PAREST Project: German IAM for Air Quality

An integrated measure-based approach to fulfill European air quality targets cost-effective on national level – Final results from the German PAREST project

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UFOPLAN-project-206 43 200/01

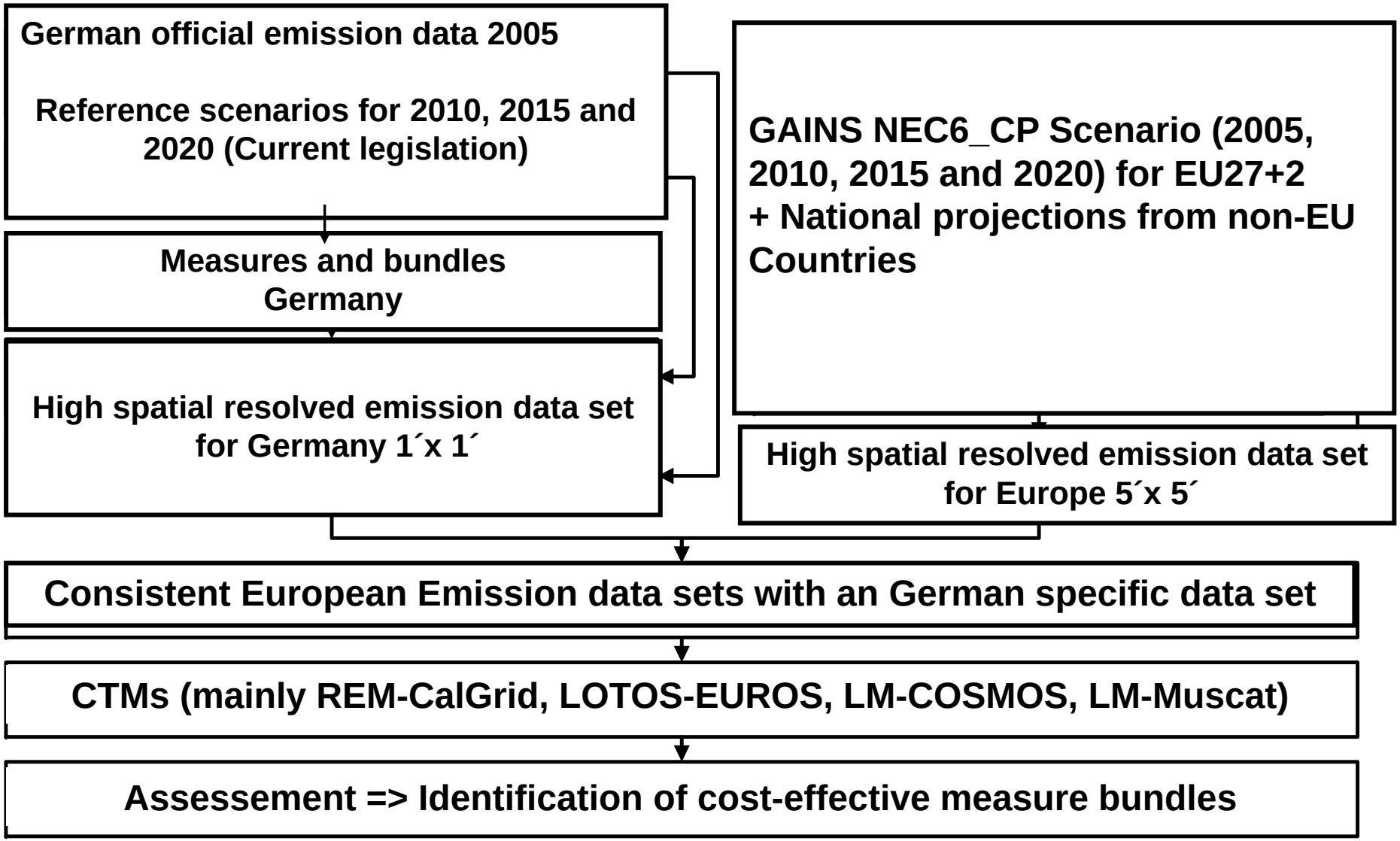
Current situation

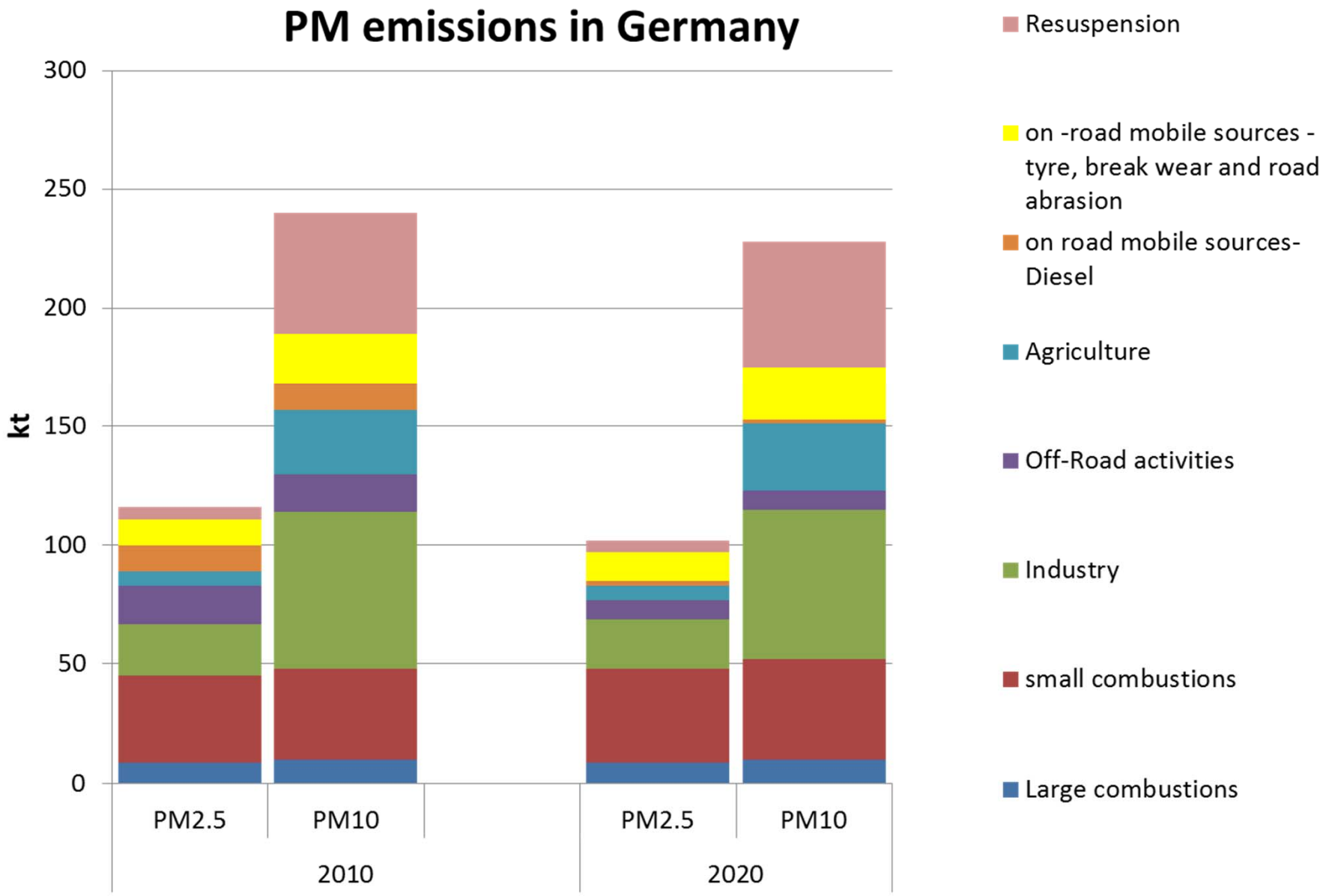
Exceedances of limit values for PM10, PM2.5 and NO_2 in Germany and other EU-Countries

