Diesel exhaust control

- since 1999: filter retrofit & fleet modernisation programme of Berlin's 1400 Diesel buses, resulted in
  - > 90% reduction of Diesel soot emissions
  - - 37 t/a Diesel soot emissions
    - ☞ ¼ of the mitigation effect of the LEZ
  - - 732 t/a NOx emissions
    - ☞ ½ of the mitigation effect of the LEZ

- Now: setting criteria for public bus services
  - attainment of Euro 5/EEV-standard for NOx in the whole fleet by 2014
    - ☞ 300 t/a less NOx emissions
  - SCR – retrofit of 200 Euro IV busses by 2015
    - ☞ 50% funding through EU regional funds



SCRT® Anordnung für SOLARIS Urbino 18 (Quelle: HJS)

  - Upgrade of OEM Euro V/EEV buses to enhance SCR performance
    - ☞ Better insulation of tailpipe & extra heating to ensure operation of SCR during urban driving mode
  - Accelerated replacement by Euro-VI/CNG/biogas-vehicles
    - ☞ Procurement condition: E VI performance required in urban driving conditions
- Successful pilot project on DPF retrofit of passenger cruising vessels
  - retrofit of 3 vessels with different filter systems:
    - ☞ >90% filter efficiency, no extra fuel consumption
    - ☞ successful filter regeneration also in difficult operation conditions
  - Retrofit programme funded through EU regional funds

New air quality plan 2011-17

☞ Emphasis on Diesel exhaust control of mobile machinery

- **Reason** for action
  - ☞ Machines release 5-10 time more Diesel – PM than comparable Diesel trucks
    - ☹ NRMM emission standards lag 5 years behind road vehicle standards
    - ☹ Even latest standard tier IIIB does not require efficient DPF
  - ☞ cost-efficient solution exists for older machinery by retrofit of closed/regulated DPF
    - ➢ vast experience in Switzerland, cost/benefit ratio >> 3:1
  - ☞ Diesel soot is a health and safety issue at work places

- **Implementation** in Berlin:
  - ↳ Demonstration project with DPF retrofit
    - ☞ retrofit is technically & economically feasible for different machines and operation modes
  - ↳ Setting environment standards in public tenders for construction services as from 2014:
    - ☞ machinery need to meet the latest EU particle emission standard (IIIB/IIIA depending on the size of equipment), or
    - ☞ retrofit with an efficient regulated/closed Diesel particle filter, type-approved with reference to new UN-ECE REC-regulation

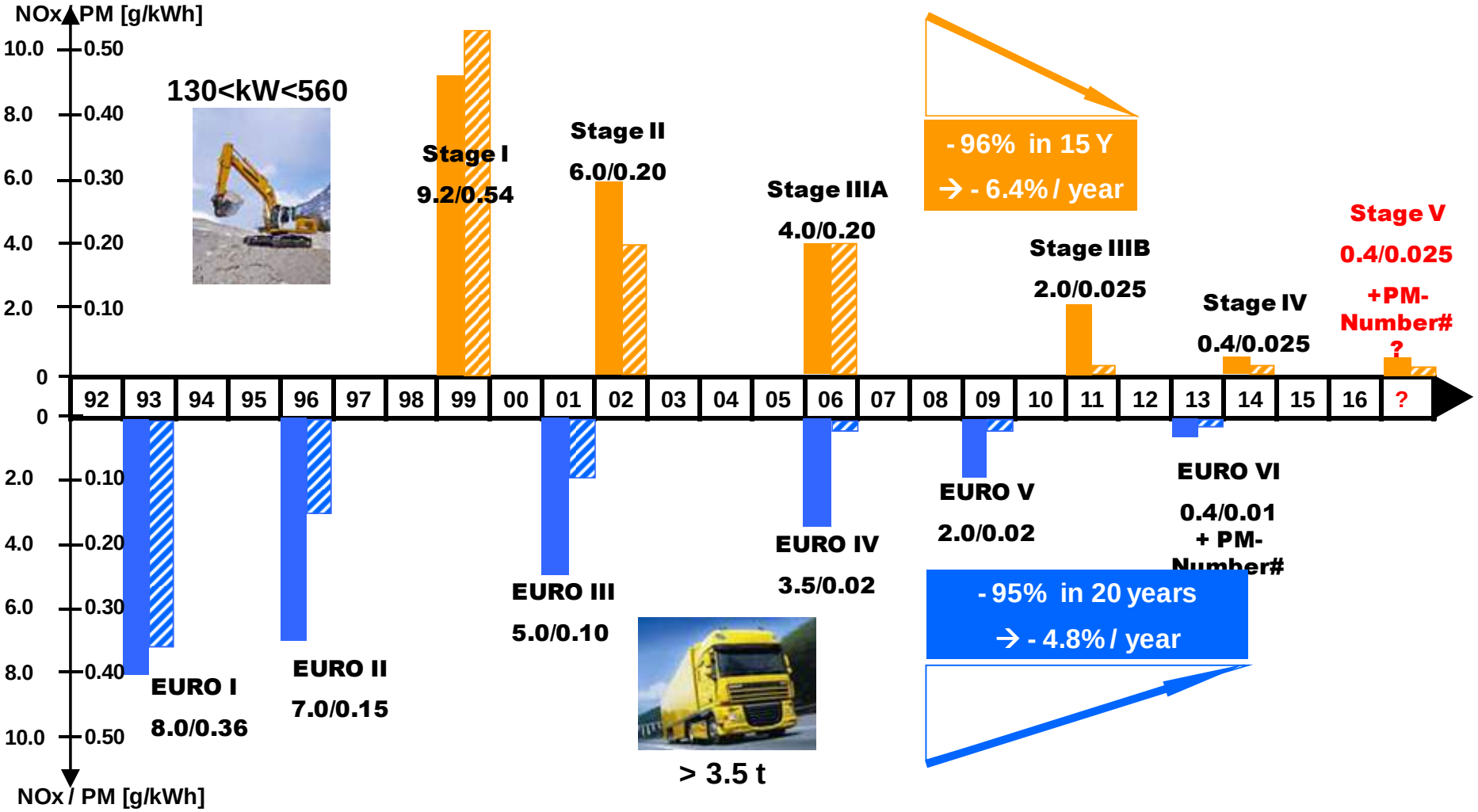
  - ↳ Setting similar criteria in permits granted to operators of large construction sites
- **impact**: in Berlin about 60-100 t/a reduction of Diesel soot emissions

! this is of the same magnitude as the benefit of the low emission zone

! Problem: missing incentives to invest in NRMM with DPF

Chronology of EU emission legislation:

