What is new in COPERT v5.8

Overview

- Introduction of Euro 7 vehicles
- Introduction of Euro VI CNG & LNG HDVs
- Revision of CO, EC, SPN23, NOx of Euro 6 HEV/PHEV
- Revision of VOCs speciation of Euro 5/6 petrol & diesel LDVs
- Revision of EC of BEVs
- Revision of cold PM & BC of Euro 5/6 petrol, diesel & CNG LDVs
- Revision of EC of Euro 6 LPG cars
- Revision of Euro 5 motorcycles
- Minor corrections

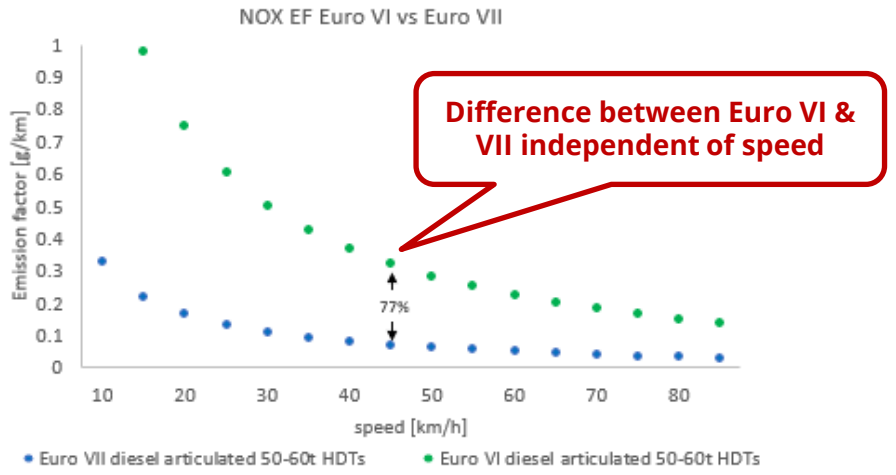
Introduction of Euro 7 vehicles

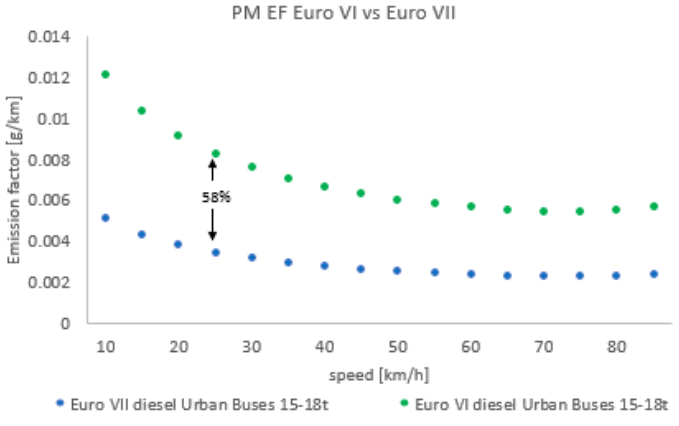
Introduction of Euro 7 vehicles

- Euro 7 LDVs & HDVs introduced in COPERT v5.8
- Numbers based on:
  - Euro 7 Impact Assessment Study[1] of CLOVE
  - Euro 7 agreed emission limits
  - Our expertise
- Euro 7 emission factors (compared to Euro 6/VI)
  - LDVs: Euro 6 exhaust emission factors with no degradation factors due to OBM & reduced (compared to Euro 6) non-exhaust emission factors
  - HDVs: Reduced (compared to Euro VI) emission factors for various pollutants by a % factor

[1] Euro 7 impact assessment study

[2] Regulation (EU) 2024/1257





Examples of Euro VII emission factors in COPERTv5.8

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Introduction of Euro VI CNG & LNG HDVs

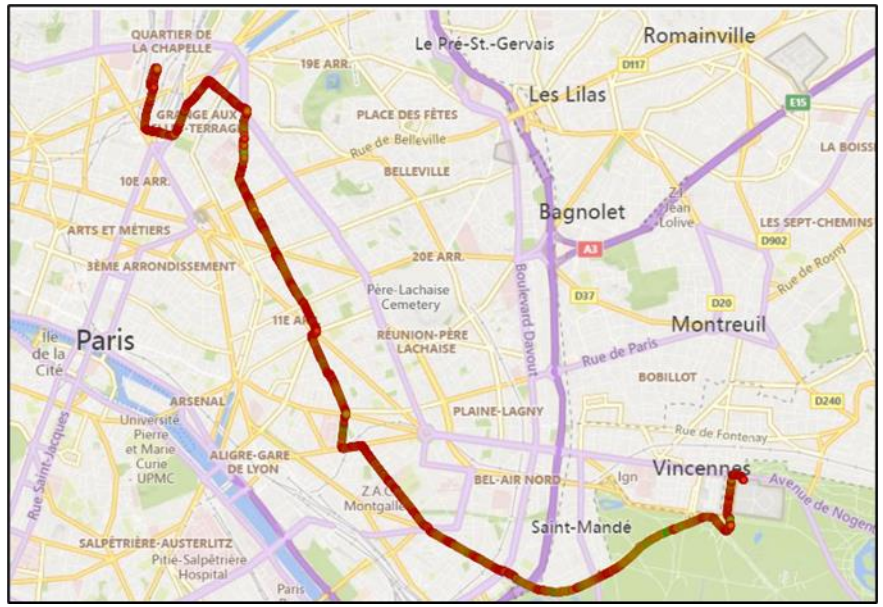
Introduction of Euro VI CNG & LNG HDVs (1/4)

- Vehicles introduced
  - *Categories*: Heavy-Duty Trucks & Buses
  - *Powertrains*: CNG & LNG (only for HDTs)
  - *Segments*:
    - HDTs: Rigid <7.5t, 7.5-12t, > 12t (only for CNG) & Articulated < 40t
    - Buses: Urban Buses <15t, 15-18t, > 18t (only for CNG)
  - *Euro standards*: Euro VI D/E
  - 7 gradients (-6% to +6%) & 3 loads (0%, 50%, 100%)

- Measurements
  - Simulated PEMS & chassis dyno data[1] for 5 HDTs & 6 Buses
  - Real operational conditions using PEMS[2] for 6 Buses

- Pollutants updated

  CO, EC, NOx, PM, PN, CH4, VOC, N2O, NH3



CNG urban buses routes in Paris[2]

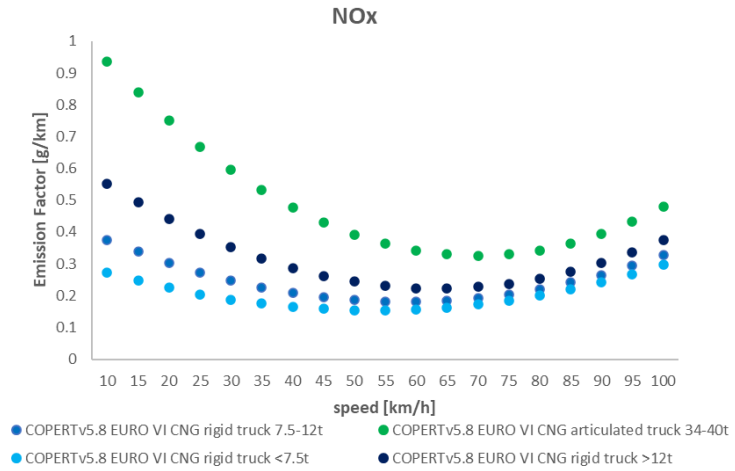
References:

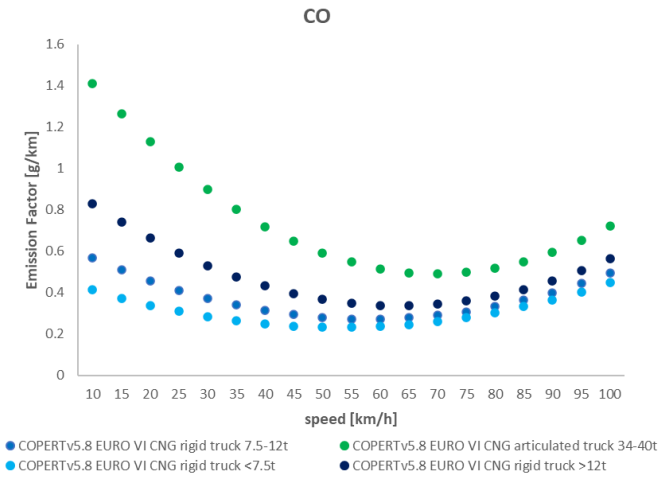
[1] HBEFA - Handbook Emission Factors for Road Transport

