

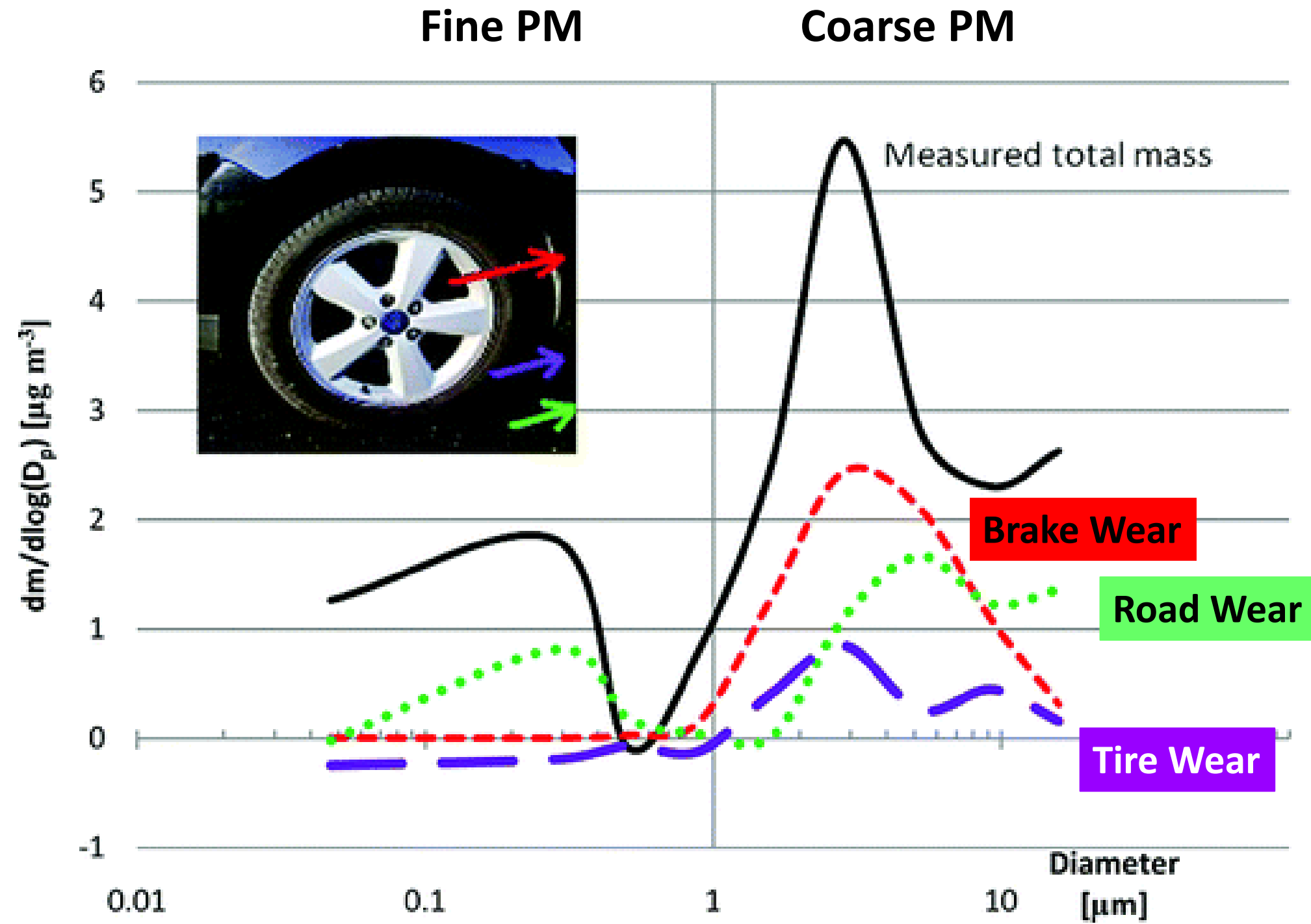
# Non-Tailpipe Emissions: Impacts on Urban Air Quality and Health

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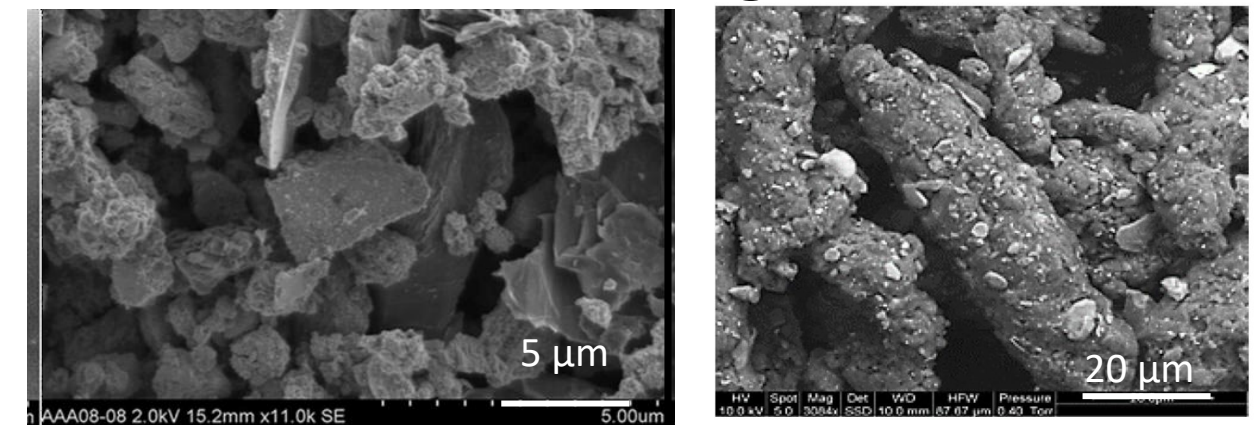
Carnegie Mellon University

