UNIVERSITY OF BIRMINGHAM

Non-Exhaust Emissions from Road Traffic

Roy M. Harrison

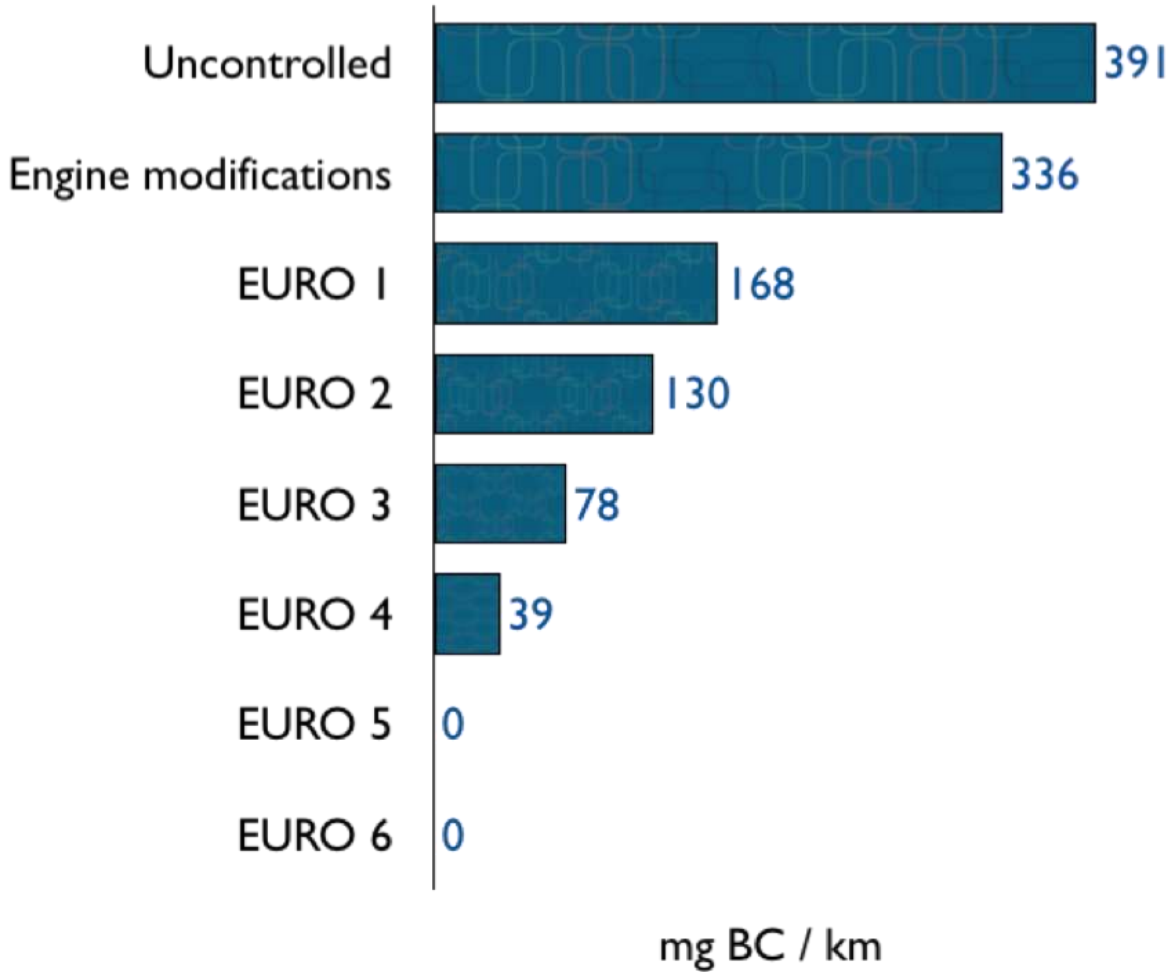
University of Birmingham

UNIVERSITY OF BIRMINGHAM

The changing air pollution climate

- **Road traffic**
  - Catalytic convertors have hugely suppressed exhaust CO and VOC emissions
  - Euro 6 is reducing NO_x at last
  - Diesel particle filters are highly effective
  - Non-exhaust emissions of PM require regulation
  - Battery-electric vehicles

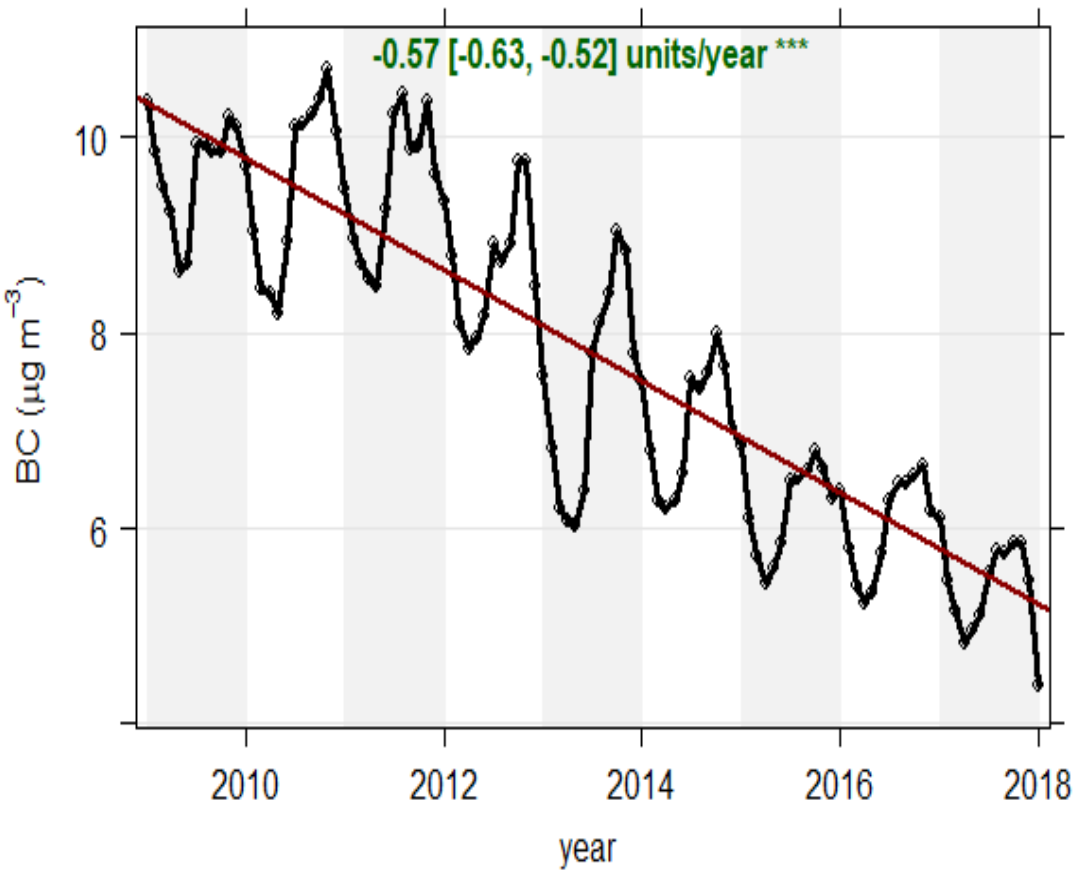
Regulations that force the best available technology have dramatically lowered black carbon emissions



Source: Based on calculations from Michael Walsh, 2010

UNIVERSITY OF BIRMINGHAM

Trends in Black Carbon based on monthly mean concentrations at Marylebone Road, London.



