

For our Environment

**46<sup>th</sup> Session, Task Force on Integrated Assessment  
Modelling (TFIAM) in Paris**

# **Ambient NO<sub>2</sub>-concentrations in Germany – Spatio-temporal distribution, effects, mitigations measures and scenarios**

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Section II 4.1 / General Aspects of Air Quality Control

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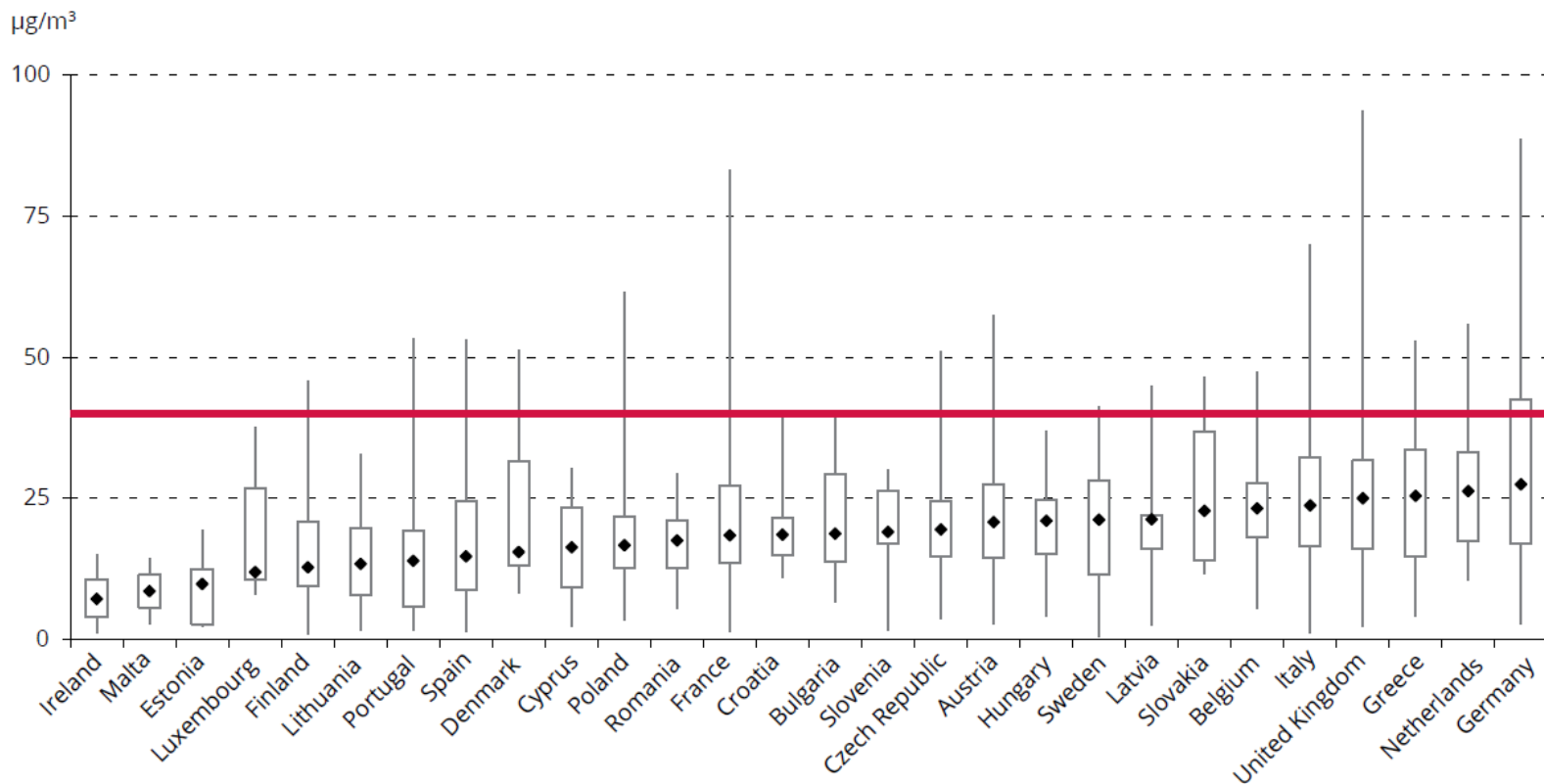
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## Outline

- **SPATIO-TEMPORAL DISTRIBUTION**
- **HEALTH EFFECTS**
- **SCENARIOS FOR MITIGATION MEASURES**
- **NEW EMISSION FACTORS (HBEFA 3.3)**

## The problem: last place for Germany

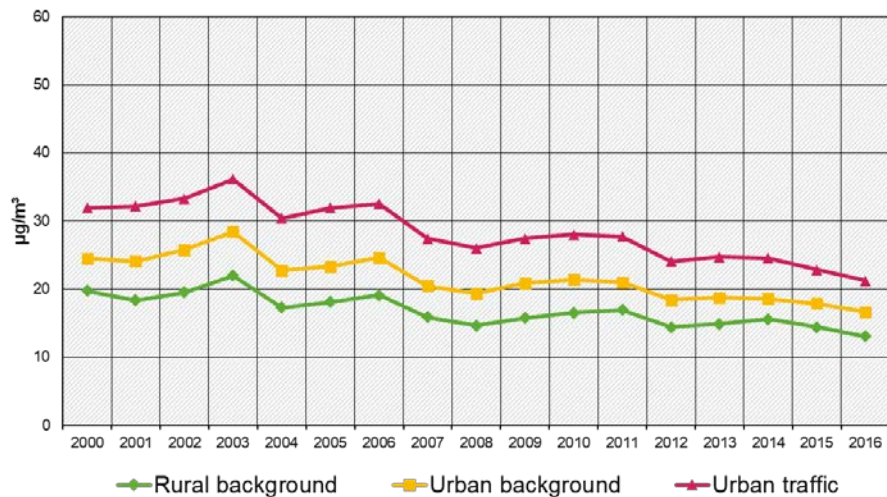
Figure 6.1 NO<sub>2</sub> concentrations in relation to the annual limit value in 2014 in the EU-28



