

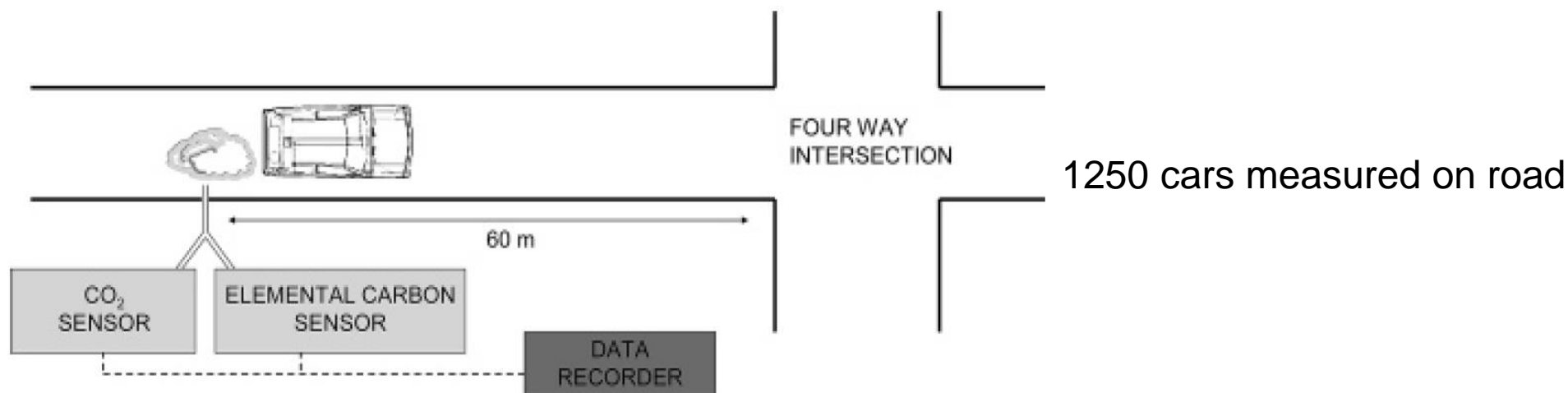
Dirty-Tail calls for Extension of NPTI to all ICE

H. Burtscher, A. Mayer



Indication that few high-polluters dominate fleet emissions exists long time

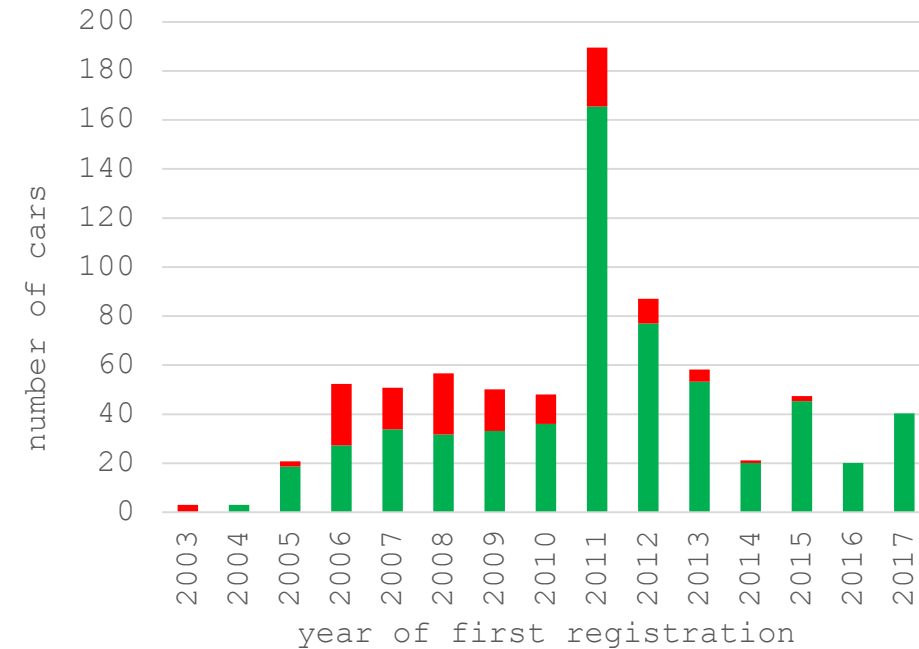
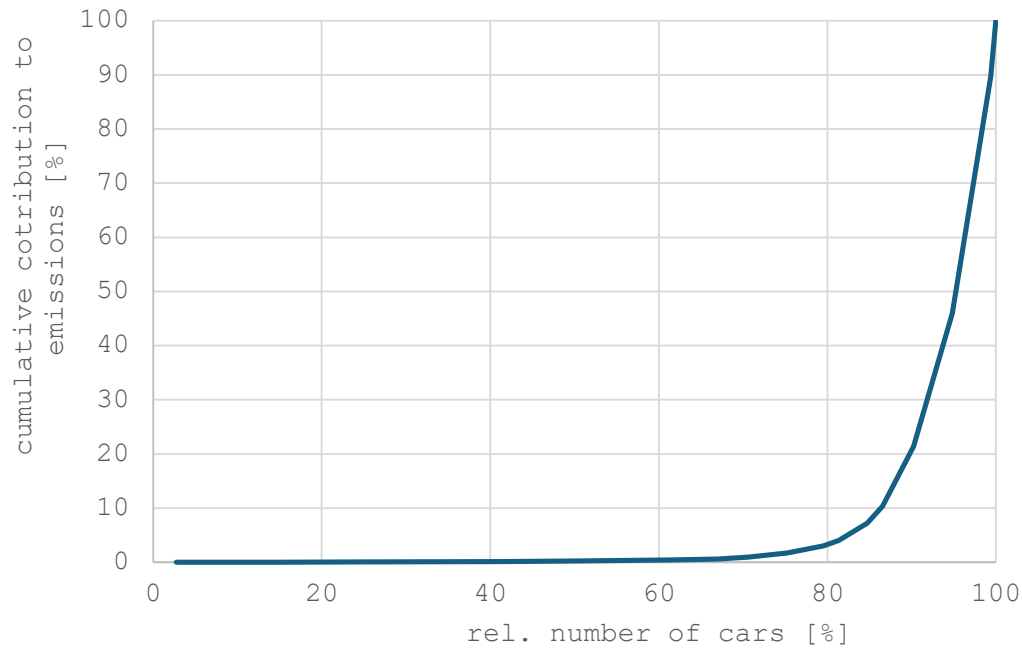
- **Kurinawan and Schmidt-Ott (2006):** A small percentage of “superpolluters” (here 5%) account for a high percentage (here 43%) of the pollution