☞ on-road vs Non-Road Mobile Machinery



Sorce: F. Jaussi, Liebherr

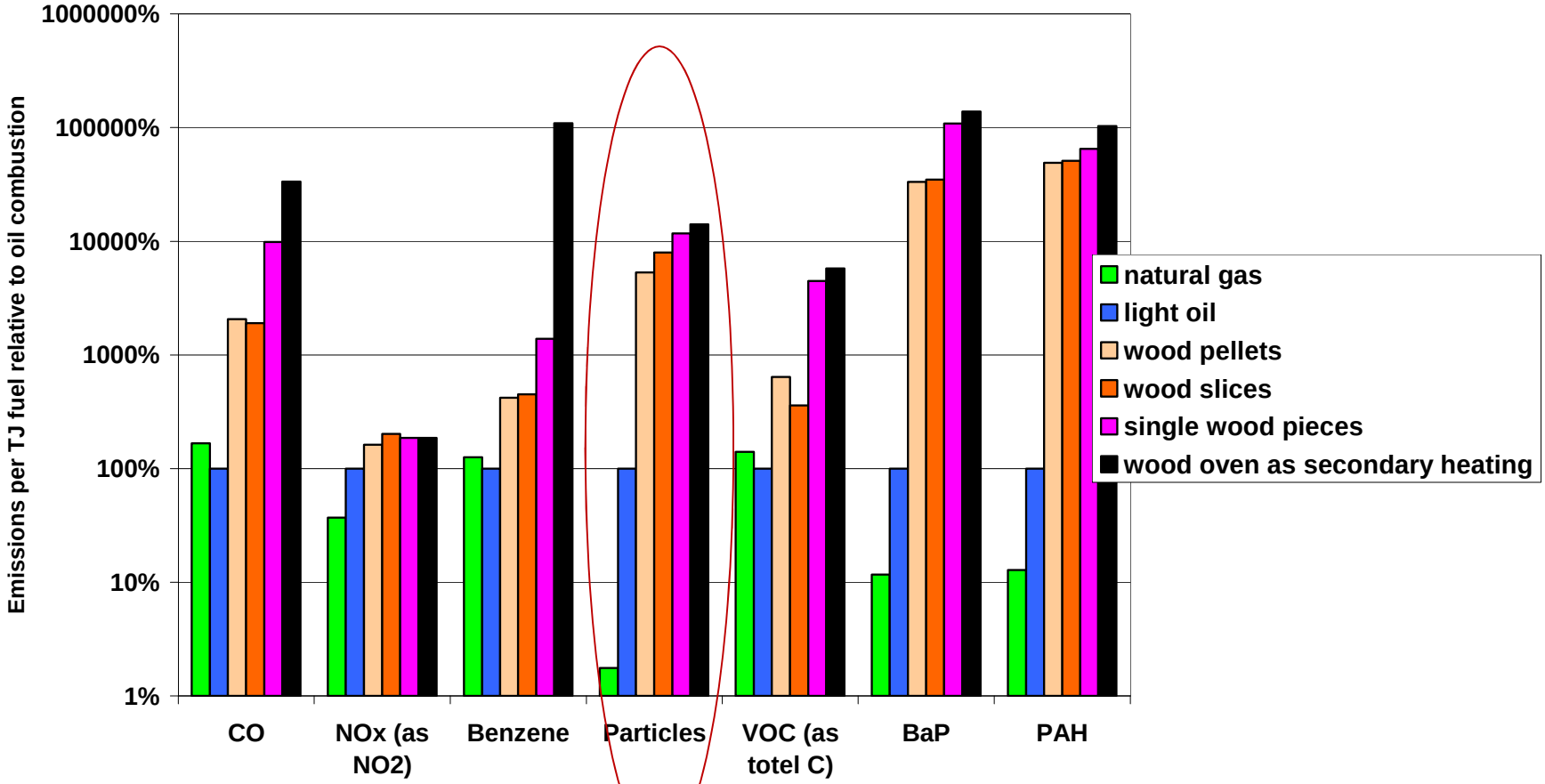
small combustion plants

☞ fuel dependant emissions

Emissions of small combustion units depending on fuel use

100% = oil combustion

source: UBA-Forschungsbericht 2009

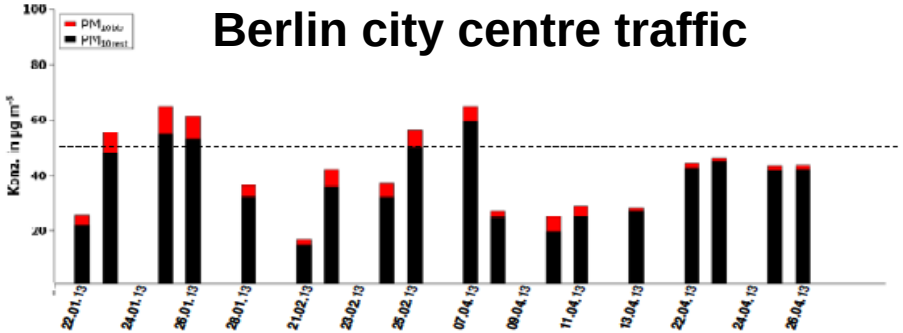


New quality plan 2011-17

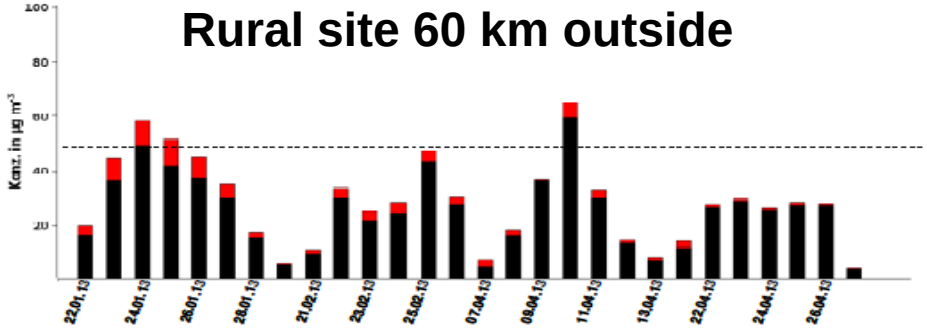
☞ **Focus on house heating**

- **We undertake extra source analysis**
- **We'll consider setting stricter standards than the national regulation for solid fuel combustion with single units**
- **We might expand existing restriction in central Berlin to set up new small heating systems based on solid fuel**
- **assumption for impact analysis until 2015:**
  - ☞ **replacement by particle free/reduced heating technology (natural gas/district heating)**
  - ☞ **reduction of PM emissions of house heating by 60%**

Berlin city centre traffic



Rural site 60 km outside



PM10 from wood burning

☞ **Needs joint regulation with region surrounding Berlin**

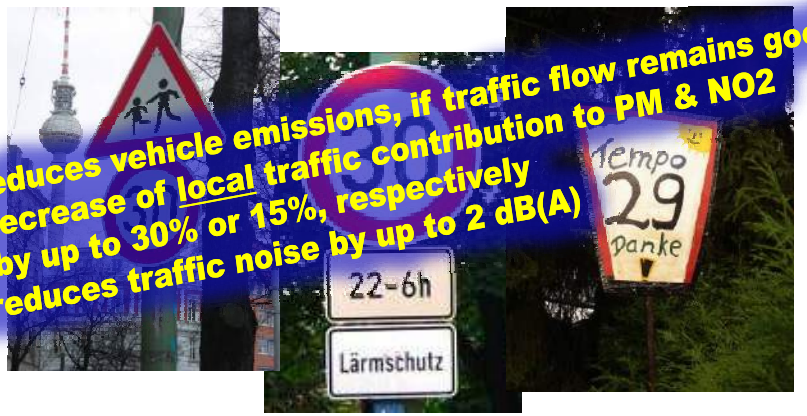
Sustainable City & Transport Planning

☞ traffic management measures

■ Re-routine lorry traffic

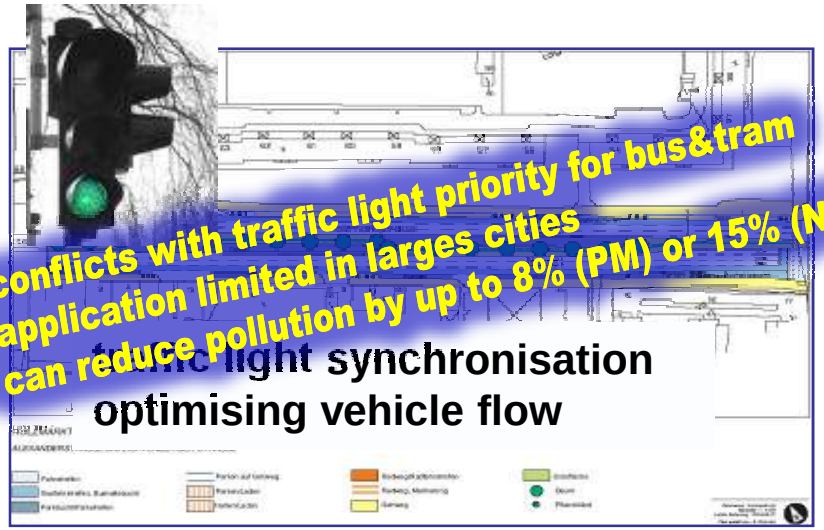
- Reduces PM pollution by 7-9%
- needs alternative lorry routes
- Application limited in larges cities

■ City-compatible speed limits



- reduces vehicle emissions, if traffic flow remains good
- decrease of local traffic contribution to PM & NO2 by up to 30% or 15%, respectively
- reduces traffic noise by up to 2 dB(A)

■ Traffic flow optimisation



- conflicts with traffic light priority for bus&tram
- application limited in larges cities
- can reduce pollution by up to 8% (PM) or 15% (NO2)

traffic light synchronisation
optimising vehicle flow

Sustainable City & Transport Planning

☞ Improving public transport

- makes public transport more attractive
- avoids car trips in urban areas
- reduces air & noise emissions
- makes transport more energy efficient
- Hence: strongly linked noise action planning, CC and AQ strategies

Sustainable City & Transport Planning

☞ Enhancing inter-modaliy

■ For freight transport…

- makes rail-road more attractive
- keeps lorries out of sensitive urban areas
- Reduces noise and air pollution
- makes freight transport more energy efficie

■ Bike & Ride

- makes PT & cycling more attractive
- shifts car traffic to cleaner modes

■ Park (& Charge) & Ride

☞ incl. priority for electric vehicles

- makes PT more attractive
- reduces car trips in the city
- incentives electric vehicles

Sustainable City & Transport Planning

☞ promoting bicycle use

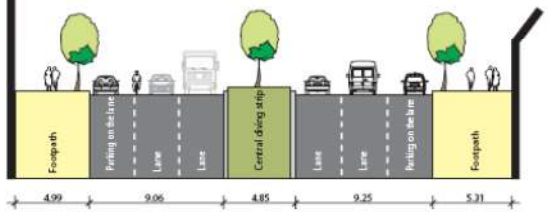
- makes bicycle us more attractive
- aviods car trips in urban areas
- reduces air & noise emissions
- makes transport more energy efficient
- good for public health
- Hence: strongly linked noise action planning, CC and AQ strategies

Re-allocation of road space in favour of cyclists & pedestrians:

☞ Safe riding on extra bicycle lanes on the road

☞ Reduces noise levels at the building line

before



after

Sustainable City & Transport Planning

☞ promoting walking

- **Berlin‘s pedestrian traffic strategy**
  - **☞Some examples…**

New green walks along the former wall

Sustainable City & Transport Planning

☞ Focus on urban climate adaptation

Micro-scale: measures for single streets & buildings

- increase albedo of building surfaces
- roof and facade greening
- courtyard greening
- tree planting
- de-sealing of surfaces

Good also for AQ (dust concentrations)

Macro-scale: Largely maintaining open space & green areas so as to keep free flow of fresh and cool air into the city centre ☞

Berlin noise action plan

☞ conceptual approach for traffic noise

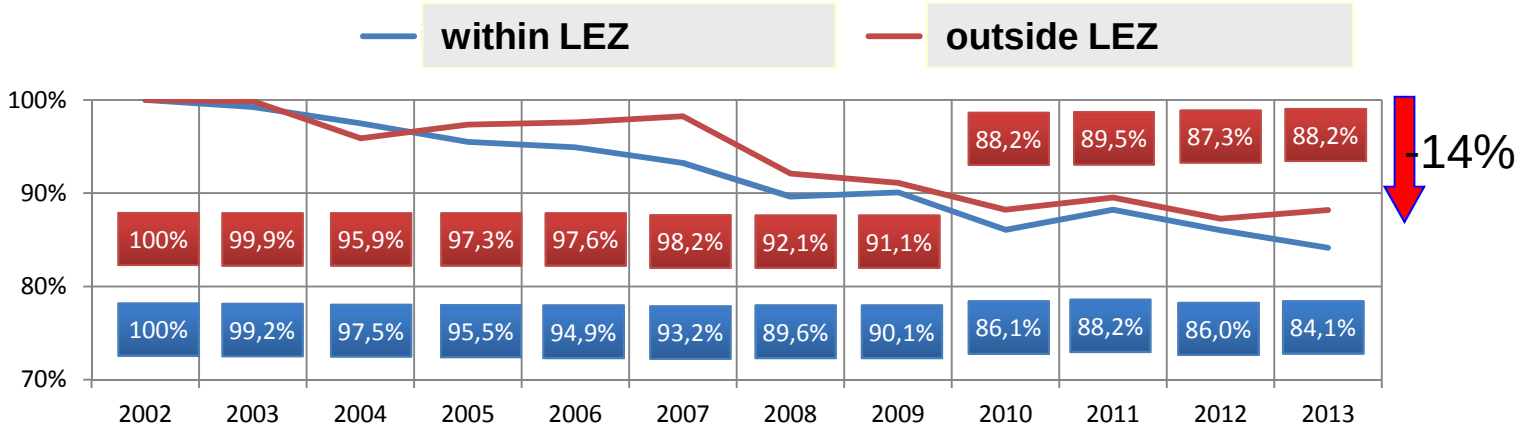
Concept	good for climate	good for air quality
Urban Planning and Development		
☞ setting objectives for low-noise city planning	(✓)	(✓)
Traffic Development and Planning		
☞ promotion of eco-mobility & clean transport modes	✓	✓
☞ mitigation of source & target traffic, area parking management	✓	✓
☞ mobility management by business	✓	✓
☞ enhancing intermodality, park & ride	✓	✓
Traffic network design and traffic control		
☞ re-routing traffic to new or existing roads outside of residential areas		✓
☞ re-routing or ban of commercial traffic		✓
Traffic management and road space re-allocation		
☞ speed limits	✓	✓
☞ improving traffic flows without traffic growth	✓	✓
☞ altering road space design in favour of green transport modes	✓	✓
Technical noise control measures for vehicles and infrastructure		
☞ Renewal of road surface with silent asphalt & silent tracks for trams/trains		✓ for PM
☞ noise standards for vehicles		(✓)

Sustainable City & Transport Planning

Senatsverwaltung für Stadtentwicklung und Umwelt | be Berlin

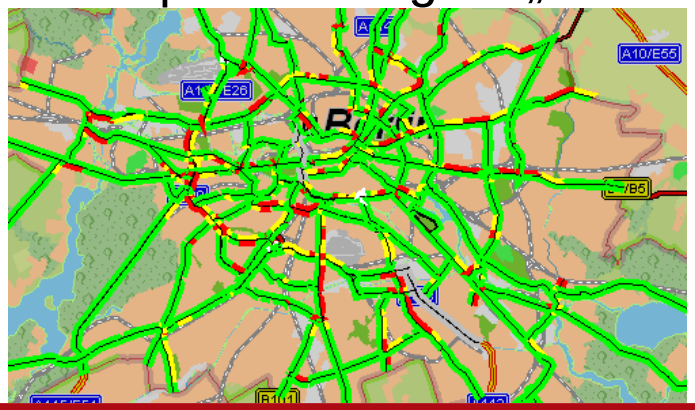
☞ Impact on traffic volumes & congestion

