



Mobile Machinery and urban air quality - Impacts and measures

Brussels, 27.11.2012 / Hinrich Helms & Christoph Heidt

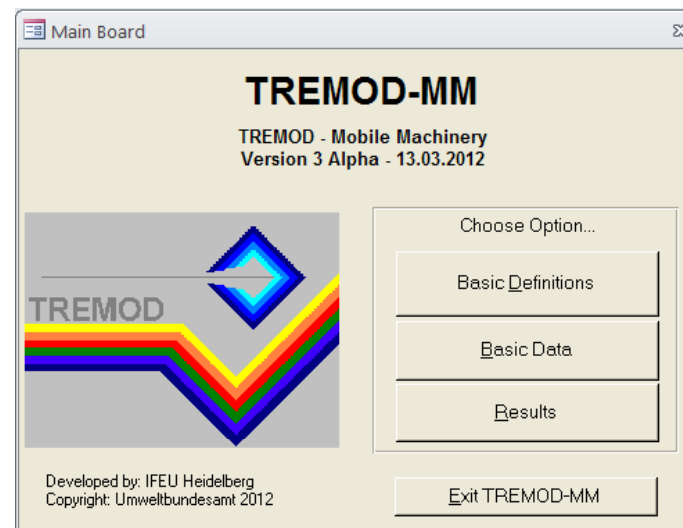
Overview

- 1 How relevant are emissions from mobile machinery?
- 2 What is the contribution to ambient air pollution?
- 3 Which mitigation measures are suitable?
- 4 Conclusions

How relevant are emissions from mobile machinery?

Emission model TREMOD-MM

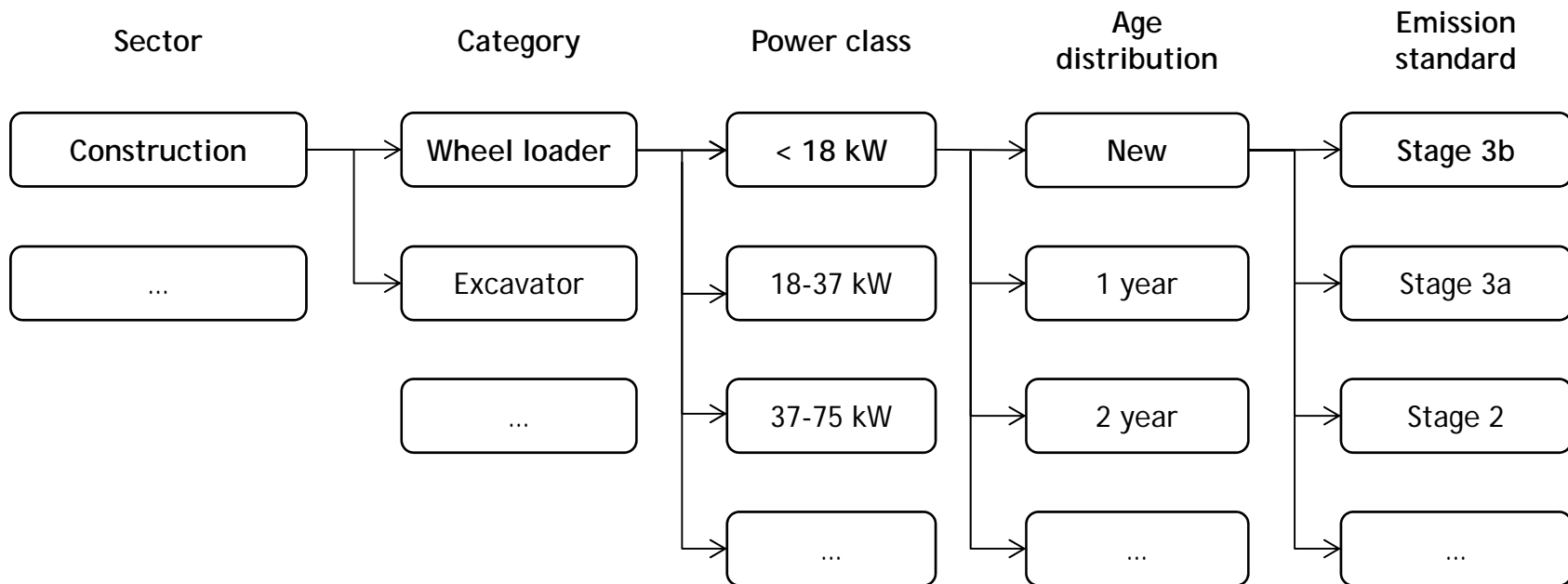
- National emission inventory for Germany
- Developed for the German Federal Environment Agency since 2004
- Calculation of fuel consumption and pollutant emissions from mobile machinery and equipment
 - Construction
 - Agriculture
 - Forestry
 - Industry
 - Gardening
 - Hobby



A population inventory...

