



*EU Regional Development Funds - Interreg Central Europe AWAIR*

**Strategies and operational tools to support adaptation actions  
in vulnerable population groups during the Severe Air Pollution Episodes (SAPes)**

*Parma - APE Parma Museo, via Farini 32a, November 6<sup>th</sup>, 2019*

# **Air Pollution in Pneumology**

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- 1. Outdoor pollution and respiratory diseases**
- 2. Chronic Effects of Pollution**
- 3. Exhacerbations and Severe Air Pollution Episodes (SAPEs)**
- 4. Counseling with the Patient**

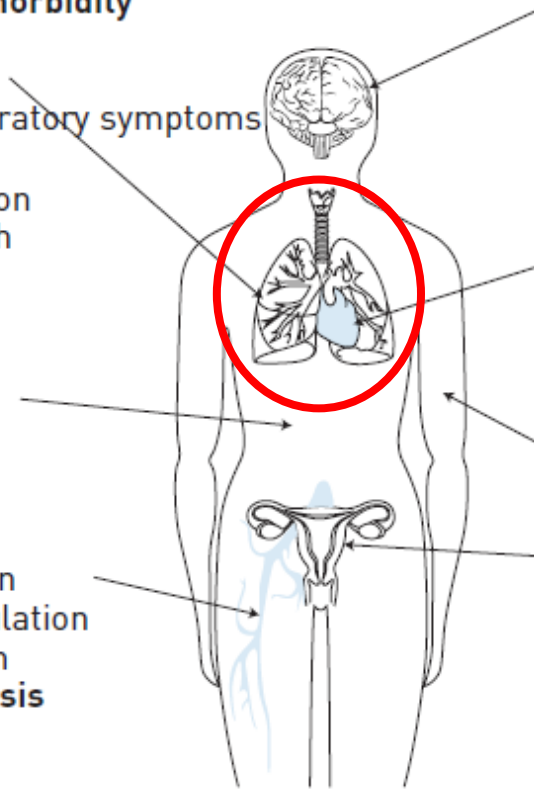
# Outdoor Pollution and Respiratory Diseases

**Respiratory disease mortality**  
**Respiratory disease morbidity**  
**Lung cancer**  
**Pneumonia**

Upper and lower respiratory symptoms  
Airway inflammation  
Decreased lung function  
Decreased lung growth

Insulin resistance  
**Type 2 diabetes**  
**Type 1 diabetes**  
Bone metabolism

**High blood pressure**  
Endothelial dysfunction  
Increased blood coagulation  
Systemic inflammation  
**Deep venous thrombosis**