Aims of PAREST

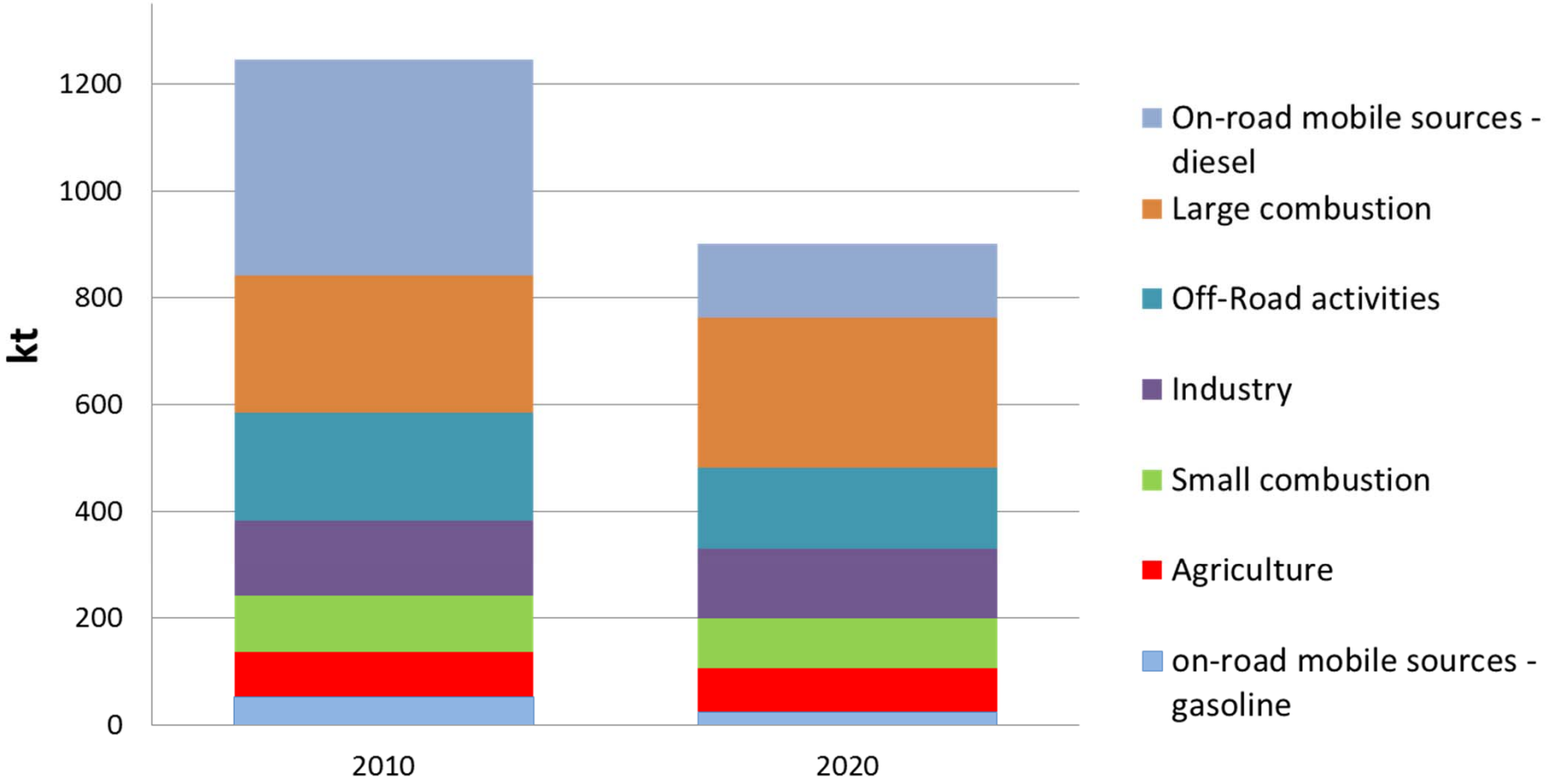
- Analysis of the current situation
- Identification of cost-effective mitigation measures and bundles for PM10, PM2.5 and aerosol precursors (NO_x, SO_2, NH_3 and NMVOC)
- Modelling of implications on concentration of PM10, PM2.5 and NO_2

Assessment Methodology

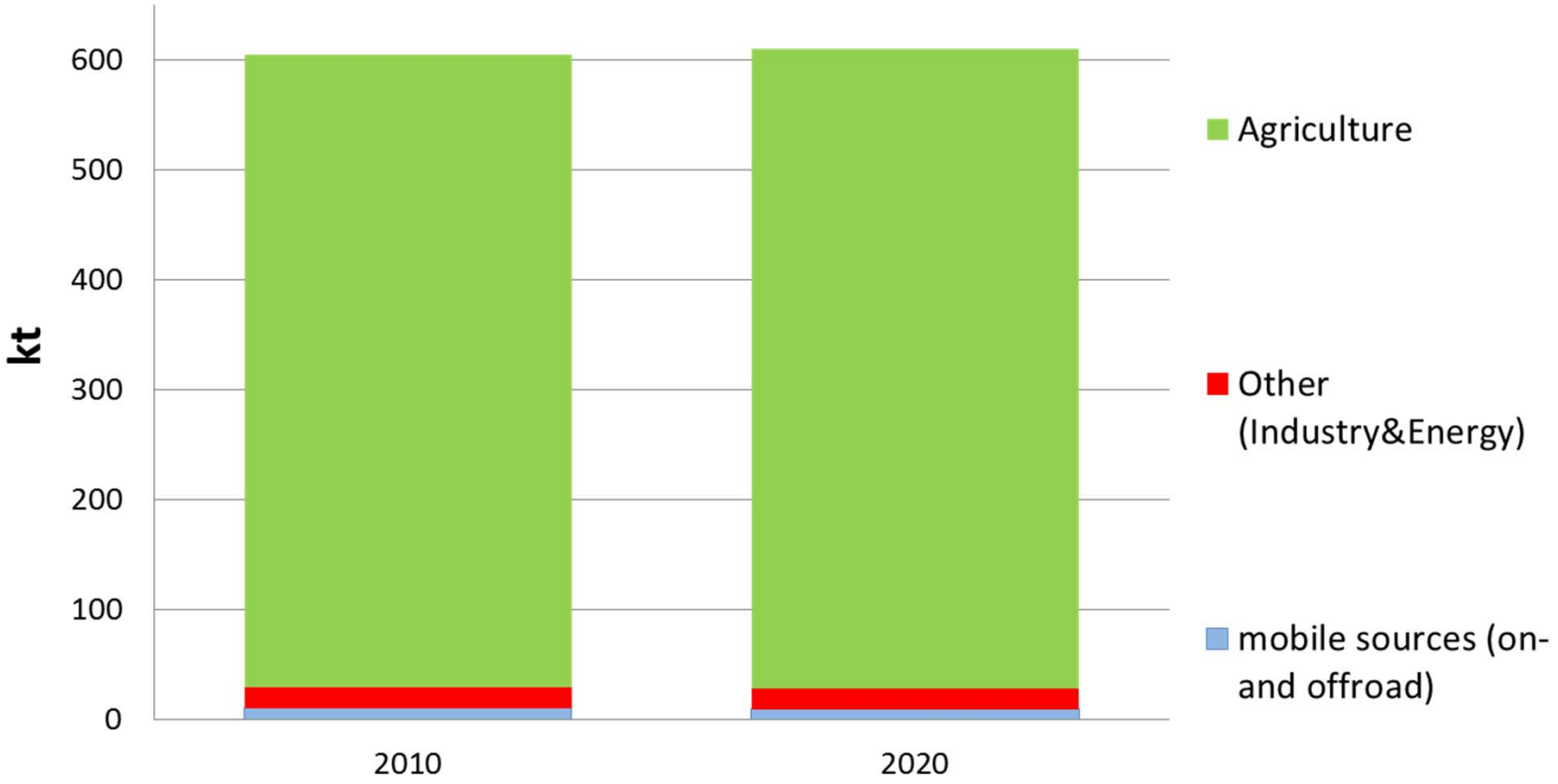



PM emissions in Germany
300
250
200
150
100
50
0
kt
PM2.5
PM10
PM2.5
PM10
2010
2020
Resuspension
on -road mobile sources - tyre, break wear and road abrasion
on road mobile sources- Diesel
Agriculture
Off-Road activities
Industry
small combustions
Large combustions