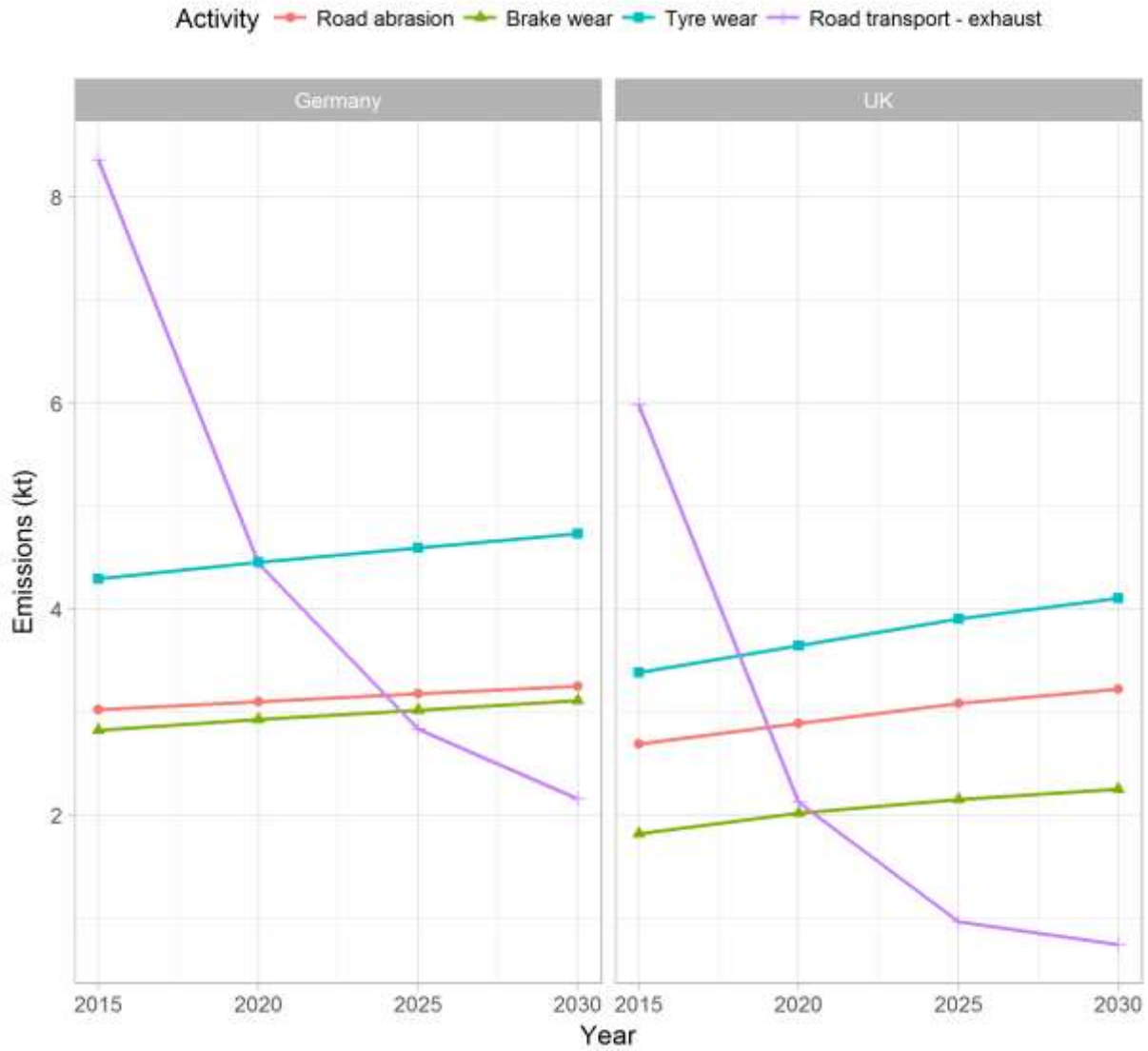
UNIVERSITY OF BIRMINGHAM

What are the non-exhaust particle emissions from road traffic?

- brake dust (from disc and pad)
- tyre dust
- road abrasion particles
- resuspended road surface dusts

