

Dealing with the notorious **NO₂** problem in **Germany**: Current **deliberations** about diesel bans, speed limits and other nasty **measures**

Martin Lutz

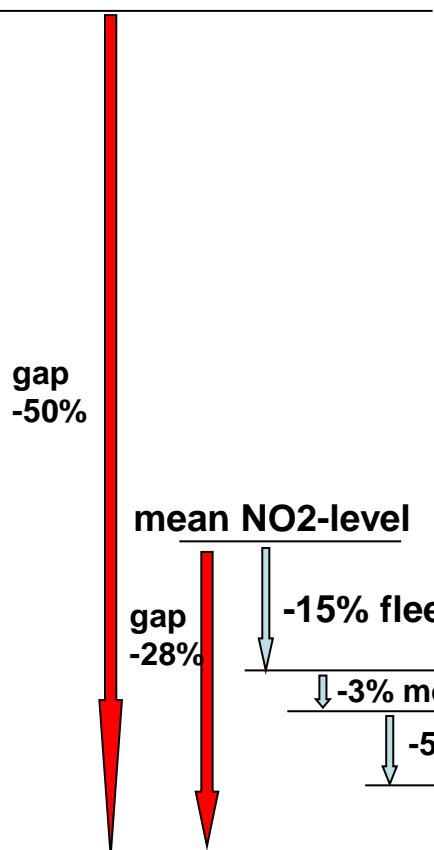
Berlin Senate Department for Urban
Development and Environment

- ☒ Compliance situation
- ☒ Pressure for measures
- ☒ Example: Low emission Zone & options for ULEZ
- ☒ Other measures being discussed
- ☒ Prospects for full attainment
- ☒ résumé



Closing the NO2-gap in Berlin

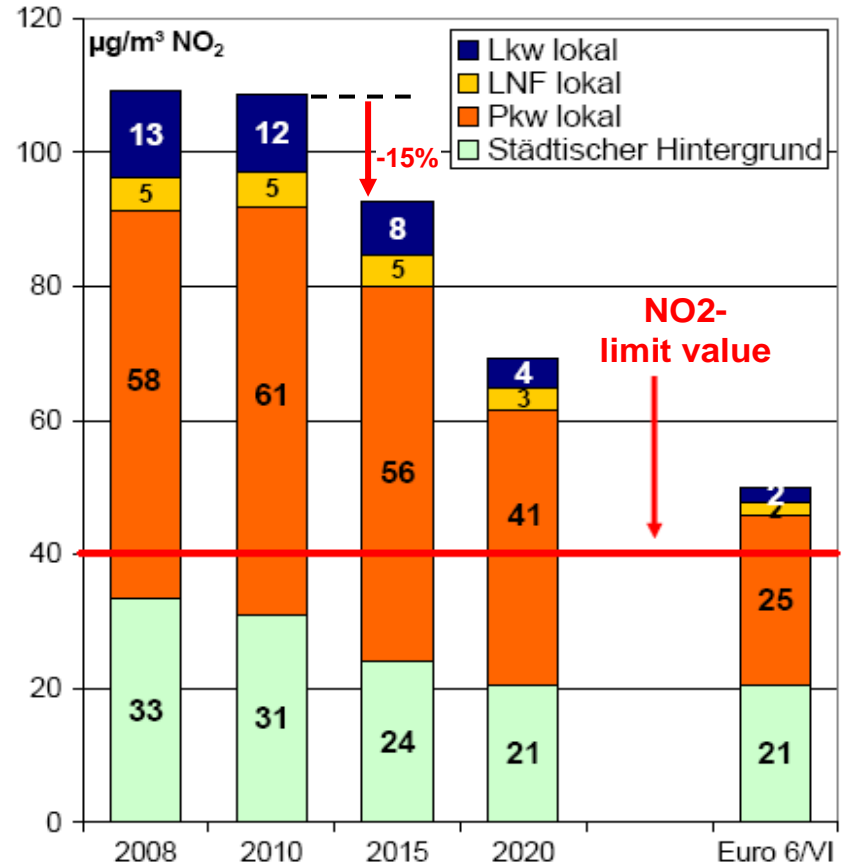
max NO2-level



- x% Euro 6/VI incentives
- x% SCRT retrofit buses & HGVs
- x% ????????

EU limit value

modelled NO2- levels at traffic site Stuttgart Neckartor



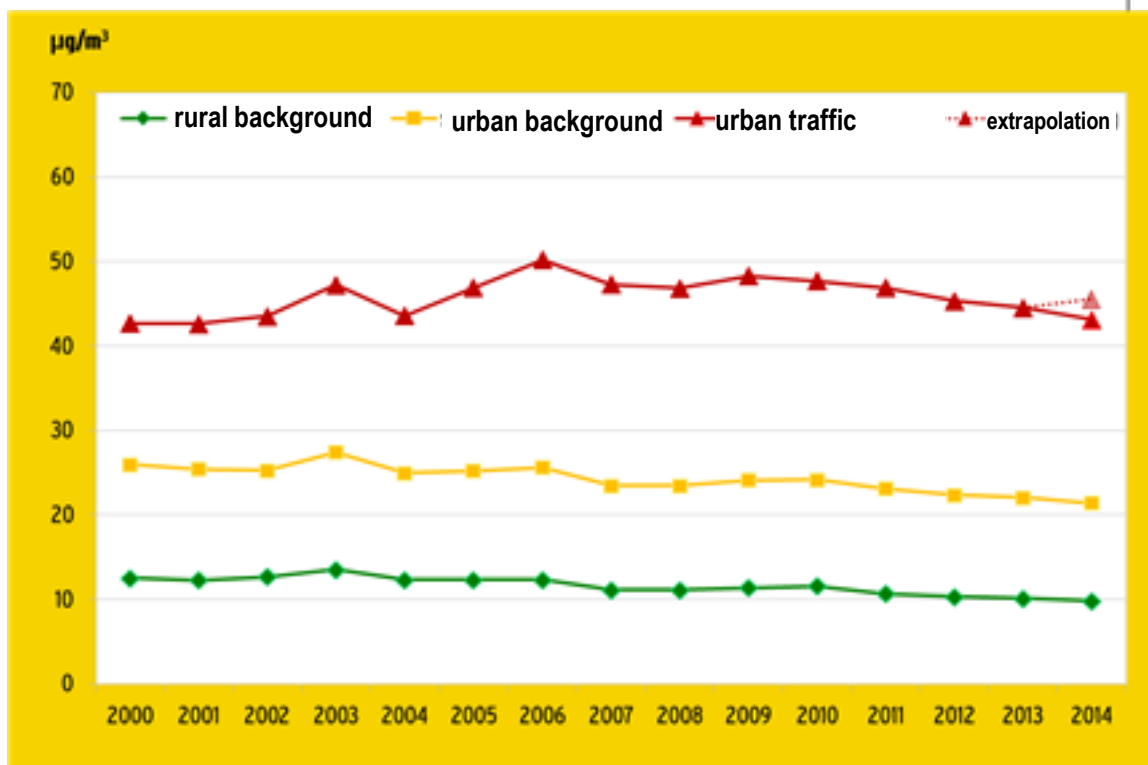
IFEU 2010 im Auftrag des UM Baden-Württemberg

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

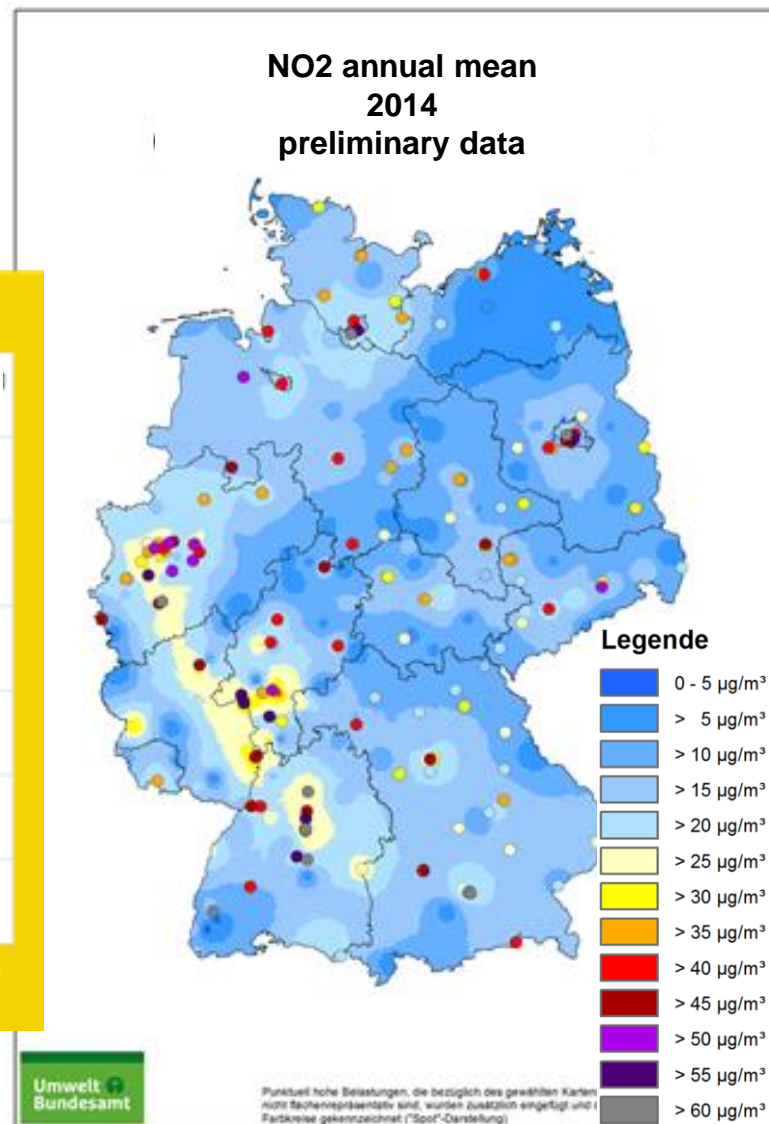
source: Udo Lambrecht
IFEU Institute 2010

