Prioritised substance group: PAHs and air pollutants

PAHs and air pollutants	Denis Sarigiannis (AUTH, GR)
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Policy Question	Short Summary of Results
Extract the main findings of the deliverable that answers (part) of the policy question, mention the deliverable	
1. What is the current exposure of the EU population to PAHs?	In WP12, exposure to PAHs was addressed using the data collected from available HBM data regarding 1-OH-pyrene. 1-OH-pyrene is a major metabolite of pyrene and is representative for the PAHs mixtures, while it is the metabolite that is commonly measured in the majority of PAH-related HBM studies. A PBTK model was parameterised and validated in Task 12.1 and it was coupled with the exposure reconstruction algorithms developed in Task 12.2. Based on the existing HBM data available at the moment, the median value of pyrene exposure ranges between 0.025 μg/kg_bw/d for non-smokers in Belgium to 0.240 μg/kg_bw/d for smokers in Netherlands. For most of the countries, median daily intake is around 0.050 μg/kg_bw/d, however, it has to be noted that, as described above, the bio samples had not been collected in the same year, while analyses were performed by different laboratories, thus, hampering the overall intercomparison; these estimates will be updated, upon the aligned study result will be available (AD12.5).
2. What is the current exposure of different occupational groups?	Exposure to the various occupational groups varies based on the specific activities of the related occupational sectors. The highest intake estimates were identified in soil remediation workers (in the range of 0.981 to 1.284 μg/kg_bw/d), followed by asphalt workers (0.093 to 0.325 μg/kg_bw/d) and workers in aluminum and rubber industry (0.035 to 0.100 μg/kg_bw/d). The lowest intake levels were identified to waste incinerator workers (0.004 to 0.104 μg/kg_bw/d), which is the only reported sector occupying both males and females. On the contrary, in all other sectors (soil remediation workers, asphalt workers, workers in aluminum and rubber industry) only males are being occupied and a differentiation on their intake results from their smoking habits, the time of their shift (pre shift, end of shift, post shift, next pre shift) and the age groups. The highest intake levels were related to soil remediation workers (1.284 μg/kg_bw/d) during the next pre shift, where pre shift and end of shift reported lower intakes (0.981 and 1.249 μg/kg_bw/d, respectively). For asphalt workers the highest intake was reported in the post shift and the specific age range of 35-52 (all workers were non-smokers). For workers in the aluminum and rubber industries, the lowest intake was reported for non-smokers (0.035 μg/kg_bw/d) comparing to smokers who exhibited a considerably higher intake (0.065 μg/kg_bw/d) (AD12.5).
3. Is there an association	Dietary exposure dominates exposure to PAHs (contributing to almost 90 %) of daily intake, while the contribution of inhalation is lower (about 10%),

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between air quality and human exposure to PAHs?	except for the cases where significant sources of inhalation exposure such as the proximity to industrial hot spots, heavily trafficked roads, biomass emissions, as well as smoking; smokers have consistently higher exposure levels to pyrene, resulting to daily intake of between 0.015 to 0.150 µg/kg_bw/d. Regarding hot spots, it is expected that they result in higher pyrene concentrations in the range of 0.005 to 0.01 µg/kg_bw/d. (AD12.5)
4. Does exposure differ between countries? Why?	The difference in intake levels among the various countries are mostly explained by the differences in dietary intake, which is the result of increased soil contamination and dietary patterns (frequency of eating smoked food) and to a smaller extent to difference in air pollution levels. More in detail, based on the available HBM data available so far, the highest intake levels were calculated in Netherlands (0.073 to 0.245 µg/kg_bw/d) followed by Germany (0.019 to 0.125 µg/kg_bw/d) and Greece (0.060 to 0.065 µg/kg_bw/d), Denmark (0.041 to 0.095 µg/kg_bw/d), Czech (0.053 µg/kg_bw/d), France (0.022 to 0.078 µg/kg_bw/d) and Italy (0.041 to 0.059 µg/kg_bw/d), Spain (0.035 µg/kg_bw/d) and Belgium (0.029 µg/kg_bw/d). The lowest intake levels were reported in Sweden (0.013 to 0.036 µg/kg_bw/d). It has to be noted that several exposure modifiers such as age, smoking status and exposure to secondhand smoke, as well as residential location have been identified as key factors affecting the overall intake levels. In Netherlands, Italy, France and Sweden the intake levels of smokers have been identified much higher compared to the ones of non-smokers (0.245 and 0.073 µg/kg_bw/d, 0.059 and 0.041 µg/kg_bw/d, 0.078 and 0.022 µg/kg_bw/d and 0.036 and 0.013 µg/kg_bw/d, respectively). In Germany the highest intake levels were reported for children of 5-8 years old, living near industrial hot spots (0.125 µg/kg_bw/d) while for children of the same ages living away from industrial hot spots the intake levels were much lower (0.064 µg/kg_bw/d). This is explained by the higher multimedia contamination in the area and the higher contribution to intake of both soil ingestion and ambient air inhalation. In Greece, living nearby areas with traffic congestion, the intake levels were higher than in urban areas free of traffic (0.065 and 0.060 µg/kg_bw/d, respectively). In Denmark the highest intake levels were reported for bus drivers of 27-60 years of age (0.095 µg/kg_bw/d) while the lowest ones were reported for people working in rural areas (0.041 µg/kg_bw/d) (AD12.5). However, the reason why differences are reported among the various countries will be further explored when the latest HBM data will be available and the statistical analysis in WP10 will have been completed.
5. Can we see a decline in exposure to the eight PAHs restricted under REACH?	Exposure to PAHs occurs through multiple pathways and routes. This also pertains for the 8 PAHs (benzo[a]pyrene, benzo[e]pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene and dibenzo[a,h]anthracene) restricted under REACH. Restrictions from REACH are expected to affect the contribution of exposure related mainly to consumer products. It is also likely that the restriction of use will result in a reduction in the overall tonnage that will be reflected in the soil levels, which in turn will be reflected in the food chain and the dietary intake. However, to identify a potential decline, a trend analysis is required, which in turn requires the acquisition of the completion of the statistical analysis of existing data (from Tasks 10.3 and 10.4) and the collection of new data (Task 8.3: Targeted new field work with EU added value). At the moment there are not enough data to support this hypothesis.

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6. Can HBM4EU data inform the development of legislation specifically targeting exposure to PAHs through ambient air?	At the moment the EU Scientific Committee on Occupational Exposure Limits (SCOEL) has provided a biological guidance value (BGV) for PAH mixtures containing benzo[a]pyrene equal to 0.5 µg/L hydroxypyrene in urine. It has to be noted that the limit values recommended by SCOEL have not been implemented into legislation by the Member States. Based on the work that will be carried out in WP5, EU HBM-HBGV will be derived on the basis of toxicological studies. The values represent the concentration of a substance in human biological material below which there is no risk for adverse health effects and, consequently, no need for action. Hence, they are an important tool to easily assess whether the exposure of a population/subpopulation (e.g. reference values) is of health-relevance and whether policy actions are needed. These values will together with the result of WP10 be used also to address this research question. In addition, input will be provided from the work done in WP12, towards the association of the dose of toxic metabolites in the target tissue, with the observed HBM levels. In addition, work on exposure reconstruction of PAHs has indicated that most of exposure to PAHs comes from dietary sources rather than ambient air pollution, which is contributing for almost 10% of the overall exposure to diet (AD12.5).