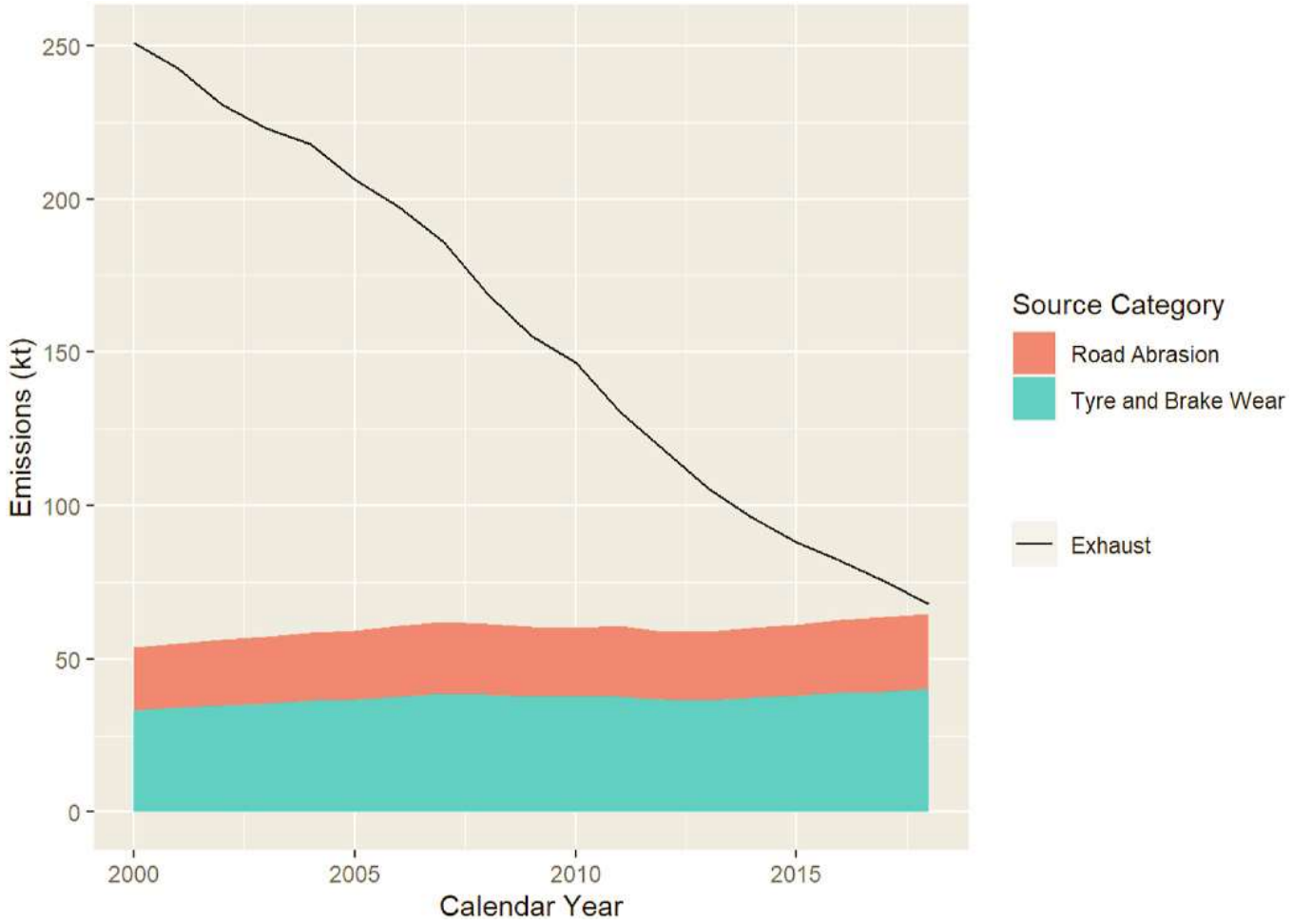
UNIVERSITY OF BIRMINGHAM

$PM_{2.5}$ emissions from road transport sources according to the UK and German Inventories. The scale on the y-axis applies to both countries



UNIVERSITY OF BIRMINGHAM

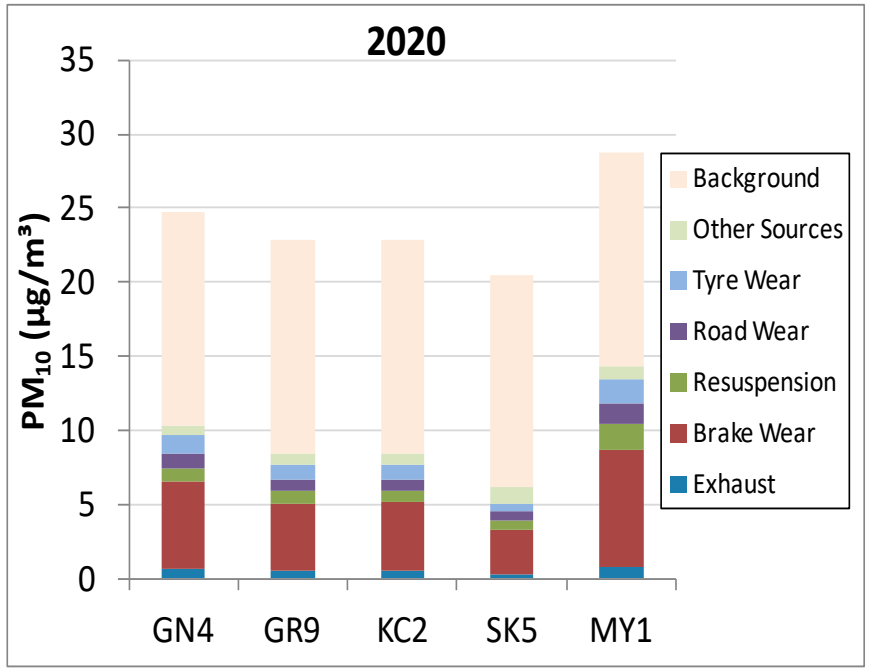
Total exhaust and non-exhaust road transport emissions of PM2.5 from EU28 countries

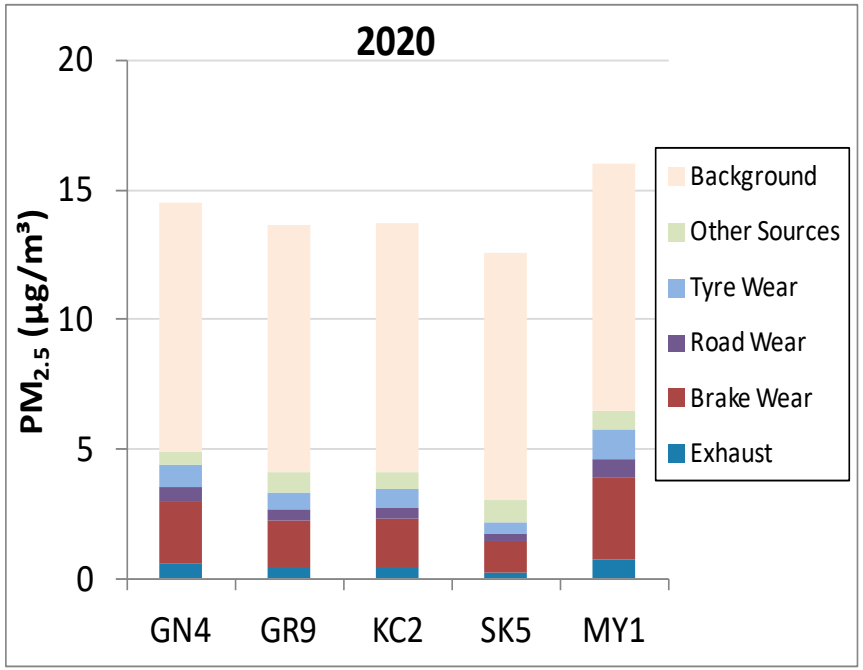


Reference: Allan et al., 2021. non-exhaust vehicle emissions of particulate matter and VOC from road traffic: A review, *Atmos. Environ.*, **262**, 118592 (2021).

