Population Exposure to Air Pollutants in Europe PEOPLE project in Brussels

Project description

Among the health related activities conducted at the Emissions and Health Unit of the Joint Research Centre, the PEOPLE (Population Exposure to Air Pollutants in Europe) project is designed to assess human exposure to pollution.

The project is assessing outdoor, indoor and personal exposure levels of/to air pollutants in about ten European larger agglomerations in the EU 15 and new EU member/candidate countries. The study focuses on emissions from transport and smoking, using benzene as a tracer pollutant.

Citizens were invited to participate into the project, through invitations launched in the media, to assess their personal exposure to benzene. In each city a number of maximum 125 volunteers were selected, according to very well defined selection criteria.

Measurements were also taken over a 24-hour period at a wide range of indoor locations – such as homes, offices, shops, schools, bars and restaurants and public transport, as well as outdoor locations throughout the city.

Air pollution by benzene

Benzene is a carcinogenic compound that is associated with an increased risk of developing leukaemia. In cities, benzene is mainly generated by automotive traffic. It is present in gasoline and is also formed as by product of the incomplete combustion of gasoline.

The risk level established by the World Health Organisation ranges between 3.8 and 7.5 cases of myeloid leukaemia per one million people exposed during lifetime to 1 µg/m^3 of benzene.

Benzene is the first carcinogen to be regulated by EU air quality directives (2000/69/EC). The new benzene directive imposes a limit value of 5 µg/m^3 to be reached by 1st January 2010.

As a primary pollutant emitted by traffic, benzene is also a good tracer for other pollutants generated by traffic, such as carbon monoxide, nitrogen oxides, volatile organic compounds and particulate matter.

Smoking is also an important source of benzene strongly affecting personal exposure to this pollutant. It should be noted that benzene is however one of many toxic compounds emitted by smoking, such as nicotine, carbon monoxide, nitrogen oxides, tar and fine particles.

PEOPLE objectives

At the moment of the entry into force of the new EC directive on air pollution by Benzene, the PEOPLE project aims to provide:

- Preliminary assessment of Benzene levels for the establishment of measurement regimes and in support to monitoring network design, mainly in the new EU member/candidate countries
- Impact of outdoor and indoor emission sources (including smoking) on human exposure to benzene levels, in support to risk assessment of urban populations in Europe and the validation of exposure models.
- Comparative assessment of the air pollution by benzene in various European capitals, in function of local mobility policies and air pollution abatement measures.
- Support to local, national and European decision making.
- Raising the awareness of citizens with regard to air quality in general, and in particular to the impact of personal behaviour (mode of living, mode of transport, smoking habit).

This last aspect constitutes a key element in the PEOPLE study approach. The development of the Clean Air For Europe (CAFE) programme is based on the participation of all possible stakeholders: EC and national authorities; international research organisations and agencies; NGO's; industry. However, the success of the CAFÉ policy can only be guaranteed if it is understood and endorsed by citizens. To raise the awareness and inform the public constitutes a major tool to change the perception and the behaviour of the population towards air pollution.

Measurement campaign

On 22 October 2002, citizens from Brussels participated in the project. They were selected according to well defined criteria, in function of their specific activities: non-smoking citizens not exposed to automotive sources (control group), smokers, commuting citizens using a personal car as transport means, citizens using public transport, citizens using a bike or walking. Each citizen carried a sensor for 12 hours to measure their personal exposure to the pollutant. These measurements were possible thanks to the use of a newly developed diffusive sampler allowing measurements in short periods of time.

Measurements were also performed for 24 hours in a wide range of indoor locations, such as offices, shops, schools, bars and restaurants and public transport means. Outdoor measurements were further performed in a number of urban sites to assess the levels and the distribution of benzene over the city (Figure 1).

In Brussels, the Joint Research Centre of the European Commission coordinated and carried out the study in conjunction with the Institut Bruxellois pour la Gestion de l'Environnement du Ministère de l'Environnement de la Région de Bruxelles-Capitale.

Results of the campaign

Outdoor pollution levels

Pollution levels in Brussels, on the day of the campaign, complied with the yearly average value of 5 µg/m^3 limit set by Directive 2000/69/EC, except in areas with dense traffic (Figure 2).

