

THE PATH TO CLEANER AIR: A PIONEERING INTER-LABORATORY STUDY ON BRAKE WEAR EMISSIONS FROM ROAD VEHICLES



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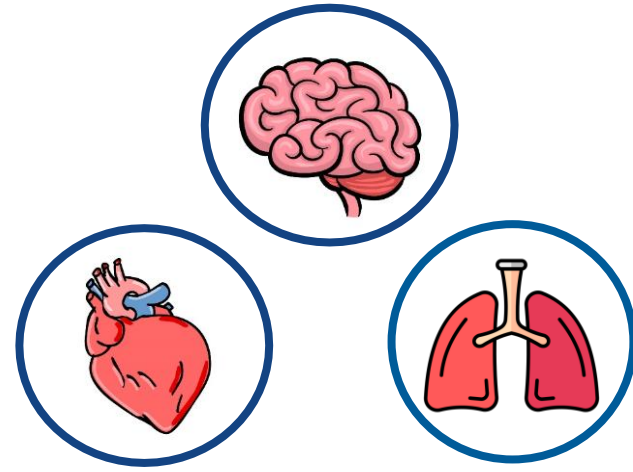


Overview

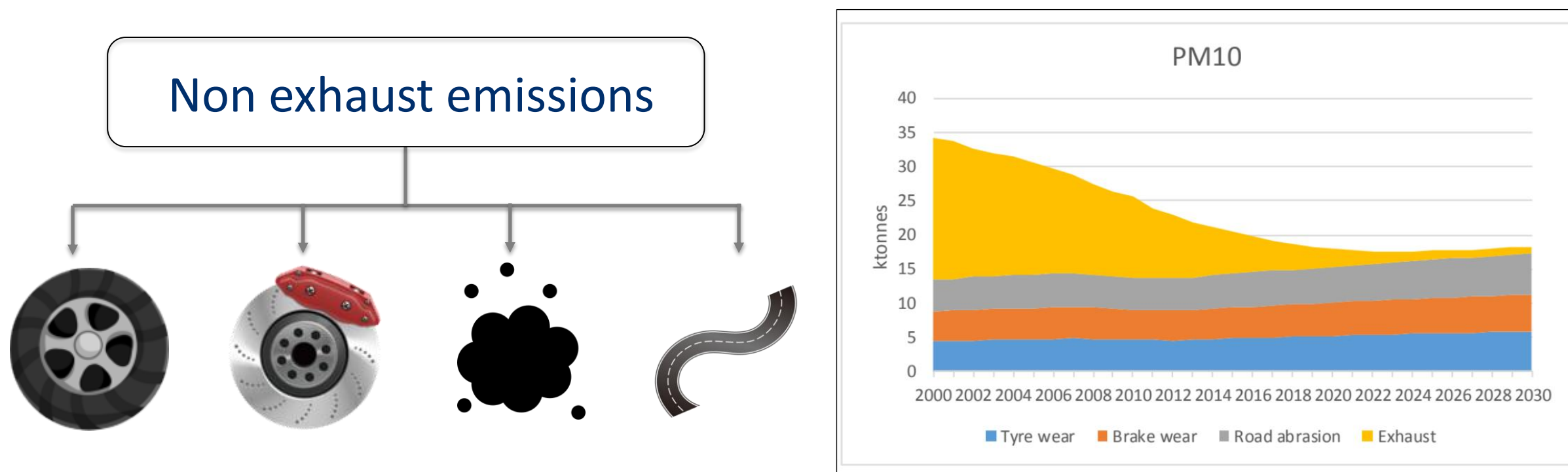
- Air pollution is a major environmental risk to **health**

