PM Matters - What More Do We Need to Know?

Air Pollution and Regulatory Challenges Ahead in the EU: Research That Can Make a Difference

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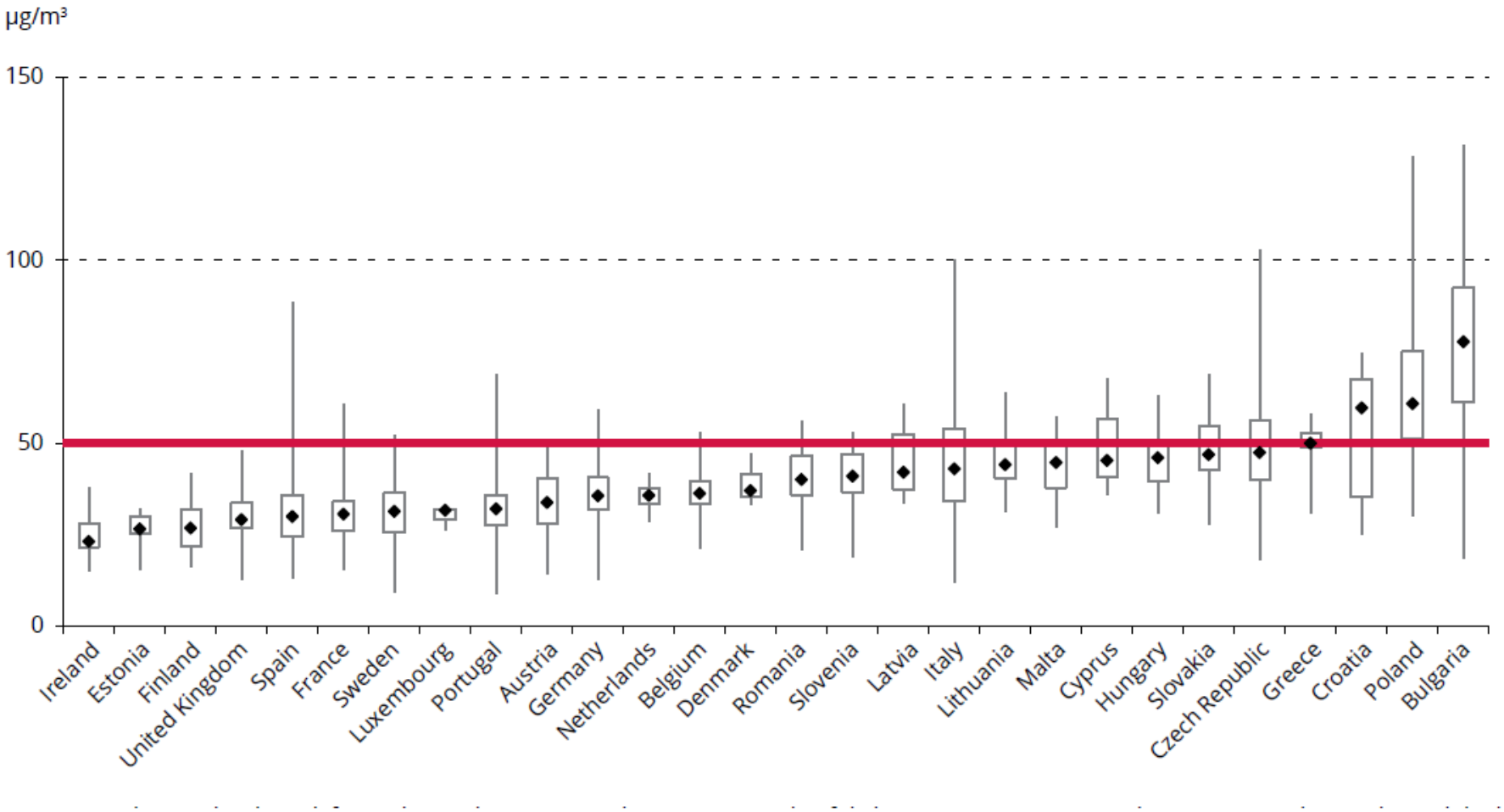
KING'S College LONDON

