

Toxicological background for measured substances list

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Ambient (outdoor) air quality and health

WHO data

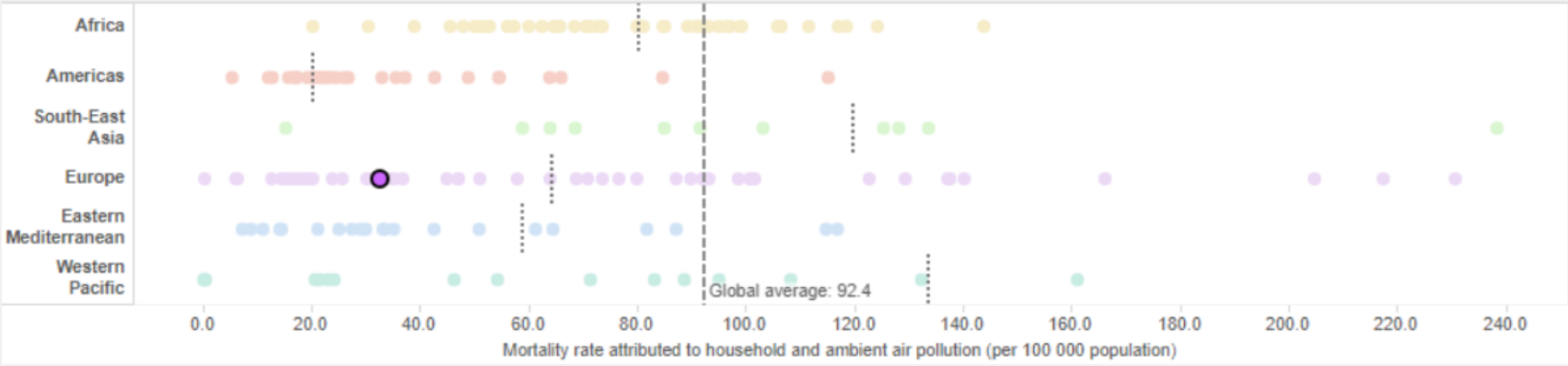
Mortality due to air pollution

Household and ambient air pollution caused an estimated 6.5 million deaths in 2012

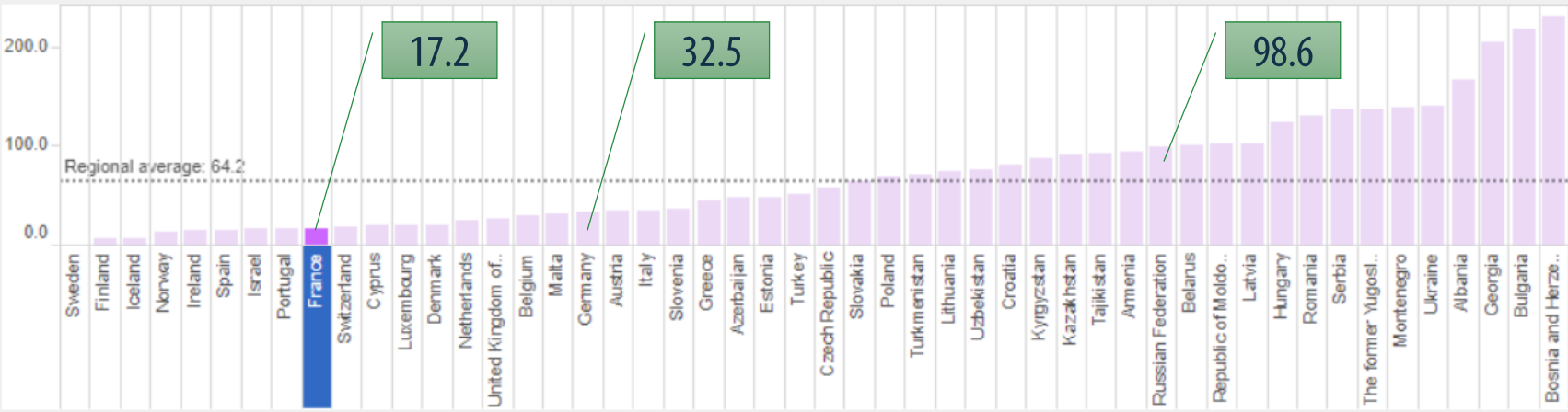
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Each circle/bar represents a country. The dotted grey line indicates the regional average, and the dashed grey line indicates the global average. Click on a region name to display the distribution by country (within that region) as a bar graph.

