

# Latest developments 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
- Software and minor corrections



# Introduction of Euro 7 vehicles



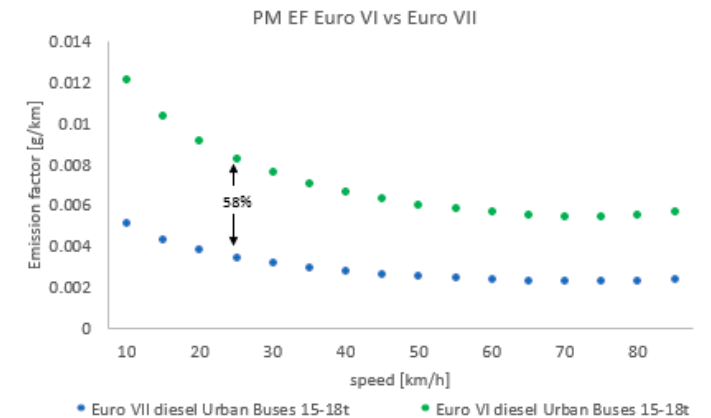
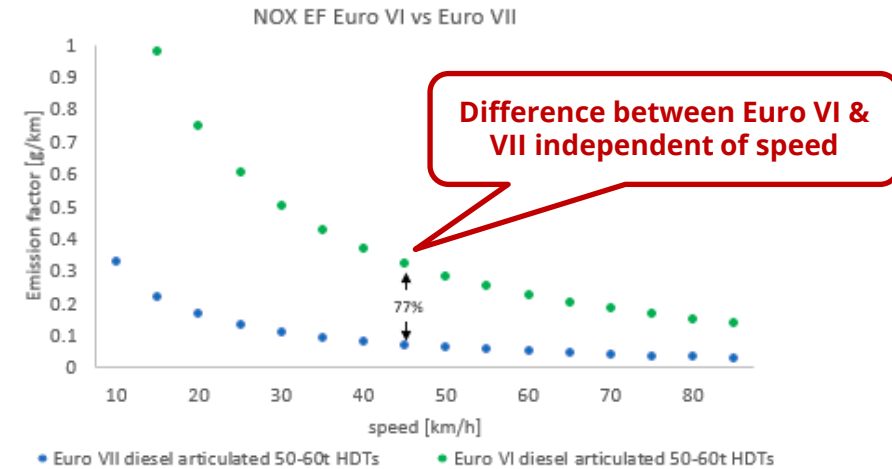
# Introduction of Euro 7 vehicles

- Euro 7 LDVs & HDVs introduced in COPERT v5.8
- Numbers based on:
  - Euro 7 Impact Assessment Study<sup>1</sup> 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/OBFCM & reduced (compared to Euro 6) non-exhaust emission factors
  - HDVs: Reduced (compared to Euro VI) emission factors for various pollutants by a % factor



<sup>1</sup> [Euro 7 impact assessment study](#)

<sup>2</sup> [Regulation \(EU\) 2024/1257](#)



Examples of Euro VII emission factors in COPERTv5.8



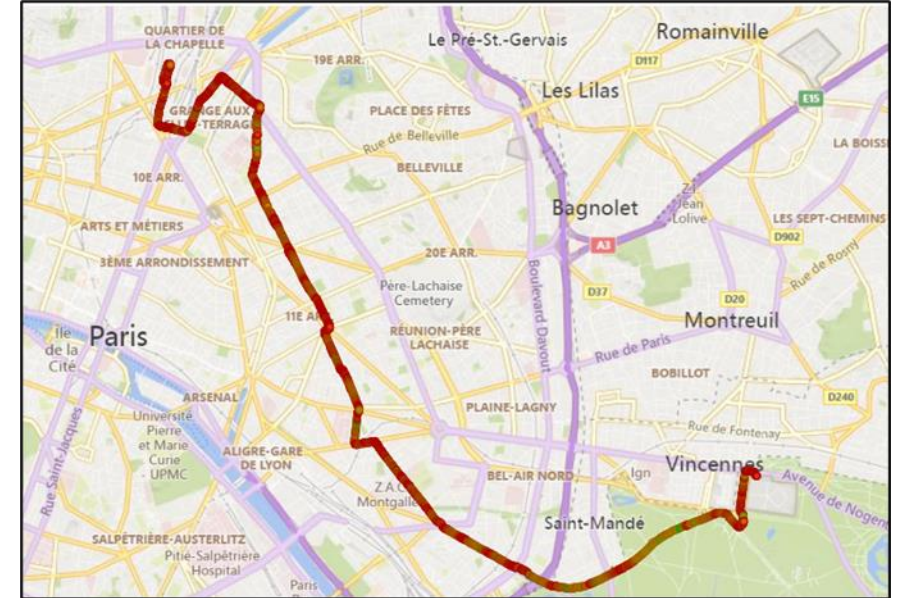
# Introduction of Euro VI CNG & LNG HDVs



# 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<sup>1</sup> for 5 HDTs & 6 Buses
  - Real operational conditions using PEMS<sup>2</sup> for 6 Buses
- Pollutants updated

CO, EC, NO<sub>x</sub>, PM, PN, CH<sub>4</sub>, VOC, N<sub>2</sub>O, NH<sub>3</sub>



*CNG urban buses routes in Paris<sup>2</sup>*

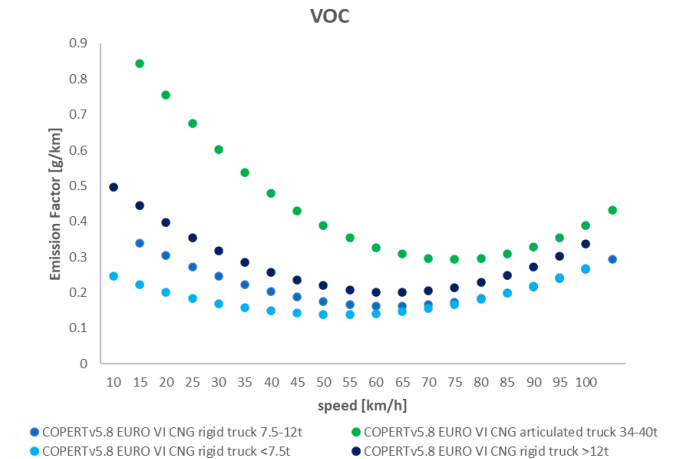
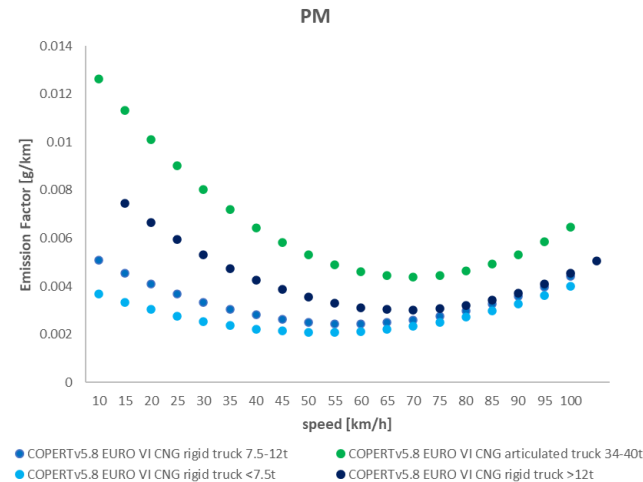
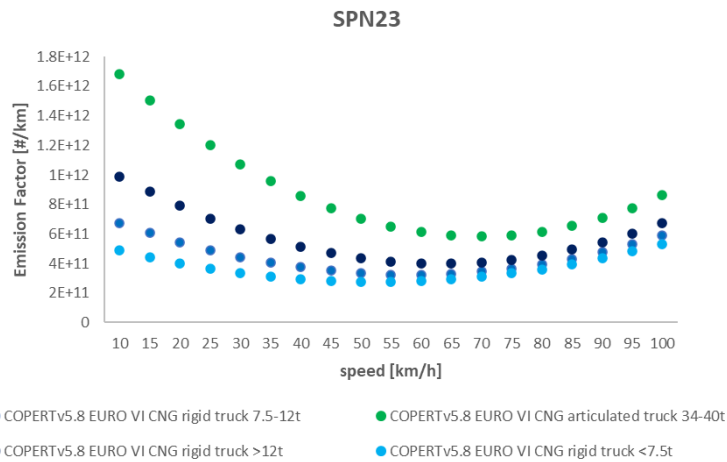
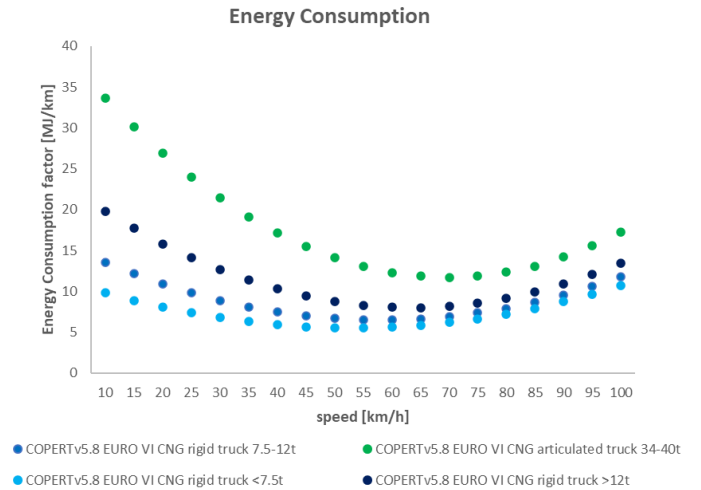
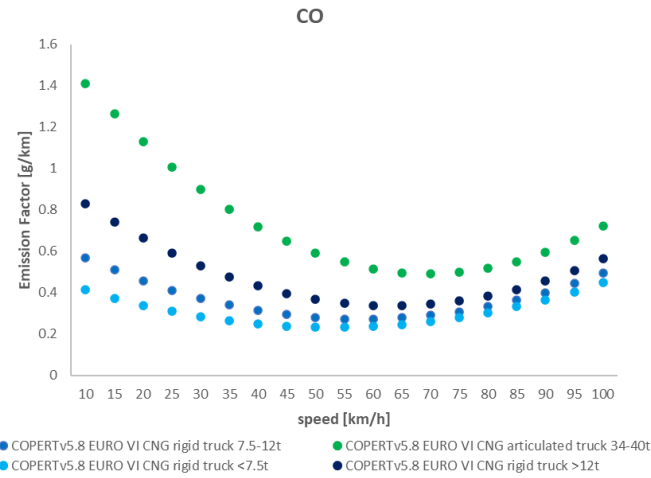
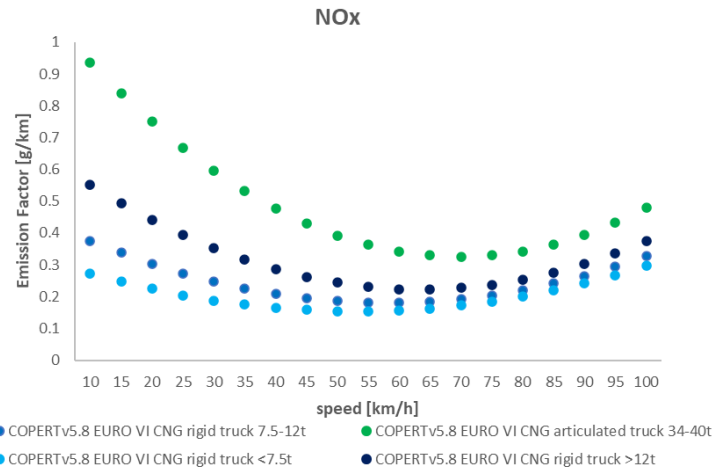
References:

<sup>1</sup> [HBEFA - Handbook Emission Factors for Road Transport](#)

<sup>2</sup> [AIRPARIF](#)

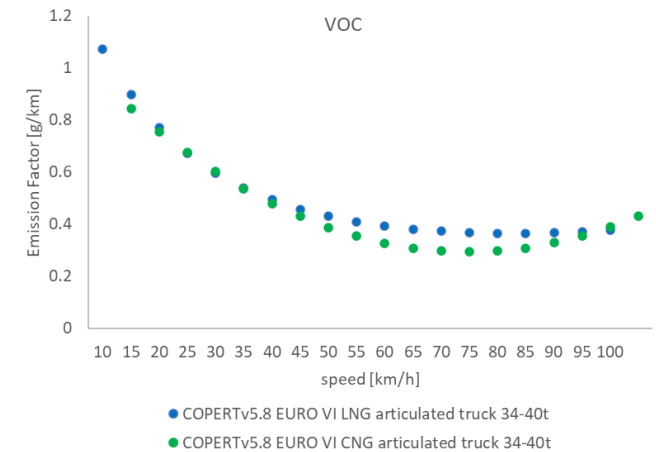
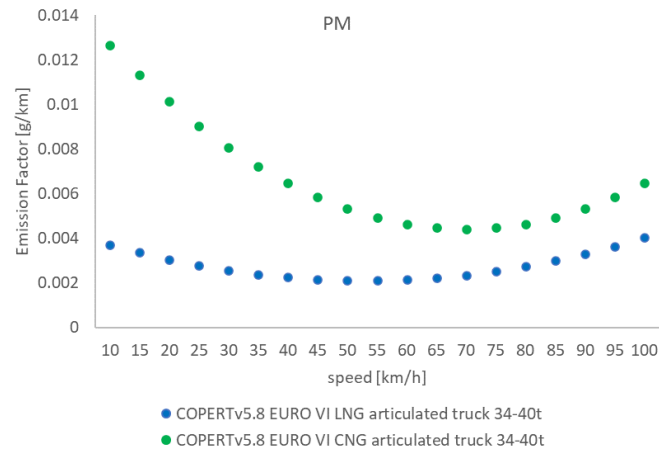
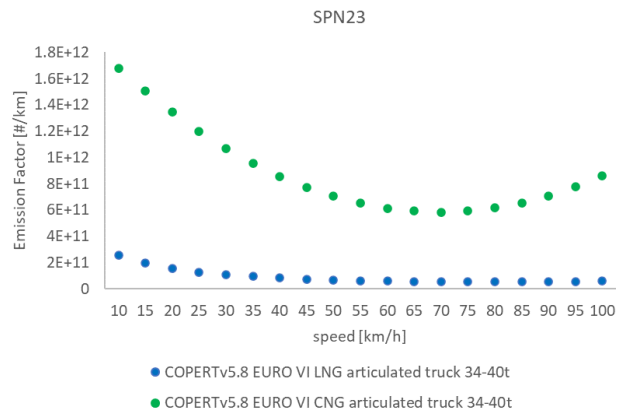
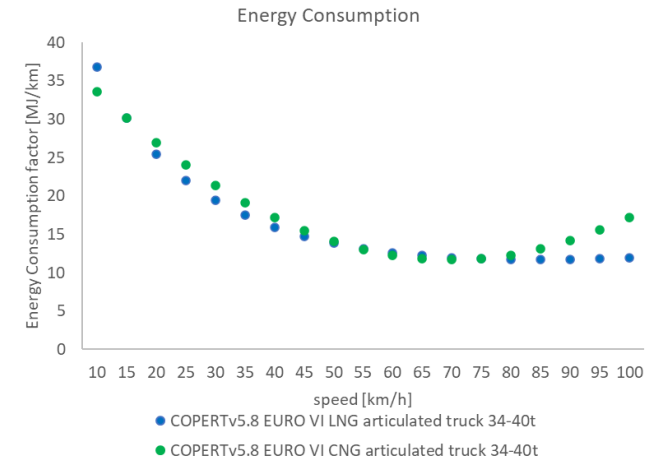
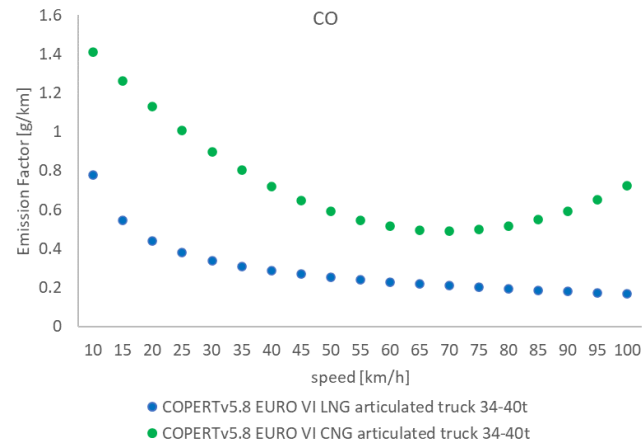
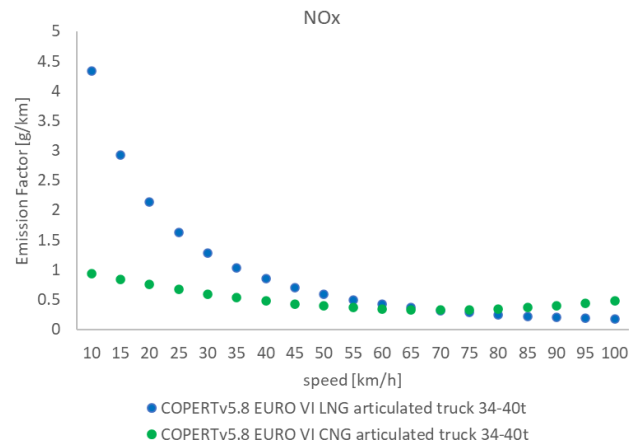
# Introduction of Euro VI CNG & LNG HDVs (2/4)

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



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

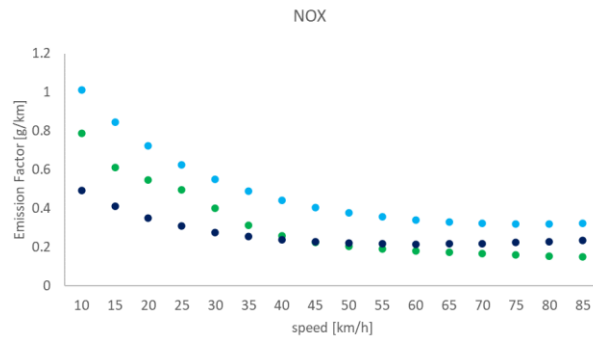
LNG HDTs were not in COPERT v5.7 so comparison is done against CNG HDTs



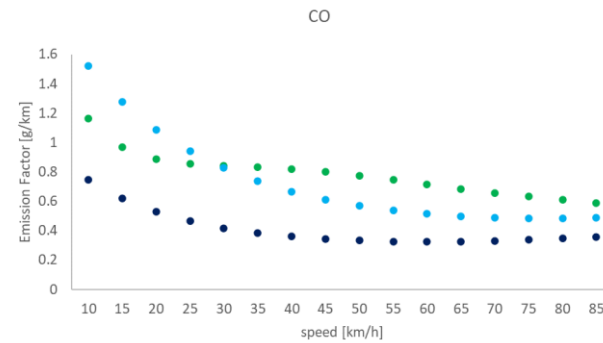


# Introduction of Euro VI CNG & LNG HDVs (4/4)

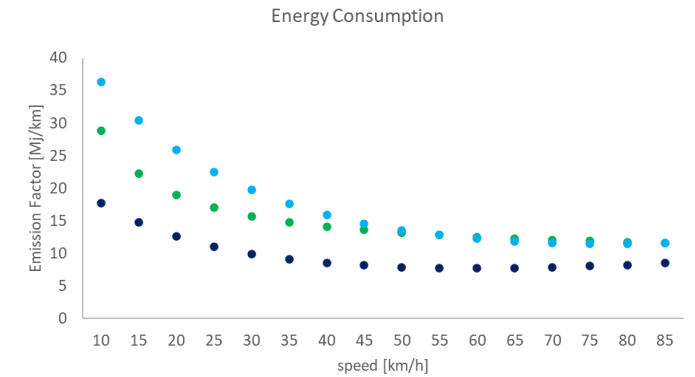
**Euro VI CNG urban Buses were not in COPERT v5.7  
so, comparison is done only among segments**