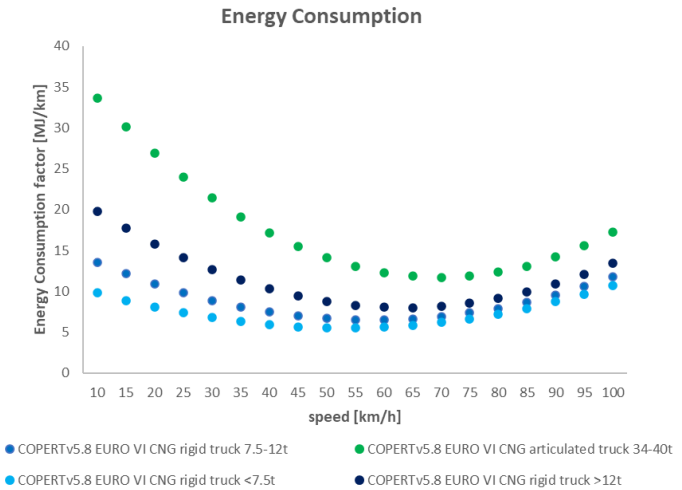
[2] AIRPARIF

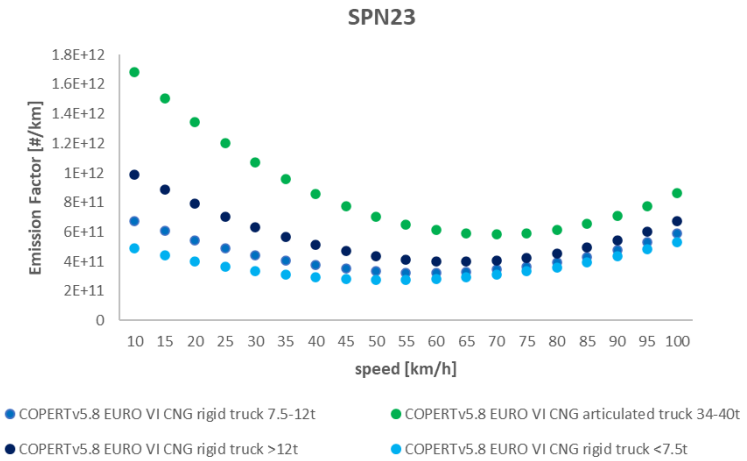
Introduction of Euro VI CNG & LNG HDVs (2/4)

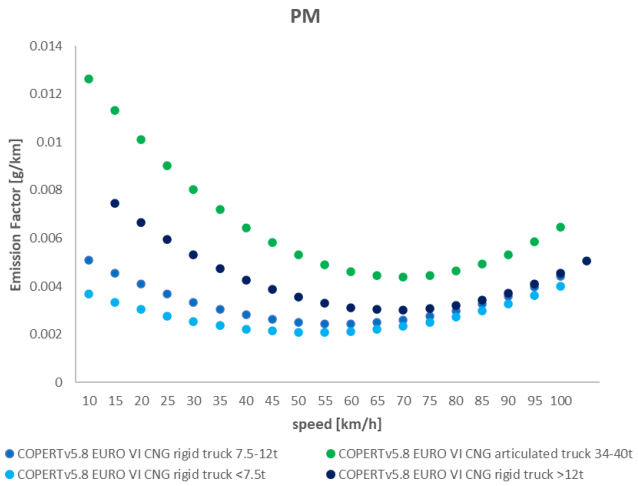
CNG HDTs were not in COPERT v5.7 so comparison is done only among segments

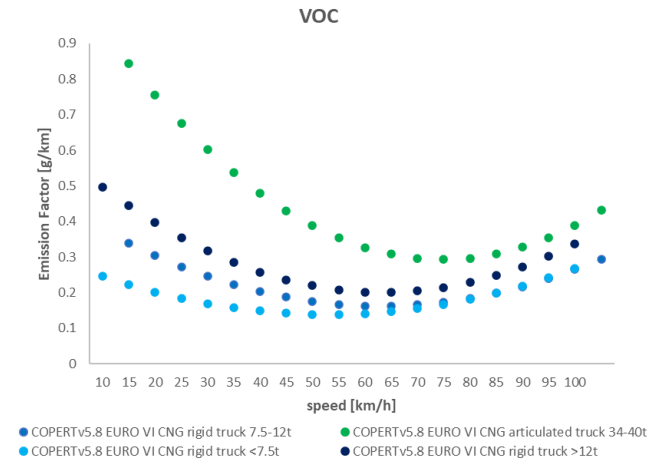












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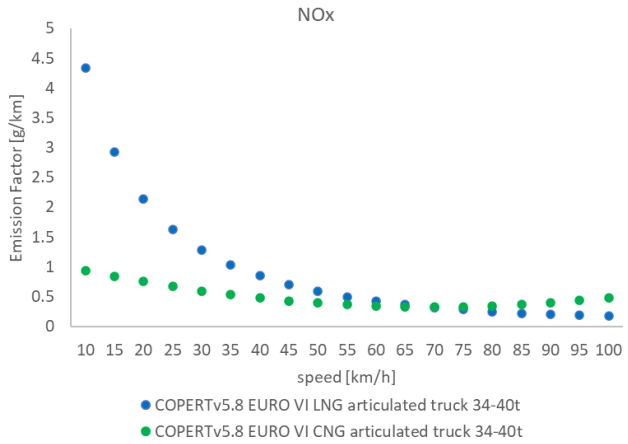
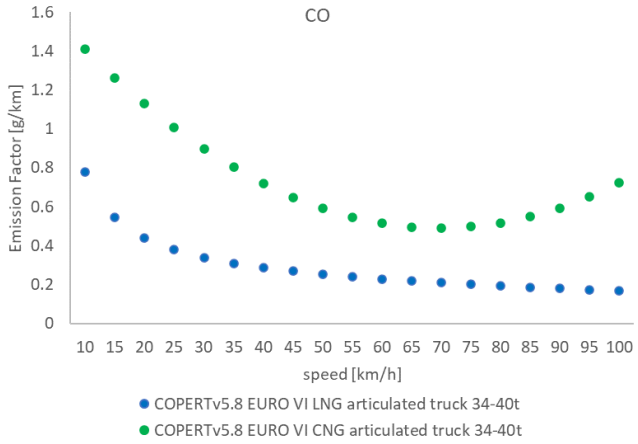
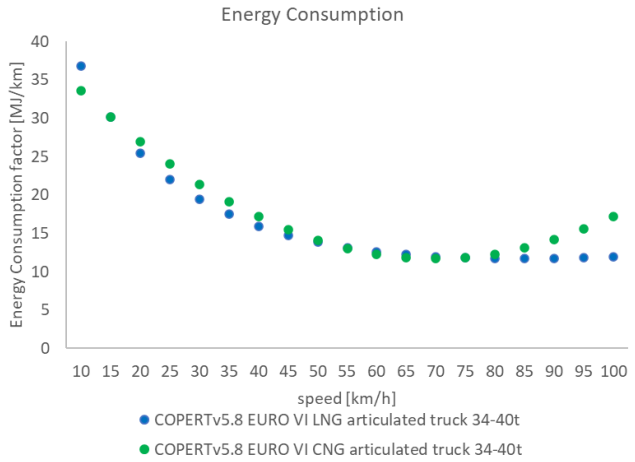
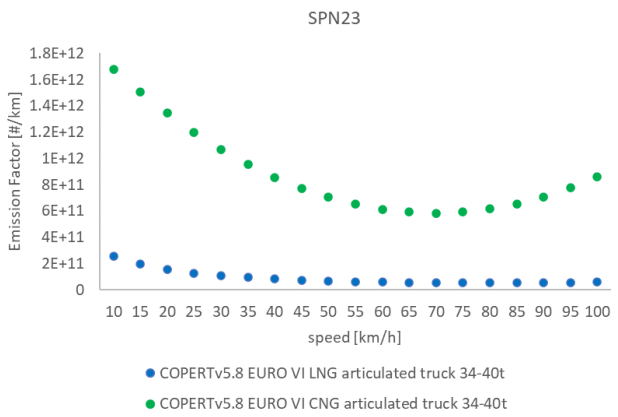
Introduction of Euro VI CNG & LNG HDVs (3/4)

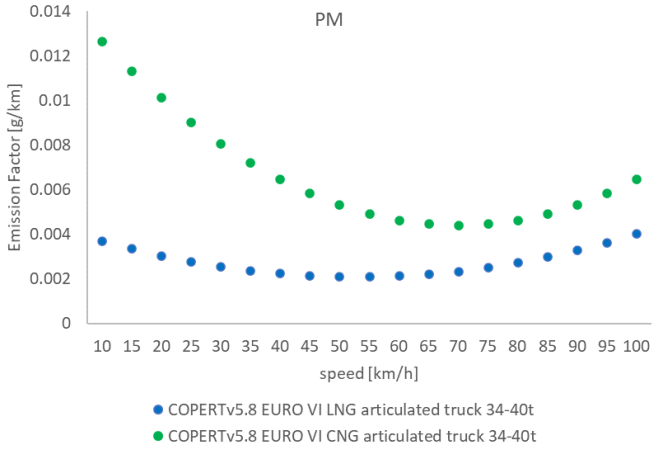
LNG HDTs were not in COPERT v5.7 so comparison is done against CNG HDTs