Mortality rate attributed to household and ambient air pollution (per 100 000 population), by WHO region, 2012



Distribution by country (in selected WHO region) mouse-over the y-axis to sort



Air pollution is a major environmental risk to health. By reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma. (WHO)



Toxicity index for i-th substance:

$$A_i = a_i \cdot \alpha_i \cdot \delta_i \cdot \lambda_i \cdot \beta_i$$

Where:

a_i – an indicator of the relative toxicity of the presence of a pollutant in the air inhaled by a person (see next slide);

α_i – correction factor, taking into account the probability of accumulation of initial or secondary pollutants in the components of the environment and in food chains, as well as the intake of pollutant into the human body by non-inhalation means (is equal 1...5);

δ_i – correction factor which takes into account the effect on different recipients, in addition to a people (is equal 1...2), if an assessment of the toxic effect only on people is carried out, is taken equal to 1;

λ_i – correction factor for the probability of secondary transfer of pollutants to the atmosphere after their precipitating on surfaces (introduced for dust and particles) (is equal 1...1.2);

β_i – correction factor for the probability of formation with the participation of initial pollutants going into the atmosphere, other (secondary) pollutants, more dangerous than the initial pollutants (introduced for light hydrocarbons) (is equal 1...5).

Indicator of the relative toxicity for i-th substance:

$$a_i = \left(\frac{\text{MAC}_{\text{CO amb}} \times \text{MAC}_{\text{CO w.zone}}}{\text{MAC}_{i \text{ amb}} \times \text{MAC}_{i \text{ w.zone}}} \right)^{\frac{1}{2}} = \sqrt{\frac{60}{(\text{MAC}_{i \text{ amb}} \times \text{MAC}_{i \text{ w.zone}})}}$$

Where:

MAC – maximum allowable concentration of pollutant in ambient air (index – amb) or in air of working zone (index – w.zone) for substance i in comparison to carbon monoxide (CO).

Carbon Monoxide

CO

Symptoms

headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope

Target Organs

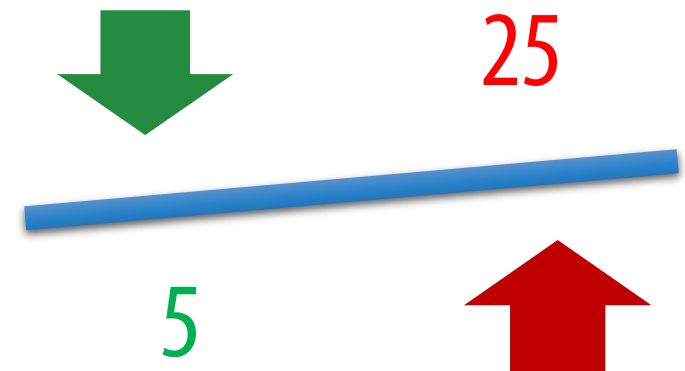
cardiovascular system, lungs, blood, central nervous system

Toxicity Index

1

MAC, mg/m ³	Russia	WHO	Europe	USA	Korea
1 year					
24 hours	3				
8 hours			10	11	11
1 hour				44	31
30 minutes	5				
Work zone	20			40	

In vehicle concentration, mg/m³



In vehicle air

Nitrogen Monoxide

NO

Symptoms

irritation eyes, wet skin, nose, throat; drowsiness, unconsciousness; methemoglobinemia