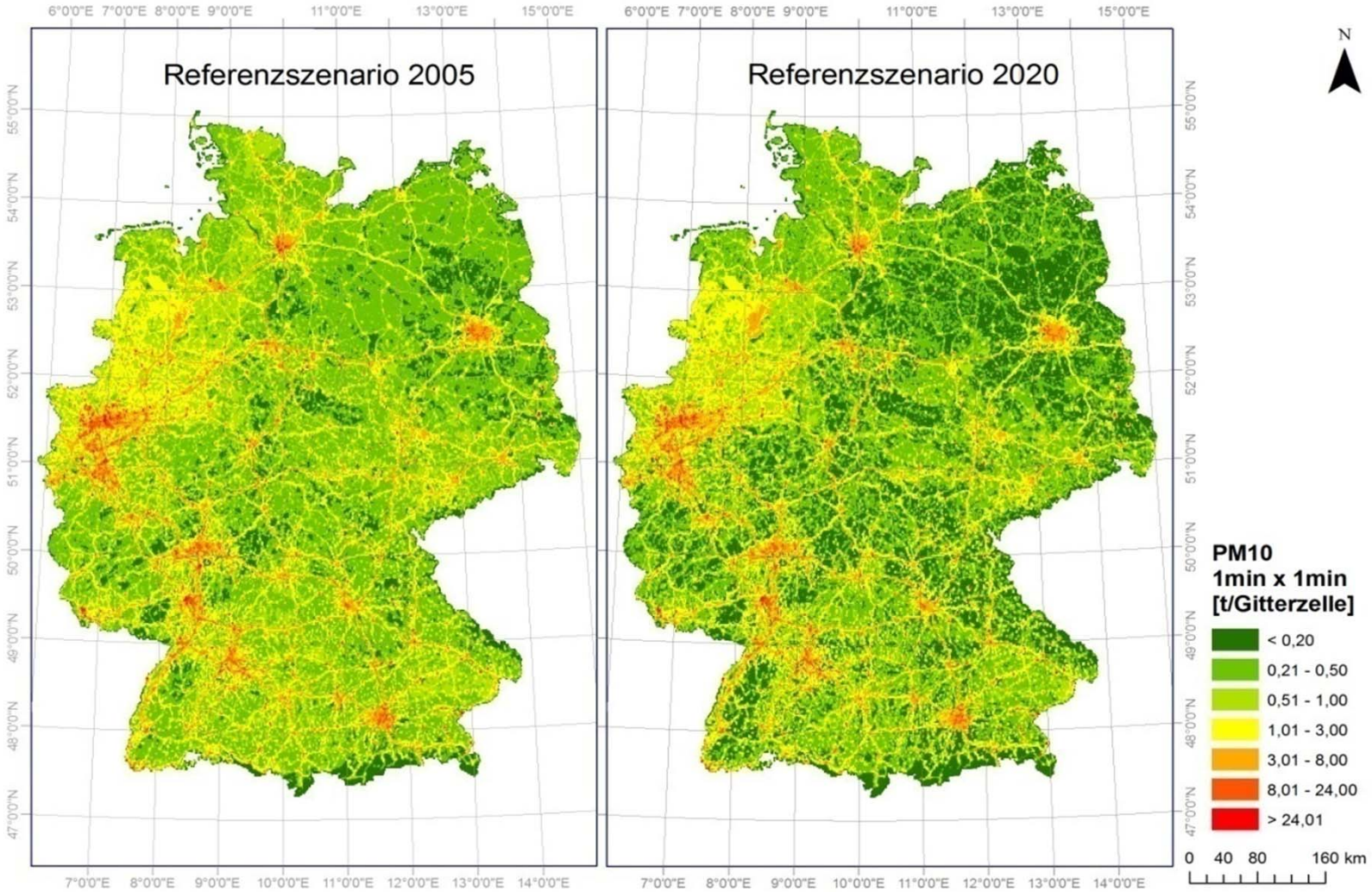
NO_x-Emissions in Germany



NH_3-Emissions in Germany

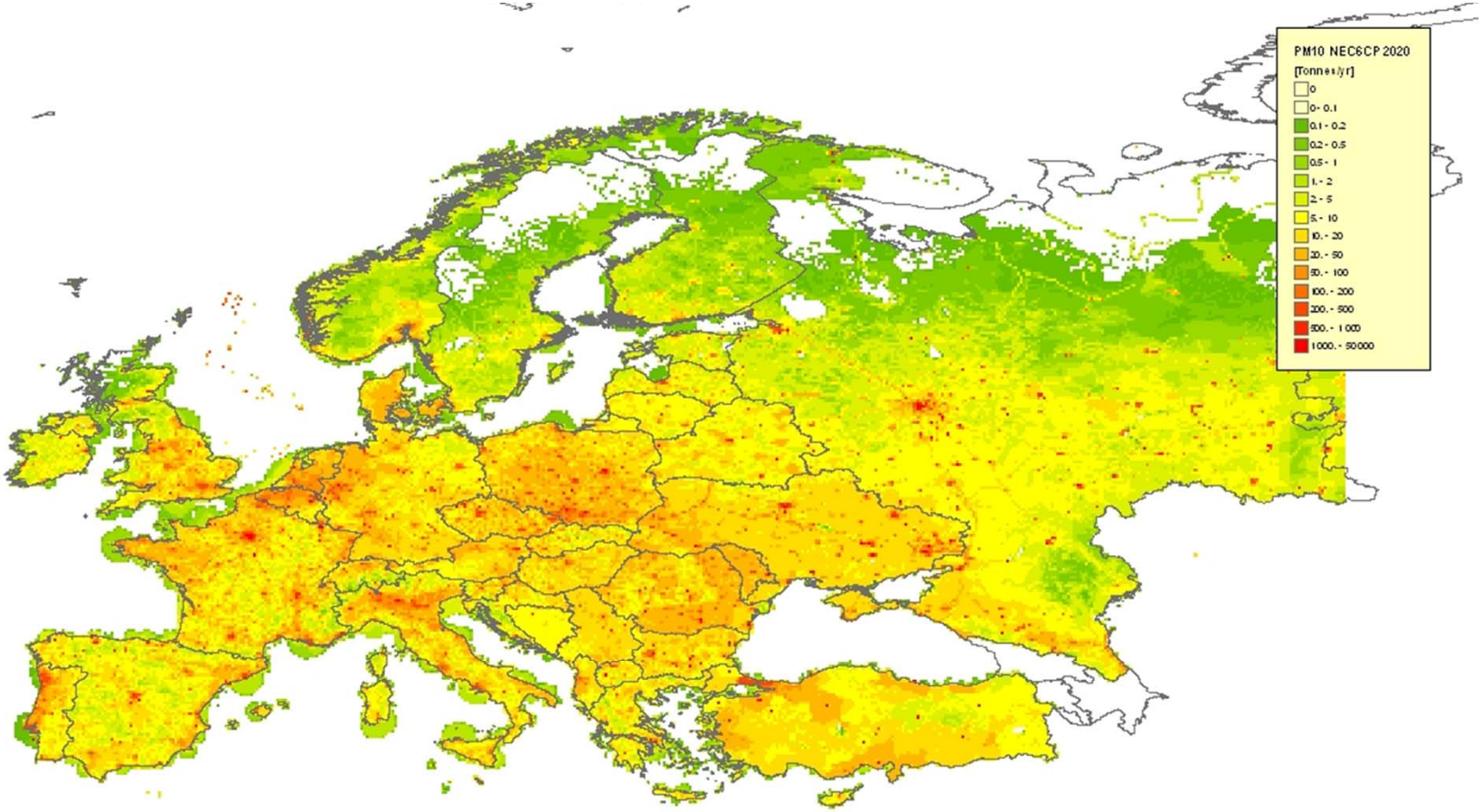


Reported for 2010: 547,8 kt

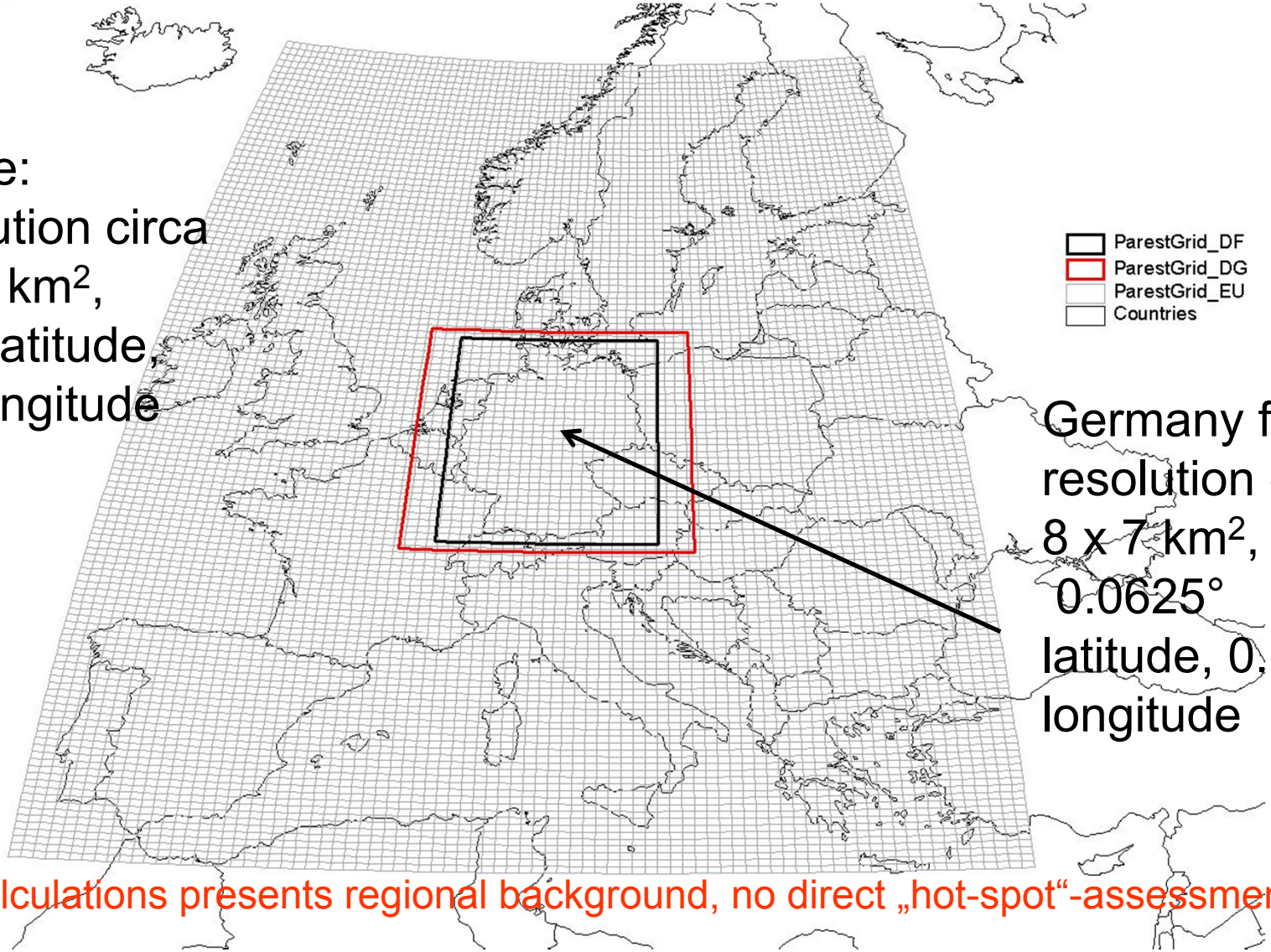


Resolution: 1/60 x1/60 ~ 1min x 1min (WGS84) ~ 1.2 km OWx1,8 km NS

PM10 emission in 2020 according to NEC6 current policy, 1/8 x 1/16 degree lon-lat (7kmx8km) (TNO)



