EU GREEN WEEK 2021

Key takeaways from Session 7.4

Road traffic exhaust and non-exhaust particulate emissions

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ZERO POLLUTION
for healthier people and planet

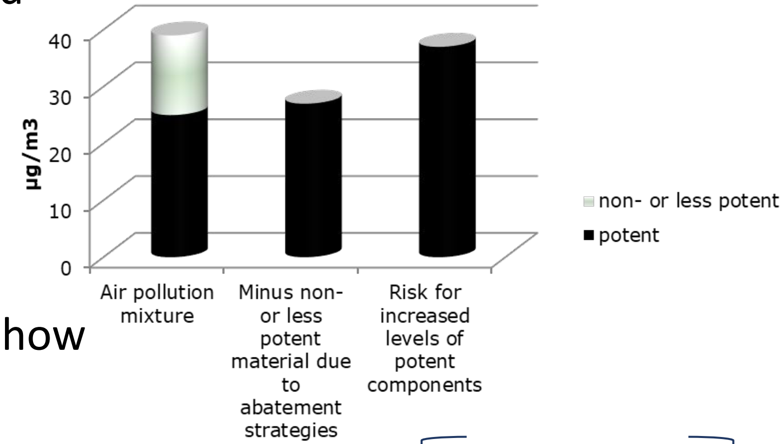
#EUGreenWeek

European Commission

Considerations air pollution policy

- Ranking PM sources on multiple health effects and effect parameters needs to be done in a standardized way to improve comparison for evaluation purposes

- At least evaluation of the health effects of transport emissions (exhaust and non-exhaust) should be considered before introducing new fuels or technologies
- But source-specific risk is a combination of hazard **and** exposure and only then could support source specific policy to improve public health



- What metric for regulation (mass, number concentration, surface area ..)
  - PM mass dominated by larger particles, particle number by smaller particles
- Which components and sources are important, better whole mixture approach but how
- And what if reduction of emission will result in increase toxicity ……