NO2 trend & compliance situation 2014

 Still **1/3** of all traffic stations **above** limit value



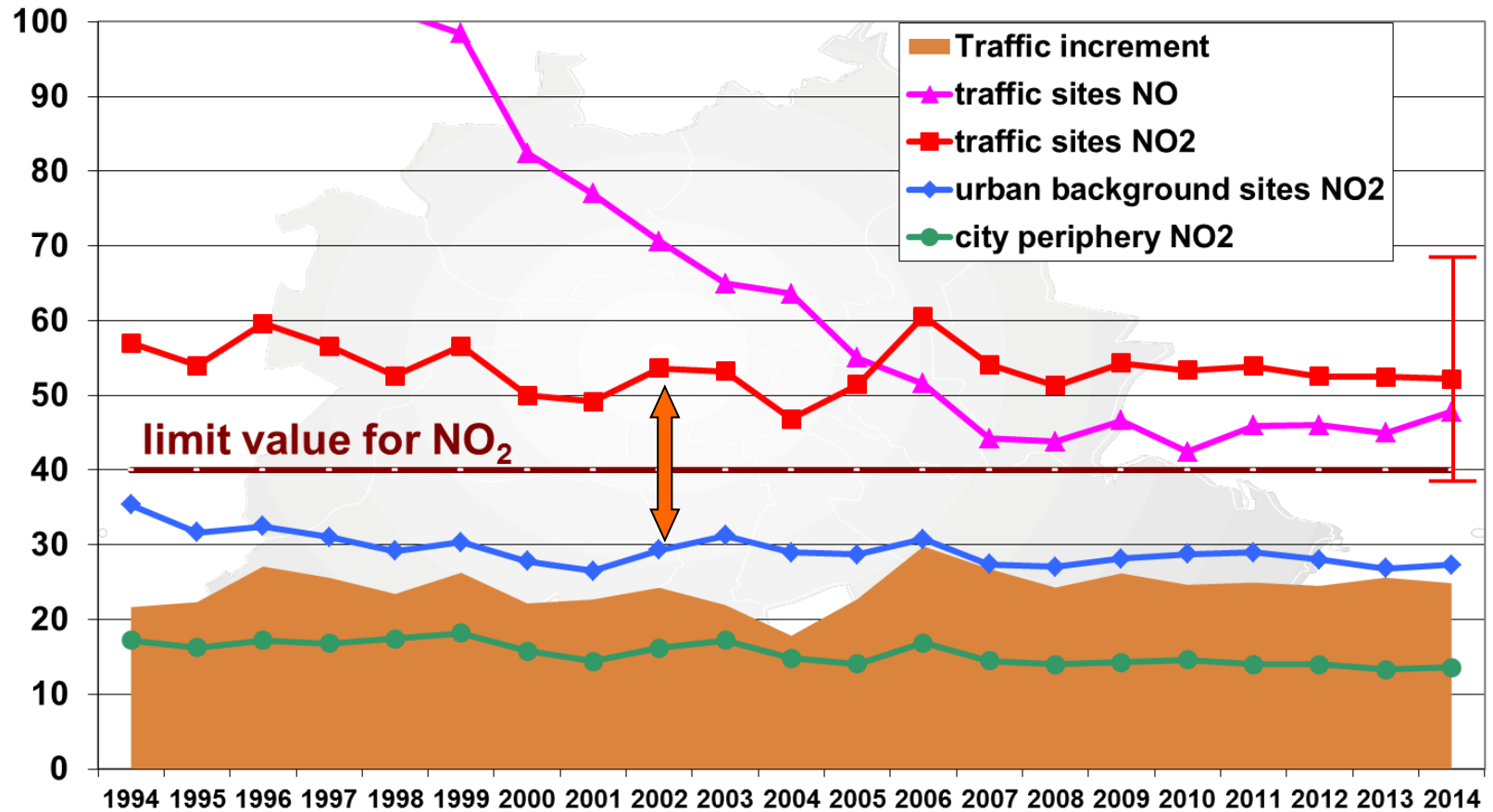
Source: UBA Germany



AQ assessment Berlin

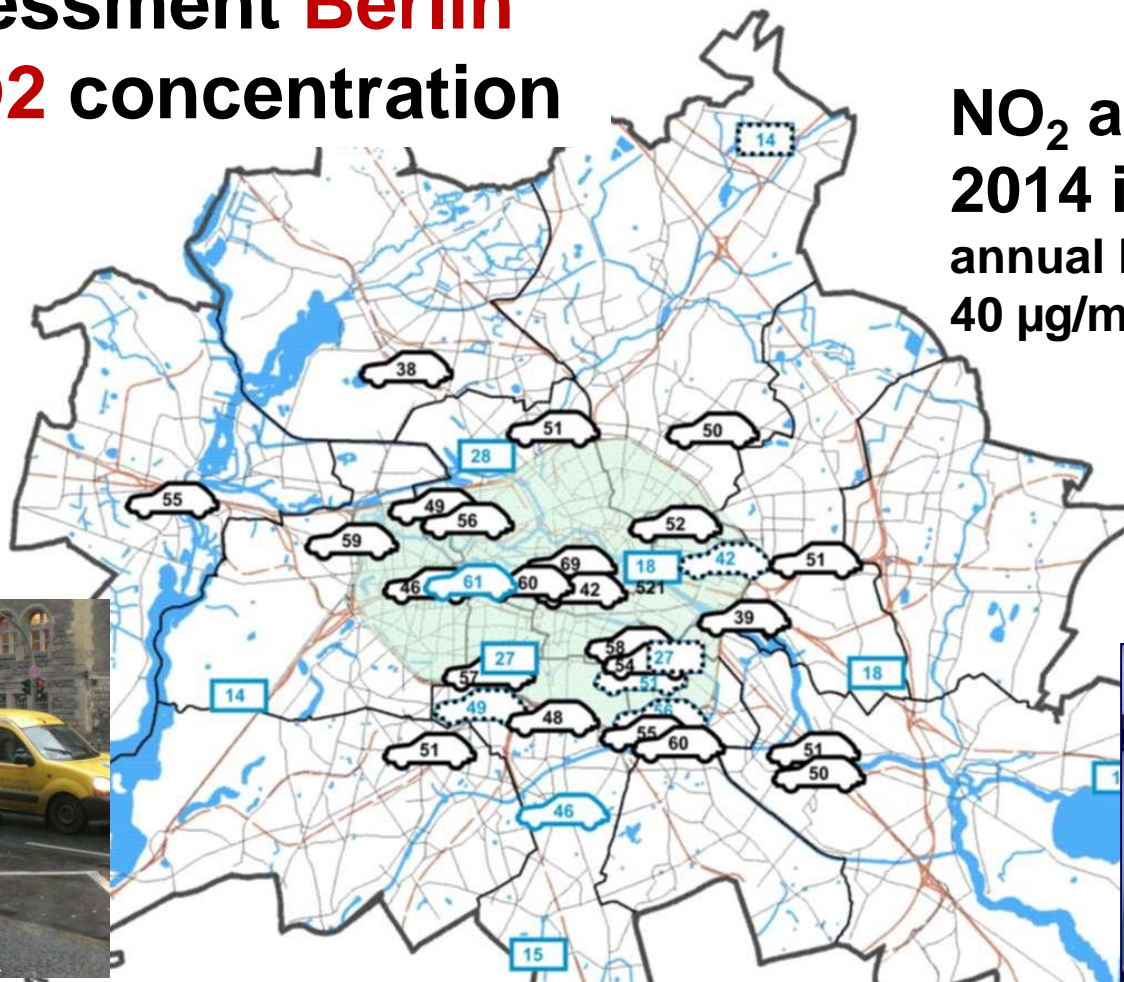
NO_2 pollution trend





$\mu\text{g}/\text{m}^3$ Long-term trend of nitrogen dioxide levels in Berlin



👉 NO₂ concentration

NO₂ annual mean
2014 in $\mu\text{g}/\text{m}^3$
annual limit value of
40 $\mu\text{g}/\text{m}^3$ **widely exceeded**