Europe:
Resolution circa
32x28 km², 0.25° latitude, 0.5° longitude

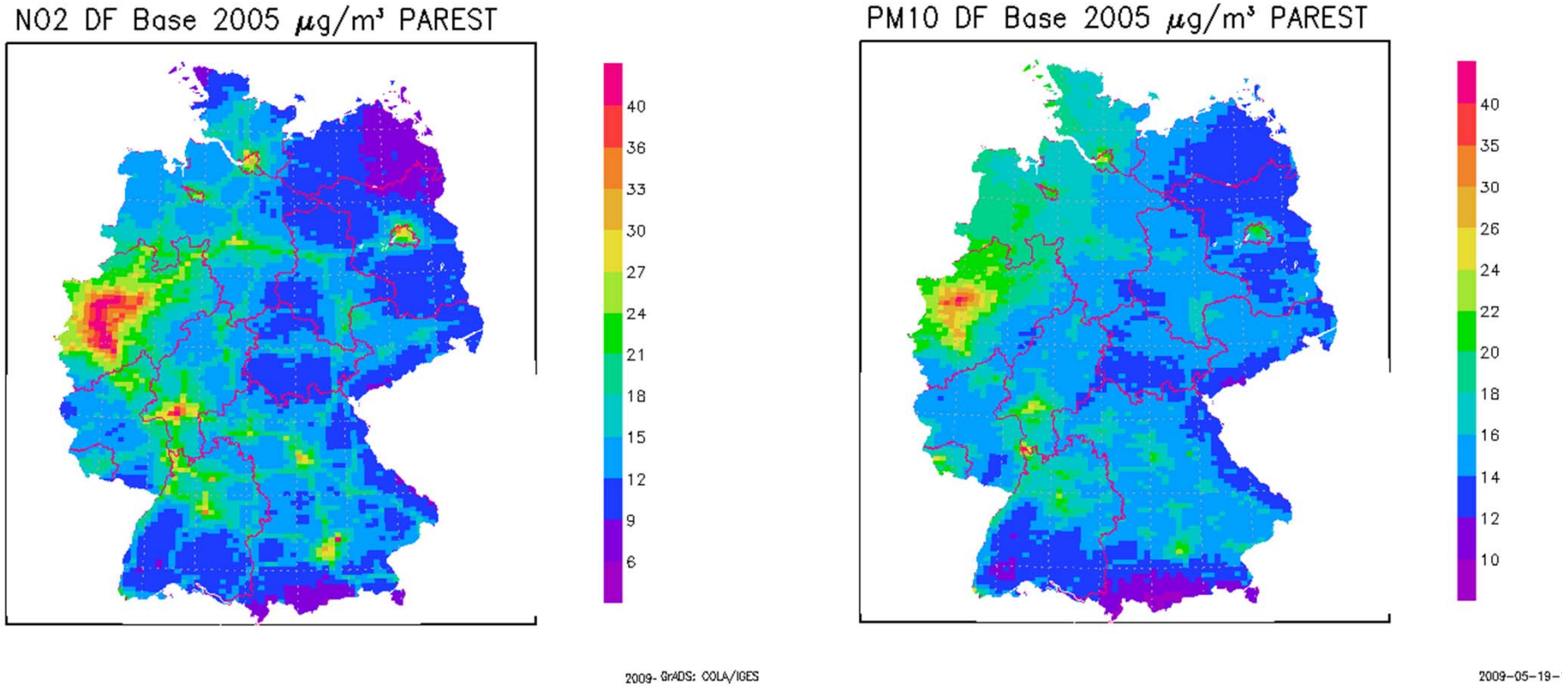


Germany fine:
resolution circa
8 x 7 km², 0.0625° latitude, 0.125° longitude

Calculations presents regional background, no direct „hot-spot“-assessment !

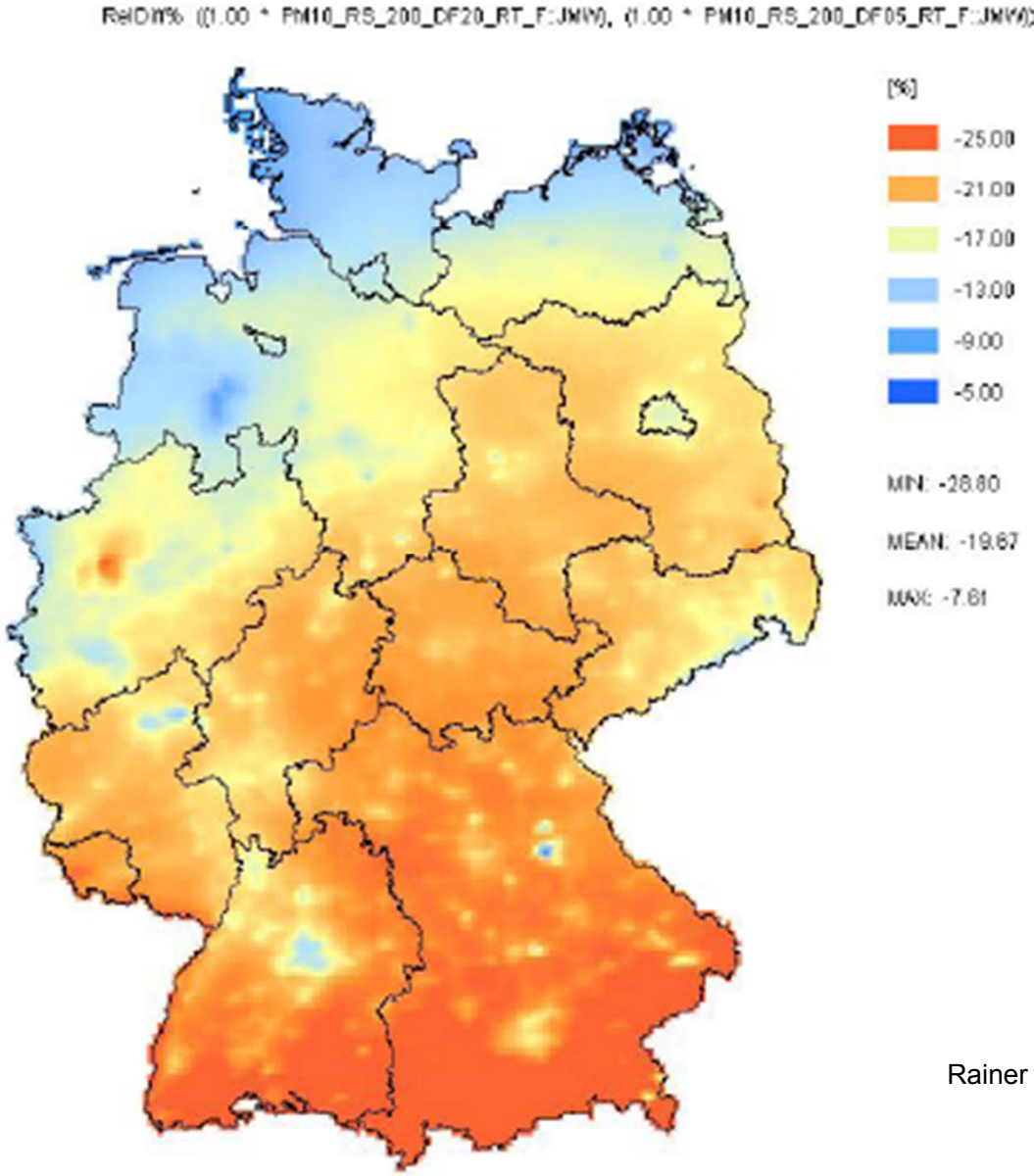
R.Stern, PAREST,

Base calculation 2005, Resolution 8 x 7 km²



Gradient urban-rural for NO2 more distinctive as for PM10 concentrations

Relative Change of PM10 Concentrations2005-2020



Rainer Stern et al., PAREST-Projekt

Mitigation measures

- Compilation of suited measures (mainly based on national research projects funded by German UBA)(=> 72 measures)
- Measures for the following source groups have been developed :
  i. Energy production (LCP and small combustion)
  ii. Production-/Industrial processes
  iii. Solvent and Product use (incl. Fire works and tobacco smoke)
  iv. Mobile Sources (On-road und Off-road)
  v. Agriculture
- Assessment of the impacts from climate change policies to air quality and vice versa
- Uniform description of the mitigation measures