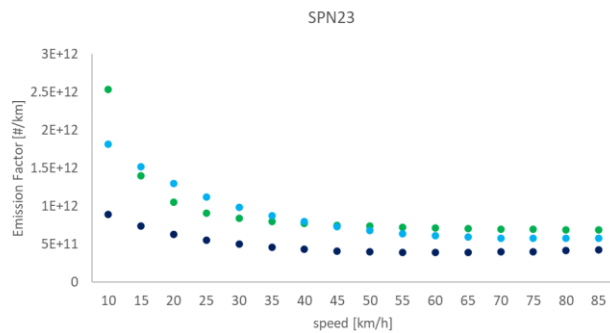
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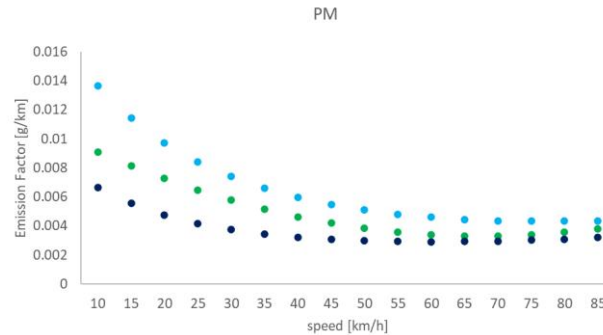
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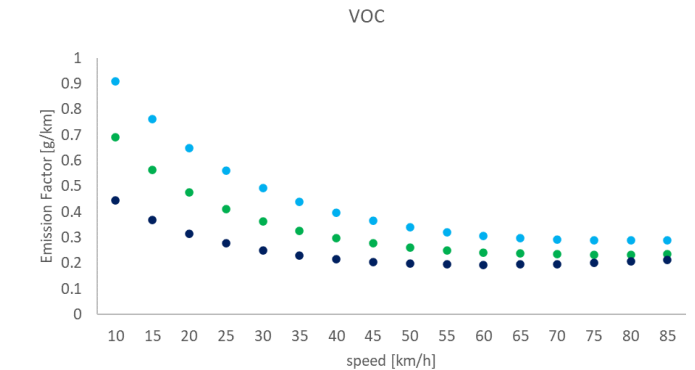
● COPERTv5.8 EURO VI CNG bus 15-18t ● COPERTv5.8 EURO VI CNG bus <15t ● COPERTv5.8 EURO VI CNG bus >18t



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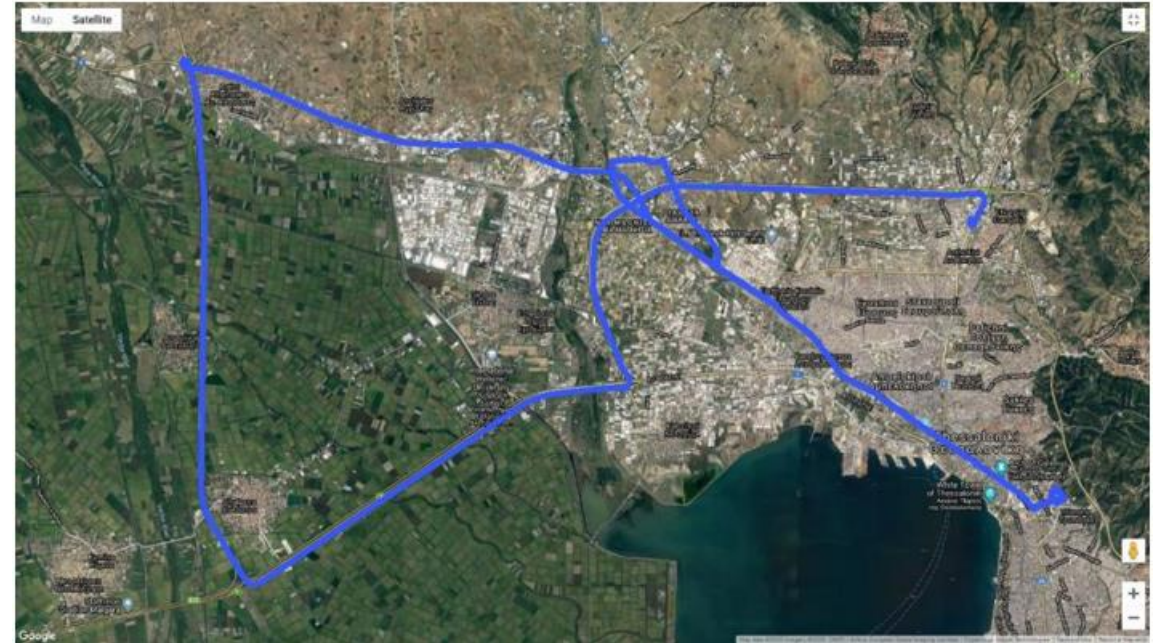
● COPERTv5.8 EURO VI CNG bus 15-18t ● COPERTv5.8 EURO VI CNG bus <15t ● COPERTv5.8 EURO VI CNG bus >18t

# 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

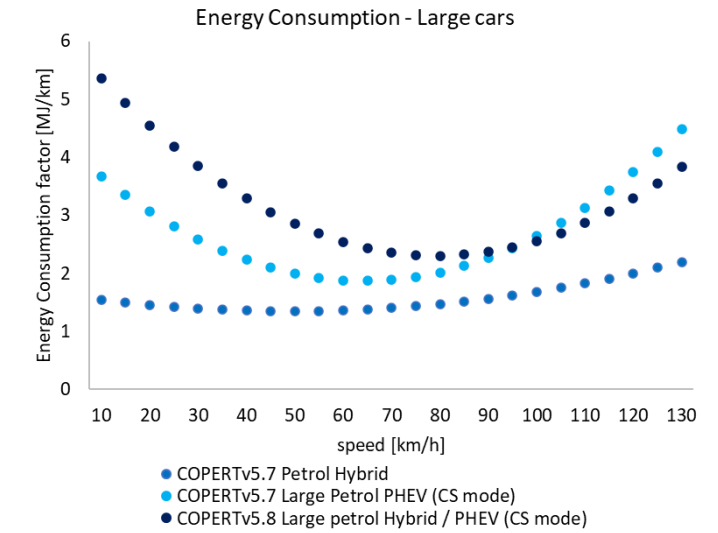
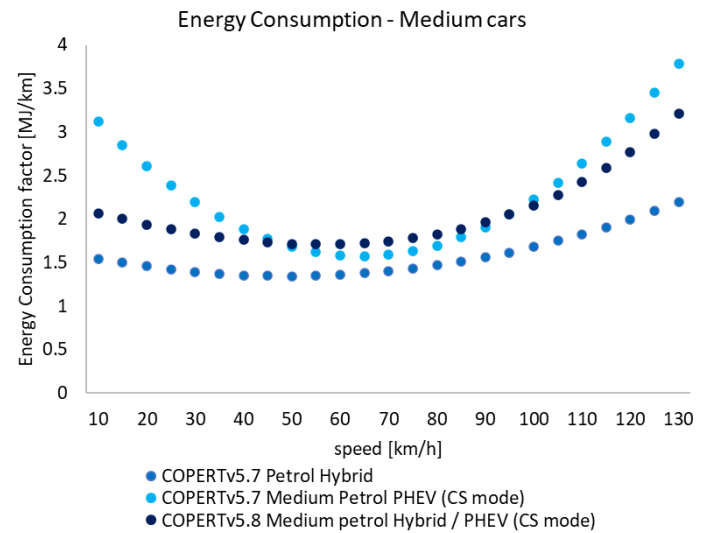
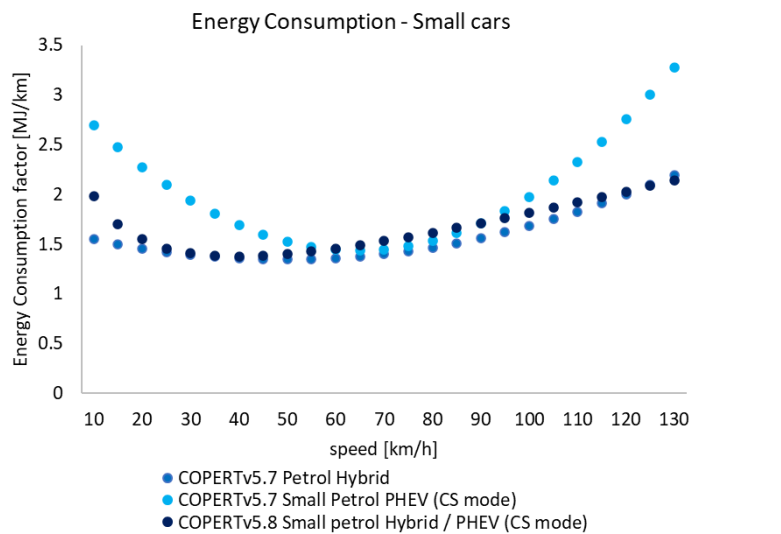
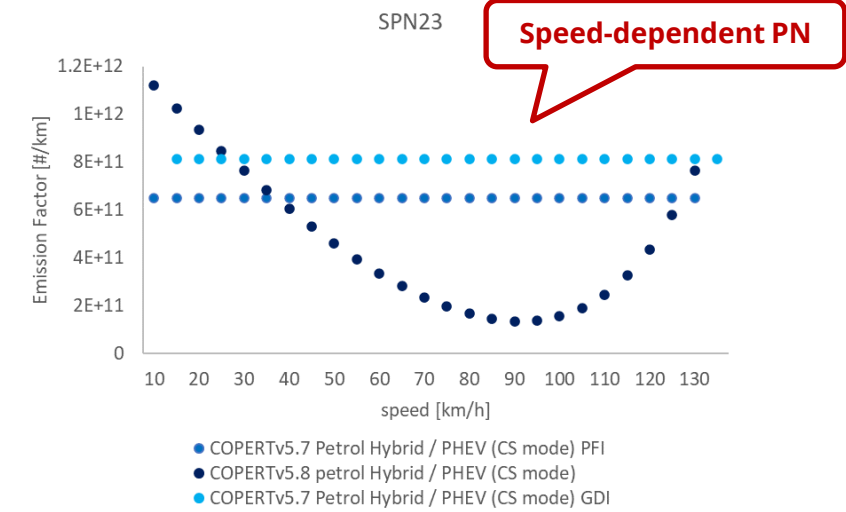
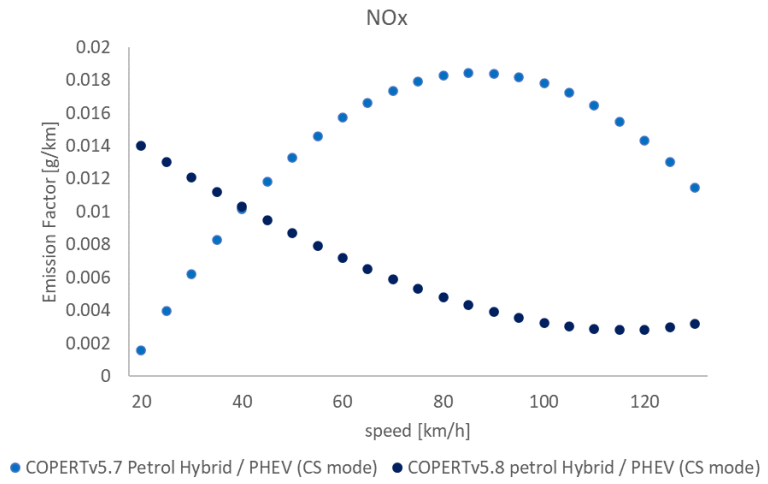
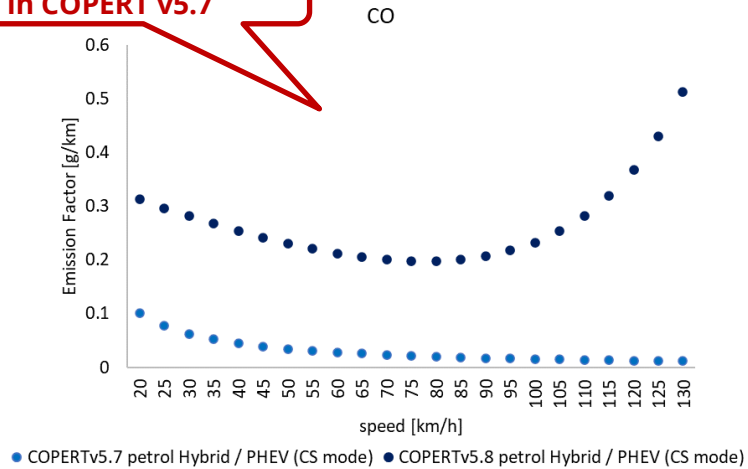