UNIVERSITY OF BIRMINGHAM

PM_{10} and $PM_{2.5}$ concentrations modelled using ADMS-Urban at five major roads in London apportioned by emission type (µg m^{-3}) for 2016 and 2020. 'Other' represents the contribution of non-traffic sources in the LAEI.

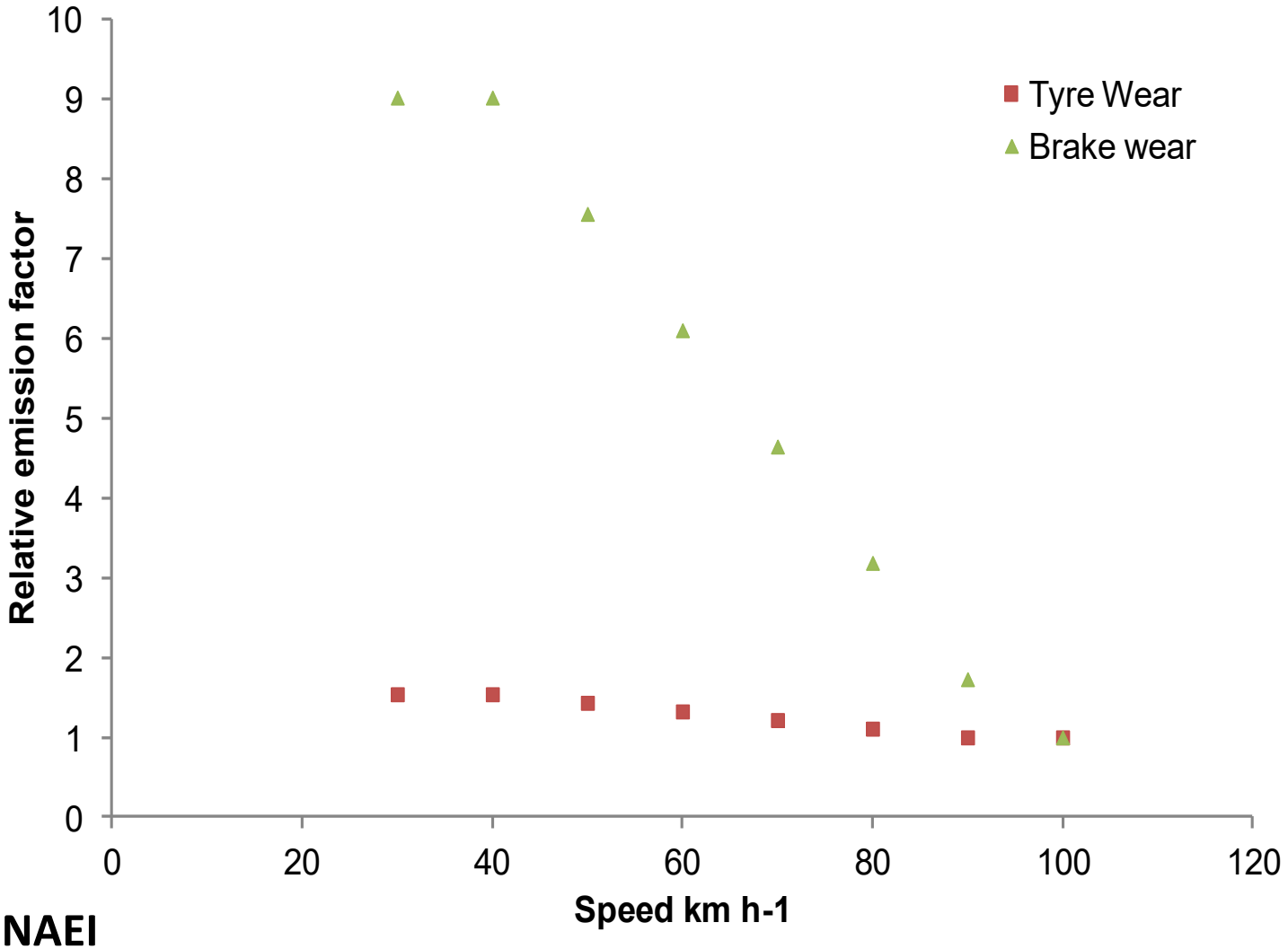




Source - AQEG Report: Non-Exhaust Emissions from Road Traffic

UNIVERSITY OF BIRMINGHAM

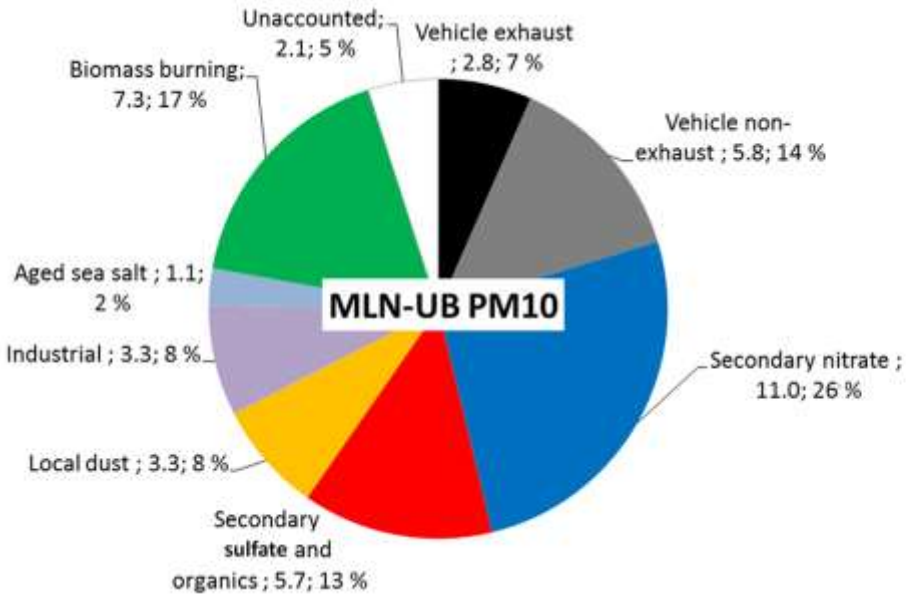
Speed dependence of emissions factors for brake and tyre wear. Each are normalised to their respective emissions rate at 100 km h^{-1}. In this plot speed refers to the average traffic speed and not the instantaneous speed of any vehicle