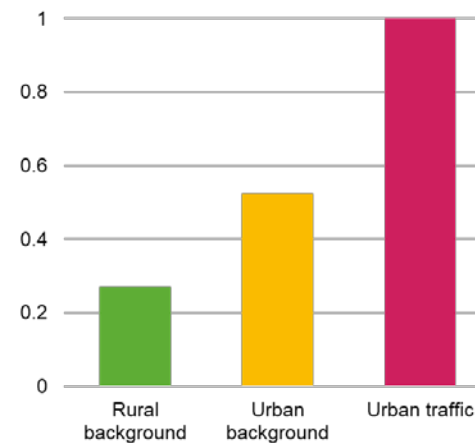
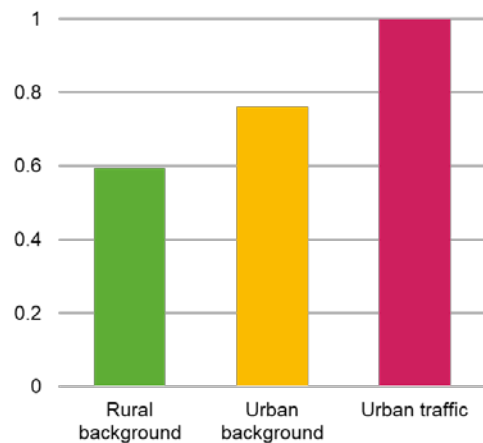
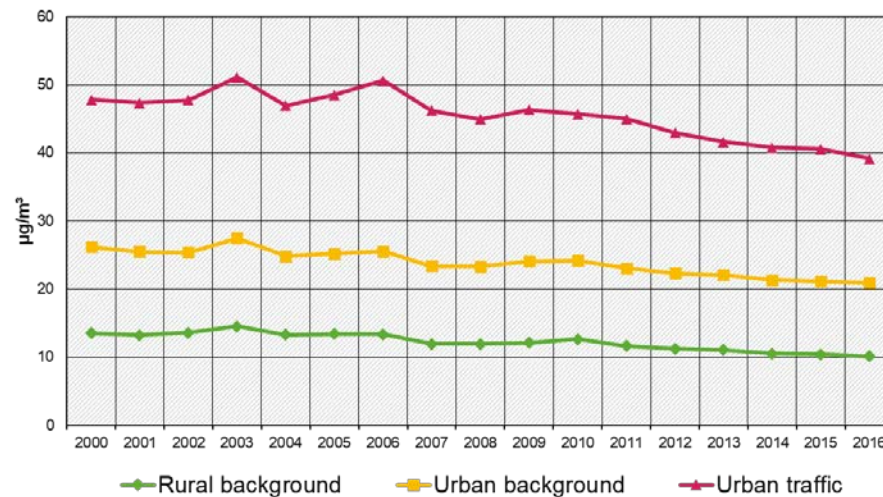
EEA Report No 28/2016

## Course of annual mean NO<sub>2</sub>- and PM<sub>10</sub>-concentrations in Germany

PM<sub>10</sub>

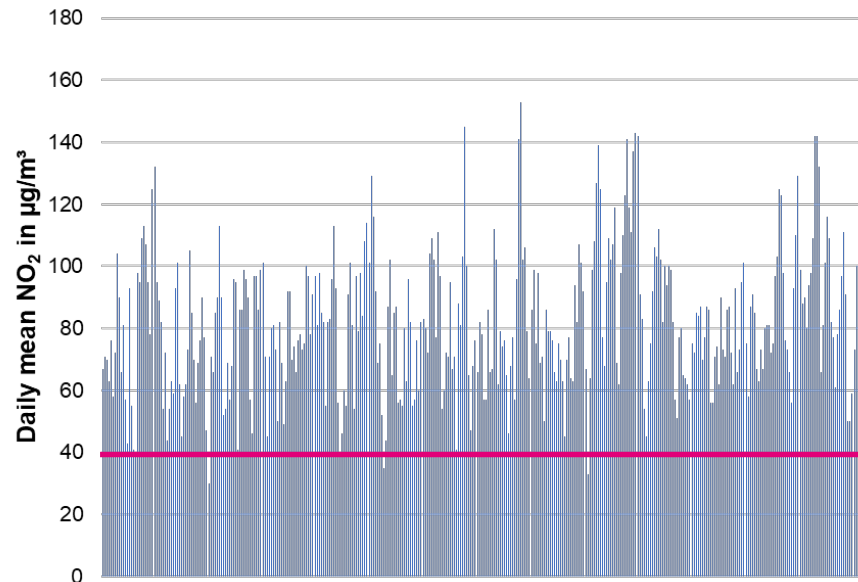
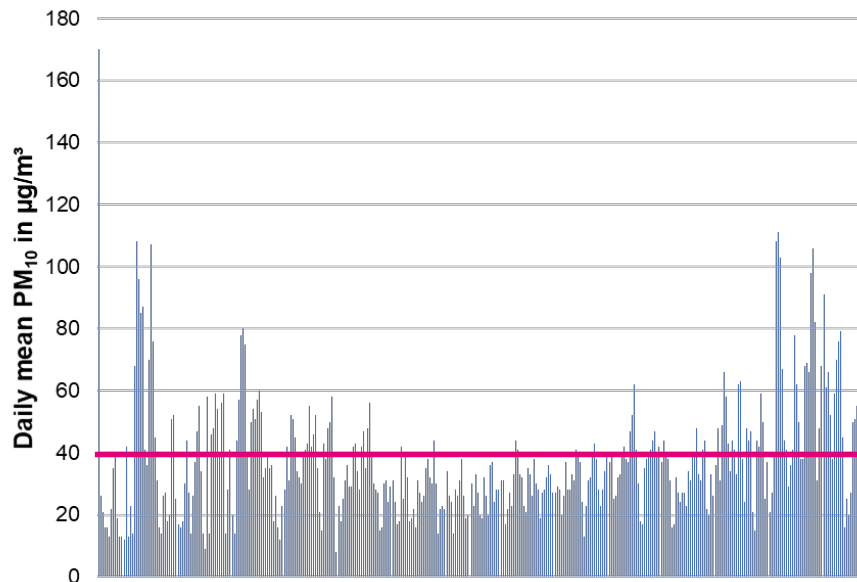