*Regular RDE routes in Thessaloniki*

\*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



# 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, methylethylketone
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

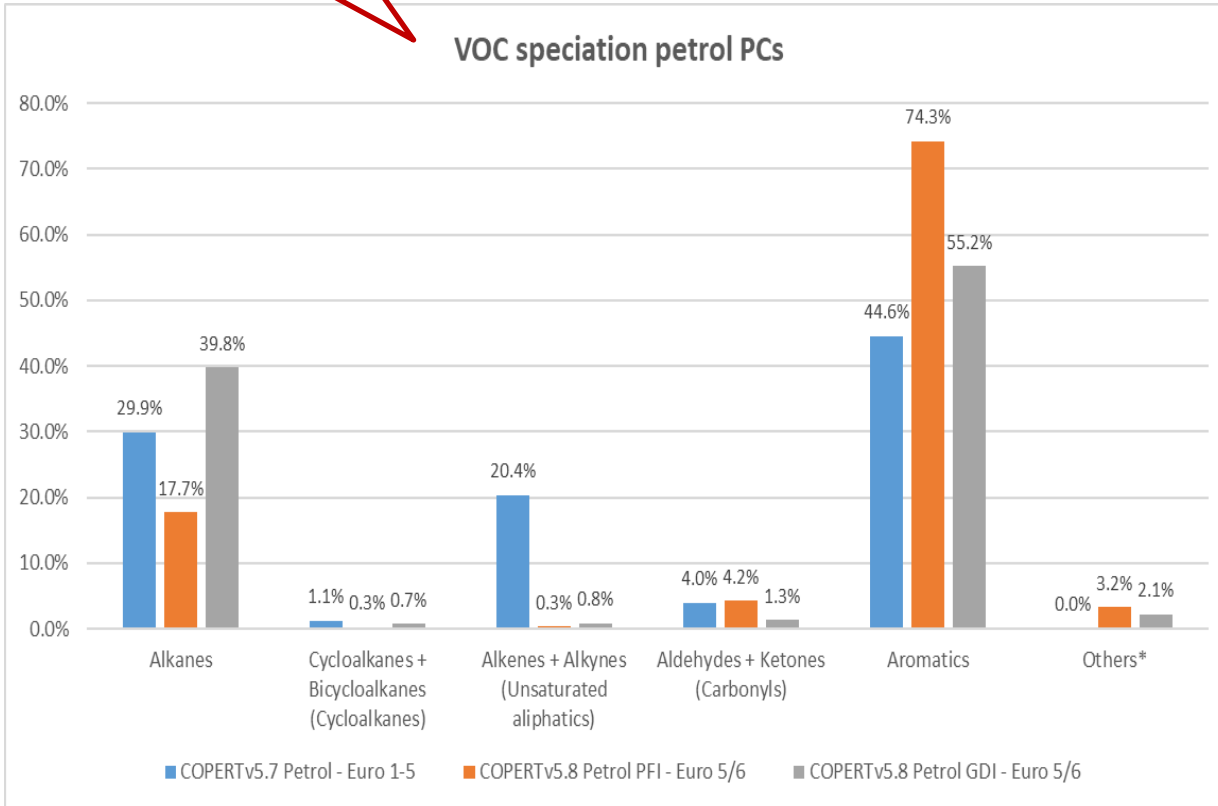
\*Reference: [Baptiste et al. \(2022\)](#)



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

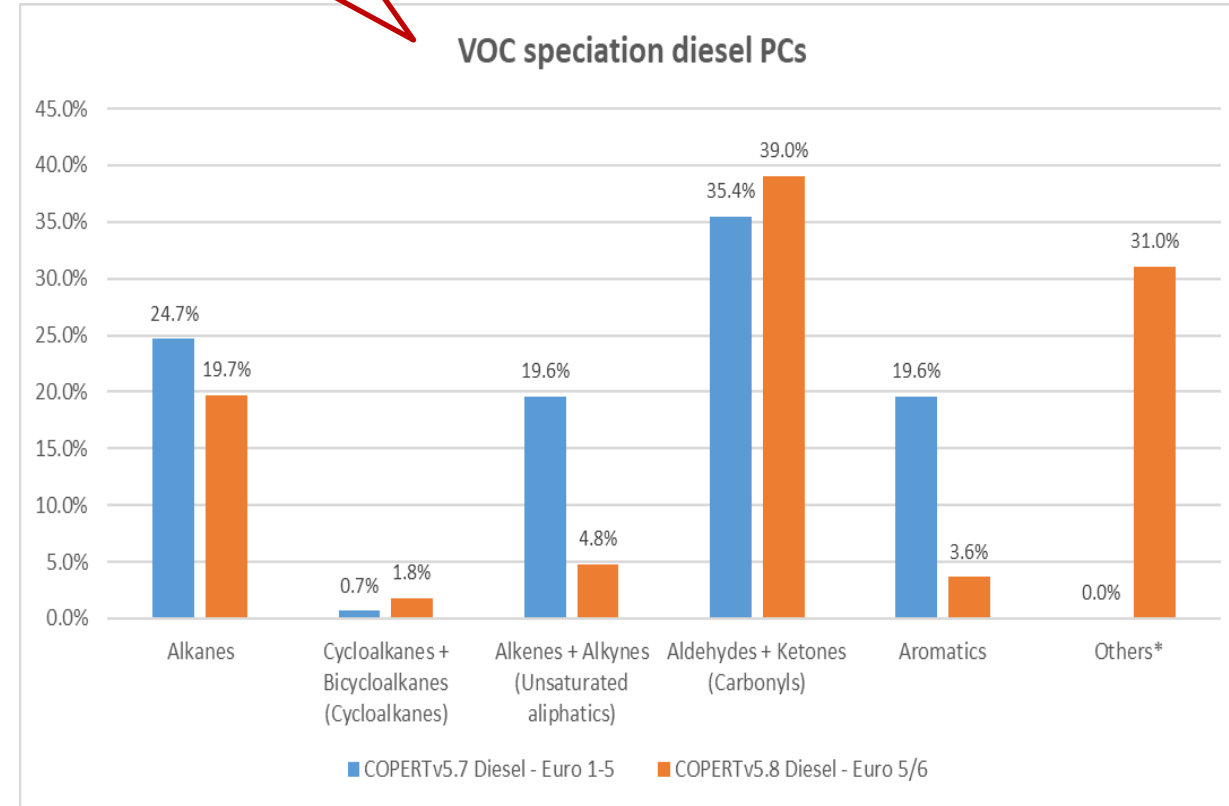
Larger differences for alkanes, alkenes, alkynes & aromatics