Beaton et al., 1995: The emission distribution is highly skewed; the half of the fleet with the lowest emissions contributed less than 10% of the CO and HC, while a few high-emission vehicles dominated the mean values. In this instance, 7% of the vehicles accounted for '50% of the on-road CO emissions, and 10% of the vehicles accounted for 50% of the on-road HC emissions.

Meanwhile corroborated by a large number of studies

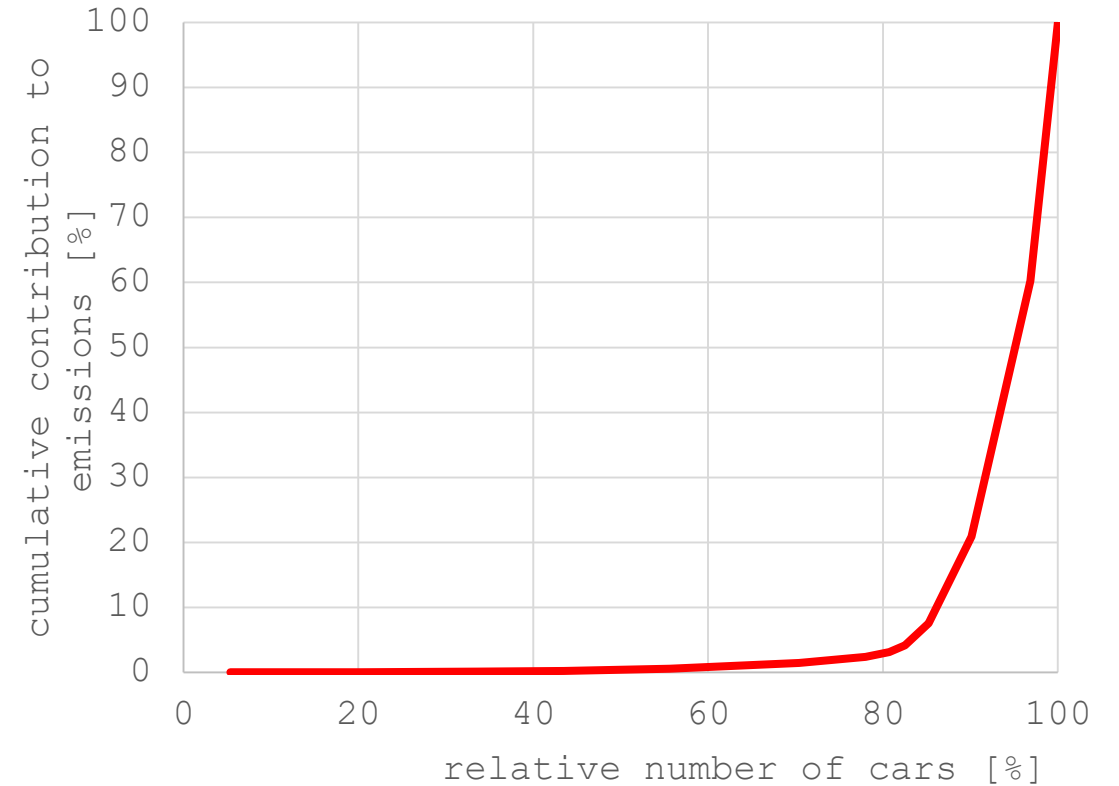
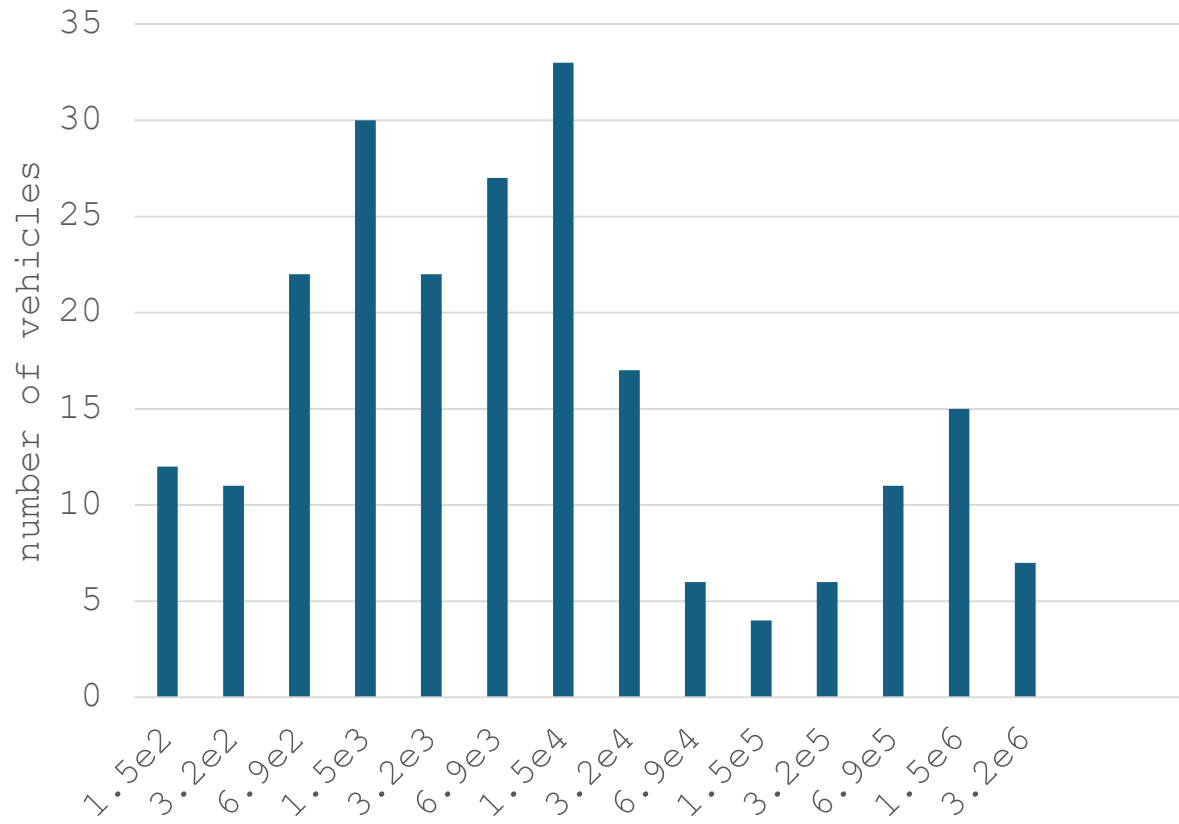
PN emissions from diesel vehicles with DPF