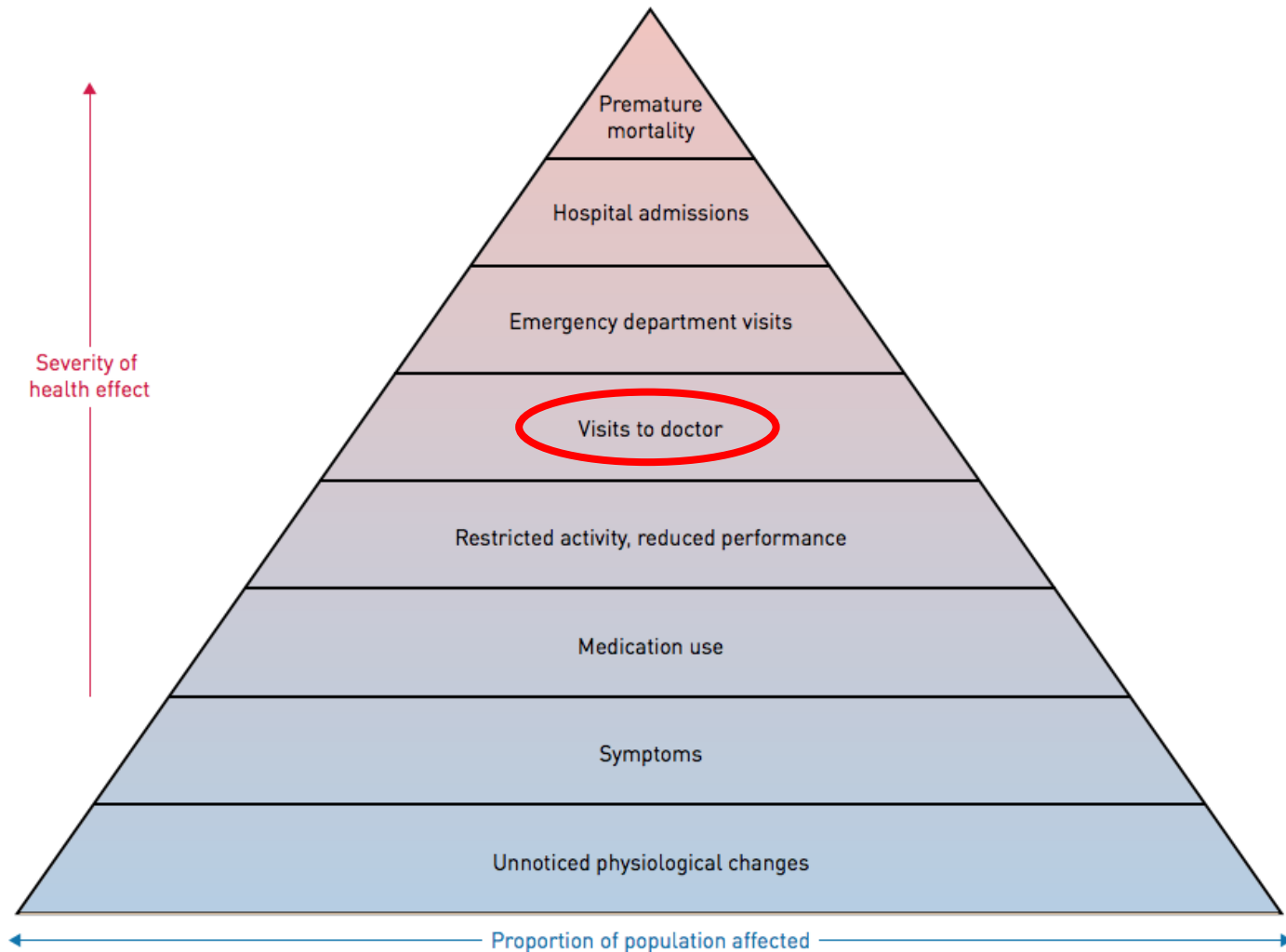
**Stroke**  
Neurological development  
Mental health  
**Neurodegenerative diseases**

**Cardiovascular disease mortality**  
**Cardiovascular disease morbidity**  
**Myocardial infarction**  
**Arrhythmia**  
**Congestive heart failure**  
Changes in heart rate variability  
ST-segment depression