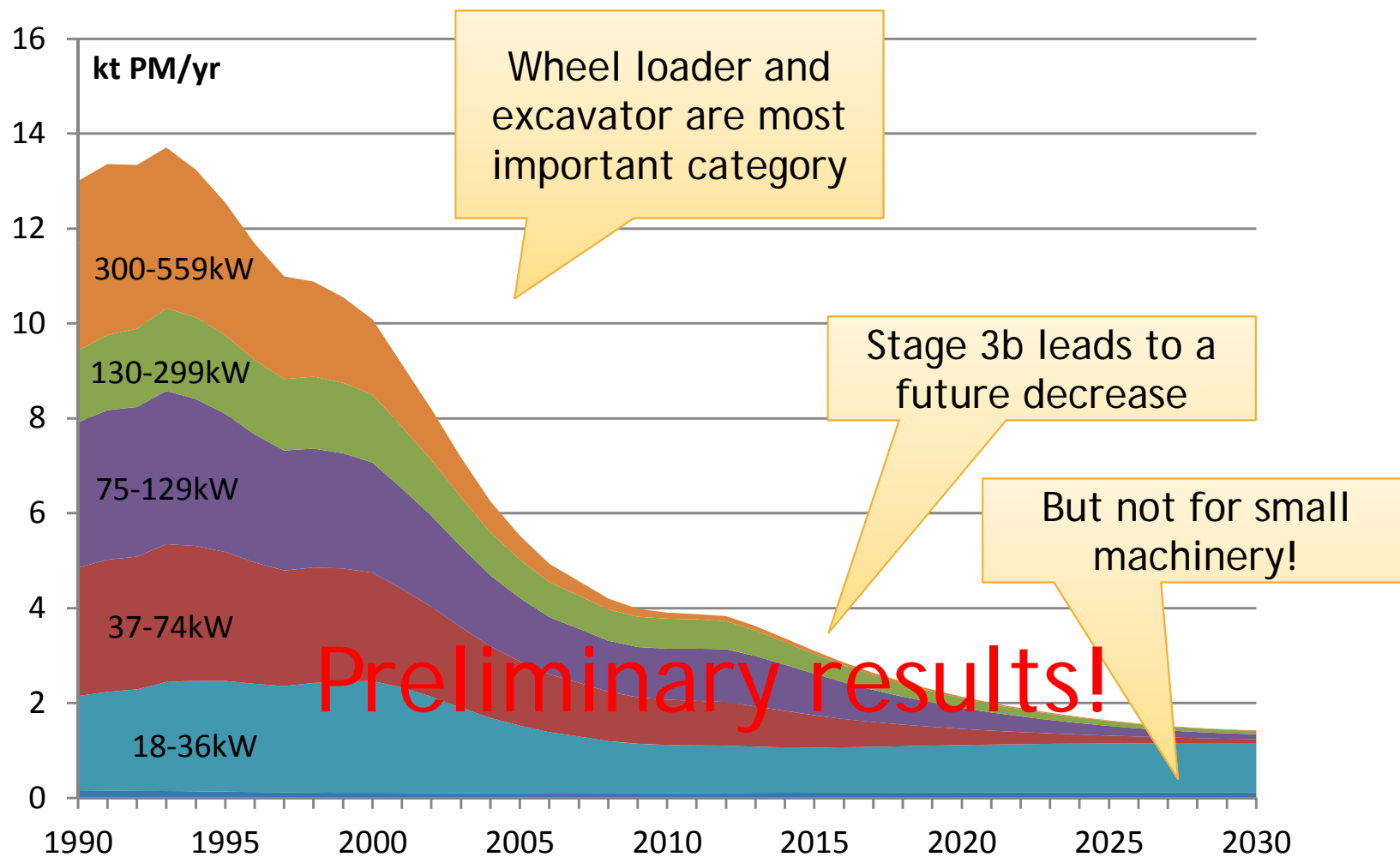
$$\text{Emissions} = \text{Population} \times \text{Power} \times \text{Use} \times \text{Emission factor}$$

Highly differentiated input data!



Construction machinery (Germany)

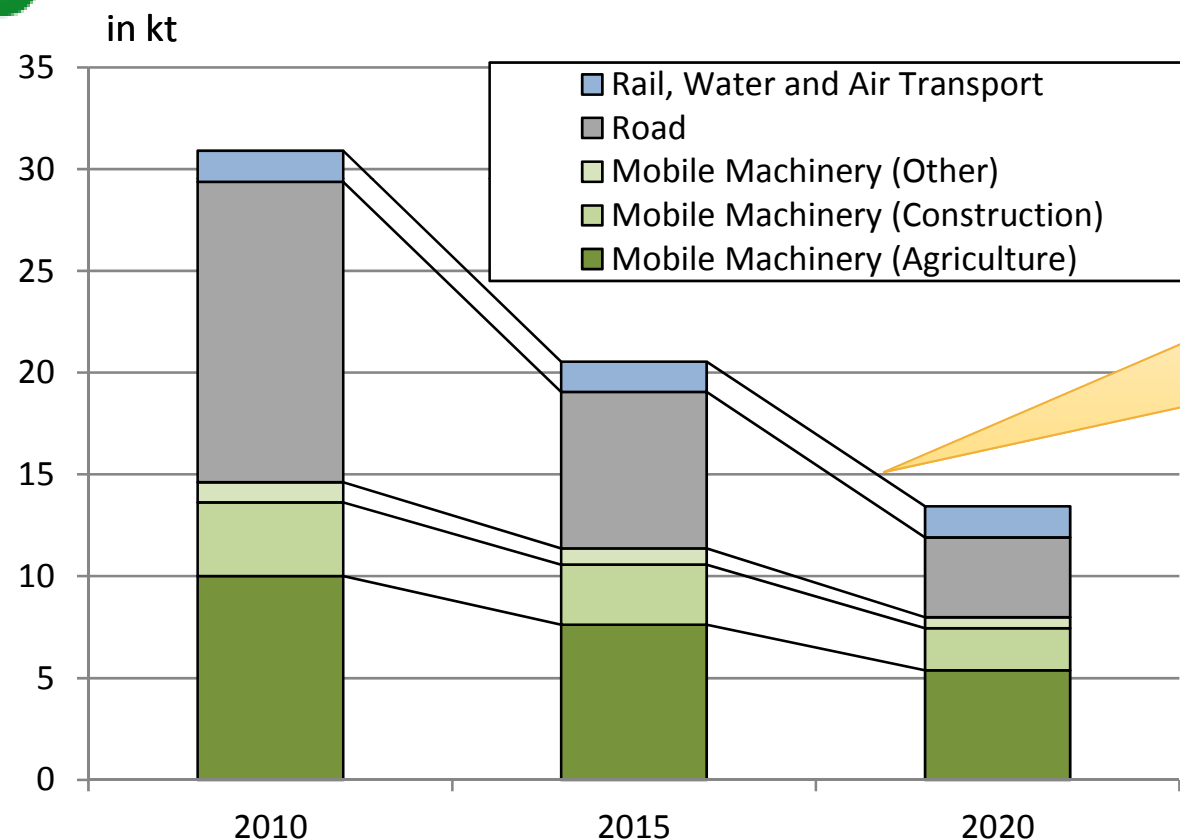
Example: Diesel particle emissions by power class