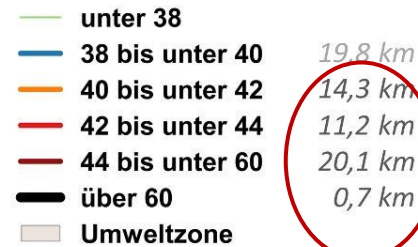
-  Low emission zone
-  Automatic monitoring site in residential areas and at the cities' periphery
-  Automatic monitoring site in busy roads at the kerbside
-  monitoring site with miniaturised monitoring devices for traffic related pollutants in busy roads

(vereinfachte kleine Sammler zur Bestimmung von Ruß und Stickstoffdioxid)

Berlin compliance assessment

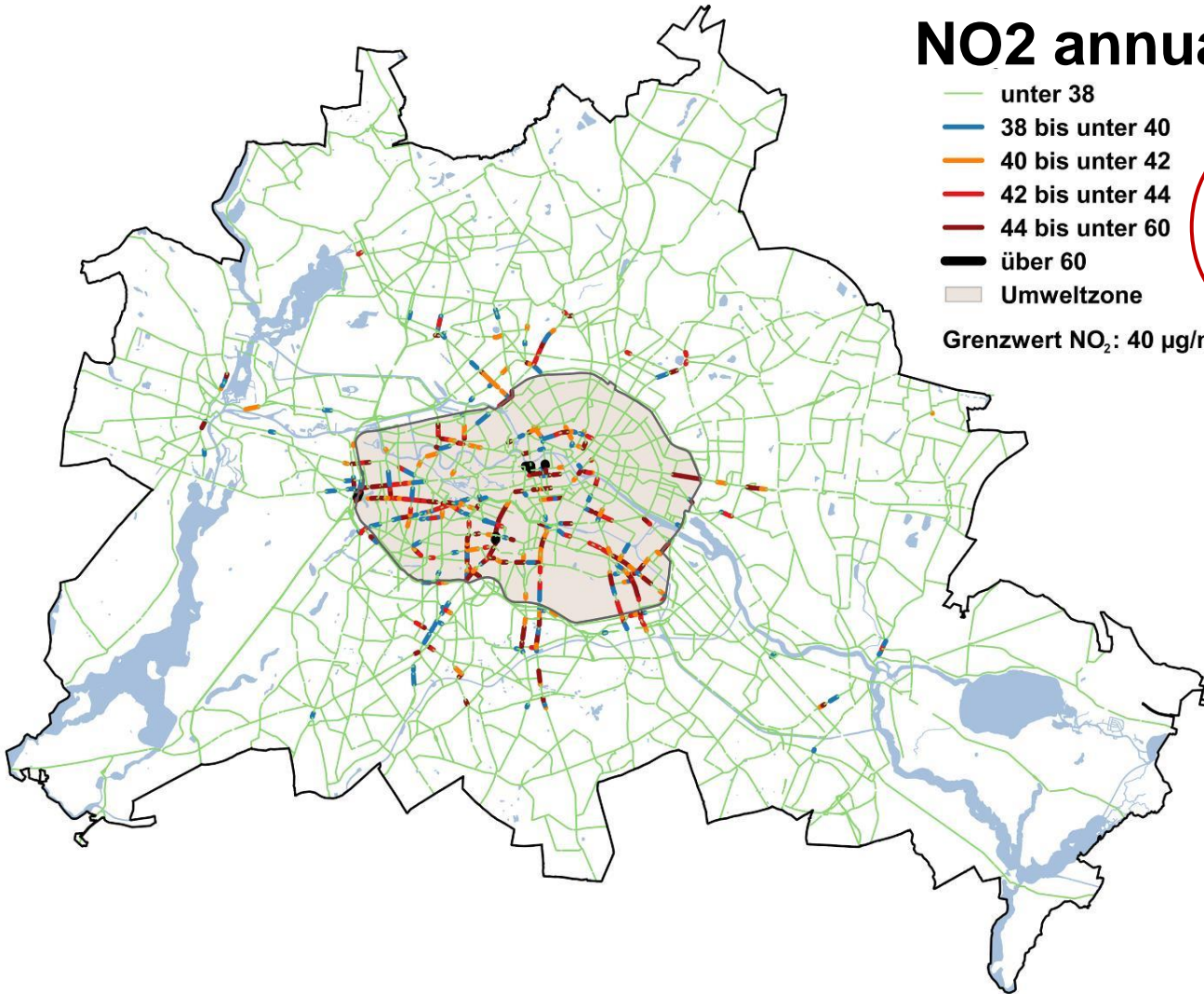
👉 modelled NO₂ concentration

NO₂ annual average 2013



**almost 50 km
exceeded**

Grenzwert NO₂: 40 µg/m³



👉 pressure for further action











■ From court rulings in Germany

- ↪ More than **30 court trials** initiated by NGOs,
- ↪ most of them ruled in favour of **more measures** and **ambition...**
 - 👉 **Non-attainment** period needs to be kept **as short as possible**
 - 👉 **Health** protection got much **stronger** weight when assessing **proportionality** of measures
 - 👉 Current AQ plans **insufficient** in that respect
 - 👉 Traffic **restrictions** are **legal**, except if impact is very small or would result in traffic re-location and risk for non-compliance **elsewhere**
 - 👉 Very **strong justification** needed, if effective measures were **neglected**
 - 👉 Compensation needed through **other measures** if traffic restrictions **not** taken

NO2 non-compliance

pressure for further action

■ From the Commission

-  **Rejected a time extension** for about 40 zones (incl. Berlin)
-  launched an **infringement** procedure due to persistent non-attainment of NO2 in **33 zones** (incl. Berlin)
 -  NO2 – LV need to be **met asap**, i.e. MS have a certain **degree of freedom** which measures to adopt, but authorities are **responsible** to achieve full **compliance** within a period „as short as possible“.
 -  Commission insists that MS take **all appropriate measures** to meet LVs asap, e.g. „access **restrictions** for **Diesel** in some urban areas“ despite the weaknesses of Euro 5 vehicle emission standards
 -  Measures taken so far in D are considered **insufficient**, if not **counter-productive**,
 -  Example: fuel **tax discount for Diesel**, despite of known RDE problems of Euro 5
 -  Clear **infraction** of the AQD in zones, where attainment is envisaged only **after 2020**, i.e. more than 10 years after the initial attainment deadline
 -  In zones, where attainment is expected **before 2020**, the Commission assessed AQ plans in more detail and considered a breach of Art 23 of the AQD because
 -  Projections deemed **unrealistic**, lack of convincing evidence for compliance before 2020
 -  **No LEZ** was implemented

(Extra) Measures and their impact

☞ example: Low Emission Zone (LEZ)

■ Low Emission Zones



☞ Stage 2: in Berlin since 1.1.2010

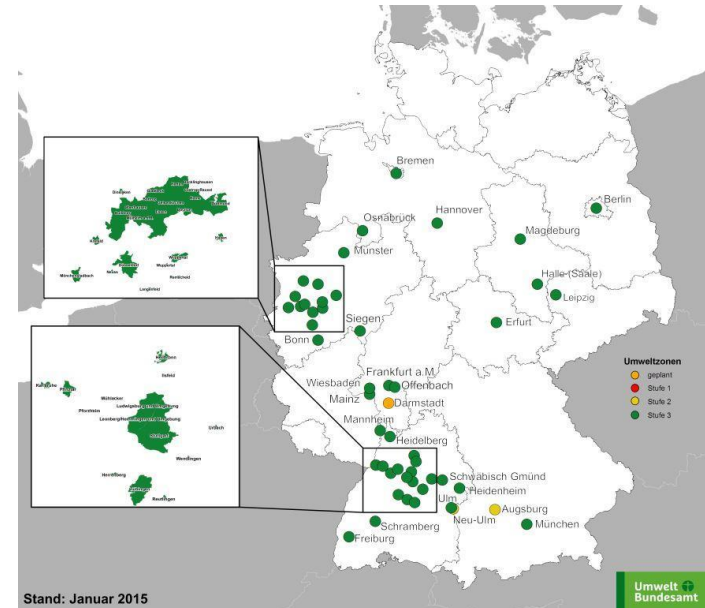
Diesel-vehicles: Particle emission **Euro 4:**

☞ cars: **Euro 3 + particle filter** or better

☞ goods vehicles: also **retrofit** of
Euro 1-3 towards Euro 4_{Particle}

Gasoline vehicles: at least **Euro1**

by now in more than 60 german cities



Given the **mess** with **NO2**, should we go for **stage 3** ?