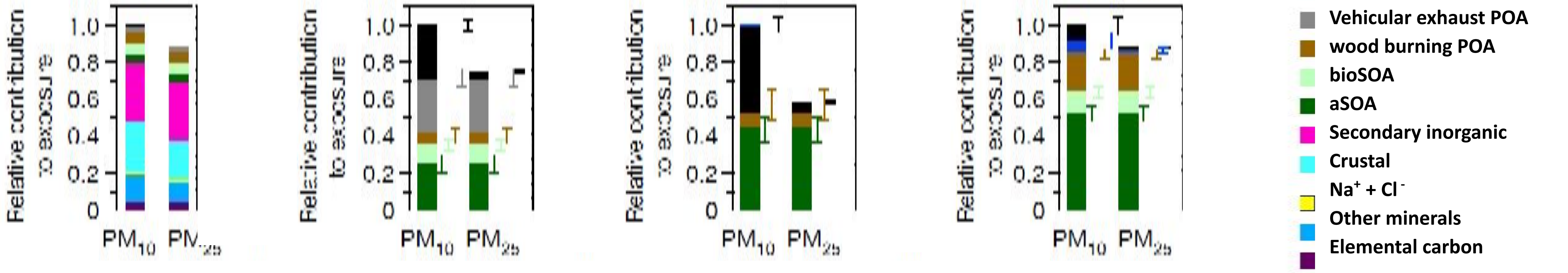
Daellenbach et al., 2020

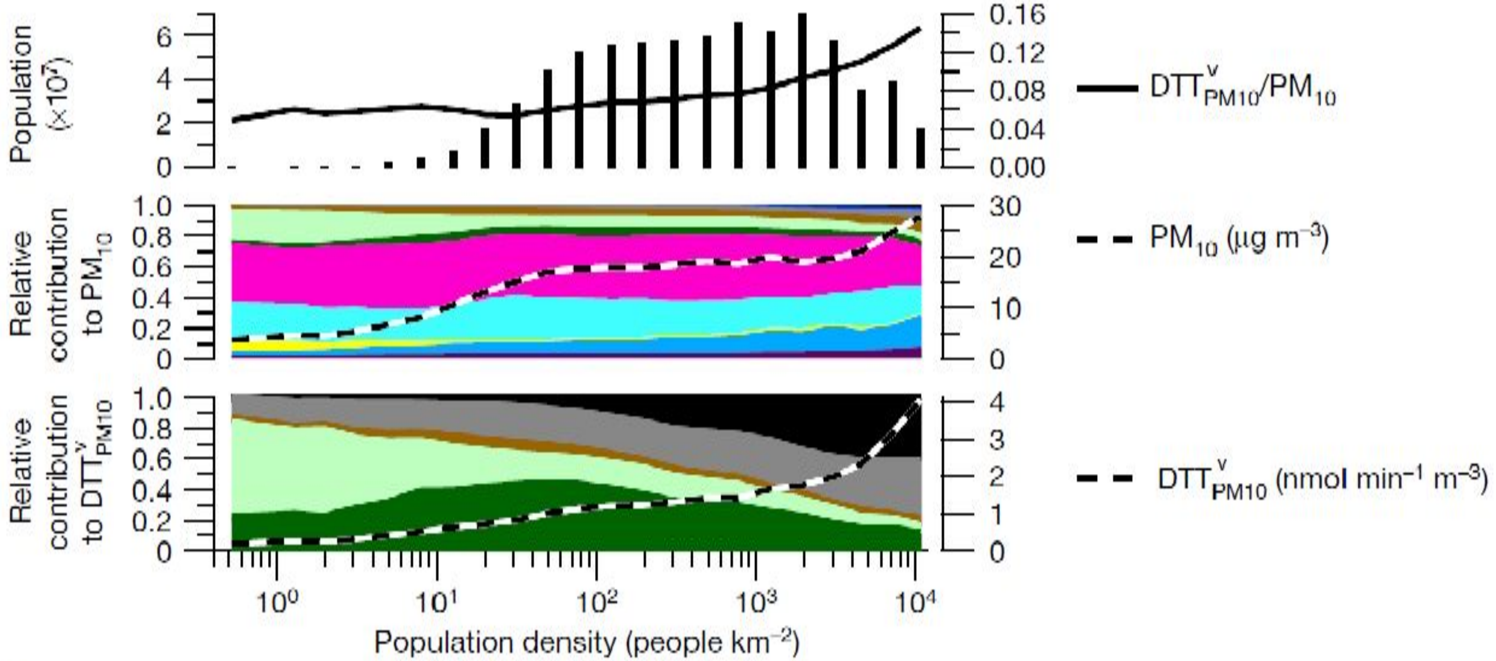
Exposure

particulate matter (PM) mass

Oxidative Potential Tests (OP)