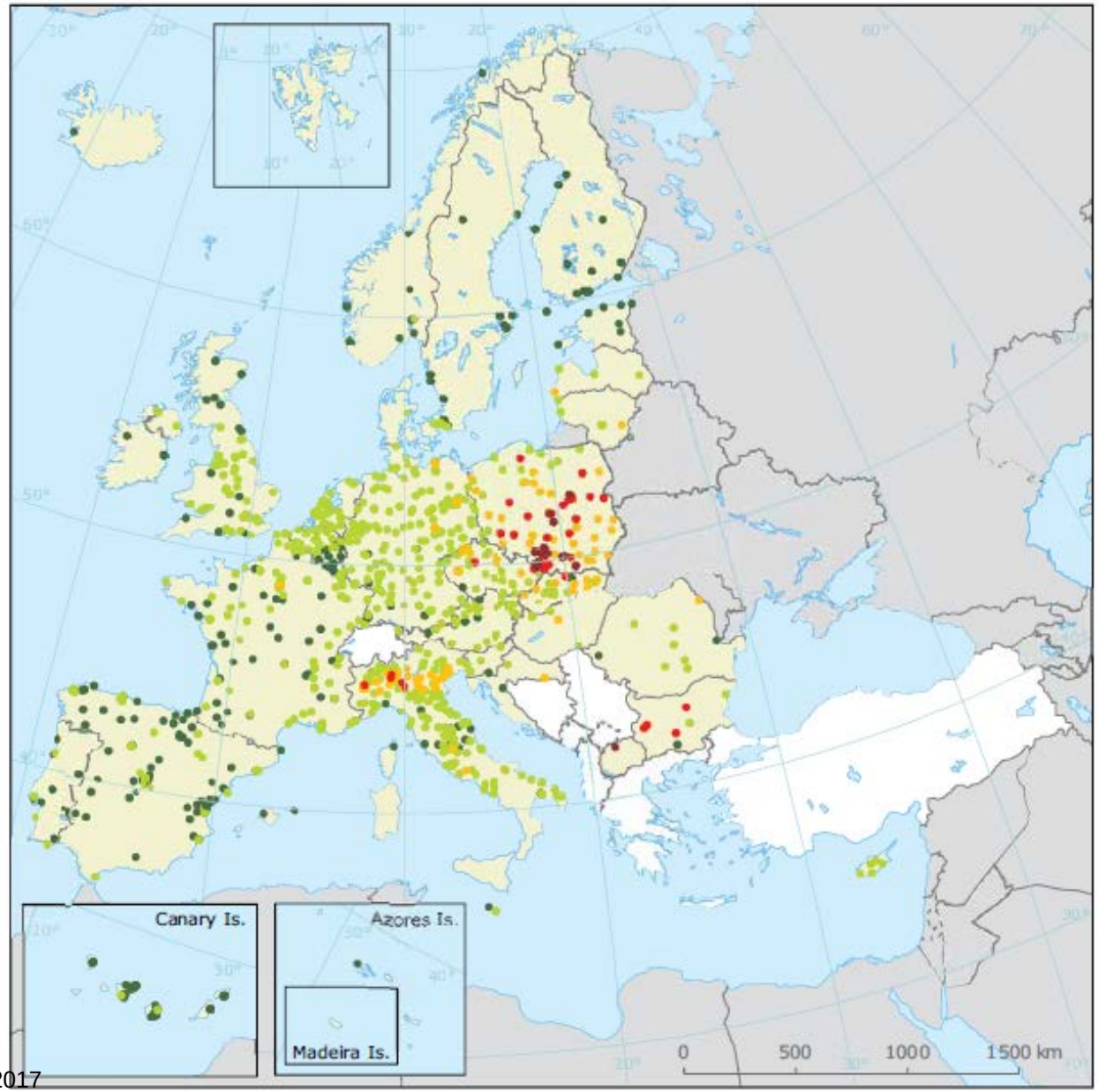
PM_{10} concentrations in relation to the daily limit value in 2014 in the EU-28