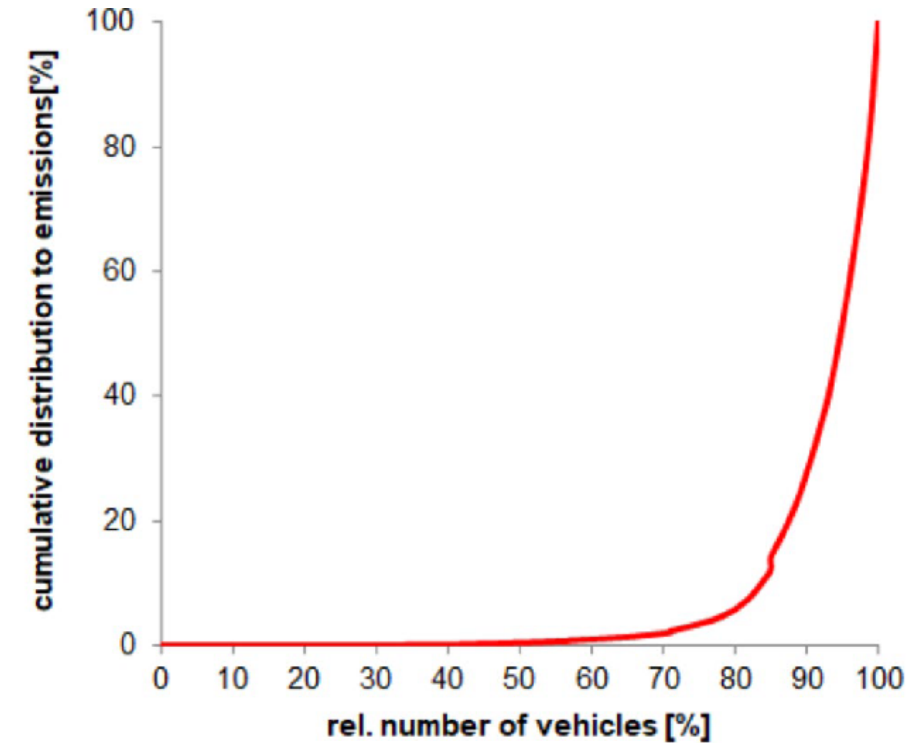
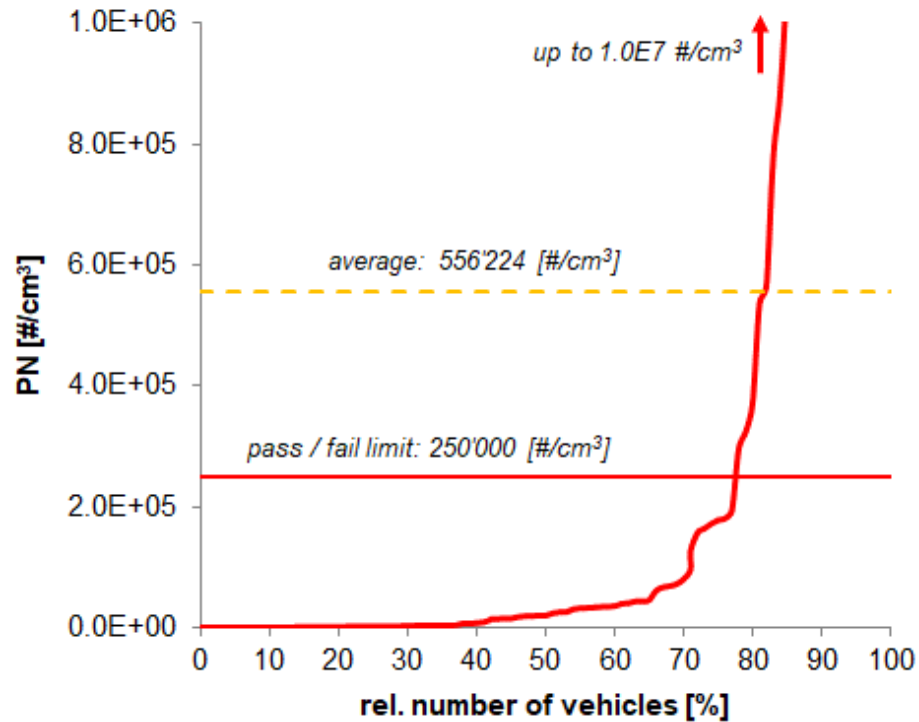
Distribution of the filter failure rate as a function of vehicle operating time (green: $< 250,000 \text{ cm}^{-3}$ red: $> 250,000 \text{ cm}^{-3}$)