NO<sub>2</sub>



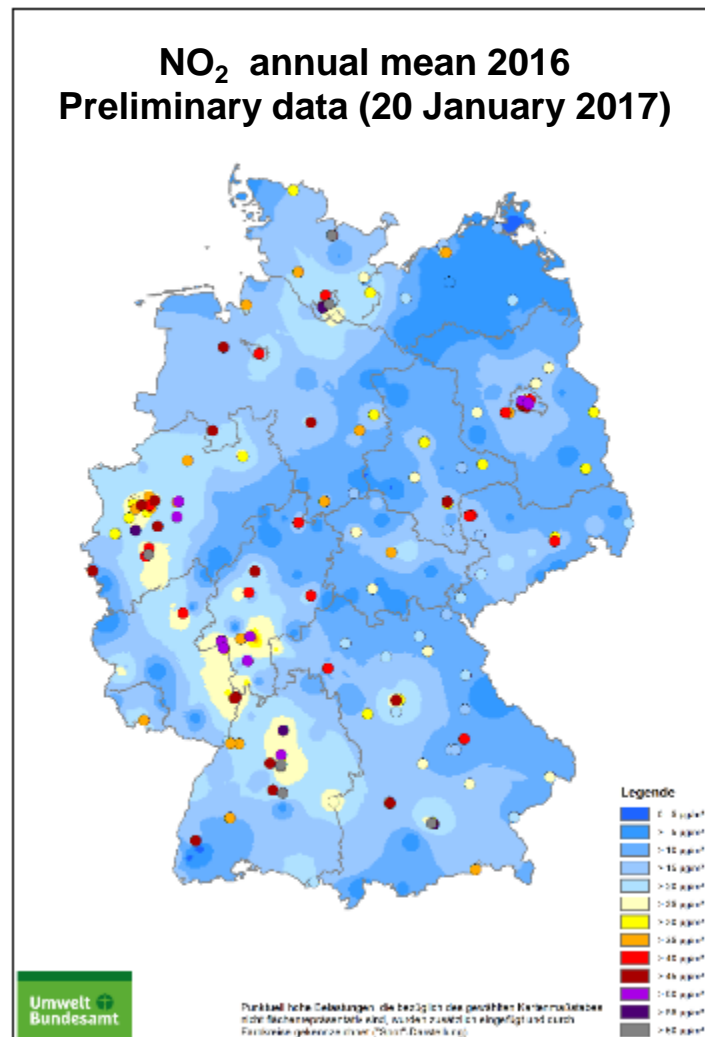
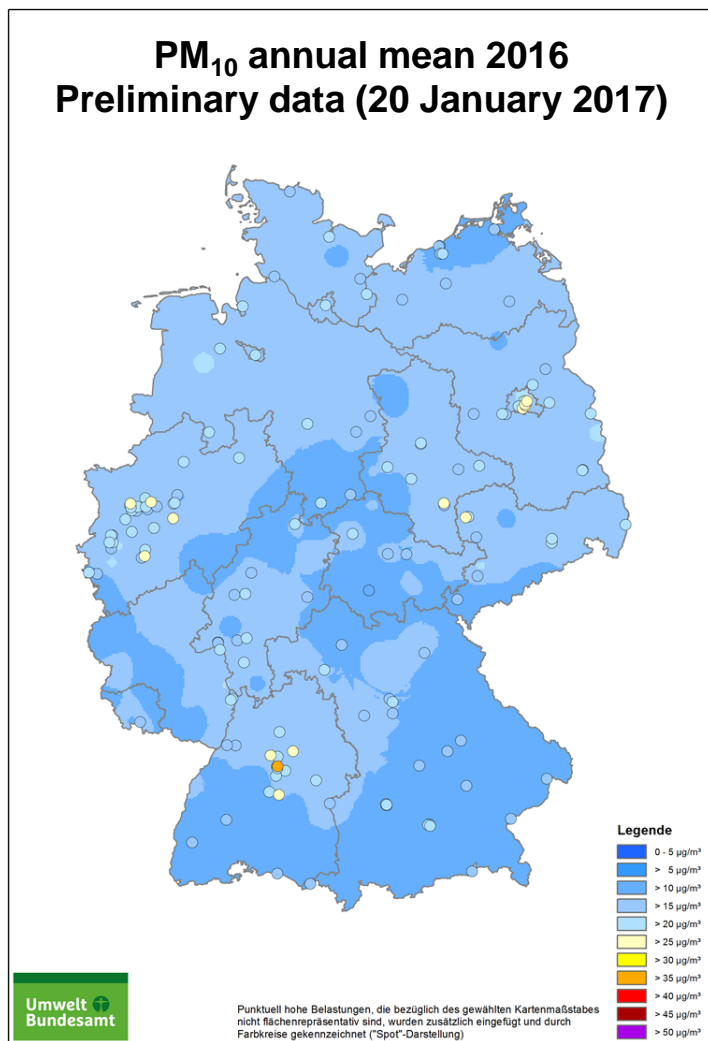
## Intra-annual variability of daily PM<sub>10</sub> and NO<sub>2</sub>-concentrations

Stuttgart Neckartor 2016, station with highest concentrations in Germany



- In Germany, exceedances of short-term limit value for NO<sub>2</sub> only occur at stations with exceedances of the long-term limit value (annual mean)
- Short-term measures are not appropriate for a substantial NO<sub>2</sub> reduction at these sites

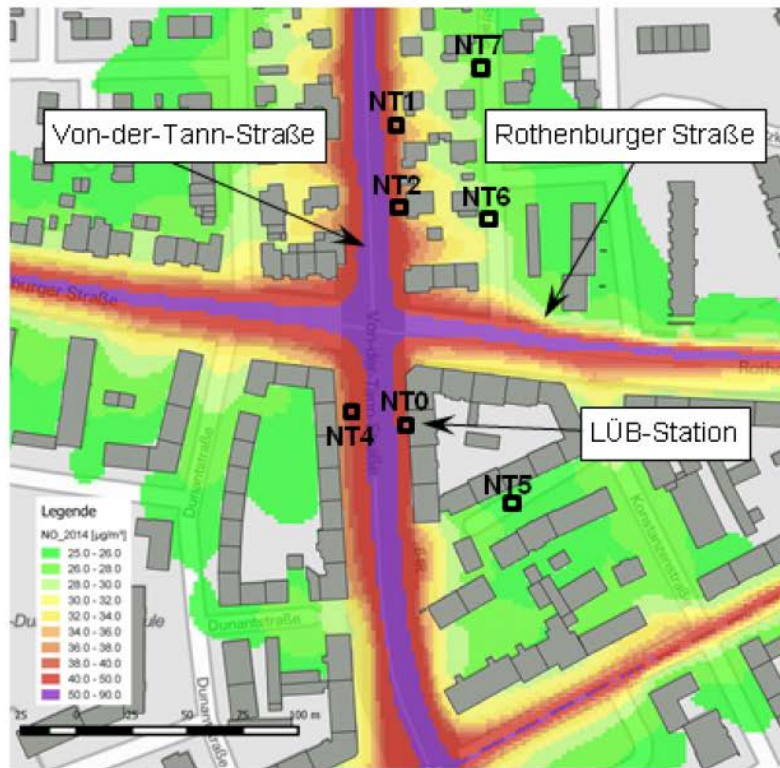
## Spatial distribution of annual PM<sub>10</sub> and NO<sub>2</sub>-concentrations in 2016



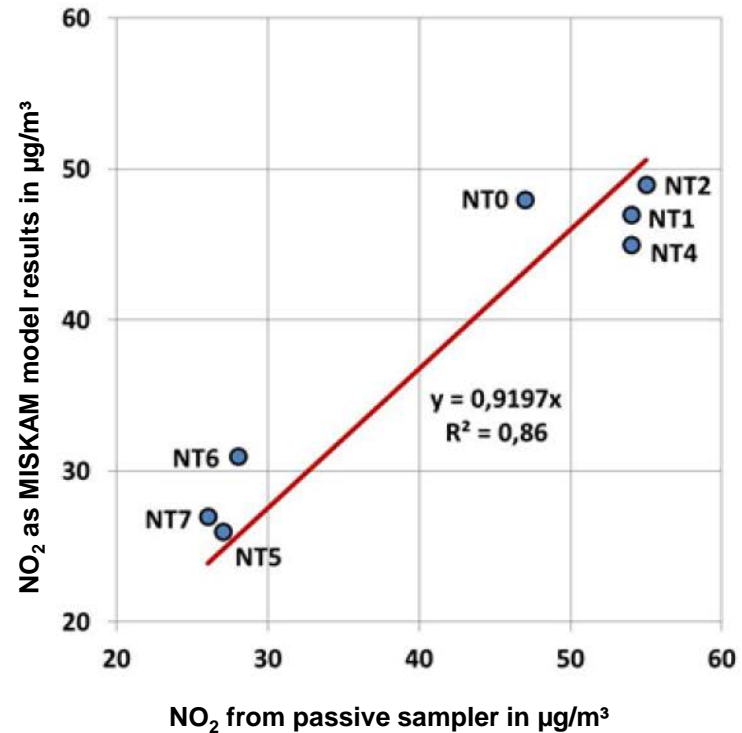
## Example of micro-scale distribution of NO<sub>2</sub>-concentrations