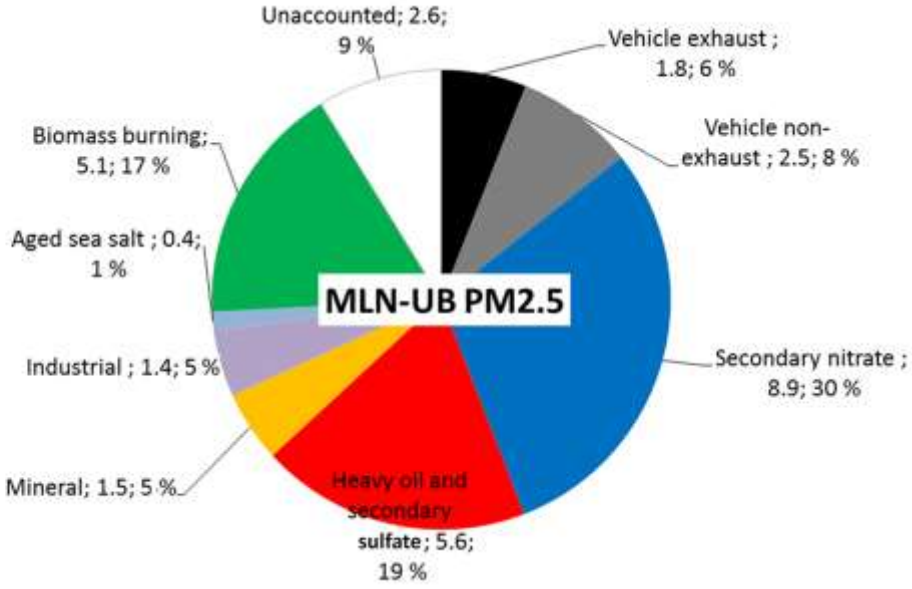


Source: NAEI

UNIVERSITY OF BIRMINGHAM

Average contribution (%) of PM_{10} and $PM_{2.5}$ sources for 12 months of study



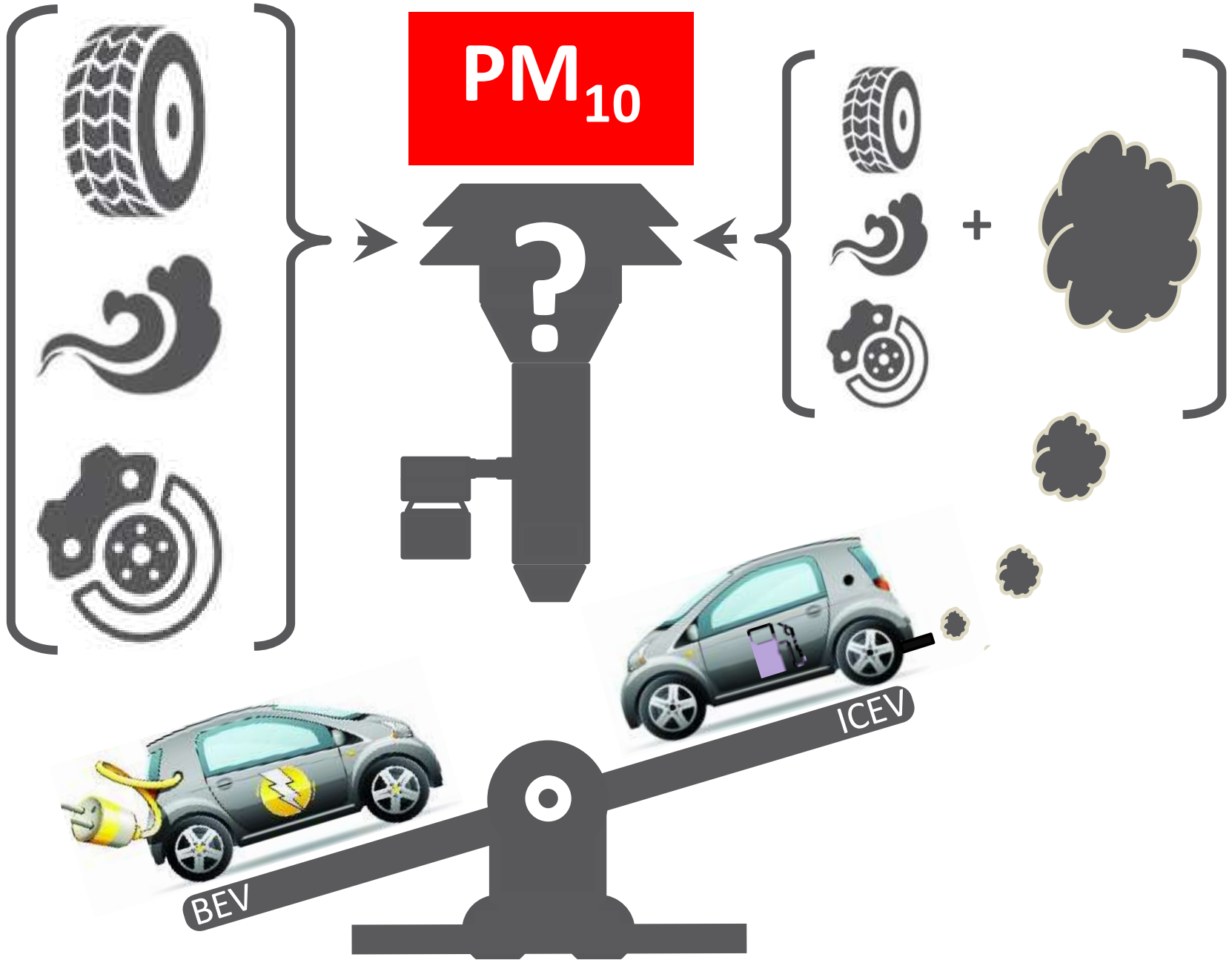


From Amato et al., ACP, 16, 3289-3309, 2016

Battery-electric vehicles (BEV)

