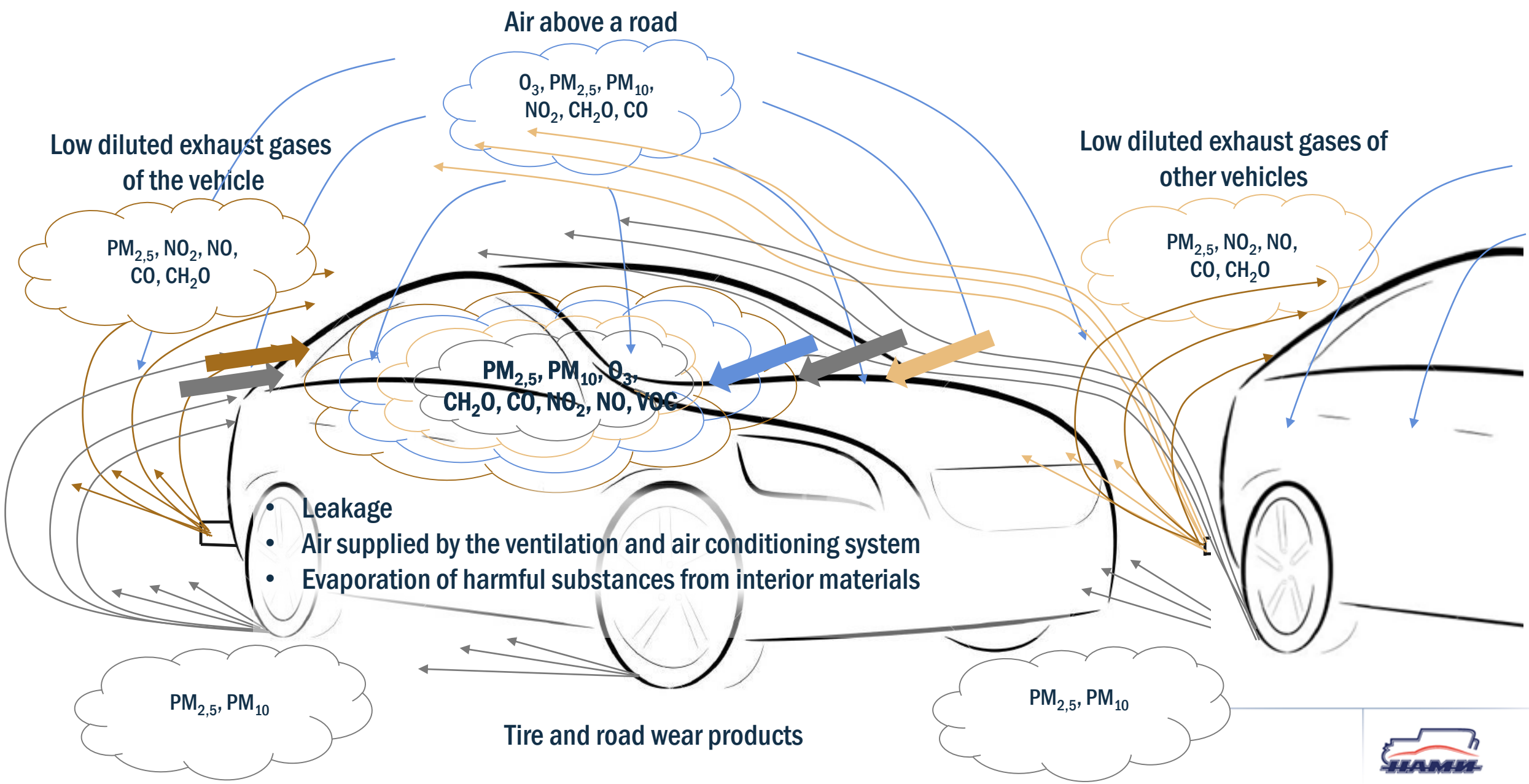
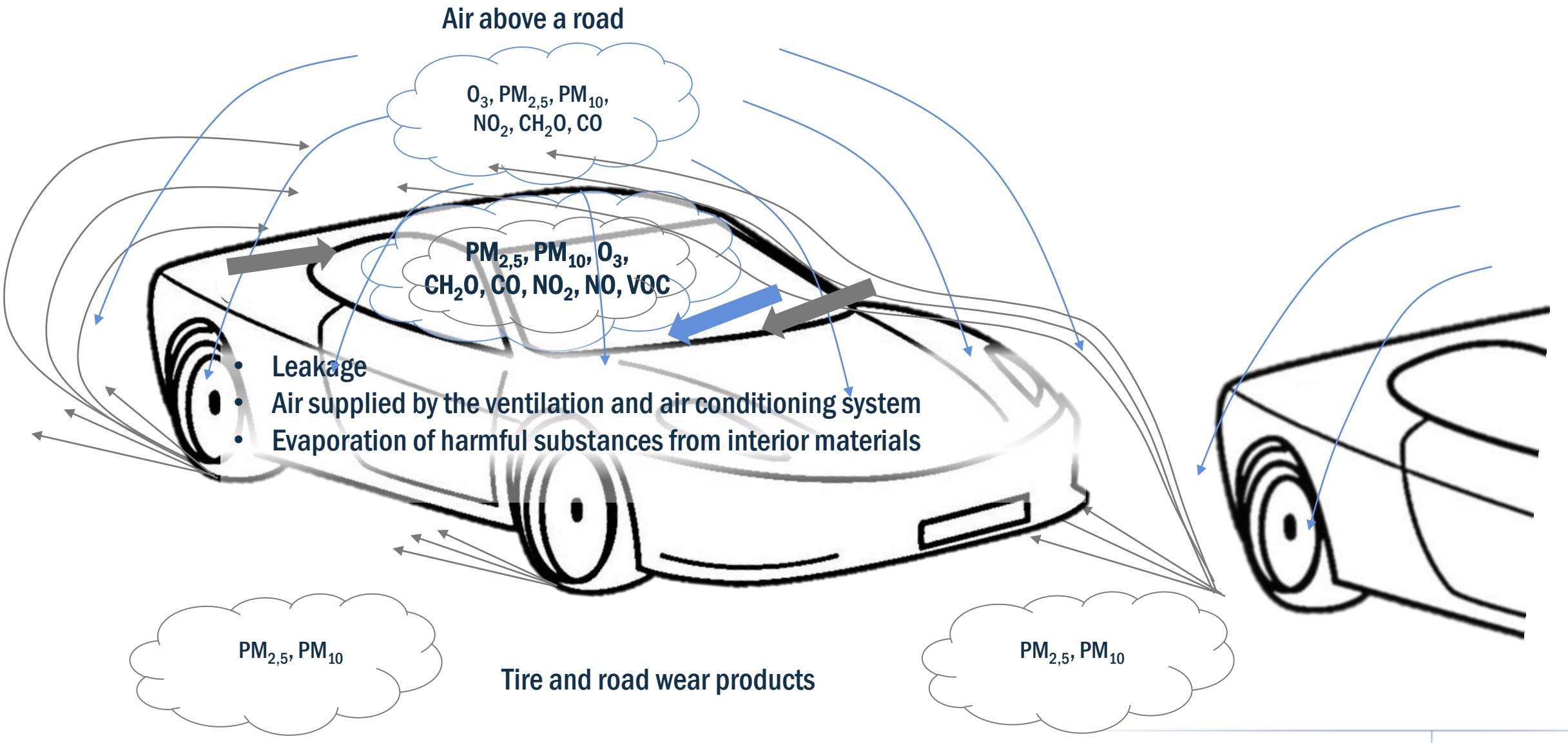
Vehicle Interior Air Quality Improvement. Next Steps