### Nuremberg

NO<sub>2</sub> sampling sites (passive sampler) and MISKAM results



NO<sub>2</sub> scatter plot



## Health effects: Results from a excess NO<sub>x</sub>-emission study

*Environ. Res. Lett.* 12 (2017) 034014

<https://doi.org/10.1088/1748-9326/aa5987>

### Environmental Research Letters

#### LETTER

## Public health impacts of excess NO<sub>x</sub> emissions from Volkswagen diesel passenger vehicles in Germany

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Keywords: Volkswagen, air quality, human health, diesel

Supplementary material for this article is available [online](#)

- Based on health effects of ozone and PM<sub>2.5</sub> on a 25 km by 28 km grid
- 1.200 premature deaths in Europe, 1.9 billion EURO costs associated with life-years lost



## Direct health effects from NO<sub>2</sub>

- EEA-estimation for Germany in 2012:  
Premature deaths attributable to

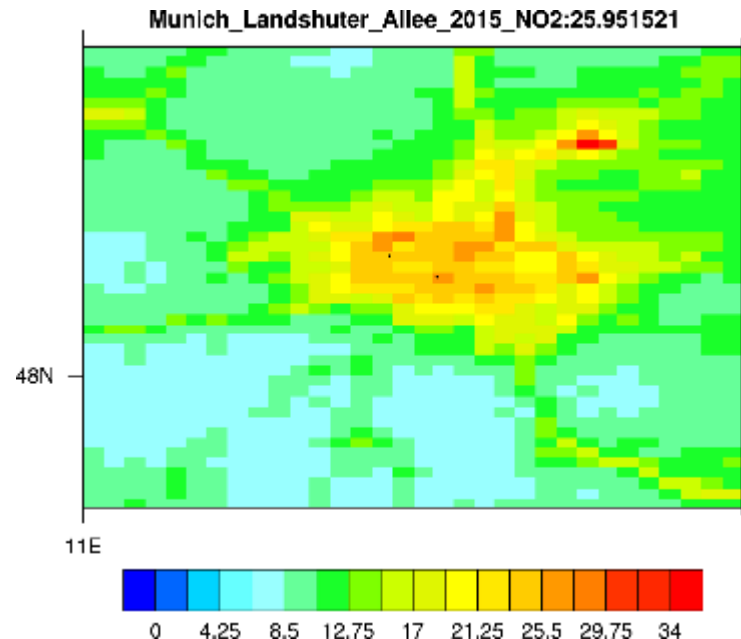
PM <sub>2.5</sub>	O <sub>3</sub>	NO <sub>2</sub>
59.500	2.100	10.400

- Results from a current UBA-project to estimate direct health effects from NO<sub>2</sub>:
  - Preliminary results show a comparable ratio between premature deaths attributable to PM<sub>2.5</sub> and NO<sub>2</sub>
  - Health outcomes depend on spatial resolution of NO<sub>2</sub> concentrations
- Methodical difficulties include selection of
  - health endpoints
  - appropriate studies providing dose-response relationships
  - counterfactual value

## Scenarios for an urban traffic site in Munich: method

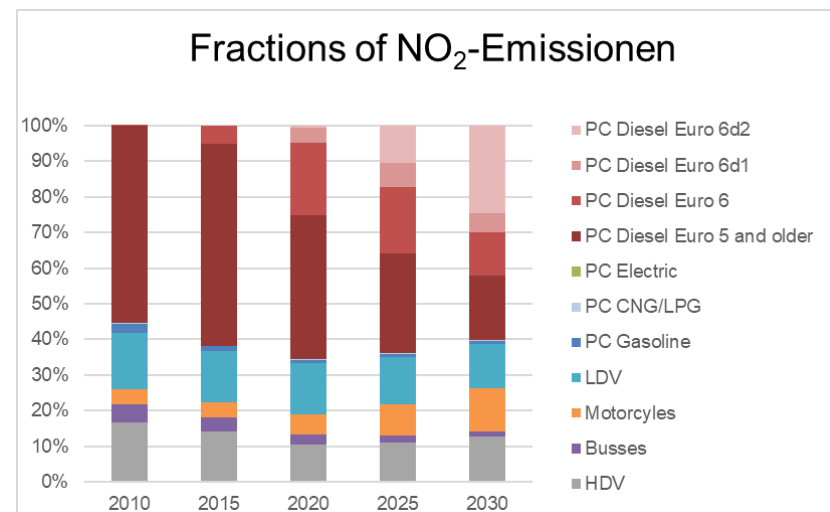
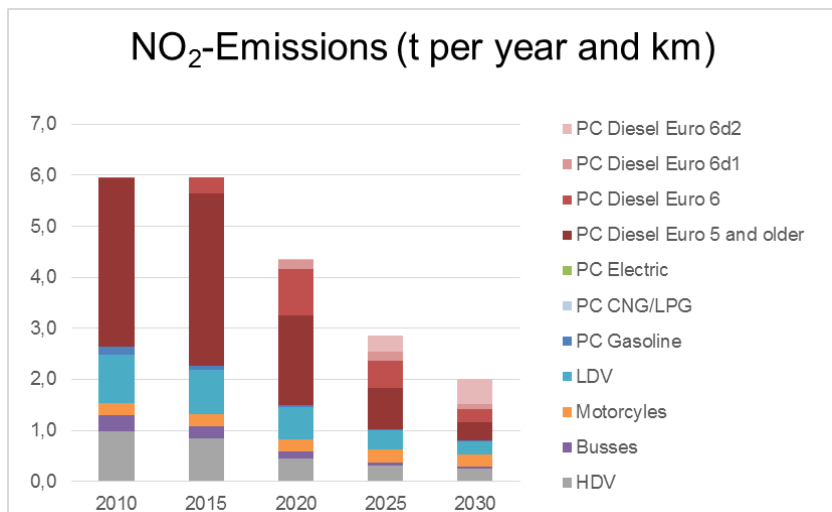
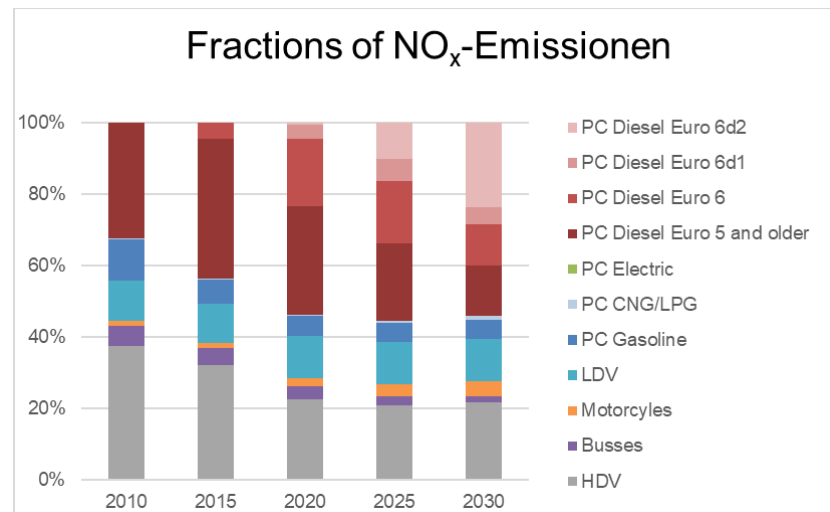
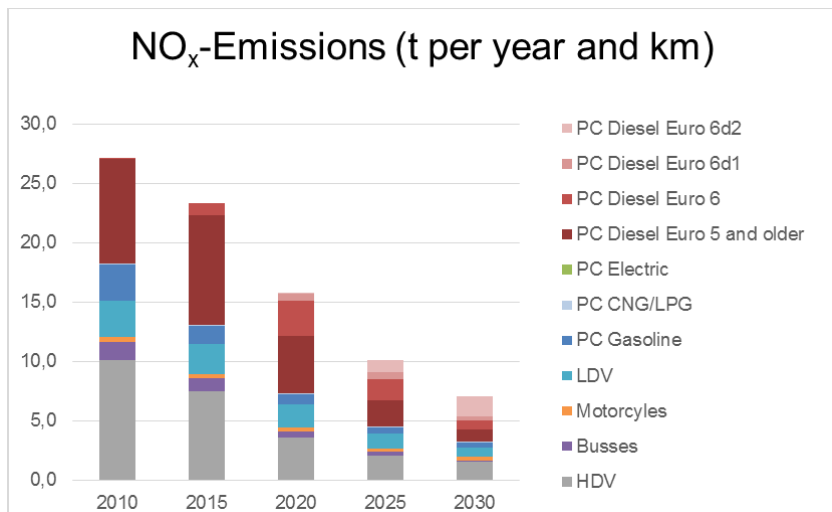
- Method according to Stern (2013), UBA-Texte 65/2013
- Background concentrations + local traffic increment from a screening model
- Screening model considers direct NO<sub>2</sub>-emissions and NO<sub>2</sub>-production via the NO-O<sub>3</sub>-reaction