The 36th highest daily mean (EU Limit Value = 50 µg/m³, EU Directive 2008)



European Economic Association (EEA) 2016

Annual mean $PM_{2.5}$ concentrations, 2014



Annual mean $PM_{2.5}$ concentrations in 2014

µg/m³

- ≤ 10
- 10–20
- 20–25
- 25–30
- > 30

No data

Countries/regions not included in the data exchange process

$PM_{2.5}$ annual mean Limit Value = 25 µg/m³

WHO AQG =10 µg/m³

AQG = Air Quality Guideline

EEA 2016

Trends in $PM_{2.5}$ annual mean concentrations by station type, EU, 2006-2014

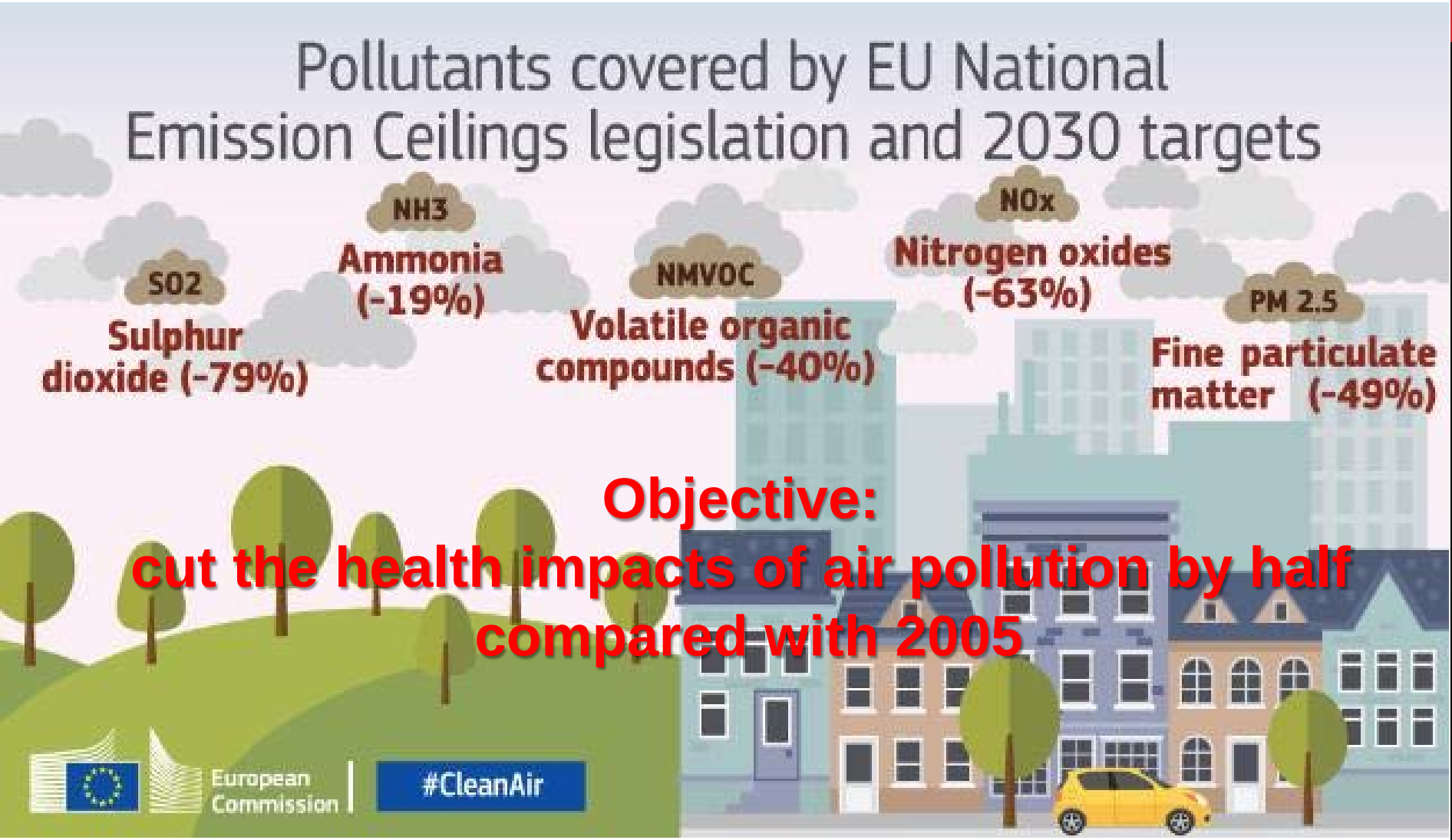
µm/m³ per year

EEA 2016

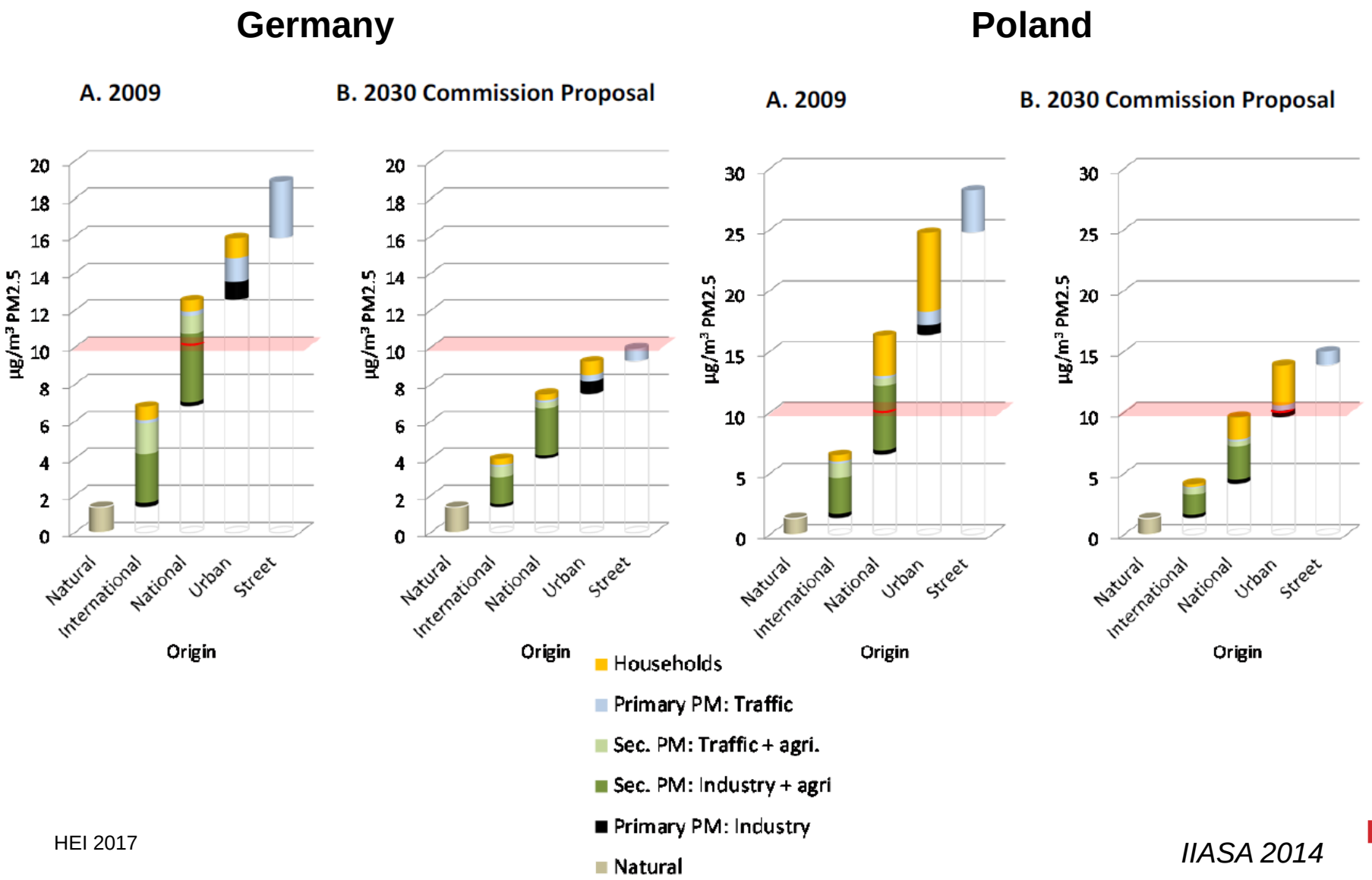
Clean Air Policy Package for Europe

- **Review of the Clean Air for Europe policy from 2005 conducted in 2011-2014**
- **Update on health effects (WHO, 2012-2013)**
  - Review of evidence on health aspects of air pollution – REVIHAAP
  - Health risks of air pollution in Europe – HRAPIE
- **Cost-benefit analysis** (Holland 2014, IIASA 2013)
- **Policy discussion setting objectives for 2025-2030**