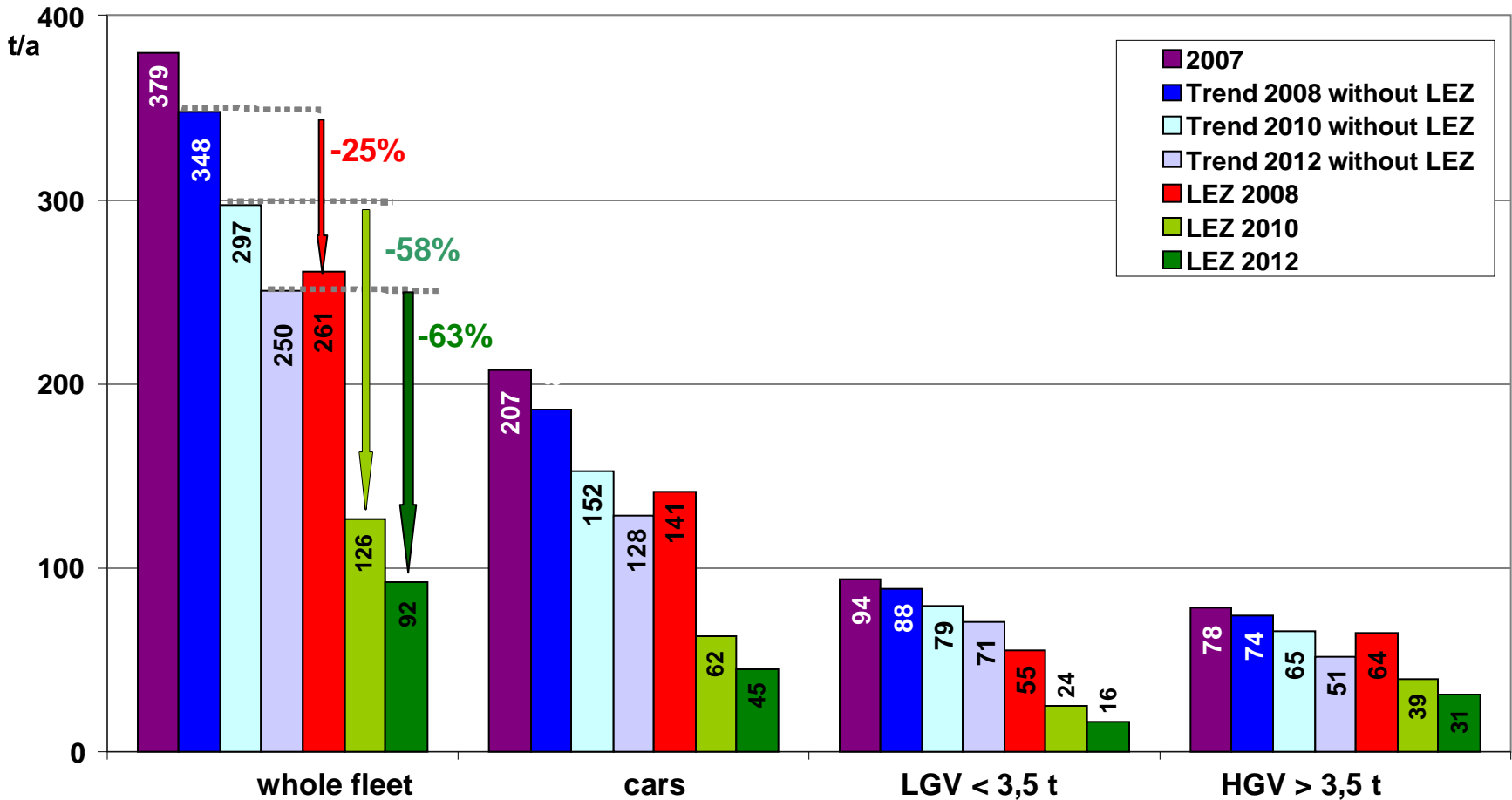
If so, **how** should that be framed ?

What would it deliver?

👉 Emissions of PM

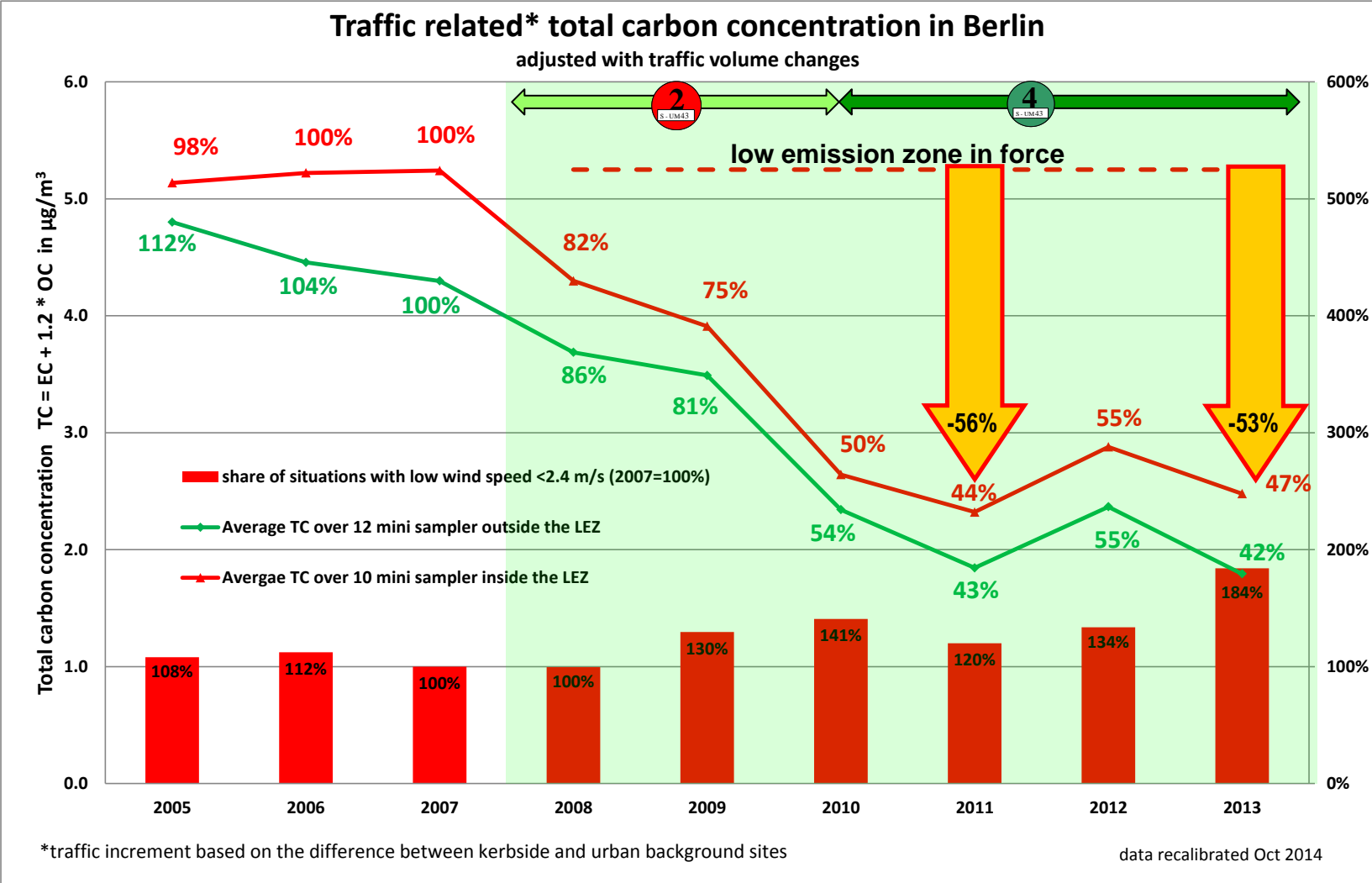
LEZ impact: change in **particle** exhaust emissions

based on fleet composition at a busy main road (new emission factor data base HBEFa 3.2)