Example of background concentration distribution  
(2 km by 2 km grid)

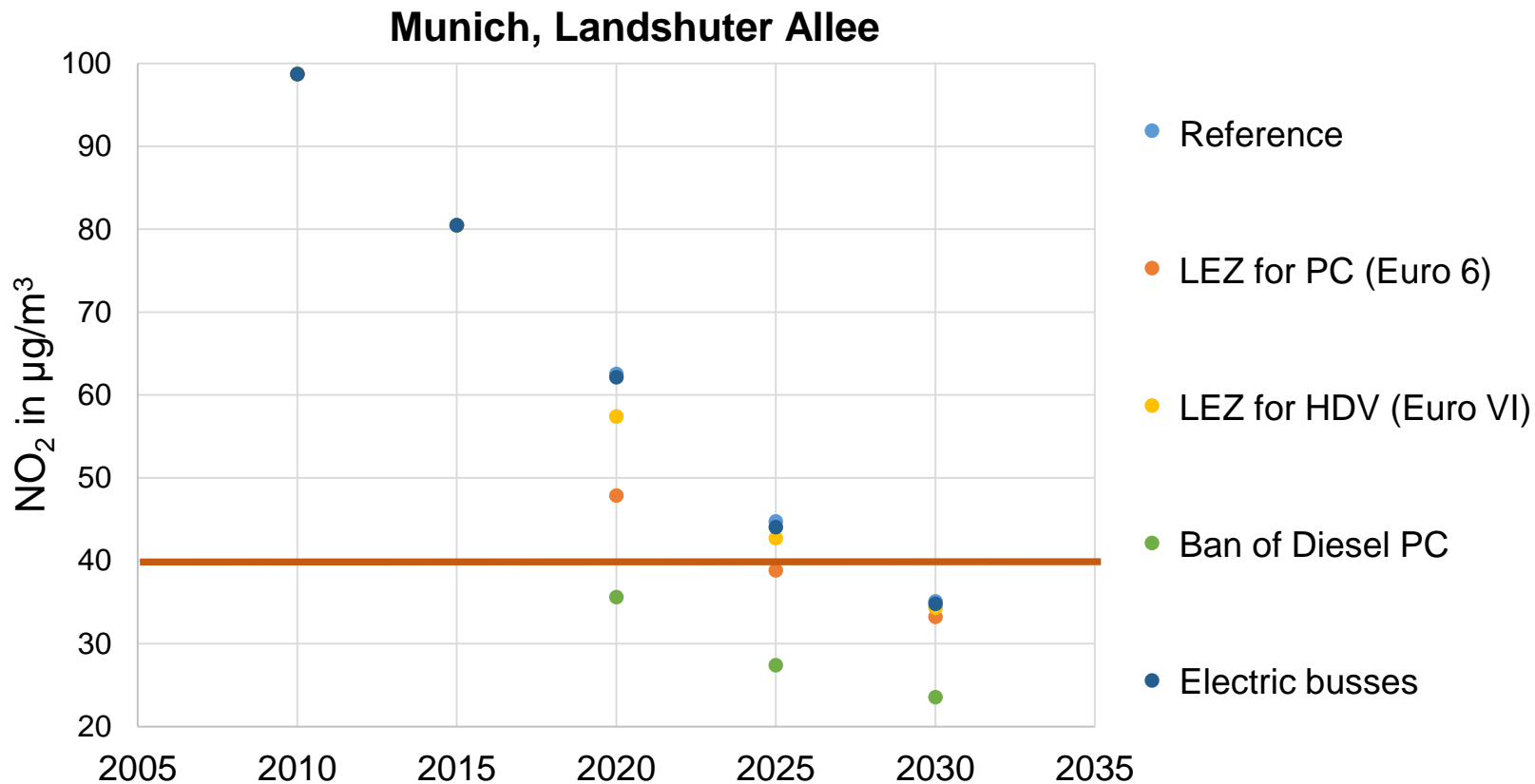


## Traffic emissions (HBEFA 3.2), Munich Landshuter Allee

Reference scenario (no additional measures), Euro 6 emissions corrected with factor of 1,9