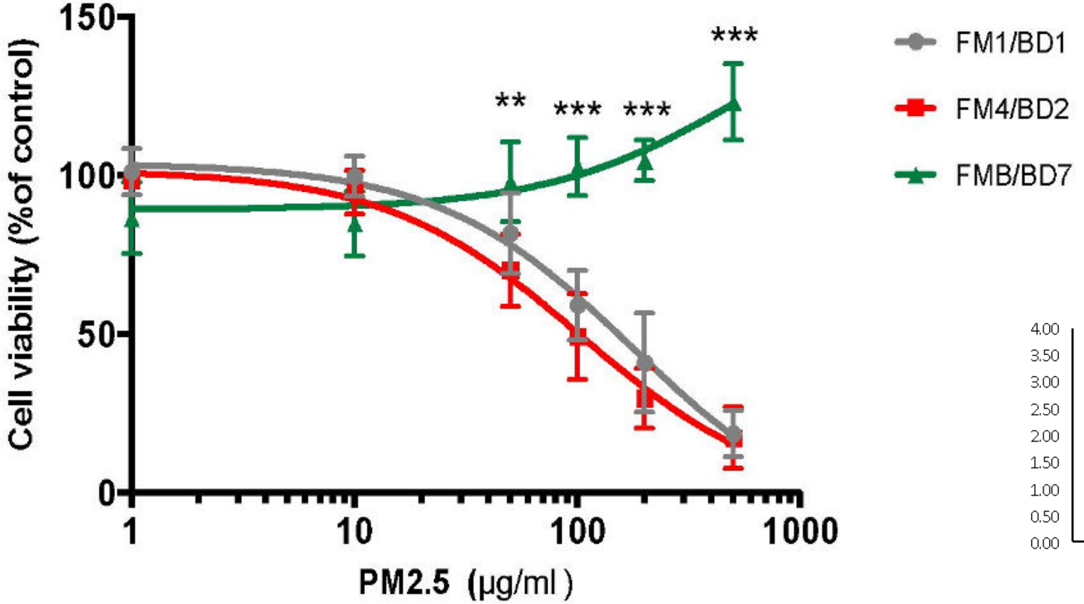
DTT AA DCFH

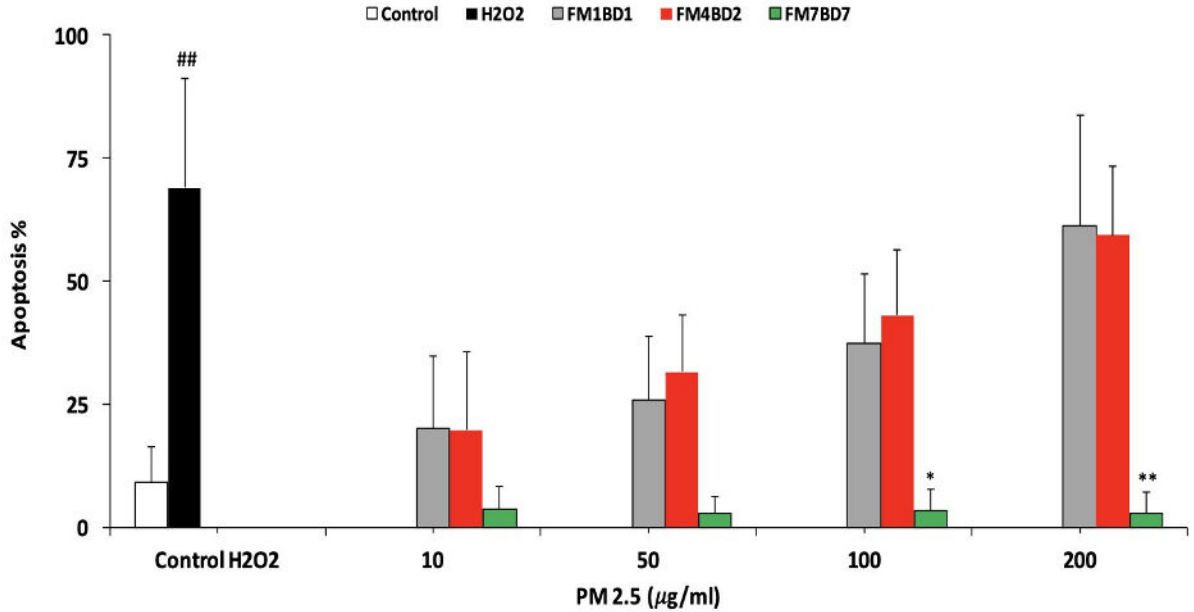




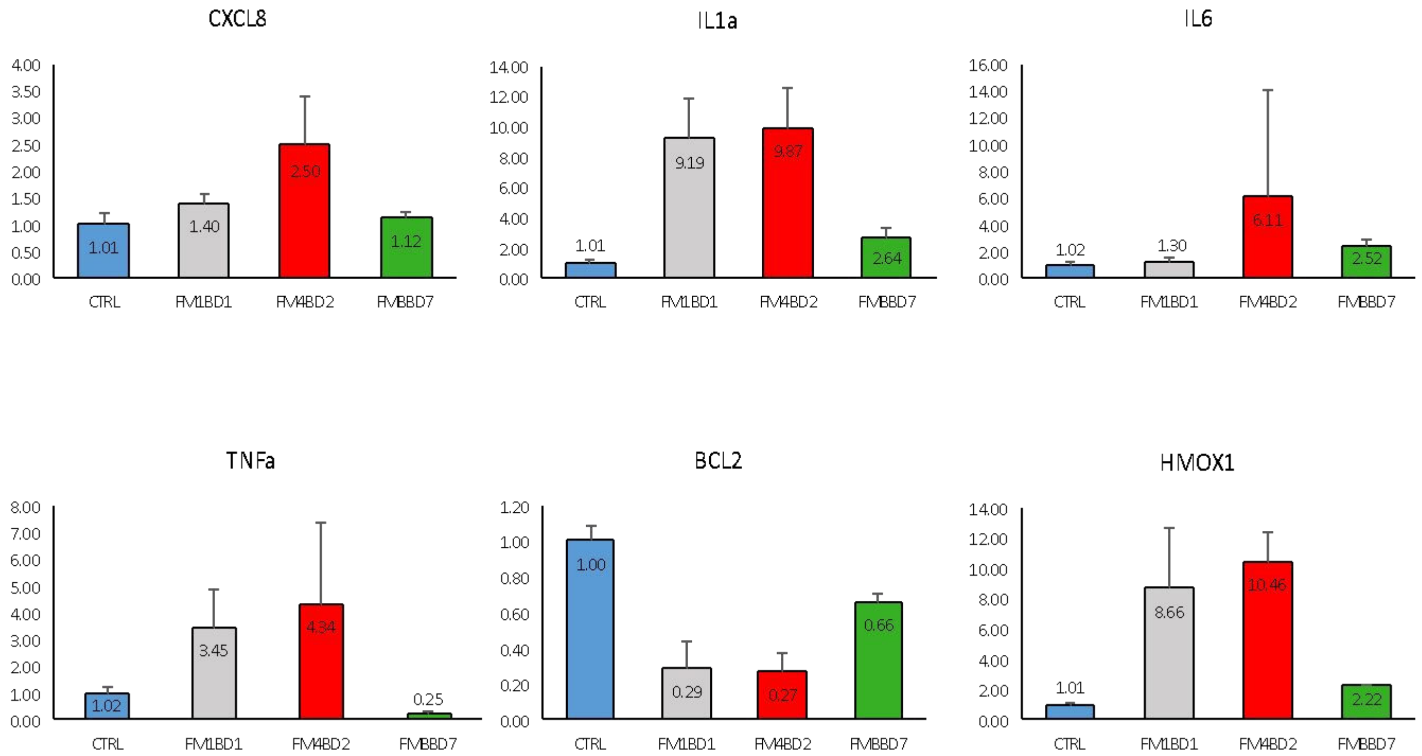
OP sources vary with population density,

urban PM10 has higher OP per mass than rural





mRNA expression



1. The methodology

Aggregated emissions are calculated based on mass emission (***m***) and the coefficients of relative toxicity (R_t) corresponding to carbon monoxide (**CO**), as:

$$\sum CO_{add} = \sum_{i=1}^{n} m(i) \times R_t(i)$$

Table 1 – Relative to carbon monoxide (CO) toxicity ratios (R_t) of 64 significant pollutants