VOC speciation petrol PCs



Larger differences for alkenes, alkynes & aromatics

VOC speciation diesel PCs



\*Others: Alcohols, Acids, Nitrogen

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

References:

<sup>1</sup> [Mamarikas et al. \(2022\)](#)

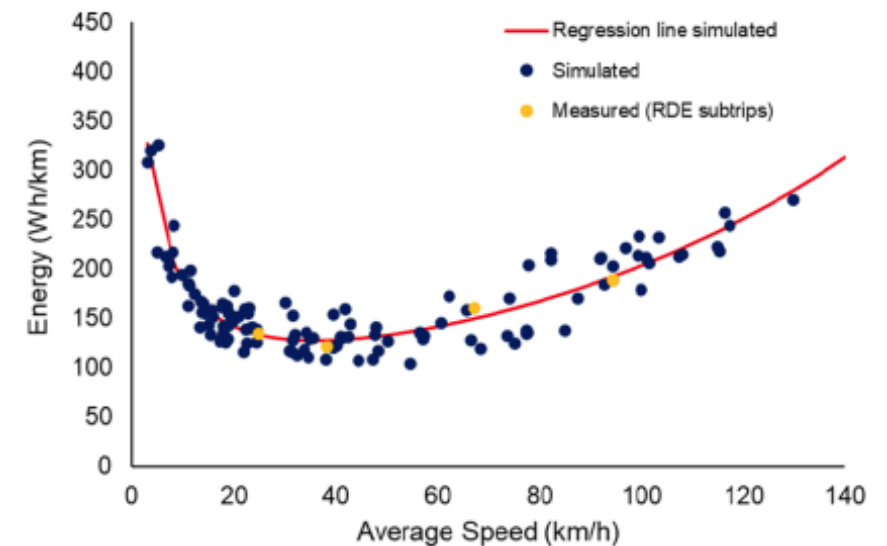
<sup>2</sup> [Mamarikas \(2024\)](#)

<sup>3</sup> [EEA](#)

<sup>4</sup> [Spritmonitor.de](#)

<sup>5</sup> [EV Database](#)

<sup>6</sup> [S Gil-Sayas et al. \(2023\)](#)



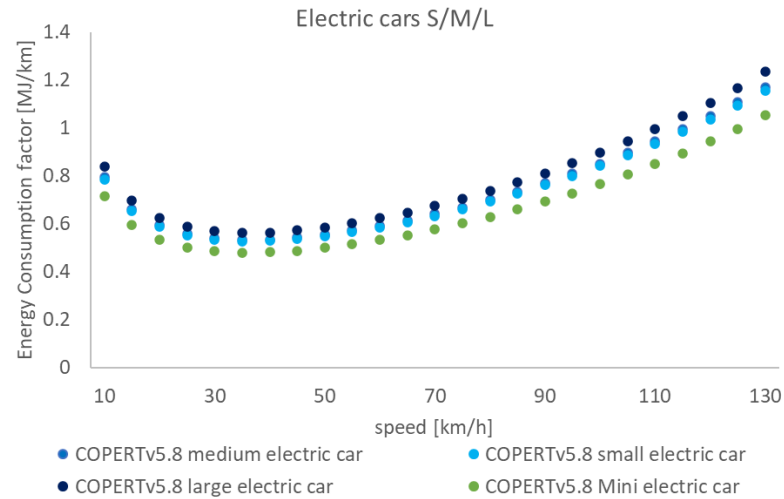
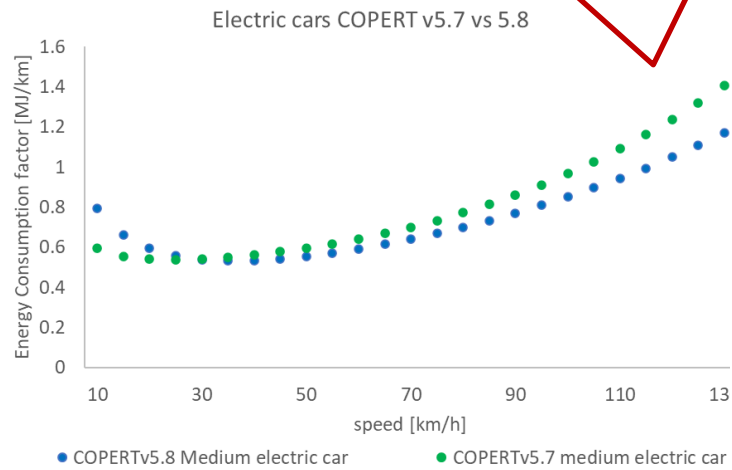
*BEV simulated energy consumption over speed<sup>1</sup>*

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

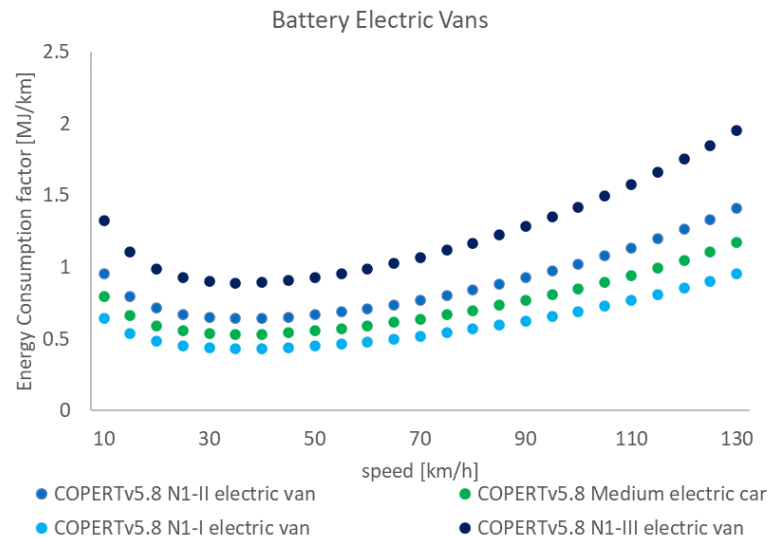
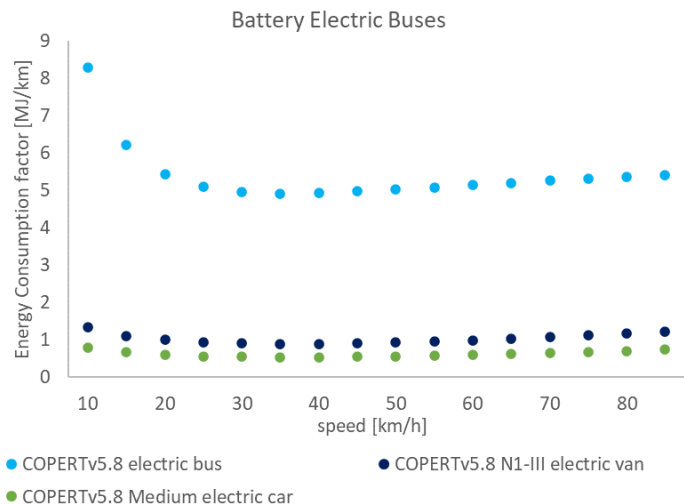
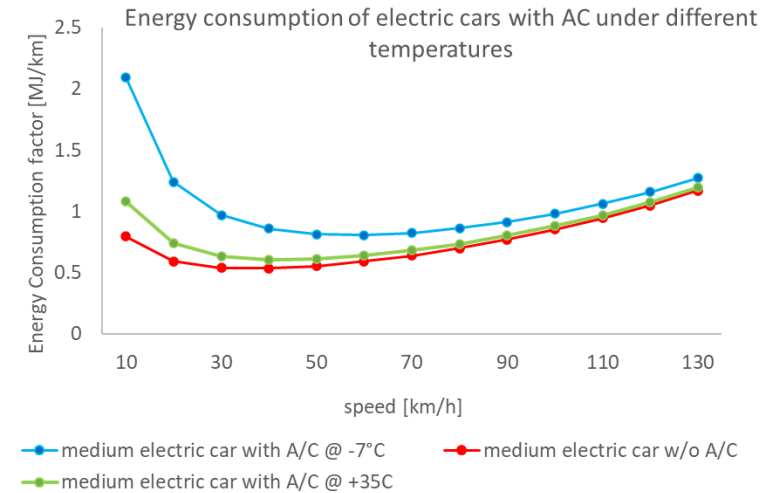
*Classification of battery electric cars based on motor power*

# 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

# 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\**

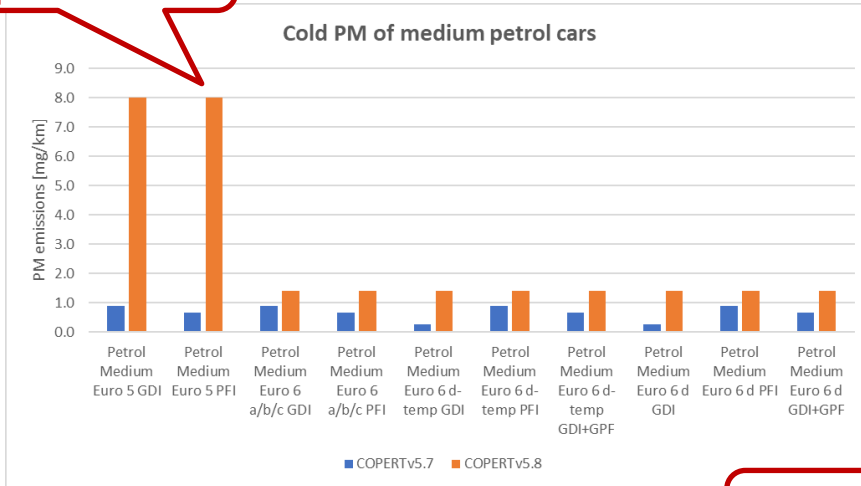
\*Reference: [VTT Technical Research Centre of Finland](#)