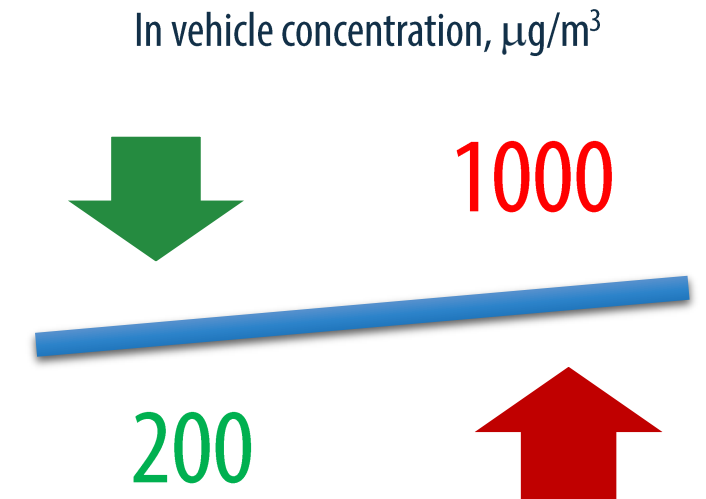
Target Organs

Eyes, skin, respiratory system, blood, central nervous system

Toxicity Index

37.5

MAC, $\mu\text{g}/\text{m}^3$	Russia	WHO	Europe	USA	Korea
1 year					
24 hours	60				
8 hours					
1 hour					
30 minutes	400				
Work zone				30000	



In vehicle air

Nitrogen Dioxide



Symptoms

irritation eyes, nose, throat; cough, mucoid frothy sputum, decreased pulmonary function, chronic bronchitis, dyspnea (breathing difficulty); chest pain; pulmonary edema, cyanosis, tachypnea, tachycardia

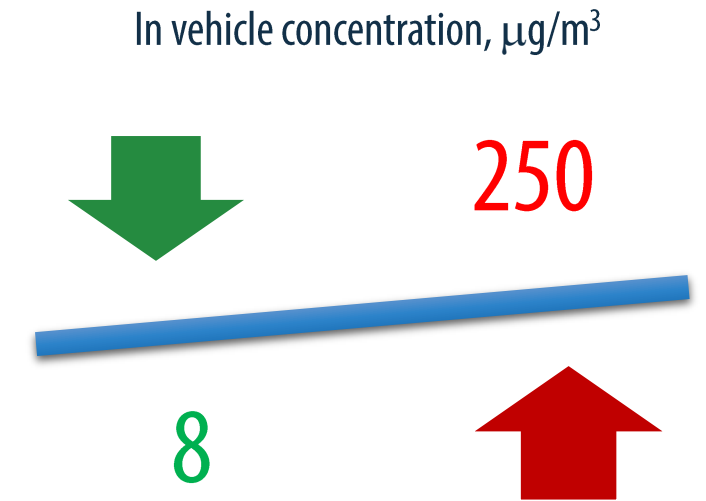
Target Organs

Eyes, respiratory system, cardiovascular system

Toxicity Index

41.1

MAC, $\mu\text{g}/\text{m}^3$	Russia	WHO	Europe	USA	Korea
1 year		40	40	109	62
24 hours	40				123
8 hours					
1 hour		200	200	205	205
30 minutes	200				
Work zone	2000			1800	



In vehicle air

HCHO

Symptoms

irritation eyes, nose, throat, respiratory system; lacrimation (discharge of tears); cough; wheezing; [potential occupational carcinogen]

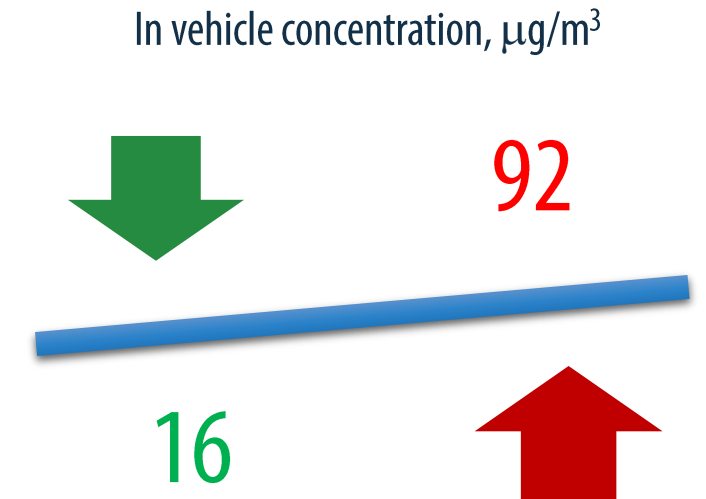
Target Organs

Eyes, respiratory system

Toxicity Index

131.5

MAC, $\mu\text{g}/\text{m}^3$	Russia	WHO	Europe	USA	Korea
1 year					
24 hours	10				
8 hours					
1 hour					
30 minutes	50				
Work zone	500			100	