National Emission Ceiling Directive 2016/2284/EU



Source contributions to ambient $PM_{2.5}$ at urban traffic stations in Germany and Poland, in the base year 2009 and for 2030 assuming adoption of the Clean Air Policy Package



IIASA 2014

Strength of evidence on health effects of $PM_{2.5}$, NO_2 and O_3

Systematic reviews:

for PM: US EPA 2009
for NO_2: US EPA 2016 / Health Canada 2016
for O_3: US EPA 2013

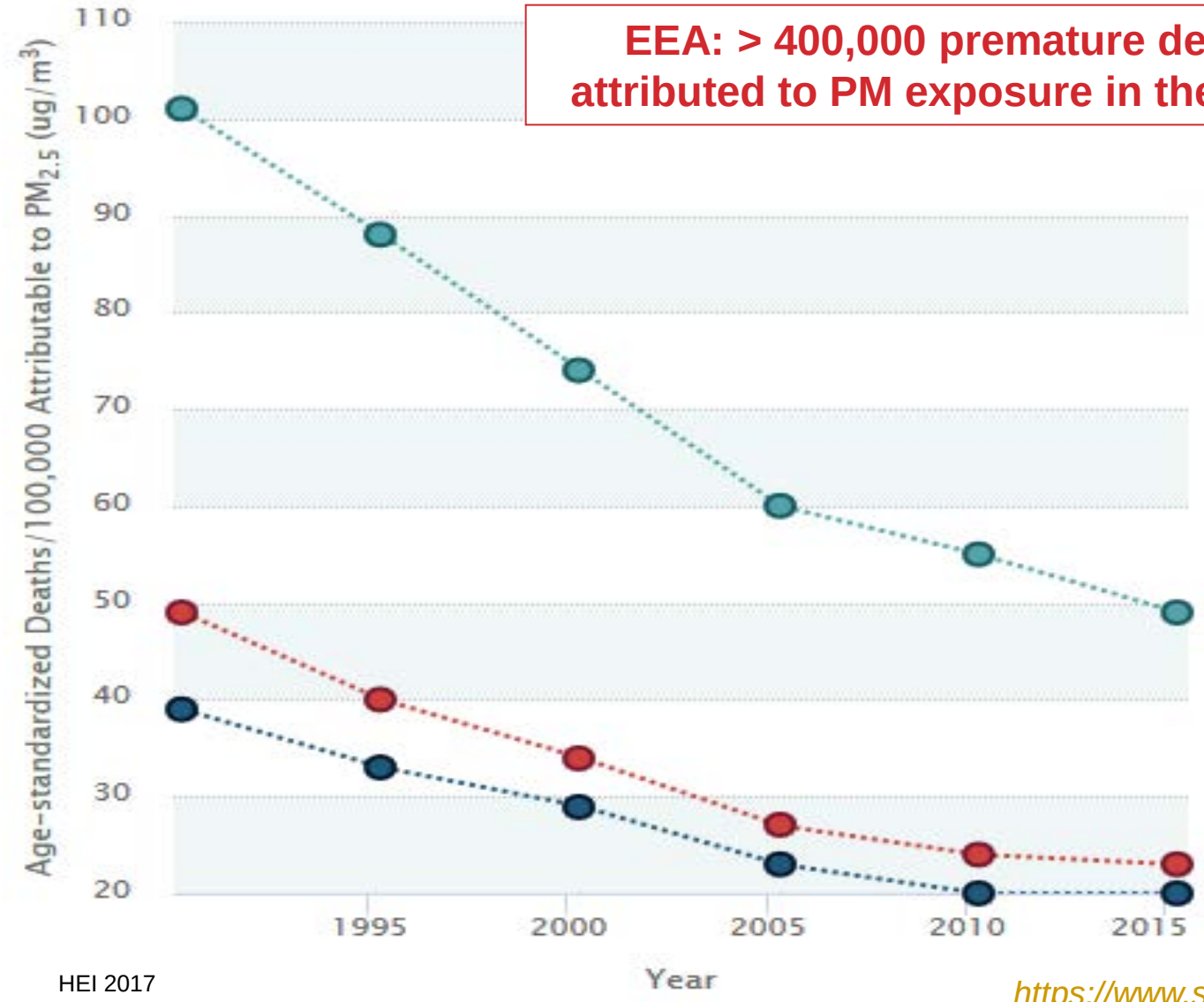
C – causal
L – likely causal
S – suggestive for causal

