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HBEFA 5.1 Outlook

ERMES Plenary, November 12th, 2024

Work program for HBEFA 5.1, main updates:

Updates of vehicles emission factors for cars, vans, HDVs and L-category; for SI, CI, CNG engines, BEVs, HEVs:

- More than 200 vehicles newly measured by HBEFA partners on chassis dyno and on-road (Euro 6/VI) including FTIR data on not regulated components. All data collected systematically in DBEFA.
- Data used to set up detailed vehicle emission model PHEM for all Eu 6 vehicle segments to simulate Efas for HBEFA
- New methods to simulate tire-, brake-, road-wear and resuspension Efas in more detail
- New method to simulate cold start extra emissions as F(cumulated exhaust heat) which uses all vehicle tests
- Remote sensing, vehicle tests (old/new pairs) and PTI-data used for deterioration functions and shares of tampered vehicles and for temperature correction functions
- Driving cycles and traffic situations (TS) get guidelines and new pre-conditioning phases
- Evaporation Efas using latest COPERT methodology
- Update of country specific data (fleet and mileage shares, real world CO_2 factors, share of tampered HDVs,…
- HBEFA 5.1 software migrated from MS Access to central server solution with APIs for front end to allow extended data sets and better handling
- Release planned ca. 03/2025

Efa…Emission factors
TS…Traffic situation, defined by cycle with speed, gradient and curvature over time

Method and data flow

Data collection and measurement campaigns

DBEFA test database

PHEM

emission map routine

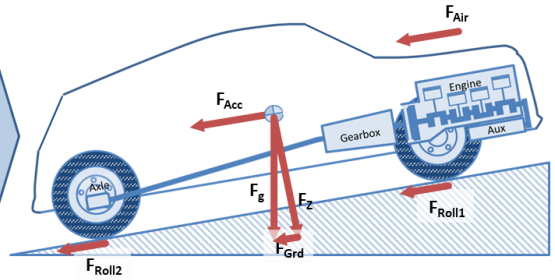
Emission maps
Vehicle data
(per car and for fleet)

Model Input

- Vehicle: C_d x a, Mass, rotational inertias, loading
- Tires: r_{dyn}, RRC, wear map
- Auxiliaries: Avg. Power demand per auxiliary
- Gearbox: Loss map, i_{gears}
- Full load curve, engine map, trans. parameter
- After treatment: Thermal capacities, masses, conversion maps,..
- RESS, Motor: (P)HEV, BEV: motor, battery, controller
- Brake wear map
- Retarder, controller

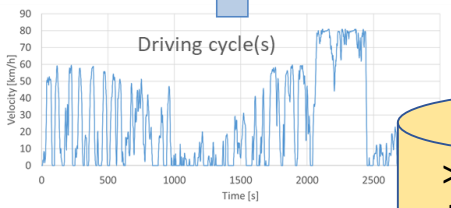
PHEM

Passenger car and Heavy duty Emission Model

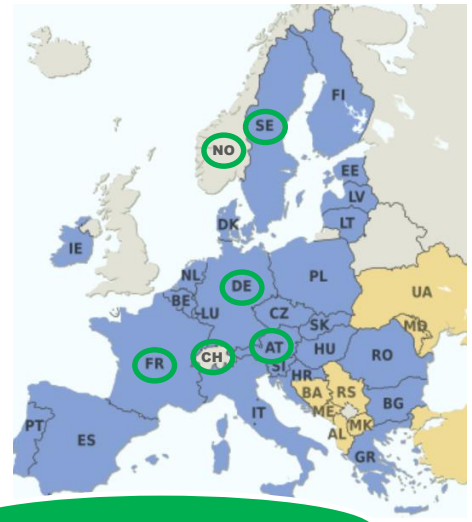


$P_e = P_{Air} + P_{Roll} + P_{Acc} + P_{Grd} + P_{Loss} + P_{Aux}$

Simulation in 1 Hz for: wheel power, engine power and speed, brake power, fuel consumption, emissions, etc.