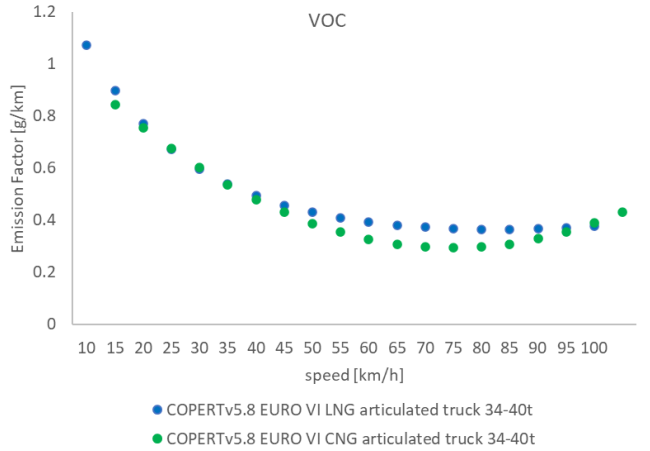












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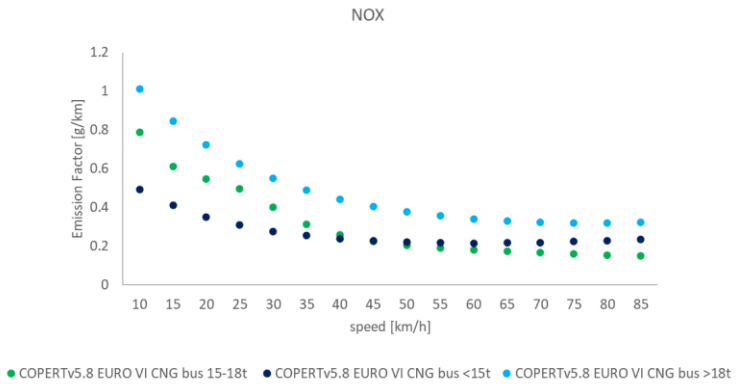
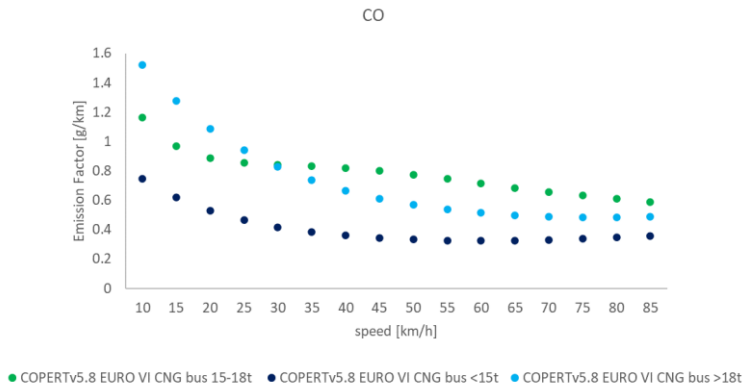
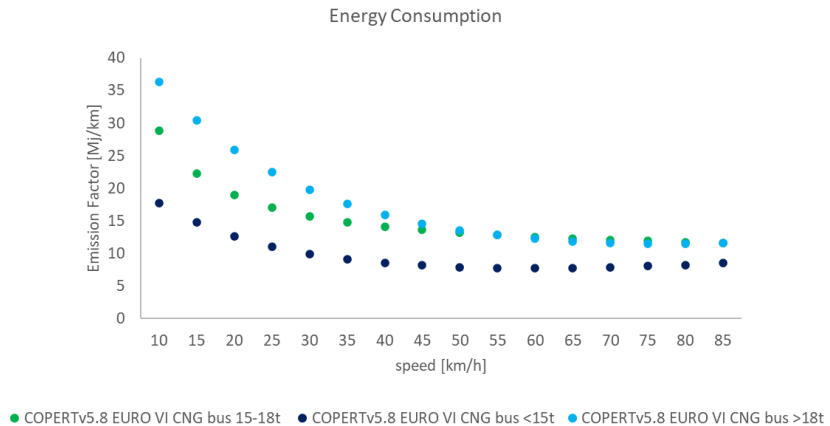
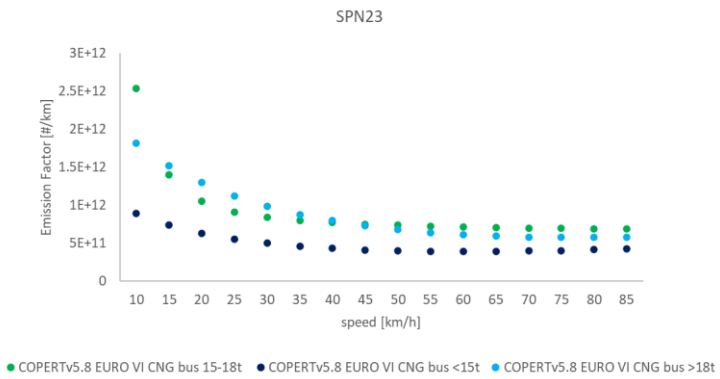
Introduction of Euro VI CNG & LNG HDVs (4/4)

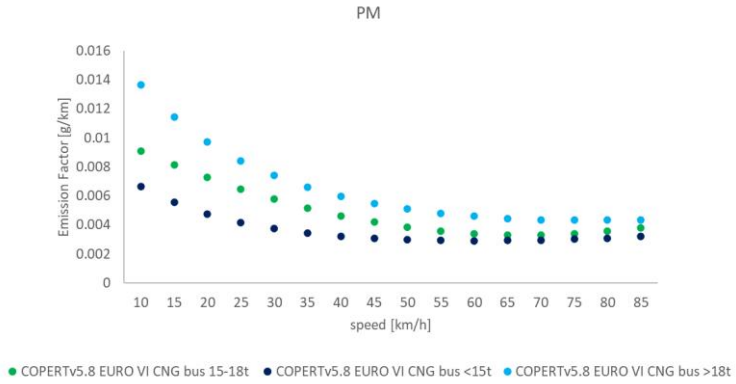
Euro VI CNG urban Buses were not in COPERT v5.7 so comparison is done only among segments

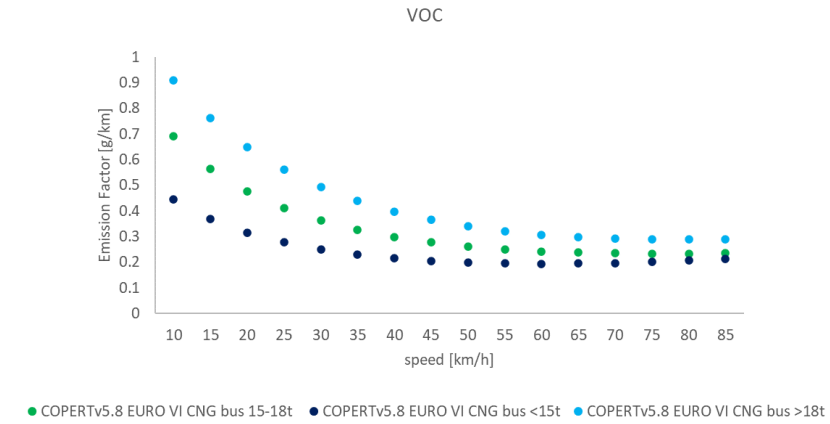












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Revision of Euro 6 HEV/PHEV cars

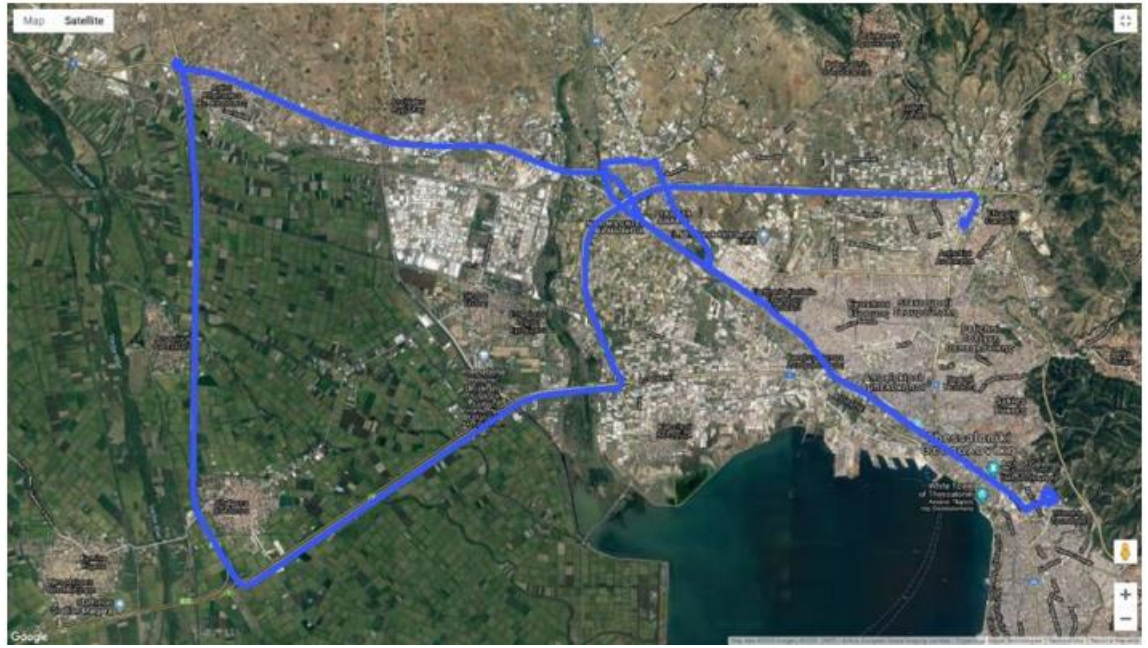
Revision of Euro 6 HEV/PHEV cars (1/2)

- Vehicles updated
  - *Categories*: Passenger Cars
  - *Powertrains*: Petrol HEV/PHEV (CS mode)
  - *Segments*: Small/Medium/Large
  - *Euro standards*: Euro 6a/b/c, d-temp, d/e

- Measurements*
  - RDE Compliant & non-Compliant
  - 6 HEV/PHEV
  - Period 2020-2022