Central scientific research
automobile and automotive
engine institute

Main sources of air pollution in an interior of modern cars



Main reasons of air pollution in an interior of advanced cars



Criteria air pollutants

Country/ Organization	Substances	Source
WHO	PM_{10}, $PM_{2,5}$, $NO_{2,}$ O_3, SO_2	19
EU	PM_{10}, $PM_{2,5}$, NO_2, O_3, CO, SO_2, Pb (Lead), NH_3 (Ammonia), CH_4 (Methane), BC (Black carbon), As (Arsenic), Cd (Cadmium), Ni (Nickel), Hg (Mercury), BaP (Benzo[a]pyrene), NMVOCs (Non-methane volatile organic compound), C_6H_6 (Benzene)	20
USA	PM_{10}, $PM_{2,5}$, NO_2, O_3, CO, SO_2, Pb (Lead)	21
RF	PM_{10}, $PM_{2,5}$, NO_2, NO, O_3, CO, SO_2, CH_2O (Formaldehyde), C_6H_6 (Benzene), CH_4 (Methane), NH_3 (Ammonia), H_2S (Hydrogen Sulphide), C_6H_6O (Phenol), C_7H_8 (Toluene), $C_6H_5CH_2CH_3$ (Ethyl benzene), C_8H_8 (Styrole), $C_6H_4(CH_3)_2$ (Paraxylol), $C_{10}H_8$ (Naphthaline)	34
UK	PM_{10}, NO_2, NO, O_3, CO, SO_2, C_6H_6 (Benzene), C_4H_6 (1,3-butadiene)	36
China	PM_{10}, $PM_{2,5}$, NO_2, O_3, CO, SO_2	37
Canada	PM_{10}, $PM_{2,5}$, NO_x, O_3, CO, SO_x, VOC	38

Air quality guideline values

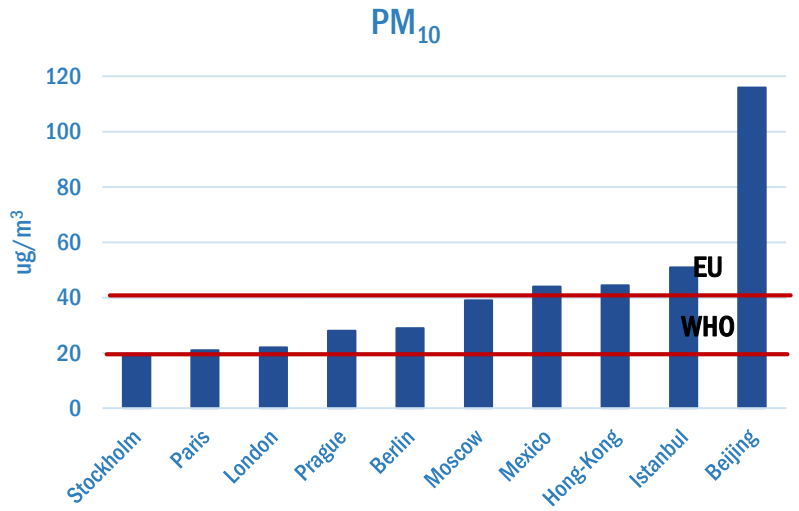
Pollutant	Air inside a vehicle	Air in populated areas										
	GOST 33554-2015*	RF*		WHO*		EU*		USA*		Korea*		
NO_2, μg/m³	200	200	40	200	40	200	40	100		190	110	57
NO, μg/m³	400	400	60	undefined		undefined		undefined		undefined		
PM_{10}, μg/m³	undefined	300	60	50	20	50	40	150		100	50	
$PM_{2,5}$, μg/m³	undefined	160	35	25	10	20		35		50	25	
O_3, μg/m³	undefined	160	30	100		120		140		200	120	
CO, mg/m³	5	5	3	undefined		10		41	11	29	10	
SO_2, μg/m³	undefined	500	50	500	20	350	125	200		400	130	53
CH_2O, μg/m³	50	50	10	undefined		undefined		undefined		undefined		
CH_4, mg/m³	50	50	undefined	undefined		undefined		undefined		undefined		
C_nH_{2n+2}, mg/m³	50	50	5	undefined		undefined		undefined		undefined		
Benzene, μg/m³	undefined	300	100	undefined		5		undefined		5		