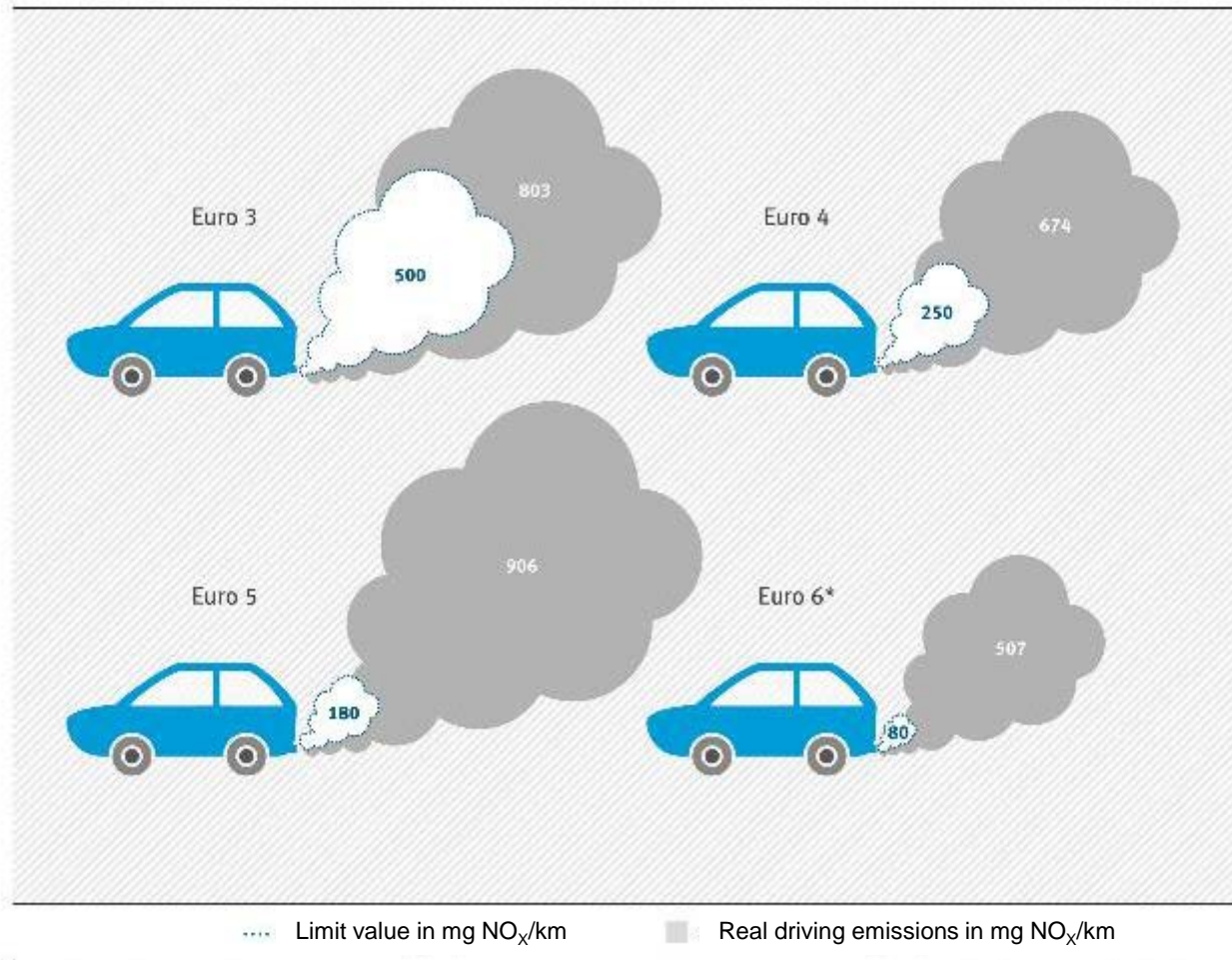


## Scenarios for ambient NO<sub>2</sub>-concentrations (Landshuter Allee)



Challenge: before looking for an **efficient** measure, we have to find an **effective** measure

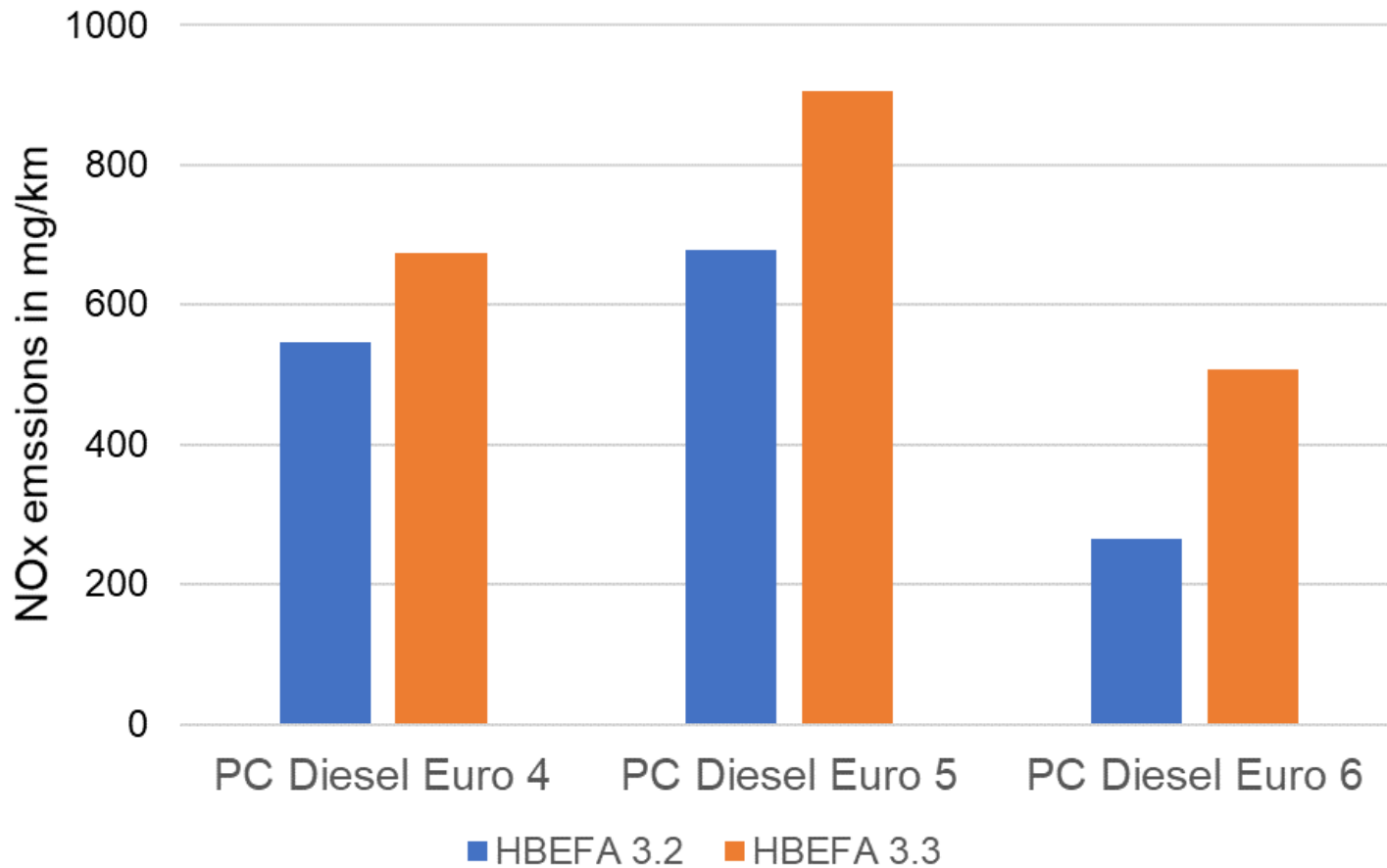
## Average NO<sub>x</sub>-emission factors for Germany in HBEFA 3.3