Outcome	$PM_{2.5}$		NO_2		O_3	
	Long	Short	Long	Short	Long	Short
Total mortality	C / C	C / C	S / S	S / L	S / S	L / L
CV[1] mortality	C / C	C / C				- / L
Respiratory mortality	C / -	C / C				- / L
Lung cancer	- / L / C[2]					
Respiratory effects	L / L	L / C	L / L	C / C	L / S	C / C
CV[1] effects		C / C				L / S

[1] CV = cardiovascular; [2] IARC 2013 (Group 1)

Age-standardized death rates / 100,000 pop. attributable to $PM_{2.5}$ in Europe

EEA: > 400,000 premature deaths / year attributed to PM exposure in the EU28 (2013)



Central Europe

Germany
Western Europe

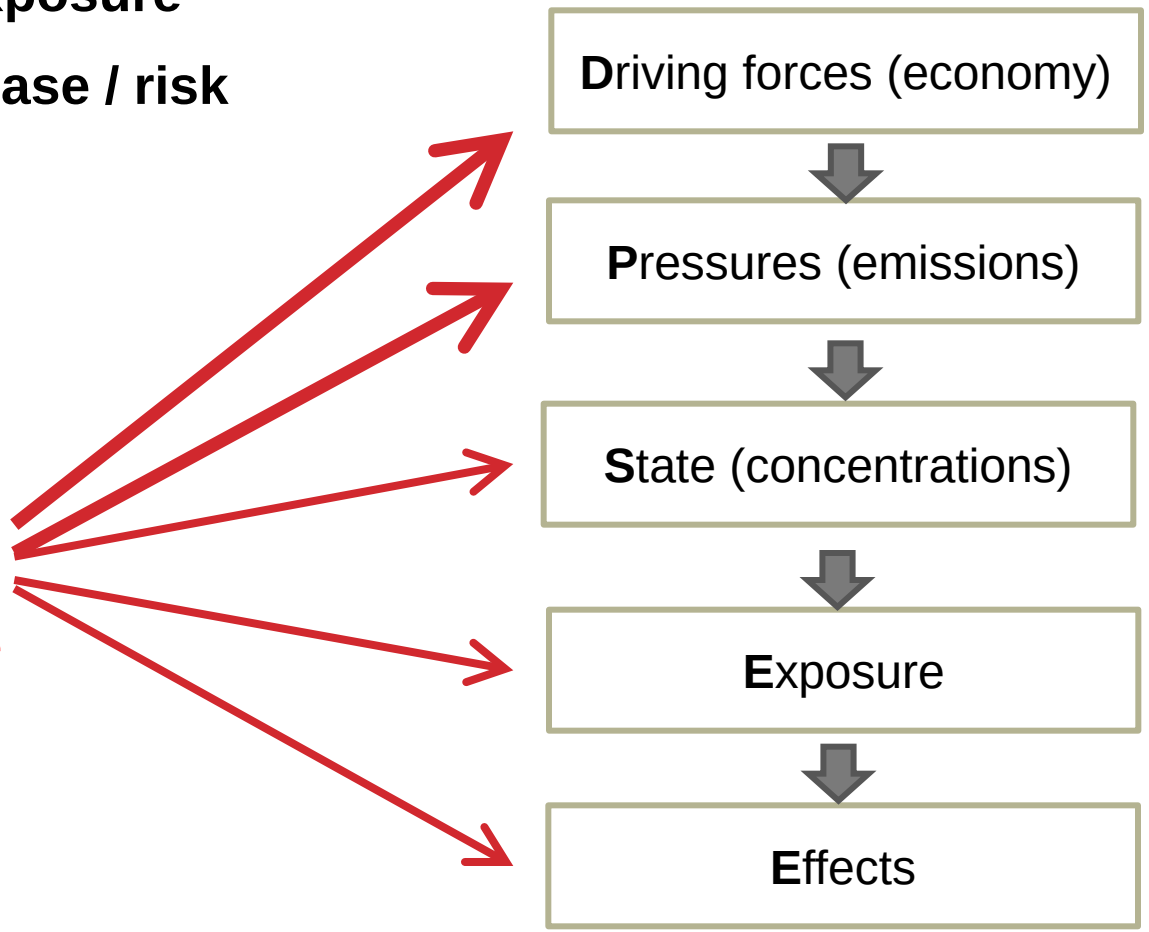
HEI 2017

https://www.stateofglobalair.org/data

Health-based reasons to reduce the health risk of air pollution in EU

- ✓ **Causality of exposure**
- ✓ **Burden of disease / risk assessment**

ACT NOW!!!
The evidence is sufficient!



Knowledge

Action

Demand for local evidence on health effects of air pollution

Arguments for local studies:

- **Local exposure or health conditions differ from that in other settings;**