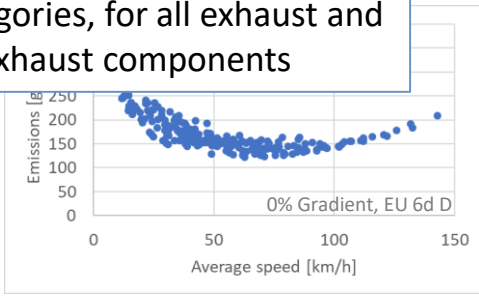
> 270 HBEFA driving cycles



HBEFA System database

Central server

Consistent emission factors for all vehicle categories, for all exhaust and non exhaust components



Some new topics and results since the last ERMES meeting

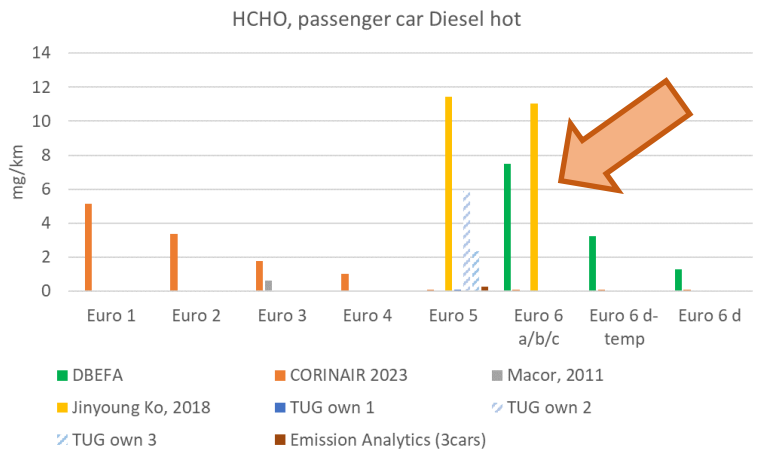
New emission test data using FTIR

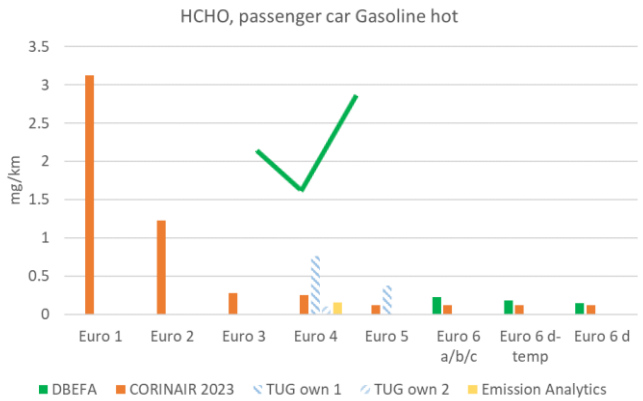
More than 100 cars, LCVs and HDVs tested with FTIR on chassis dyno and on-road.
PHEM produces engine emission maps for all components with instantaneous test data
For HBEFA emission factors for following "new" components will be produced

- Formaldehyde (HCHO)
- Isocyanic acid (HNCO)
- Acetaldehyde (CH3CHO)
- Nitrous acid (HNO2)

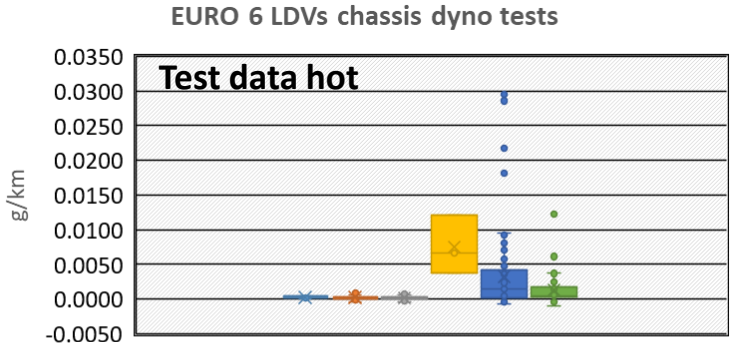
Open: almost no test data for vehicles before EURO 6/VI
to produce complete data set for fleet emissions
→ **any input?**