In vehicle air

Particulate matter less than 2.5 μm

PM_{2.5}

Symptoms

Nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing, premature death in people with heart or lung disease

Target Organs

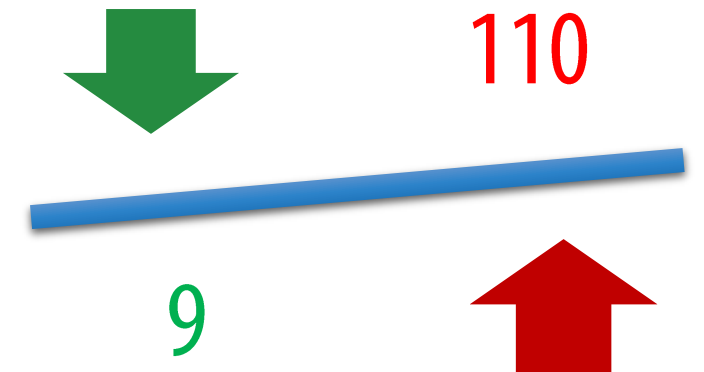
Respiratory system, cardiovascular system

Toxicity Index

124.2

MAC, μg/m ³	Russia	WHO	Europe	USA	Korea
1 year		10	25	12	25
24 hours	35	25		35	50
8 hours					
1 hour					
30 minutes	160				
Work zone					

In vehicle concentration, μg/m³



In vehicle air



Particulate matter less than 10 μm

PM₁₀

Symptoms

Nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing, premature death in people with heart or lung disease

Target Organs

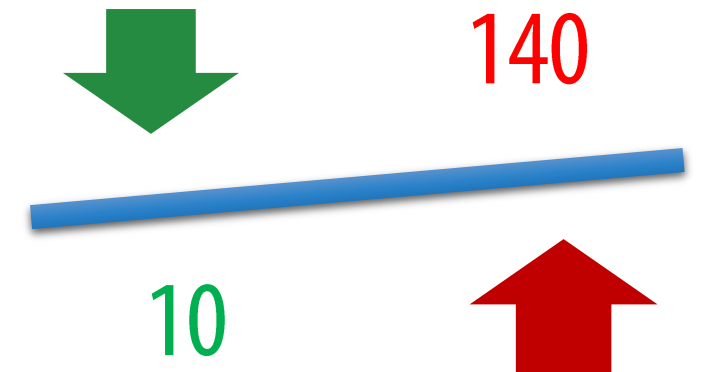
Respiratory system, cardiovascular system

Toxicity Index

69.3

MAC, μg/m ³	Russia	WHO	Europe	USA	Korea
1 year		20	40		50
24 hours	60	50	50	150	100
8 hours					
1 hour					
30 minutes	300				
Work zone					

