



National Institute for Public Health  
and the Environment  
*Ministry of Health, Welfare and Sport*

# Hazard assessment of source-specific fine particulate matter

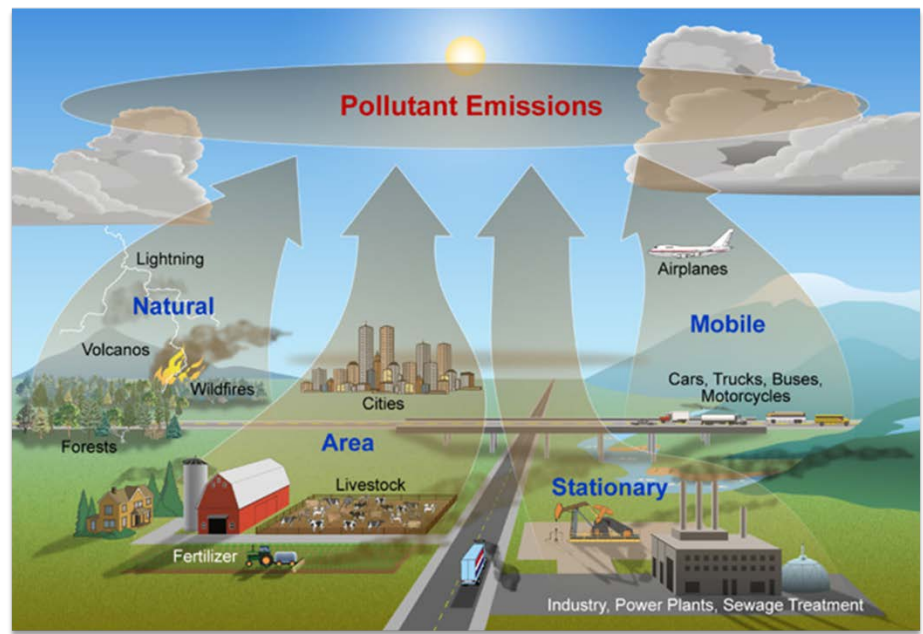
- Introduction
- Study design
  - PM collection
  - Mice inhalation study
- Results
- Summary



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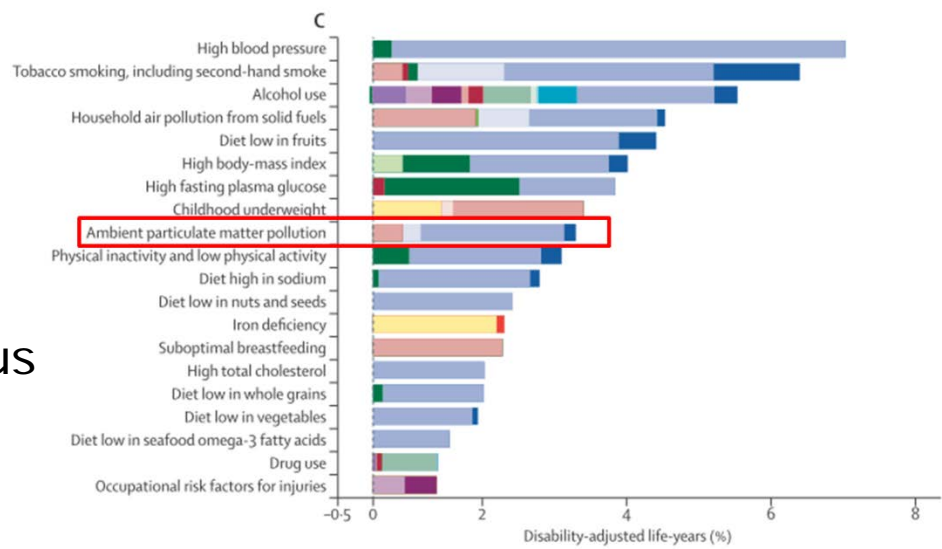


# Introduction – Air pollution: sources and health



Emission mixture particles and gaseous

## Risk factor for global burden of disease



Lim et al. LANCET (2012)



## Air pollution sources – importance for health

- Traffic is an important source (emission and health effects) and therefore focus has been on reduction of engine emission
- Relative contribution of non-exhaust emissions and wood smoke is increasing although the health implications are mainly unknown
- As health effects occur even below the EU standards it is important to elucidate the relative toxicity of different sources
- Hazard of source-specific PM (advise policymakers)