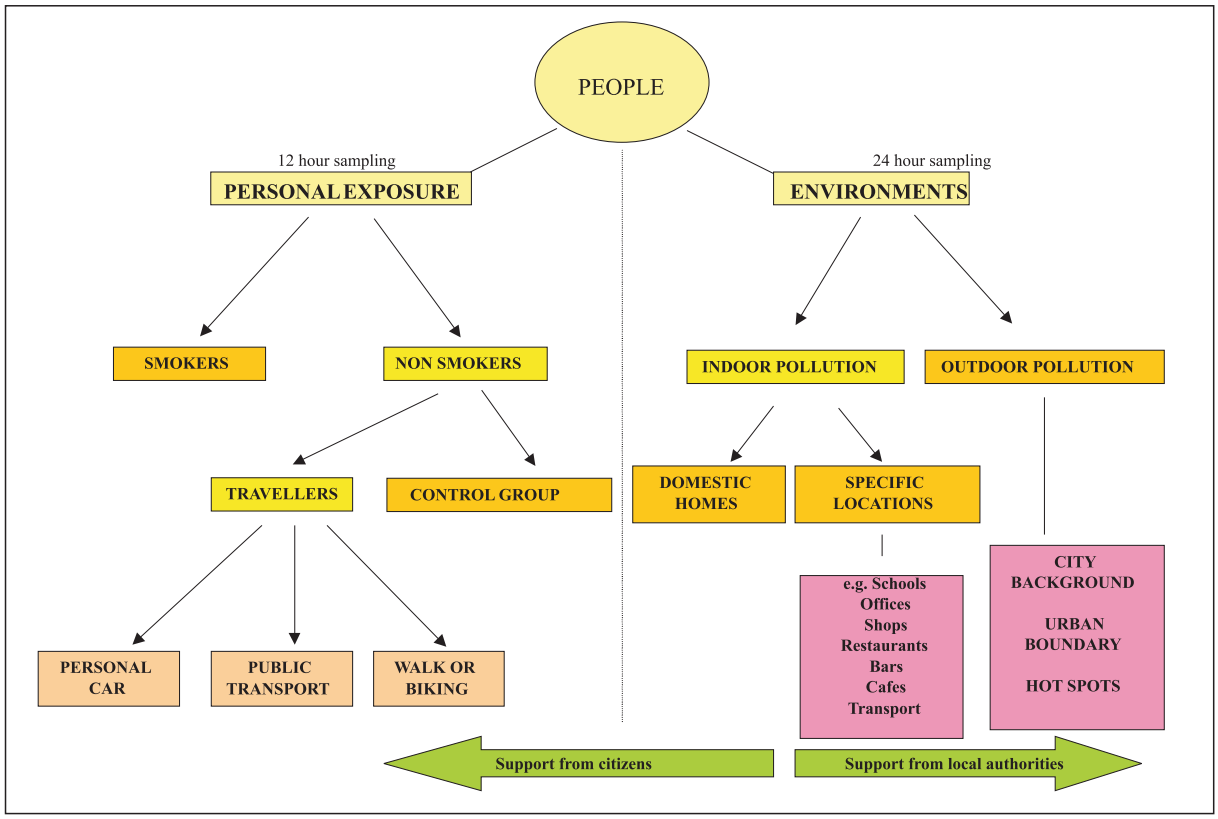

Figure 1. PEOPLE project measurement strategy.