Linked to
> 30,000 UK deaths/year

Costs the economy
> £27 billion/year

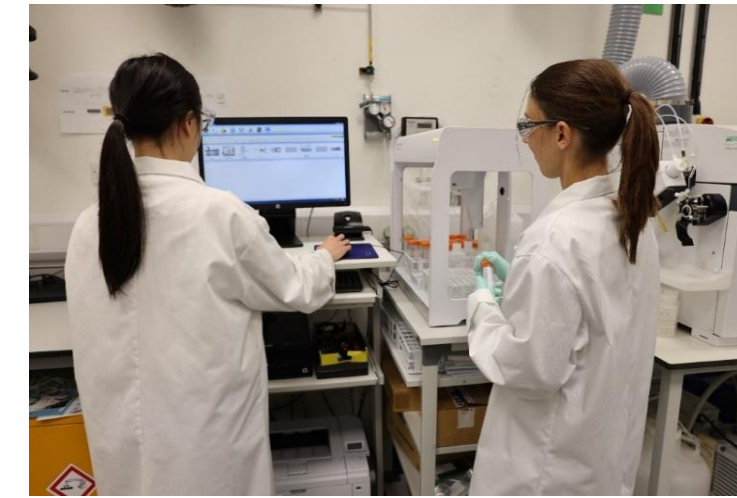


- Non-exhaust emissions** now **dominate** road-traffic particulate pollution as exhaust emissions fall
- Brake wear** is a key contributor and contains **toxic metals**



The Challenge

- Brake wear has complex chemical composition → Analyse **trace metals** using **ICP-MS/MS**
- Sampling challenges → Develop a **custom sampling system**
- Sample preparation challenges → Enable **full digestion** using **milder** reagents by switching filter types
- Lack of reference materials → Validate via the **first academia–industry inter-laboratory study**



Our Approach: develop a fit-for-purpose analysis method for brake wear

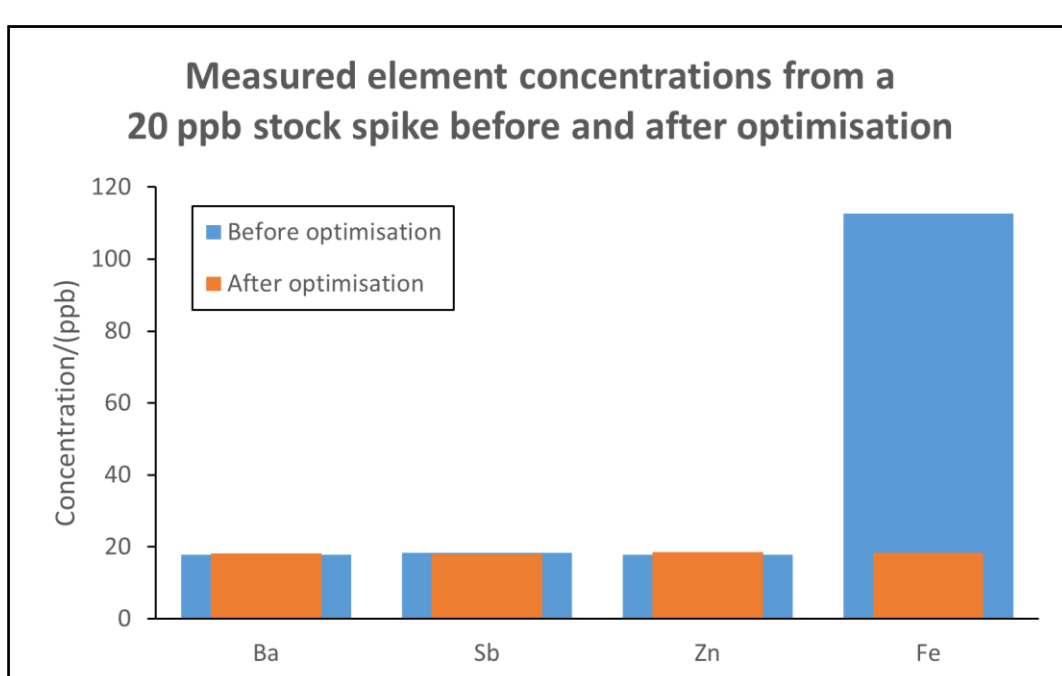
Method development & validation

Through optimisation:

Collision gas → remove **interferences**

Gas flow optimisation → **boost signal**

1. Spike recovery:

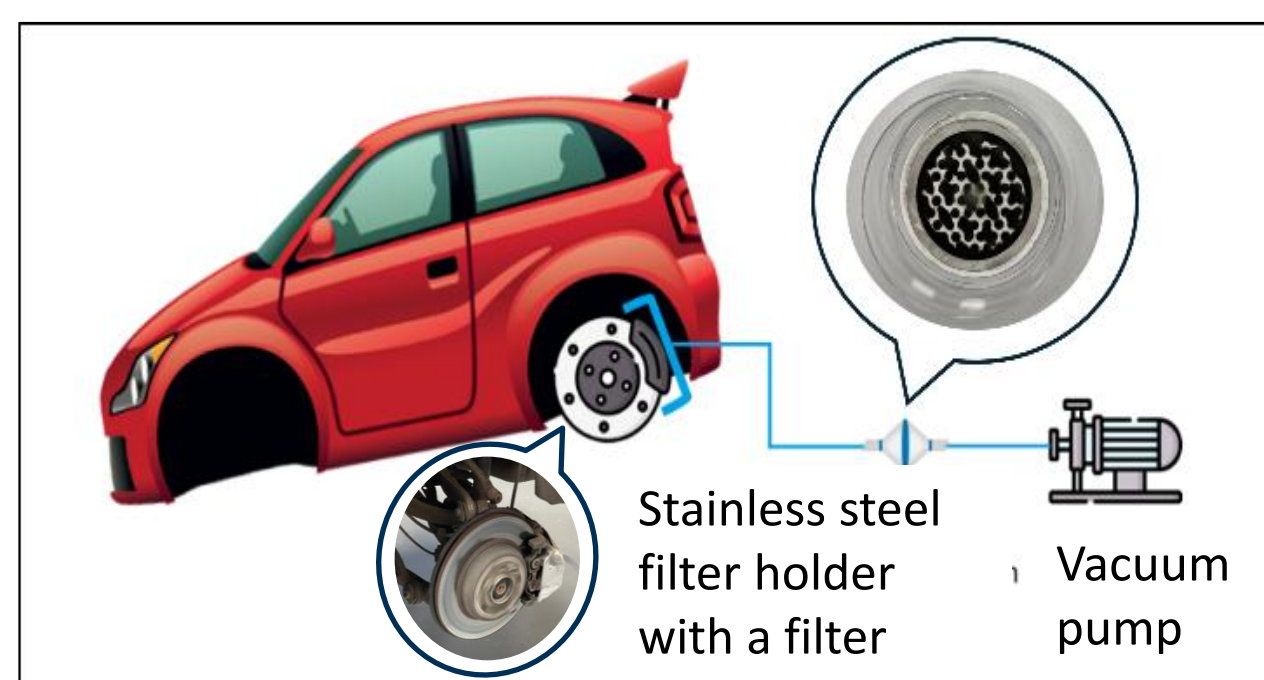


2. Certified reference material (CRM) recovery:

- Good recoveries** achieved (**87-113 %**) using NIES no.8 exhaust particulate
- Sb slightly low (near the detection limit, 0.01 ppb)