- Pollutants measured

  CO, EC, SPN23, NOx

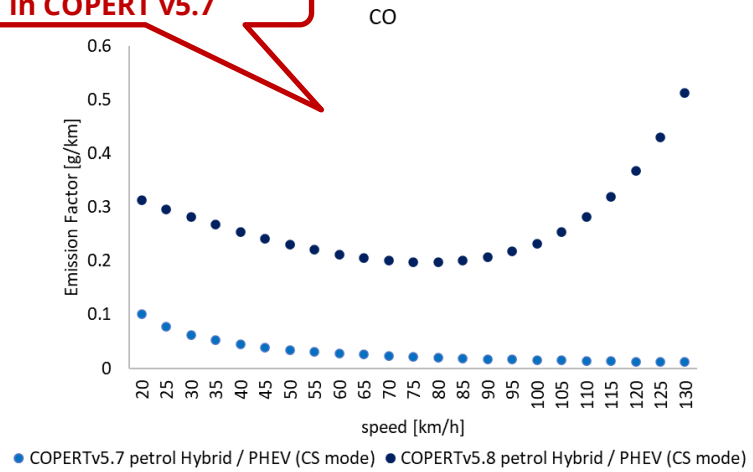


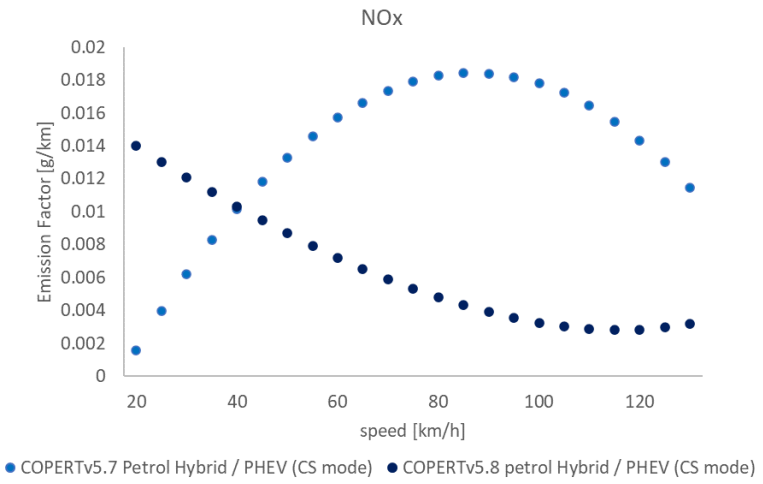
Regular RDE routes in Thessaloniki

*Reference: Laboratory of Applied Thermodynamics (LAT), Aristotle University of Thessaloniki

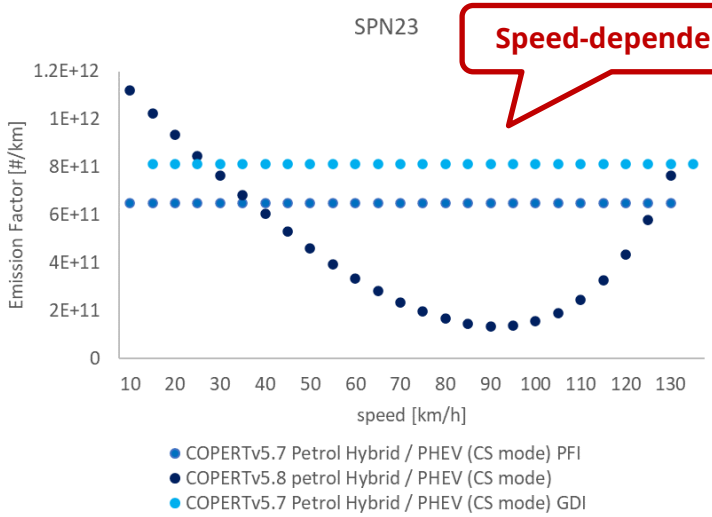
Revision of Euro 6 HEV/PHEV cars (2/2)

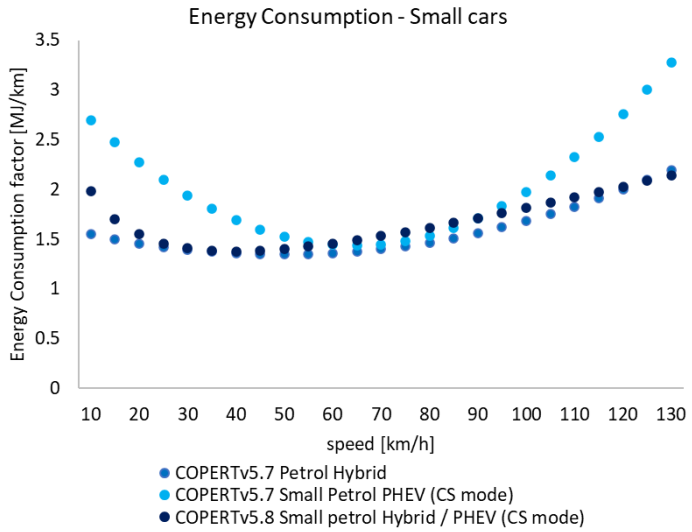
CO was underestimated in COPERT v5.7

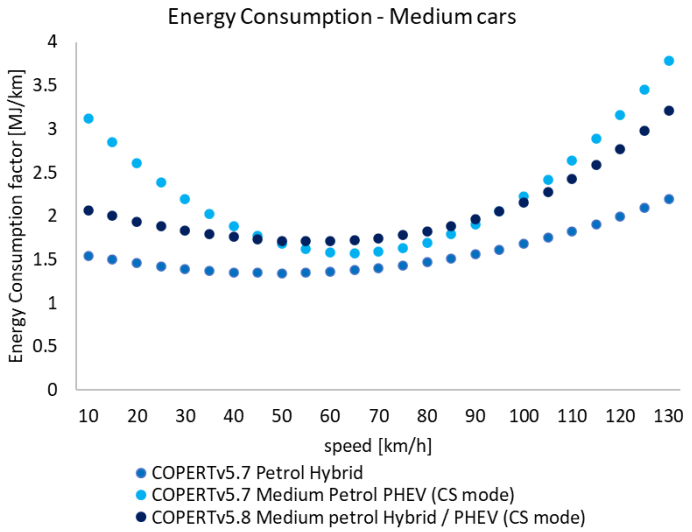


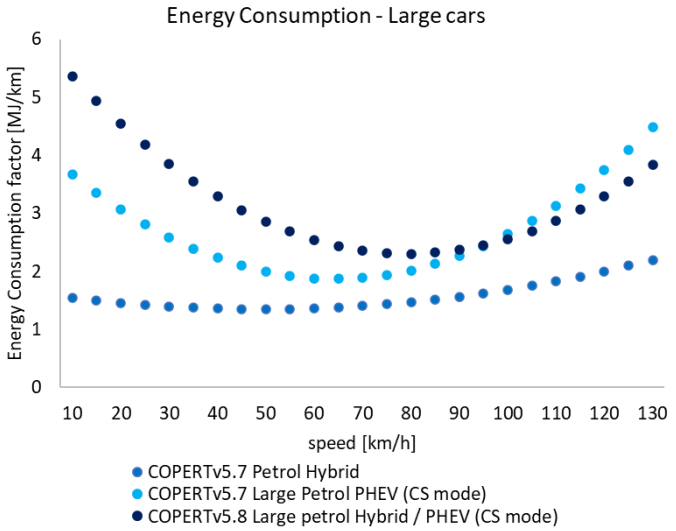


Speed-dependent PN









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Revision of VOCs speciation of Euro 5/6 LDVs

VOCs Speciation of Euro 5/6 LDVs (1/2)

- Vehicles updated
  - *Categories*: Passenger Cars & Light Commercial Vehicles
  - *Powertrains*: Petrol/Diesel
  - *Segments*: Small/Medium/Large & N1-I/II/III
  - *Euro standards*: Euro 5 & 6
- Measurements*
  - Artemis Driving cycle (Urban cold - Motorway)
  - Three Euro 5 vehicles (1 diesel - 2 petrol PFI/GDI)
- Pollutants updated

  NMVOCs speciation

Groups	Species
Alkanes	ethane, propane, butane, isobutane, pentane, isopentane, hexane, heptane, octane, 2-methylhexane, nonane, 2-methylheptane, 3-methylhexane, decane, 3-methylheptane, alkanes C10-C12, alkanes C>13
Cycloalkanes	All
Alkenes	ethylene, propylene, propadiene, 1-butene, isobutene, 2-butene, 1,3-butadiene, 1-pentene, 2-pentene, 1-hexene, dimethylhexene
Alkynes	1-butine, propine, acetylene
Aldehydes	formaldehyde, acetaldehyde, acrolein, benzaldehyde, crotonaldehyde, methacrolein, butyraldehyde, isobutanaldehyde, propionaldehyde, hexanal, i-valeraldehyde, valeraldehyde, o-tolualdehyde, m-tolualdehyde, p-tolualdehyde
Ketones	acetone, methylethlketone
Aromatics	toluene, ethylbenzene, m,p-xylene, o-xylene, 1,2,3 trimethylbenzene, 1,2,4 trimethylbenzene, 1,3,5 trimethylbenzene, styrene, benzene, C9, C10, C>13
Others	Others

*Reference: Baptiste et al. (2022)