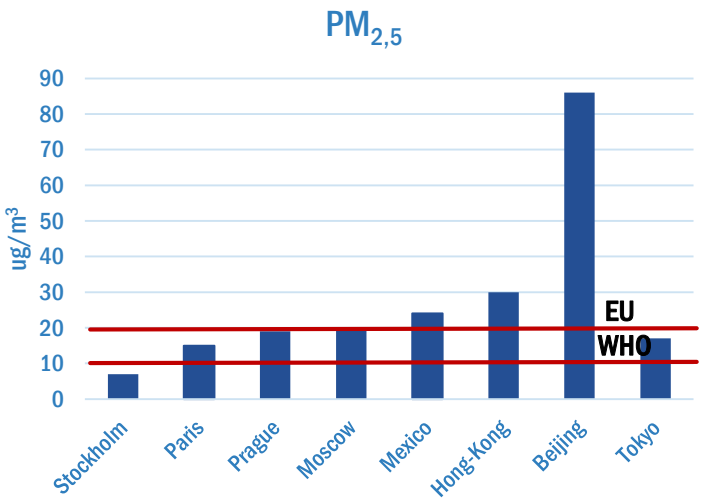
*Exposure time

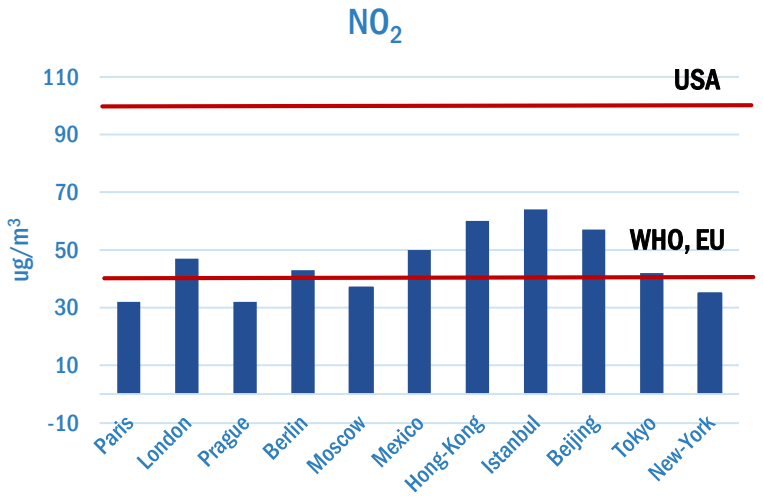
10 minutes	30 minutes	1 hour	8 hours	24 hours	1 year

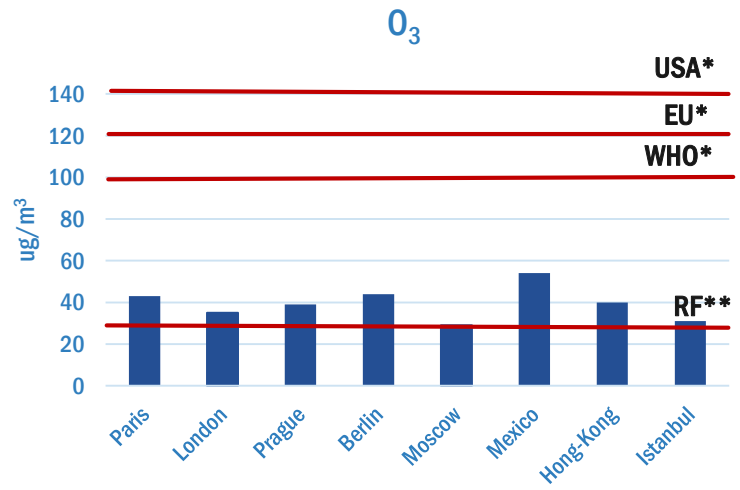
Data sources: 17-21

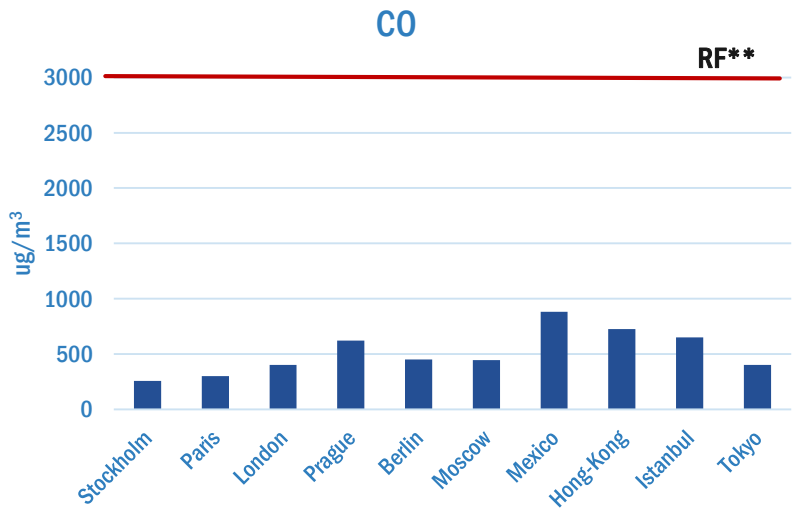
Annual mean concentrations of air criteria pollutants in megapolises