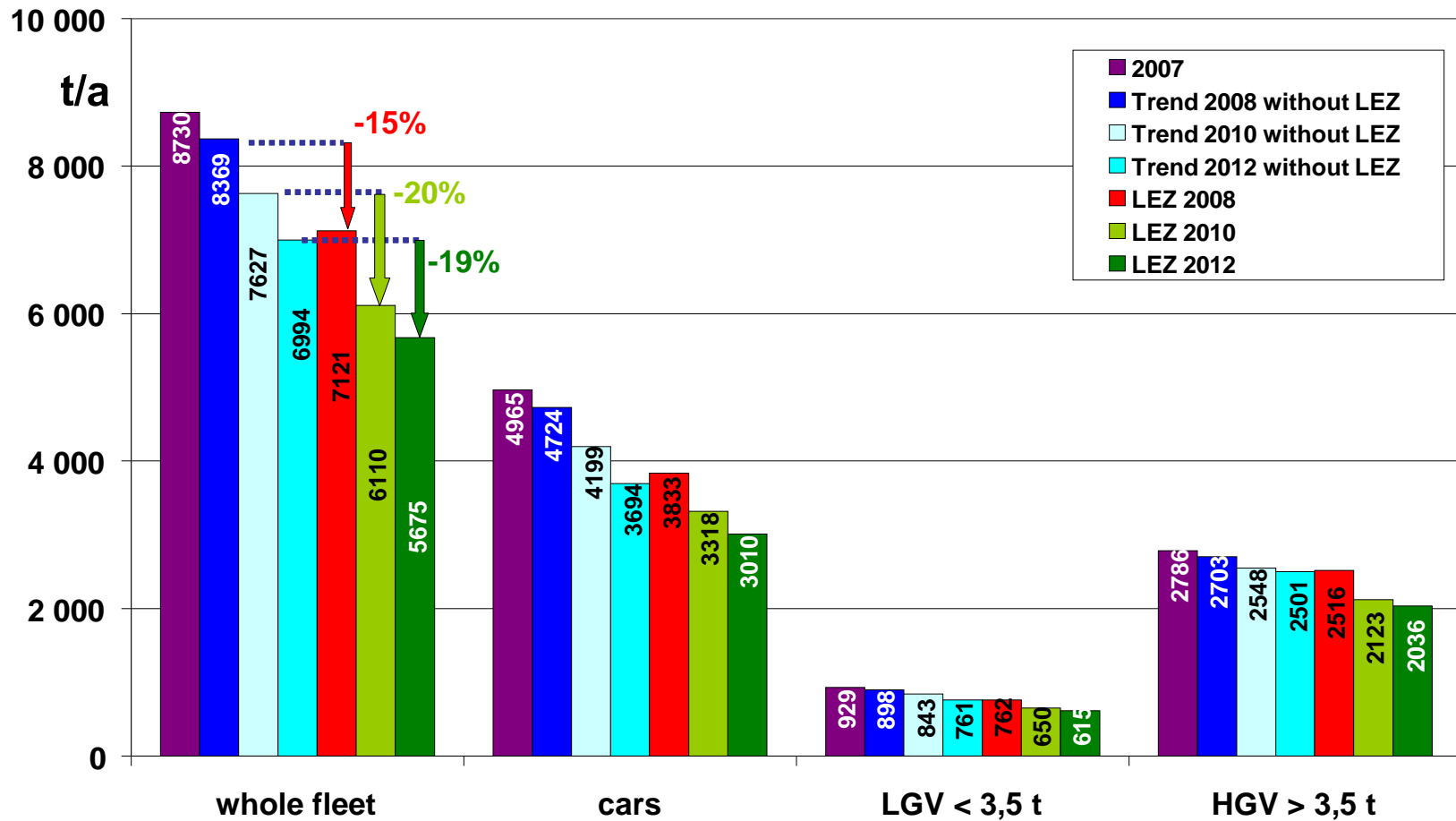
Impact analysis of current LEZ in Berlin

total carbon air concentrations from traffic



👉 NOx emissions

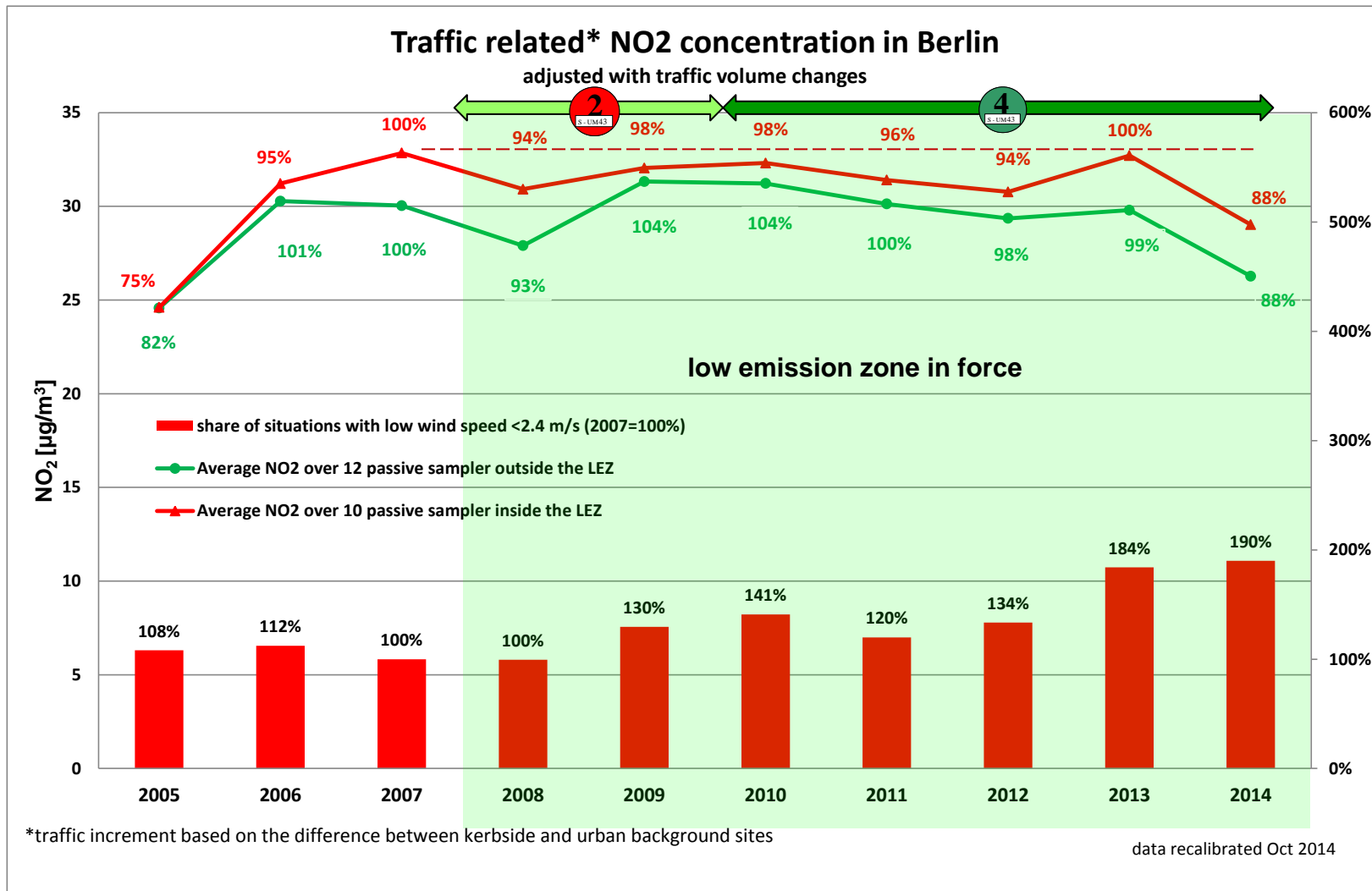
based on fleet composition at Frankfurter Allee (new emission factor data base HBEFa 3.2)



emissions extrapolated to the entire main road network based on the fleet composition at Frankfurter Allee (with DPF-retrofit, only warm emissions, no cold start impact)

Berlin LEZ – impact analysis

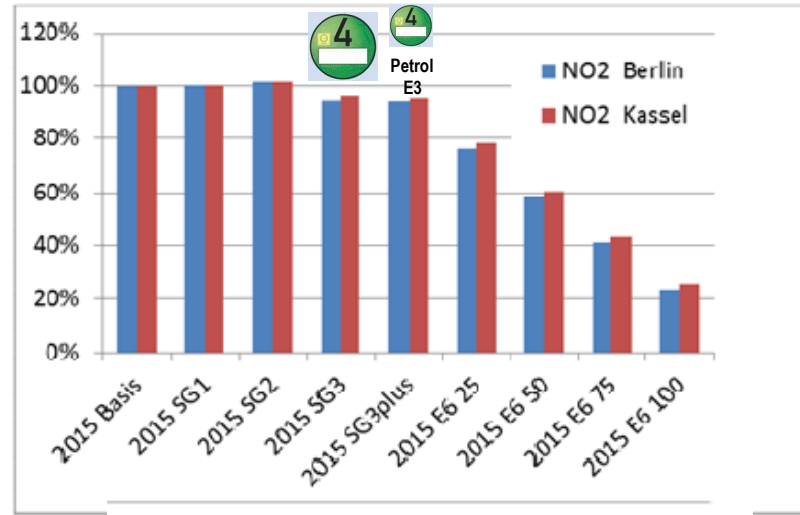
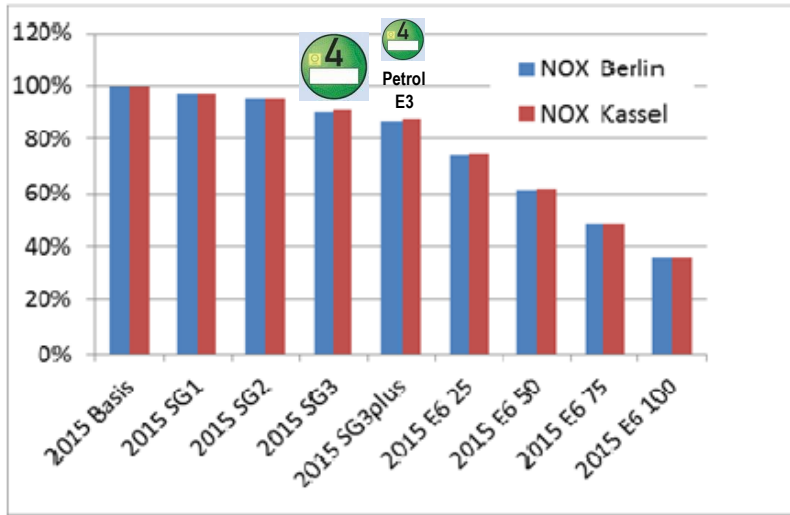
👉 **NO₂** air concentrations **traffic** increment