Less Traffic: trend in traffic volumes 2002-2013 in Berlin (2002 = 100%)



Less congestion: Morning traffic peak during an „normal“ Thursday

(Forecast from 24/02/10 for the 25/02/10)
Quelle: Verkehrsmanagementzentrale Berlin i.A. der Senatsverwaltung für Stadtentwicklung. www.vmzberlin.de/vmz

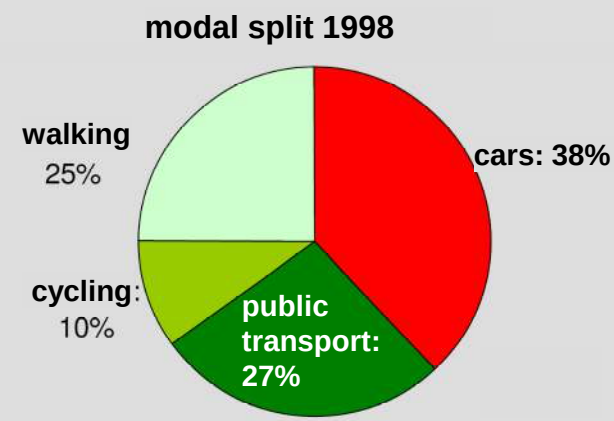


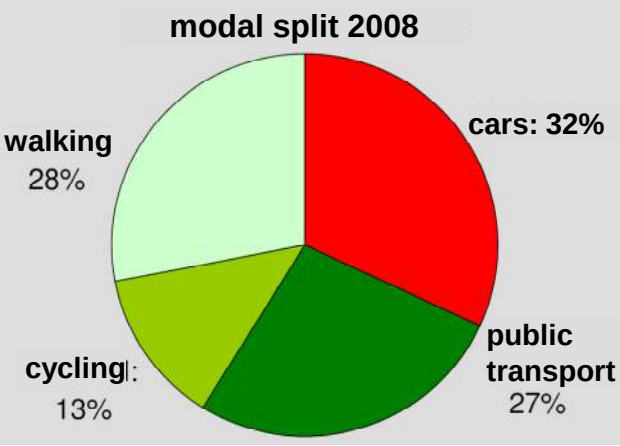
Traffic Jams
Disruptions
No Problems

Sustainable City & Transport Planning

☞ Impact on CO2 – emissions

Shift towards cleaner means of transport





source: master plan transport 2011

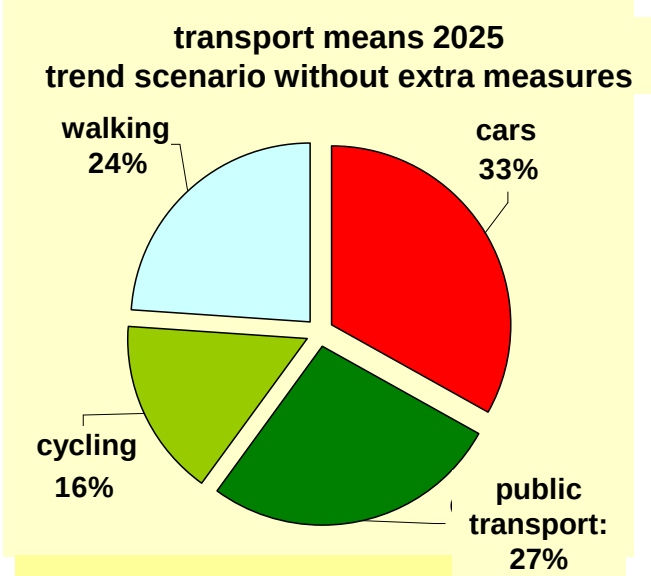
expected decrease of CO2-Emissions from road transport on Berlin's main road network

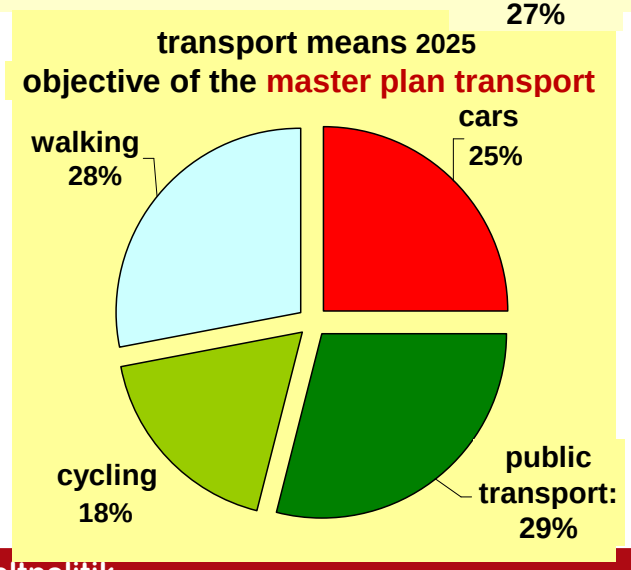
2.6 Mio t CO2 in 2006

⇩ -38%

1.6 Mio t CO2 in 2025

incl. renewal of vehicle fleet



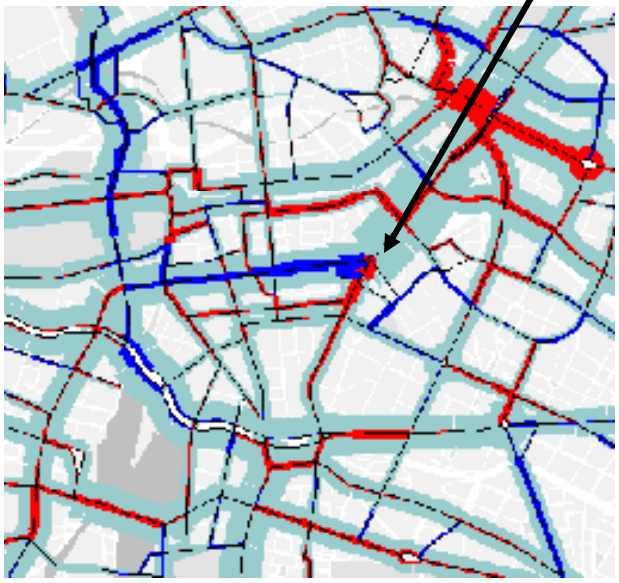


AQ planning

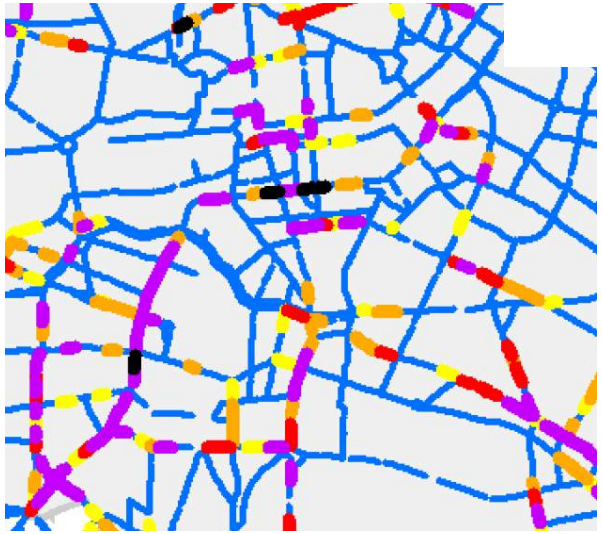
☞ relevance of urban planning processed

- **exemplary case Leipziger Straße**
  - ↳ **mitigation trough new road link Axel-Springer Str**

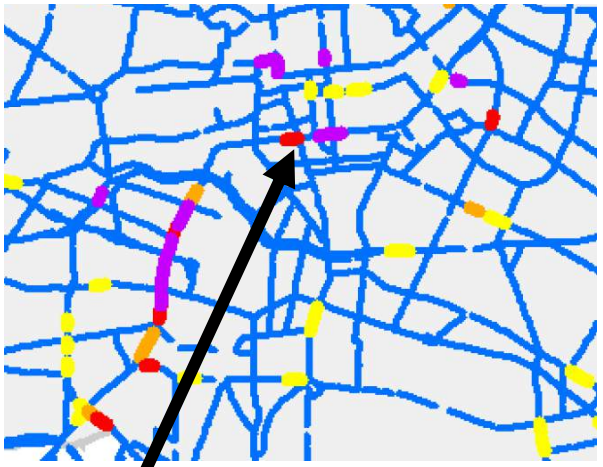
change in traffic volume 2009-2015



NO2-pollution 2009



NO2-pollution 2015 implementation of traffic management & vehicle-technology measures



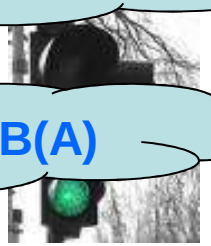
- **! still limit values excess despite LEZ & mitigation by 10.ooo less veh/d due to alternative route**
- **! additional traffic load (+3.ooo veh/d) due to planned business & shopping centre not yet taken into account**

traffic management measures

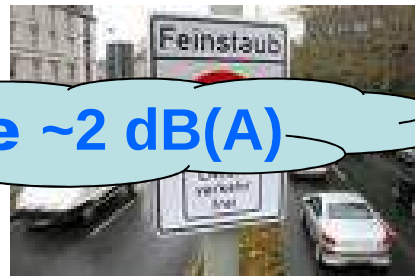
☞ potential impact on air quality

- **shift modal split from motor traffic to clean transport modes**
  - Berlin‘s planning objective:
    -10% less motor traffic in 10-15 years
    results in up to -10% NO2, 3-4% less of 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
- **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
- **speed limit 30km/h whole day:**
  - example Schildhornstraße Berlin: -10 % of total NO_2, -6% of total PM
    if traffic light coordination with 30 km/h works well
    speed limit is enforced
    → also less noise and traffic accidents

☺ noise ~0.5dB(A)



☺ noise ~1 dB(A)