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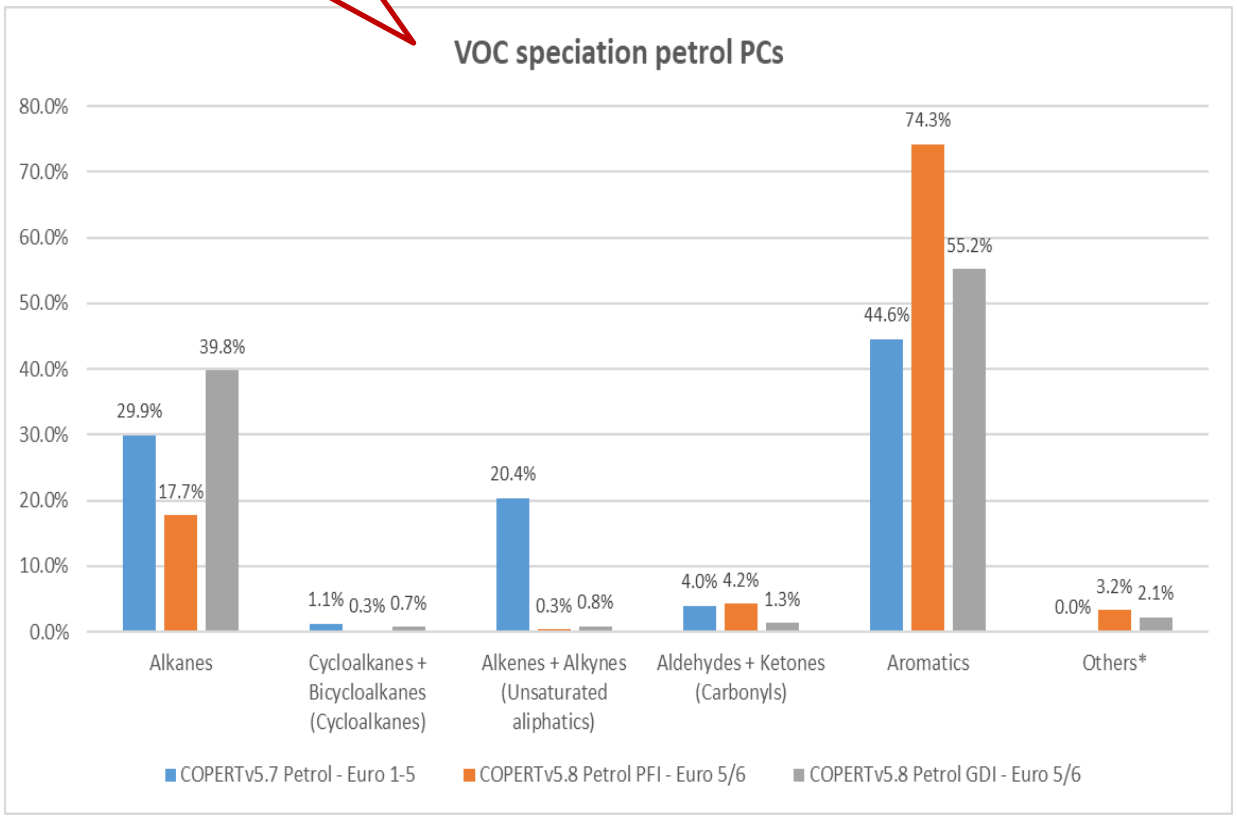
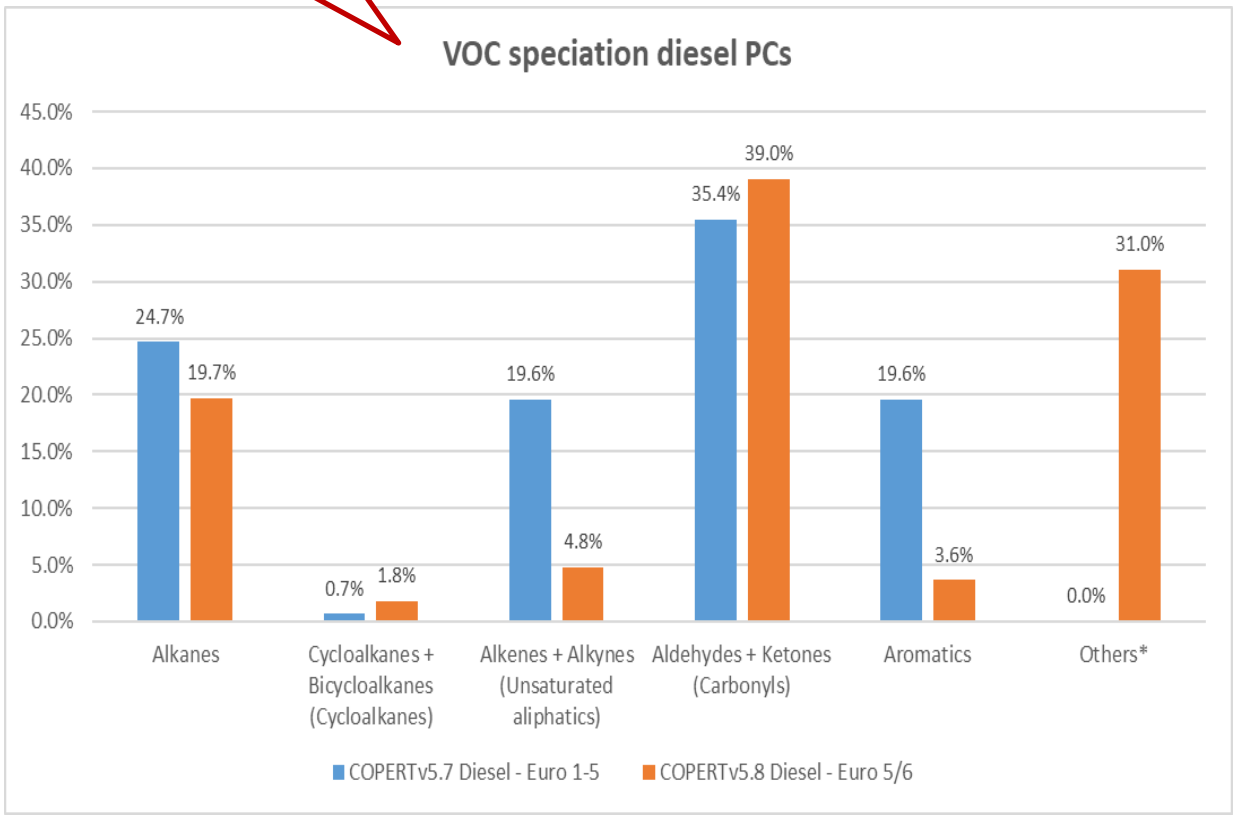
VOCs Speciation of Euro 5/6 LDVs (2/2)

Larger differences for alkanes, alkenes, alkynes & aromatics



Larger differences for alkenes, alkynes & aromatics



*Others: Alcohols, Acids, Nitrogen

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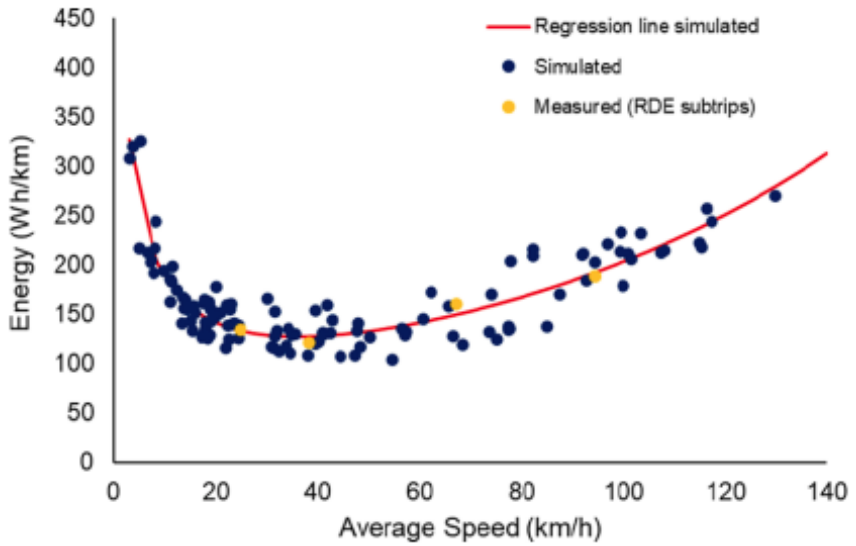
Revision of Energy Consumption of BEVs

Revision of Energy Consumption of BEVs (1/2)

- Vehicles introduced/updated
  - *Categories*: Passenger cars, Light-Commercial Vehicles, Urban Buses
  - *Powertrains*: Battery Electric
  - *Segments*: All
  - *Euro standards*: Euro 6/VI
  - w/wo A/C

- Measurements of energy consumption
  - Simulation data[1,2] for >100 popular standardized driving cycles validated by real data for calculating EC over speed
  - Several databases[3,4,5] for differentiation among S/M/L
  - Data from WLTC[6] for consumption of A/C



BEV simulated energy consumption over speed[1]

	Average Mass [kg]	Motor Power [kW]	Avg. Energy Consumption [Wh/km]
Mini	1250	< 50	174
Small	1650	50 - 80	192
Medium	1800	80 - 145	194
Large	2100	> 145	204

Classification of battery electric cars based on motor power

References:

[1] Mamarikas et al. (2022)
[2] Mamarikas (2024)
[3] EEA
[4] Spritmonitor.de
[5] EV Database
[6] S Gil-Sayas et al. (2023)