ULEZ impact projection NOx & NO2

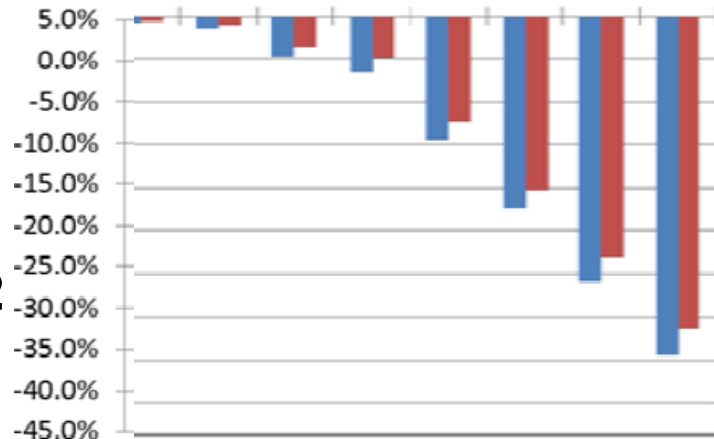
Effect of banning certain vehicle categories in 2015

...on emissions



...on NO2 concentrations

calculated with HBEFa* 3.2



*Handbook Emission Factors, Vers. 3.2, latest available vehicle emission data base used in many MS, incl. Germany

Source: UBA Texte 26/2014

Impact analysis of current LEZ

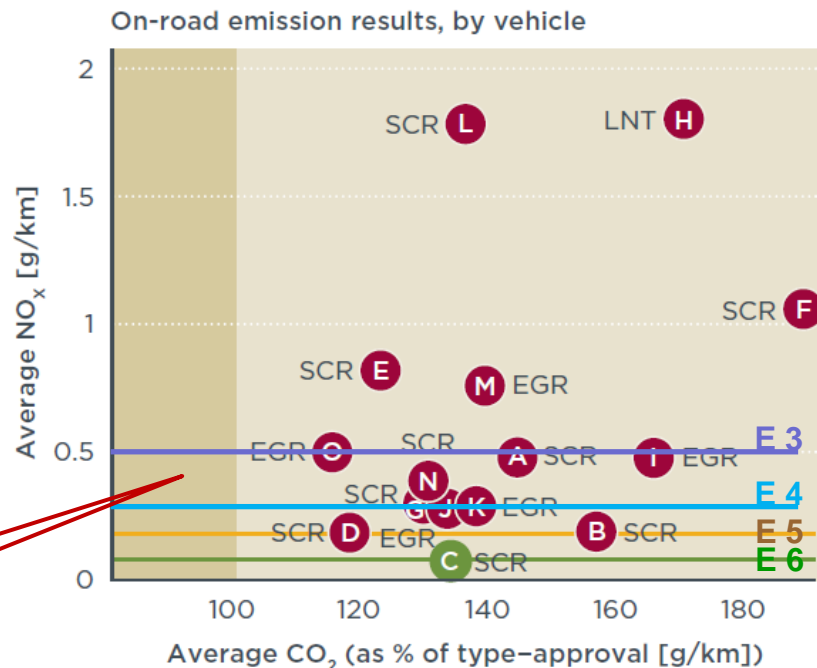
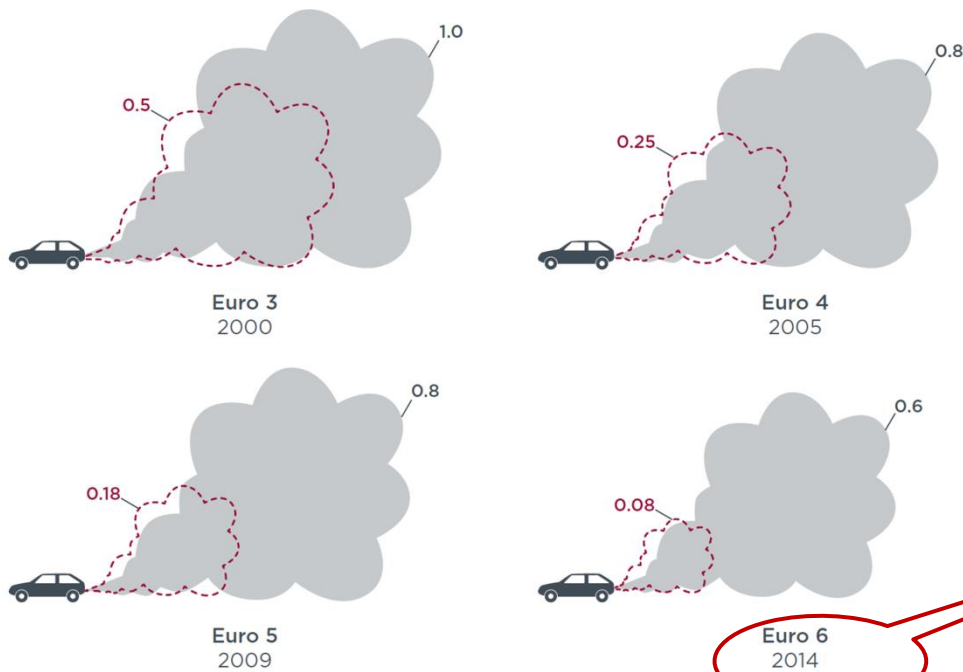
Reason for the meagre LEZ effect on NO₂

Increasing share of Diesel cars in Germany

From 20% in 2005 up to 30% now

Almost no improvement in real driving emissions (RDE)

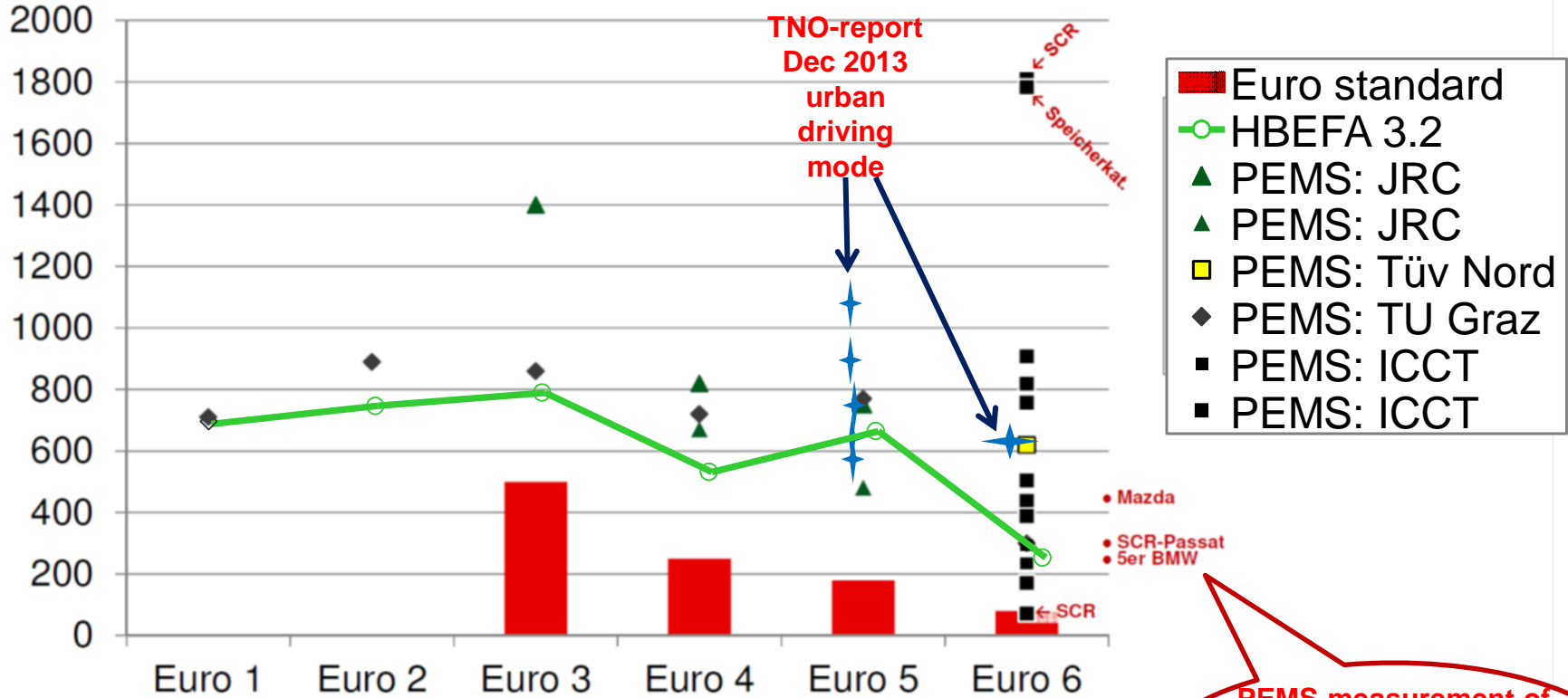
for Euro 6 independent from the NO_x control technology used



Real Driving Emissions (RDE) of NOx

👉 Performance of Diesel cars

mg NOx/km



PEMS...portable Emission measurement system

Source: Presentation by Lars Mönch (UBA) at TU Darmstadt, 2015, extended

PEMS measurement of
3 Euro 6 Diesel cars
by Regional EPA
(LUBW) Baden-
Württemberg (2015)

👉 How to define a **proper ULEZ** scheme?

