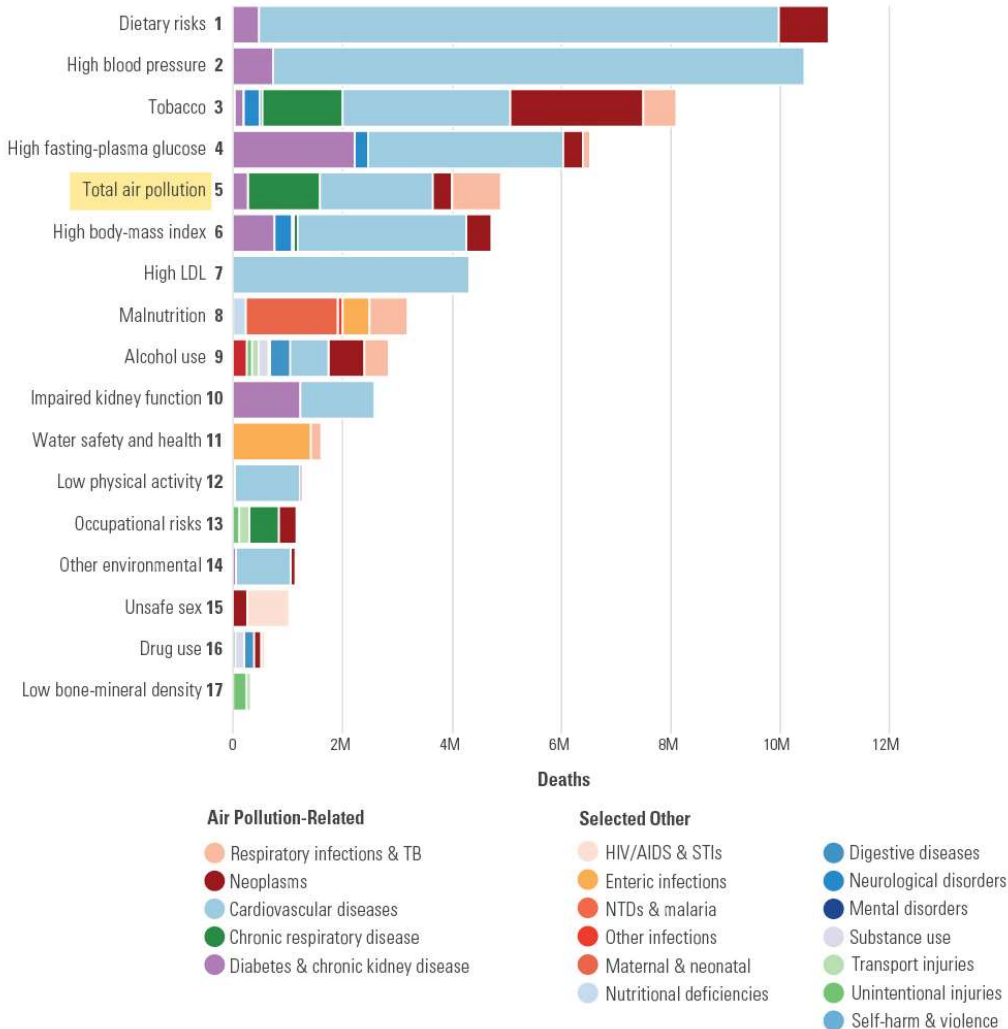




What does atmospheric particulate matter tell us about emission sources and health effects?