Measures: examples

Small combustion sector:

- Changes in the 1.BImSchV (e.g. reduction of the limit value for PM, changed requirements concerning fuel properties)

Mobile machines:

- Stronger emission limit values
- Cost internalisation of emission impacts for air traffic activites (Kerosine tax and integration in Emission trading schemes) → Climate change policies
- Emission dependent landing fees for air traffic activities

Road traffic:

- Speed limits (e.g. of 120 km/h for Highways)
- Support of use of light run tyres and oils

Measures – Industrial processes

Activity	Measure	Pollutant
Sinter	NO_x < 100 mg/Nm³ (SCR)	NO_x
Cement, Rolled steel	NO_x < 200 mg/Nm³ (SCR)	NO_x
Glass	NO_x < 500 mg/Nm³ (SCR)	NO_x
Sinter	SO_2 < 100 mg/Nm³ (wet desulfurisation)	SO_2
Sulphuric acid production	secondary abatement measures for SO_2 (activated carbon filter, wet scubber, other absorption techniques (only for double contact process!))	SO_2
Sinter, Cement, Glass	PM < 10 mg/Nm³ (fabric filter , improved electric precipitator)	PM10, PM2.5

Emission reduction potential 2020 in kt – maximum feasible reduction (MFR)

Sector	Measure	NO_x	PM10	PM2.5	NH_3	SO_2	NMVOC
Reference emissions (2020) (kt)		904	228	101	609	455	1381
Max. reduction (kt)		126 14%	24 11%	16 16%	102 17%	110 24%	95 7%
Small combustion (kt)	3	12,3	9,9	9,2			
Large combustion (kt)	8	37,0	3,5	3,1		88,3	
Industry (kt)	10	30,1	4,8	2,1	1,1	21,6	
On-road (kt)	12	22,0	2,7	0,7	0,2	0,07	7,0
Off-road (kt)	10	24,2	0,5	0,5	0,2	0,4	15,4
Solvent use (kt)	6						72,7
Agriculture (kt)	13		2,9	0,4	100		

Population density in Germany inhabitants/Km² (taking exposure into account)

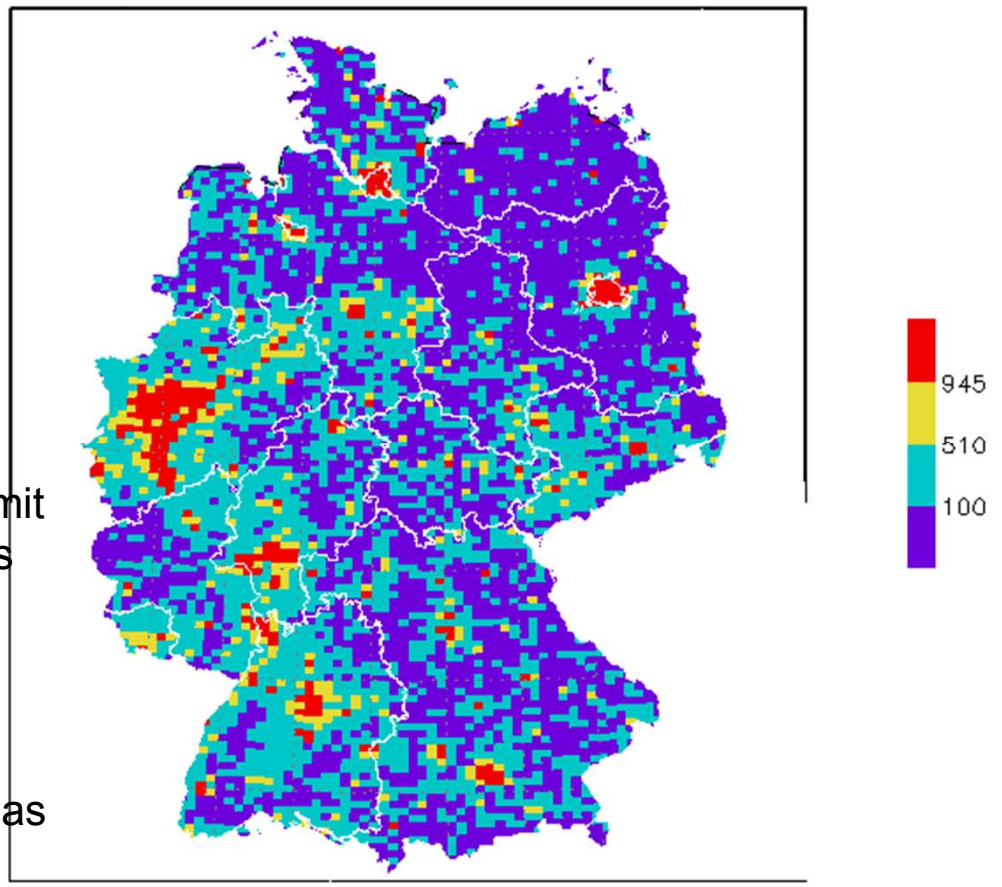
Population density in 4 classes in Nest 2

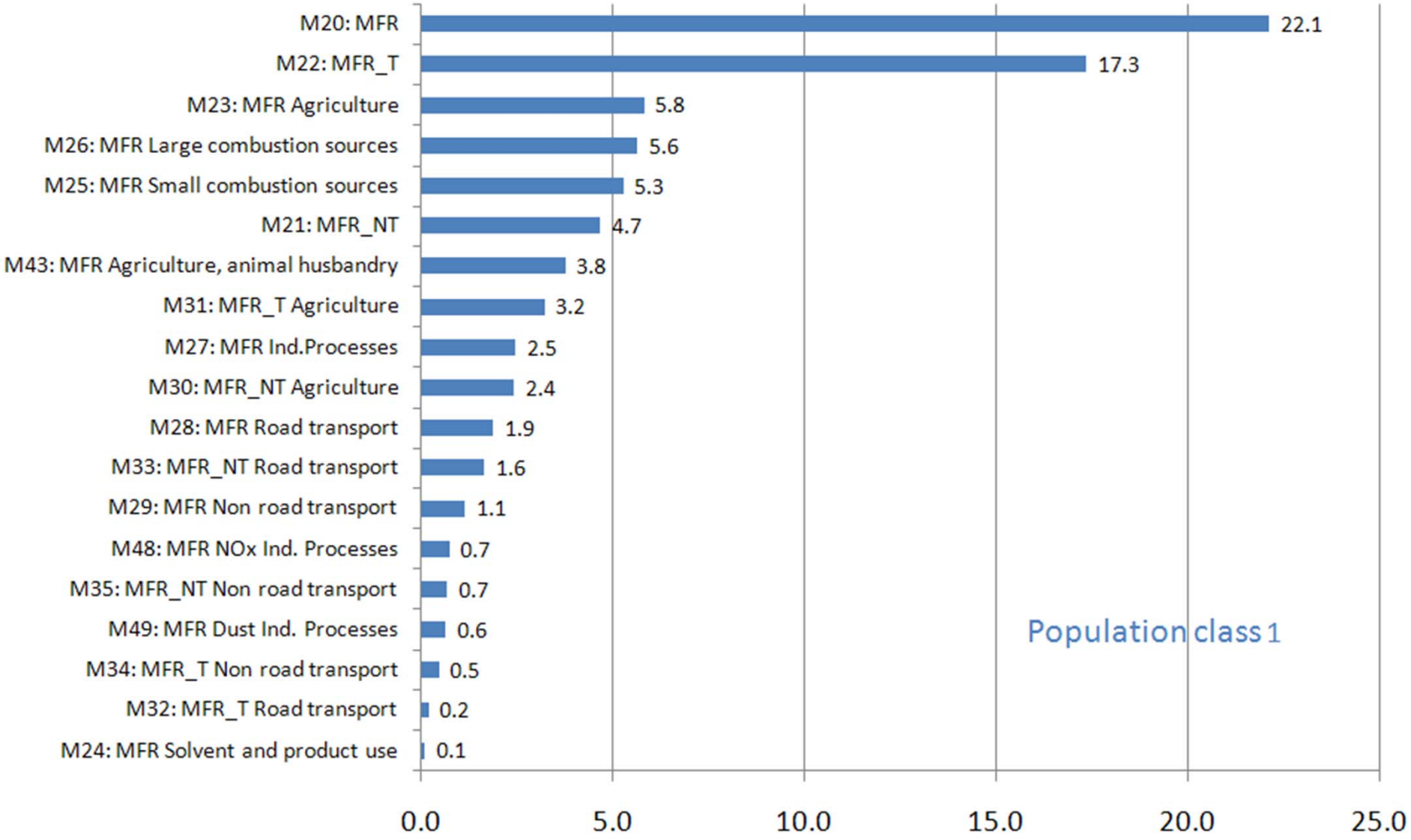
Class 1: rural area, low density
population density < 100 inhabitants/km2