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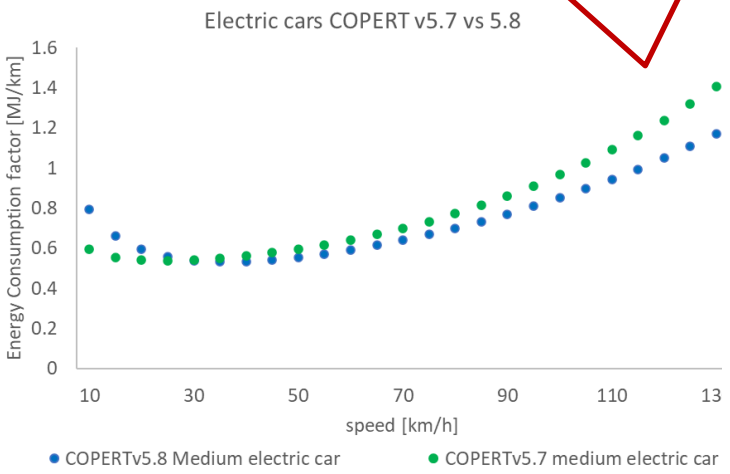
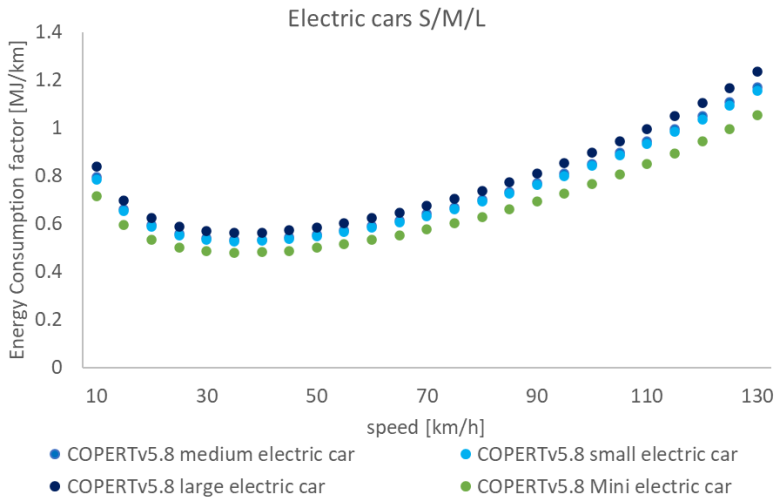
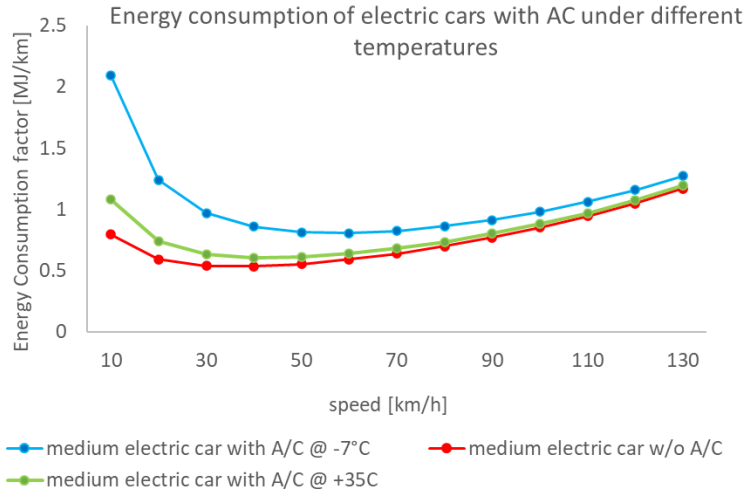
Revision of Energy Consumption of BEVs (2/2)

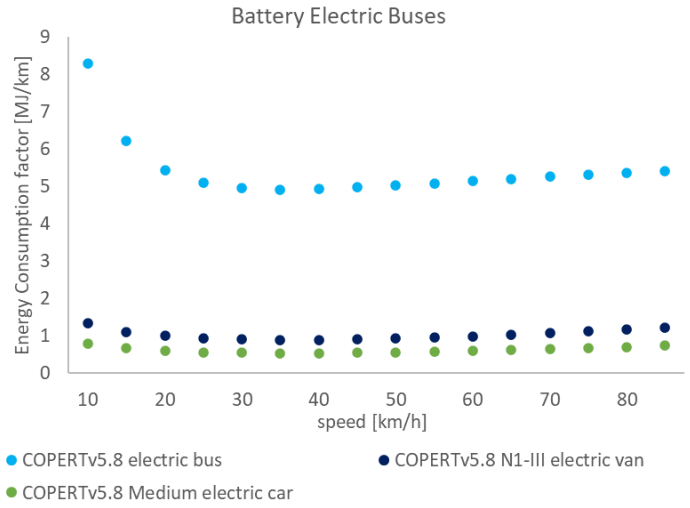
Higher energy demand on high speeds than v5.7

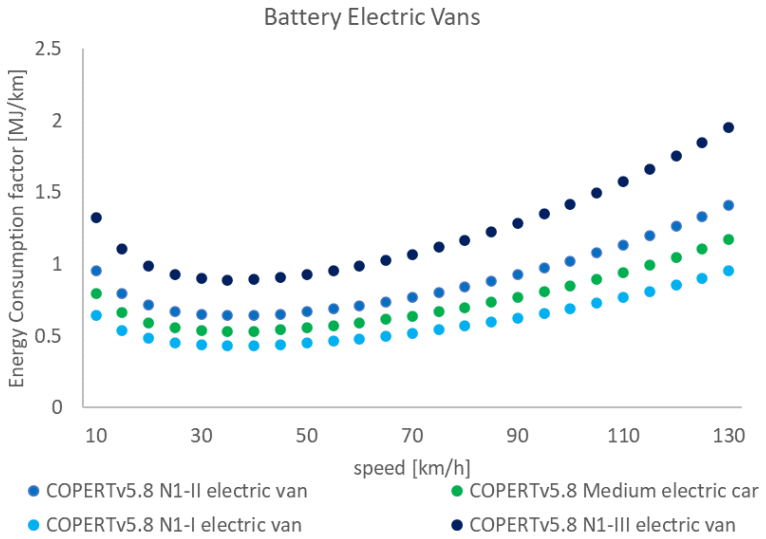




Higher energy consumed for heating in low temperatures and in low speeds







Vehicle	Average Mass [kg]	Avg. Energy Consumption [Wh/km]
N1-I	< 1305	158
N1-II	1305-1760	233
N1-III	> 1760	324

Classification of battery electric vans based on mass

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Revision of cold PM & BC of Euro 5/6 LDVs

Revision of cold PM & BC of Euro 5/6 LDVs (1/2)

- Vehicles
  - *Categories*: Passenger cars, Light-Commercial Vehicles
  - *Powertrains*: Petrol, Diesel, CNG
  - *Segments*: All
  - *Euro standards*: Euro 5/6

- Measurements*
  - 21 vehicles (13 of them Euro 5/6)
  - NEDC cycle
  - Several tests @ -7 °C and selectively @ +23 °C

- Pollutants updated

  Cold PM & BC**

Emission standard	Car/Fuel	No of cars	Temperature (°C)	No of tests per car/fuel
Euro 2/3	Diesel/ Diesel fuel	3	+23, +5, −7	2–8
Euro 2	NGV/CNG	1	+23, +5, −7	2
Euro 3	MPI, DISI/ Gasoline	2	+23, +5, −7	2
Euro 3/4	FFV-MPI/ E85	2	+23, +5, −7	2
Euro 5	Diesel/ Diesel fuel	3	+23, −7	2
Euro 5	MPI, DISI/ Gasoline	4	+23, −7	2
Euro 5	FFV/E85, Gasoline	2	+23, −7	2
Euro 6	DISI/ Gasoline	1	−7	7
Euro 6	FFV/E85	1	−7	7
Euro 6	Diesel/ Diesel fuel	1	−7	4
Euro 6	NGV/CNG	1	−7	4

*Cars tested by VTT**

*Reference: VTT Technical Research Centre of Finland

** OM also affected since it is a fraction of BC

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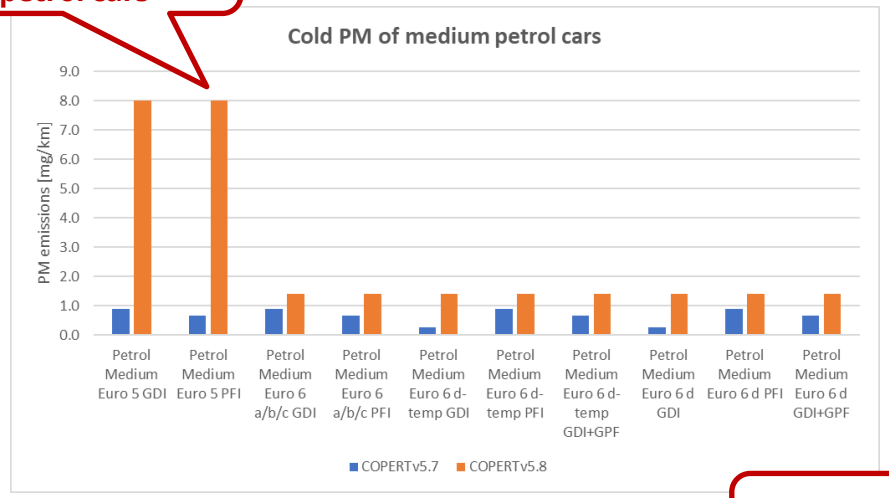
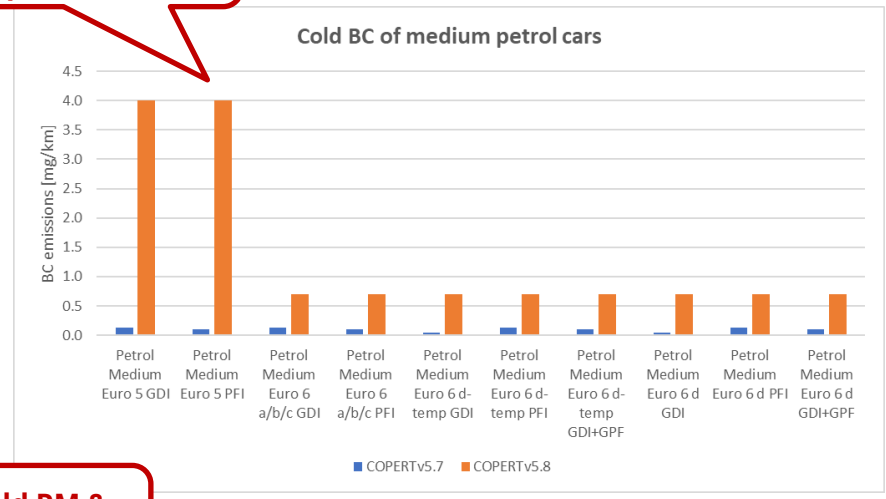
Revision of cold PM & BC of Euro 5/6 LDVs (2/2)