Célia Alves

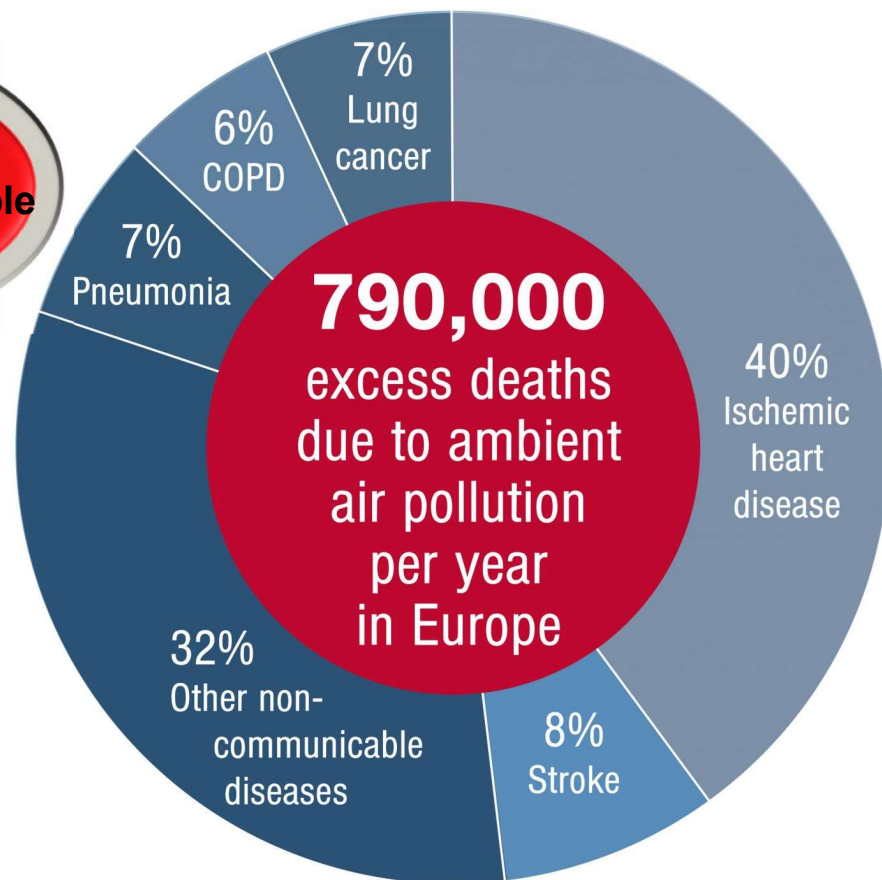
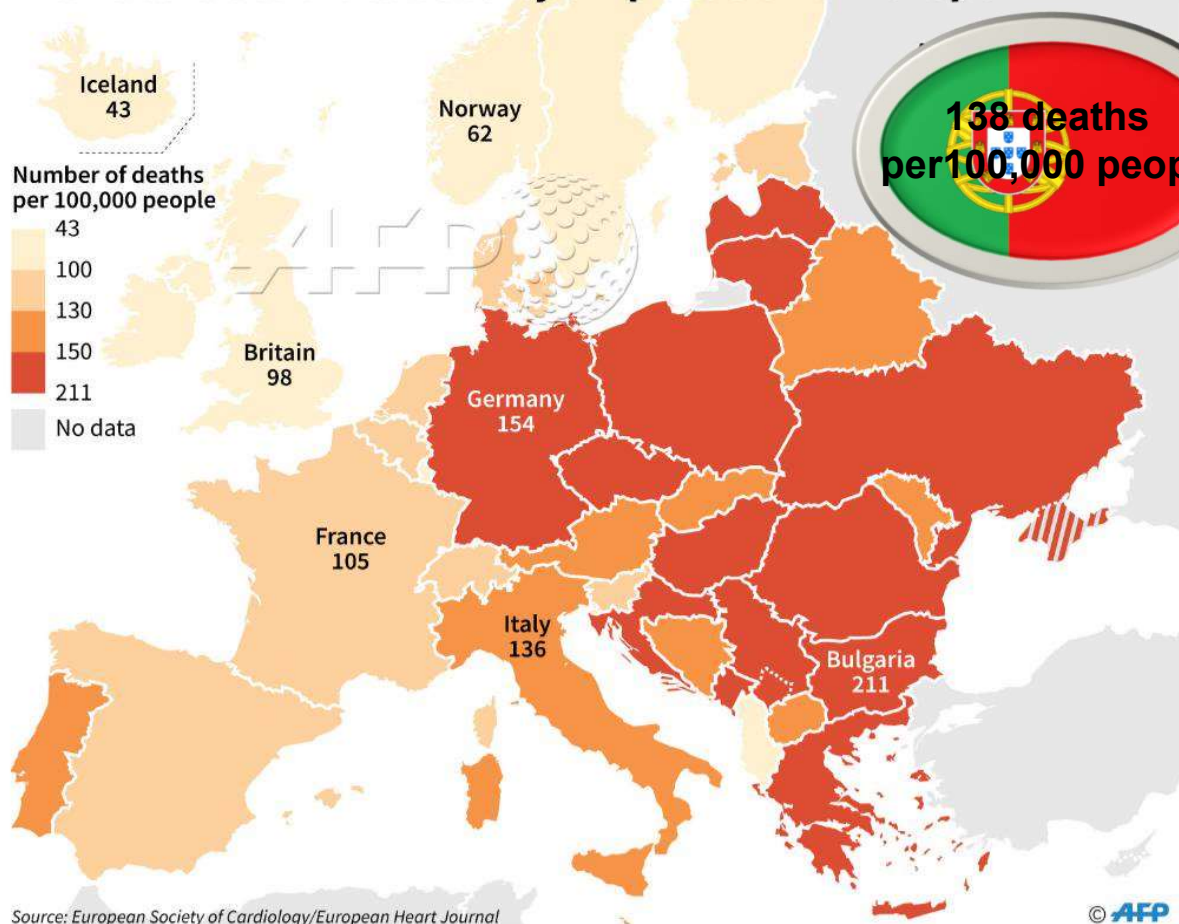
(celia.alves@ua.pt)



Global ranking of risk factors by total number of deaths from all causes in 2017



Premature deaths caused by air pollution in Europe



Lelieveld et al., 2019. *European Heart Journal*.