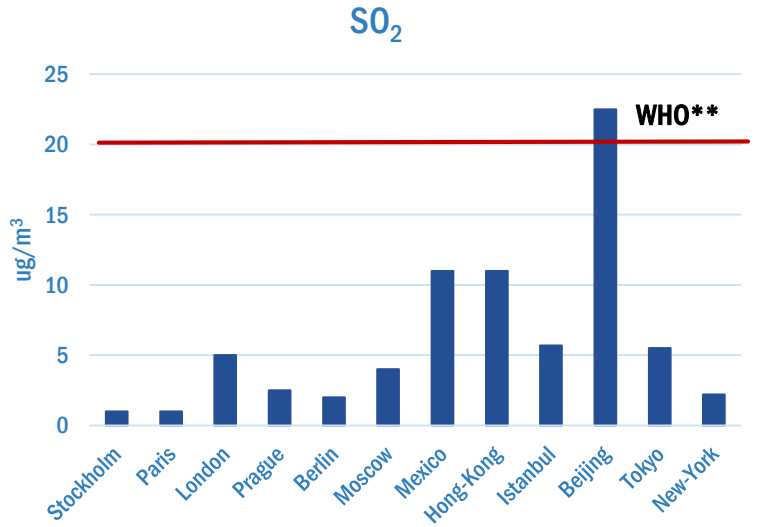










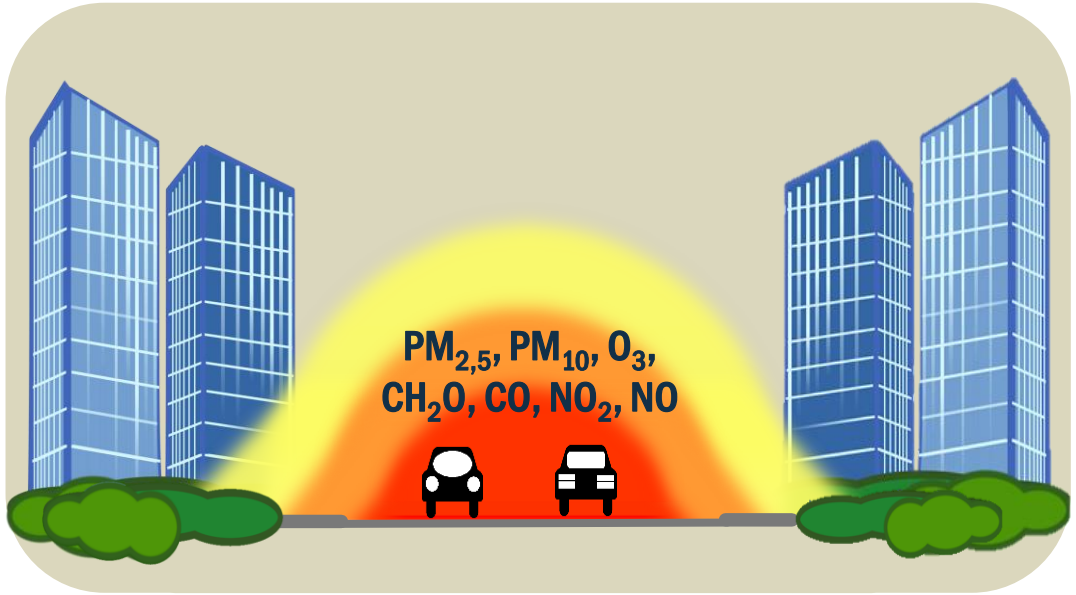


*8 hours mean

**24 hours mean

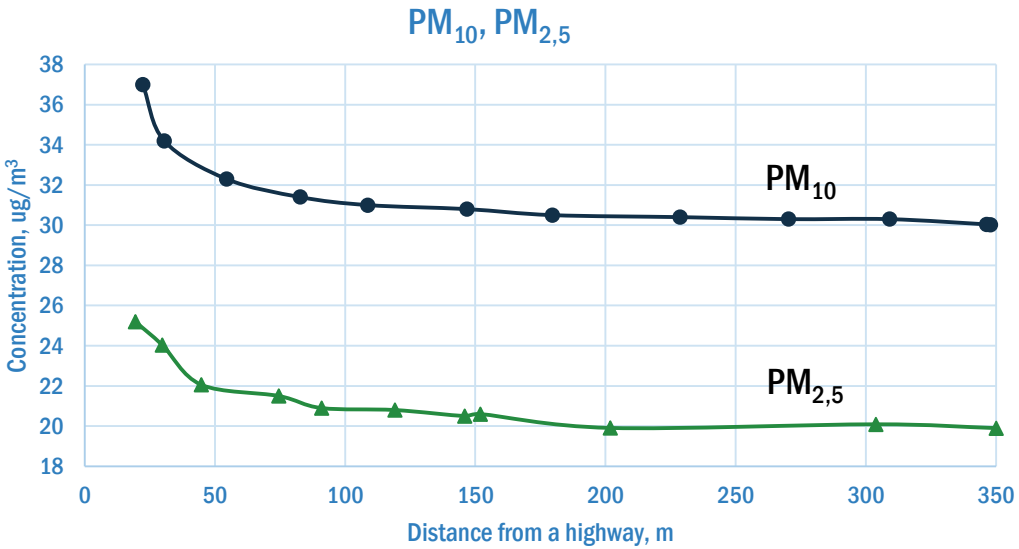
Data sources: 22-34

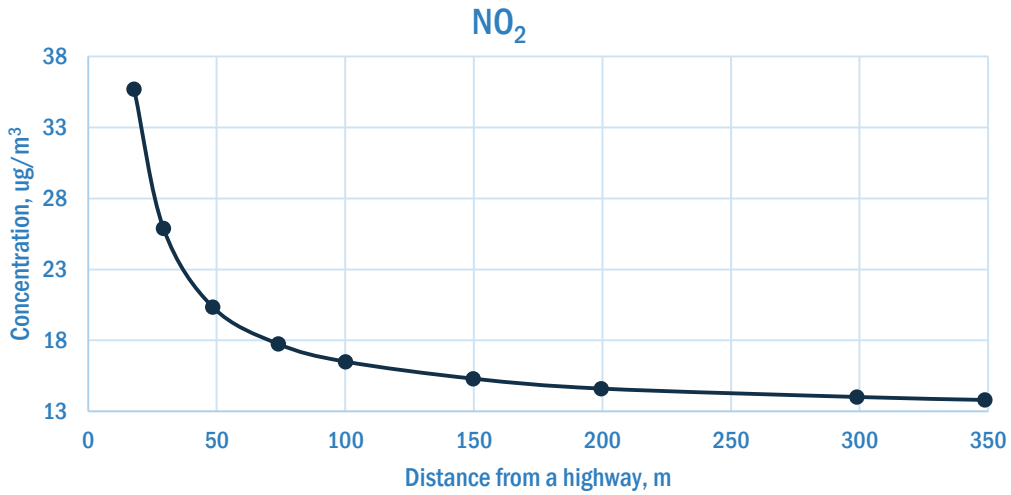
Increased air pollution above a road



Degree of air pollution