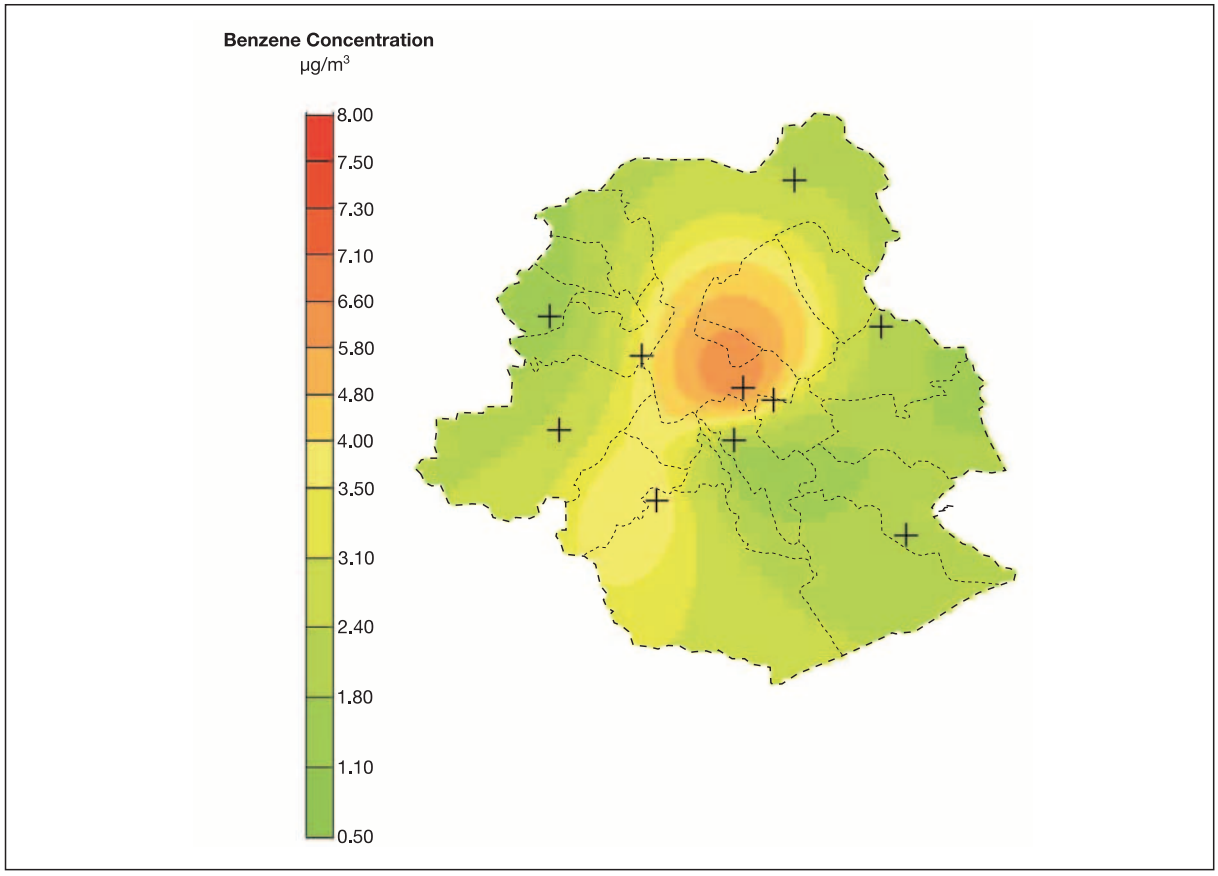

Figure 2. Map showing benzene concentration levels and maximum exposure zones in Brussels on the day of the campaign (22 October).

In Brussels, higher concentrations corresponded to the area between Arts-Loi and Place Schuman, rue de la Loi and rue Belliard, characterised by dense and bottlenecked traffic. Measurements from the continuous monitoring network showed that pollution levels on the day of the campaign were low in comparison with the median annual level (35th percentile value). Benzene concentration levels measured in Brussels in 2002 were approximately half of those observed 10 years ago.

Several factors can explain this reduction, including EU regulating actions i.e. limiting car emissions (1753/2000/EC) and reducing benzene content in gasoline to 1% (98/70/EC); improved testing of cars and transport at national level; and various other national and local measures.

Indoor pollution levels

Levels were measured in typical indoor city locations, where people usually spend significant amount of time during the day (Figure 3).

Homes
Benzene concentrations in houses of citizens were twice that of the city background air with a median value of 6.4 micrograms per cubic meter. When indoor sources, including tobacco smoke were not present, the outdoor levels determined the measured concentrations at these locations.

Schools and offices
Schools showed the lowest benzene concentrations (median value of 1.6 micrograms per cubic meter), indicating that pollution sources were not present. The values measured in offices (median value of 3.1 micrograms per cubic meter) were at a similar level as the city background measurements.