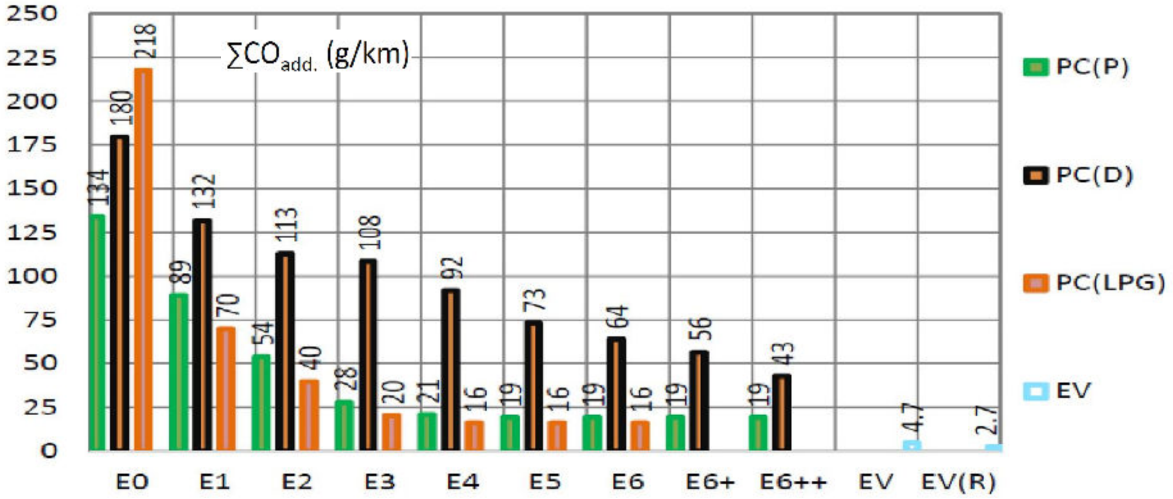
Pollutant	R_t
Group I (the bulk of the exhaust emissions):	
CO	1
CO_2	0,0022
NO_x	75
N_2O	188
NH_3	75
LHC	3,16
Group II (Aldehydes):	
formaldehyde	1000
acetaldahyde	300
acrolein	100
benzaldehyde	50
crotonaldehyde	5
methacrolein	5
butyraldehyde	5
isobutanaldehyde	5
propionaldehyde	5
hexanal	5
i-valeraldehyde	5
valeraldehyde	5
o-tolualdehyde	5
m-tolualdehyde	5
p-tolualdehyde	5

Pollutant	R_t
Group III (Ketones):	
acetone	8,57
methylethlketone	5
Group IV (Aromatics):	
toluene	5
ethylbenzene	150
m,p-xylene	15
o-xylene	15
1,2,3 trimethylbenzene	100
1,2,4 trimethylbenzene	200
1,3,5 trimethylbenzene	300
styrene	1500
benzene	30
C9	5
C10	10
C>13	20
Group V (PAHs & POPs):	
ID(1,2,3,cd)P (indeno(1,2,3-cd)pyrene)	1500000
B(k)F (benzo(k)fluoranthene)	3000000
B(b)F (benzo(b)fluoranthene)	3000000
B(a)P (benzo(a)pyrene)	3000000

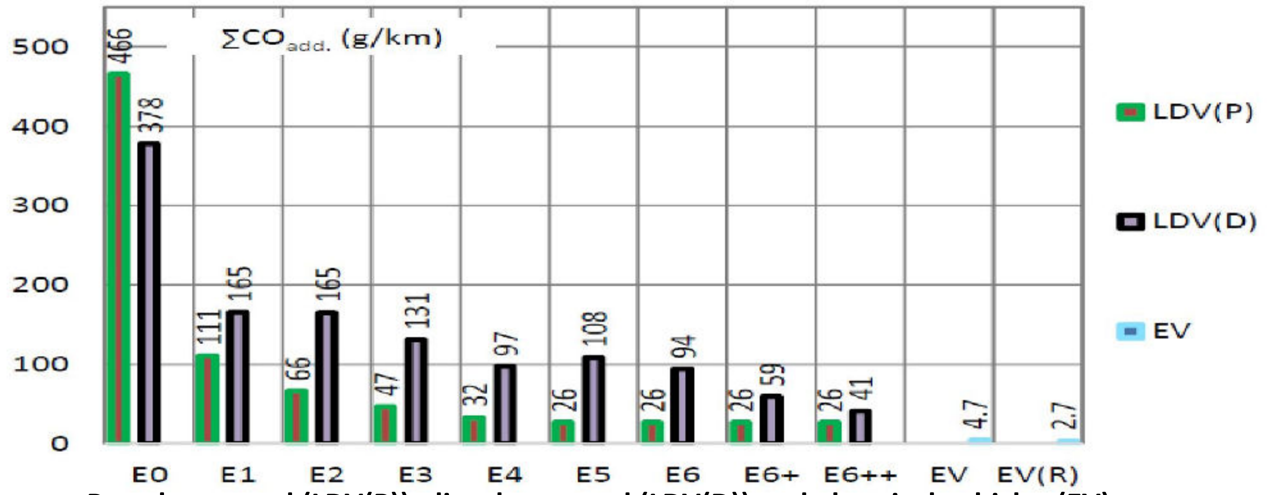
Pollutant	R_t
Group VI (particulate matter (PM)):	
EC(PM)	41,5
PM2.5 petrol	300
PM2.5 diesel	200
PM2.5 tyre	100
PM2.5 brake	150
PM2.5 road	50
Group VII (sulfur compounds):	
SO4--	30
SO2	22