Mobile Machinery are responsible for a large share of diesel particle emissions in Germany

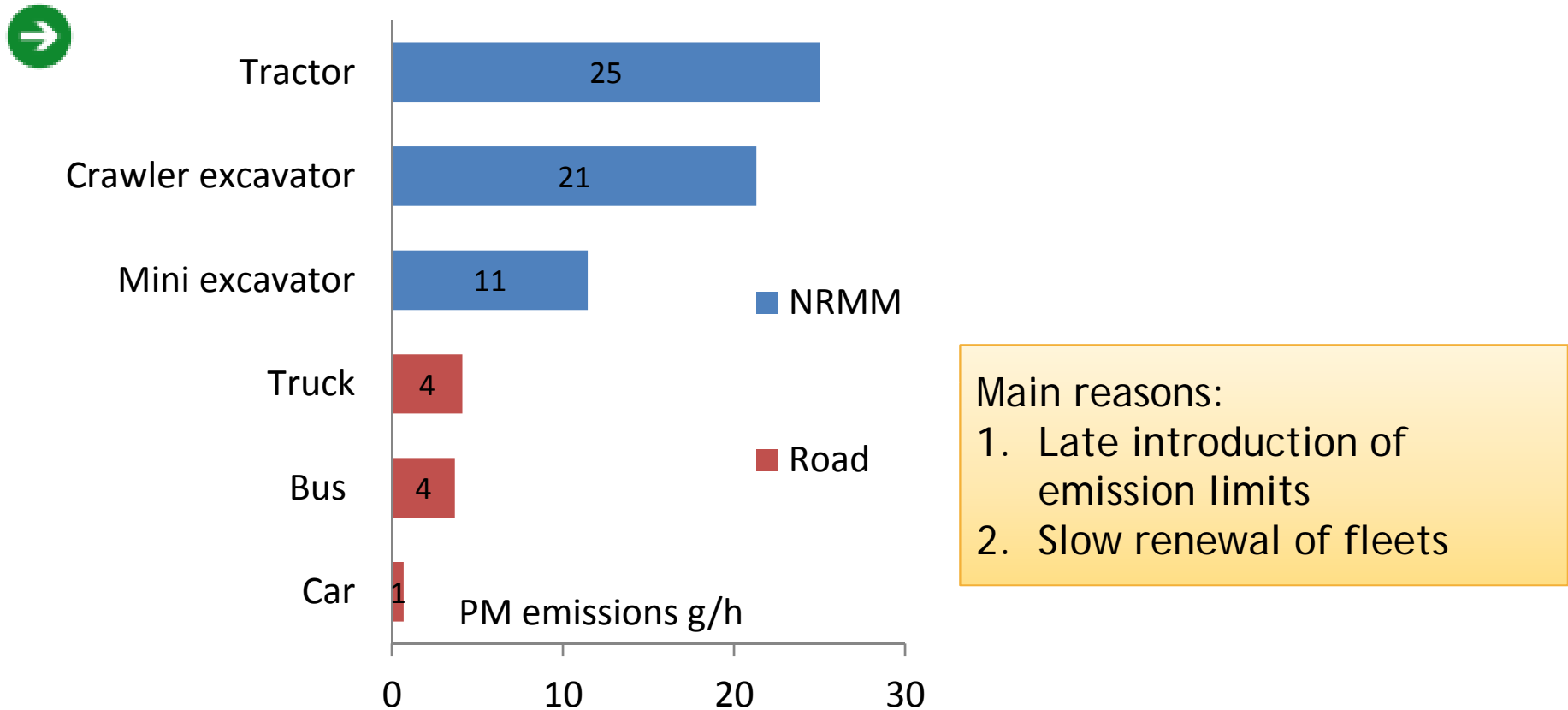


Annual PM emissions of transport in Germany



PM emissions of MM will decrease in the future - but to a lesser extent than road transport

Mobile machinery have particularly high specific particle emissions (average values)



What is the contribution to ambient air pollution?