International Agency Research on Cancer



**World Health
Organization**

GROUP


**WHAT DOES IT
MEAN?**


**GROUP
1**

**CARCINOGENIC
TO HUMANS**

Sufficient evidence in
humans. Casual
relationship established.

Atmospheric Particulate Matter (PM)

PM_{2.5} |  | **<2.5 μm** combustion particles,
organic compounds, metals

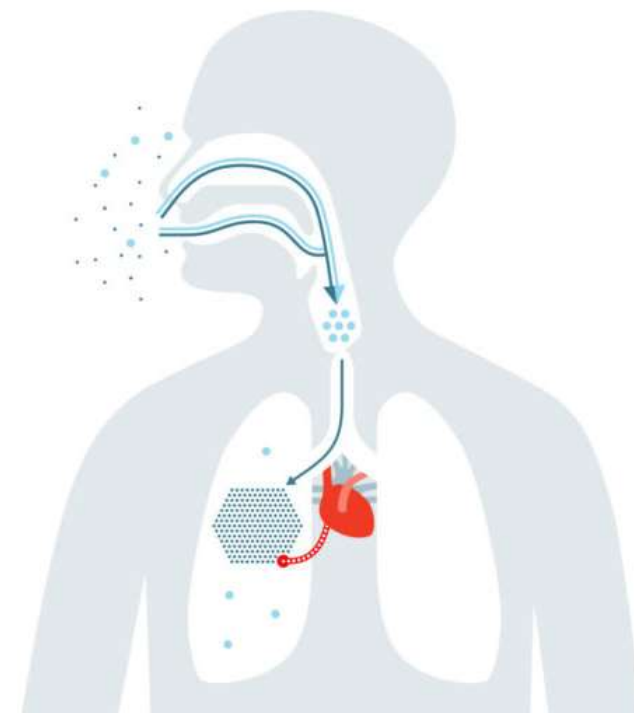
PM₁₀ |  | **<10 μm** dust, pollen, mold

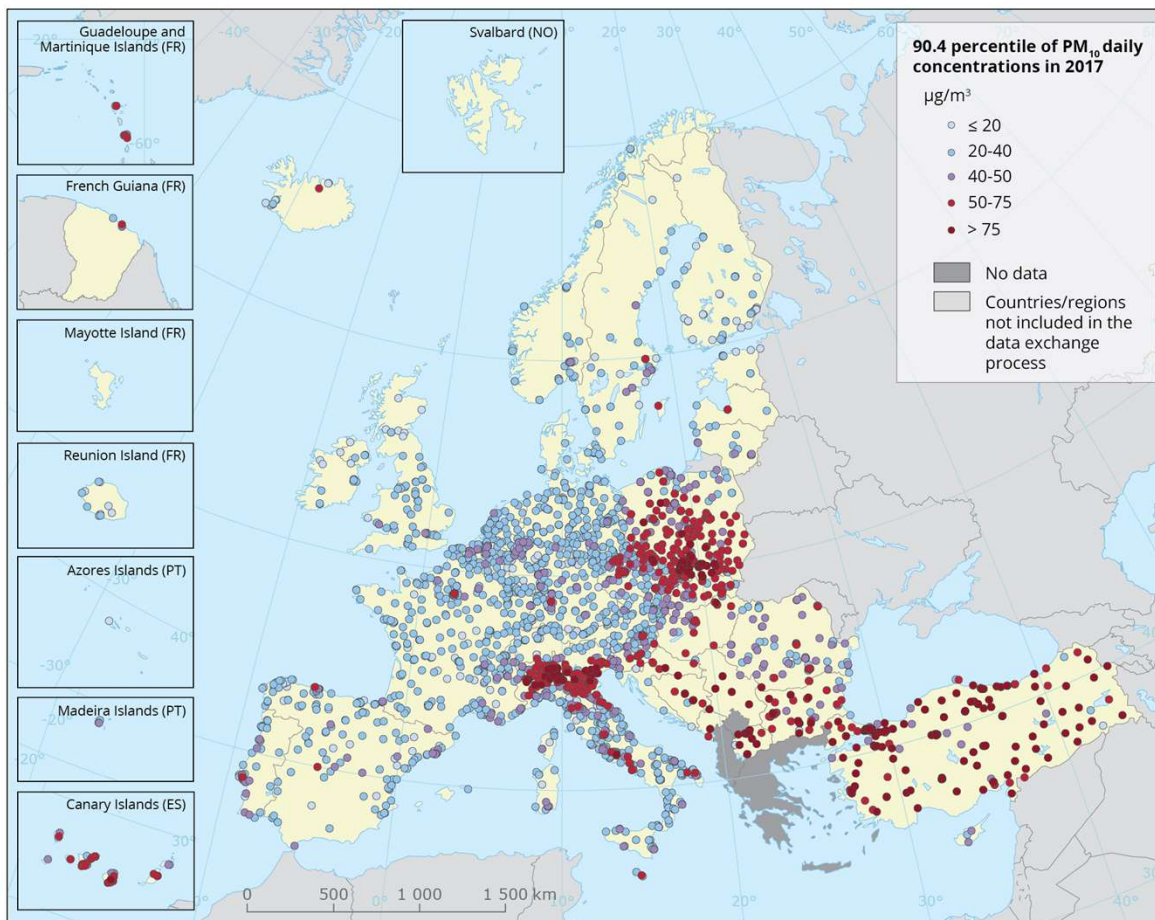
Grain of
Beach Sand