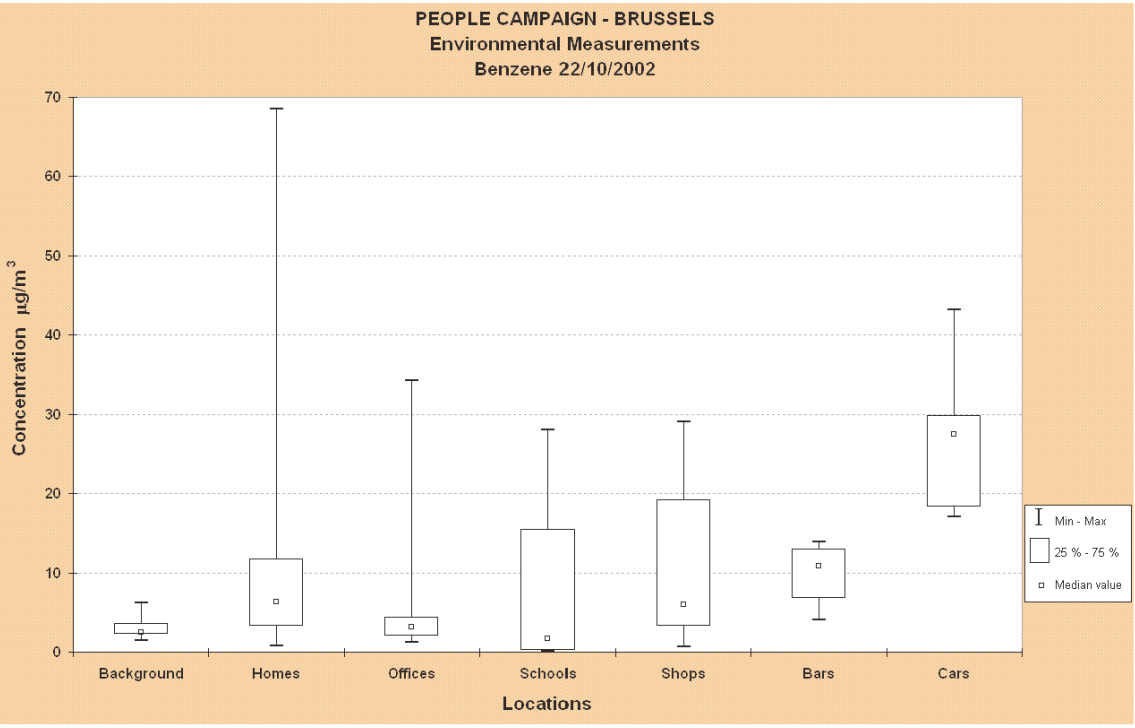

Figure 3. Indoor pollution levels on the day of the campaign (22 October)

Shops and bars
In bars and some shops, where tobacco smoke may be present, the benzene concentration was higher (median value of 10.8 micrograms per cubic meter) than the corresponding city background levels.

Cars
The highest values of benzene concentration were found inside cars (median value of 27.5 micrograms per cubic meter). Frequently cars are travelling through areas with high levels of pollution (hot spot areas). This situation also influenced personal exposure, in particular when people travelled at rush hour through the city.

Personal exposure

The personal exposure measurements represent the average concentrations to which a citizen was exposed. Exposure to benzene was related to a person's life style and surrounding environments. The main factors that affected benzene exposure were tobacco smoke and the time and mode of travelling (Figure 4).

Control group
The non-smoking sedentary citizens, who acted as control group in the study, produced the lowest levels of exposure (median value of 0.6 micrograms per cubic meter) as was expected.

Smokers
Smokers were by far the most polluted class of citizens, exhibiting a median value of 7.5 micrograms per cubic meter. The strong variation in concentration levels depended on the number of cigarettes smoked and on the confinement space (e.g. indoor, outdoor).