- **Need to convince local authorities and the public about the scale of air pollution problem with local data.**

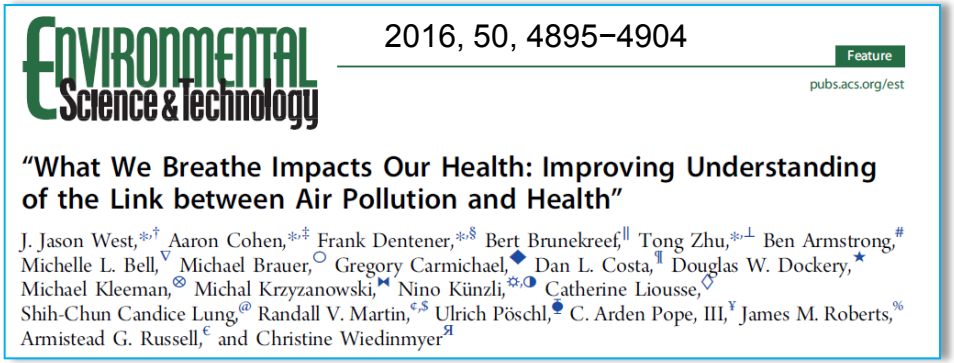
Arguments against:

- **Insufficient power / quality of local study;**
- **Time, costs, expertise…**
- **Delay in coping with the problem.**

Research to improve exposure – response functions

- **Further studies in Europe and N. America:** increase precision of health risk assessment (HRA), especially in low exposure levels;
- **Studies in low/medium income regions:**
  - increase confidence in HRA results in medium – high exposures;
  - confirm applicability of exposure response function in local conditions;
- Identification of the **role of PM components and sources** (e.g. coal combustion, traffic, desert dust) – focus on the most effective strategy to cope with pollution;
- Studies examining **effects of multiple pollutants**: enable consideration of possible confounding or synergistic effects of various pollutants.

Multi-disciplinary collaboration!