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

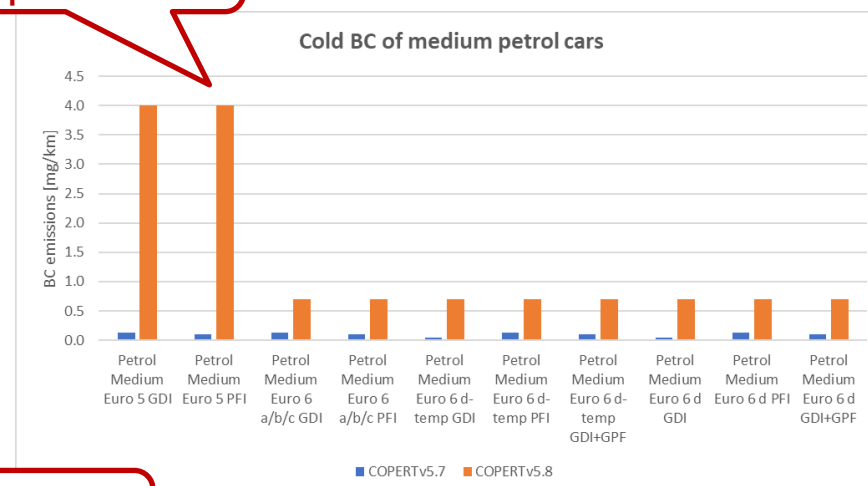


# Revision of cold PM & BC of Euro 5/6 LDVs (2/2)

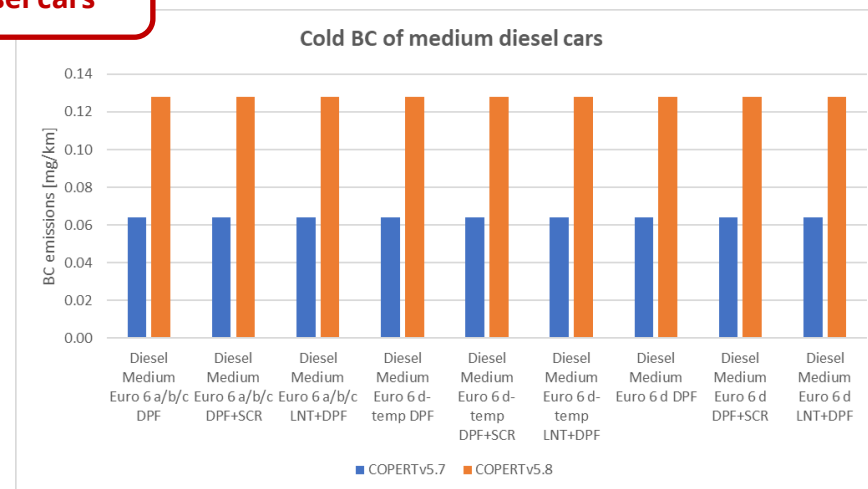
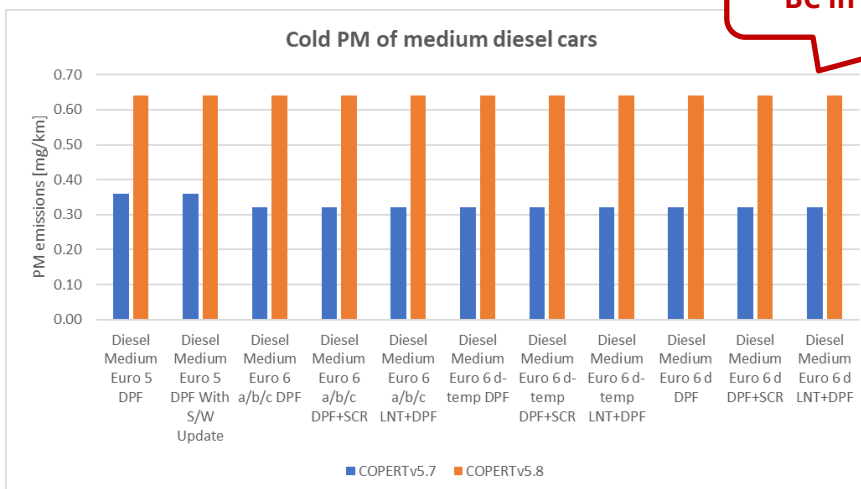
Much higher PM emissions in cold-start especially for Euro 5 petrol cars



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



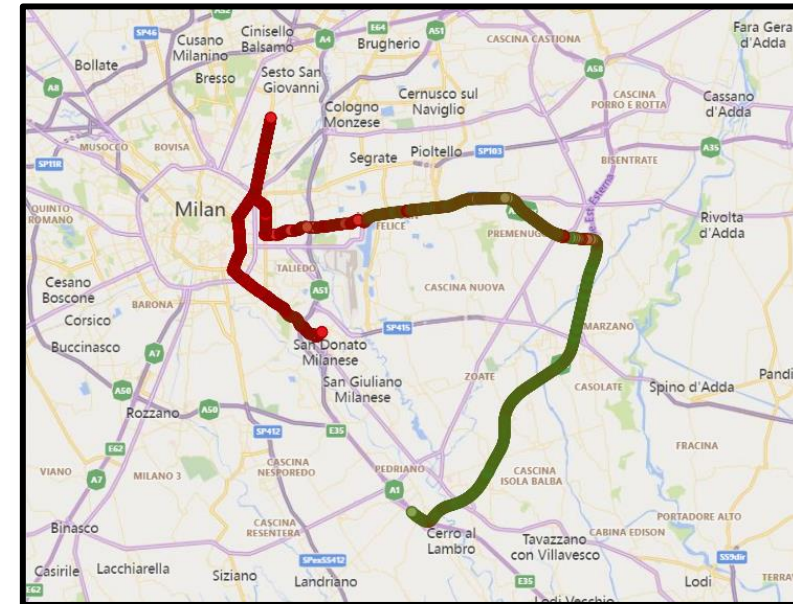
# Revision of EC of Euro 6 LPG passenger cars



# 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  
(NO<sub>x</sub>, CO, VOC, SPN23, CH<sub>4</sub> updated in v5.6)