Class 2: top class threshold define the 50%-threshold of population
population density > 100, < 510 inhabitants/km2

Class 3: top class threshold define the lower limit of population density in metropolitan areas
population density > 510, <945 inhabitants/km2

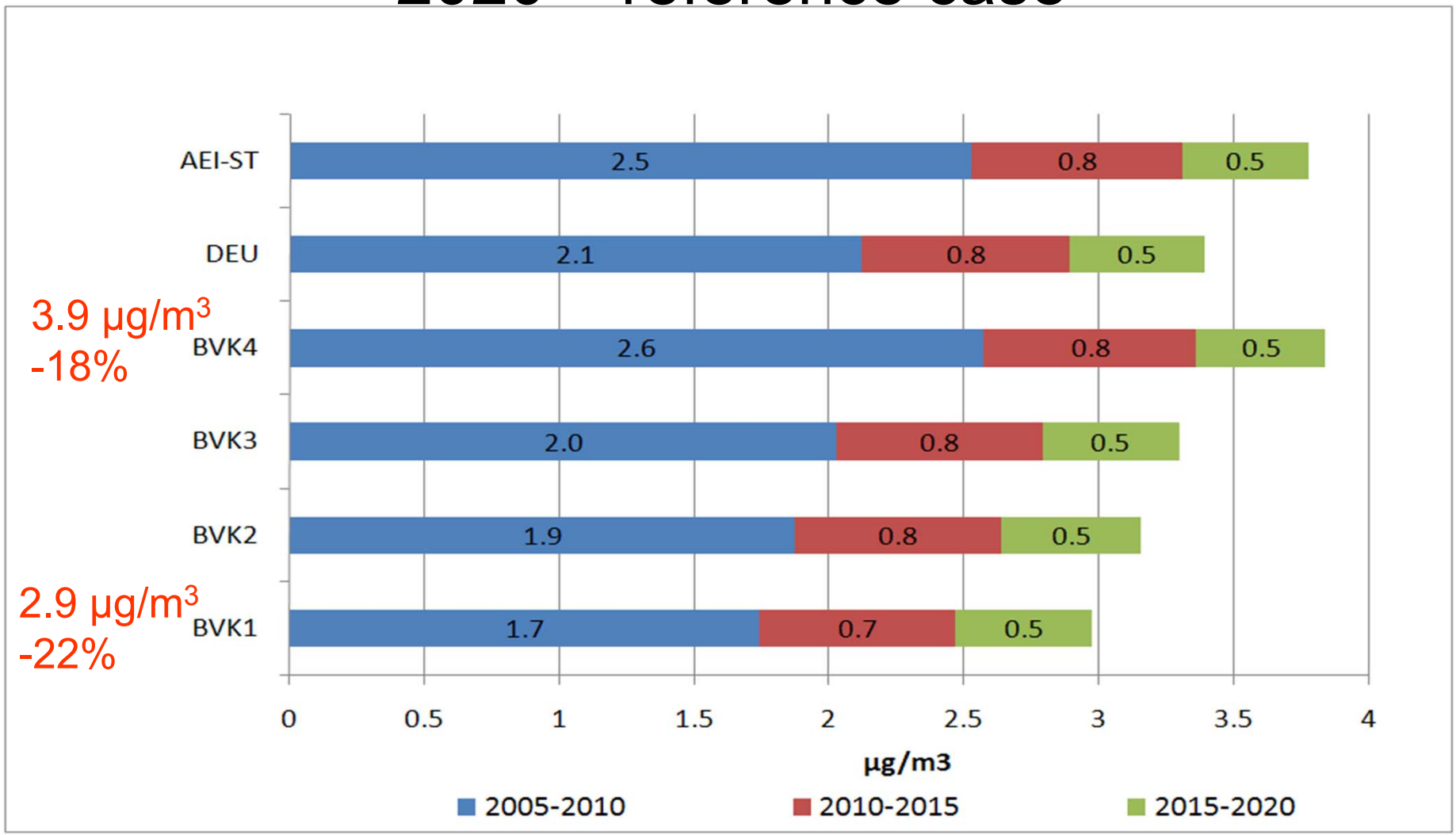
Class 4: Population density in metropolitan areas
population density > 945 inhabitants/km2





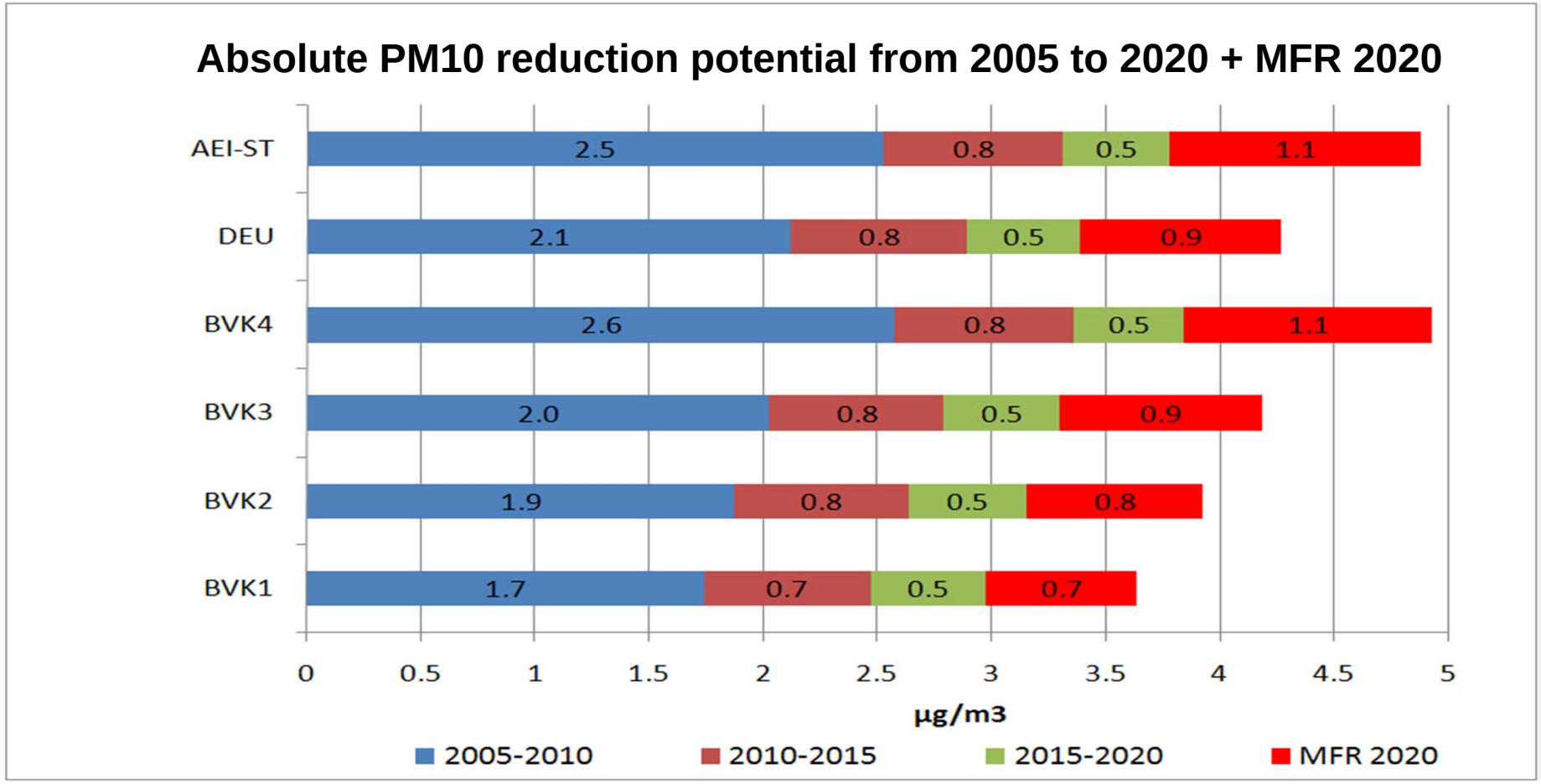
Changes of PM10 concentrations (annual average) in relation to CLE [%] (2020)