In vehicle concentration, μg/m³



In vehicle air



Ozone



Symptoms

irritation eyes, mucous membrane; pulmonary edema; chronic respiratory disease

Target Organs

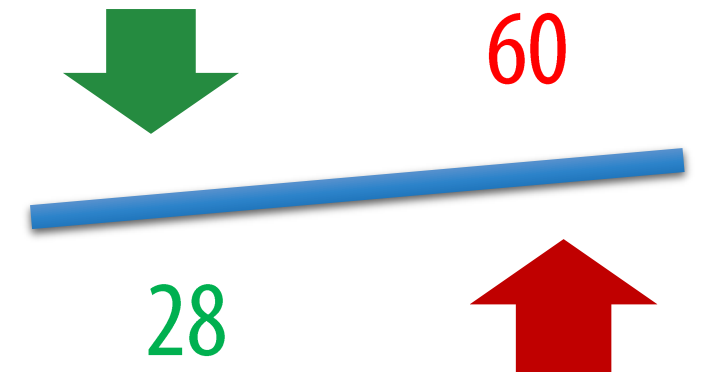
Eyes, respiratory system

Toxicity Index

212.1

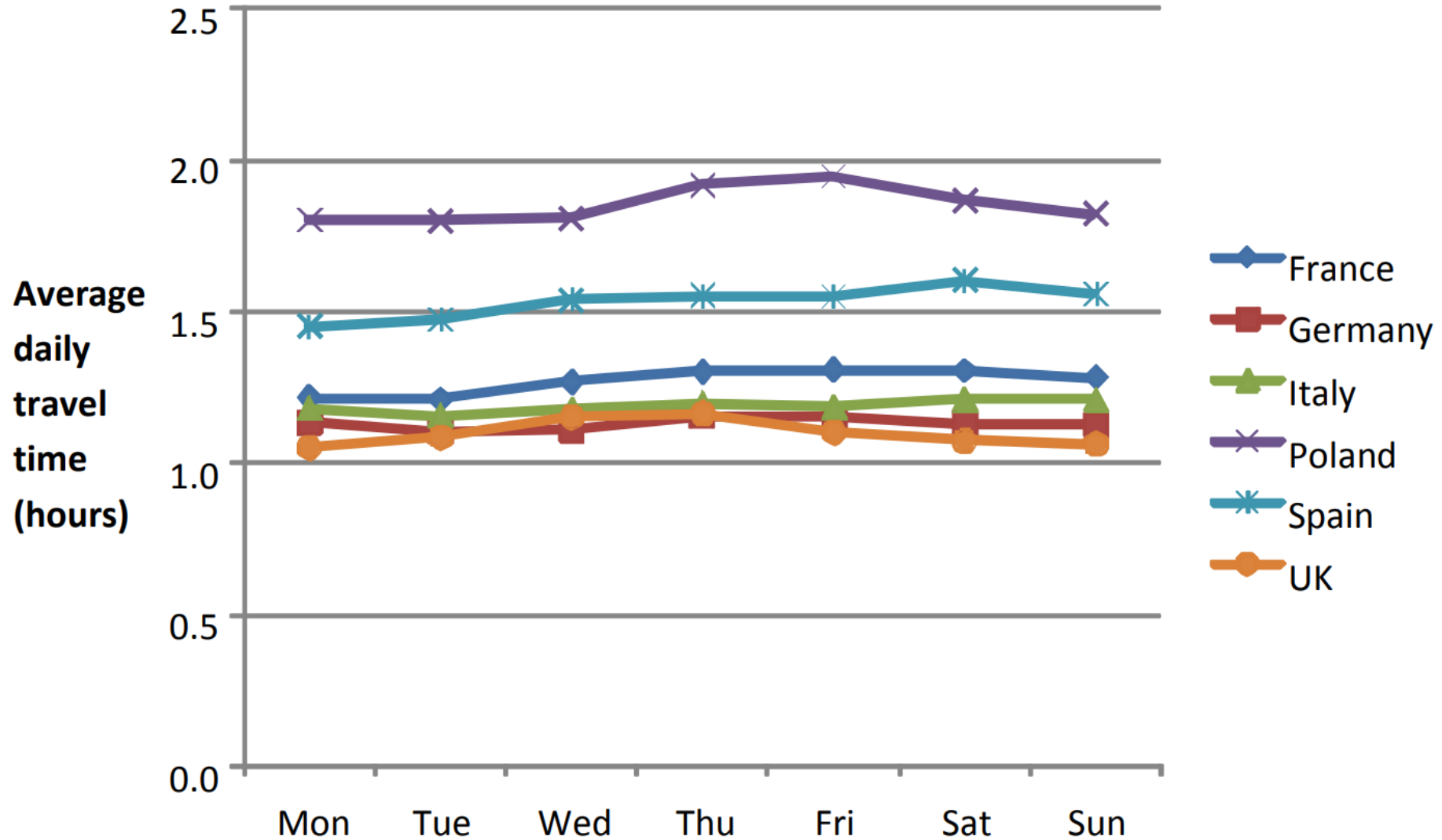
MAC, $\mu\text{g}/\text{m}^3$	Russia	WHO	Europe	USA	Korea
1 year					
24 hours	30				
8 hours		100	120	141	121
1 hour					
30 minutes	160				
Work zone				200	202