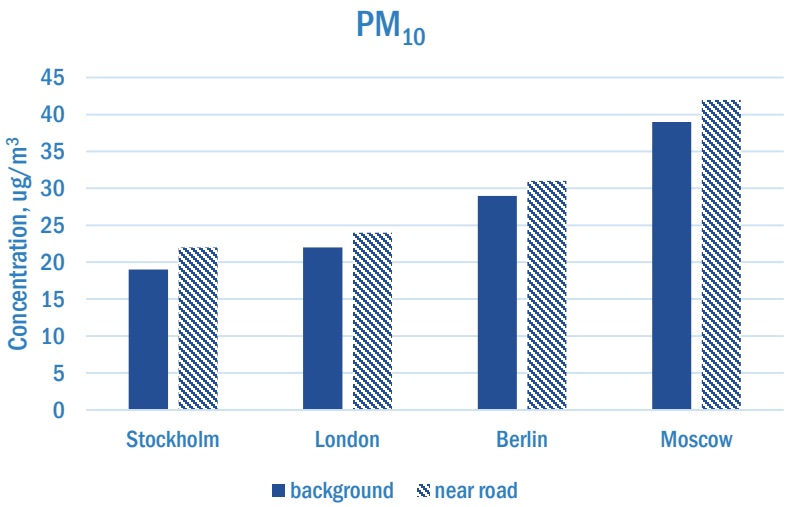
Maximum	Medium	Minimum	Background

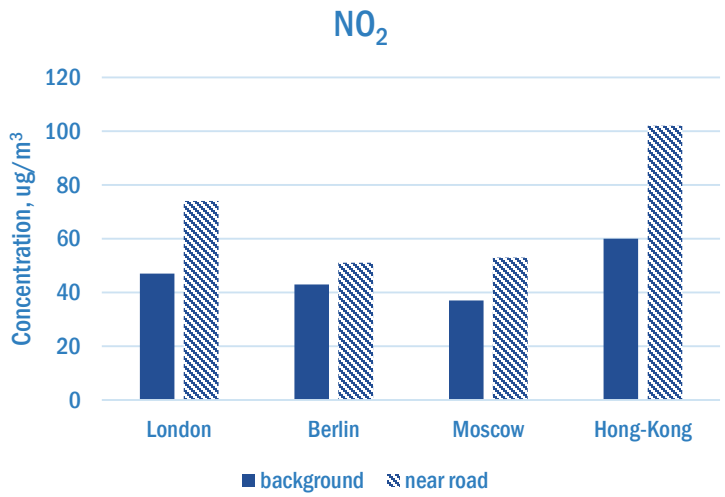


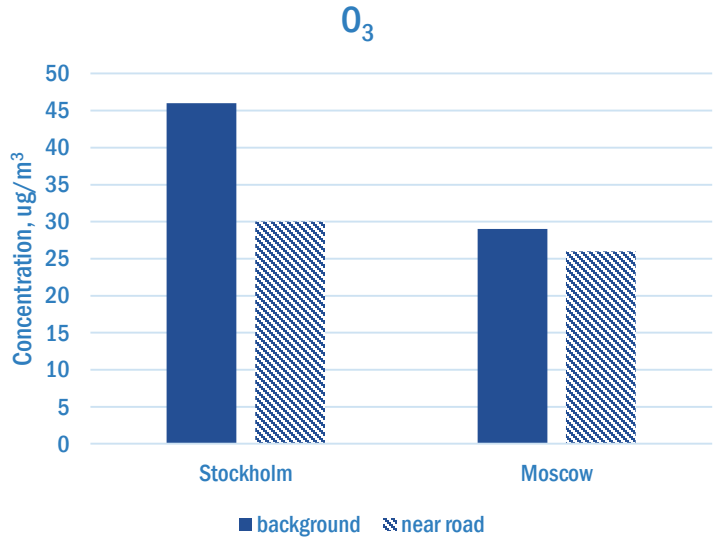


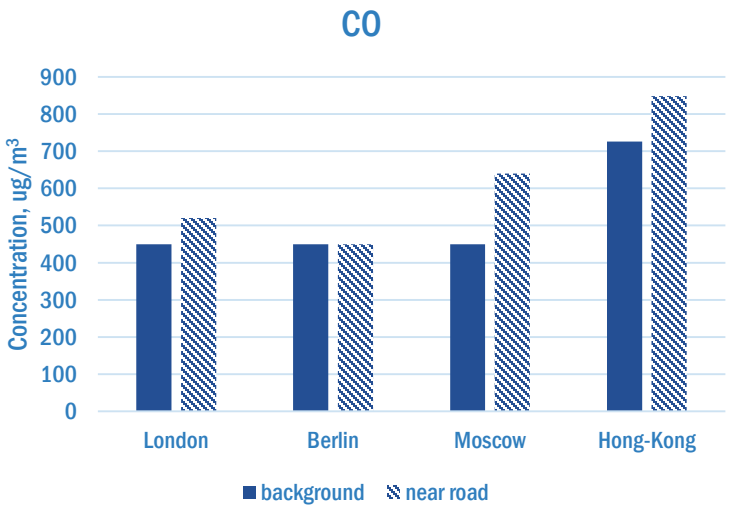
Data source: 35

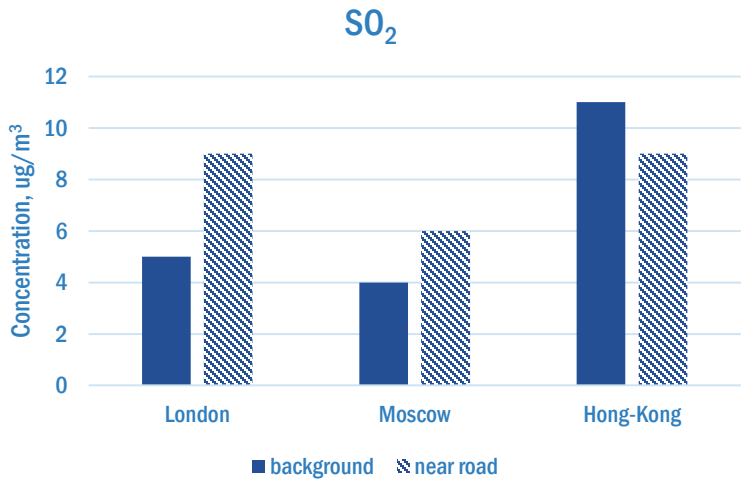
Comparison of background and near road concentrations