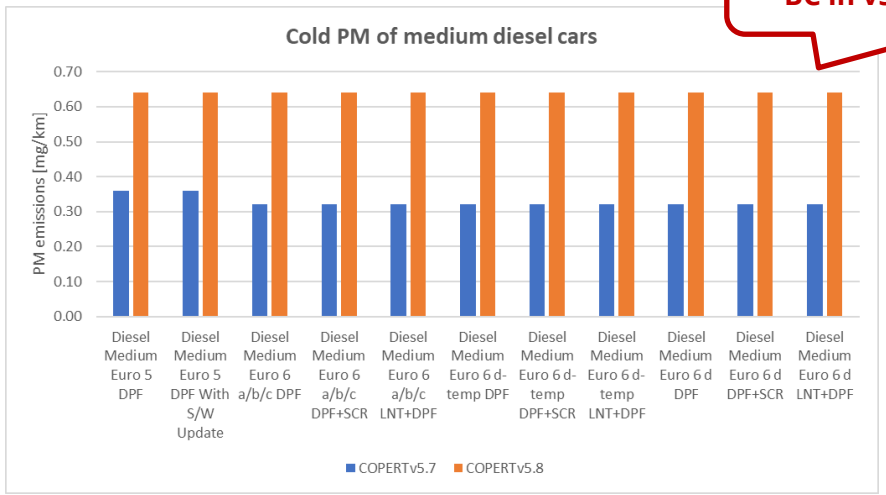
Much higher PM emissions in cold-start especially for Euro 5 petrol cars

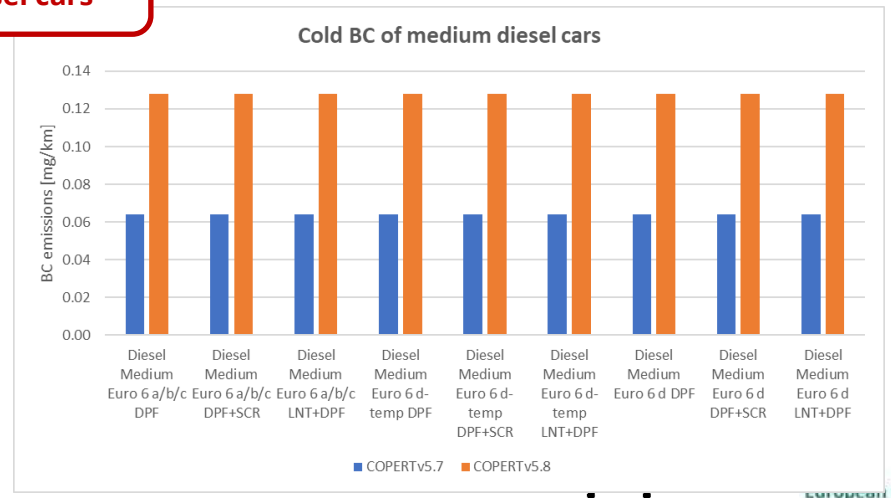


Much higher BC emissions in cold-start for both Euro 5 and 6 petrol cars



Underestimations of cold PM & BC in v5.7 also for diesel cars





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Revision of EC of Euro 6 LPG passenger cars

Revision of EC of Euro 6 LPG passenger cars (1/2)

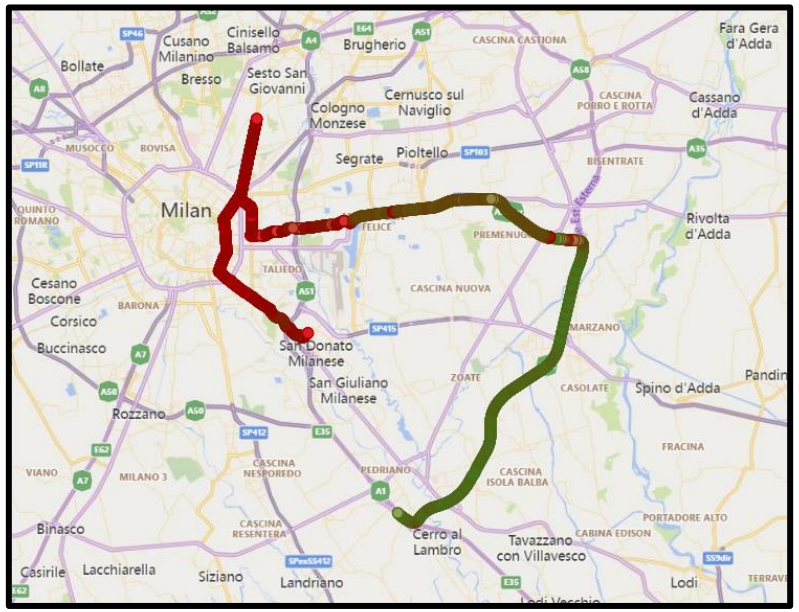
- Vehicles updated
  - *Categories*: Passenger Cars
  - *Powertrains*: LPG
  - *Segments*: Mini/Small/Medium/Large
  - *Euro standards*: Euro 6 a/b/c, d/e, d-temp

- Measurements*
  - Chassis cycles (WLTC, NEDC, ECE…)
  - RDE (on road measurements)

- Pollutants updated

  Energy Consumption only

  (NOx, CO, VOC, SPN23, CH4 updated in v5.6)



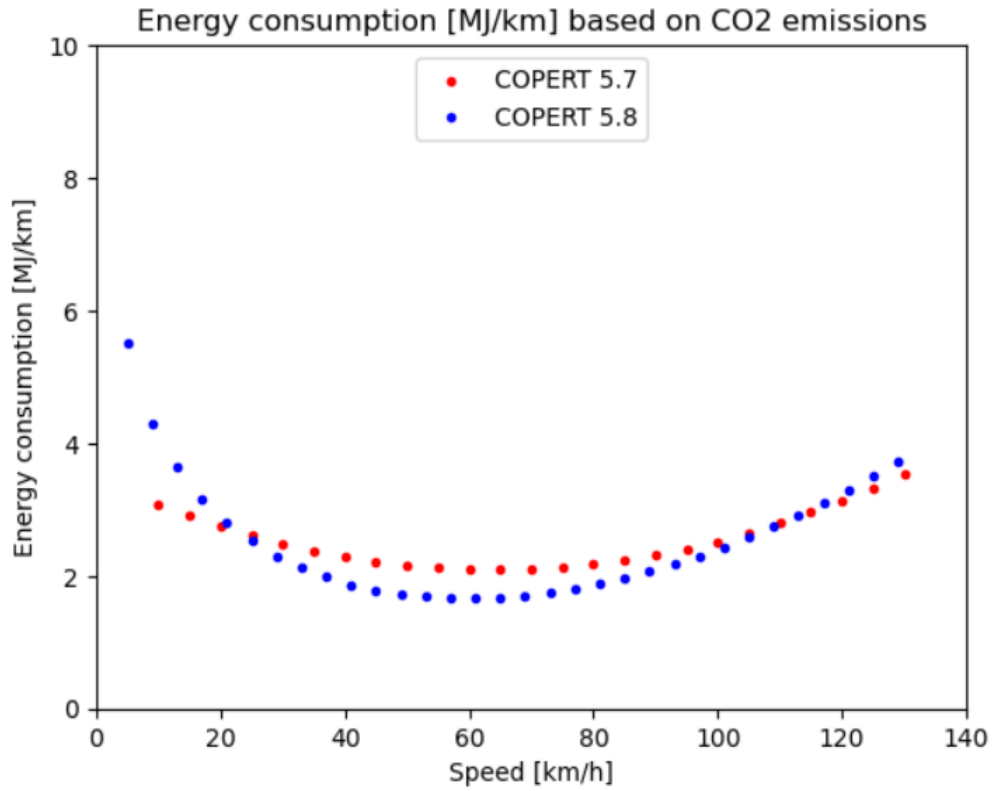
RDE cycle in Milan

*Reference: Laboratory and On-road cycles (conducted by Innovhub in Italy)

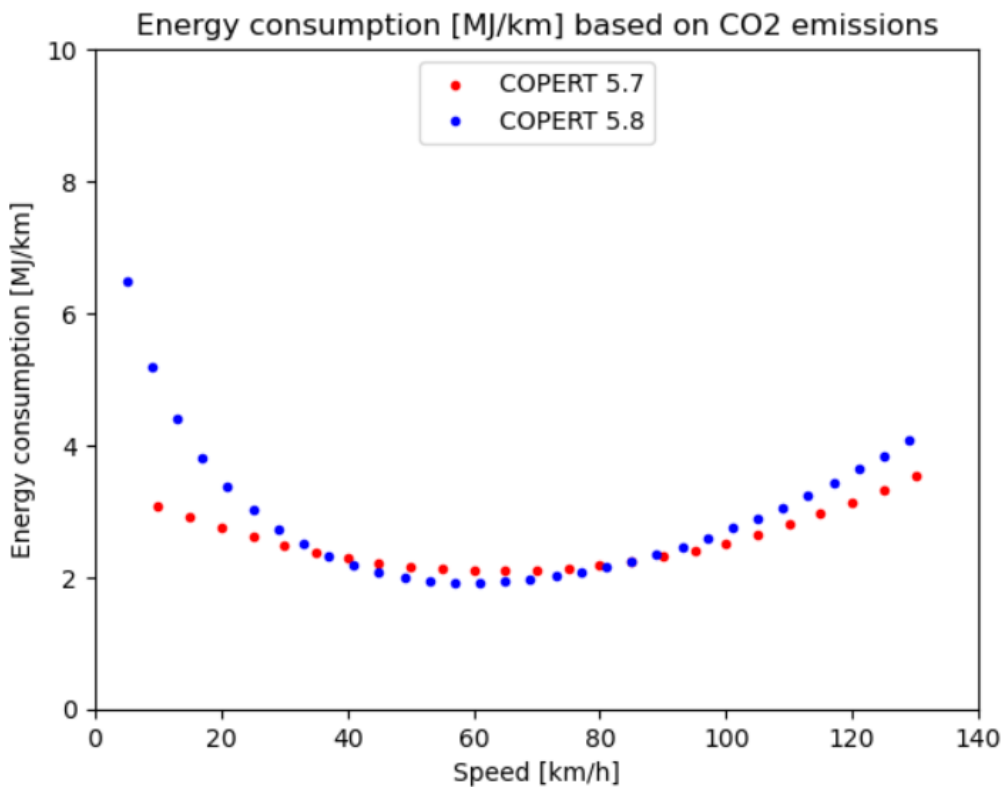
Revision of EC of Euro 6 LPG passenger cars (2/2)