In vehicle concentration, $\mu\text{g}/\text{m}^3$



In vehicle air

Average daily travel time (hours) by day of the week in Europe



Exposure and toxic effect calculation

for in-vehicle air

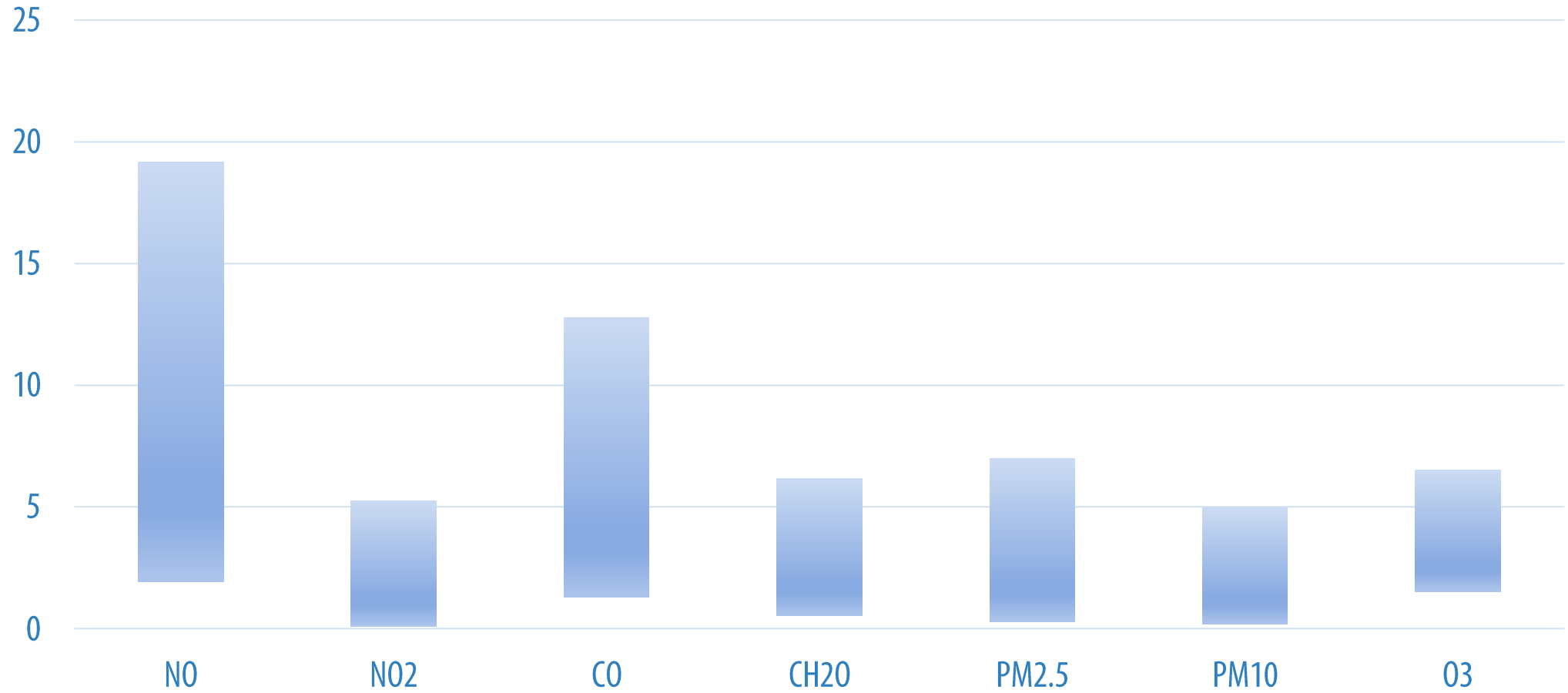
Aspirated air volume per year: 1 hour * 700 l/hour * 365 days = 255,5 m³/year
or 2 hour * 700 l/hour * 365 days = 511,0 m³/year

Doze of aspirated toxicant (NO) per year: minimal: 255,5 m³/year * 0,2 mg/m³ = 0,051 g/year
maximal: 511,0 m³/year * 1,0 mg/m³ = 0,511 g/year