Data from B. Gloor, AWEL

400 buses (Santiago, Chile)



Emissions from construction machinery



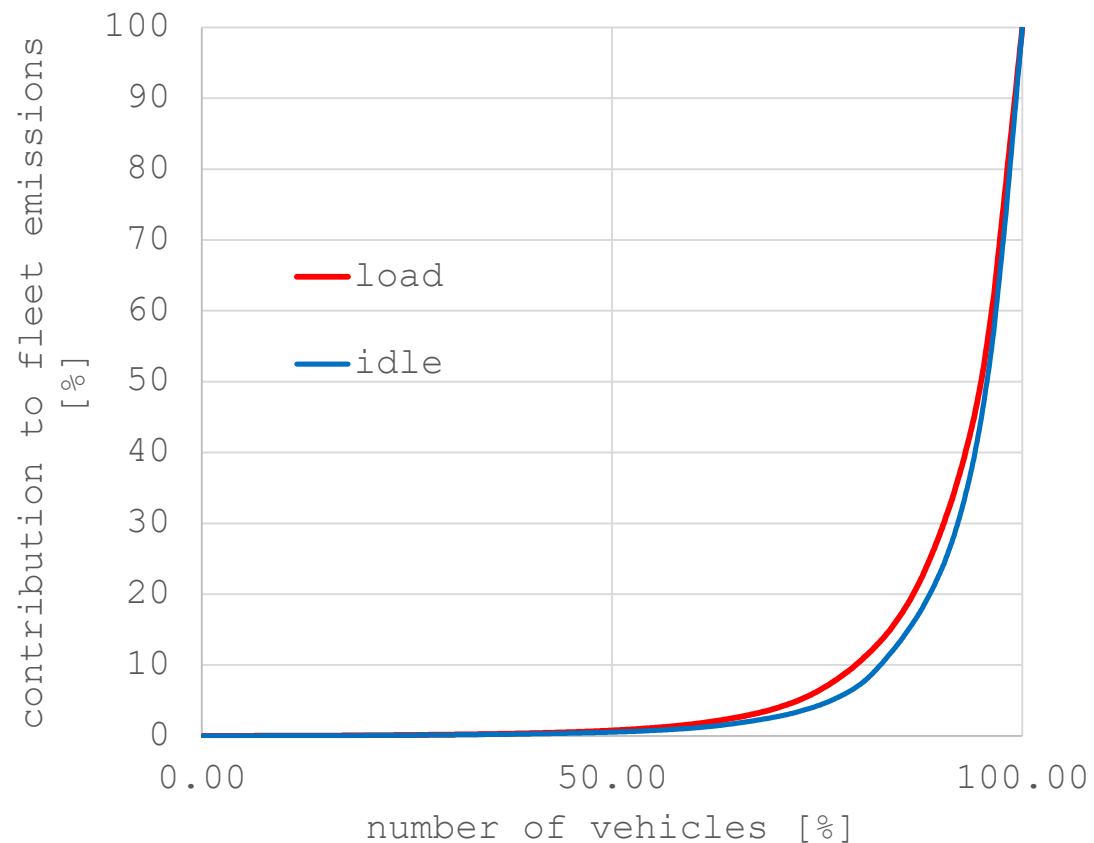
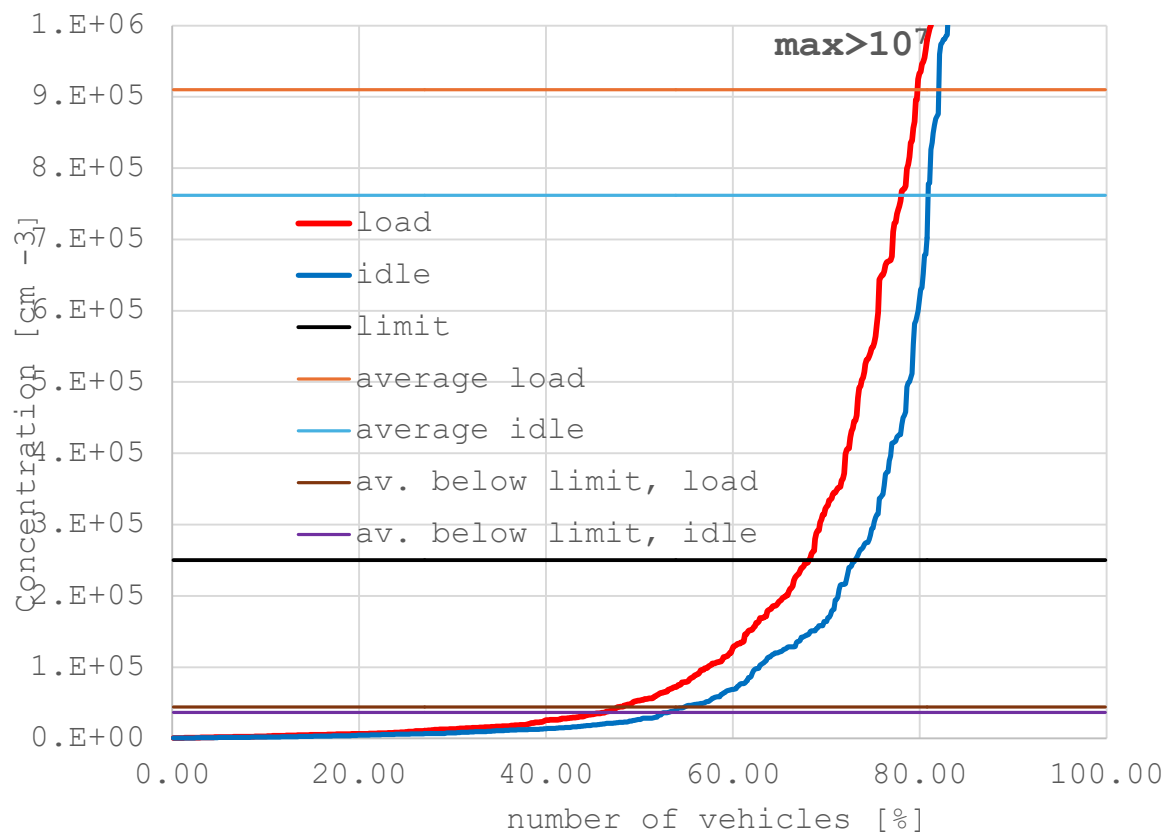
Cumulative impact on the emissions of the entire fleet