Small differences between COPERT v5.7 & v5.8 – Larger differences for low speeds

Mini/Small



Medium/Large



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Revision of Euro 5 motorcycles

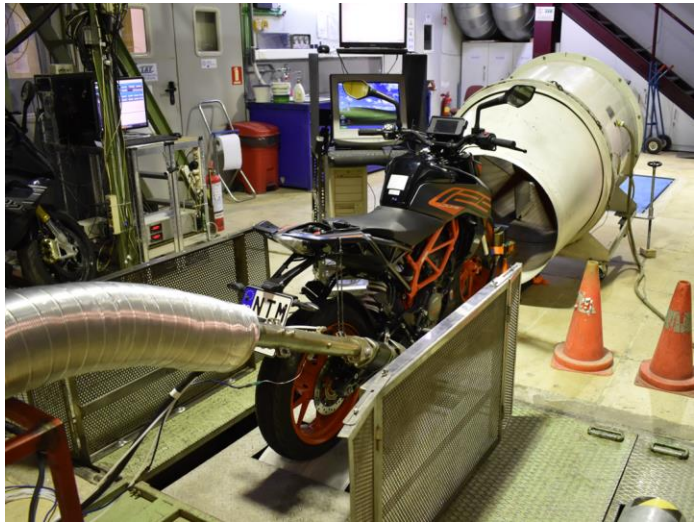
Revision of Euro 5 motorcycles (1/2)

- Vehicles updated
  - *Categories*: L-Category (Motorcycles)
  - *Powertrains*: Petrol
  - *Segments*: <250 cm³, 250-750 cm³, >750 cm³
  - *Euro standards*: Euro 5

- Measurements*
  - 10 Euro 5 L-category vehicles
  - Chassis dyno tests using WMTC & RDC
  - On-road RDE tests
  - Locations: Thessaloniki & Gratz

- Pollutants measured

  EC, CO, NOx, PM, PN, VOC, CH4



In-lab emissions testing by EMISIA in LAT

*Reference: EMISIA, TUG

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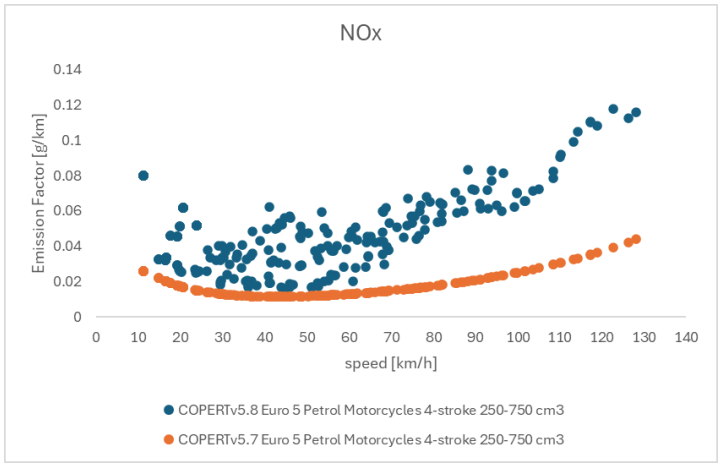
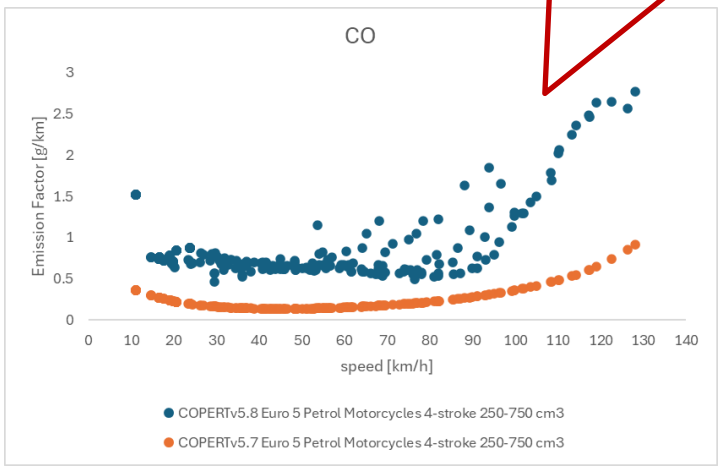
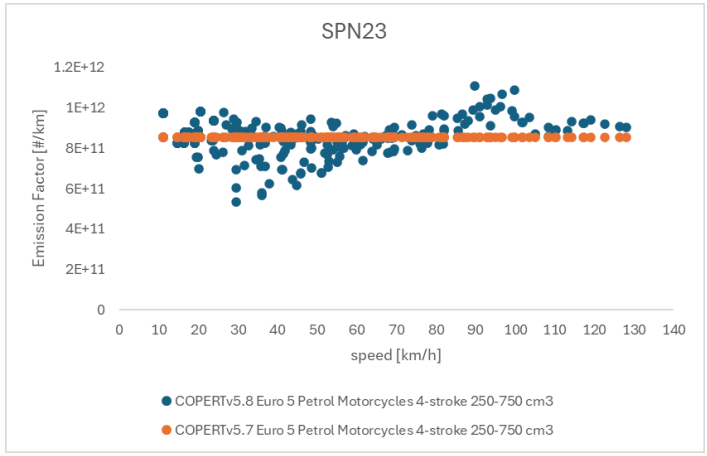
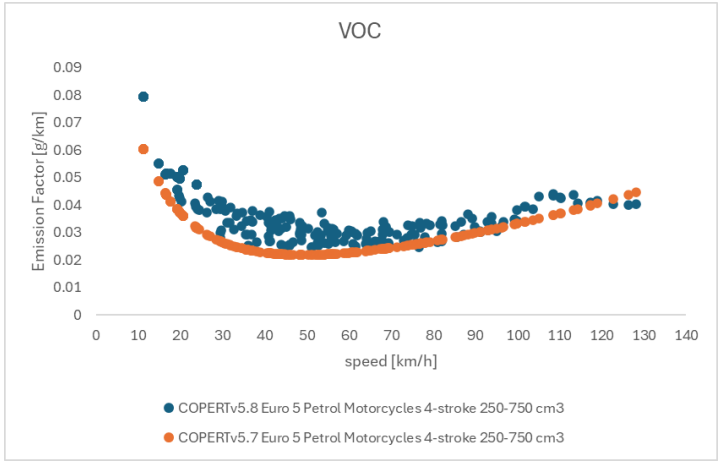
Revision of Euro 5 motorcycles (2/2)

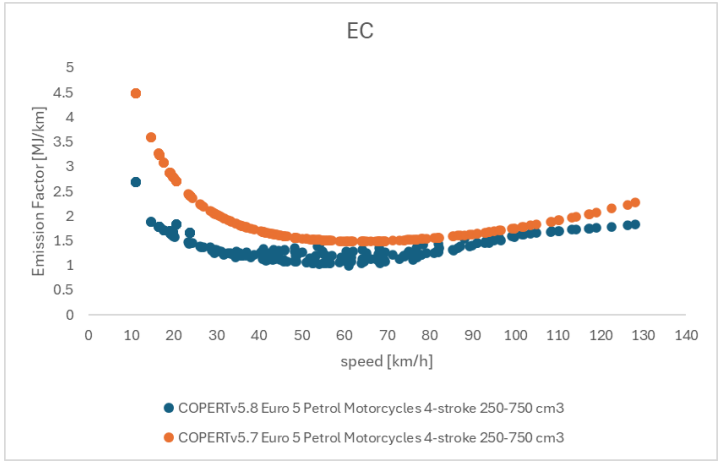


Great difference in high speeds due to rich combustion









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Software & bug corrections in COPERT v5.8

Software & bug corrections in COPERT v5.8

- Extension of the functionalities of the Command Line Interface:
  - Ability to point an existing .cop file
  - All pollutants
  - Mileage degradation
- Share of cold CH4 and NMVOC over VOC for Euro 6 LDVs
- Hot CH4 emission factors of LPG cars
- PM, PN emission factor of CNG/LPG Euro 5 & 6 vehicles
- Minor issues

Overall impact of COPERTv5.8 in inventories?

	Passenger Cars	Light Commercial Vehicles	Heavy-Duty Trucks	Buses	L-category
> 5% growth	OM	CH4	Pb, As, Cr, Cu, Ni	N2O	-
1% - 5% growth	CO, NMVOC, PM2.5	-	Zn, Cd, Se, PM2.5, PM10, TSP	Pb, As, Cr, Cu, Ni, Zn, Cd, Se, PM2.5, PM10, TSP	NO, NOx, NO2, CO
1% - 5% reduction	-	-	-	-	CH4, BC
> 5% reduction	BC, CH4	BC, OM	-	-	-
Minor change	Rest	Rest	Rest	Rest	Rest

**Results compared against 5.7.3 based on latest EU data*

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Planned updates for next year

Planned updates for next year

- Revision of energy consumption factors of LDVs
- Revision of non-exhaust emission factors from brake wear (PM & PN)
- Revision of emission factors from L-category vehicles
- VOC speciation of Euro 6 vehicles
- Introduction of electric HDTs
- Regular software updates and improvements

Thank you for your attention!

For more information, please see our website or contact us at support@emisia.com

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