Skin ageing

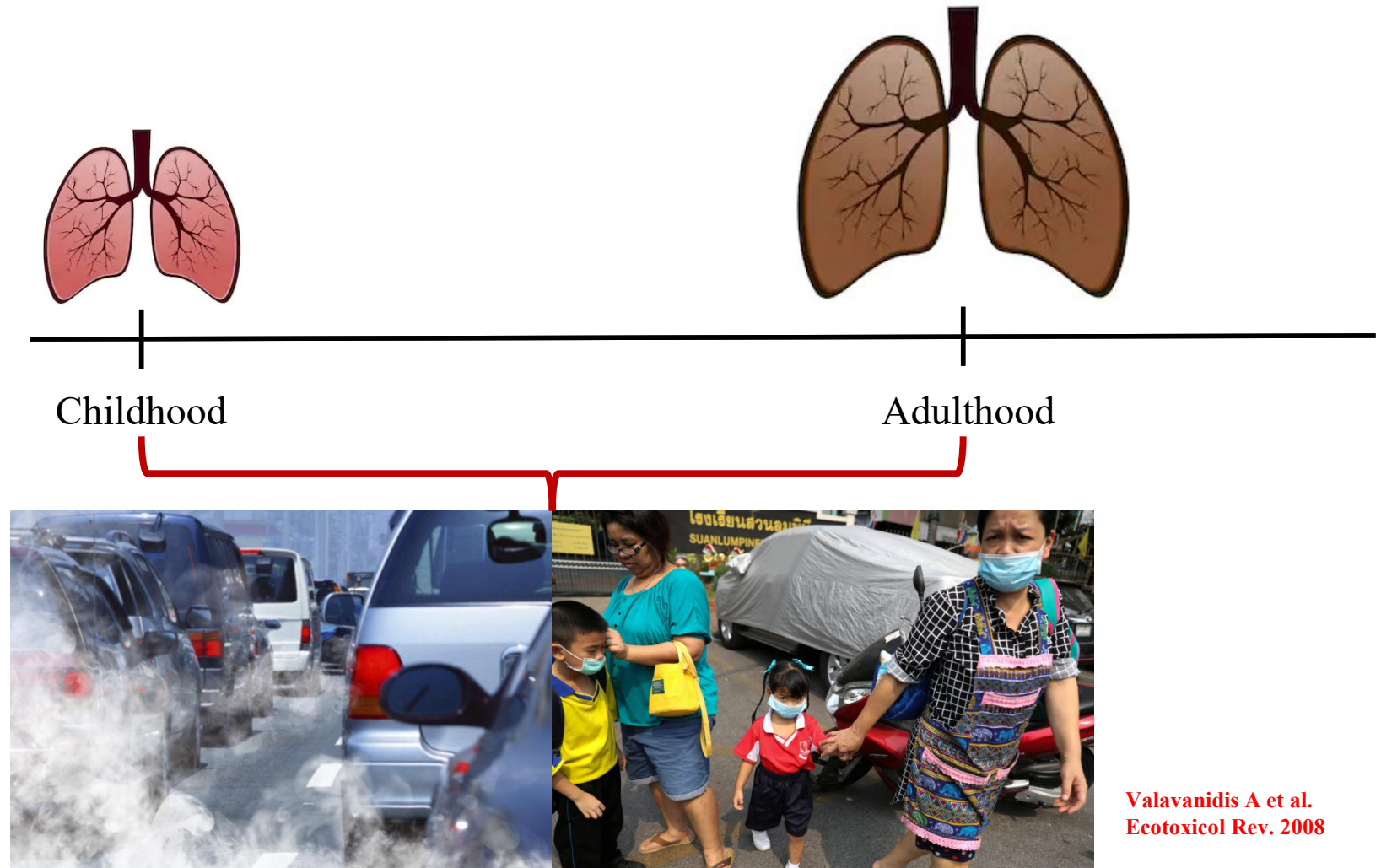
**Premature birth**  
**Decreased birthweight**  
Decreased fetal growth  
Intrauterine growth retardation  
Decreased sperm quality  
Pre-eclampsia