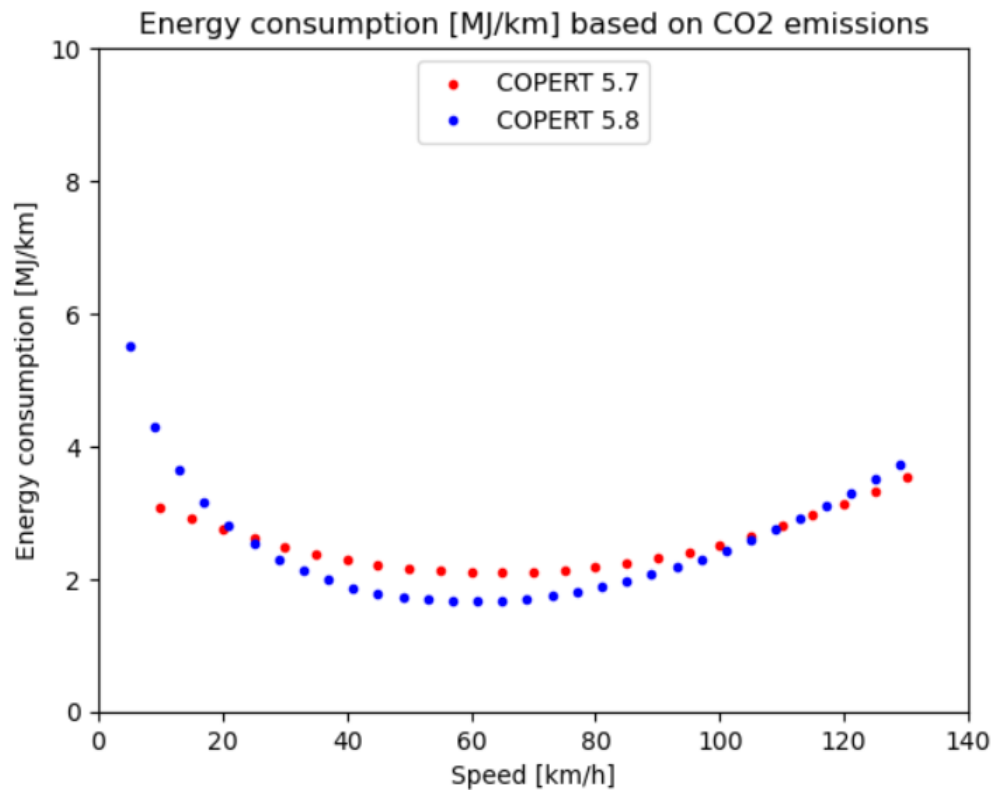
*RDE cycle in Milan*

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

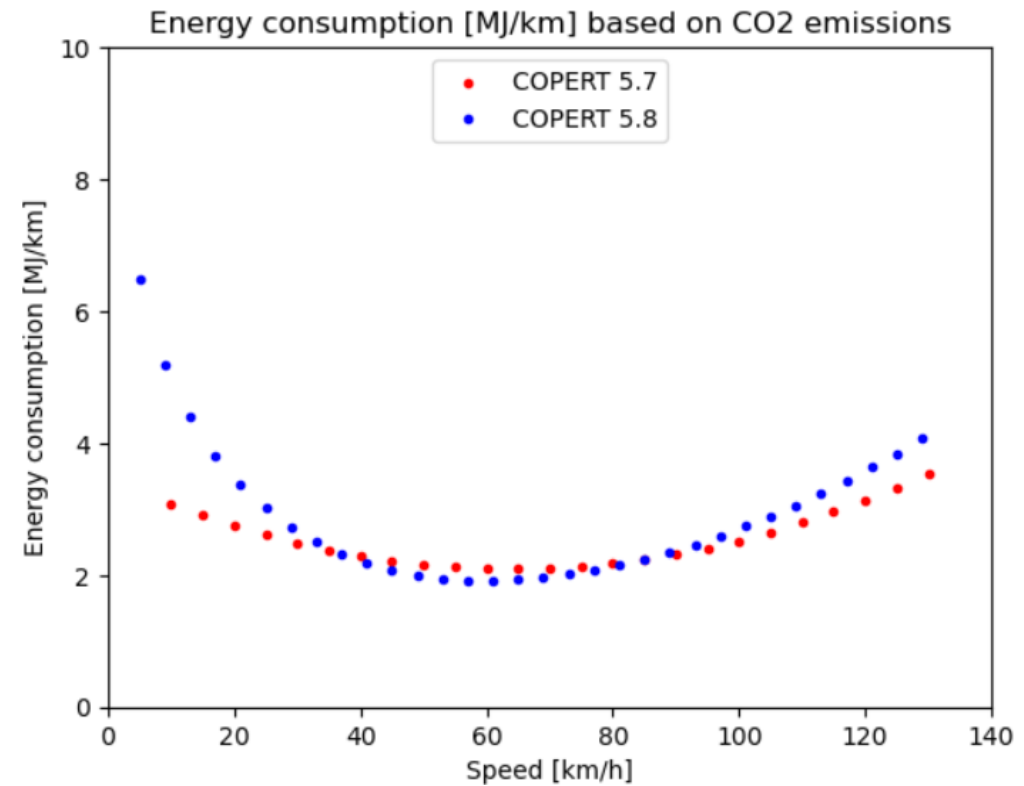
# Revision of EC of Euro 6 LPG passenger cars (2/2)

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

## Mini/Small



## Medium/Large





# Revision of Euro 5 motorcycles



# Revision of Euro 5 motorcycles (1/2)

- Vehicles updated
  - *Categories:* L-Category (Motorcycles)
  - *Powertrains:* Petrol
  - *Segments:* <250 cm<sup>3</sup>, 250-750 cm<sup>3</sup>, >750 cm<sup>3</sup>
  - *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, NO<sub>x</sub>, PM, PN, VOC, CH<sub>4</sub>

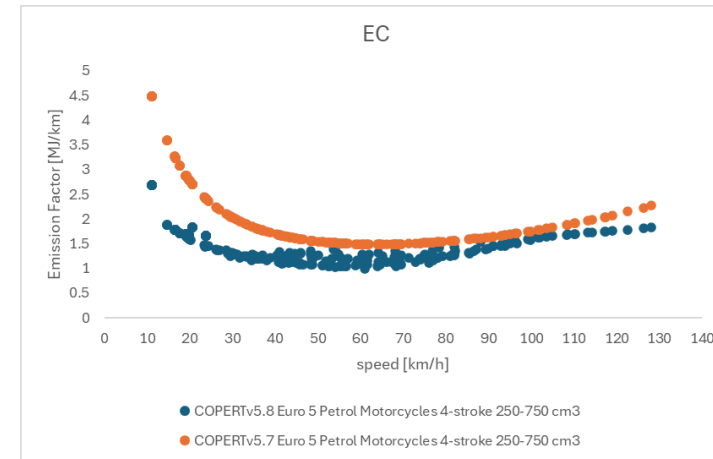
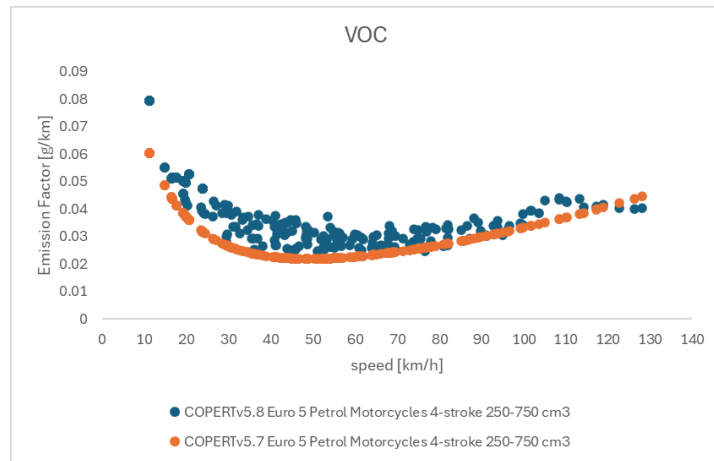
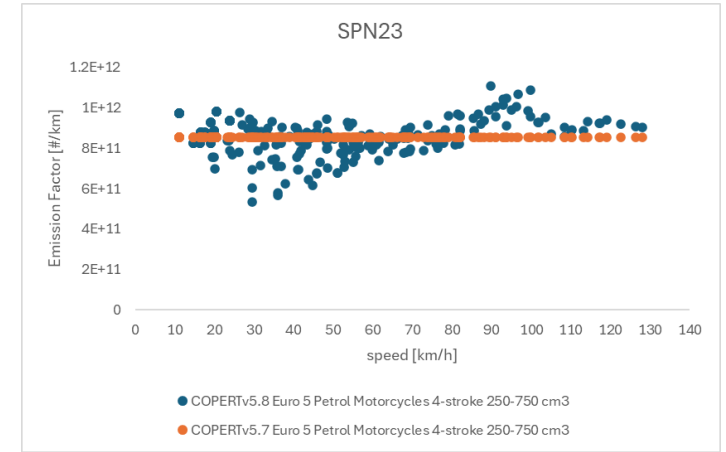
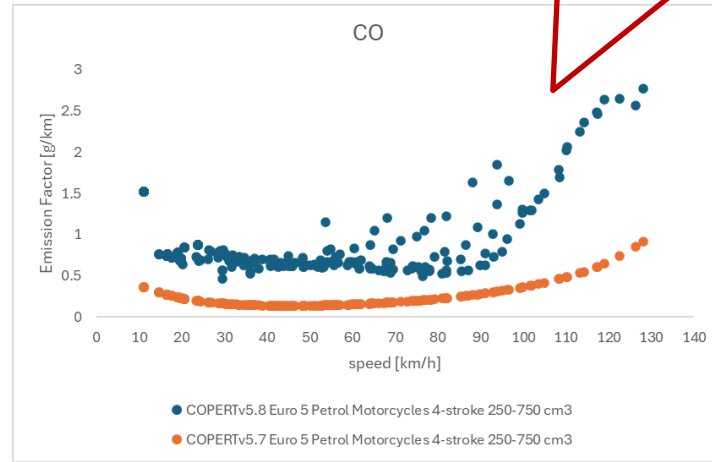
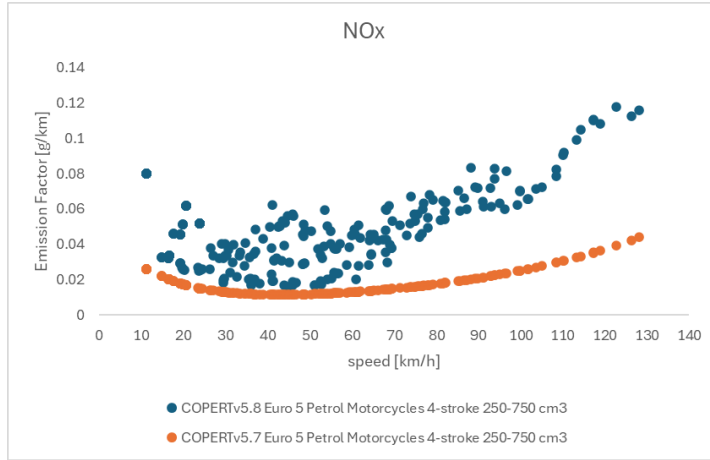


*In-lab emissions testing by EMISIA in LAT*

\*Reference: EMISIA, TUG

# Revision of Euro 5 motorcycles (2/2)

Great difference in high speeds due to rich combustion



# 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 CH<sub>4</sub> and NMVOC over VOC for Euro 6 LDVs
- Hot CH<sub>4</sub> emission factors of LPG cars
- PM, PN emission factor of CNG/LPG Euro 5 & 6 vehicles
- Minor issues



# Overall impact of COPERTv5.8



# Overall impact of COPERT updates 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*



# Planned updates for next year





# Planned updates for next year

- Revision of energy consumption factors of Euro 6d/e LDVs running in liquid fuels
- 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