# Collection of source-specific fine particulate matter (PM<sub>2.5</sub>)





## Source-specific PM2.5

- Brake wear (4 different brake pad types, realistic combined driving conditions)
- Wood combustion

modern/efficient



modern/deliberate-poor



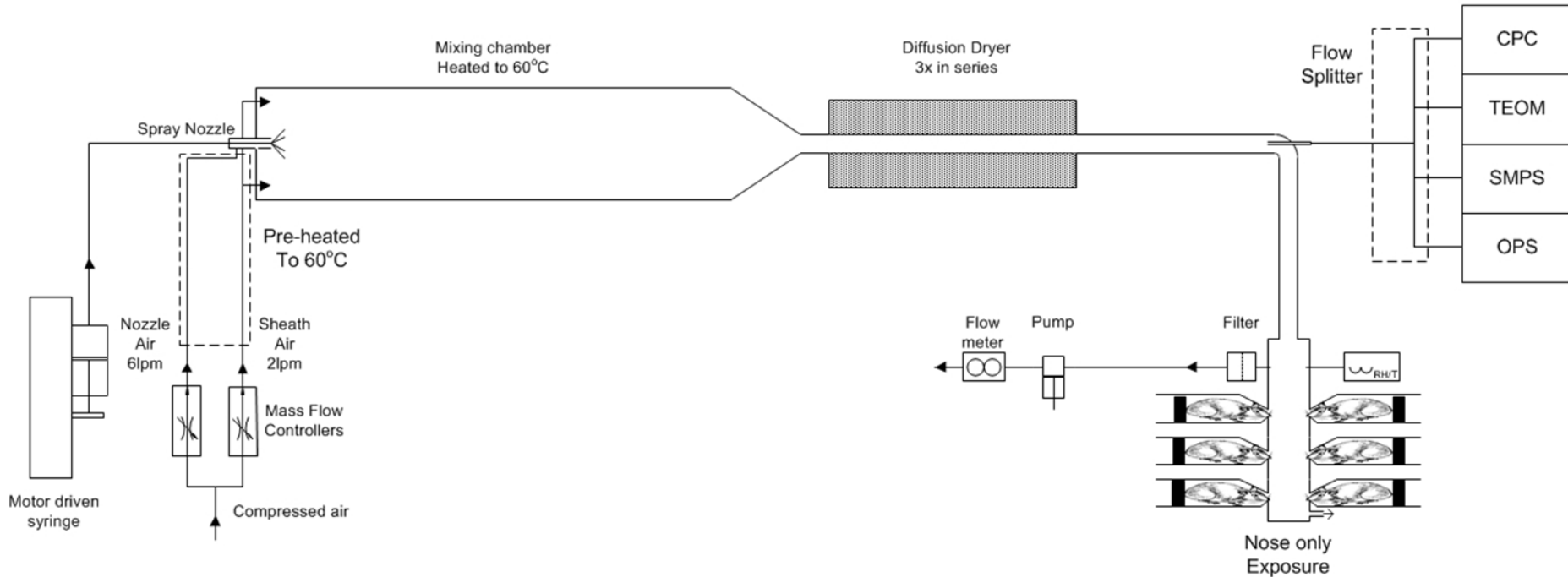
old/efficient



- Diesel combustion (stationary HD diesel engine, Euro III / Euro V combined)
  - TU Eindhoven; Reijnders et al, SAE Technical paper 2013-24-0108, 2013, doi: 10.4271/2013-24-0108
- Poultry farm ( $\pm 70,000$  animals)
- Tyre/road wear (spiked tyres, tarmac road pavement)



# Mice nose-only exposure – aerosol source-specific PM



- 3 exposure dose: low (L) 0.3-0.4 mg/kg bw; medium (M) 0.6-0.8 mg/kg bw; high (H) 1.2-1.6 mg/kg bw
- 24-hour post-exposure examination health effects (effect parameters)
  - inflammation, cytotoxicity, cardiovascular



## Inflammatory cells (absolute lung neutrophil numbers)

- Number of lung neutrophils different for each source
  - highest response: poultry farm, deliberate-poor wood combustion modern stove
- Dose-response
  - poultry farm, diesel combustion
- Low dose already highest response
  - deliberate-poor wood combustion modern stove



# Benchmark dose (BMD) modeling

- BMD approach is applied to assess the differences in potency (source hazard identification)
- Examine the potency by elucidating the PM dose needed to reach 10% or 20% increase in a specific effect parameter (neutrophils)
- The lower the PM dose needed to observe this effect the more hazardous the PM material is
- Ranking sources based on their relative toxicity







## BMD outcomes : lung and blood neutrophils

- PM dose-range resulting in 10% increase of neutrophils compared to controls
  
- Ranking relative toxicity (hazard; effect parameter lung neutrophils)
  - deliberate-poor wood combustion modern stove > poultry farm >> brake wear type 3 and 4 = efficient wood combustion modern stove = diesel combustion ≥ efficient wood combustion old iron stove ≥ tyre/road wear = brake wear type 1 and 2
  
- Ranking relative toxicity (hazard; effect parameter blood neutrophils)
  - comparable hazard for all sources tested



## Summary source-specific PM toxicity

- Most hazardous PM source?
  - Indication for higher hazard of wood combustion and brake wear emissions compared to the other PM sources
  - Ranking PM sources on multiple health effects and biological effect parameters
- Source-specific risk – combination of hazard **and** exposure (emission, distribution)
  - Support for source specific policy to improve public health



# Contributions and thanks



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Assignment Air pollution and health



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Thank you for your attention!