

Domestic wood burning: A major contributor to air pollution in Cypriot cities?

J. SCIARE, E. BIMENYIMANA, K. OIKONOMOU

Climate and Atmosphere Research Centre (CARE-C), The Cyprus Institute

Use of solid biomass (wood) as a renewable energy source for domestic heating is considered to play a crucial role in reaching the greenhouse gases reduction targets of the European Union. On the other hand, solid fuel combustion in households contributes more than 45% to total emissions of fine particulate matter in Europe (i.e. three times more than road transport), leading to high exposure of fine particulate matter (PM_{2.5}), which is the Europe's most serious pollutant in terms of harm to human health (EEA, 2019).

However, there are large differences across EU Member States in the contribution of household to national emissions of PM_{2.5}, owing to differences in climatic conditions, heating practices, fuel compositions, regulations, technological standards and climate policies that promote the use of biomass. Cyprus lies at the bottom end of EU countries with less than 1% of PM_{2.5} emissions from the household sector (Amann, 2018), whilst road transport exceeds 30%¹. **Based on these statistics, traffic emissions are likely to be a major contributor to local air pollution in Cyprus whereas domestic heating from wood burning in Cyprus could be considered negligible.**

However, the AQ-SERVE project has recently revealed a completely different story, with major underlying impacts for the health of the Cypriot population.

As part of this project, a continuous monitoring of PM_{2.5} chemical composition was initiated for a period of 1 year at a sampling site (Athalassa campus, Nicosia; see [Figure 1](#)) representative of the city background pollution (i.e. representative of the air pollution breathed by the inhabitants of the Nicosia urban area). Samples were analyzed on-site at the Environmental Chemistry Laboratory² of the Cyprus Institute for a wide spectrum of chemical compounds ranging from anions/cations, elemental/organic carbon, trace organics (carbohydrates), and trace metals.

Traffic and domestic wood burning do emit specific chemical compounds that were detected in our samples and allowed for the calculation of the mass contribution of PM of these two sources for each of the daily sample collected over the 1-year period (see [Figure 2](#)). As shown in this Figure, domestic wood burning signal covers the entire 4-month heating season (December-March) and is inexistent for the rest of year. As expected, the PM signal of traffic is present throughout the year but surprisingly shows a strong seasonal variability with higher concentrations during winter. Such pattern is not linked to larger traffic emissions at that time

¹ Air pollution country fact sheet 2019 (<https://www.eea.europa.eu/themes/air/country-fact-sheets/2019-country-fact-sheets/cyprus>)

² <https://emme-care.cyi.ac.cy/research-infrastructure/environmental-chemistry-laboratory-ecl/>

but to an atmospheric phenomenon called “inversion layer” which traps (and concentrates) air pollutants in the first hundred meters above ground during wintertime. This phenomenon is even more pronounced at night and will further amplify the domestic wood burning signal (usually observed every evening) and will bring its concentrations at the same levels as those recorded for traffic. As a result, **the contribution of domestic wood burning to PM_{2.5} is equivalent to the contribution of traffic during winter (December-February)**³. Similar studies are currently performed in Limassol (the second biggest urban agglomeration after Nicosia) with preliminary results suggesting that **air pollution due to domestic wood burning is also significant, highlighting here the importance of this pollution source in major Cypriot cities**. A multi-year, and multi-site estimation of PM pollution from domestic wood burning is currently being investigated under the framework of the AQ-SERVE project.

Nonetheless, existing results already have important implications for health impacts of air pollution in Cyprus, given that **wood burning is the major contributor of EU-regulated “Polycyclic Aromatics Hydrocarbons” (PAHs), whose compounds are highly cancerogenic**.

This experimental data acquired in the framework of AQ-SERVE (WP5) will constrain the Air Quality model that is currently under construction at the Cyprus Institute (WP8) and support Health Impact and Risks Assessment of particulate pollution (WP9). Several recommendations will be made in the framework of AQ-SERVE to mitigate domestic wood burning emissions based on abatement policies tested and implemented in many European cities affected by domestic wood burning.

References:

Amann, M., et al., (2018). Measures to Address Air Pollution From Small Combustion Sources. Clean Air Outlook Combustion Sources Report, European Commission., available at https://ec.europa.eu/environment/air/pdf/clean_air_outlook_combustion_sources_report.pdf.

European Environment Agency, Air quality in Europe - 2019 report, 99 pp., ISBN 978-92-9480-088-6 doi:10.2800/822355, available at <https://www.eea.europa.eu/publications/air-quality-in-europe-2019>

Sciare, Jean, et al. (2011), Large contribution of water-insoluble secondary organic aerosols in the region of Paris (France) during wintertime." Journal of Geophysical Research: Atmospheres 116.D22.

³ The contribution of traffic to PM_{2.5} is twice more important than domestic wood burning on an annual basis.



Figure 1: Outside and inside views of the Cyprus Institute Air Quality Observatory (Athalassa campus, Nicosia)

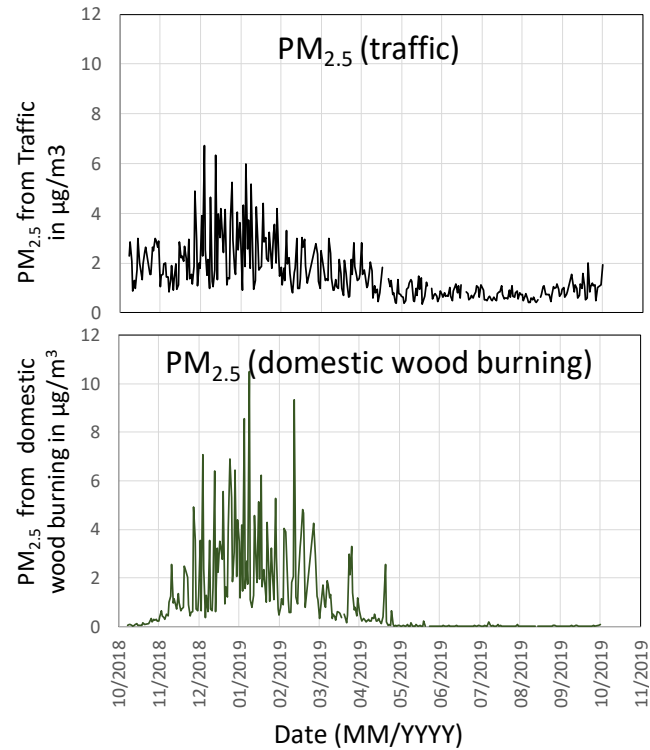


Figure 2: Daily (24h) concentrations of PM_{2.5} from traffic (upper) and domestic wood burning (lower) at an urban background site of Nicosia.

Note: Hypotheses used to calculate both PM_{2.5} from Traffic and Domestic wood burning can be found in [Sciare et al. \(2011\)](#).