Dilemma:

- Current **Euro 6** cars & LGV **not** much **better** than previous standards
 - ↪ current emission factor databases/models not appropriate
 - ↪ Assessment to be based on PEMS – **need more such data! Quickly!**
- **Need benefit** rather **early** given the huge pressure
- **Diesel ban** would be very **effective**, but Diesel cars still popular
- **Charging** (like London ULEZ) instead of banning would be **easier** to implement, but **infrastructure** (CCTV) lacking & **difficult** to realize

LEZ & sticker scheme currently proposed by City of **Paris** 👉

Ban proposed 07/19

Ban proposed 07/18

Ban proposed 07/17

Ban proposed 07/16



👉 How to define a **proper ULEZ** scheme?

Current **deliberations** on ULEZ/sticker schemes in **Germany**

■ Define a **clean vehicle** category **exempted** from access restrictions in future ULEZ covering ...

- ↪ Electric vehicles, Hybrids, CNG, LNG and petrol cars Euro 4+
- ↪ **Euro VI** HDV & buses as they are already type approved on **RDE** (NOx CF factor 1.5)

■ How to treat **Diesel cars & LGVs**? **Options** currently discussed....

- ↪ (1) **One** new category based on current **Euro 6a** for Diesel 
 - ☺ Could be imposed **earlier** (~2020, like London ULEZ plan)

- ☹ but **difficult to justify** (also in legal terms) given the relative **small progress** in RDE

- ↪ (2) **One** new category based on future **Euro 6c, incl. RDE** conformity factor 1.5 

- ☺ Enforcement rather **late** (2020+x), depends on Euro 6c introduction

- ☺ **Large RDE improvement**, easier to sell, more **solid** legal ground

- ☺ **Sticker** could be introduced **early** based on recently adopted RDE monitoring method, already incentivizing truly clean Diesel cars

- ↪ (3) **Both**

- ☹ **Difficult** to communicate

- ☹ **Awards** manufacturers of **bad** Euro 6a cars

- ☺ Allows approach in **2 stages**

■ Any option will be **tough** given the heavy **promotion** of **Diesel** by car industry

■ Potential impact of option(1) for Stuttgart:

- ↪ **-40%** exceeded street sections in 2020, but calculated with **optimistic** CF factors for Euro 6a

☞ Means to **reduce** urban car traffic

Reason: Vehicle emission control **technology won't deliver** the improvement sufficient "to keep non-compliance as short as possible"

Idea: **Emission-dependent** urban **road pricing** scheme in **cities** with NO₂-problems

■ Aim

- ☞ **Awarding** clean vehicle technology & clean modes of transport
- ☞ Raising money to **finance public transport** & **cycling** infrastructure

■ Implementation options:

- ☞ **Vignette** system: ☺ easy to implement ☹ **benefits frequent drivers**
- ☞ **Camera** enforcement: ☺ trip/mileage dependent charging ☹ expensive, conflicts with data privacy law
- ☞ **GPS-based** enforcement: ☺ trip/mileage dependent charging ☹ expensive, but technical **infrastructure applied** on German motorway

■ Legal basis still lacking

■ Potential **impact** based on experience in London, Stockholm, Milan:

- ☞ 14-28% less car traffic
- ☞ 8-18% less NO₂ and PM₁₀ pollution

■ **Politically sensitive** issue, but could be sold by

- ☞ pointing to benefits for **urban living quality**
- ☞ **Investments** in **clean** transport modes as a **back-up** measure

Means to **reduce car traffic**

☞ **promoting bicycle use**

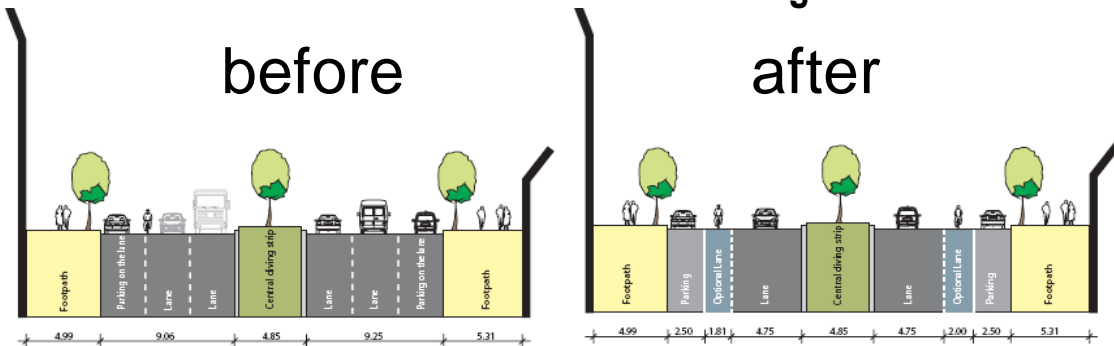


• made bicycle use more attractive
→ share of bicycle trips doubled within 15 years from 6% to almost 15%
Despite of tiny budget (~3€/capita)



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



(Extra) Measures and their impact

☞ traffic management

■ shift modal split from motor traffic to clean transport modes

☞ Berlin's planning objective:

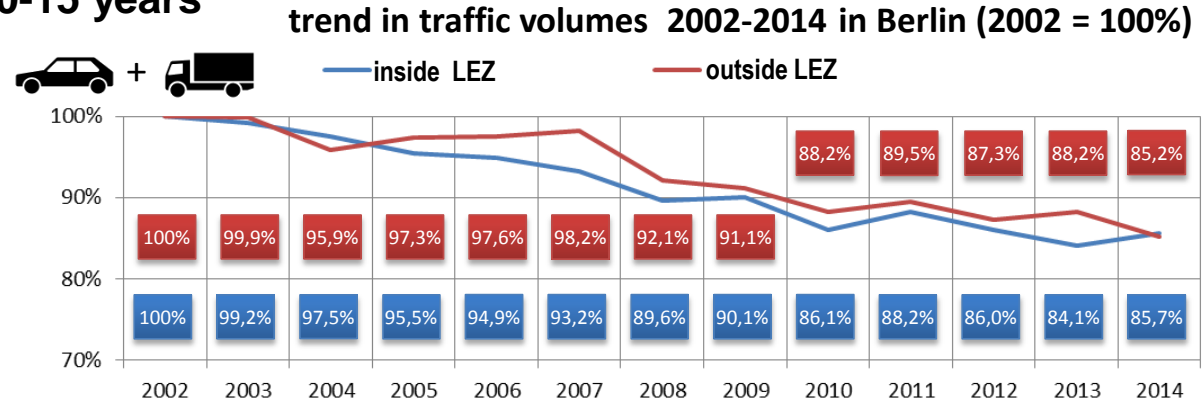
-10% less motor traffic in 10-15 years

results in

☞ up to **-10% NO2**

☞ up to **-4% PM10**

...based on modelling
and source apportionment
study results



■ truck ban & re-routing:

☞ up to **20% less NO2**, **-7% PM**, results based on monitoring data
Problem: **local** effect only in single roads,
traffic **shift** to other roads, no net reduction



■ 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



☞ Means discussed to **reduce** urban car **traffic**

Idea: Emission-**independent** traffic **bans** during peak **episodes**

■ Aim

☞ **Reducing car traffic** volumes & emissions during stagnant atmospheric dispersion conditions

■ Implementation:

☞ Based on **alternating number** plates, focusing on **car** traffic

☞ Triggered by forecasted stagnant **meteo conditions**

☞ Option: additional **pollution** threshold as a trigger

☹ **simple** to enforce, but no long-term impact on fleet composition

☺ Pushes commuter traffic into cleaner transport means, but

☹ Could be circumvented by buying cheap inefficient **second cars**

☹ Trips are often **shifted** to next day without access restriction

☹ **Commercial** traffic (Diesel!) largely **exempted**, to ensure supply of essential goods

☹ Alert management needs **extra** resources

■ Appropriate trigger criteria still to be discussed

■ Potential **impact** on days with bans based on experience in **Paris** :

☞ car traffic and NOx emissions dropped by ~20%

☞ NO2 pollution decreased by about 10%

(Extra) Measures and their impact

👉 speed limits

Speed limit 30 km/h (instead of 50 km/h) can deliver ...