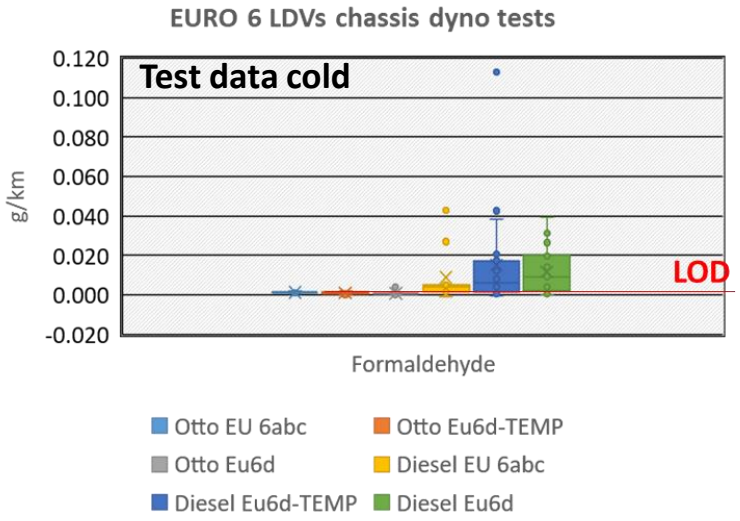
E.g. CORINAIR data does not fit for formaldehyde diesel LDVs:





Example for HCHO
LDV test data

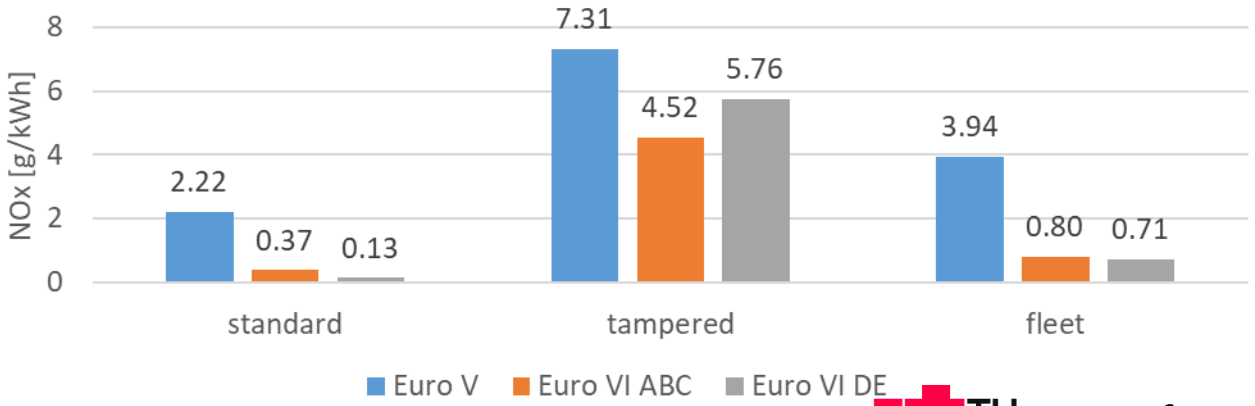




HDV deterioration and tampered vehicles

- Development from HBEFA 4.2 to 5.1
  - 4.2: deterioration function includes ageing and tampering
  - 5.1: separate functions for ageing and tampering (tampering rates are country specific)
- Ageing functions based on PEMS/chassis dyno test data and remote sensing (wo. high emitters)
  - Euro V, Euro VI ABC, Euro VI DE
  - NOx, NO2, CO
  - Nearly doubling of the emissions over lifetime