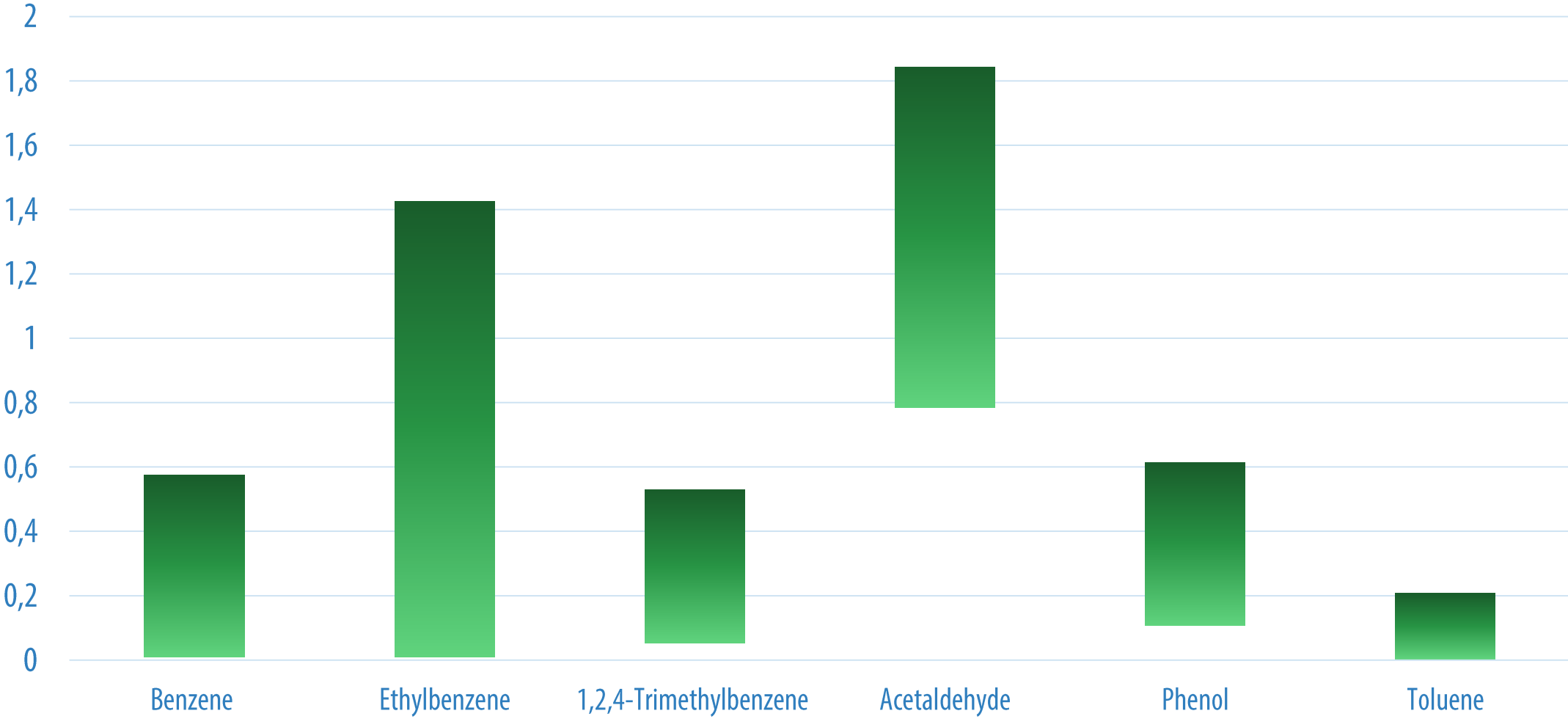
Relative toxic effect of NO: minimal: 0,051 g/year * 37,5 = 1,92 rel.g/year
maximal: 0,511 g/year * 37,5 = 19,2 rel.g/year



Relative toxic effect of main pollutants



Relative toxic effect of hydrocarbons



1. The assessment of relative toxic effect of main pollutants in vehicle interior air showed that most aggressive components are NO and CO, but formaldehyde and particles have also strong negative potential effect on human health.
2. Relative toxic effect of other hydrocarbons is small in comparison to effect of main pollutants.
3. It is advisable to include to scope of VIAQ IWG particulate matters with dimensions less than 2.5 and 10 μm .
4. It is important to collect and analyze the information about fine particles in vehicle interior, because they have very strong negative effect on human health.

Thank you for your attention!

