

# COPERT Training

## 6. What's new in version 5.3



# Summary of new elements in v5.3

- Revision of emission factors for mopeds and motorcycles
- Calculation of the fossil fuel fraction in biodiesel
- Revision of Euro 6 evaporation emission factors
- Revision of Euro 6 LCVs emission factors



# Emission factors update: Mopeds & Motorcycles



# Test campaigns

- New tests in the framework of the ERMES-ACEM study (2018)
  - Sample: 3 mopeds and 15 motorcycles
  - Technology: Euro 4
  - Lab: JRC, TUG and FHB
- Tests in the framework of the L-category Euro 5 Effect Study (2017)
  - Sample: 41 vehicles
  - Technology: Euro 1 to Euro 4
  - Lab: JRC (mostly) and LAT



# Test campaigns cont'd

- Tests on mopeds in the Netherlands (2017)
  - Sample: 15 mopeds
  - Technology: Euro 2 and Euro 3
  - The measurement programme was set up by TNO
- Tested driving cycles:
  - WMTC, ECE R40, ECE R47, WOT, IUC, AMA, SRC-LeCV, FHB1, FHB2, FHB3, FHB4, RCC, RDC1, RDC2, RDM



# Methods: mopeds

- Euro 3
  - Based on the data from the TNO study (*data from the Euro 5 Effect study have been used only for verification*)
  - Based on the driving cycle: ECE R47
- Euro 4
  - Based on the data from the ERMES-ACEM study
  - Based on the driving cycles: ECE R47 and RDM



# Methods: motorcycles

- Technology: Euro 3 to Euro 5
- Pollutants: CO, VOC, NO<sub>x</sub> and energy consumption
- Motorcycle classes: 2-stroke, 4-stroke <250 cc, 4-stroke 250-750 cc, 4-stroke >750 cc
- Calculation steps
  - Step #1: the measurement data have been processed by TUG, providing the emission factors of HBEFA v4.1
  - Step #2: regression analysis: Levenberg-Marquardt (LM) algorithm for non-linear curve-fitting of data, using the robust least absolute residuals (LAR) fitting method

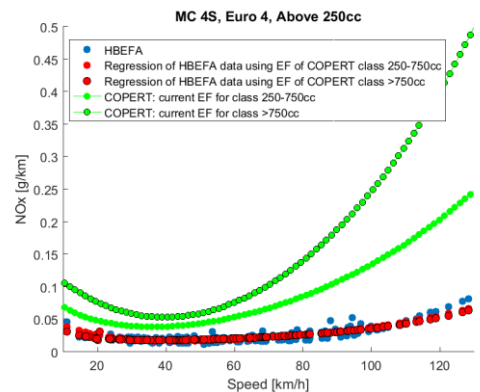
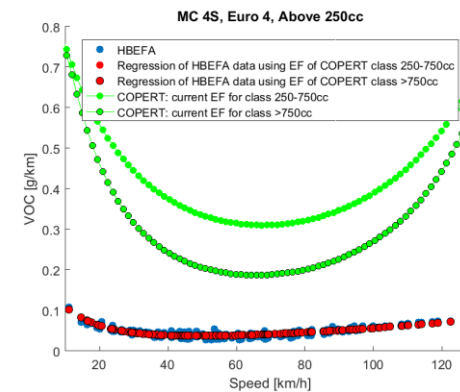
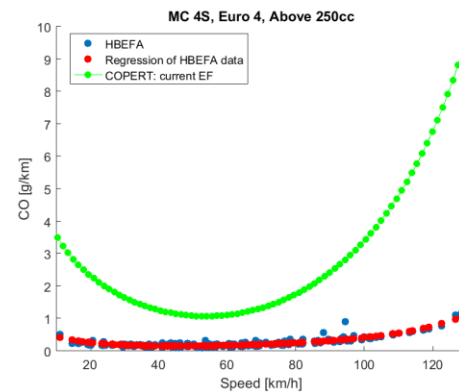
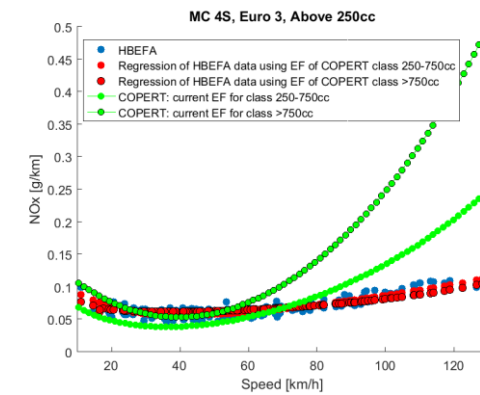
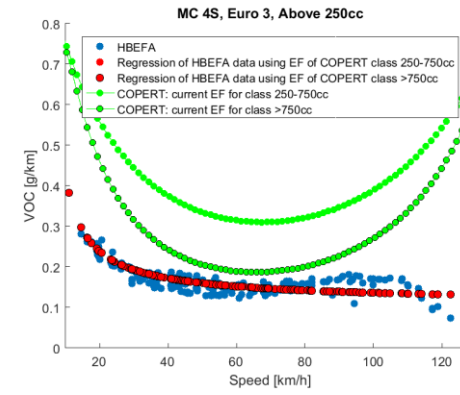
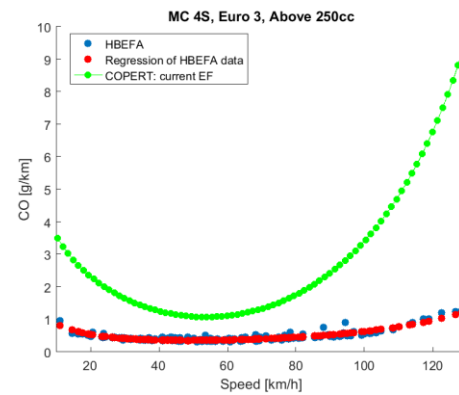