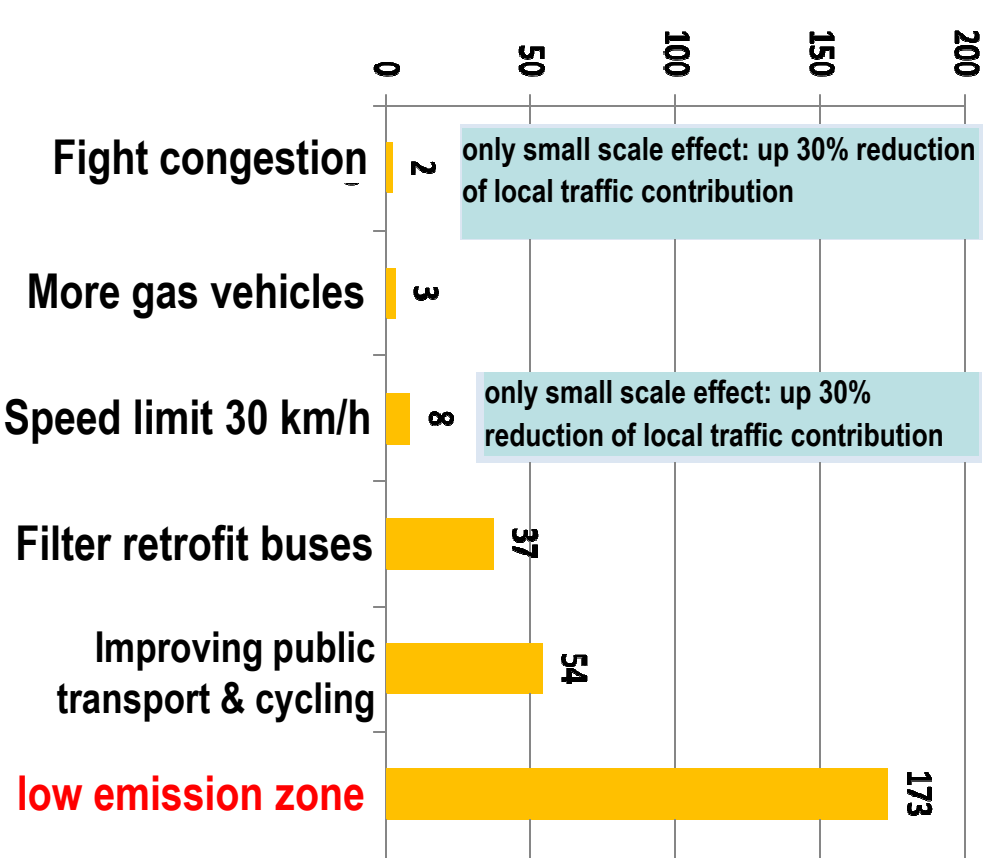


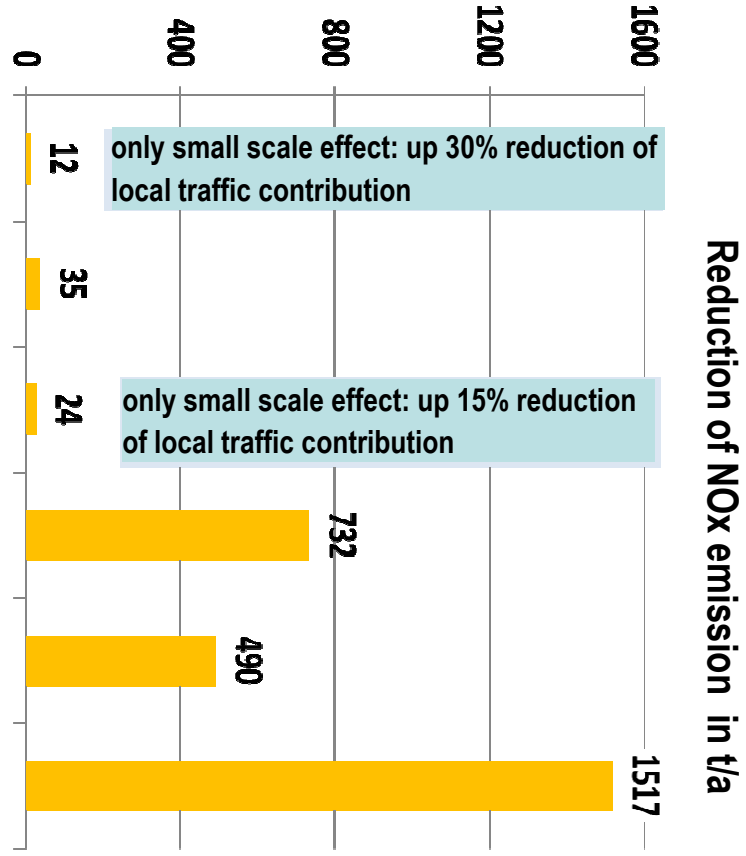
☺ Noise ~2 dB(A)

☺ Noise ~2 dB(A)