Nauroy, H., Compte, P., Czerwinski, J., Willi, P.: Field Particle Number and Opacity Measurements on Construction Machinery. Report Berner Fachhochschule, Labor für Verbrennungsmotoren und Abgastechnik (2017)

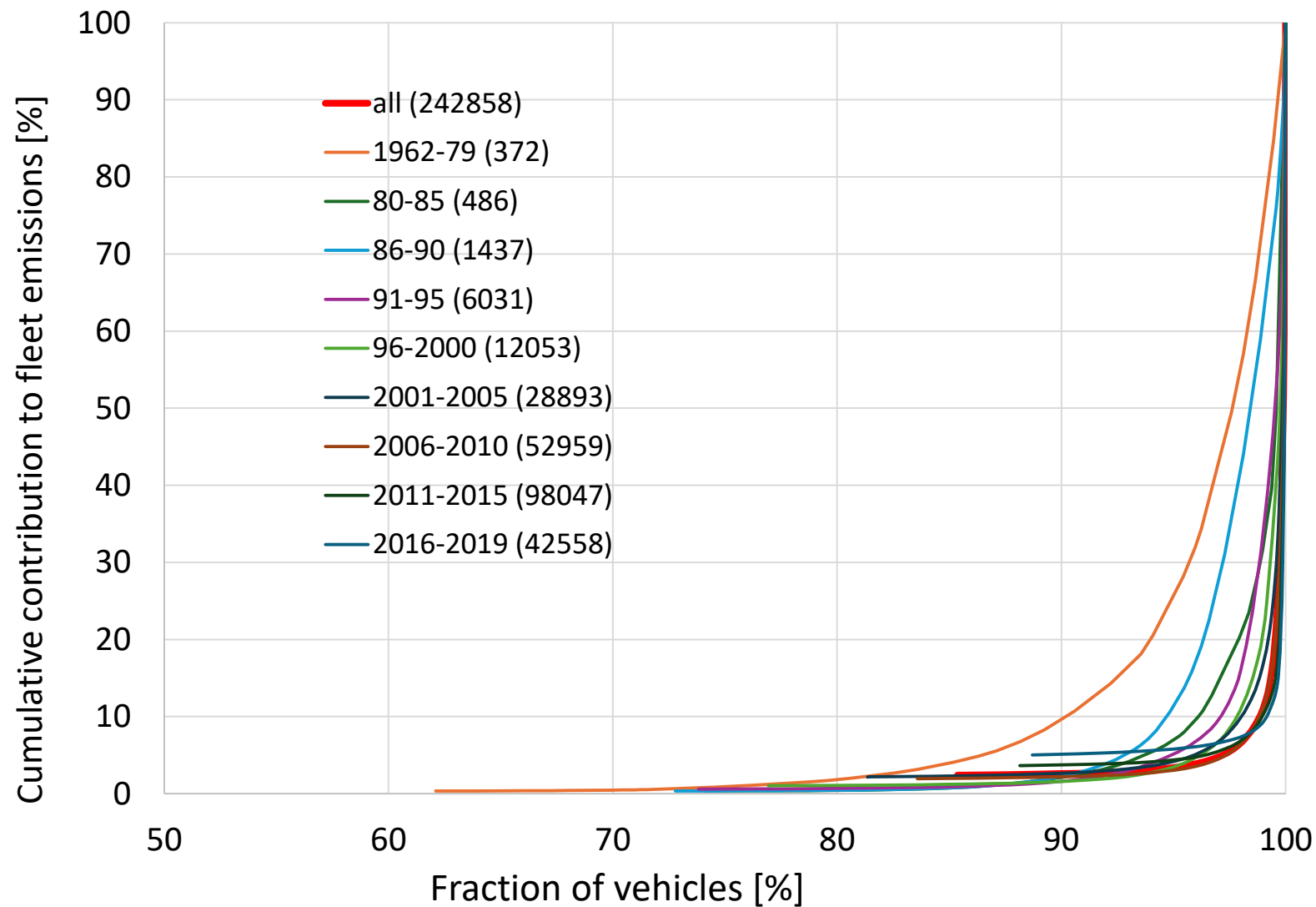
? Only Diesel with DPF?