~90μm

μm: micrometers in diameter

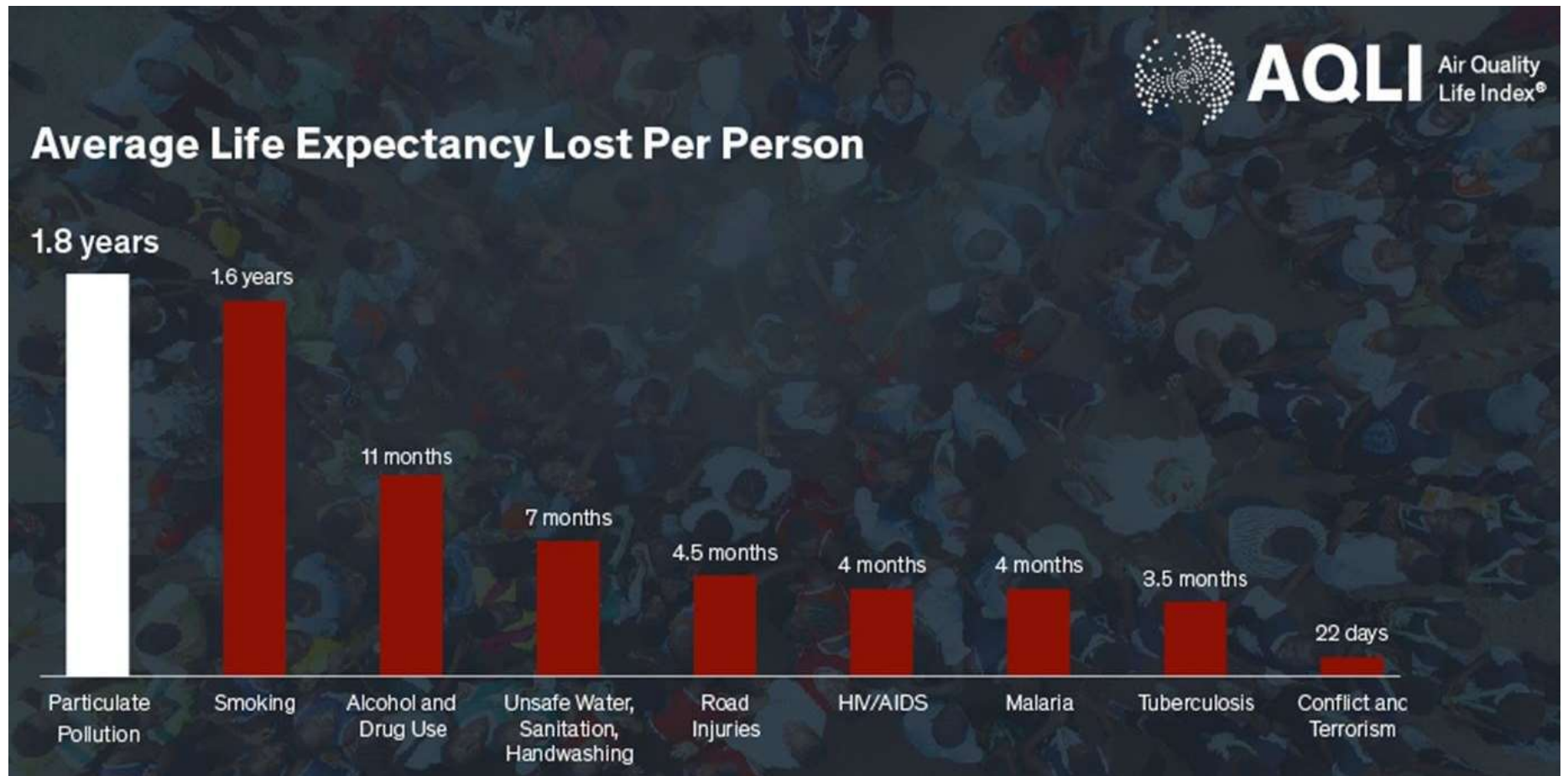




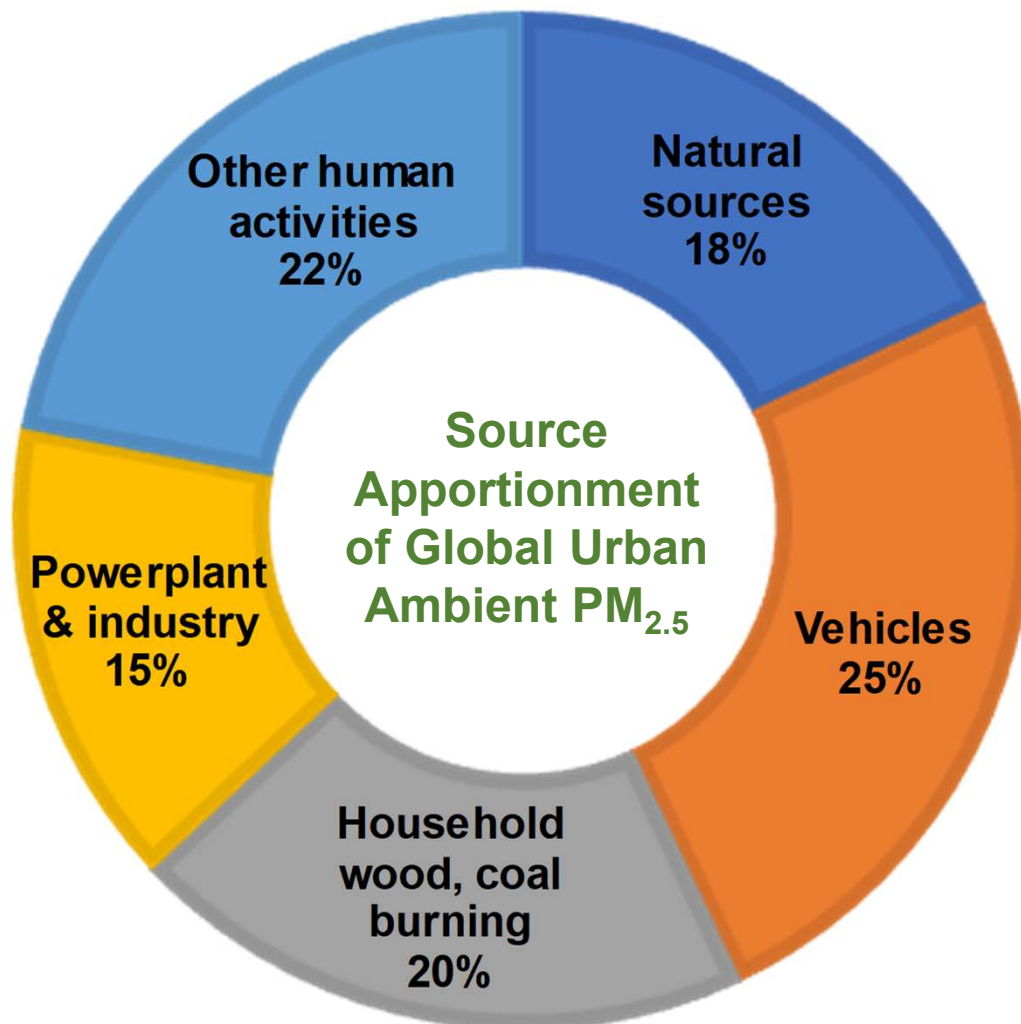
PM₁₀ concentrations in 2017

The WHO air quality guideline for PM₁₀ (20 µg/m³) was exceeded at 51 % of the stations