Case study: Berlin

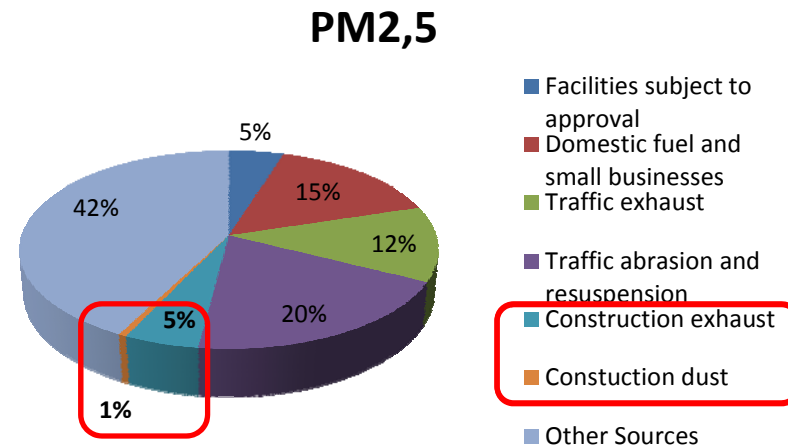
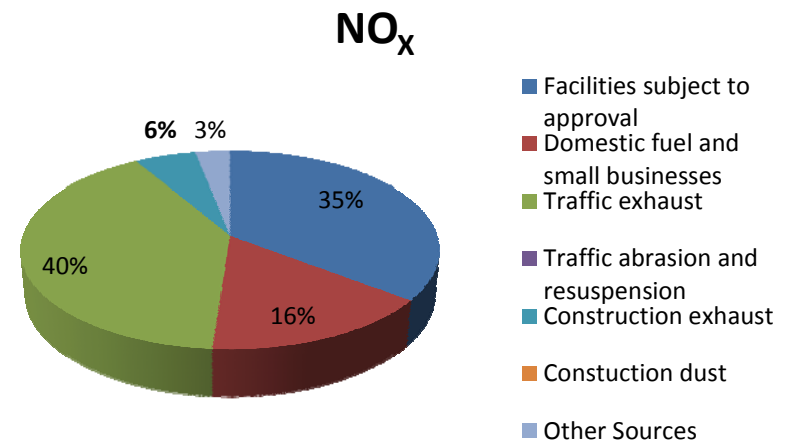
- Well documented and topical source appointment:
 - Update of the Clean Air Plan 2009-2020 (IVU 2011)
 - PM_{2,5} Source appointment analysis (Pesch 2008)
 - Umweltatlas Berlin
- Background concentration:
 - PM₁₀ between 20-30 µg/m³ with a large share of long distance transport
 - NO₂ also between 20-30 µg/m³, but mainly from within city limits
- Assessment of the the contribution of mobile machinery?
 - Top-Down calculation of urban emissions
 - Deduction of contribution to concentration based on contribution of road traffic
 - Similar diffusion behaviour is assumed (low level sources)
 - **Preliminary results from ongoing project - Final results early 2013!**

Construction machinery have a relevant share on urban NO_x- and particle emissions

Estimate for case study Berlin:

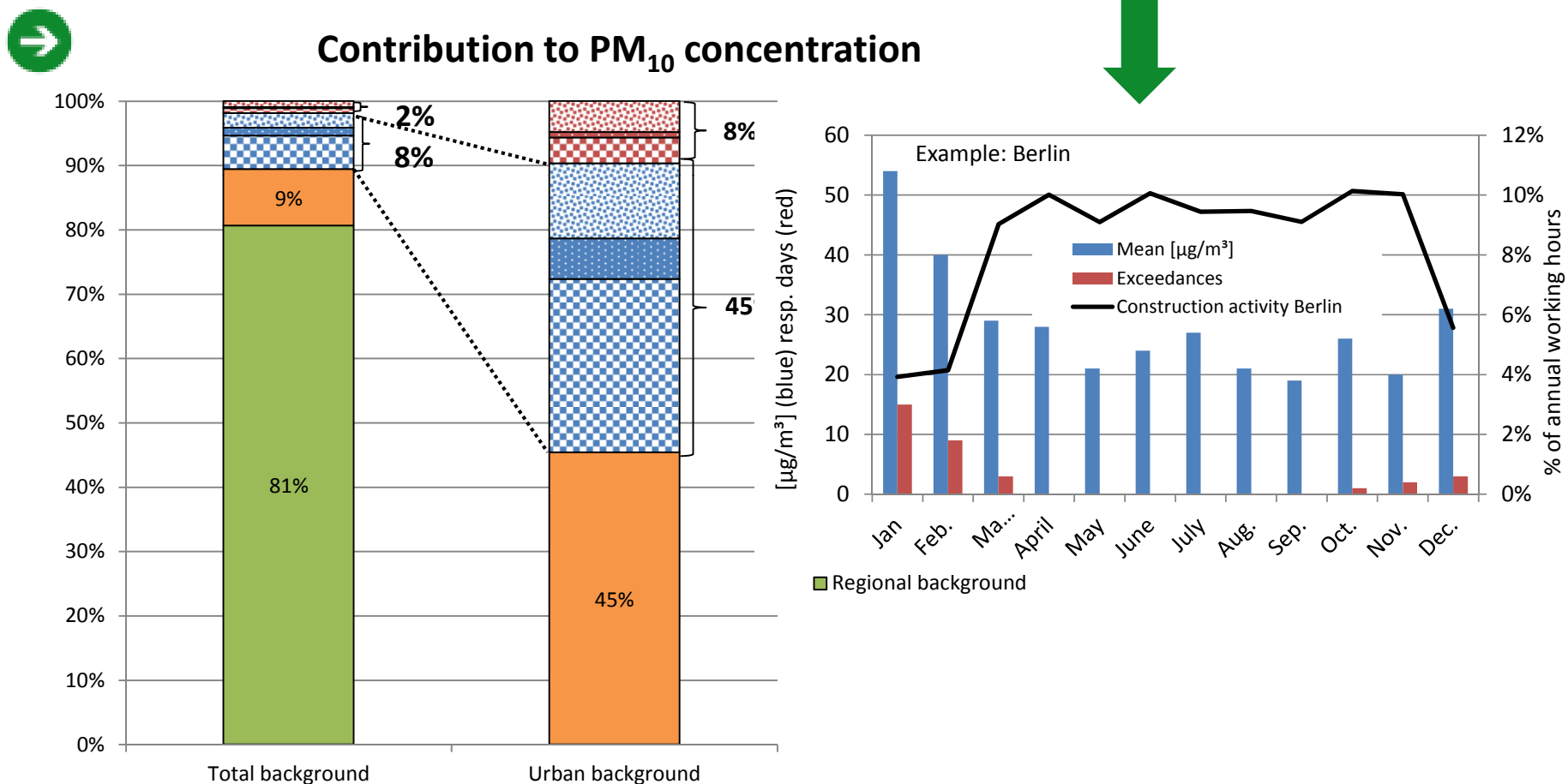
- 6% for NO_x

- 6% for PM₁₀, of which
 - 3% engine exhaust
 - 3% Dust (from building construction)
- 6% for PM_{2,5}
 - with larger share of engine exhaust (5%)



PM₁₀ background from many different sources

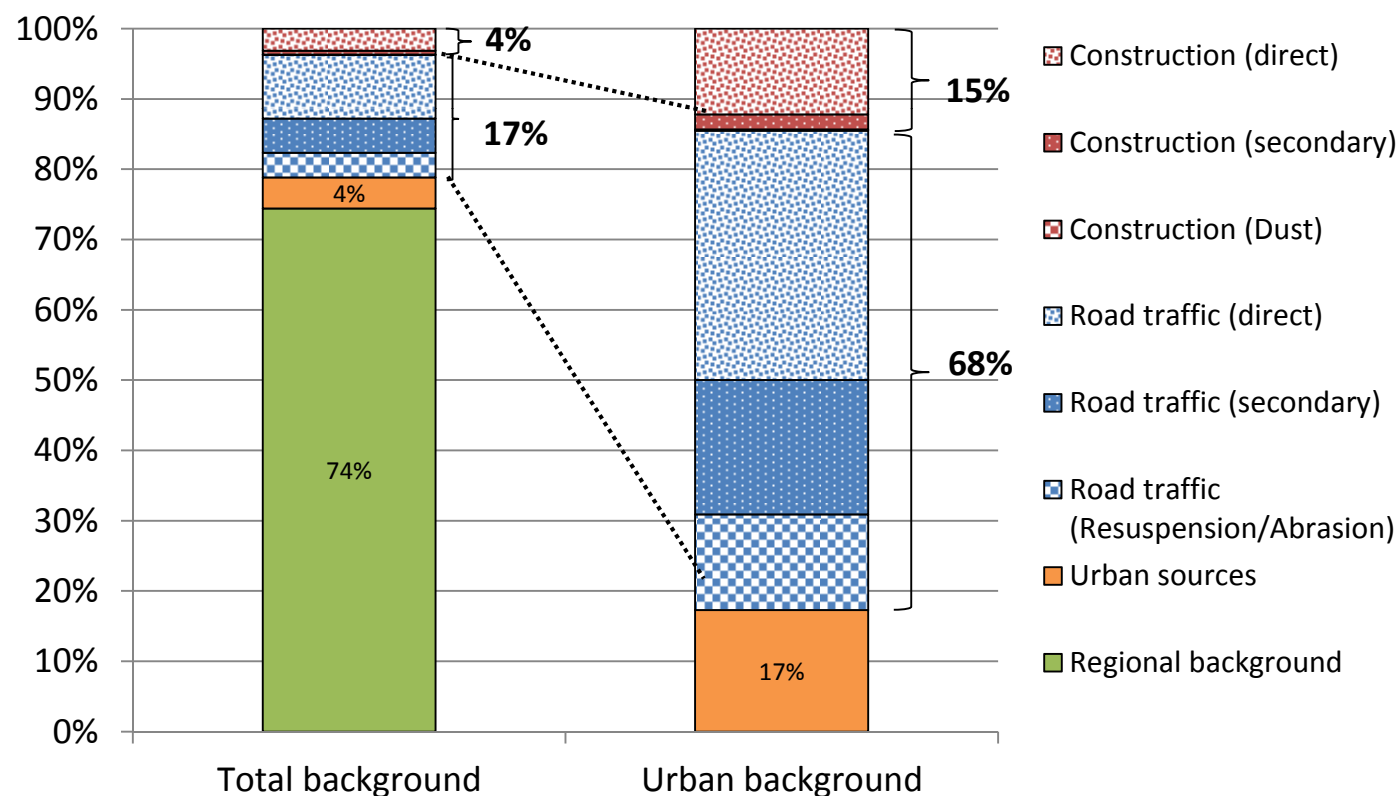
Construction emissions mainly in summer,
exceedances mainly in winter!