# Emission factors

- Mopeds:

Euro	Driving Mode	CO [g/km]	VOC [g/km]	NO <sub>x</sub> [g/km]	PM (exhaust) [mg/km]	PN [# /km]	CO <sub>2</sub> [g/km]	FC [l/100km]
Euro 3	Urban	3.9	1.8	0.39	8.4	2.3E+12	41.3	2.3
	Rural	2.0	1.0	0.36	6.5	2.3E+12	44.1	2.1
Euro 4	Urban	2.4	0.5	0.05	2.1	-	46.5	2.2
	Rural	2.0	0.4	0.04	1.5	-	46.4	2.2

- Motorcycles:



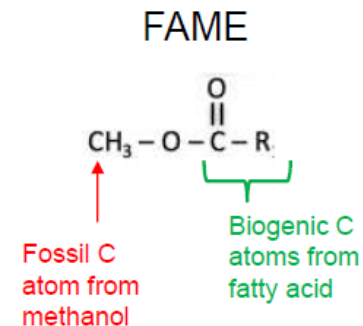
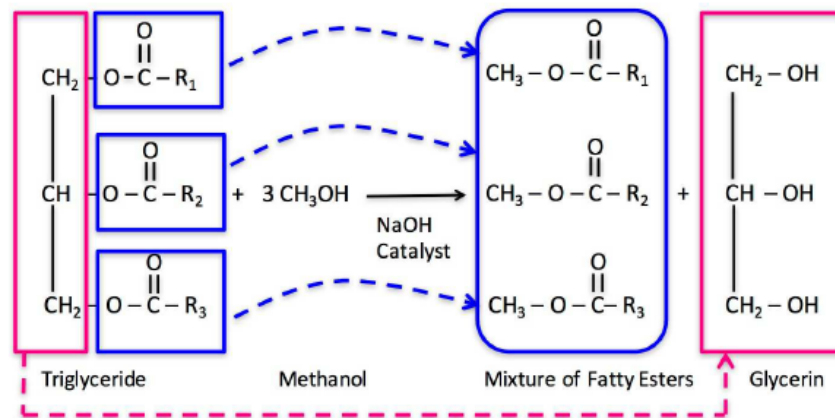