*European Environmental Agency.
Air quality in Europe — 2019 report*



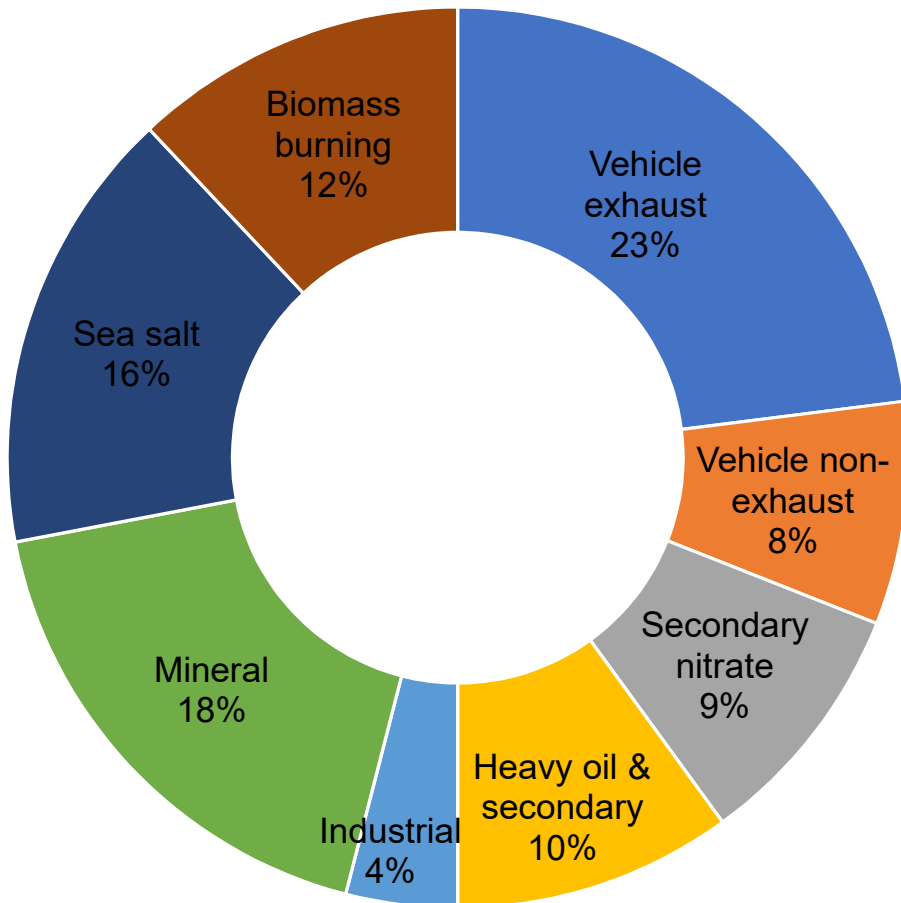
Greenstone and Fan, 2018. Energy Policy Institute, University of Chicago.



Where does particulate air pollution come from?

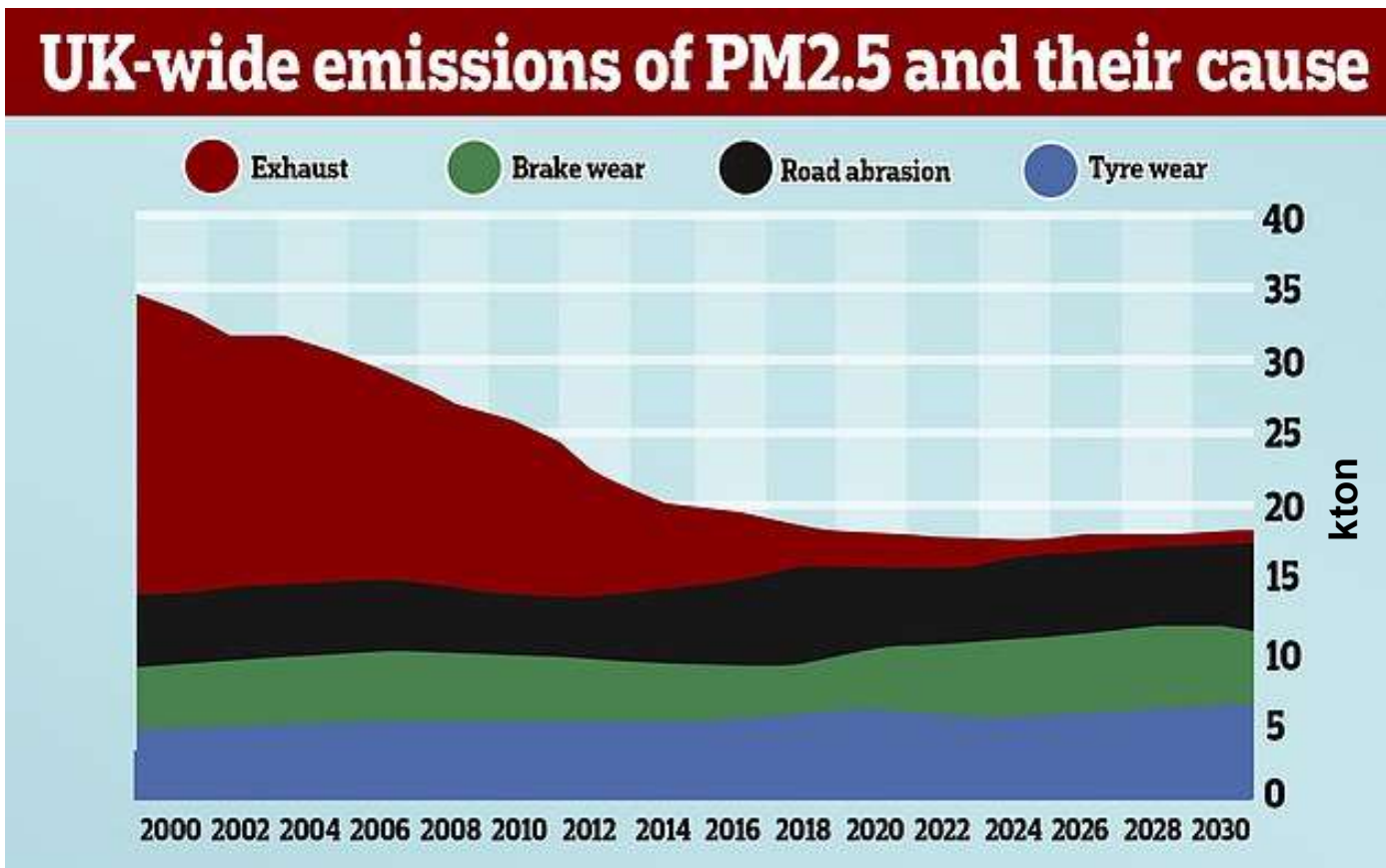
*Karagulian et al., 2015.
Atmospheric Environment.*