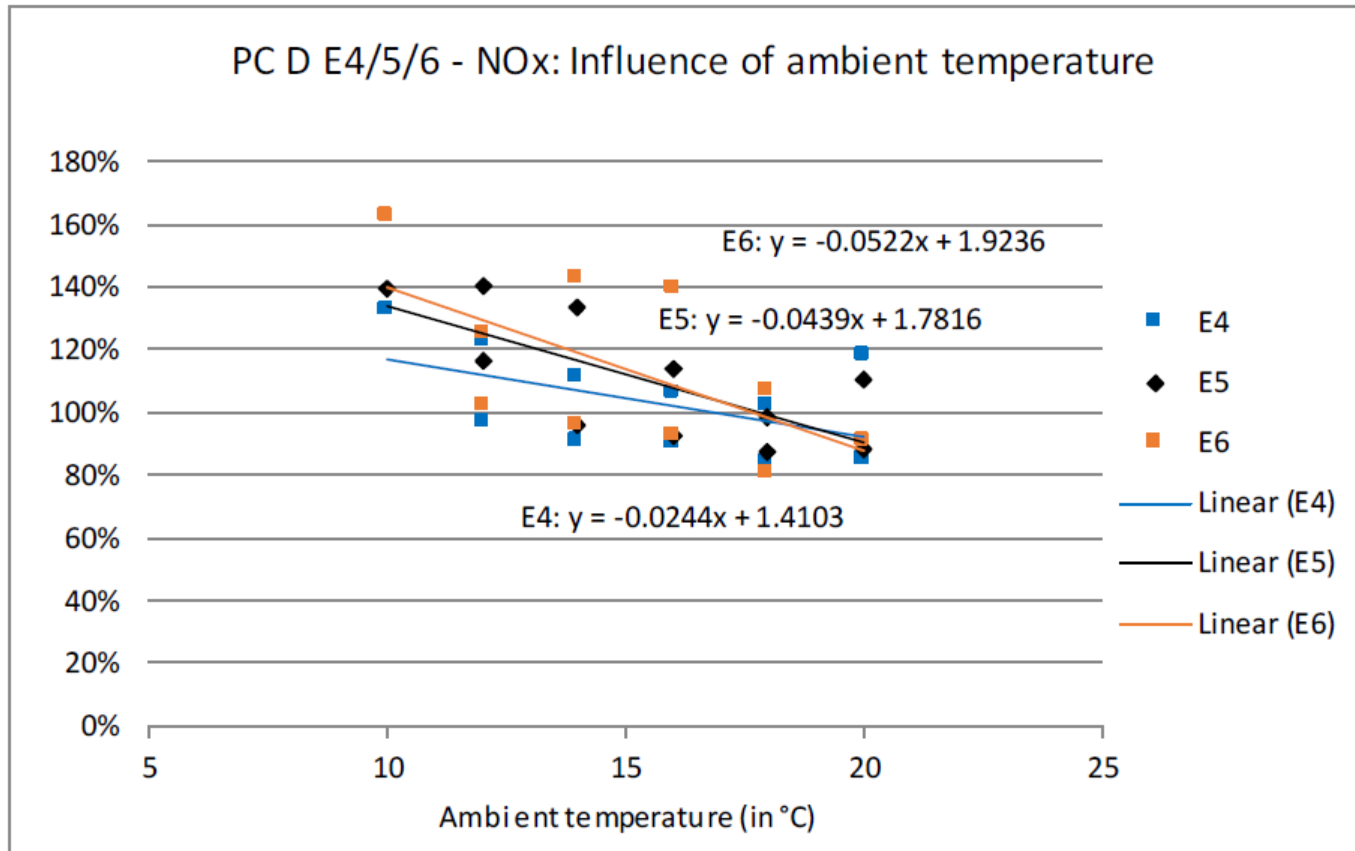
\* Before introduction of RDE

<http://www.umweltbundesamt.de/presse/pressemitteilungen/stickoxid-belastung-durch-diesel-pkw-noch-hoehler>

## Difference between HBEFA 3.2 and HBEFA 3.3



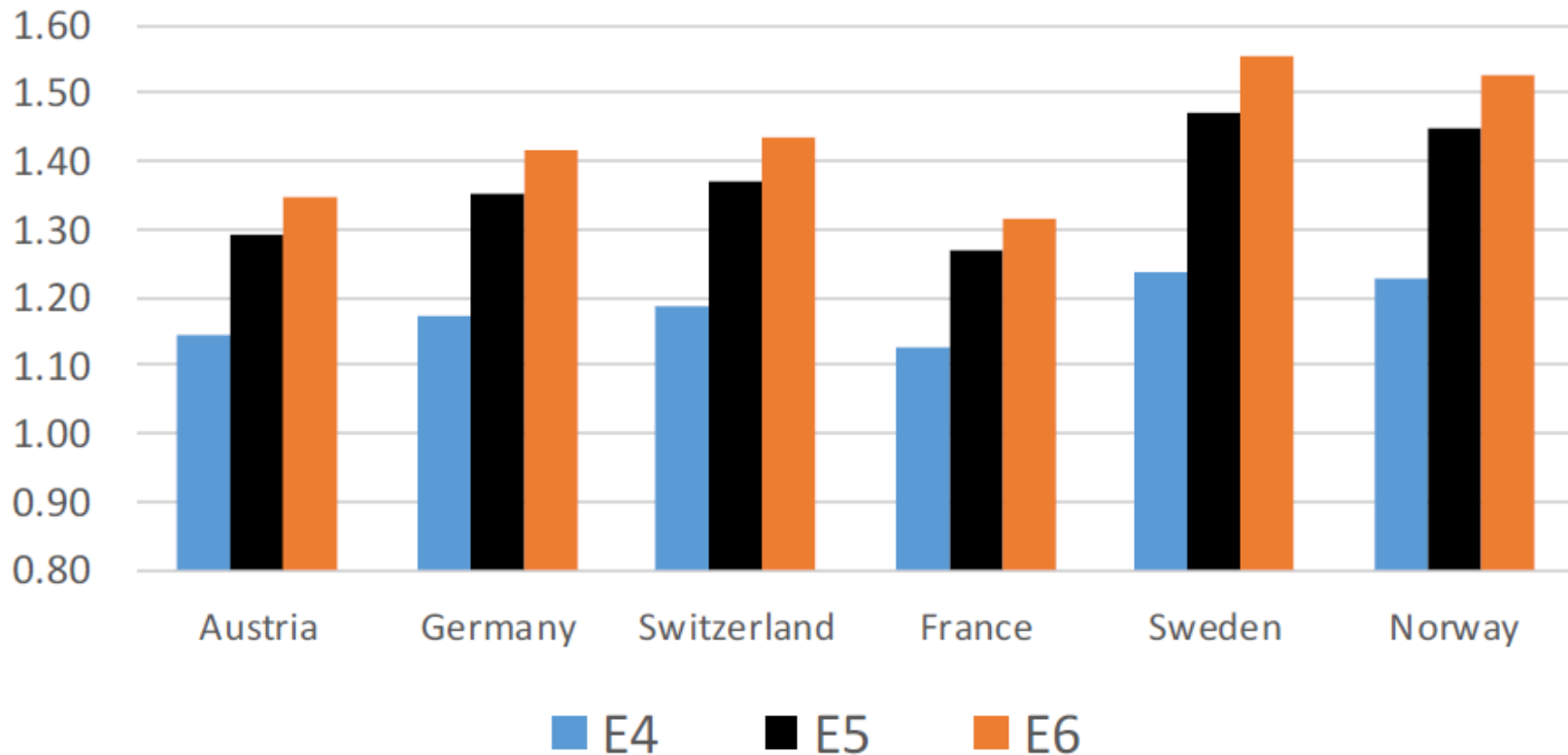
## Dependence of NO<sub>x</sub>-emission on ambient temperature