# Calculation of the fossil fuel fraction in biodiesel



# Why this update?

- Assessment of biodiesel origin: Identify & separate biogenic and fossil feedstock involved in the production process. E.g. biodiesel from coal methanol with vegetable oil has a non-zero fossil fuel fraction, thus not entirely carbon neutral fuel
- Depending on the production pathway, fossil fuel carbon content is about 5.5%
- Aim: Calculation of fossil fuel carbon content of biodiesel deriving from the most widely used production pathways



Source: <https://www.e-education.psu.edu/egee439/node/684>



# Fossil and biogenic CO<sub>2</sub> emissions to FAME

- Fossil origin g CO<sub>2</sub> / g FAME = (carbon content of FAME) \* (fossil part of C of FAME) \* 44/12
- Bio origin g CO<sub>2</sub> / g FAME = (carbon content of FAME) \* [100% - (fossil part of C of FAME)] \* 44/12

	C fossil part	Carbon content	g fossil CO <sub>2</sub> / g FAME
<b>Sunflower</b>	5.3 %	77.2 %	0.150
<b>Rapeseed</b>	5.3 %	75.5 %	0.147
<b>Palm oil</b>	5.5 %	71.8 %	0.145
<b>Cottonseed</b>	5.4 %	77.0 %	0.152
<b>Tallow</b>	5.5 %	73.6 %	0.148
<b>Lard</b>	5.4 %	74.4 %	0.147



# New Euro 6d evaporation emission factors



# Why this update?

- Regulation (EU) 2017/1221 introduced a new procedure for evaporative emissions, applicable to Euro 6d-temp and Euro 6d vehicles
- Whereas the emission limit remains at 2.0 g of NMVOC per test, the procedure becomes more severe, specifically targeting the aging of the carbon canister and the permeability of the fuel system



# Methodology

- Modelling work carried out in the framework of the “Review of the European test procedure for evaporative emissions | Cost/Benefit analysis” (JRC)
- A number of scenarios developed to assess different policy options
- COPERT model adjusted to simulate the developed scenarios

## Scenario 1

- More aggressive purging

## Scenario 2

- More aggressive purging
- Bigger canister (size x 2)

## Scenario 3

- More aggressive purging
- Bigger canister (size x 2)
- Improved durability (lower carbon degradation)
- Multi-layer tanks for all cars



# Results

- Stricter procedure in Regulation (EU) 2017/1221:
  - Longer (48 h) diurnal test --> Bigger activated carbon canister
  - Shorter preconditioning time --> More intense purging strategy
  - Stricter aging procedure of the carbon canister --> Low degradation carbon

		Canister size (liters)		Degradation / purging strategy	
		Current (GB 2018)	Suggested (GB 2019)	Current (GB 2018)	Suggested (GB 2019)
Mini & small Passenger Cars (petrol only)	Euro 3 – Euro 6c	0.8	0.8	High degr. / low purge rate	High degr. / low purge rate
	Euro 6d-temp / 6d		1.6		Low degr. / high purge rate
Medium Passenger Cars N1-I, N1-II LCVs (petrol only)	Euro 3 – Euro 6c	1.0	1.0	Low degr. / high purge rate	Low degr. / high purge rate
	Euro 6d-temp / 6d		2.0		
Large Passenger Cars N1-III LCVs (petrol only)	Euro 3 – Euro 6c	1.5	1.5	Low degr. / high purge rate	Low degr. / high purge rate
	Euro 6d-temp / 6d		3.0		