For $PM_{2,5}$ larger share of direct engine exhaust emissions – but overall limited contribution to background



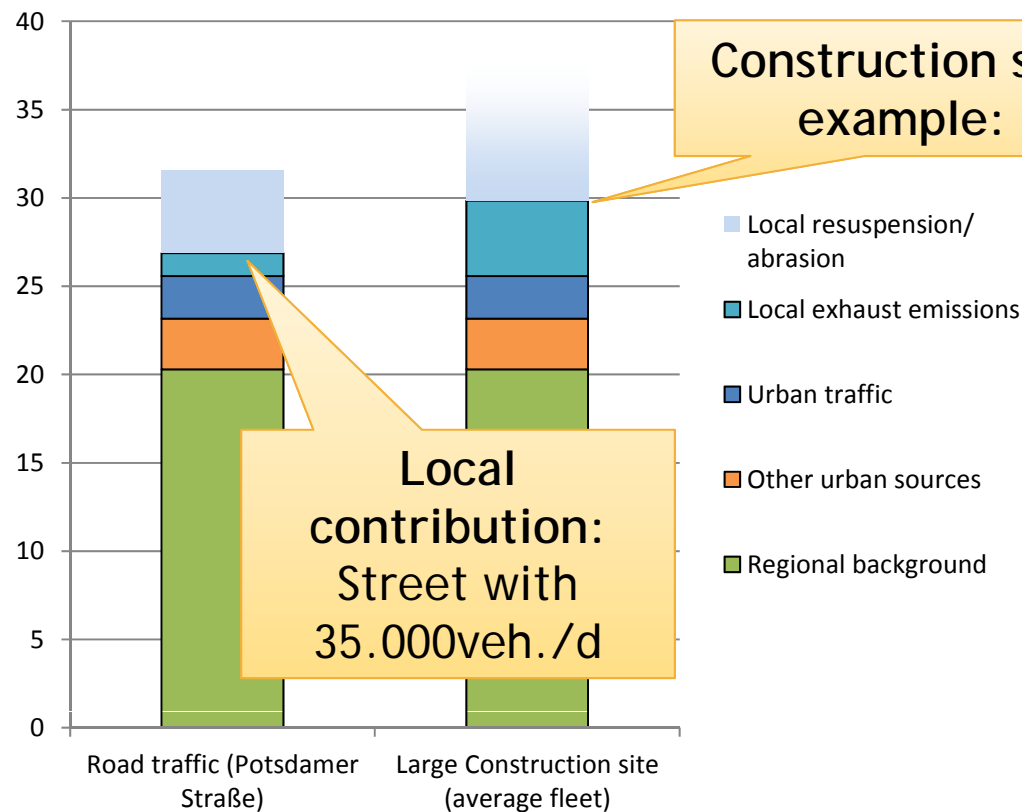
Contribution to $PM_{2,5}$ concentration



BUT: local contribution of construction machinery can be higher than 10%

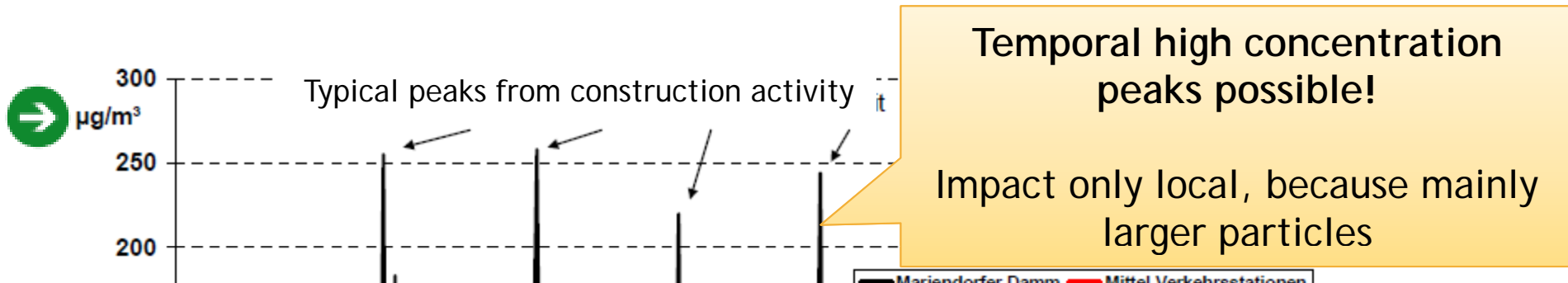


Comparison of additional local contribution
(Daily mean PM_{10})