Reduction of PM10-Concentrations from 2005 to 2020 – reference case



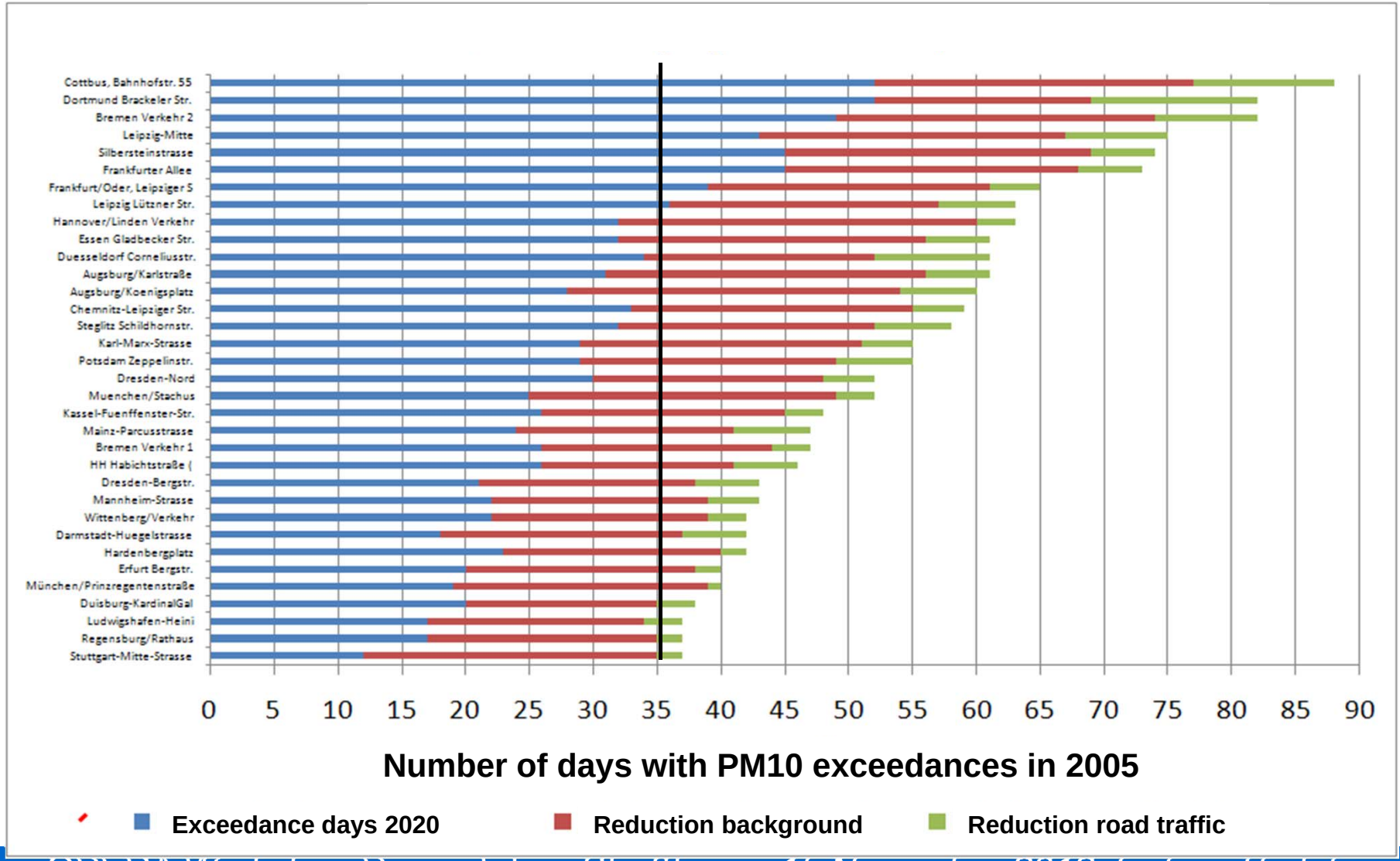
Quelle R.Stern et al, PAREST

Reduction of PM10-Concentrations 2005 -2020 maximum feasible reduction scenario



R.Stern, PAREST, 3. Nov. 2009

Days of exceedance of 50 µg/m³ for different stations in Germany 2005 and 2020, meteorology 2005



Range	Measure bundle	Cost effectivity 10^6 € /(ng/m^3) for PM10	Reduction (Germany) [ng/m^3]	
			PM10	PM2.5
1	scenario_tempolimit	-43.9	20	10
2	MFR_Scenario_V_NT	-15.0	80	40
3	MFR_Scenario_V	-11.2	90	50
4	MFR_Scenario_NT	-5.6	180	140
5	Reduction of meat consumption	0	340	220
6	MFR_Scenario_MM_NT	0	30	30
7	Cost internalisation in aviation (Cerosine tax and ETS	0	20	20

Hypothetical life-style scenario's:

- Replacing residential woodburning by oil burning in the CLE reference scenario, a reduction of 63 % in rural, and 87 % in urban areas (PM10).

- Reduced meat-consumption (50 - 60 gr meat per person per day), relative to CLE, a reduction of 42 % in rural, and 36 % in urban areas (PM10)

The contribution of NH3 is strongly non-linear.

NH3-reduction, in %	PM reduction per NH3-unit
5	1.0
25	1.12
50	1.34
75	1.72
100	2.75

=> „Small“ ammonia reductions are very effective

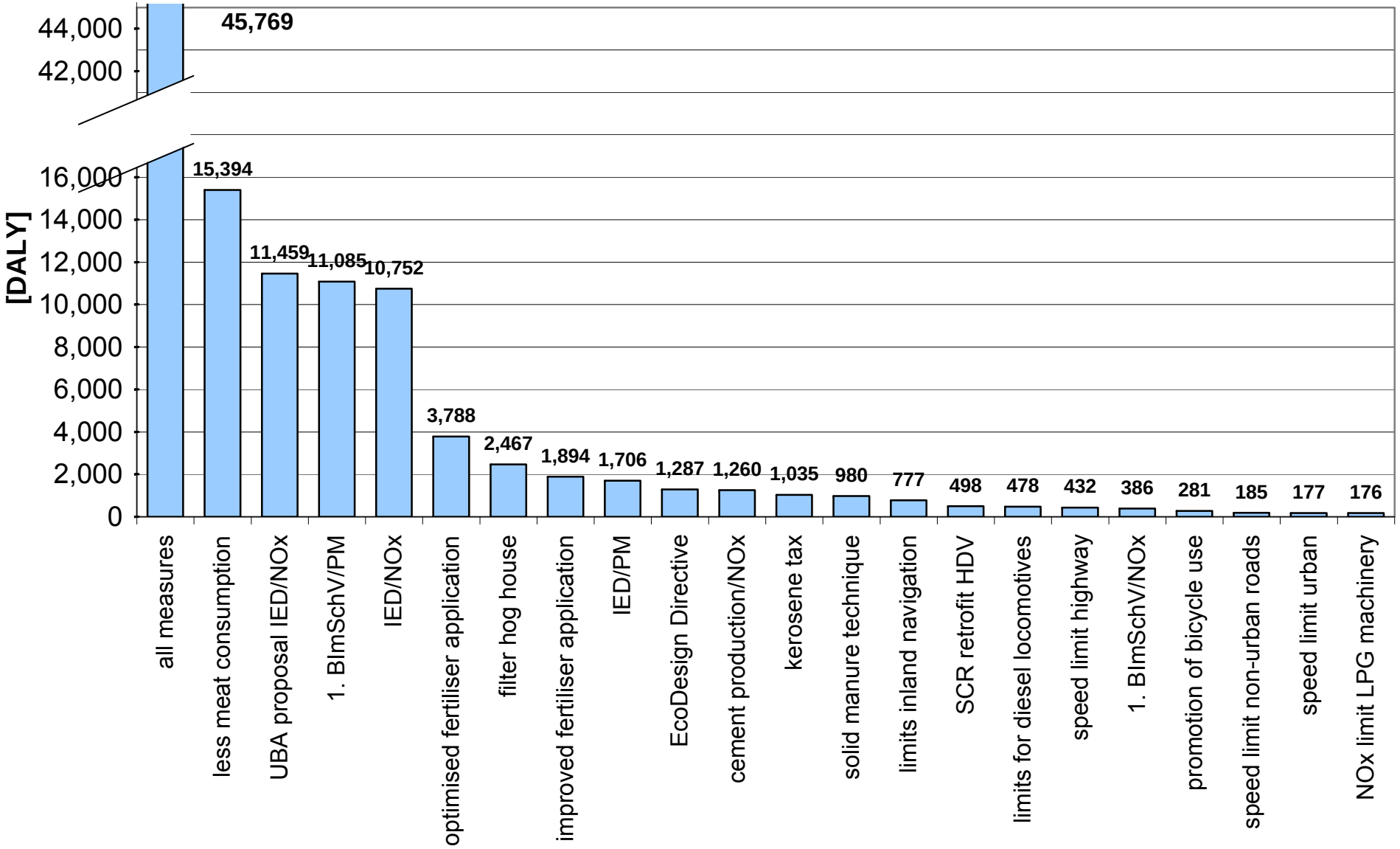
Cost benefit analysis

Use of the ExternE methodology and the integrated assessment model ECOSENSE.