- Meanwhile many studies with diesel vehicles, equipped with DPF
- High emissions ascribed to filter problems
- This led to reintroduction of PTI for particle emissions
- More and more evidence that also important for gasoline

Emissions from modern vehicles with gasoline engines with CO

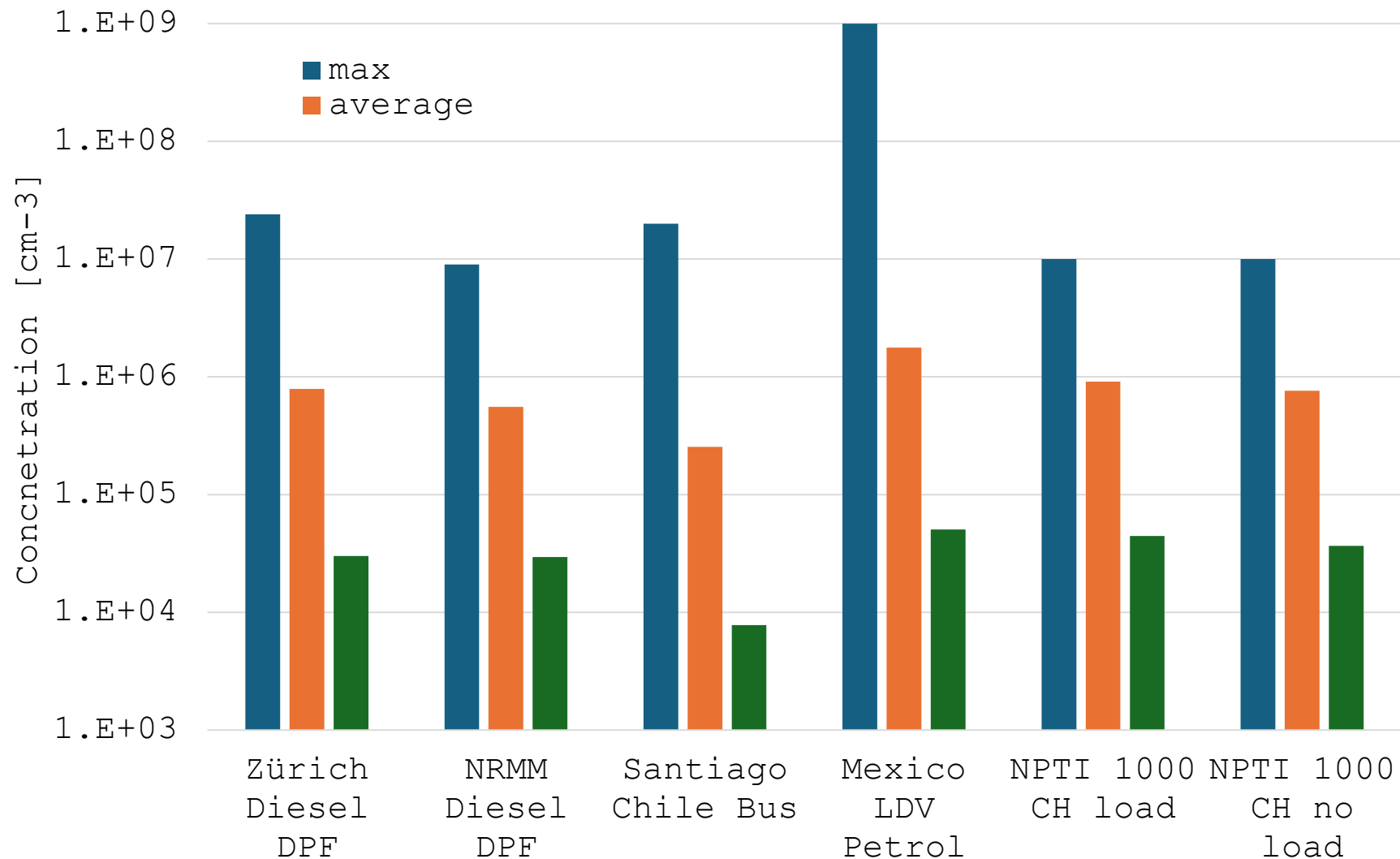


Emissions from >400'000 vehicles in Mexiko



Vehicles without fil
PFI and DI
Same picture

Max. and average emissions of all vehicles and those compliant with the limit of 250'000 cm⁻³



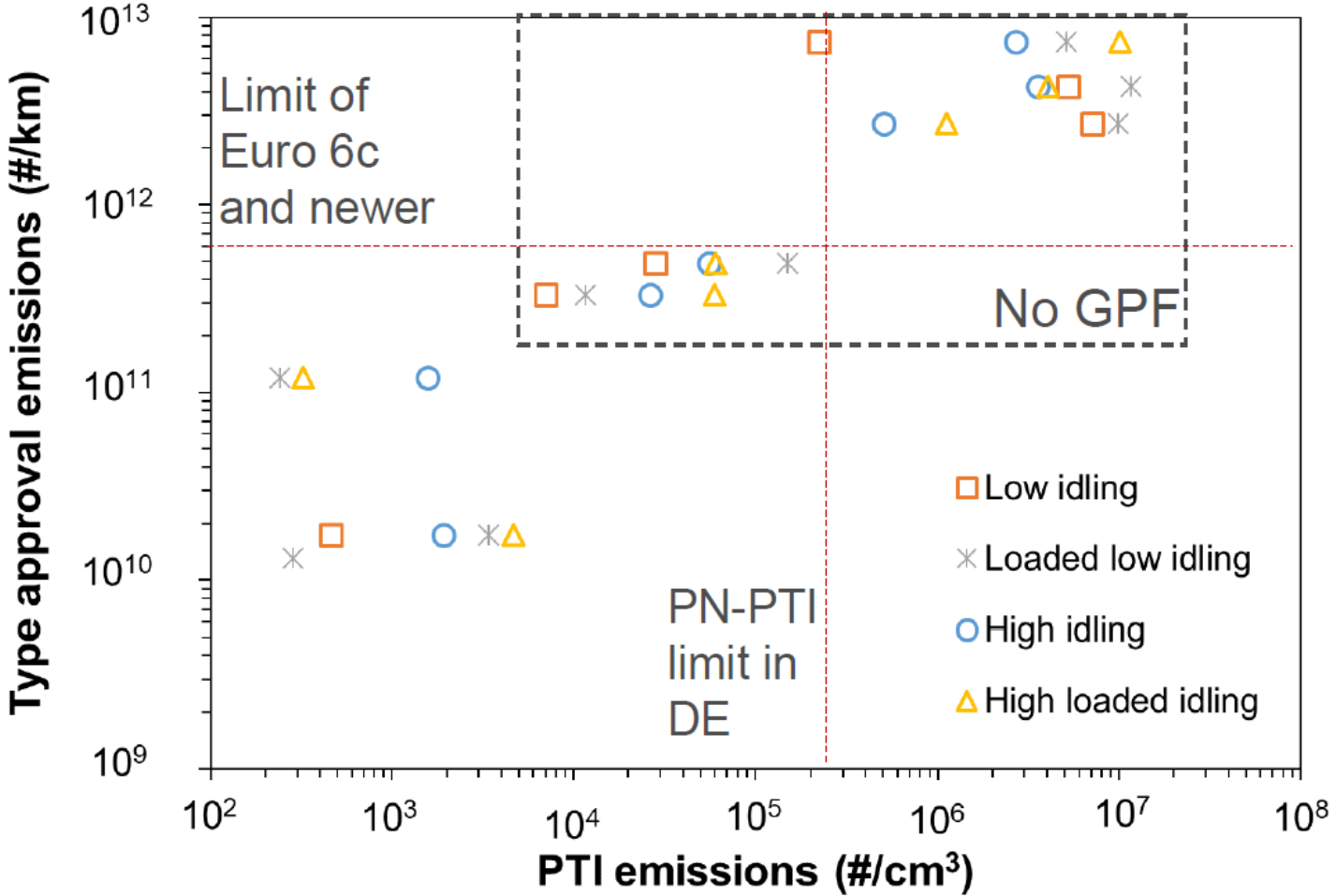
- Very similar results also for gasoline vehicles with and without filters
- PTI is important for all internal combustion engines
- Beside filter problems also other reasons lead to this result, we need to learn more about these reasons, engine + filter are responsible for the emissions

