

Impact of residential heating on PM_{2.5} levels and composition: effects of the energy crisis

S.M. Almeida¹, N. Canha¹, C.A. Gamelas¹, L. Samek², A. Ryś², Z. Kertész³, K. Eleftheriadis⁴, E. Diapouli⁴, I. Bešlić⁵, R. Godec⁵

¹Centro de Ciências e Tecnologias Nucleares, Instituto Superior Técnico, Universidade de Lisboa, Estrada Nacional 10, 2695-066, Bobadela-LRS, Portugal

²AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, ul. Mickiewicza 30, 30-059, Krakow, Poland

³ICER Centre, Institute for Nuclear Research, Bem ter 18C, 4026, Debrecen, Hungary

⁴Environmental Radioactivity Laboratory, INRaSTES, National Centre for Scientific Research “Demokritos”, Patriarhou Gregoriou E’ and Neapoleos, Agia Paraskevi, 15341, Athens, Greece

⁵Environmental Hygiene Unit, Institute for Medical Research and Occupational Health (IMROH), Ksaverska cesta 2, P.O. Box 291, 10001, Zagreb, Croatia

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Presenting author email: smarta@ctn.tecnico.ulisboa.pt

The zero pollution action plan sets the target to decrease the number of premature deaths due to exposure to fine particulate matter (PM_{2.5}) by 55% by 2030, compared to 2005. Until 2020, emissions of particles have decreased and the premature deaths attributed to exposure to PM_{2.5} in Europe fell by 45%. Nevertheless, according to the European Environment Agency report “Air Quality in Europe 2022” in 2020, 96% of the urban population was still exposed to levels of PM_{2.5} above the health-based guideline level set by the World Health Organization, resulting in 238,000 premature deaths in the EU-27. These numbers indicate that although there is a great deal of improvement as a result of emission control strategies in Europe, PM_{2.5} is still a major risk regarding its negative impact on the citizens’ health. Moreover, the energy crisis that Europe is scrambling with is obliging people turn to coal, wood and even trash to heat their homes. Some countries waived environmental regulations that shielded protected forests from logging to secure energy supplies for households, while wood suppliers have reported an unprecedented demand for logs, briquettes and other biomass products. Therefore, it is expected that this energy crisis will exacerbate air pollution with significant implications for people’s health. The objective of this work is to assess the impact of the residential heating on PM_{2.5} levels and composition and to evaluate the effect of the energy crisis on air quality.

PM_{2.5} samples were collected in 24-h periods in five European cities from 2018 until 2023. Particles were sampled on PTFE filters with reference samplers. Before and after sampling, filters were weighed, in the laboratories located in each city, by means of a microbalance using the procedure described in EN12341. Afterwards, filters were analyzed by XRF and PIXE for the determination of major and trace elements. The Multi-wavelength Absorption Black Carbon Instrument (MABI, by ANSTO) was used to assess the contribution of fossil fuel combustion (BC_{ff}) and biomass burning (BC_{bb}) to BC

concentrations. EPA-PMF5.0 was used to assess the contribution of residential heating to PM_{2.5}.

Results show that residential heating is a significant contributor to atmospheric fine particles, especially in Eastern Europe. It is expected that several factors may contribute to a further increase of the contribution of this source, such as the energy crisis, which the European countries are facing, and the efforts of the European Union to decrease the consumption of fossil fuels and increase the use of carbon neutral solutions, which are leading to a return to biomass burning.

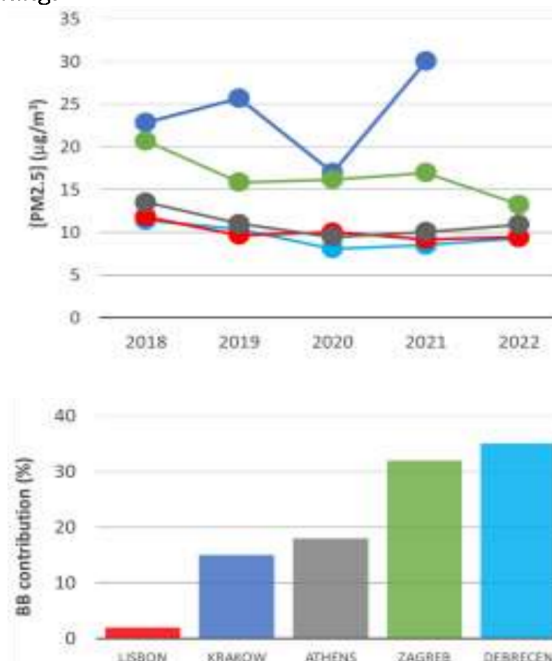


Figure 1. PM_{2.5} average concentration (µg/m³) and average biomass burning contribution to PM_{2.5} (%).

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