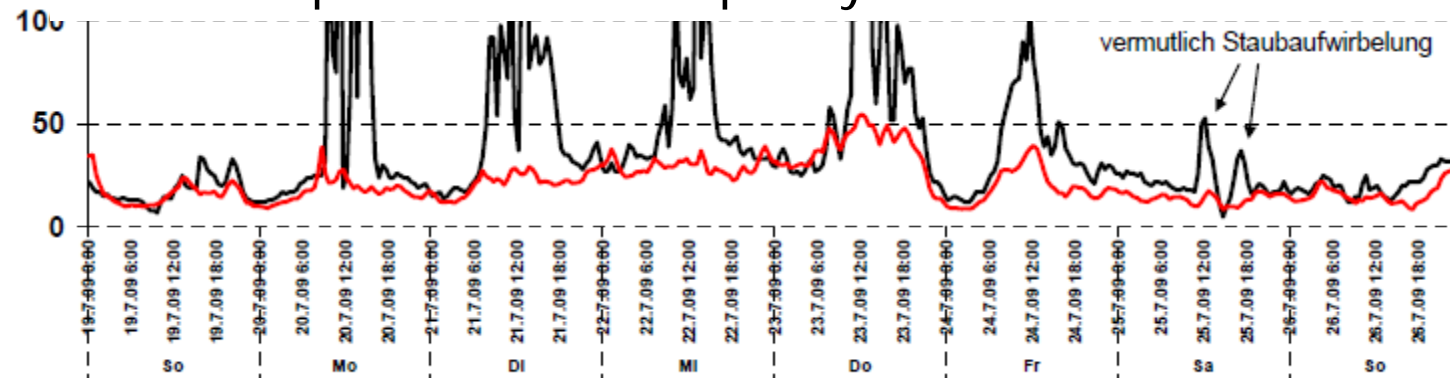


| Anzal | Typ | Leistung [kw] |
|-------|--------------|---------------|
| 1 | Mobilbagger | 90 |
| 1 | Raupenbagger | 90 |
| 2 | Radlader | 60 |
| 2 | Minibagger | 25 |
| 1 | Walzen | 20 |
| 2 | Vibratoren | 12 |
| 2 | Kompressor | 20 |

BUT: local contribution of construction machinery can be higher than 10% - additionally Dust emissions



15 Local measures can considerably contribute to a local compliance with air quality standards!



Especially diesel particle emissions should be considerably reduced, because ...



Diesel emissions classified as **cancerogenic** by WHO since June 2012

International Agency for Research on Cancer



PRESS RELEASE
N° 213

12 June 2012



Black carbon from mobile machinery contributes to global warming

A general reduction of diesel emissions is also important due a health and climate perspective

Which mitigation measures are suitable?

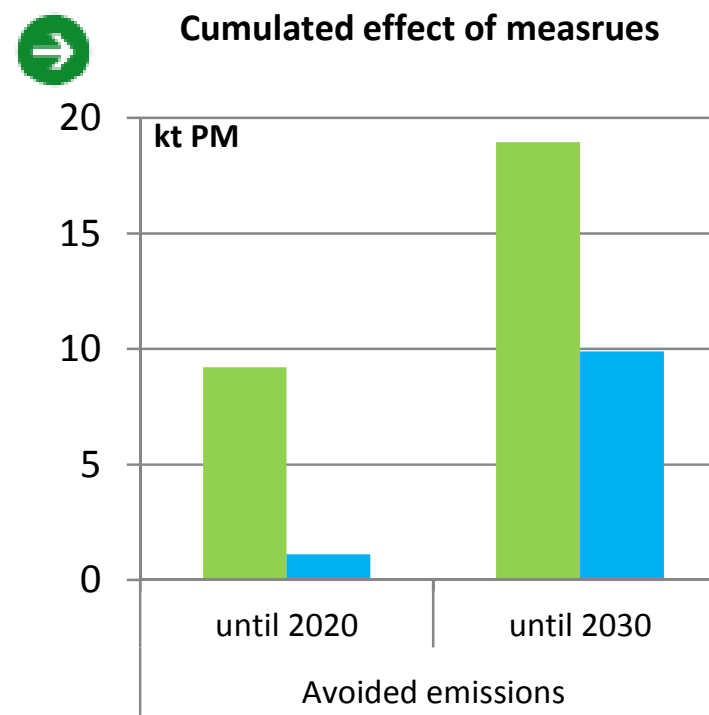
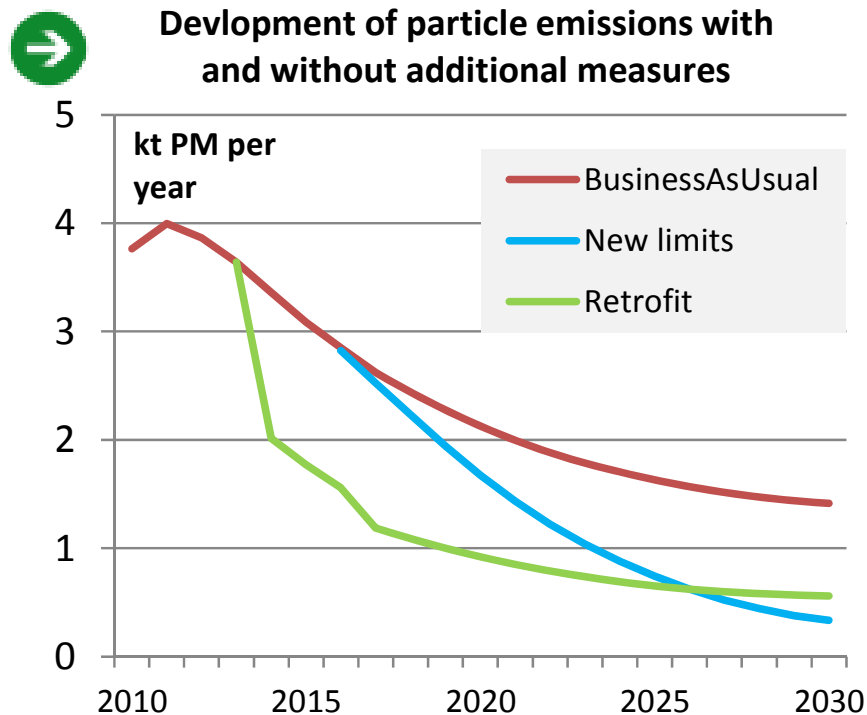
Examples for additional measures from the US and Switzerland

| Year of Introduction | 2008 | 2010 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|------------------------------|--------------------------------------|------|---|-----------------|-----------------|------|
| OEM Option: Extension of emission standards for new engines similar to US-Standards | | | | | | | |
| Example: USA | <19 kW, MY≥2008* | 19-37 kW, MY≥2013* | | | | | |
| Scenario: EU | Focus on small power classes | | | | | <37 kW, MY≥2016 | |
| Retrofit Option: DPF for new and existing engine similar to the Swiss Air quality directive | | | | | | | |
| Example: Switzerland | | ≥37 kW, MY≥2000 19-37 kW, MY≥2010 | | | ≥37 kW, MY<2000 | | |
| Scenario: Germany | | | | >37 kW, MY≥2002 19-37 kW, MY≥2014 | | ≥37 kW MY<2002 | |
| MY: Manufacture Year | | | | Old machinery can be used slightly longer | | | |
| References: (BAFU 2010), (Dieselnet 2012) | | | | | | | |
| | | | | IFEU 2012 | | | |