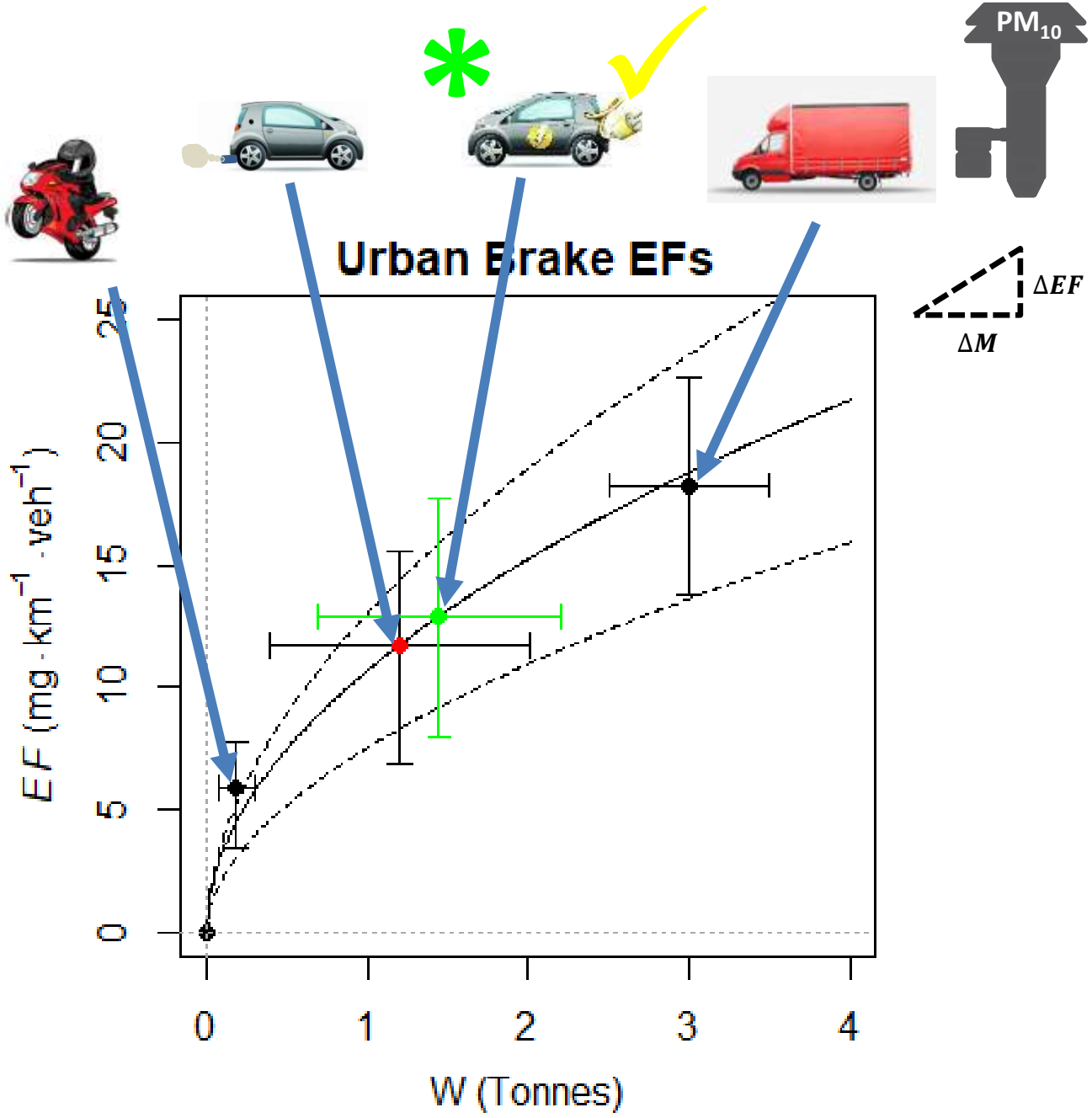
- It has been suggested that BEV are heavier than their equivalent ICE vehicle.
- A greater vehicle weight implies greater abrasion emissions and dust resuspension.
- However, regenerative braking reduces brake wear.
- The net effect is uncertain

ELECTRIC VEHICLES:- Will they lower PM emissions?