# Revision of Euro 6 LCVs emission factors





# Why this update?

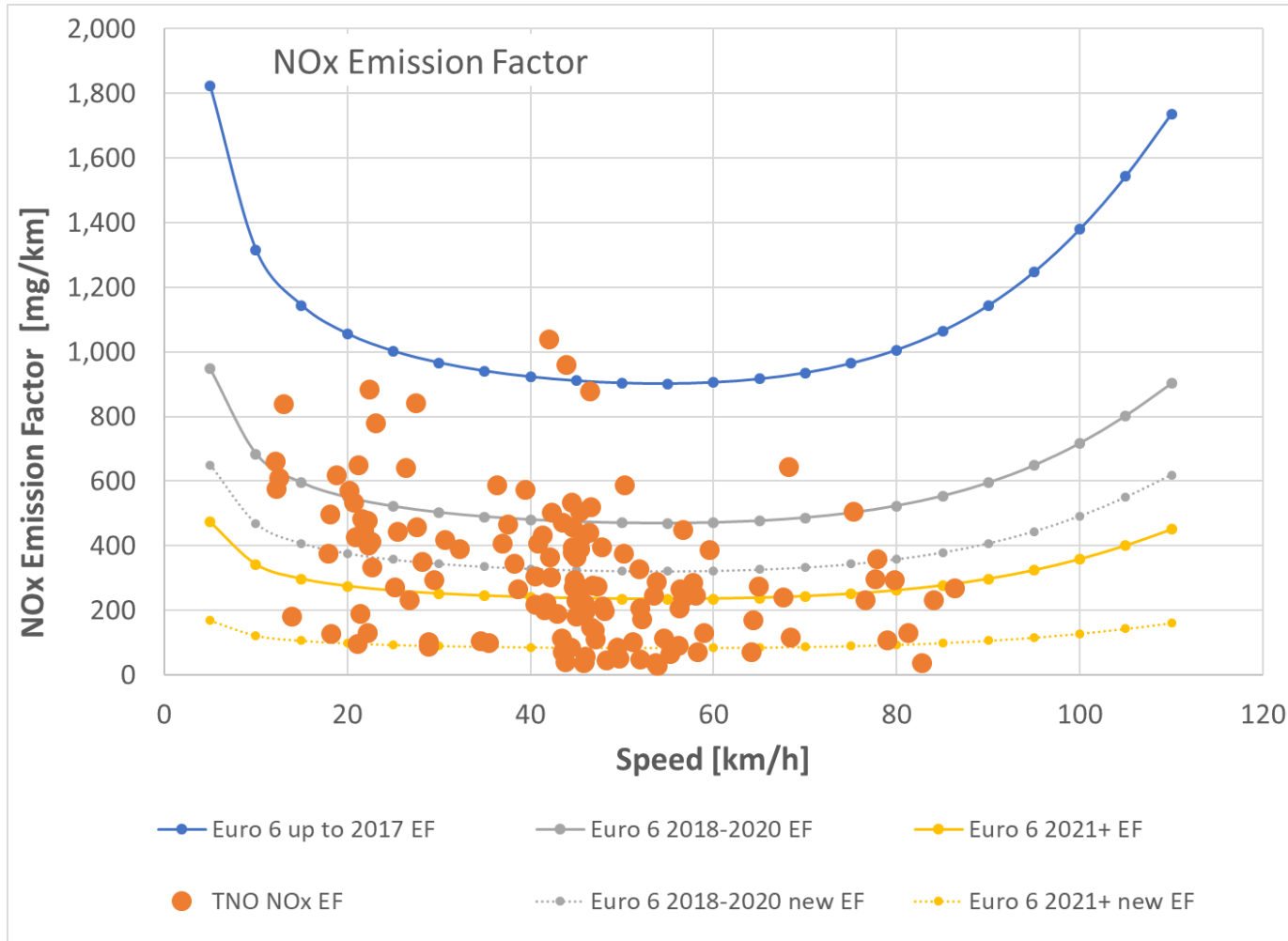
- Previous EFs based on assumed developments over previous standards, in line with passenger cars
- New experimental data has become available



- 3 TNO reports:
  - Investigations and real world emission performance of Euro 6 light-duty vehicles (2013 R11891)
  - NOx emissions of Euro 5 diesel vans – test results in the lab and on the road (2016 R10356)
  - NOx emissions of eighteen diesel Light Commercial Vehicles: Results of the Dutch Light-Duty road vehicle emission testing programme 2017 (2017 R11473)



# Results (N1 II-III)



# Planned updates for next year

- Inclusion of electrified vehicles (diesel hybrids, plug-in hybrids, battery electric vehicles)
- Review of emission degradation functions
- Revision of PM characteristics (particle number and surface area) as a result of H2020 projects
- Review of Euro 6d emission factors in light of new RDE measurements
- Revision of non-exhaust emissions from tyre wear



**Thank you for your attention!**