# Outdoor Pollution and Respiratory Diseases



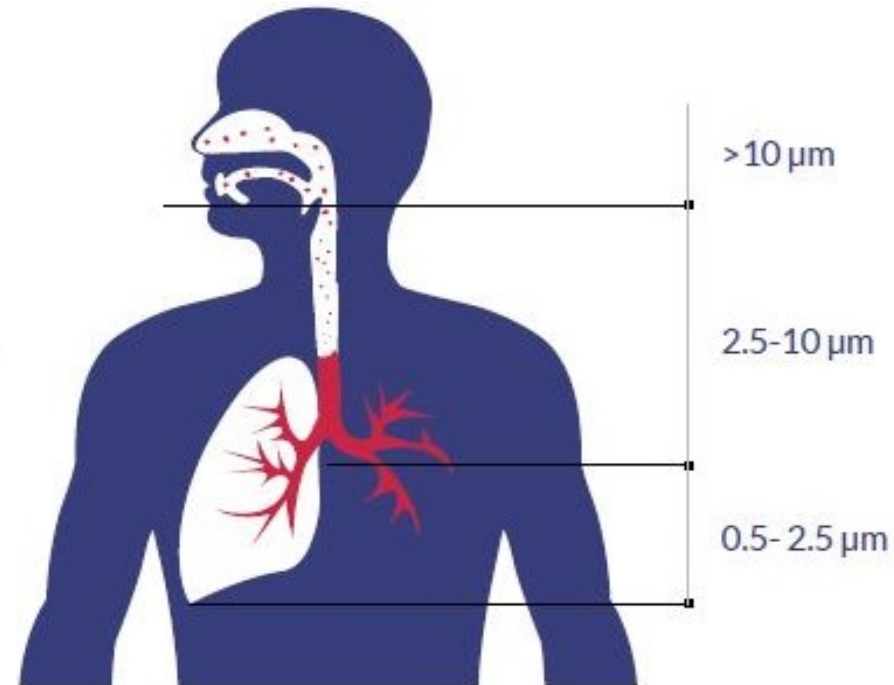
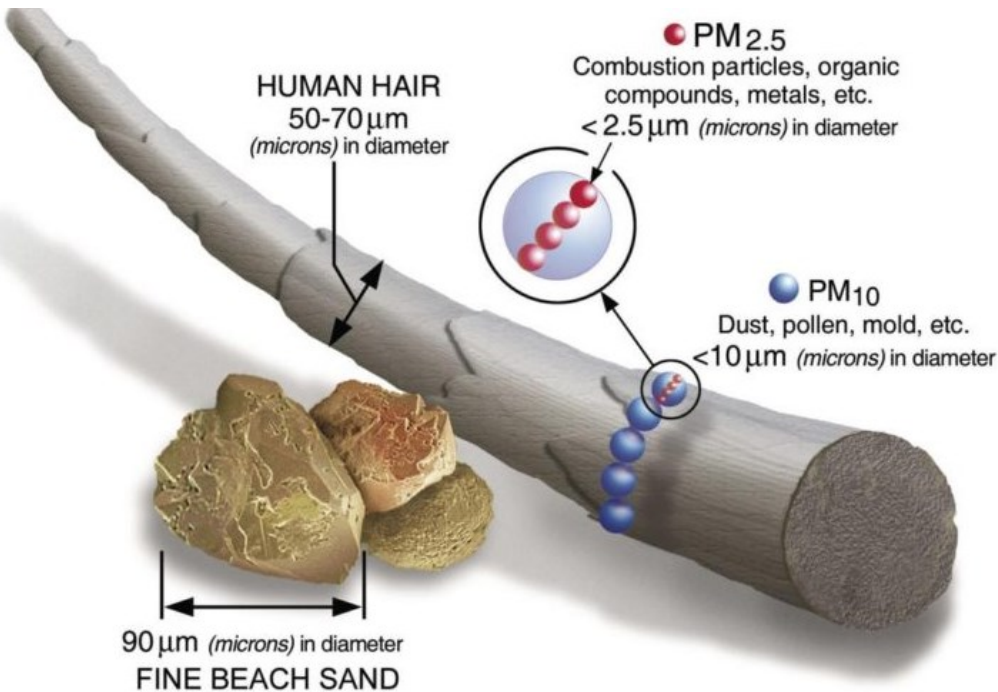
# Outdoor Pollution and Respiratory Diseases

## The Beginning of a Process



# Outdoor Pollution and Respiratory Diseases

## The Beginning of a Process



# Chronic Respiratory Effects of Pollution

- Chronic cough
- Increased Phlegm Production
- Breathlessness
- Atopy
- COPD
- Asthma
- IPF
- Lung Cancer
- Increased Mortality



**Even in never smokers!**

Brunekreef et al., Lancet. 2002  
Dockery DW et al., NEJM. 1993  
Limaye et al., Breathe. 2010  
Conti et al., ERJ. 2018

# The RHINE study - Population

- 7 Northern European study centres
- Time points: 1990, 2000 and 2010
- N = 7466