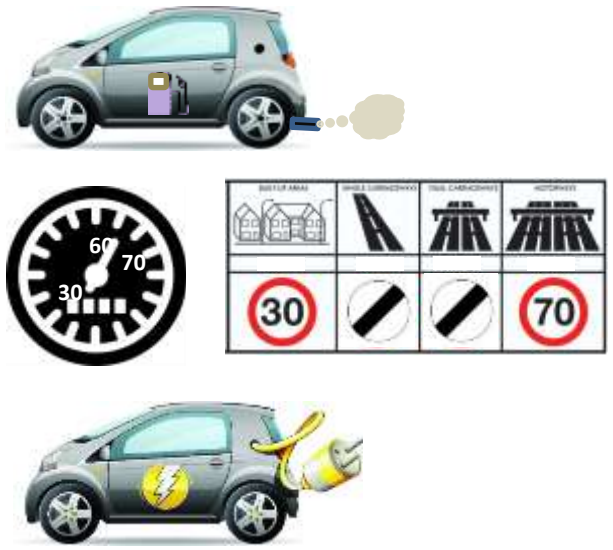


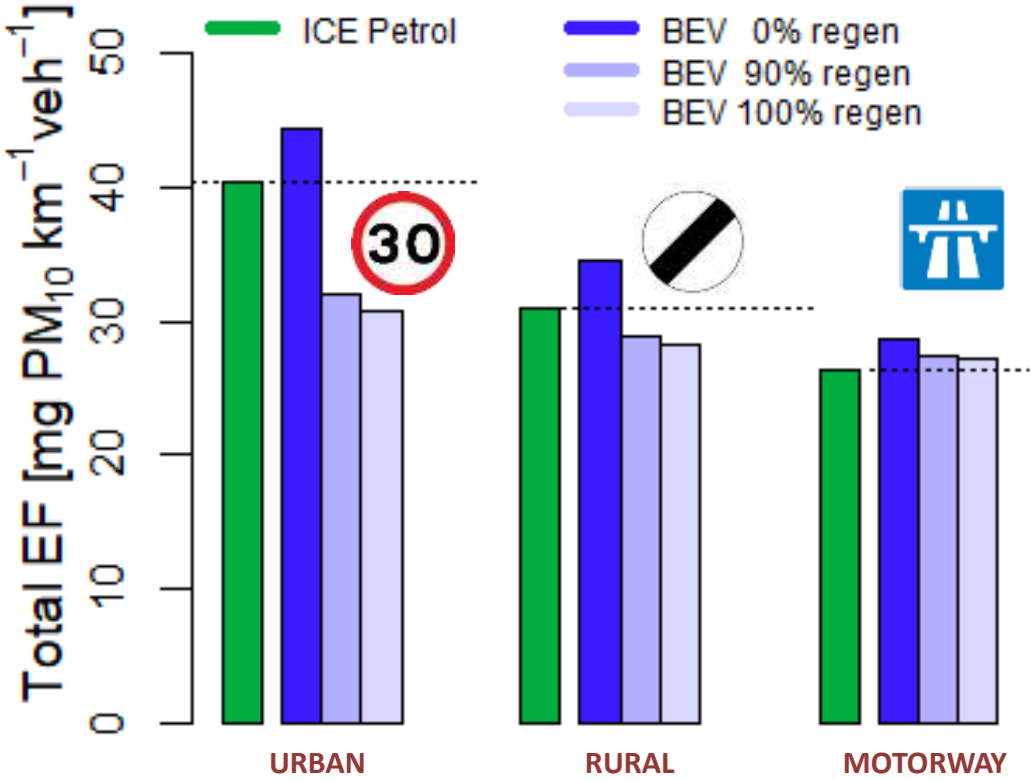
Regression: EF_{brake} vs Vehicle Mass

$$EF^{brake} = bW_{rel}^{\frac{1}{c}}$$



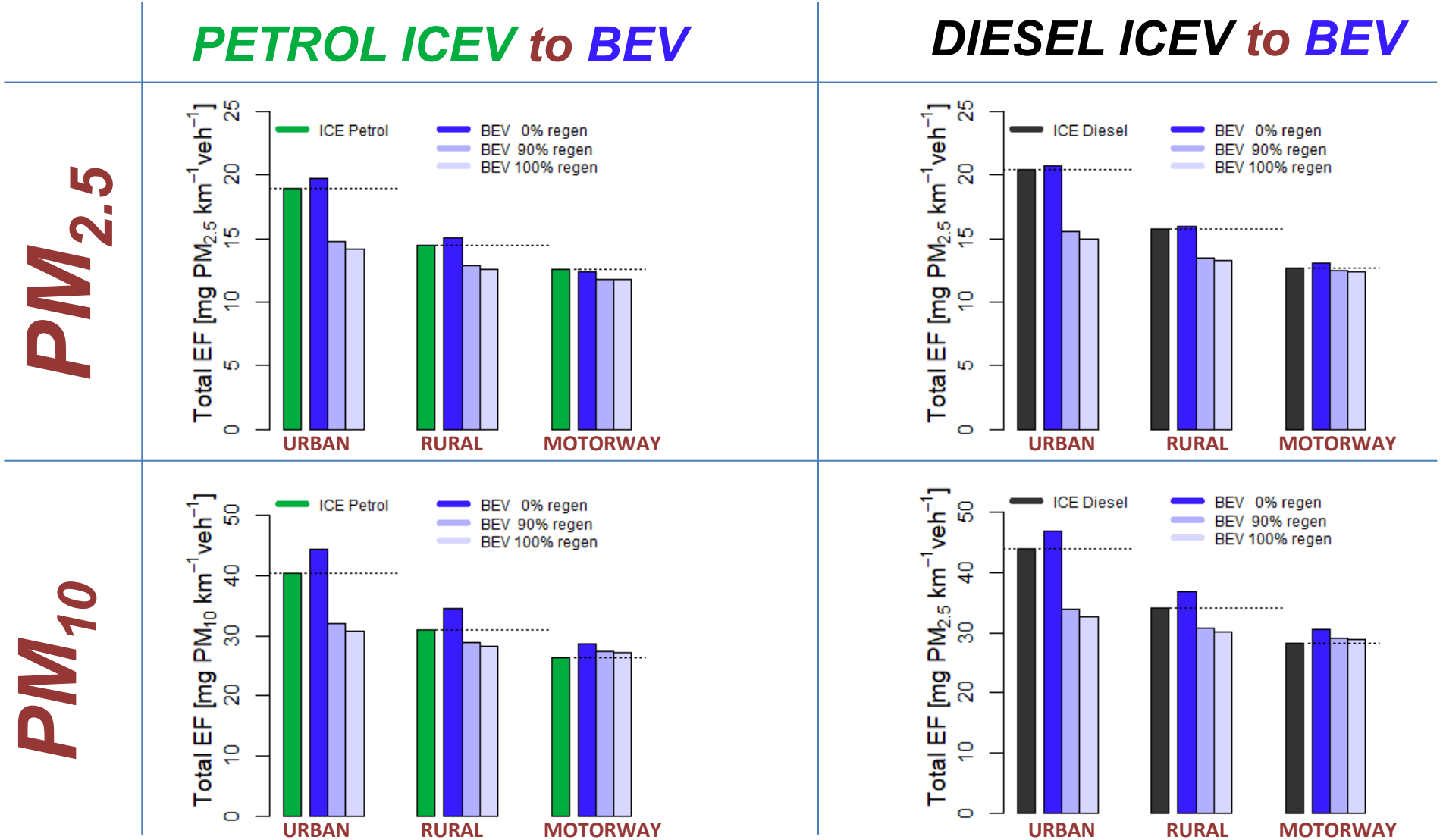
Estimation of Electric Vehicle Emission Factor PM_{10} (petrol)