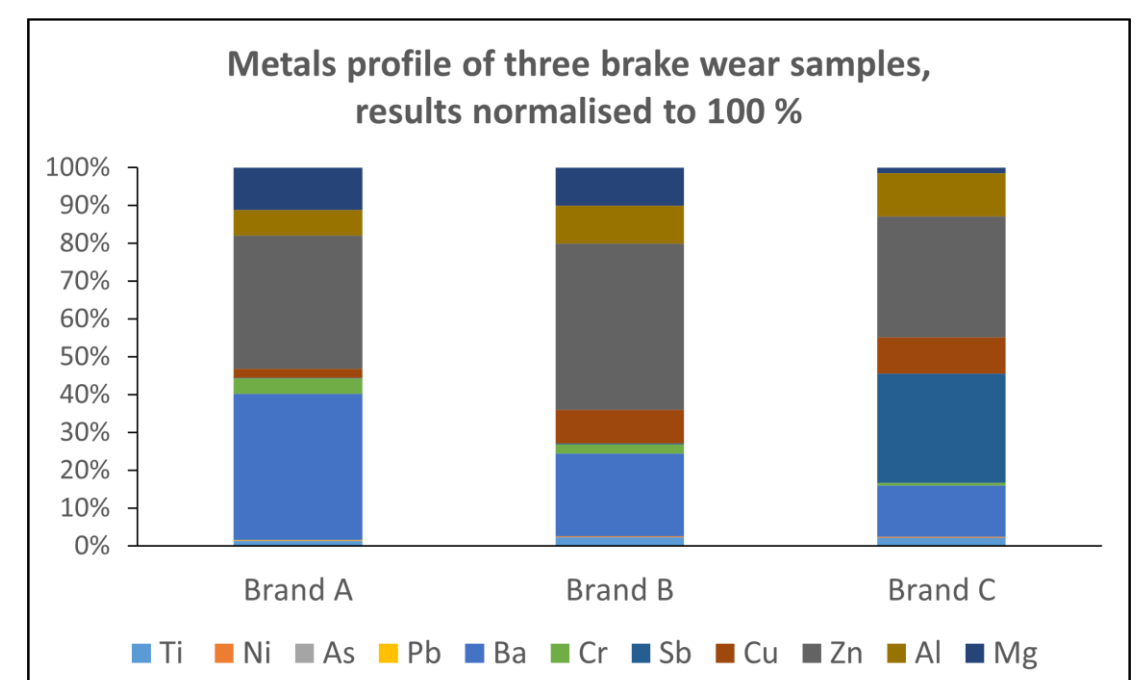
Sampling

- Brake-wear sampling system developed by NPL and Emissions Analytics
- Static tests** rear-brake test
- No wheel** to rule out tyre wear contribution

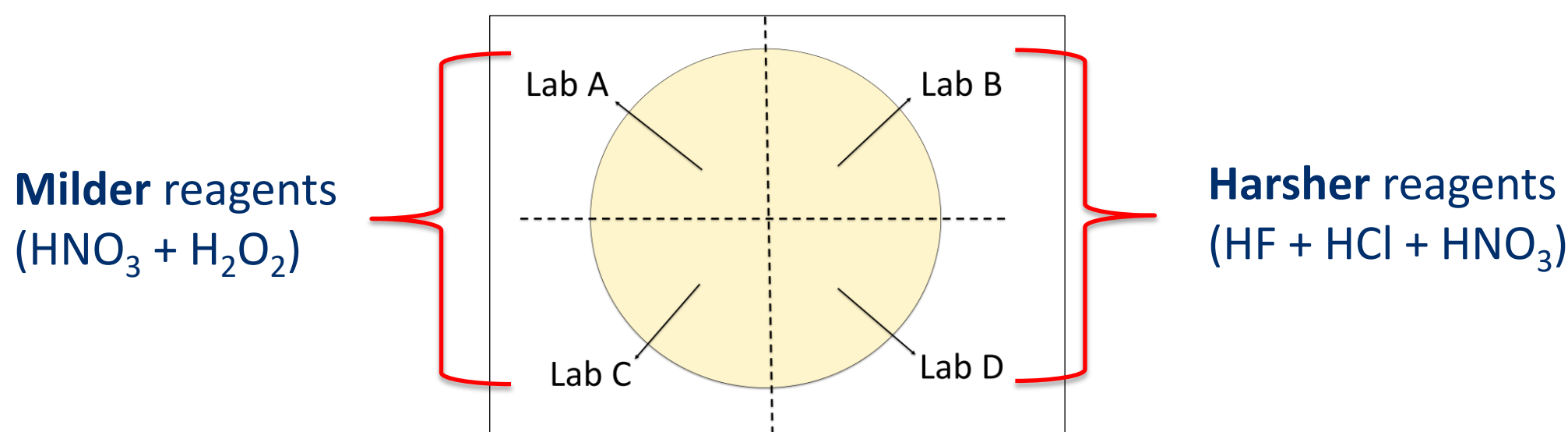


Real sample testing

- Three** commercial brake-wear samples analysed
- Fe signal dominated (> 80 %** among all elements), excluded from plots for clarity
- Clear brand differentiation**