# The RHINE study - Exposures and outcomes

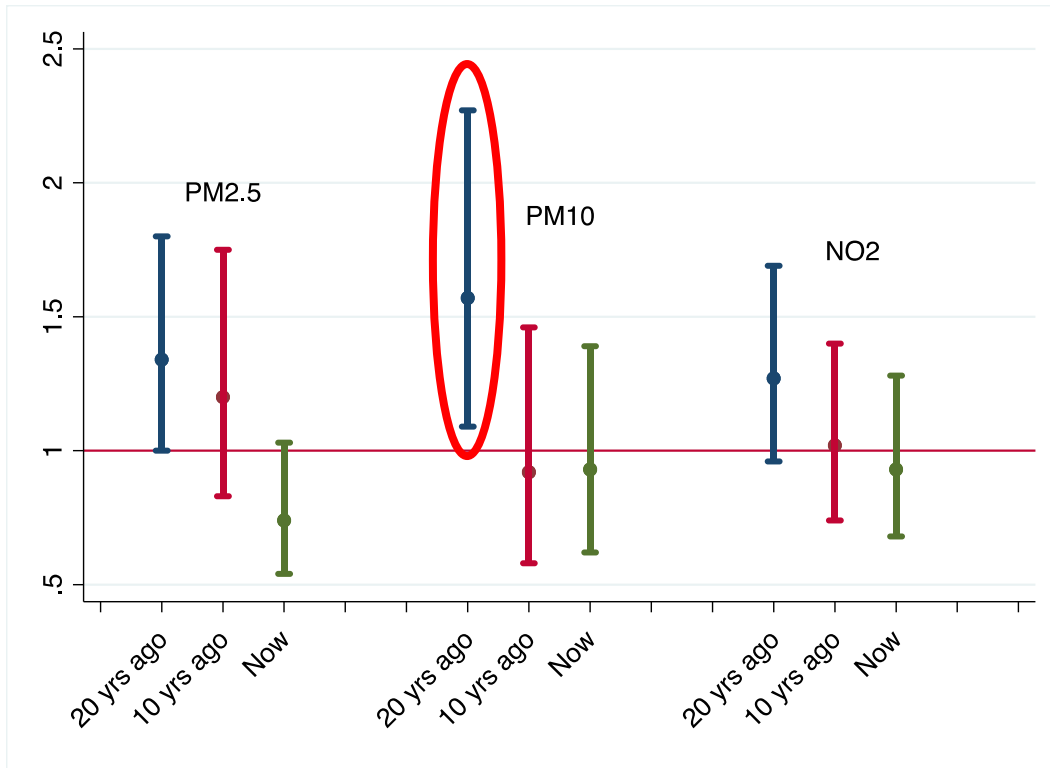
Geocoded residential addresses at each time point  
Annual average air pollution concentrations evaluated

PM <sub>2.5</sub> $\mu\text{g}/\text{m}^3$	}	0 years ago
PM <sub>10</sub> $\mu\text{g}/\text{m}^3$		10 years ago
NO <sub>2</sub> $\mu\text{g}/\text{m}^3$		20 years ago

Outcome: evaluate risk of all-cause and respiratory  
sick leave in the last 12 months

# The RHINE study - Results

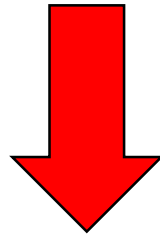
OR



- Multilevel logistic regression model
- **OR for respiratory sick leave per quartile increase in exposure**
- Multivariate models, adjusted for same exposure in the other time periods, sex, smoking, education, previous health-related work change

# The RHINE study - Conclusions

Air pollution exposure in a general population was associated with an increased risk of sick leave 20 years later



**Even low air pollution levels have adverse health effects over time**

**Healthcare Cost**

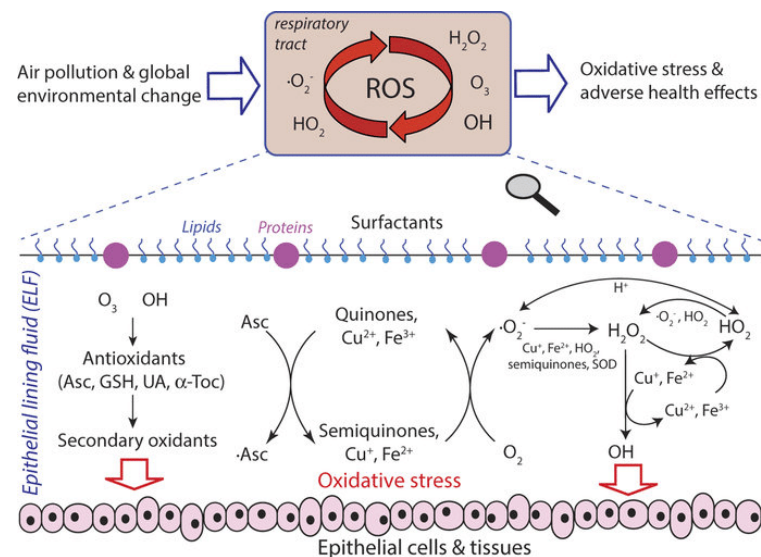
# Exacerbations and Severe Air Pollution Episodes (SAPEs)