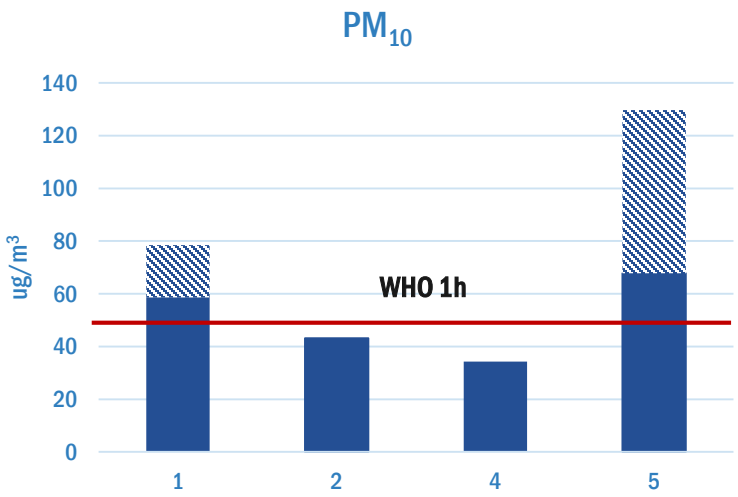


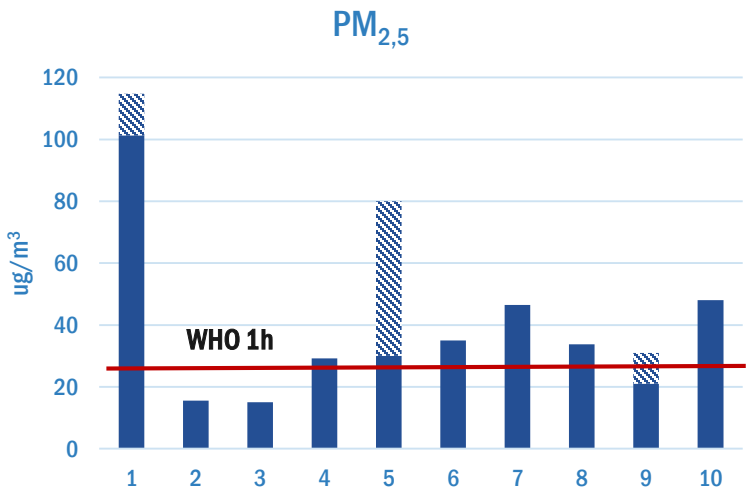


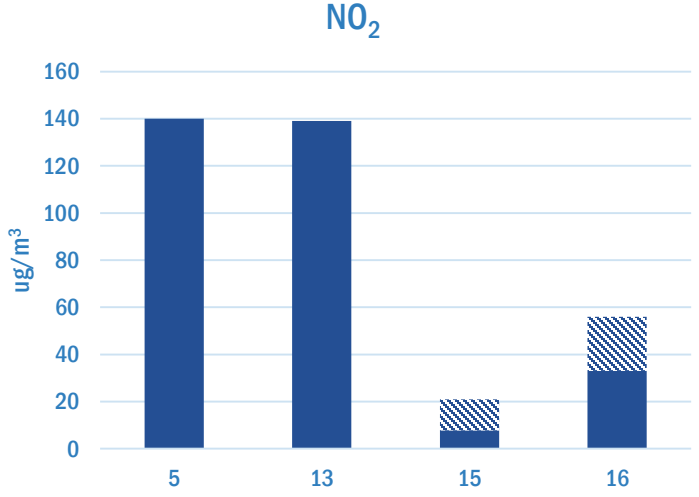


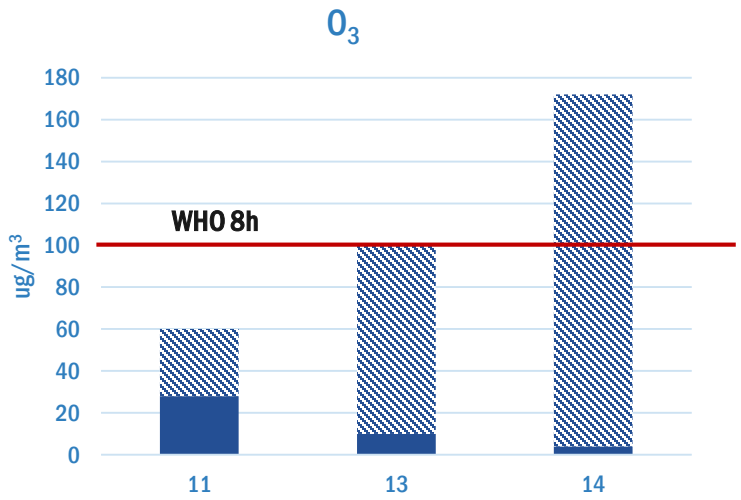
Data sources: 22-34

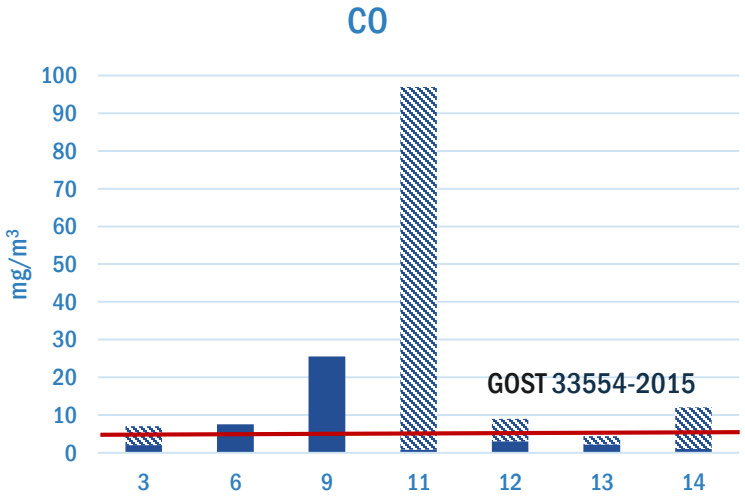
Concentrations of air pollutants inside cars