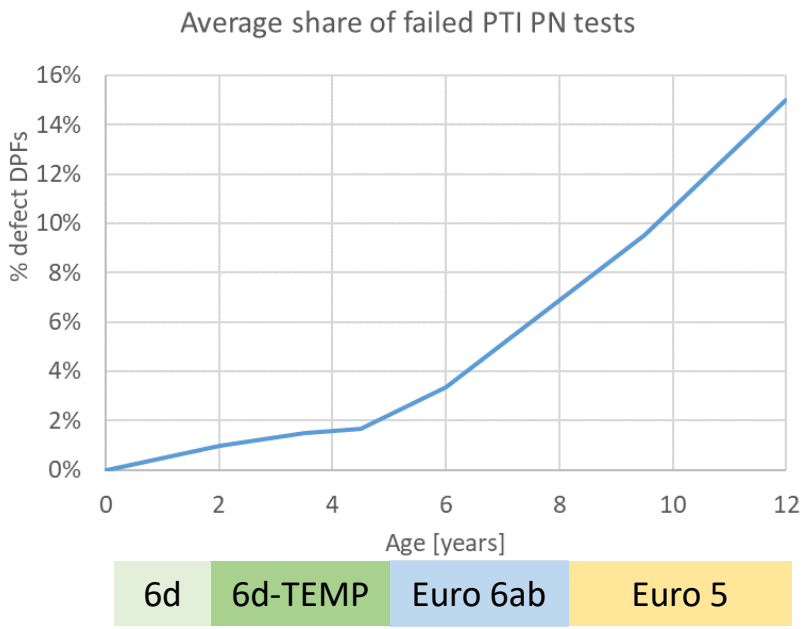
- Tampering shares based on plume chasing studies
  - European average as default value
    - Euro V: average about 30 %
    - Euro VI: average about 10 %
  - Country specific function possible
- Emission factors based on lab tests
- Fleet emissions can increase multiple times depending on the shares of tampered vehicles



LDV defect DPFs and effects of PTI testing

PTI tests with PN measurement in idling introduced in some EU member states 2022/2023
Results analysed for Germany, Netherlands and Flanders (from VERT-NPTI Implementation workshop, 03/2024)

Unexpected high share of cars and LCVs failed (<2.5E+05 to 1E+6 PN/cm³)



Possible emission range defect DPFs

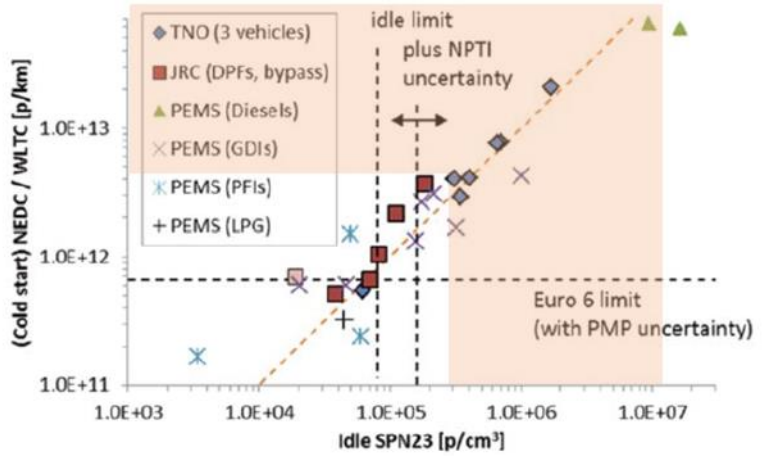
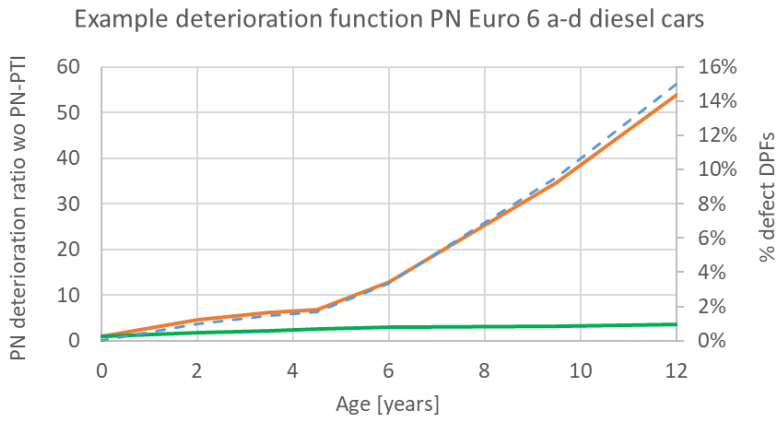