Can the same procedure be used?

Diesel:

- Measurement at low idle, cutoff at 23 nm
- Has good correlation to type approval

- High idling emissions (loaded or not) exhibited better linearity with type approval emissions compared to low idling (loaded or not)



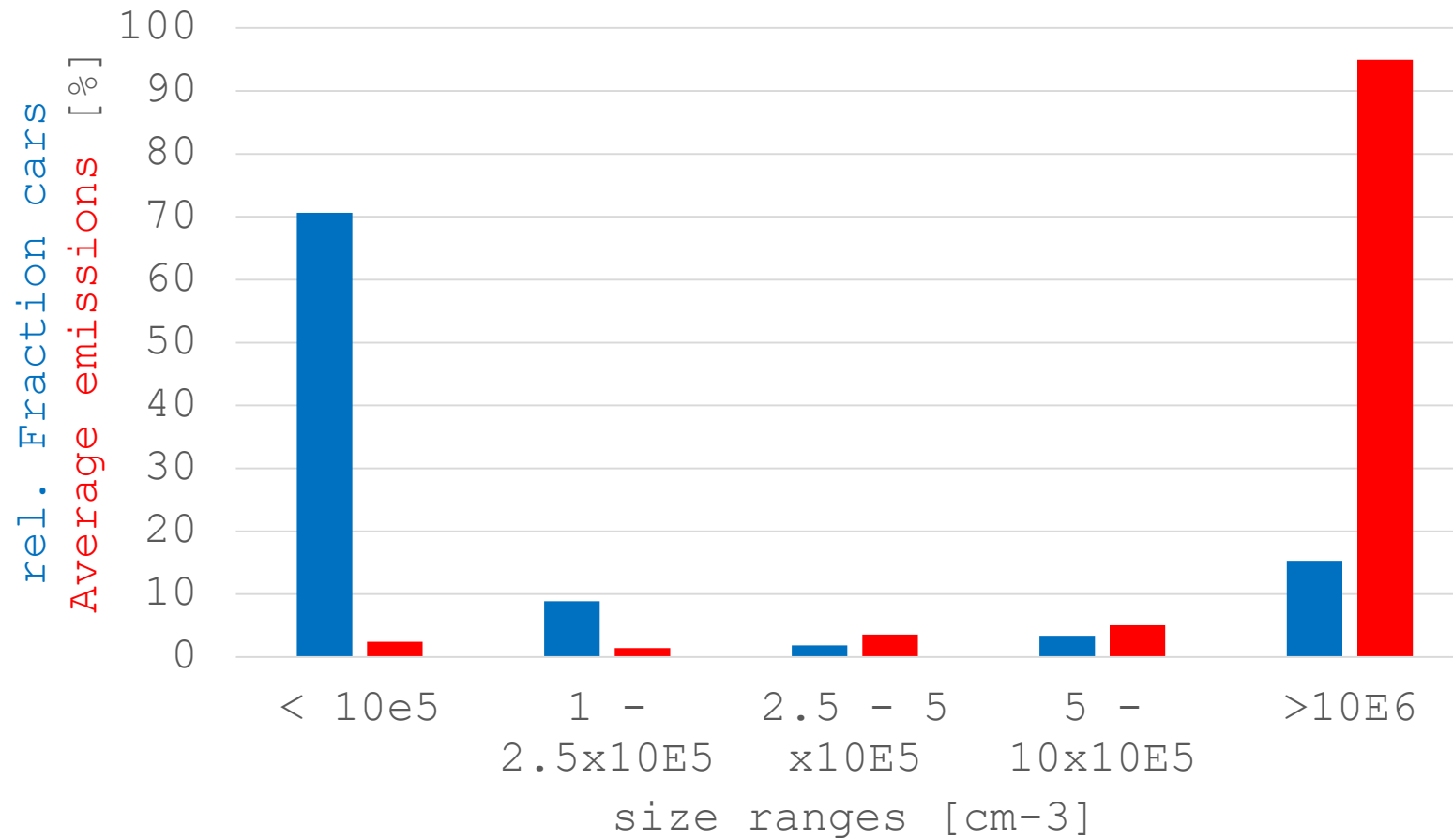
Test	R ²
Low idling	0.01
Loaded low idling	0.41
High idling	0.72
Loaded high idling	0.90