Pollutant	R_t
Group VIII (metals and its compounds (MS)):	
Pb	400
Cd	2000
Cu	40
Cr	1000
Ni	4000
Se	200
Zn	40
Hg	4000
As	2000
Fe	75
Mg2+	60
Mo	150
Sb	150
Si	60
Sn	150
Ti	20
$C_8H_{20}Pb$	224000

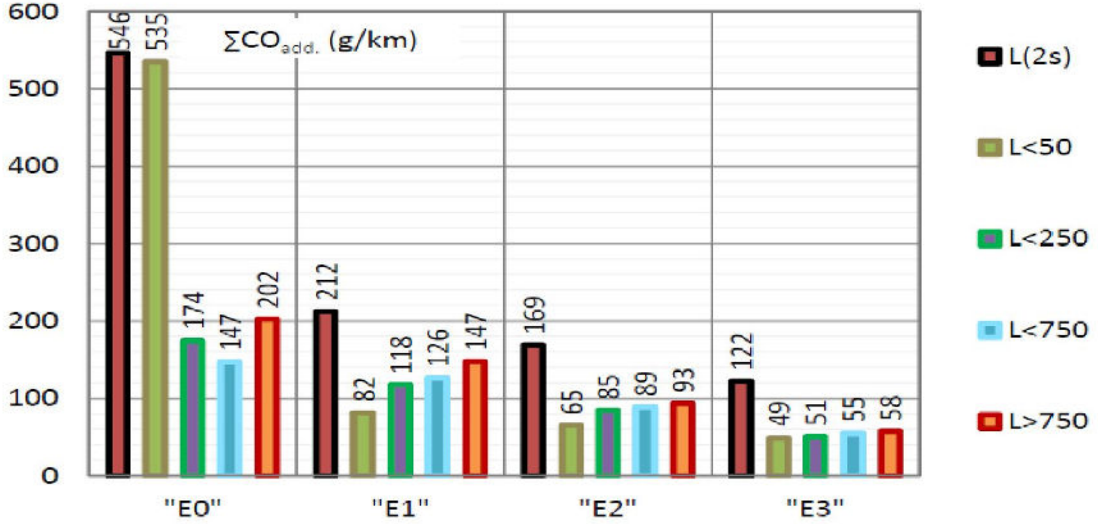
4. Some results (3): ICE and Elecric powered Vehicles comparison in view of aggregated toxicity