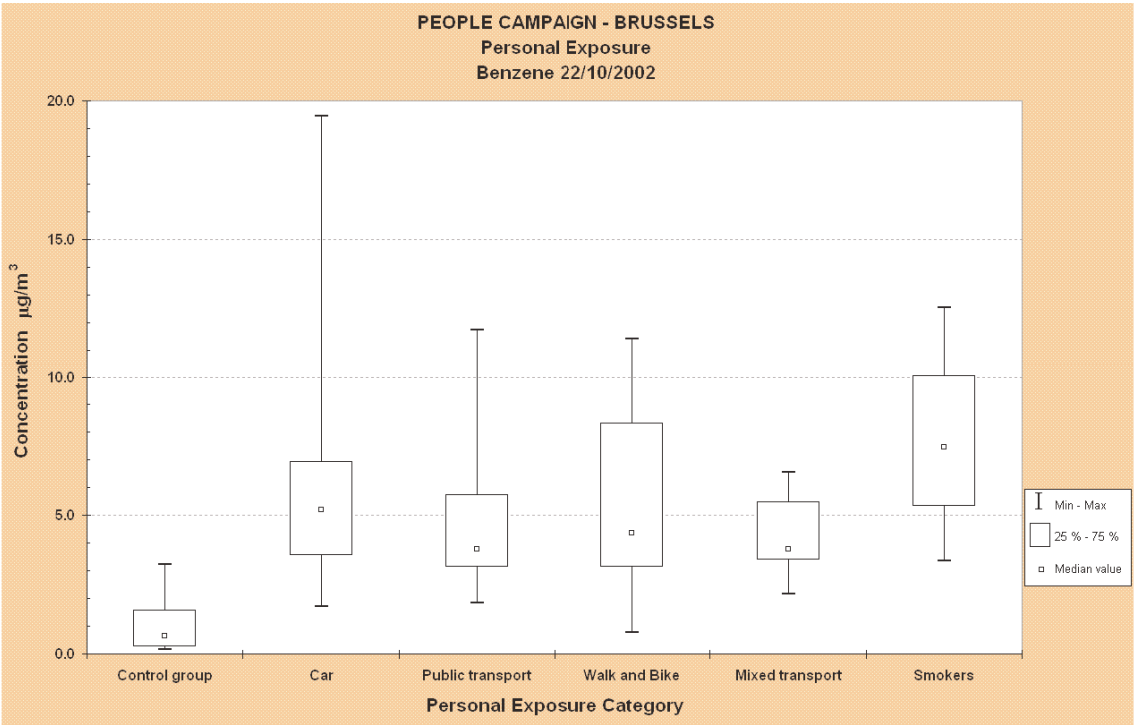

Figure 4. Personal exposure levels on the day of the campaign (22 October)