↪ about 5% less (total) PM

👉 derived from a 25-30% drop of local PM increment

↪ 6-10% decrease of total EC

👉 derived from a 14-21% drop of local PM increment

👉 Depends on share of Diesel vehicles

↪ 7-12% less total NO₂

👉 derived from a 15-25% drop of local NO₂ increment

👉 **Enforcement is key**

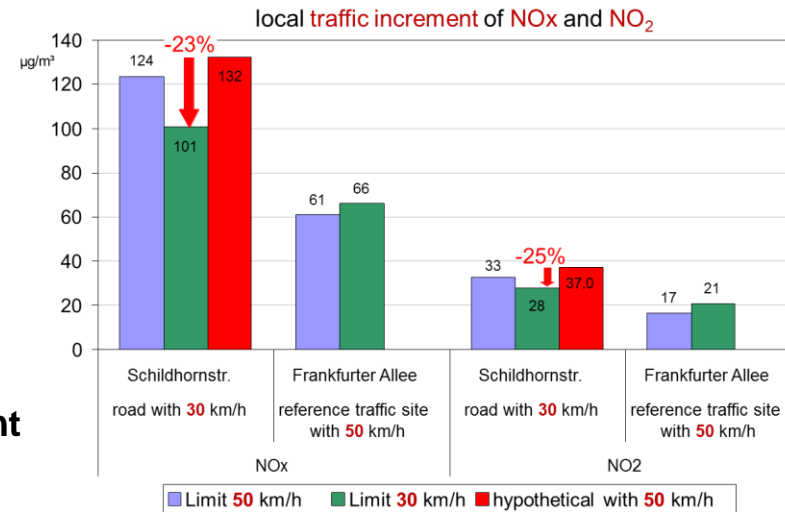
👉 Results are **not** fully coherent with speed-dependent **emission** measurements

👉 Effect depends on keeping a **smooth** traffic flow

👉 Impact is **site specific**, difficult to extrapolate

👉 Generates wind-fall **profit** for **road safety** and **noise** (-2 dBA)

👉 Berlin: 17% of main road network limited to 30 km/h, **7%** whole day because of air quality problems



👉 Economic measures under discussion

■ Eliminating the Diesel fuel tax differential of 19 ct/l (28%)

- ↪ Would gain **7 billion** additional tax **revenue** if Diesel tax raised to petrol
- ↪ Likely result: simultaneous deduction of petrol tax
- ↪ Fast implementation, but **long-term** impact:
halving Diesel car share would mean **13% drop of NO2** concentration
- ↪ (regional/local) freight transport on the road becomes more expensive
 - 👉 **Rail road** transport more **competitive**
- ↪ Strong **resistance** from transport business

■ Economic incentives for electric vehicles & plug-in hybrids

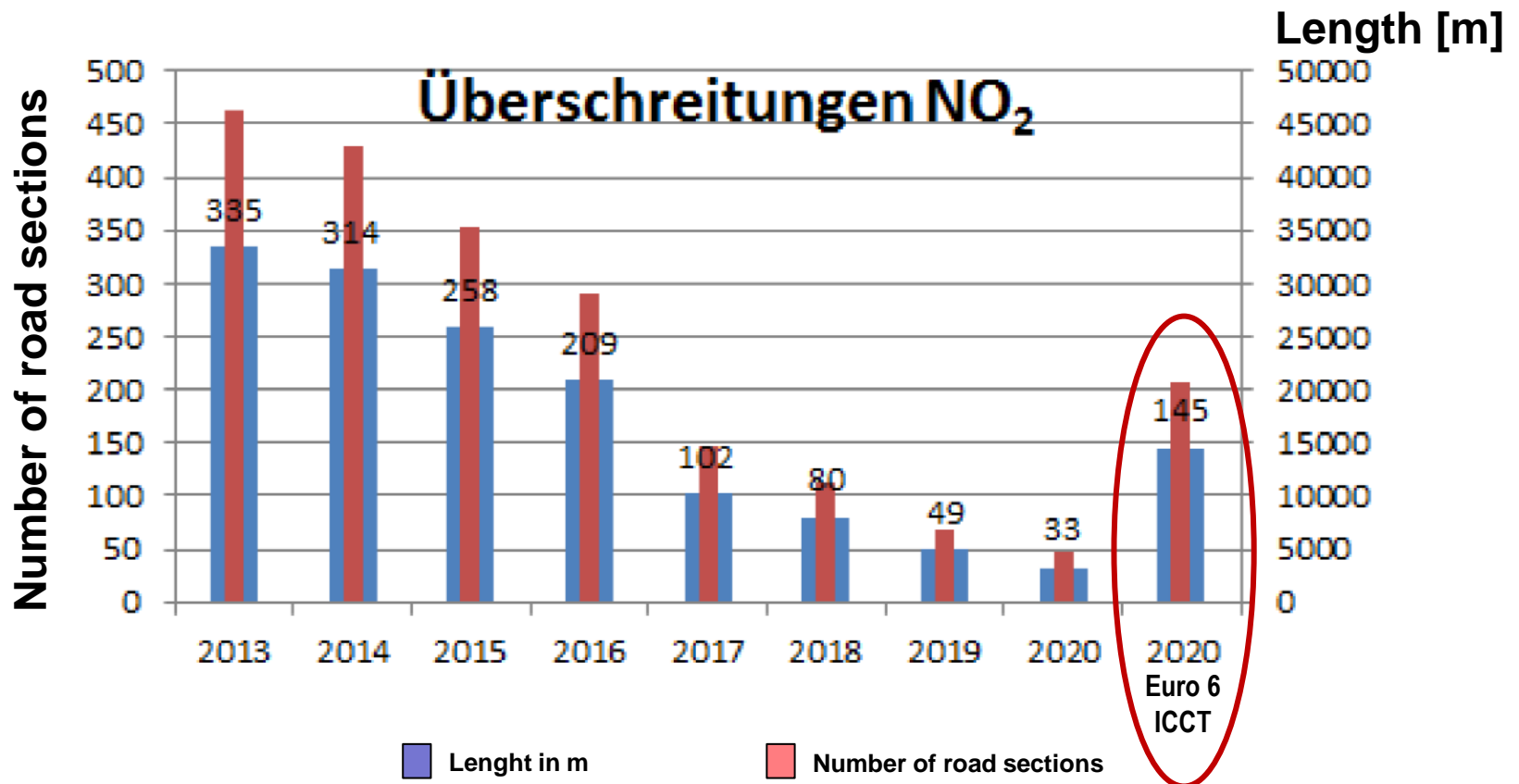
☞ current proposal by State of Hesse given the low number of currently 25.000 e-vehicles in D

- ↪ one time **premium** of **5000 €** per purchase
- ↪ **no vehicle tax for 10 years**
- ↪ additional **capital allowance** of up to **50%** costs for commercial e-vehicles & charging infrastructure
- 👉 Means 140 Mio €/a **lower** tax revenues
- 👉 **Too early** to heavily invest in charging infra-structure given the current **uncertainty** on future e-vehicle **technology**
- 👉 **Better** spend money for public transport & (e-)cycling infrastructure^{*emissions}

Anticipating NO2 attainment

☞ (very) preliminary **scenario** run for **2020** without extra measures

Length and number of road sections exceeding NO2-LV in Berlin



Dealing with NO₂ non-compliance

👉 Conclusions

- Envisaged time frame notified to the Commission to meet NO₂ – LV with current AQ plans

Federal State	Expected compliance in non-attainment areas
Baden-Württemberg	2030 In Stuttgart agglomeration, elsewhere 2016-2024
Bavaria	2030 in Munich agglomeration, elsewhere before 2020
Berlin	2020
Hamburg	2020
Hesse	2025 in Darmstadt, Limburg, elsewhere in 2020
Northrhine-Westphalia	By 2015 for Bielefeld and Münster, After 2020 for Rhine-Ruhr Area
Rhinland-Palatinate	2018 - 2022
Saxony-Anhalt	By 2020
Thuringia	2016/17 for Gera and Weimar, after 2020 for Mühlhausen

- Too long a way to go! Need to speed up!

■ **NO2 attainment 2020/current** measures in Berlin:

- ☑ 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** by 2020 only **realistic**, if

- 👉 EU sets ambitious CF-factors for RDE-based type approval of Euro 6c
- 👉 Our Federal Government
 - 👉 Comes up with a sticker scheme for truly clean vehicles
 - 👉 Sets the legal ground for city toll schemes
 - 👉 Stops the subsidies for Diesel
- 👉 Länder and city governments
 - 👉 have the courage to exploit the given potential of measures

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)
- ➔ Berlin's Air Quality Plan see www.berlin.de/luftreinhalteplan (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)
- ➔ ICCT study on Euro 6 performance of Diesel cars <http://www.theicct.org/real-world-exhaust-emissions-modern-diesel-cars>