Huge difference in R²
 However: all vehicles, fulfilling type approval limit also pass the PTI test and vice versa for all 4 conditions

Melas: JRC activities on PN-PTI tests for gasoline vehicles, VERT-Forum 2024

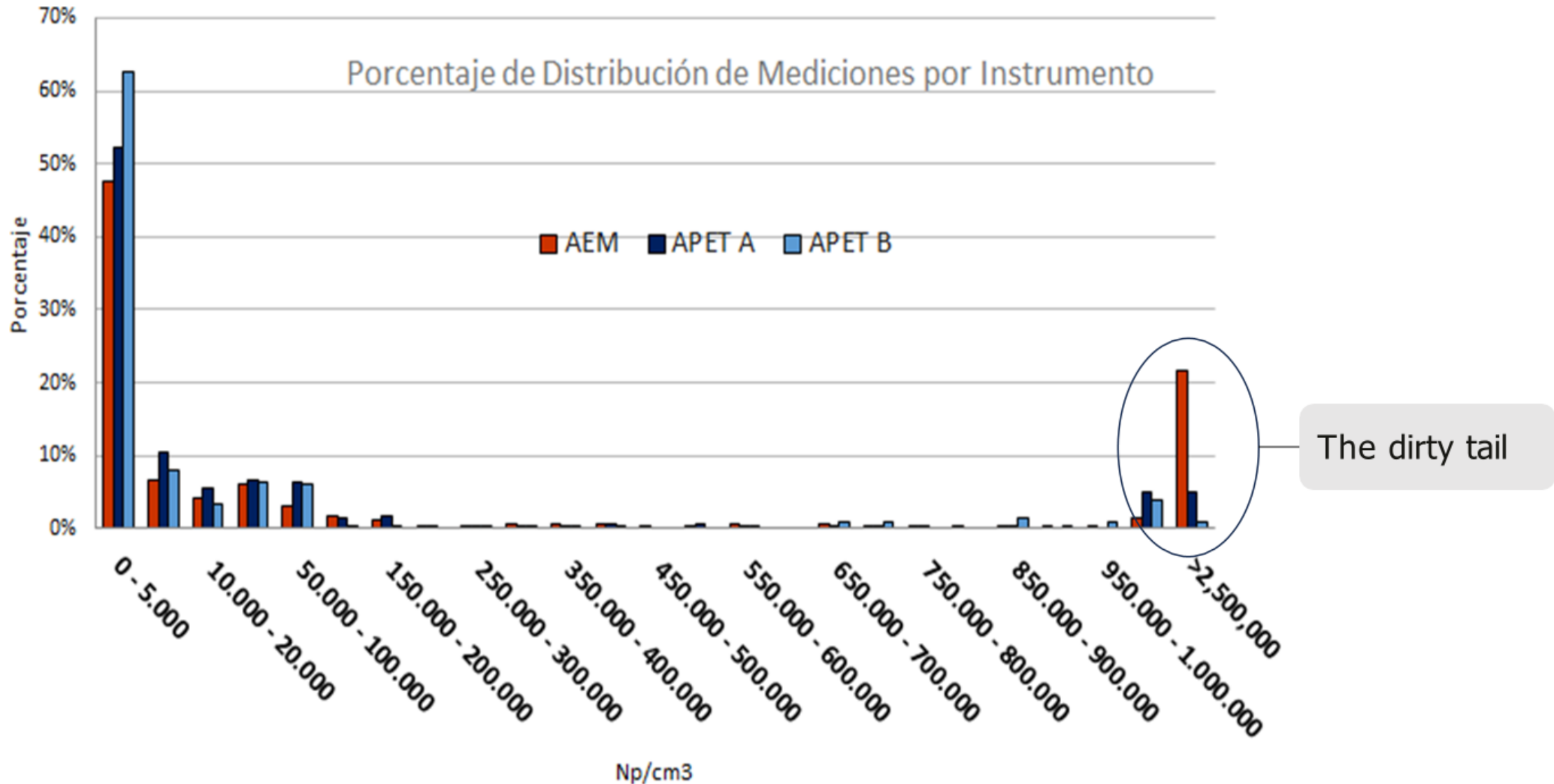
- High idling tests show better correlation to type approval (with and without load)
- Tests at METAS (Tobias Hammer, NPC 2024) show:
The PTI devices are in general able to measure particulate emissions from gasoline exhaust, however:
 - High relative humidity levels can in some cases disturb PN-PTI operation or result in low CE.
- For type approval, the cutoff is reduced to 10nm. What about PTI?

Number of cars and contribution to emissions in size classes



Data from Gloor, AWEL

Measurement of particle number in 1,000 light and medium duty vehicles equipped with diesel particulate filter (DPF) in Periodic Test Inspection Stations in Santiago de Chile, 2021



Conclusions

- Fleet emissions are dominated by high polluters, diesel and gasoline
- PTI should be applied to all ICE
- Tighter limits in type approval only make sense if high polluters are eliminated
- As there is large gap between clean vehicles and high polluters, the setting of the limit is not critical, also the cutoff
- Test can be implemented as:
 - PTI
 - on road tests (by police)
 - Ristovski suggested for public busses tests when a bus leaves a stop
 - Remote sensing only possible, when traffic density very low, in particular for particles

A person wearing a blue and green jacket and an orange high-visibility vest with 'AWEL' written on the back is using a handheld air sampling device. The device is connected to a grey box labeled 'Partikel' mounted on a yellow truck. The person is holding the device up to the air. In the background, there are residential buildings and trees. The text 'Thank you for your attention?' is overlaid in red on the image.

Thank you for your attention?

Questions ?