Impact of different measures

☞ current emission reduction





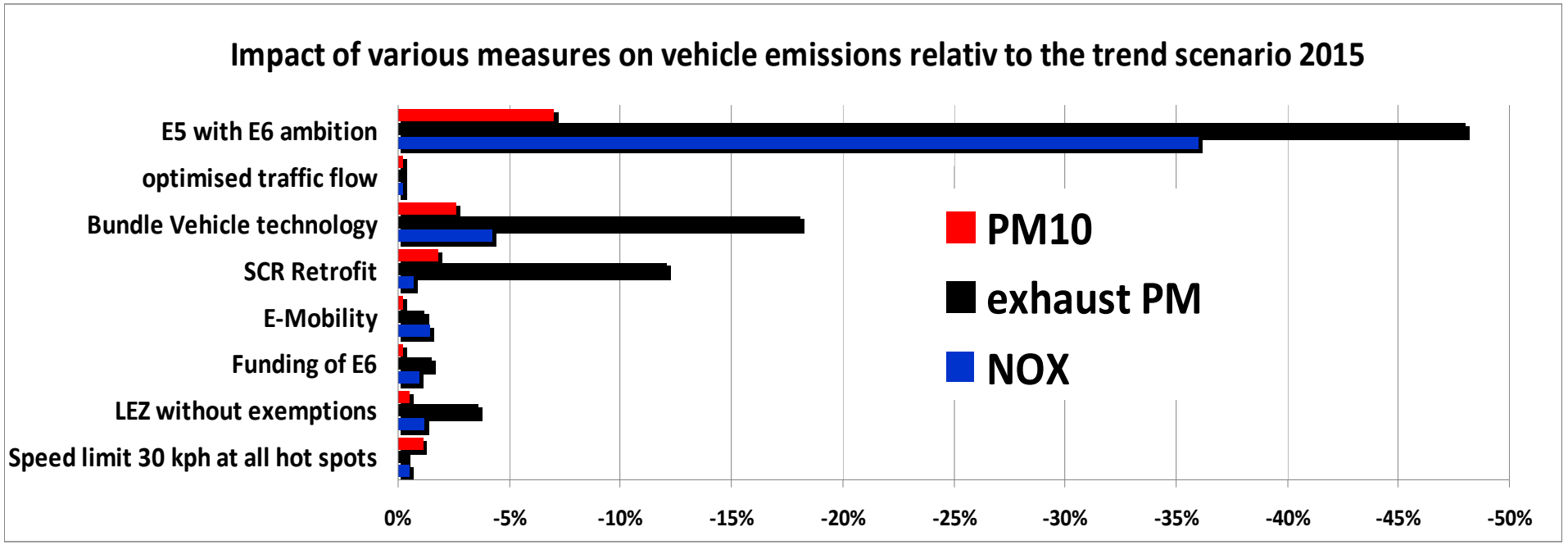
Total PM10-Emission in 2005: 3854 t/a

Total NOx-Emission in 2005: 20292 t/a

New air quality plan Berlin

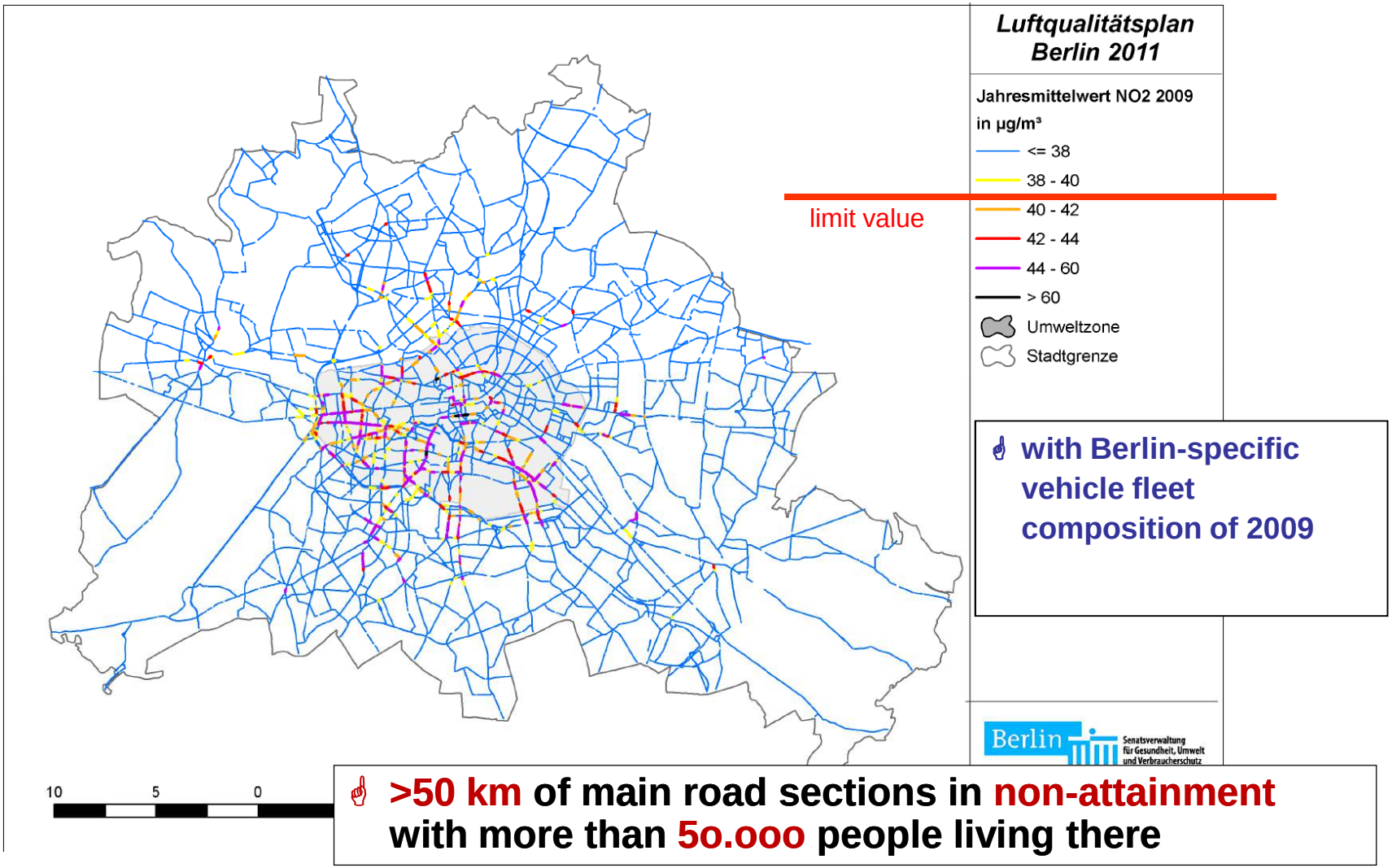
☞ impact of extra measures by 2015

- Impact of different bundles of measures on emissions



New air quality plan 2011-17

☞ simulated NO2 - pollution 2009

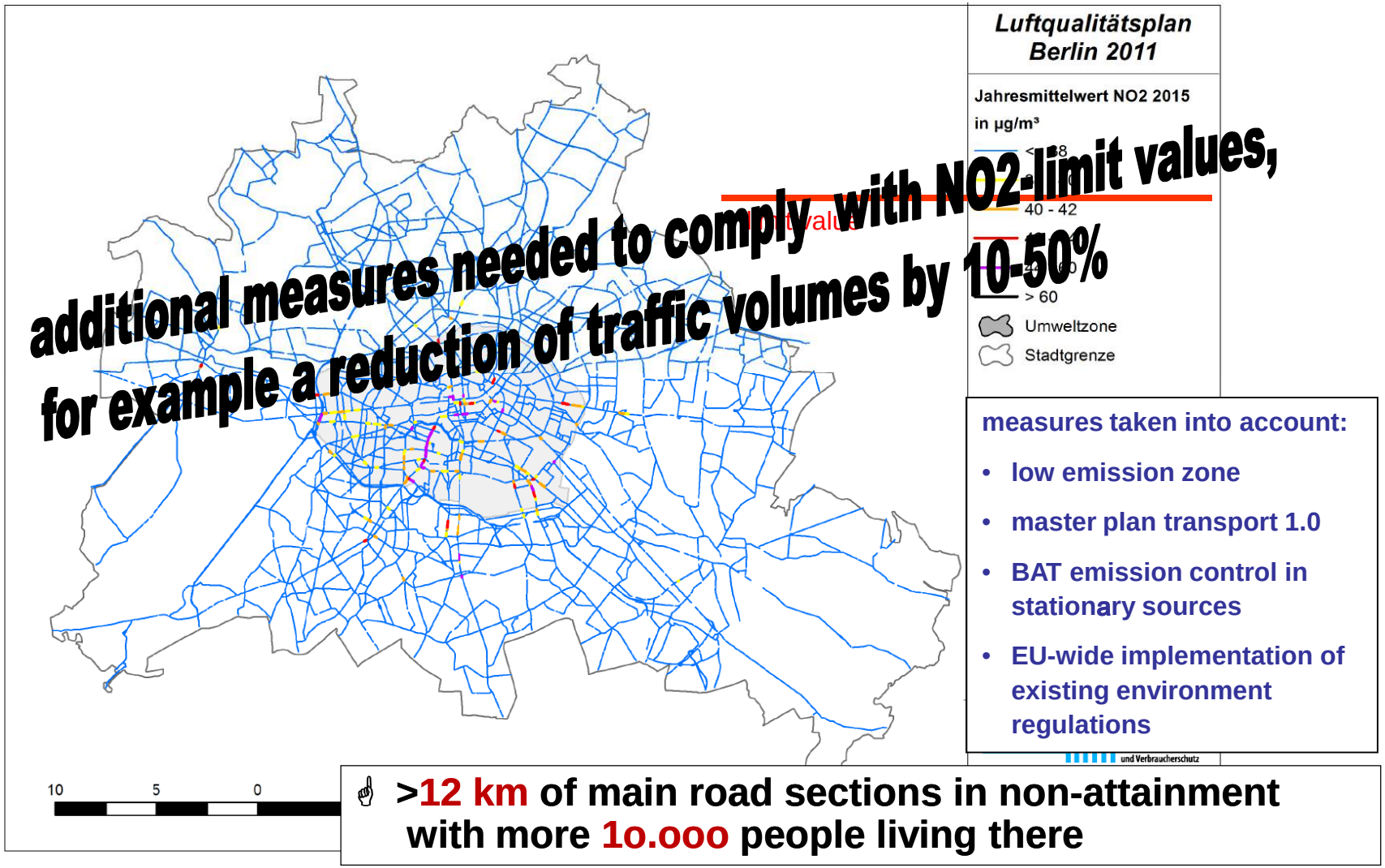


☝ **with Berlin-specific vehicle fleet composition of 2009**

☝ **>50 km of main road sections in non-attainment with more than 5o.ooo people living there**

New air quality plan 2011-17

☞ simulated NO2 - pollution trend scenario 2015



additional measures needed to comply with NO2-limit values, for example a reduction of traffic volumes by 10-50%

measures taken into account:

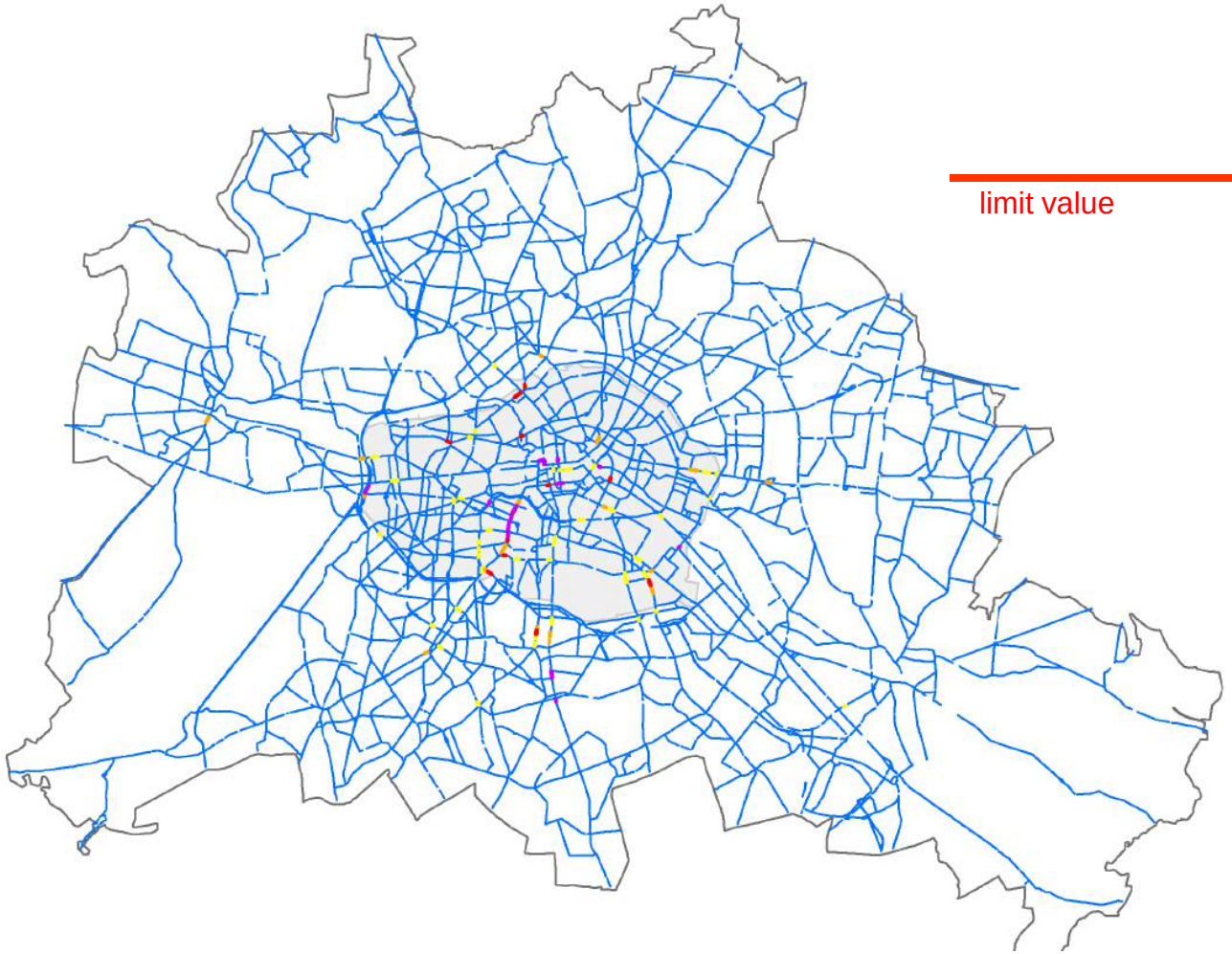
- **low emission zone**
- **master plan transport 1.0**
- **BAT emission control in stationary sources**
- **EU-wide implementation of existing environment regulations**

☝ **>12 km of main road sections in non-attainment with more 1o.ooo people living there**

Simulation of NO2-pollution 2015
☞ action bundle vehicle technology

Senatsverwaltung für Stadtentwicklung und Umwelt

Berlin



limit value

Maßnahmenbündel 2

Jahresmittelwert NO2 2015 in µg/m³

- <= 38
- 38 - 40
- 40 - 42
- 42 - 44
- 44 - 60
- > 60
- Umweltzone
- Stadtgrenze

Measures taken into account:

- trend scenario 2015
- retrofit of buses with SCR
- retrofit of HGV with SCR/EGR
- LEZ without exemptions
- E6 funding

☝ **>7 km of main road sections in non-attainment with more 6.000 people living there**

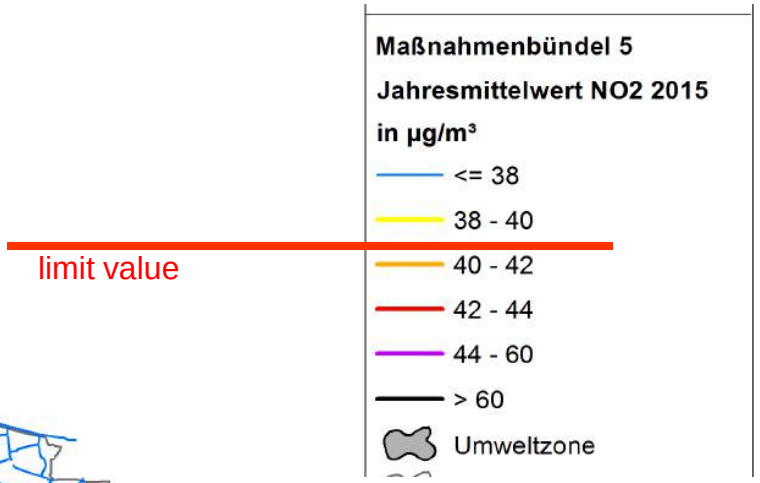
10 5 0

simulation of NO2-pollution 2015

Senatsverwaltung für Stadtentwicklung und Umwelt

Berlin

☞ scenario E5 with ambition of E6



limit value

Measures taken into account:

trend scenario 2015, plus

implementation of our plea of 2005:

- ☞ set new Euro 5 NOx- emission standard for Diesel – vehicles at an level equal to E4 petrol vehicles = 80 mg/km
- ☞ equivalent to E6 introduction 5 years earlier

☝ 0.14 km of main road sections in non-attainment with about 150 people living there