Studies on "novel" health outcomes affected by air pollution

- **Emerging fields: child development, cognitive effects, …;**
- **Identify (new) susceptible / vulnerable groups;**
- **Complete burden of disease assessment (years lived with disability, productivity / wellbeing);**
- **Provide additional arguments for coping with pollution.**

www.thelancet.com **January 4, 2017**

Living near major roads and the incidence of dementia, Parkinson's disease, and multiple sclerosis: a population-based cohort study

Hong Chen, Jeffrey C Kwong, Ray Copes, Karen Tu, Paul J Villeneuve, Aaron van Donkelaar, Perry Hystad, Randall V Martin, Brian J Murray, Barry Jessiman, Andrew S Wilton, Alexander Kopp, Richard T Burnett

Review article

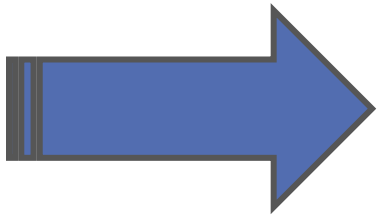
Environ Res 2016

Exposure to air pollution and cognitive functioning across the life course – A systematic literature review

Angela Clifford [a], Linda Lang [a,b], Ruoling Chen [a,b,*], Kaarin J. Anstey [c], Anthony Seaton [d]

Studies to explain biological mechanisms of effects

- **Epidemiologic studies of early indications of disease conditions, e.g.**
  - Cardiovascular indicators;
  - Epigenetics?
  - Changes in brain?
  - …
- **Epi studies of vulnerable groups (cardiovascular disease, COPD patients, diabetics);**
- **Clinical controlled exposure studies;**
- **Exposome (including metabolic factors, hormones, oxidative stress, …)?**



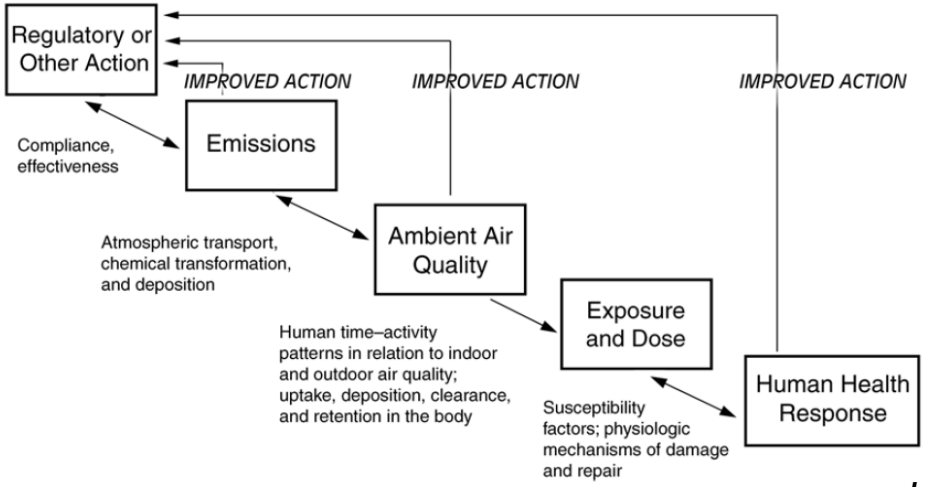
Understanding of disease causation;

Improvement of disease prevention.

Accountability research

- **Monitoring of effects of intervention (changes in emissions, air quality, exposure and health);**
- **Use of randomized control design** (when feasible)**;**
- **Identification of <u>conditions</u> of effective interventions** (including social and environmental characteristics of the target population);
- **Optimization of interventions from public health point of view;**
- **Information / communication / policy support for effective intervention.**

Multi-disciplinary collaboration!



HEI 2016

Conclusions

1. **Primary (current) concerns:**

- Current health burden of air pollution;
- Slow implementation of existing air quality legislation;
- Challenges in achieving new emission reduction targets.

2. Research which can (?) make difference:

- Local evidence on health effects of air pollution;
- Improvement of concentration response functions to increase reliability and precision of health burden estimates;
- Identification, understanding and quantification of air pollution "novel" health effects – potential impact on burden of disease estimates;
- Identification of the most feasible, socially acceptable and effective approaches to air pollution reduction to comply with current EU legislation and beyond.

Thank you!