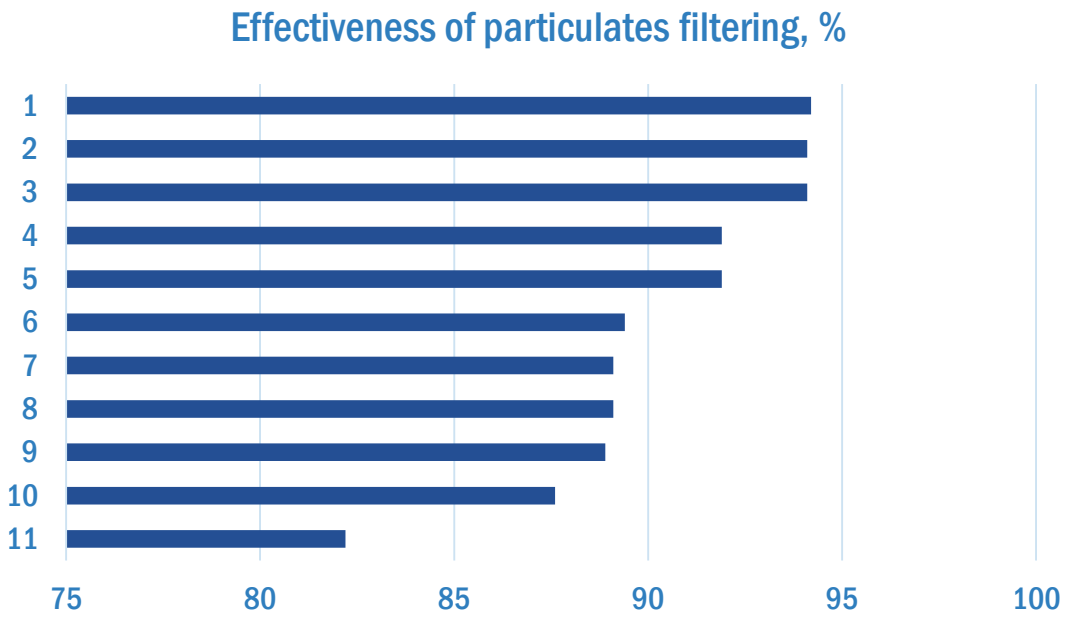


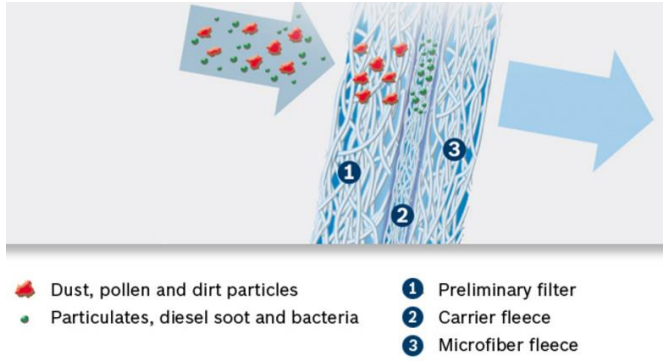


Data sources: 1-16 (denoted below histogram bars)