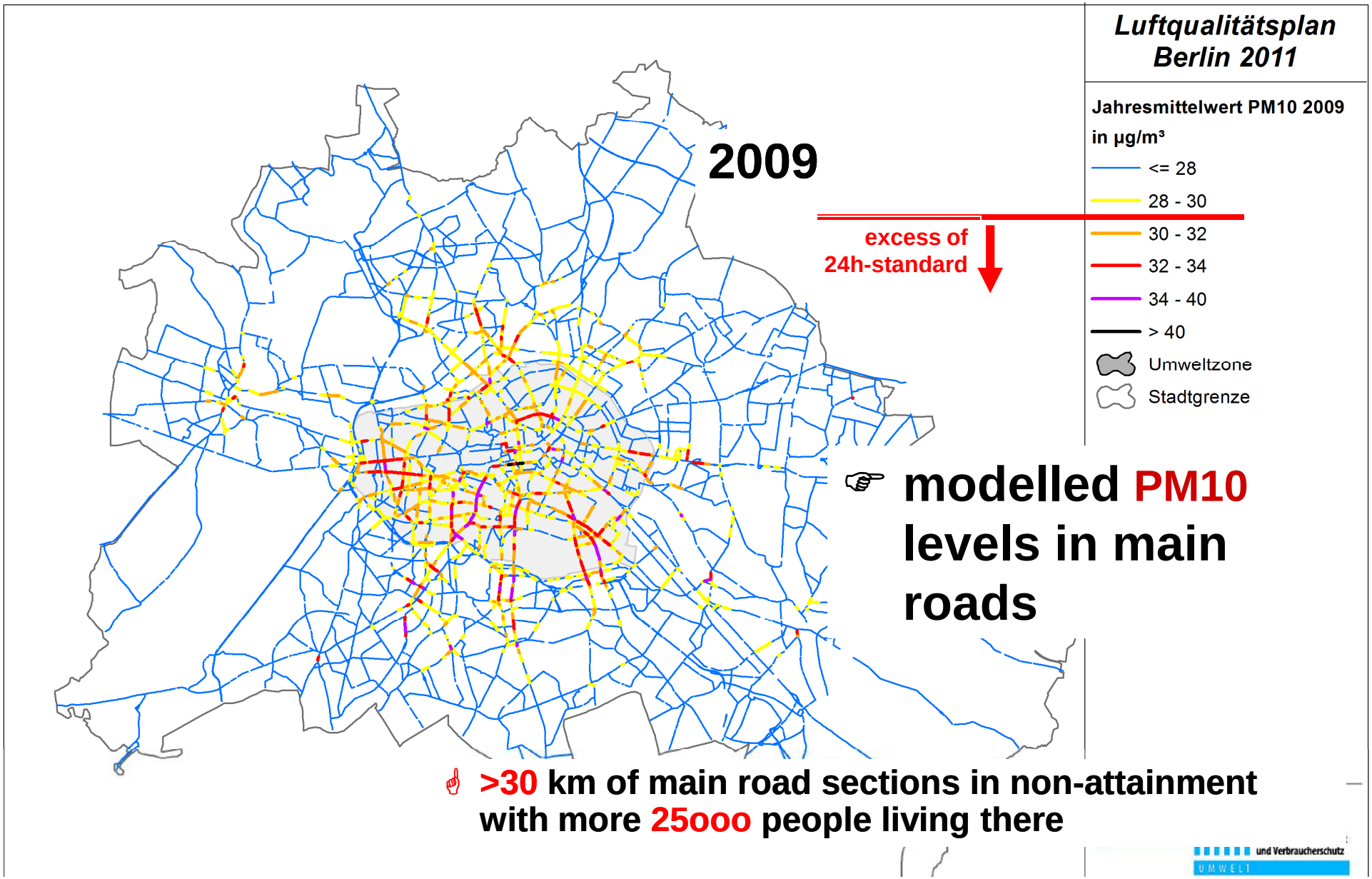
10 5 0

New air quality plan 2011-17

☞ simulated PM10 - pollution 2009

Senatsverwaltung
für Stadtentwicklung
und Umwelt

Berlin



☞ modelled PM10 levels in main roads

☝ >30 km of main road sections in non-attainment with more 25ooo people living there

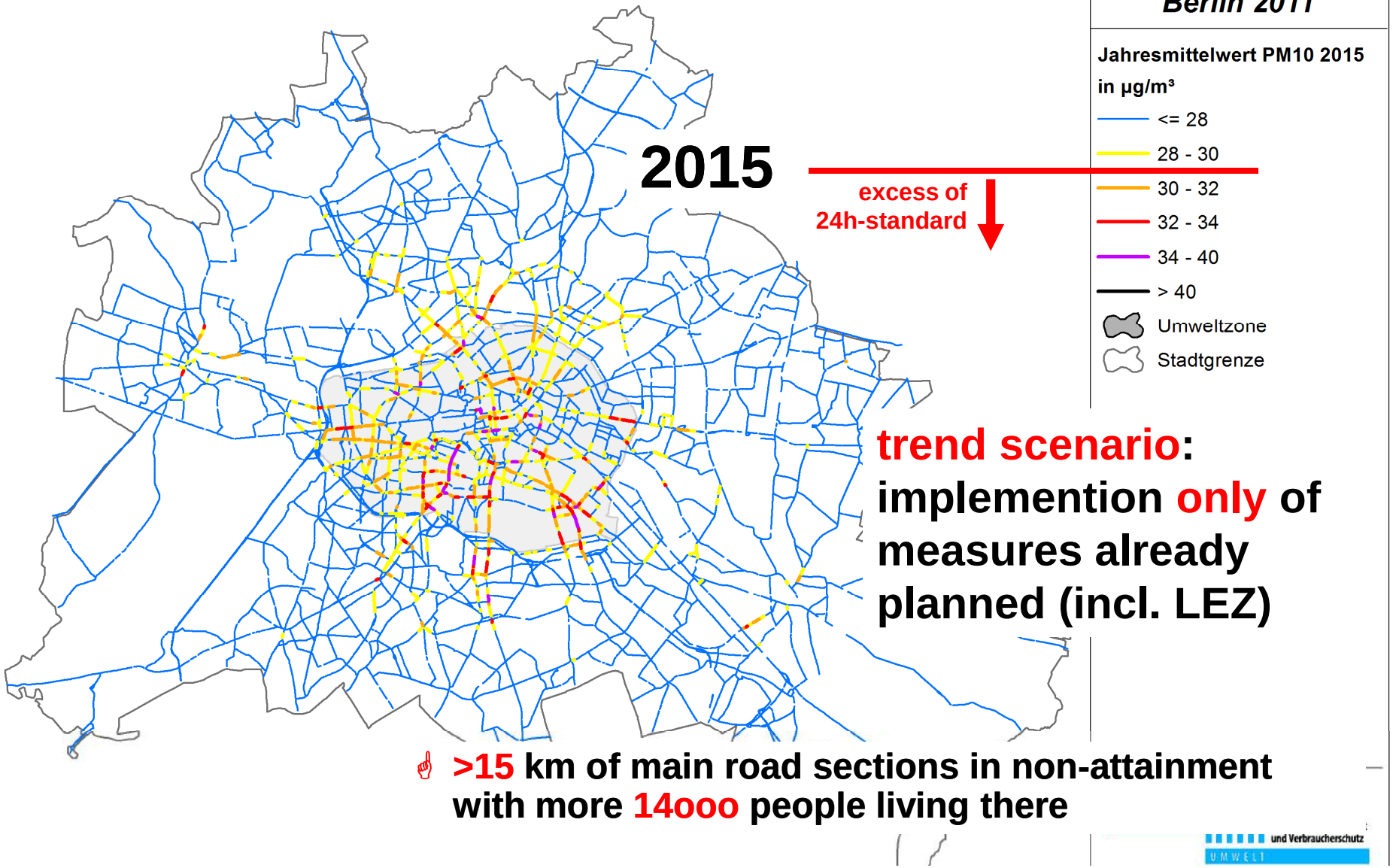
und Verbraucherschutz
UMWELT

New air quality plan 2011-17

Senatsverwaltung
für Stadtentwicklung
und Umwelt

Berlin

☞ simulated PM10 - pollution trend scenario 2015



trend scenario: implemention **only** of measures already planned (incl. LEZ)

☝ **>15** km of main road sections in non-attainment with more **14ooo** people living there

und Verbraucherschutz
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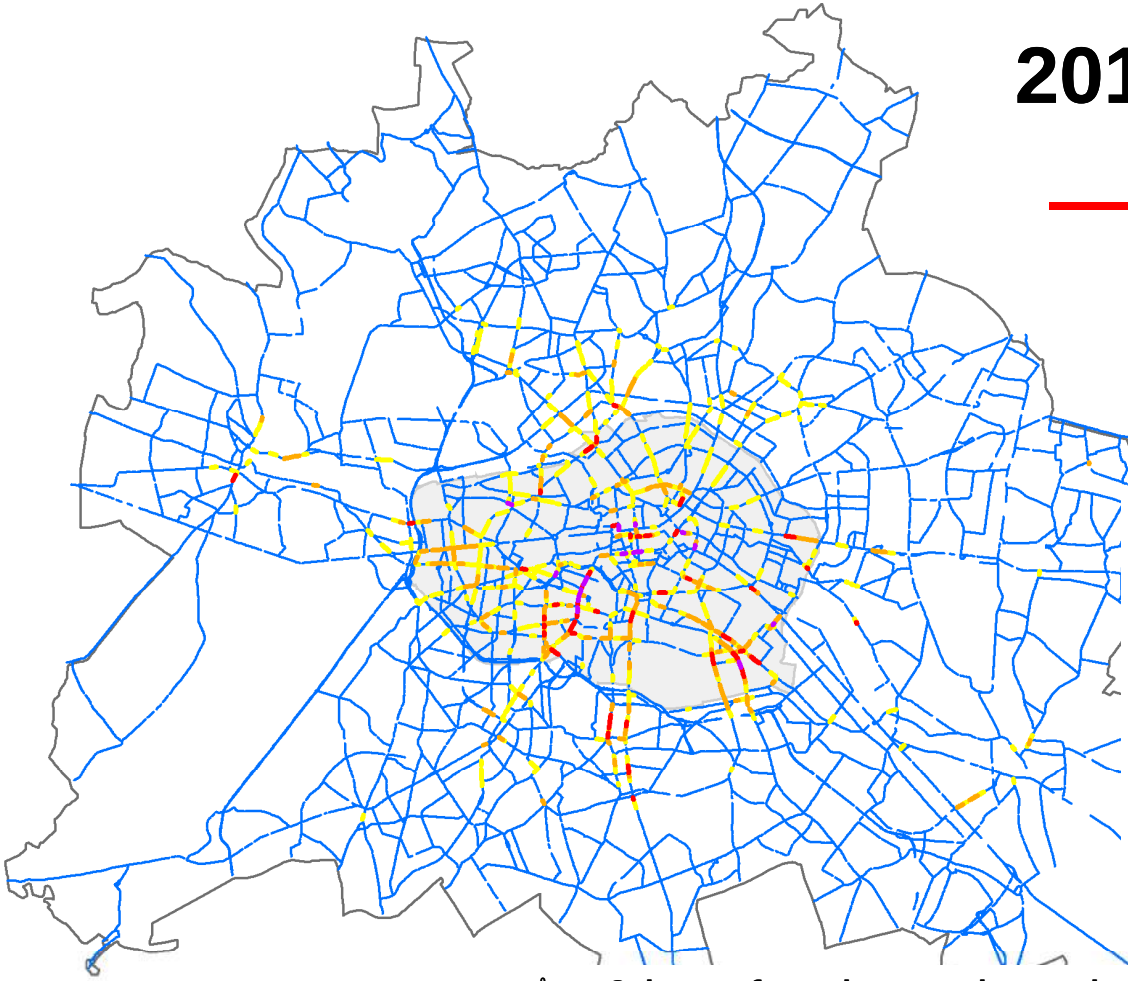
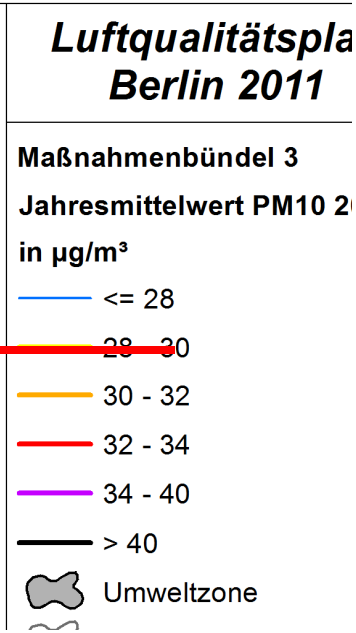
New air quality plan 2011-17