# What are non-tailpipe emissions?



- Primary/directly emitted particles
- Mechanical abrasion  $\rightarrow$  larger particles!
- Composition:
  - Brake Wear: metals (Fe, Cu, Zn, ...)
  - Tire Wear: microplastics, Zn
  - Road wear: crustal (Si, Al, Fe, Ca ...)
  - Resuspended road dust: Crustal

## SEM images

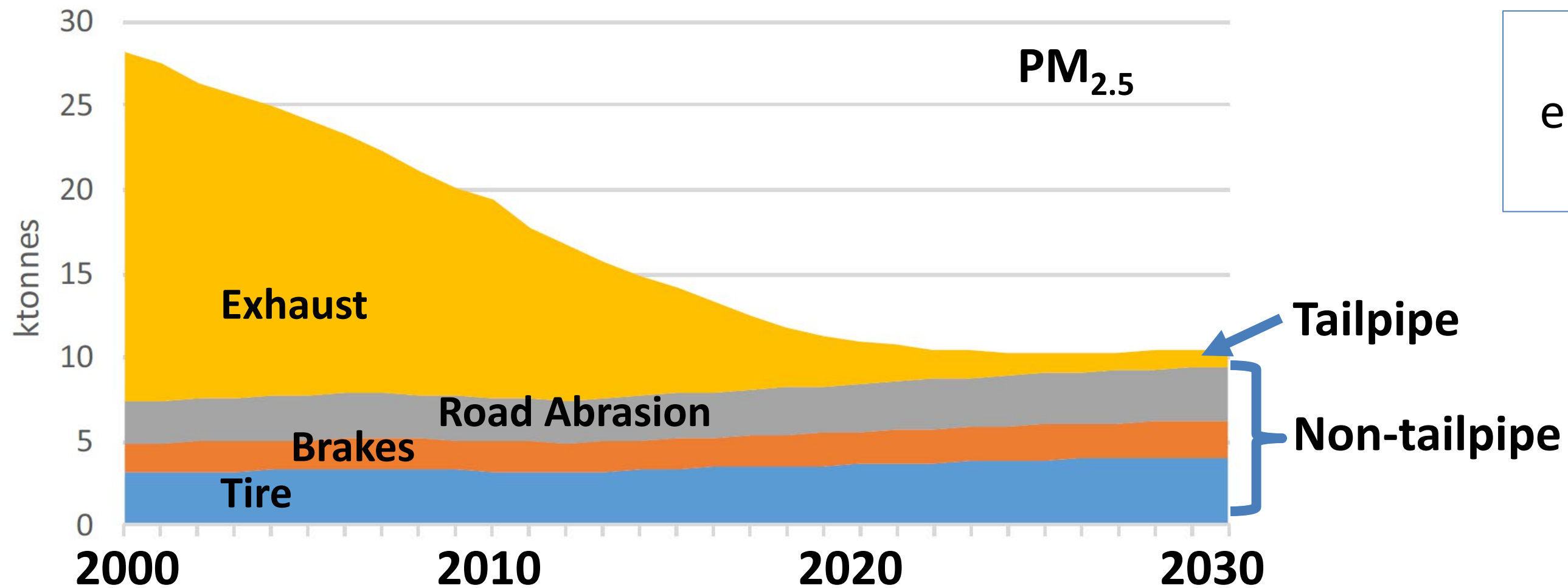


Brake wear

Tire/Road wear

# How important are non-tailpipe emissions?

**Non-tailpipe emissions now exceed tailpipe emissions?**



On-road vehicle emissions in United Kingdom

Could be even more skewed is very substantial electrification of the fleet.

# Assessing Risk

Risk = hazard x exposure

Toxicity  
PM size  
PM composition  
Mixture Effects

Concentration  
Duration

Emission factors  
Activity  
Meteorology  
Proximity

**What are concentrations of non-tailpipe PM?**

- near road
- urban background
- more spatial variability than “generic” PM<sub>2.5</sub> mass

**Are non-tailpipe emissions more toxic than other types of PM?**

# Regulatory framework

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## PM2.5 NAAQS:

- Mass based standard → Equitoxicity
- What is the contribution of non-tailpipe to PM<sub>2.5</sub> mass?

## Source oriented perspective

- Are non-tailpipe more toxic than other types of PM2.5 mass?
- Potential control strategy → some sort of reformulation strategy (e.g. removal of Cu from brake pads)
- Challenges due to competing demands for safety, performance