PM₁₀ source apportionment in Oporto



1-year long sampling campaign in 2013

Vehicle non-exhaust emissions



BRAKE WEAR



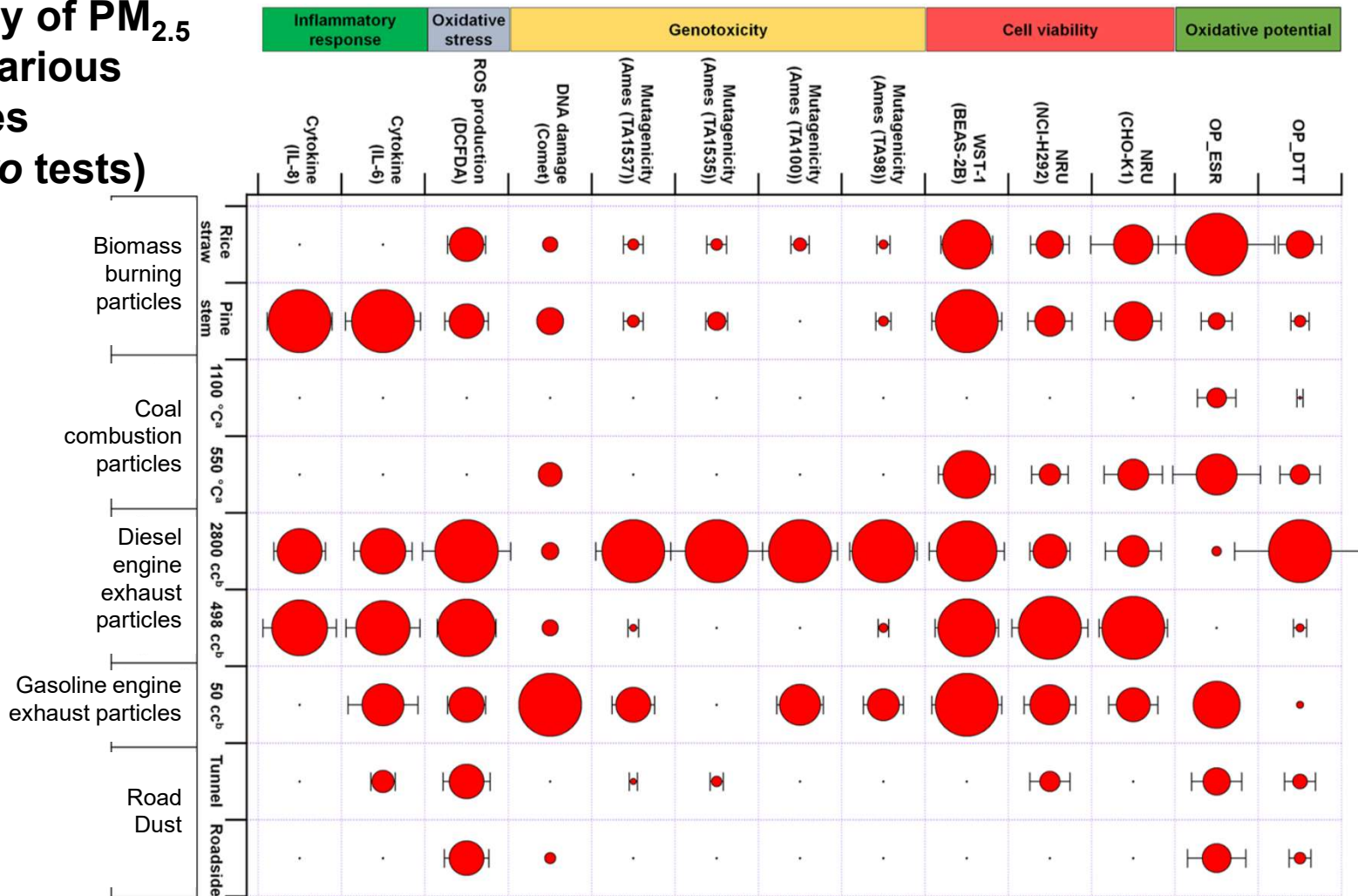
TIRE/ROAD WEAR



ROAD-DUST RESUSPENSION

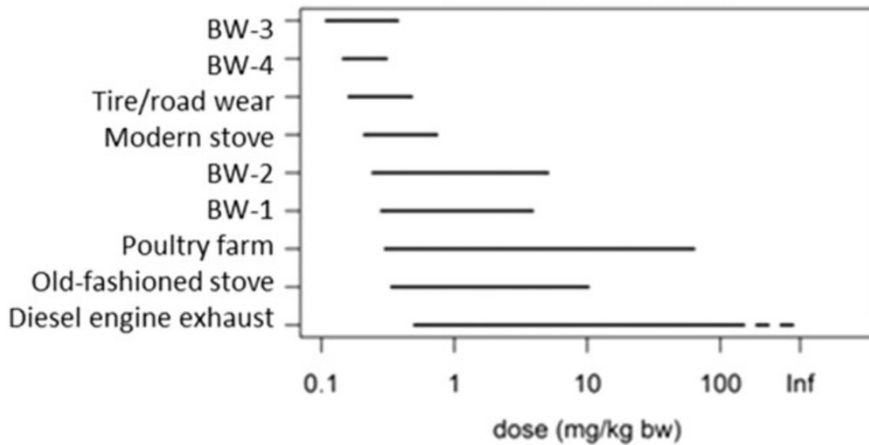
Air Quality Expert Group, DEFRA, 2019

Toxicity of PM_{2.5} from various sources (in vitro tests)

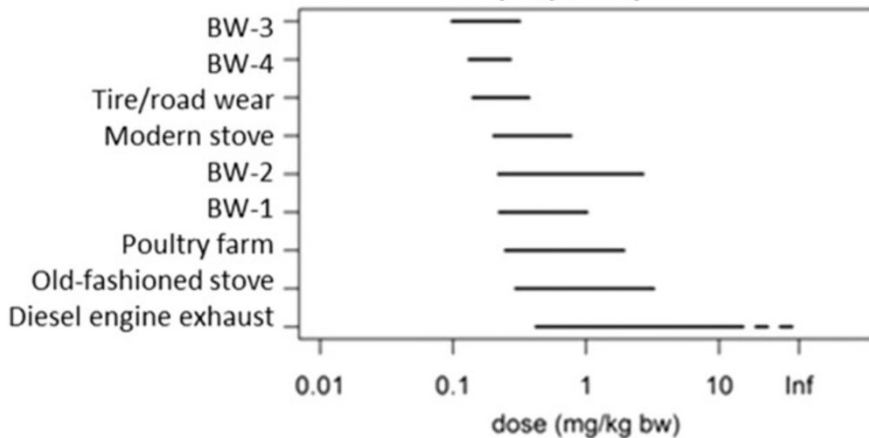


Park et al., 2018. Scientific Reports.

White blood cells



Lymphocytes



Toxicity of PM_{2.5} from various sources

(*in vivo* tests)

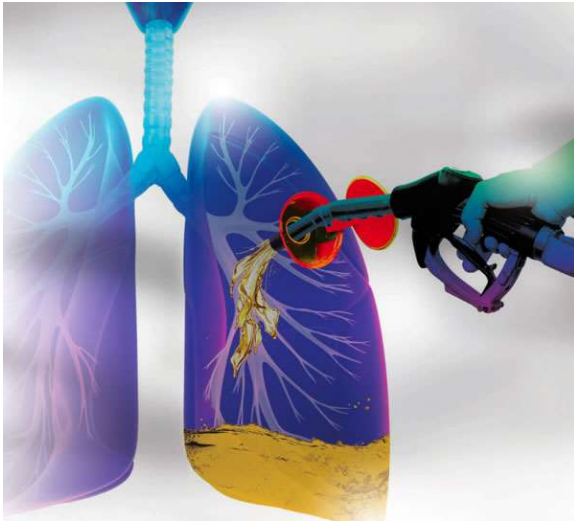
- Analysis of hematological parameters



- BW-1: Brake wear (low-metallic brake pads including copper, ECE)
- BW-2: Brake wear (semi-metallic brake pads without copper)
- BW-3: Brake wear (non-asbestos organic, NAO, brake pads)
- BW-4: Brake wear (ECE-NAO hybrid brake pads)
- Tire/road wear: studded winter tires and asphalt concrete pavement
- Modern stove: efficient combustion conditions
- Old-fashioned stove: inefficient combustion conditions
- Diesel exhaust: Euro III engine

Gerlofs-Nijland et al., 2019. *Inhalation Toxicology*.

Take home message



Source: Institute for Energy Resourcefulness, 2019.

Air pollution (especially PM): many times an invisible killer!

Understanding of sources that are most harmful to health can provide valuable information for risk management strategies and could help decision-makers to develop more targeted air pollution regulation.

Chemical composition and toxicological mechanisms of particles vary greatly with source type and are still scarcely known: multidisciplinary studies are needed!

The right to clean air is a human right. We can all help reduce air pollution!

Acknowledgments