☞ simulated PM10 - pollution trend scenario 2015



2015

excess of
24h-standard



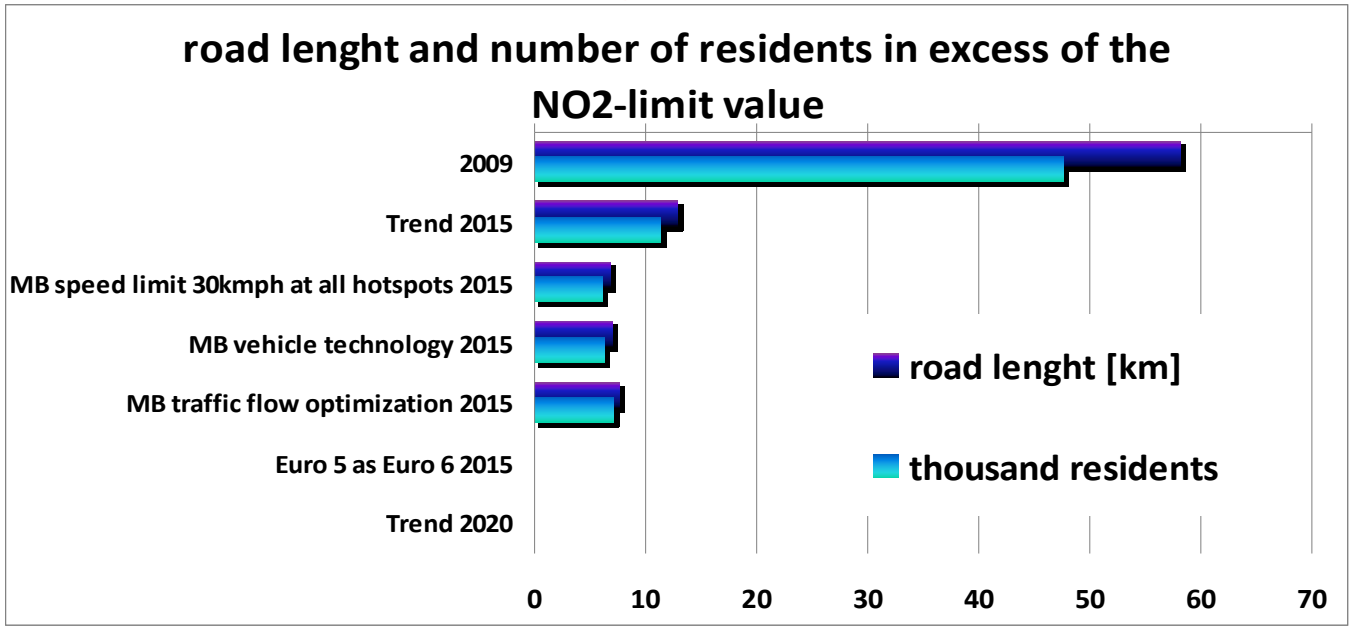
trend scenario plus:
ban of solid fuel for house heating & retrofit of mobile machinery

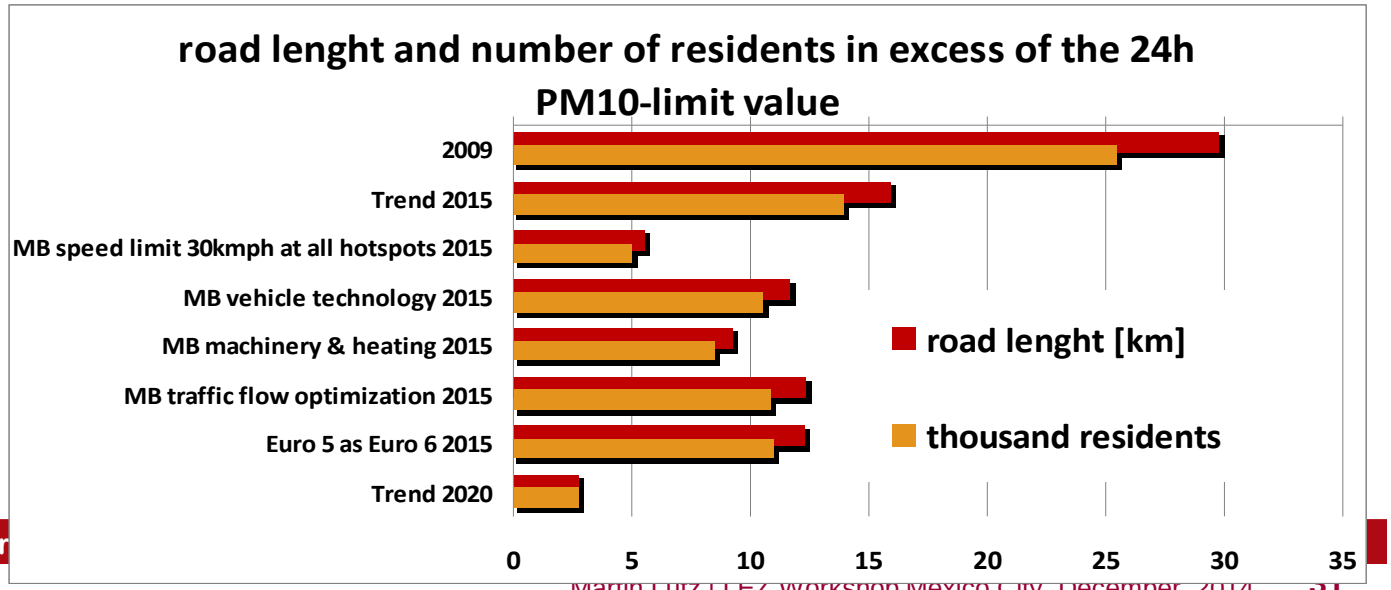
☝ >9 km of main road sections in non-attainment with more 8500 people living there

New air quality plan Berlin

☞ impact of various measures on AQ

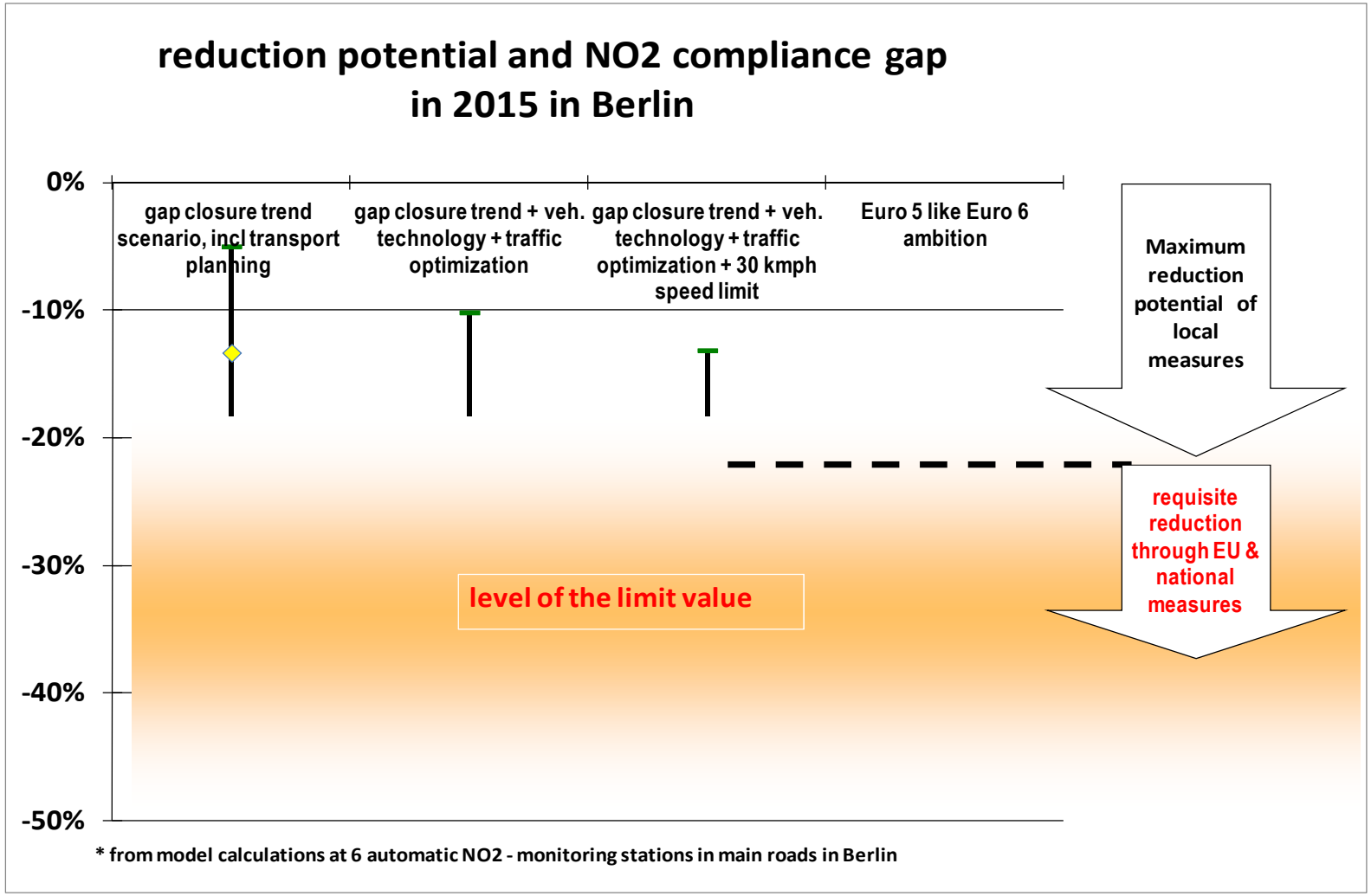
impact of different bundles of measures on NO2 and PM10 pollution