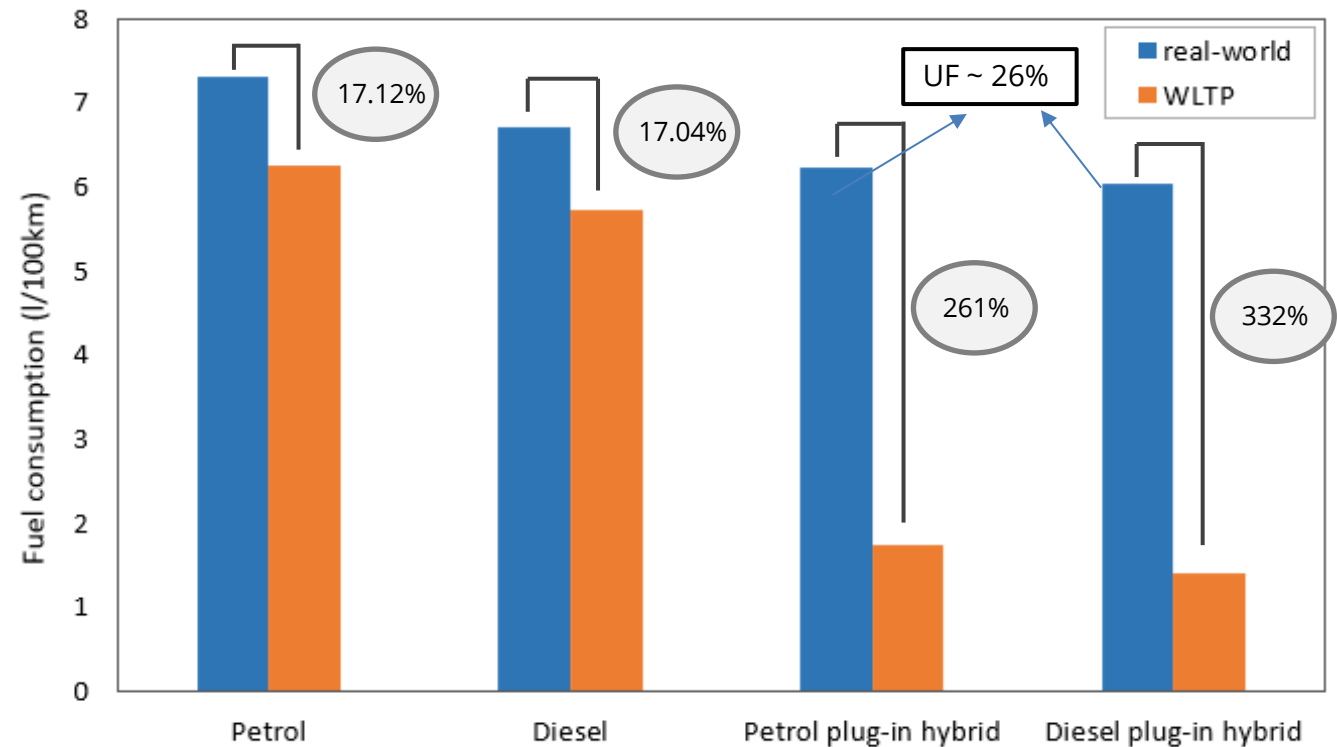
**Thank you for your attention!**

**For more information, please see [our website](#) or  
contact us at [support@emisia.com](mailto:support@emisia.com)**



# Revision of energy consumption factors of LDVs

- **Who:** European Commission
- **What:** First real-world data on Consumption & CO2 data:
  - 3M Euro 6 cars running in liquid fuels
  - 100K Euro 6 vans running in liquid fuels
- **When:** New cars 2021 and 2022
- **Where:** All EU Member States
- **How:** OBFCM devices
- **Why:** TA vs Real-world consumption & CO2



**What about COPERT vs real-world?**

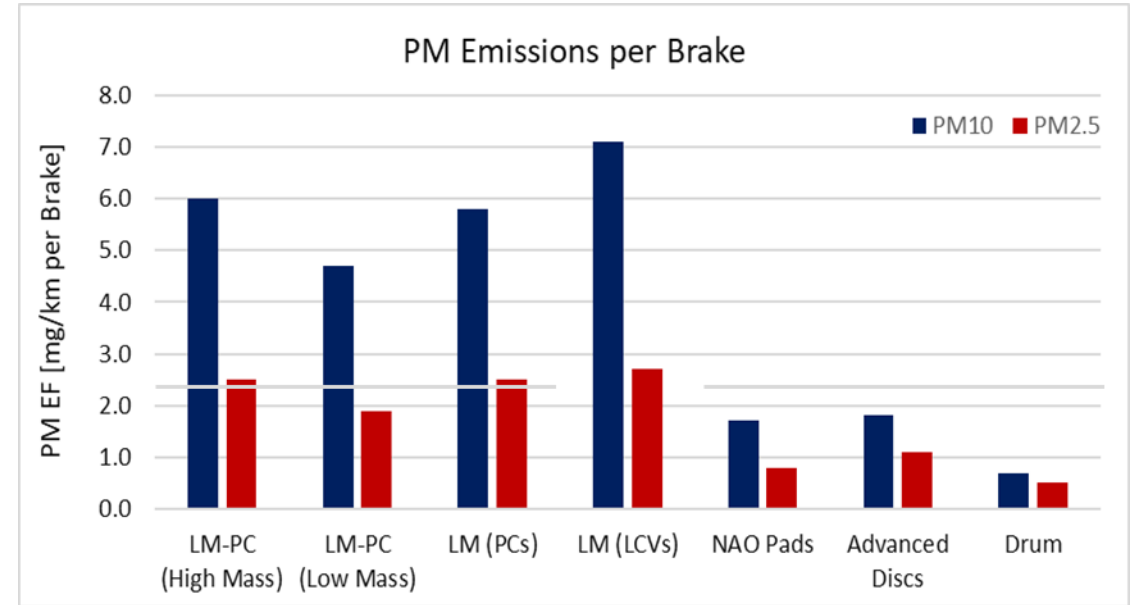
e:misia

European Environment Agency  
European Topic Centre  
Climate change mitigation

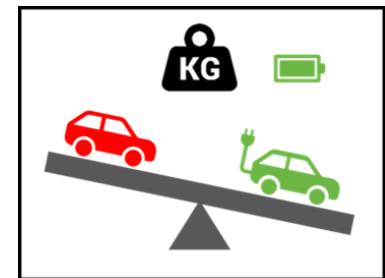


# Revision of brake emissions factors

- **Who:** [Giechaskiel, B; Grigoratos, T. et al. \(2024\)](#)
- **What:** PM & PN emission factors of LDVs from brake wear based on GTR 24
- **When:** 2024
- **How:** Literature review of all measurements follow a GTR24-compliant approach
- **Why:** Euro 7 Regulation introduces brake PM10 emission limits for LDVs based on GTR 24 by PMP



Powertrain	Friction share coefficient in GTR
PEV	0.17
PHEV	0.34
HEV	0.52-0.9
ICEV	1



# Revision of Emission Factors from L-cat vehicles

Update of EFs for the following vehicle categories and Euro standards

- Vehicle Categories
  - Motorcycles
  - Mopeds
  - Quads and ATVs
  - Mini-cars
- Euro Standards
  - Euro 5
  - Euro 4
  - Euro 3 or older
- Measurements ongoing\*
  - In-lab emissions testing (chassis dyno using WMTC & RDC)
  - On-road emissions testing (RDE tests)
- Pollutants measured
  - EC, CO, NO<sub>x</sub>, PM, PN, VOC, NH<sub>3</sub>



**LENS**

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Climate change mitigation

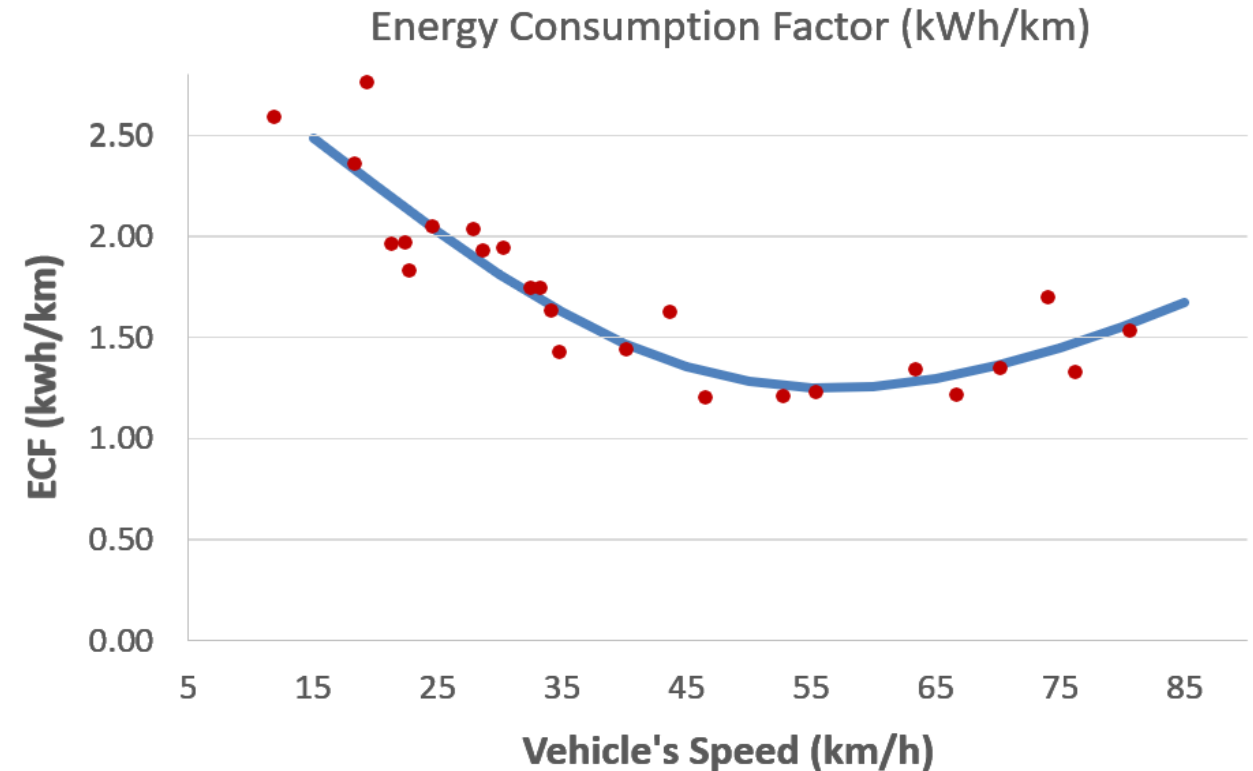


\*Reference: LAT, IDIADA, TUG for the LENS Horizon Project funded by EU

# Introduction of electric heavy-duty trucks

A study conducted within the ESCALATE Horizon project, by LAT (AUTH) which is a main partner.

- **GT Suite Modelling:** Curve derived from GT-Suite simulations for a BEV HDT & verified with literature.
- **GVW of 40 Tons:** Corresponds to COPERT category Rigid > 32t.
- **Future Segments:** Additional vehicle segments and an FCEV model are planned.
- **Future Values Comparison:** Real driving data from a prototype equivalent truck within ESCALATE



100% load, Temperature 20 Celsius