## Macro Risk

- Pneumonia
- Asthma Exhacerbation
- COPD Exhacerbation
- Hospital Admission

## Micro Damage

- Increase in lung oxidative stress
- Surfactant abnormalities
- Induction of inflammation and fibrogenic mechanisms
- Telomere shortening



# Exhacerbations and Acute Pollution

## Acute exacerbation of idiopathic pulmonary fibrosis associated with air pollution exposure

Kerri A. Johannson<sup>1,2,3</sup>, Eric Vittinghoff<sup>4</sup>, Kiyoungh Lee<sup>5</sup>, John R. Balmes<sup>1,2</sup>, Wonjun Ji<sup>6</sup>, Gilaad G. Kaplan<sup>3</sup>, Dong Soon Kim<sup>6</sup> and Harold R. Collard<sup>1</sup>

*“Increased ozone and nitrogen dioxide exposure over the preceding 6 weeks was associated with an increased risk of acute exacerbation of idiopathic pulmonary fibrosis, suggesting that air pollution may contribute to the development of this clinically meaningful event.”*

**1 and 3 month mortality rates after AE-IPF:  
60% and 67%, respectively**

# Counseling the Patient with a Respiratory Disease General Principles

- Avoid exposures to high levels of pollution
- Be careful of urban cycling and similar exposures
- Take in consideration the distance from busy motorways when choosing where to live/study







# Counseling the Patient with a Respiratory Disease Severe Air Pollution Episodes (SAPEs)

## Face Masks / Particulate Filters



**Differences due to different type of construction  
material and types of filter used**

**Scientific data is currently limited**



# Counseling with the Patient - Interventions

## Antioxidant supplementation

- **N-acetyl cysteine**
- **Sulforaphane** (brussels sprouts, turnips, cabbage, broccoli and cauliflower).
- **Vitamin C, Vitamin A, Vitamin E** at high doses



**Eat Fruits and Vegetables**

# Conclusion

- Both acute and chronic exposure to air pollutants, although of low level, causes important clinical consequences
- We need to implement national prevention policies
- Patients must be informed and educated about pre-exposure prevention, although evidence is scarce at the moment



## ERS 10 PRINCIPLES FOR CLEAN AIR

- 1 Citizens are entitled to clean air, just like clean water and safe food.
- 2 Outdoor air pollution is one of the biggest environmental health threats in Europe today, leading to significant reductions of life expectancy and productivity.
- 3 Fine particles and ozone are the most serious pollutants. There is an urgent need to reduce their concentrations significantly.
- 4 Roadside pollution poses serious health threats that cannot be adequately addressed by regulating fine particle mass or ozone. Other metrics such as ultrafine particles and black carbon need to be considered in future research and to inform further regulation.
- 5 Non-tailpipe emissions (from brakes, tyres and road surfaces, etc.) pose a health threat for road users and subjects living close to busy roads.  
  
Real-world emissions of nitrogen dioxide from modern diesel engines are much higher than anticipated. This may expose many road users, and subjects living on busy roads, to short-term peak concentrations during rush hours and periods of stagnating weather that may impact on health, although to what extent requires further research.
- 7 Global warming will lead to more heatwaves, during which air pollution concentrations are also elevated and during which hot temperatures and air pollutants act in synergy to produce more serious health effects than expected from heat or pollution alone.
- 8 Combustion of biomass fuel produces toxic pollutants. This is true for controlled fires, such as in fireplaces, woodstoves and agricultural burning, as well as for uncontrolled wildfires. There is a need to assess the real health impacts of air pollution from these sources in many areas in Europe to inform on the need for better control.
- 9 Compliance with current limit values for major air pollutants in Europe confers no protection for public health. In fact, very serious health effects occur at concentrations well below current limit values, especially those for fine particles.
- 10 EU policies to reduce air pollution are needed that ultimately lead to air that is clean and no longer associated with significant adverse effects on the health of European citizens. The benefits of such policies outweigh the costs by a large amount.



***“If you think the economy is more important than the environment, try holding your breath while counting your money”***

Prof. Guy McPherson, 2009  
School of Natural Resources, University of Arizona

**Thank You for Your Attention**

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