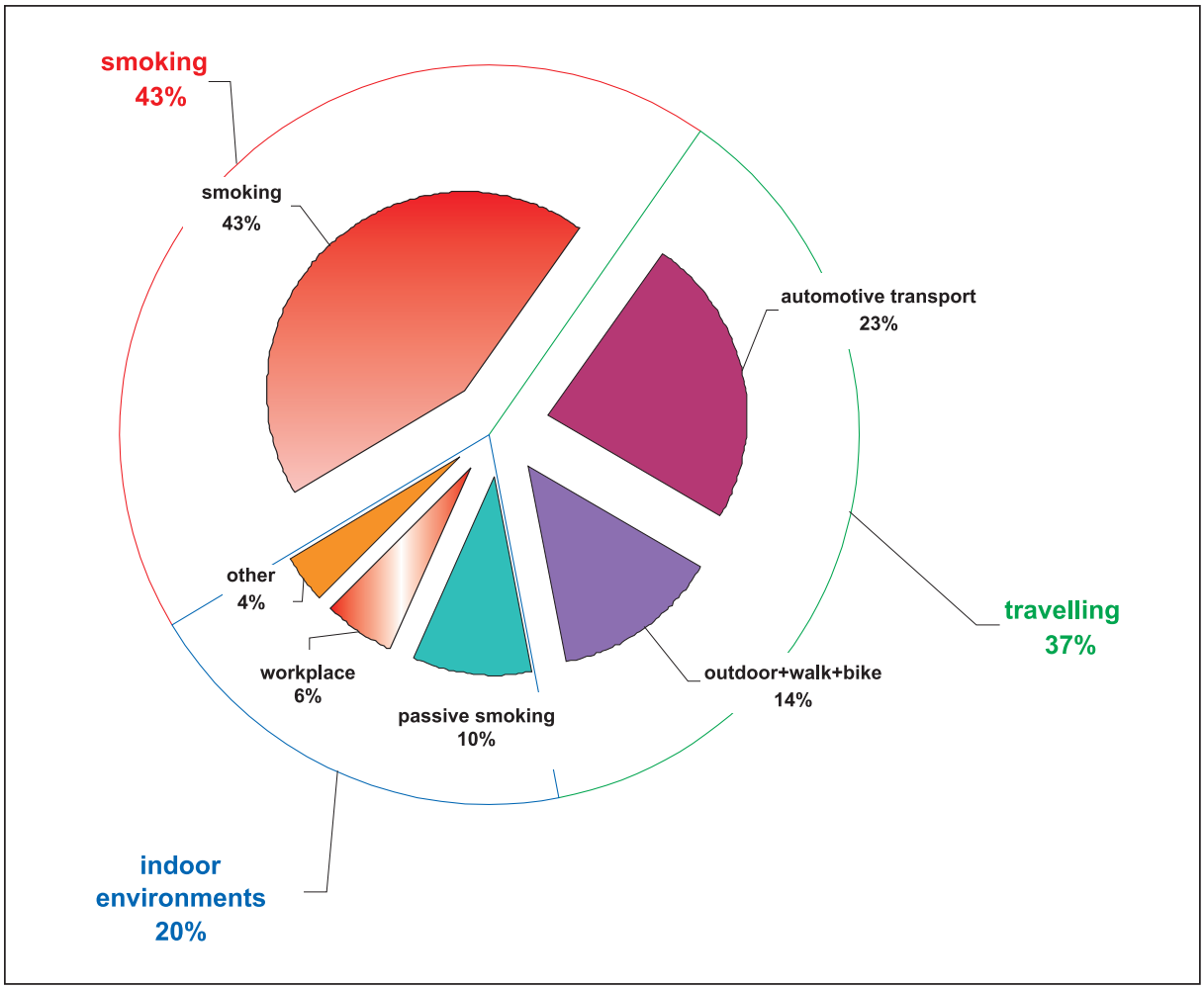

Figure 5. Relative influence of the variables considered in the personal exposure model.

It should be noted that the exposure value determined for smokers corresponds to the concentration level of benzene in their surrounding area. If smoke is inhaled, the concentration level could be 10 times higher than the one measured in their surrounding (CONCAWE report no 2/99).

Travellers

In situations with the absence of smoking or other indoor pollution sources, the mode of transport was the main factor affecting personal exposure. Amongst the various transport modes, car users were the most exposed travellers (median value of 5.2 micrograms per cubic meter). The level decreased when the travelling media changed. Walkers-cyclists (median value of 4.4 micrograms per cubic meter), public transport (median value of 3.8 micrograms per cubic meter) and the mixed transport category (median value of 3.8 micrograms per cubic meter) presented lower values. With respect to public transport users, the exposure was linked to the type of transport used, e.g. bus users were more exposed to higher concentrations than metro users.

Stepwise multiple regression technique was used to identify factors affecting exposure levels among the volunteers; of which 10% were non-smokers unexposed to traffic, 20% were smokers and 70% were travellers. It was possible to establish the influence of the variables considered in the personal exposure model in relative terms. Figure 5 shows the influence, as a percent, in the personal exposure level as a function of the activity and location of the people during the study.

Conclusions and further perspectives

Even if the city of Brussels complies with the limit value of 5 mg/m3 for benzene, the PEOPLE project clearly identified higher levels of exposure to benzene due to tobacco smoking and emissions from automotive traffic.

European Air Quality legislation can only be successful if understood and endorsed by the individual citizen. Raising the awareness of the public can lead to environmentally friendly behaviour. The active support of citizens to pollutant issues is important for the success of environmental policy. The development of local abatement strategies is an effective step in the quest for better air quality in our cities. The enthusiastic participation of the volunteers in Brussels through the PEOPLE project clearly shows that improved environmental quality is a common goal for citizens and policy makers.

Further PEOPLE campaigns were recently conducted in Lisbon (22 October 2003), Bucharest and Ljubljana (27 May 2003), and will follow soon in Madrid and Budapest (end of 2003). The study will be extended to other cities in 2004. So far the following cities have expressed their interest to be associated in the project: Belgrade, Dublin, Paris, and Roma. The project will be extended to other toxic pollutants in the longer perspective, with emphasis on particulates.