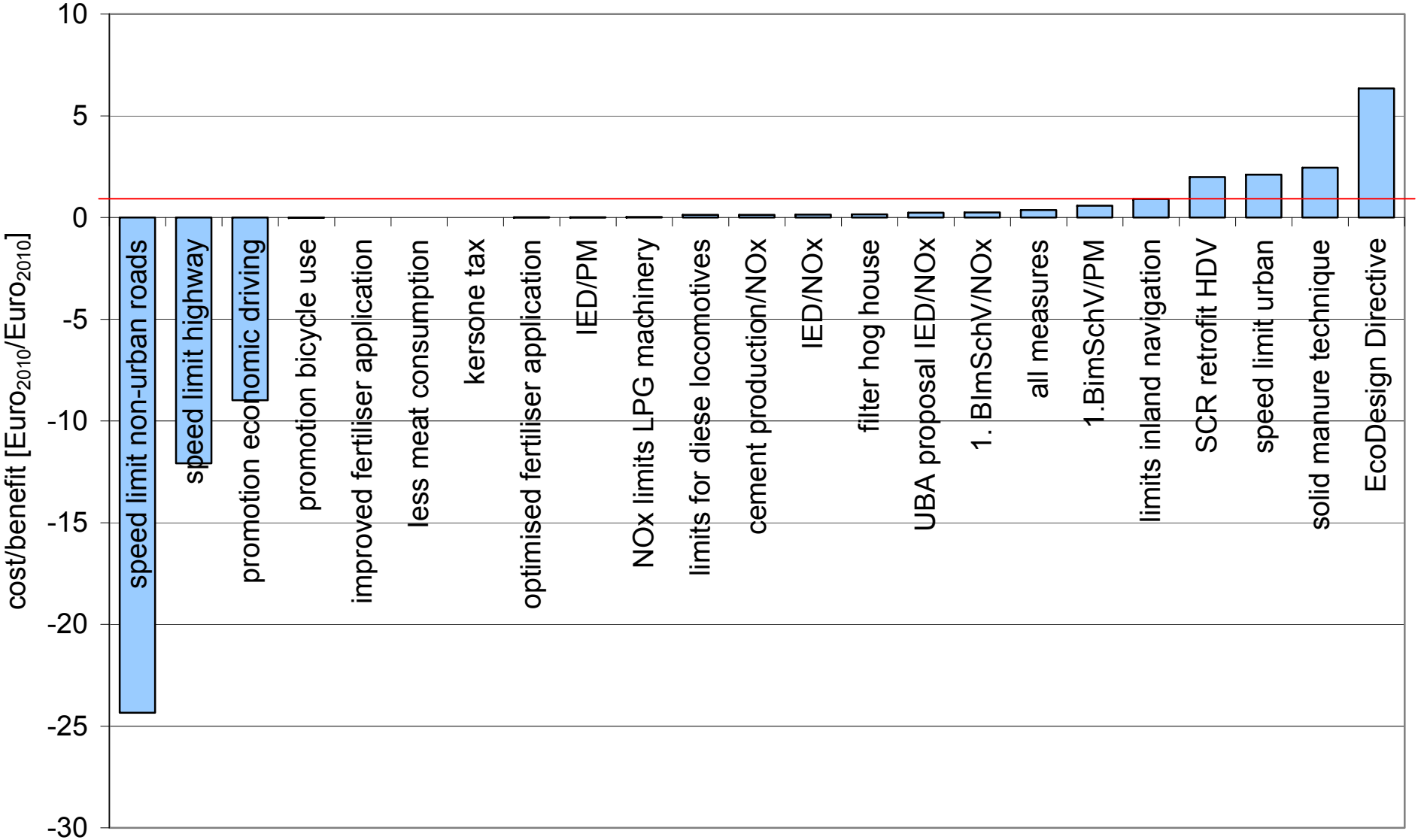
- **Includes: estimation of health impacts (health endpoints including YOLL (Years of Life Lost) and DALYs (Disability adjusted life years)**
- **Estimation of crop yield losses and material damage (e.g. soiling)**
- **Estimation of damage to ecosystems due to acidification, eutrophication (in pdfs (Potentially Disappeared Fraction)**
- **Monetising all effects using contingent valuation (willingness to pay)**

However: impacts on climate due to GHG emission changes not included, although they should be taken into account!!

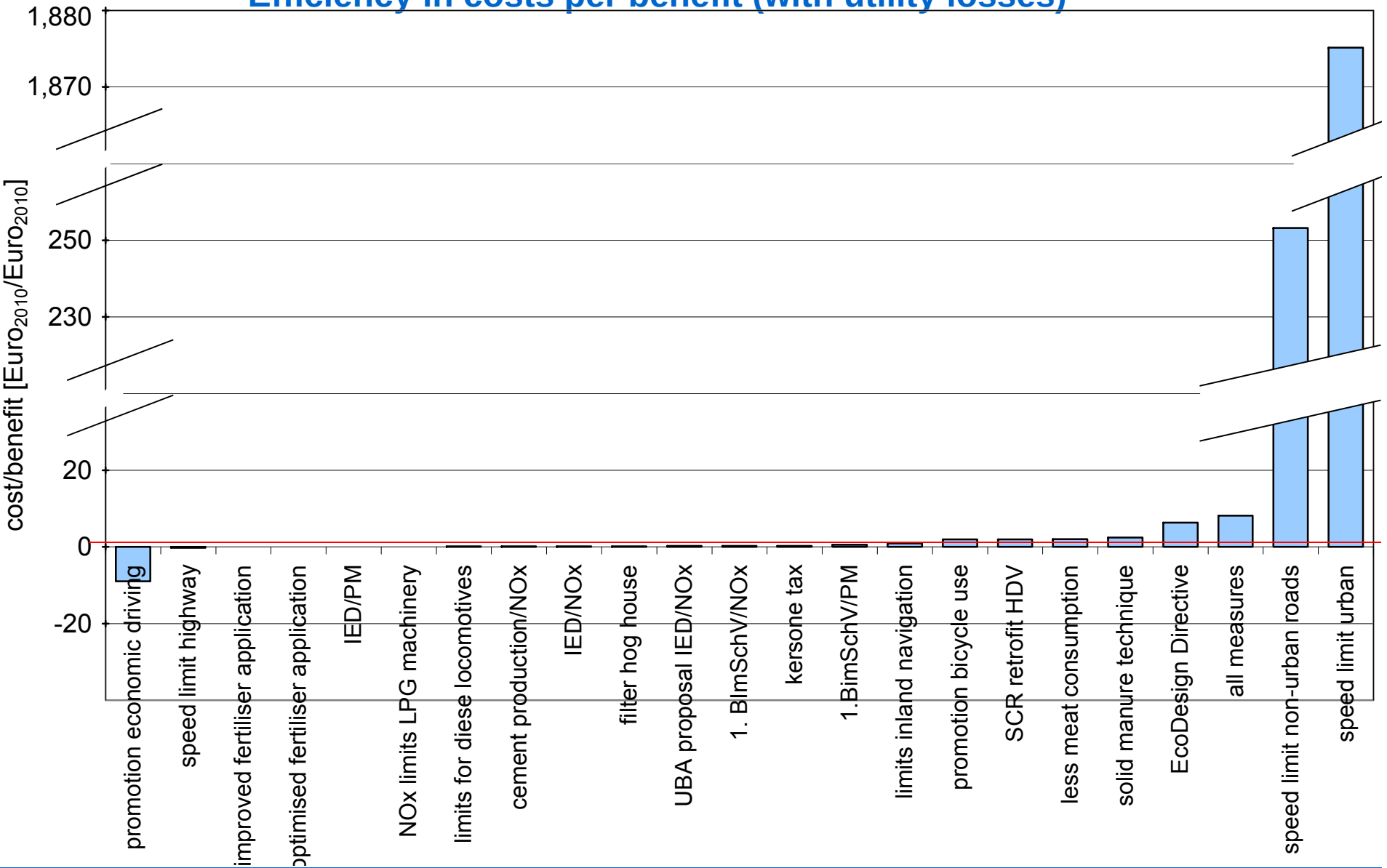
Reduction potentials



Efficiency in costs per benefit (no utility losses)



Efficiency in costs per benefit (with utility losses)



Conclusions

- **An integrated approach on national level has been developed to assess reduction strategies for PM and NO_2 for Germany.**
- **Under MFR in 2020, the limit values of PM 10, and most likely also PM 2.5 will still be exceeded. Only if MFR combined with additional climate change reduction measures the limit values might be reached.**
- **The assessment of policies and measures crucially depend on assumptions about the toxicity of PM ingredients or other measures like number (PN)**
- **Effective and efficient additional measures for Germany would be:**
  - **Promotion of economic driving (small effect), speed limit on motorways (small)**
  - **Improved application and amount of fertilizer and manure (large), filter in hog houses (large),**
  - **Less animal protein consumption on voluntary basis (very large)**
  - **Offroad: diesel locomotives (small) , gasoline/LPG mobile machinery (small), kerosine tax (medium), inland navigation (small)**
  - **Emission reduction industrial processes (cement, glas, sinter) (large)**
  - **Further PM reduction large coal combustion (10 mg/m³) (medium)**

Thank you for your attention!

Further questions to:

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&

http://www.umweltbundesamt.de/uba-info-medien/4268.html

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