* Current emission limit; Sources: [BAFU 2010]; [dieselnet.com]

Measures can further reduce emissions

- New limits are important for a long term reduction
- Retrofitting leads to a faster decrease with higher cumulated avoided emissions



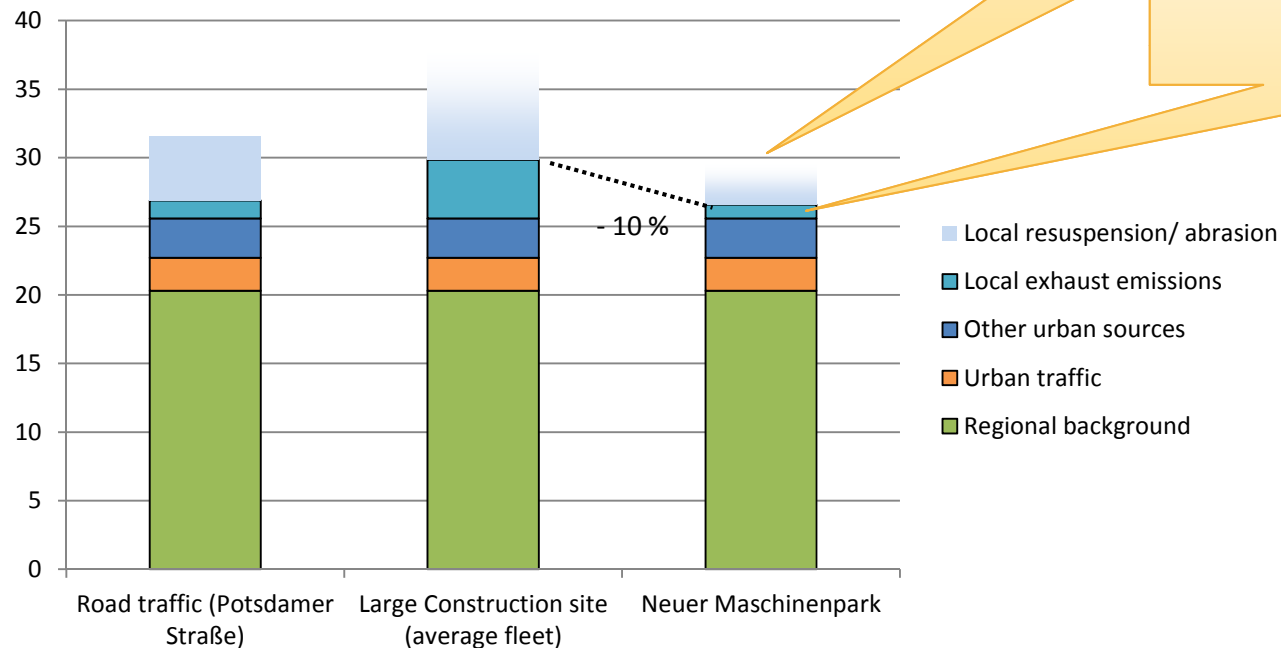
Local measures can also lead to a considerable local reduction

Reduction of dust emission?

Machinery of the latest emission limit



Impact of local measures on additional local contriction
(Daily mean PM₁₀)



Current examples for a local / builder specific approach

■ Germany

- Berlin plans to demand new machinery (>37kW Stage 3b, 18-36kW Stage 3a) for public construction activity
- German Railways demand a particulate filter on urban construction sites from 2013

■ Austria

- Between October and march only machinery complying to newer emission standards or with particulate filter can be used in low emission zones

Conclusions

- Differentiated inventory model TREMOD-MM for mobile machinery in Germany => Basis for assessment of mitigation measures
- Assessment of contribution to ambient air quality complex
 - Air pollution from many sources
 - Contribution of construction machinery to background limited
 - Large local contribution possible (also dust emissions)
- Retrofitting can reduce the emission level quickly, new emission limits need more time
- Local solutions (e.g. low emission zones) are an alternative
- From a health and climate perspective, a further reduction (even beyond compliance with air quality legislation) would be important
- A combination of (local) retrofitting and a further development of emission limits could be effective

Thank you for your attention!

Are there any questions?

Hinrich Helms

ifeu - Institut für Energie- und
Umweltforschung Heidelberg GmbH
Wilckensstraße 3
69120 Heidelberg

Fon: +49 (0) 6221 / 47 67 -33
Fax: +49 (0) 6221 / 47 67 -19
E-Mail: hinrich.helms@ifeu.de

Christoph Heidt

ifeu - Institut für Energie- und
Umweltforschung Heidelberg GmbH
Wilckensstraße 3
69120 Heidelberg

Fon: +49 (0) 6221 / 47 67 -39
Fax: +49 (0) 6221 / 47 67 -19
E-Mail: christoph.heidt@ifeu.de