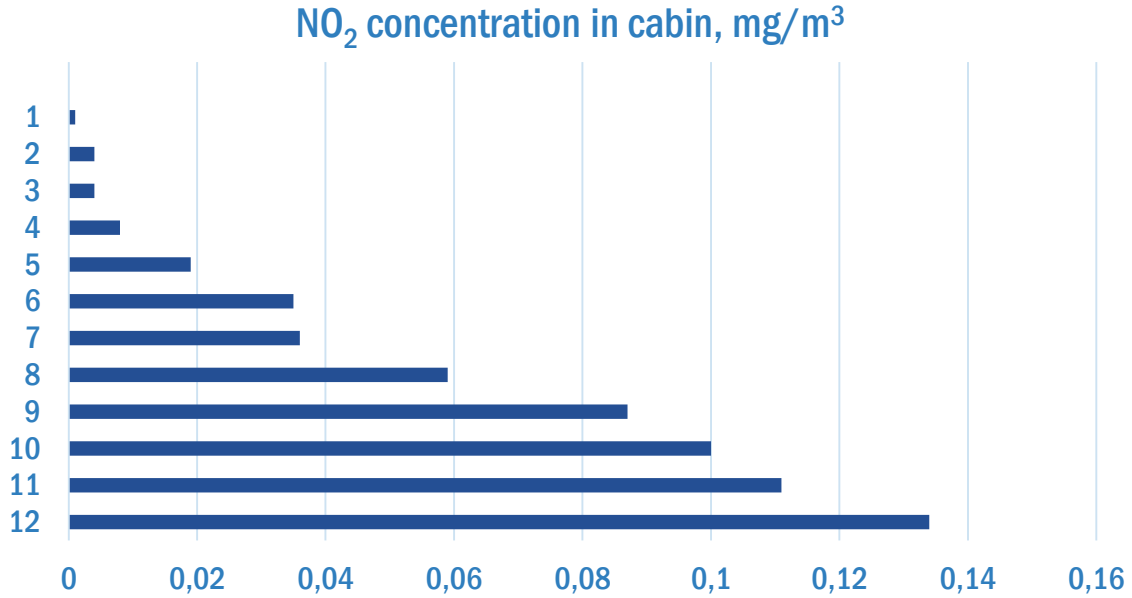
Effectiveness of cabin filters

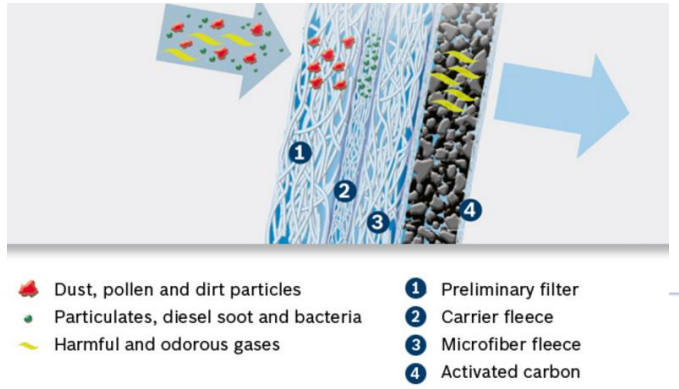
Dust filters
Results from NAMI (V.Volkov)





Carbon filters
Results from NAMI Testing Centre (Z.Bulicheva)





Pictures form Bosch

Interior air quality monitoring

Sensors

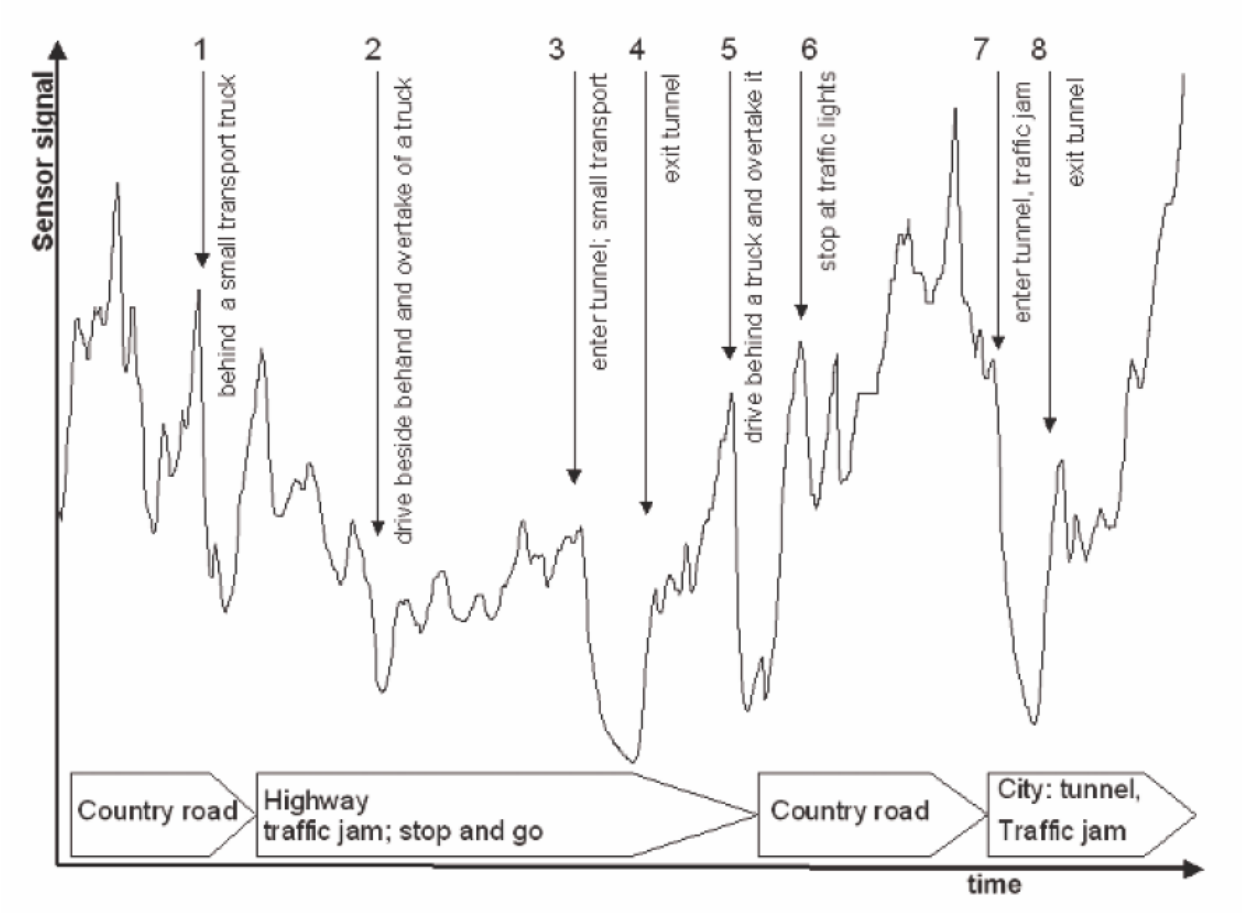
Fuel vapors

Carbon oxide

Comparison of three gas-sensing technologies with respect to vehicle air quality monitoring criteria

Criteria	Infra Red–Optical	Electrochemical	Metal Oxide
Cost	$15US	$10US	$10US
Life time	>6 years	2–5 years	>6 years
Sensitivity	Very Good	Very Good	Very Good
Selectivity	Excellent	Very Good	Poor
Response time	seconds	seconds	seconds
Size	Medium	Medium	Small
Ease of use	Good	Excellent	Excellent

Typical sensor signal during a test drive



Data sources: 39-40

The roadmap for improving vehicle interior air quality

Stage 1

- Prevention of air pollution from interior materials

Stage 2

- Prevention of air pollution from vehicle itself exhaust gases

Stage 3

- Improvement of cabin filter quality

Stage 4

- Monitoring of interior air quality

2015 2017 2019 2022

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We are ready to answer your questions.

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