Inter-laboratory Study



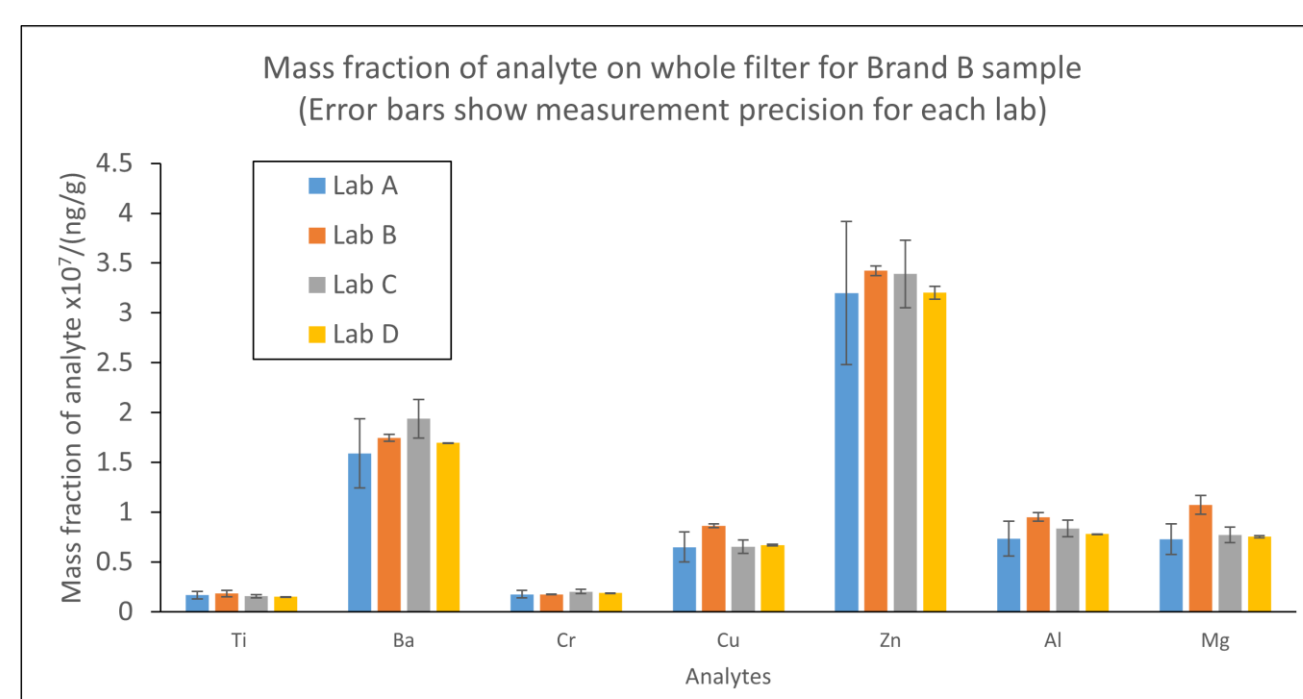
- Four labs**, identical samples

- Results consistent across labs**

High agreement (low RSD)

- Mild digestion** performed well

HF not needed under optimised condition



Conclusions

- Euro 7** targets particulates → next likely focus: **toxic metals** within brake wear
- Fit-for-purpose** method developed → robust metal-composition analysis
- NPL capability strengthened → improved emissions-inventory evidence towards **Net Zero**
- Harmonised** method supports different areas → **health data • automotive design • future regulation**



References

- Department of Health and Social Care (2022), Chief Medical Officer's Annual Report 2022 Air pollution.
- Royal College of Physicians (2025), A breath of fresh air: responding to the health challenges of modern air pollution.
- Publications Office of the European Union (2025), Euro 7 standards: new rules for vehicle emissions.