New air quality plan Berlin

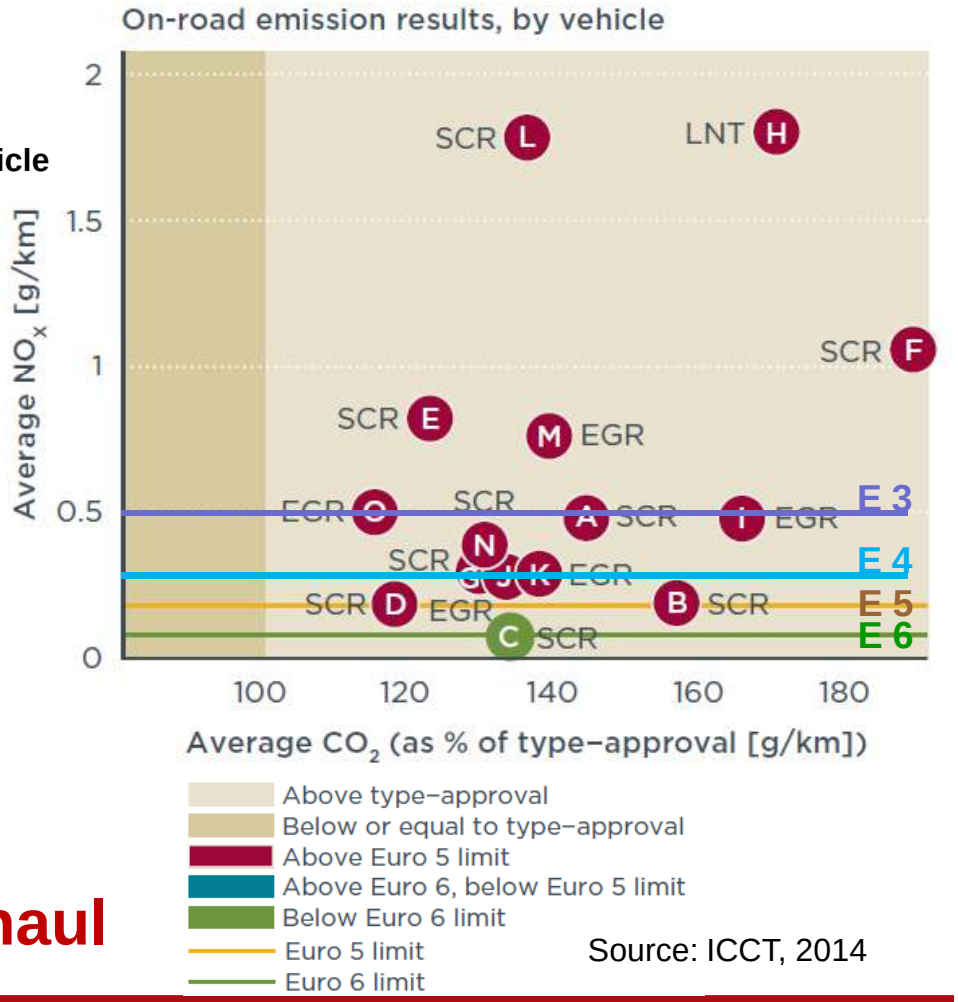
☞ NO2 reduction potential of local measures



Real Driving Emissions (RDE) of NOx
☞ Performance of Euro 6 vehicles

In-use emission testing of 15 Euro 6 passenger cars

- Using PEMS during typical real-world driving modes
  - ☞ but differing number & type of driving cycles per vehicle
- Average NOx RDE exceed Euro 6 by factor of seven
  - ↳ Excess mainly due to short emission peaks during high engine load
- Some vehicles almost meet Euro 6
- Huge variation of emissions among vehicles
- Weak relation between fuel consumption and emissions



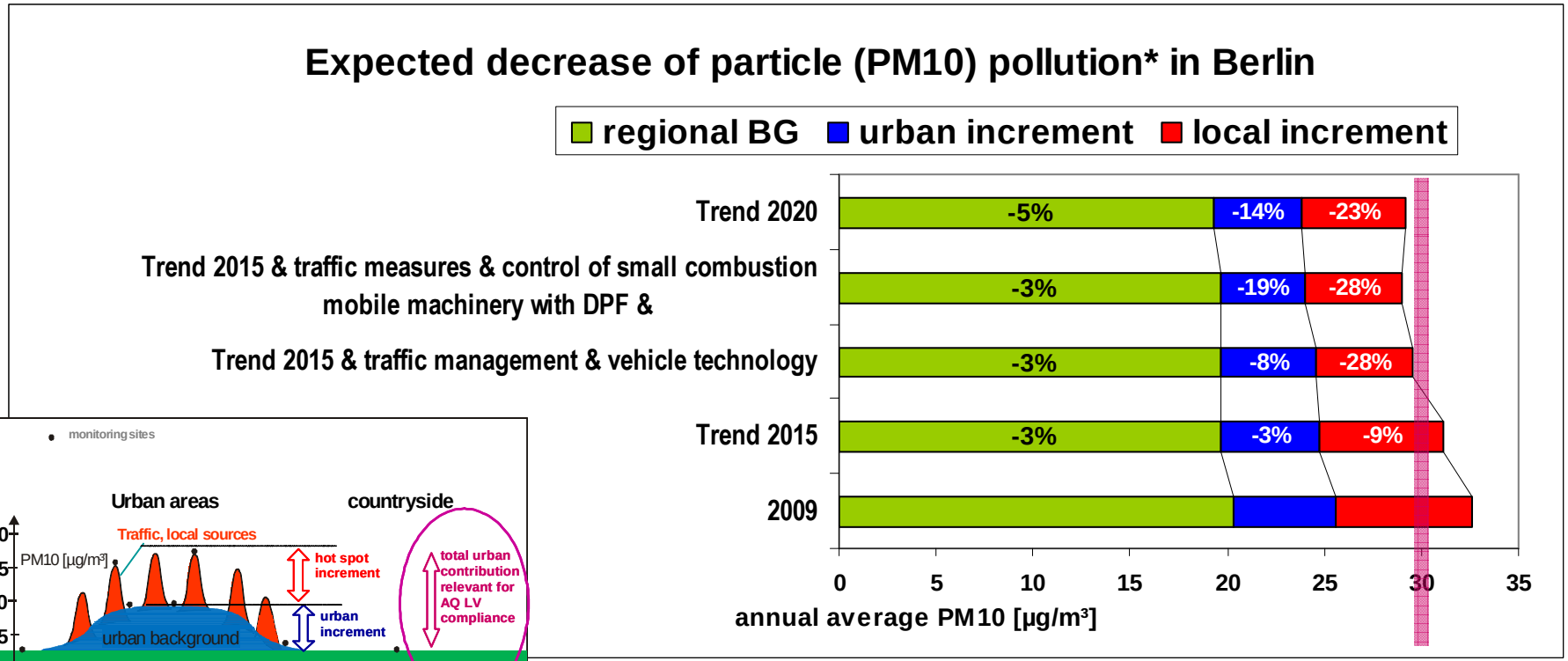
Source: ICCT, 2014

☝ Euro 6 needs an urgent overhaul

Technical & Planning Measures

☞ Projected impact on PM10 levels

Impact of different bundles of additional measures to reduce particle pollution by 2015 & 2020



*averaged over 27 traffic spots, based on modeling

24h-limit value

Berlin AQ management

☞ résumé

- **Efficiency of previous measures**
  - **Industry: Requiring Best Available Technology for emission control & strict enforcement and permitting regime was huge success**
  - **Residential heating: Enforcement of switch to cleaner fuels & expansion of combined heat & power generation**
  - **Road traffic: significant reduction PM (black carbon) and NO2 due to LEZ**
  - **improvement of similar magnitude through transport planning & traffic management**
- **Focus on new measures**
  - **Faster introduction of Euro 6 vehicles & alternative concepts**
  - **Exploit potential of optimizing traffic flows**
  - **clean up off road machinery & local shipping**
- **remaining problems**
  - **long-range transport of particulate matter**
    - ☞ **missing national strategy**
  - **timing of compliance critical with regard to ultimate NO2 compliance**
    - ☞ **Requires national & European action**

Air Quality Planning

☞ some final recommendations

- AQ Planning needs networking across different administrative levels, departments, interest groups, lobbyist, stakeholders
  - ↳ on the long-term: integration of environment objectives into other policy making processes
    - ☞ Commitment for other administrations to take into account the needs of air quality management in their business
  - ↳ Set up AQ Steering Committee as a durable platform for collaboration, also during implementation phase
    - ☞ consider setting up a sub-working group drafting the chapters on measures
    - ☞ Environment Department need to take the lead, invite important departments of transport, city planning, economic affairs, etc
  - ↳ provide for permanent sufficient personnel resources
- Some hints regarding the drafting of an AQ plan
  - ☞ measures to reduce the pollution are the essence of an AQ plan
  - ☞ put the focus on justification, description and definition of measures
  - ☞ try to be as concrete as possible
  - ☞ if concrete action is not possible now, stipulate a clear commitment for further scrutiny/study/investigation & subsequent decision on action
  - ☞ add steps to improve databases/tools/resources as measures

Measures of Berlin's Air Quality Plan 2011-2017

Measures vehicle emission control technology				
M 2.1	low emission zone without exemptions	↺city-wide ✋+	to 2015	SenStadtUm
M 2.2	funding of purchase of Euro-6-vehicles	↺city-wide ✋ +	to 2015/16	SenStadtUm Federal Gov.
M 2.3	funding of purchase of CNG vehicles	↺city-wide ✋limited	laufend	SenStadtUm Federal Gov. GASAG
M 2.4	Promotion of electro mobility	↺city-wide; ✋unclear	medium- to long-term	SenStadtUm SenWiTechForsch Federal Gov. Districts
M 2.5	clean vehicles for public transport	↺city-wide ✋+ /local ++	short- to long-term	SenStadtUm BVG
M 2.6	clean municipal vehicles	↺city-wide ✋0	Medium-term	all municipal enterprises
M 2.7	retrofitting Euro-4-Diesel vehicles	↺city-wide ✋+	Medium-term	SenStadtUm Federal Gov.
M 2.8	Particle filters for passenger cruising vessels	↺local ✋0/+	short- to medium-term	SenStadtUm Districts
M 2.9	environment standards for Diesel locomotives	↺local ✋0/+	medium- to long-term	SenStadtUm Federal Gov., VBB
M 2.10	Communication campaign to promote procurement of clean vehicles	↺city-wide ✋ -/0	medium-term	SenStadtUm business associations

New AQ Plan Berlin: Example how to describe measures

M 1.2 Avoid new pollution hotspots

Time frame	Competence
Until the end of 2013	SenStadtUm, Bezirke
Reduction potential	**Costs**
To be modelled for the individual case	n.A.

Changes in the urban development must be examined with regard to their impact on potential limit value exceedances. Particular attention should be given to street canyons, which are characterized by largely enclosed roadside structures on both sides of the street. The narrower and the more closed the canyon is, the worse is the dilution of exhaust gases from vehicles. High air pollution levels thus occur particularly on roads with high traffic volumes, and concurrently, a low width/height ratio.

Objective:
No additional road sections or pollution hotspots as a result of urban development changes.

Implementation:
- → Development of guidelines and recommendations on the preservation of wide road spaces and the avoidance of new pollution hotspots due to urban development changes
- → Guidelines on modelling air quality
- → Consideration of the guidelines in the context of mandatory urban land-use planning
- → Examination of the effects of ventilation passages in areas with high pollution levels and poor ventilation

Effect:
Locally high - depending on the initial situation, the traffic-induced incremental pollutionon a local level can more than double through the creation of a street canyon[84]. The shorter the distances to the next building and the higher the buildings are, the higher is the air pollution from traffic. Gaps between buildings in the development of road spaces reduce the traffic-induced local incremental pollution by/through a better dilution. The share of empty sites/gaps between buildings at 20%, leads to an incremental pollution that is approximately 10% lower than of enclosed road spaces.

Thanks for listening!

Better you slim down rather than the ice shelves. So, take the bike!

For more information on

- ☞ **Berlin‘s LEZ see www.berlin.de/umweltzone (also in EN)**
- ☞ **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)
- ☞ **The air implementation pilot by EEA**
  http://www.eea.europa.eu/themes/air/activities/the-air-implementation-pilot-project