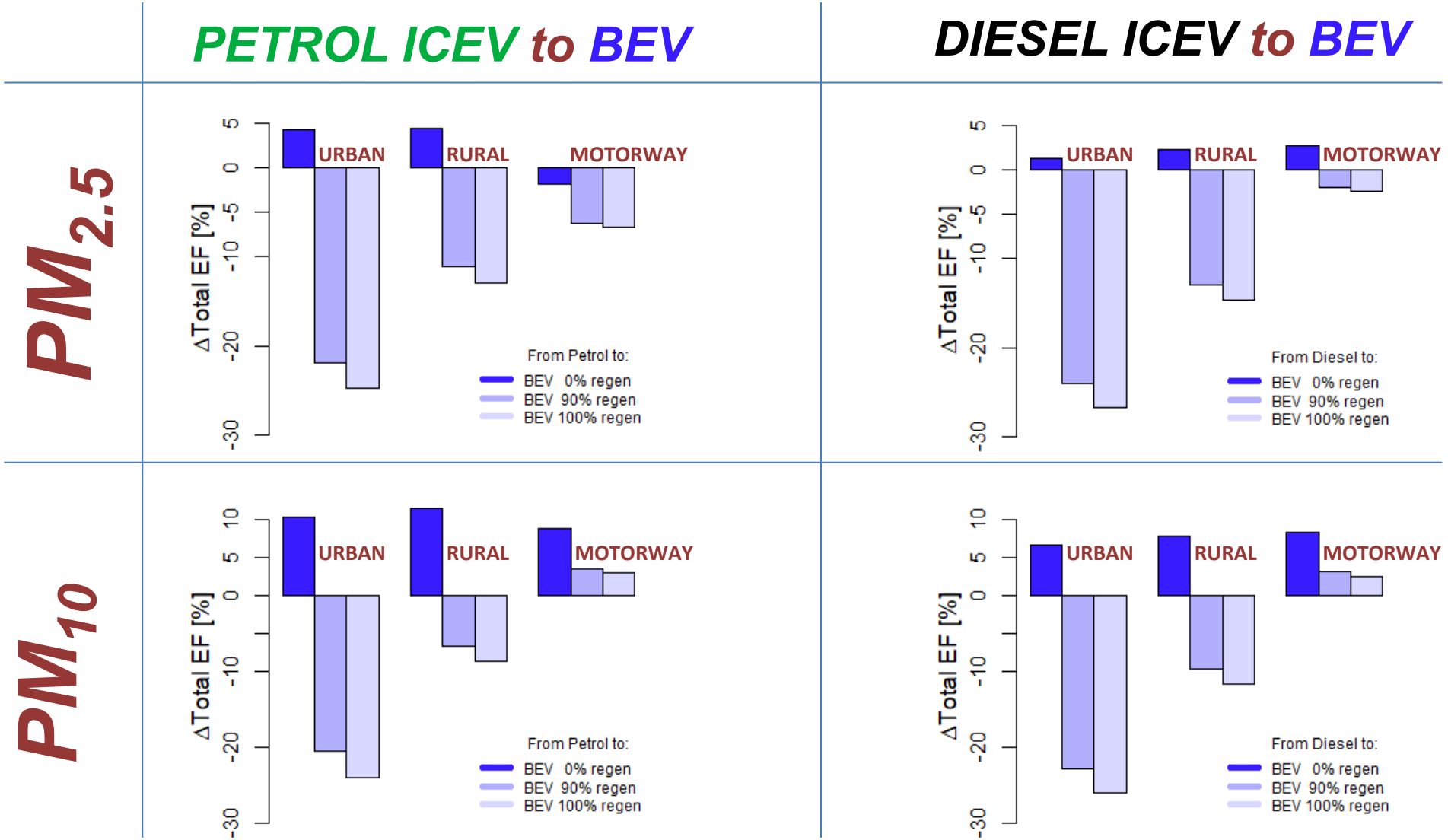


Total emission factors *with* / *without* regenerative braking

The absolute values of total emission factor estimated for petrol, diesel and battery electric vehicles, the latter with 0%, 90% and 100% regenerative braking on different road types.

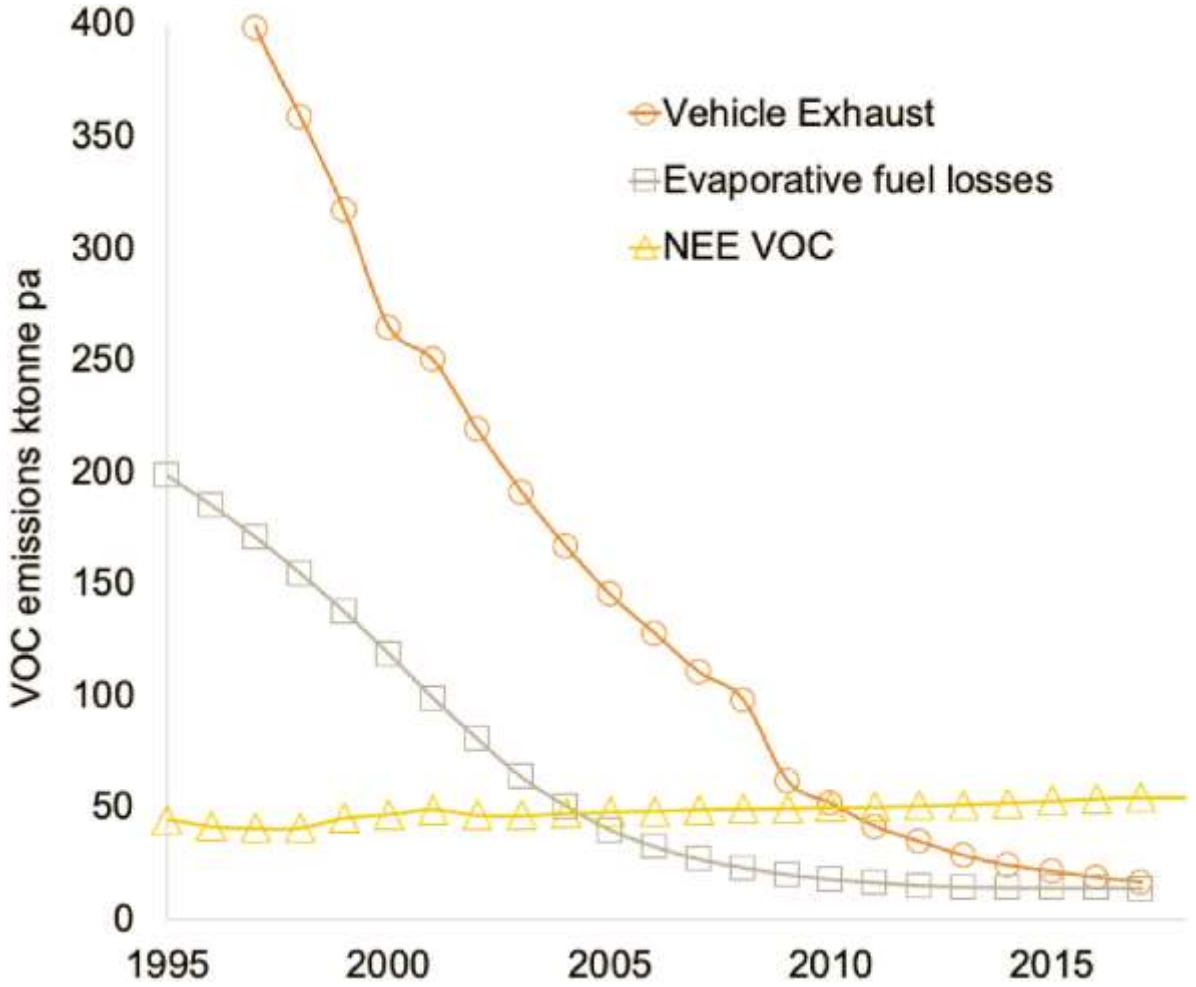


The percentage change in emission factor from a diesel (left panel) or petrol (right panel) vehicle to a battery electric vehicle with 0%, 90% or 100% regenerative braking.



UNIVERSITY OF BIRMINGHAM

UK emissions of NMVOCs from all road transport by sources according to the United Kingdom National Atmospheric Emissions Inventory



Reference: Allan et al., 2021. non-exhaust vehicle emissions of particulate matter and VOC from road traffic: A review, *Atmos. Environ*., **262**, 118592 (2021).

UNIVERSITY OF BIRMINGHAM

THANK YOU