# Trends in exhaust and non-exhaust particle emissions in road transport

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The low particle exhaust emissions from modern vehicles lead to increasing importance of tire-, brake and road wear as well as re-suspended particle emissions, [1]. To meet future EU air quality limits and the even more demanding WHO targets for PM 2.5, reductions in the non-exhaust particle emissions (NEP) seem to be necessary, [2]. Consequently, the EURO 7 emission regulation foresees limits for PM and PN emissions from brake and tire wear. TU Graz is working on test methods, simulation tools and the assessment of reduction technologies for NEP in course of the next update of the HBEFA (Handbook on Emission Factors, www.hbefa.net) and in some research projects with several partners.

In the presentation, we will show results of measurement and data collection campaigns for NEP and for exhaust PN and PM, which are used to parametrise the vehicle emission model PHEM from TU Graz. PHEM is calculating all emission factors for the HBEFA using equations of longitudinal dynamics and load dependent maps for emissions from combustion, tire and brake wear. Effects of brake energy recuperation from hybrid and battery electric vehicles as well as from retarder use in HDVs are considered. The physical approach allows the simulation of all propulsion systems in any driving cycles. The current data in the model shows e.g. for EURO 6d new passenger car fleets some 4 to 6% share of exhaust in PM2.5 and 17% to 43% for PN23. The diesel cars have lower exhaust emissions but are on average much heavier than the gasoline fleet (1700 kg vs. 1250 kg) and thus have higher NEP emissions. However, results indicate, that even pure electric vehicle fleets will not show significantly lower total PM emissions than gasoline and diesel vehicles. Thus, further reduction targets have to include also NEP emissions.
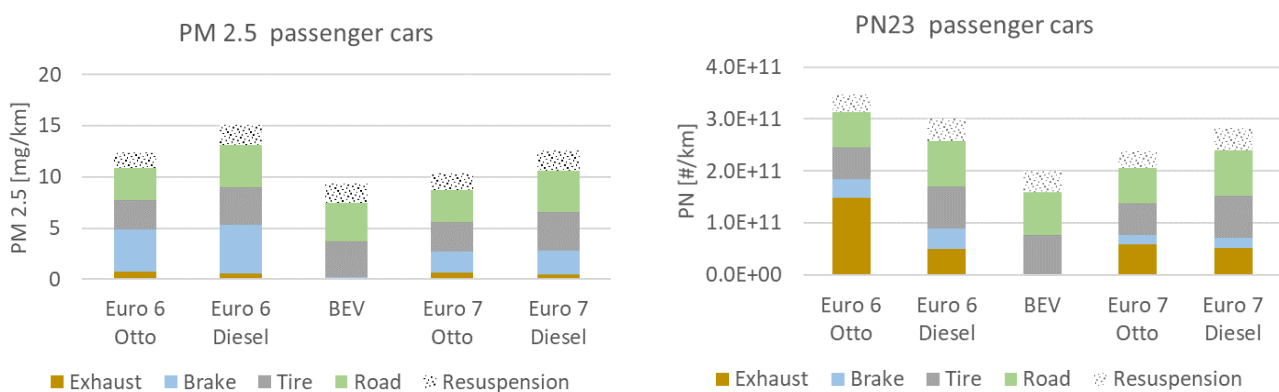
Using the emission factors computed with PHEM as input for an EU 27 road traffic emission inventory model developed in the H 2020 project LONGRUN, we will show PM and PN emission results for Europe LDV and HDV traffic up to 2050 with different technology scenarios.

[1] Landl L., Hausberger S.: A Novel Simulation Approach for Non-Exhaust Particle Emissions; TAP&SE Conference; Goteborg 2023.
[2] Kufferath A., Hausberger S., Toenges-Schuller N., et.al: Die kommende EU-Luftqualitätsrichtline und EU7 – Betrachtungen zum Beitrag des Straßenverkehrs zur Luftqualität; 19. Symposium Nachhaltigkeit in Mobilität, Transport und Energieerzeugung, Graz, 2023