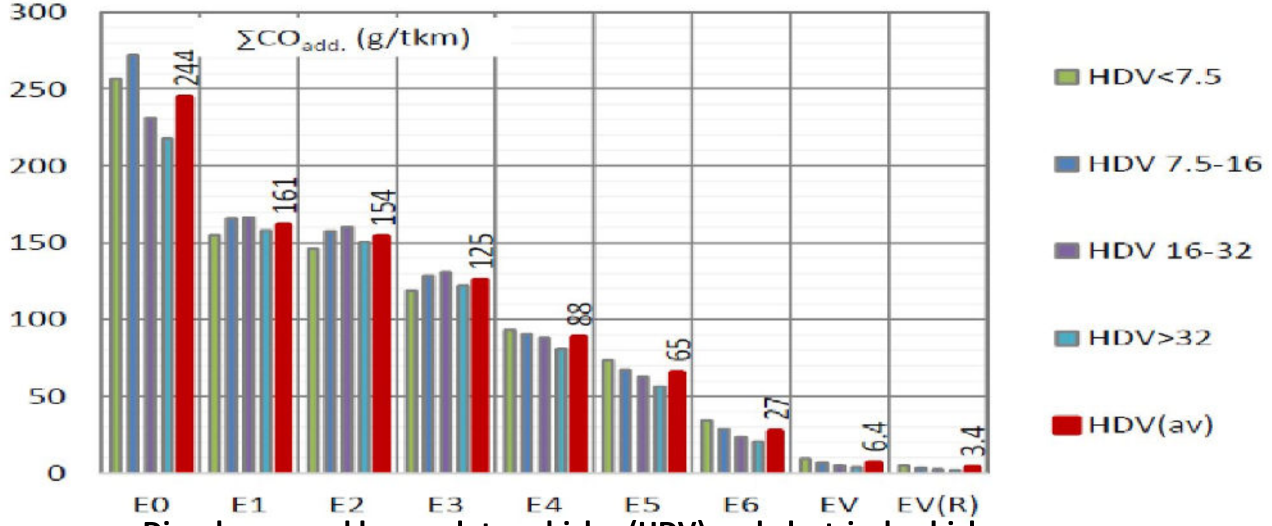
Petrol-powered (PC(P)), diesel-powered (PC(D)), and LPG-powered (PC(LPG)) passenger cars, as well as modern (EV) and future EV(R) electrical vehicles



Petrol-powered (LDV(P)), diesel-powered (LDV(D)) and electrical vehicles (EV)

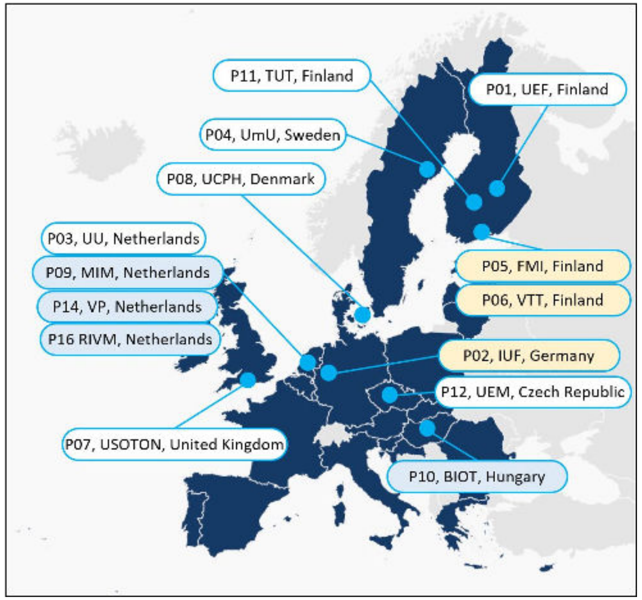


Petrol-powered mopeds and motorcycles of different range of four-stroke engine volume (cub/cm) and two-stroke (L(2s)) engines



Diesel-powered heavy-duty vehicles (HDV) and electrical vehicles (EV) of different full weight as well as average values (HDV(av))

Transport derived Ultrafines and the Brain Effects (TUBE)



- Epidemiological studies link pollutant exposure to dementia
  - Risk of dementia is increased the closer people live to major roadways
  - Brain atrophy in MRI scans of people exposed to high PM levels
  - Epidemiological studies report that risk of Alzheimer’s disease is increased with exposure to higher levels of PM
  - Increased Alzheimer pathology in brains of individuals living in highly polluted areas
- Main focus on effects of UFPs from road traffic to brain health, including disease mechanisms, translocation and clearance
- Respiratory toxicology and genotoxicity with online exposure systems
- Engine exhaust from cars, trucks/buses, marine engines
- Combining toxicological research in cells, mice and human to provide better tools for risk assessment
- Epidemiological data combined with biomarkers