

Abrasive Emissions from NFR 1.A.3.c – Railways

Germany's tier 0.5 approach

For more information and detailed data, please refer to the relevant [IIR chapter](#)!

emissions likely to occur:

- particulate emission from abrasion of power line, tyres on rails, current collector, and brakes
- (heavy-)metal emissions from power line (Cu) and brakes (Cr & Ni) and current collector (Al)

limited original data available:

- PM₁₀ emission estimates *for entire railway sector*, provided directly from Deutsche Bahn AG (DB AG):
→ separate numbers for...
 - ...brakes
 - ...contact line
 - (...and current collector),...but from 2013 onwards only!
- annual mileage data *for entire railway sector*, from TREMOD model, for all years and separately for...
 - ...electric and
 - ...diesel traction

data needed – and how we “produce” it:

- **IEFs for PM₁₀**: estimated via backward extrapolation from original DB AG estimates:

$$\rightarrow \text{IEF}_{\text{brakes}} = \text{EM}(\text{PM}_{10})_{\text{brakes, DB AG}} : \text{mileage}_{\text{Total, TREMOD}}$$

$$\rightarrow \text{IEF}_{\text{contact line}} = \text{EM}(\text{PM}_{10})_{\text{contact line, DB AG}} : \text{mileage}_{\text{electric traction, TREMOD}}$$

- **IEF for PM_{2.5} and TSP**: by “expert” judgement, a *highly uncertain* 1:1:0.5 distribution (TSP:PM₁₀:PM_{2.5}) is applied:

$$\rightarrow \text{IEF}_{\text{PM}_{2.5}} = 0.5 \times \text{IEF}_{\text{PM}_{10}}$$

$$\rightarrow \text{IEF}_{\text{TSP}} = \text{IEF}_{\text{PM}_{10}}$$

- **IEF for HMs**: based on information from DB AG and Wikipedia, we assume that particle abrasion from the power line consists of 100% copper...

$$\rightarrow \text{IEF}_{\text{copper, contact line}} = \text{IEF}(\text{PM}_{10})_{\text{contact line}}$$

...and particle abrasion from brakes are 1% Ni and 2% Cr (*another uncertain assumption*):

$$\rightarrow \text{IEF}_{\text{nickel, brakes}} = 0.01 \times \text{IEF}(\text{PM}_{10})_{\text{brakes}}$$

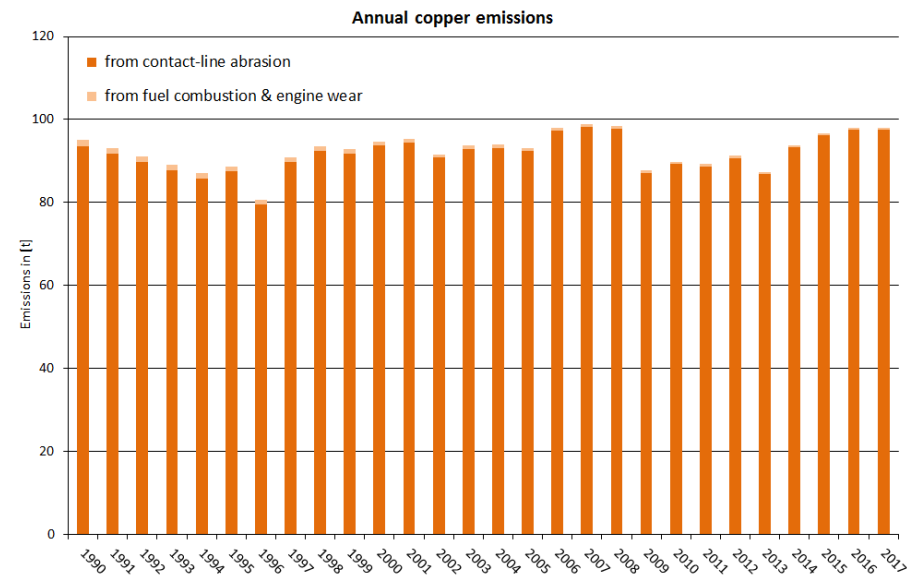
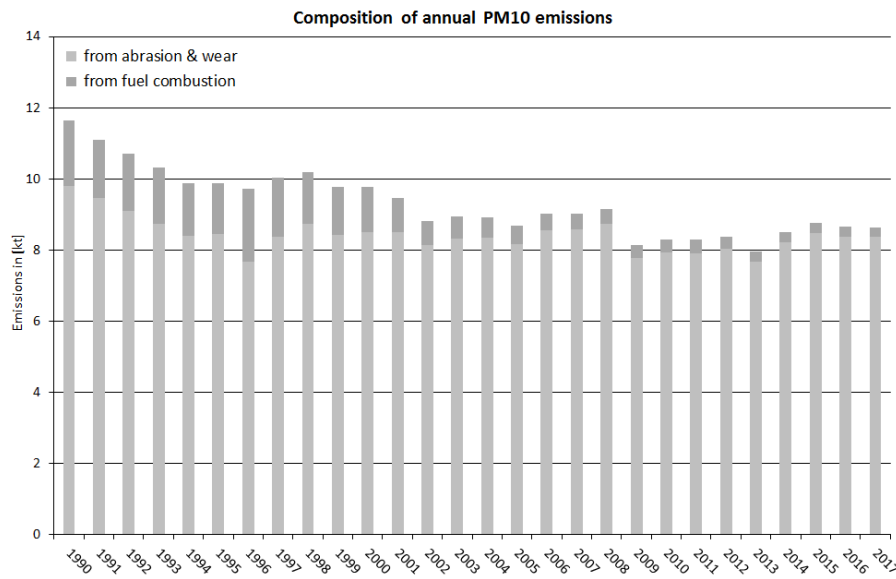
$$\rightarrow \text{IEF}_{\text{chromium, brakes}} = 0.02 \times \text{IEF}(\text{PM}_{10})_{\text{brakes}}$$

emissions estimated & reported so far

- PM emissions from abrasion of brakes (for electric and diesel traction) and power line (electric traction only)
- copper emissions from abrasion of power line)
- chromium & nickel emissions from abrasion of the tyres

impact on NFR and National Totals (NT) exceptionally strong for PM and copper

By including abrasive emissions in the 2018 submission, PM and Cu emissions from 1.A.3.c increased by several orders, with the abrasive emissions by far dominating the over-all amounts reported:



With respect to the National Totals reported by Germany for 2017, over 4% result from power line abrasion now! (Second-largest contribution with ~95 % resulting from abrasive emissions in NFR 1.A.3.b vi.).