Figure 2-3: PN emissions at low idle speed and NEDC/WLTC tests of different vehicles (with DPF or variable bypass), source JRC [2].

PN deterioration, assuming 2.7E+13 PN/km for defect DPFs

Really???

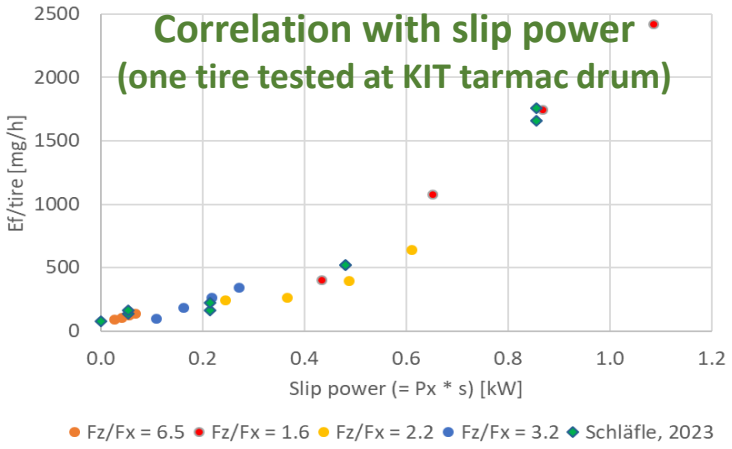


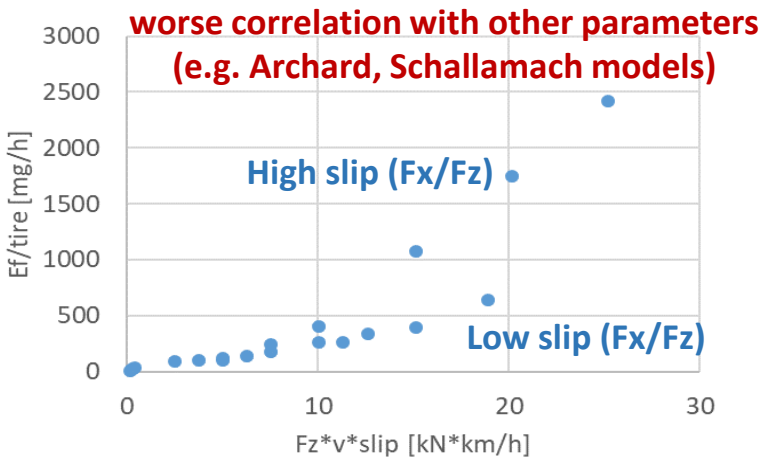
PTI……Periodical technical inspection

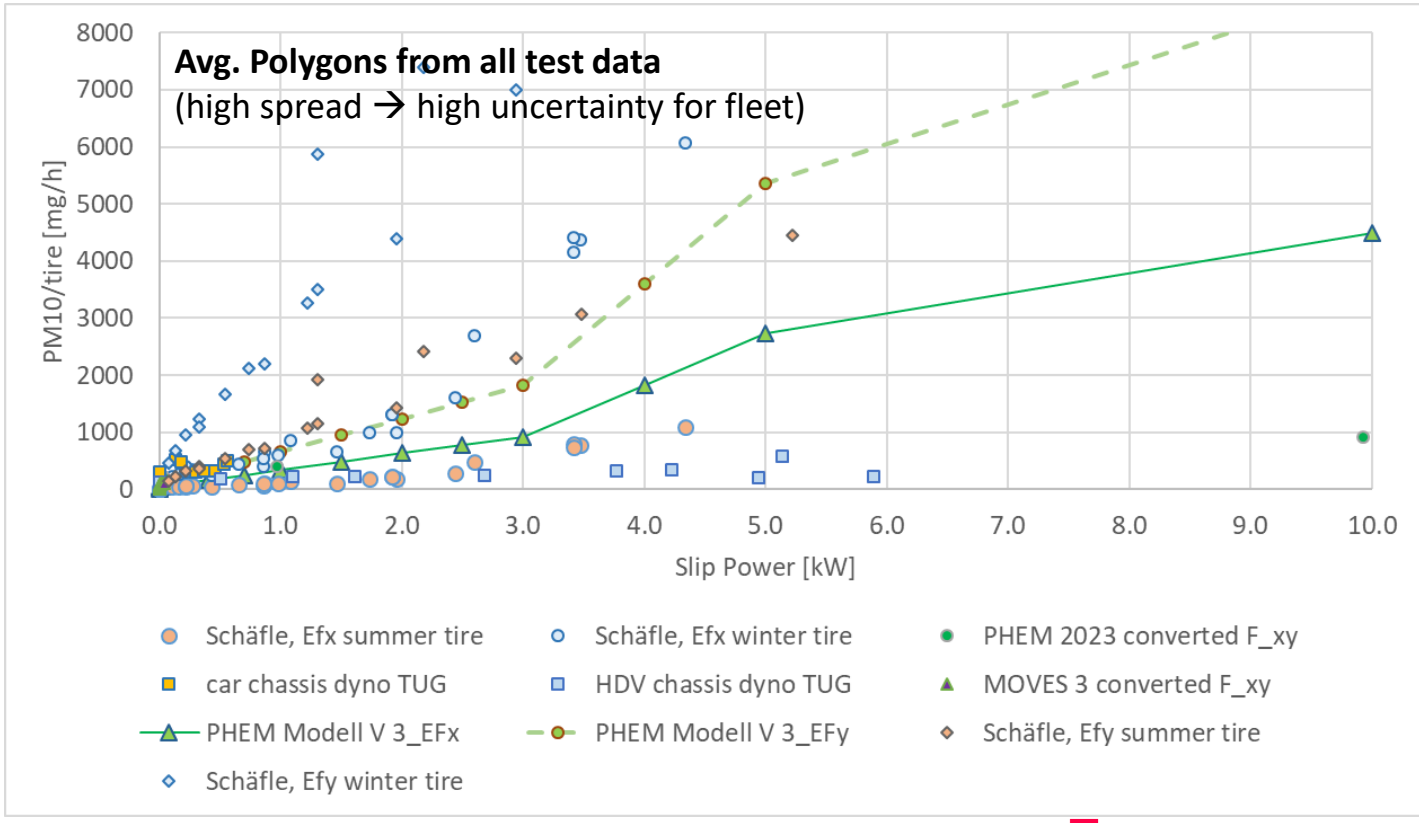
New non exhaust model

Brake emissions: simulated from instantaneous PHEM brake power
Tire and road wear: simulated from instantaneous PHEM instantaneous slip-power (longitudinal and lateral)
Resuspension: simulated from k0 x (k1 x air drag (~turbulence) +K2 x slip power (mechanic effects))

Some details for new tire model: new test data (KIT and TUG) demonstrate dependency on slip power (= Fx/y x v x slip)







Thank you for your attention!