Keller et al. 2017, [http://www.umweltbundesamt.de/sites/default/files/medien/2546/dokumente/hbefa33\\_documentation\\_20170425.pdf](http://www.umweltbundesamt.de/sites/default/files/medien/2546/dokumente/hbefa33_documentation_20170425.pdf)

Main reason: exhaust gas recirculation is switched off at low temperatures to reduce moisture condensation

## Average ambient temperature corrections factors for NO<sub>x</sub> emissions

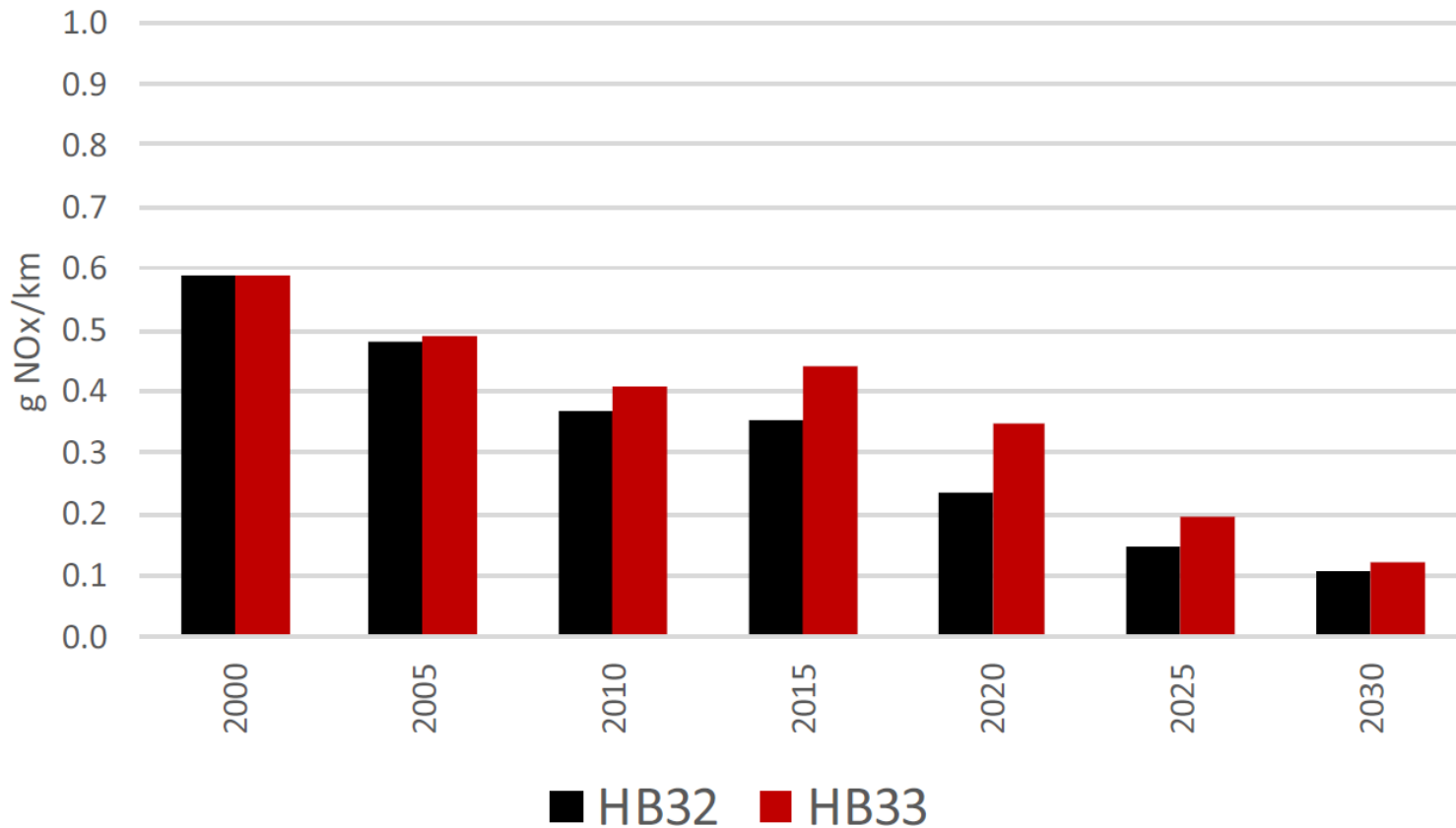


Keller et al. 2017, [http://www.umweltbundesamt.de/sites/default/files/medien/2546/dokumente/hbefa33\\_documentation\\_20170425.pdf](http://www.umweltbundesamt.de/sites/default/files/medien/2546/dokumente/hbefa33_documentation_20170425.pdf)



## Impact on national NO<sub>x</sub>-emissions from traffic in Germany

Weighted NO<sub>x</sub>-emissions factors for the German total car fleet in HBEFA 3.2 vs 3.3



## Summary

- NO<sub>2</sub>-concentrations at urban traffic sites are the most urgent air quality problem in Germany  
(in terms of limit value exceedances, not in terms of health effects)
- Diesel passenger cars are the main reason for locally increased ambient NO<sub>2</sub>-concentrations; successful measures have to address this source
- Quantifying direct health effects of NO<sub>2</sub> is possible
- Update of HBEFA from version 3.2 to 3.3 increased emission factors for Euro 4, 5 and 6 diesel passenger cars

# Thank you very much for your attention!

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<http://www.umweltbundesamt.de/en/topics/air>