

HOW DO WOOD STOVES AFFECT RESIDENTIAL AIR QUALITY?

At first glance, wood stoves seem like a great way to heat your home. However, air pollution from wood stove flue gases can cause environmental and health problems.



Figure 1: Spread of wood stove fumes in a residential area

WHY CAN WOOD STOVE FUMES BE PROBLEMATIC?

Burning wood releases solid and gaseous pollutants in varying concentrations: particulate matter, carcinogenic soot, and harmful gases such as CO, benzene, and formaldehyde. Not only untreated wood is often burned, but also lignite briquettes, painted furniture, or waste. As a result, other pollutants such as benzene, furans, dioxins, and hydrogen cyanide are released into the air.¹ Particularly small particulate matter and nanoparticles smaller than 2.5 micrometers can have health effects. Breathing in larger quantities can lead to so-called "oxidative stress" and result in diseases of the lungs or cardiovascular system.² According to recent studies, ultrafine fractions (nanoparticles) are hazardous.

Particularly insidious, particulate matter is usually not seen or measured sufficiently or at suitable locations. The issue is receiving more attention in larger cities due to emission sources such as traffic and construction

sites. Here, measuring stations or entire measuring networks are being set up more and more frequently. One of the best-known measuring stations in Germany is the Neckartor in Stuttgart.

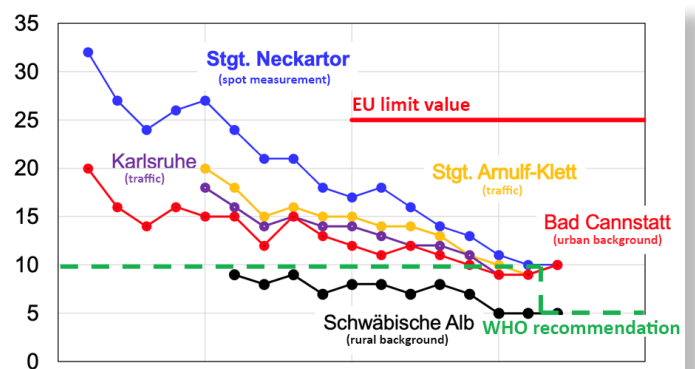


Figure 2: PM_{2.5} immissions at different locations

The PM_{2.5} values (annual mean) shown in Figure 2 show the pollution levels at traffic sites in Baden-Württemberg compared to the urban and rural background. Despite improvements in recent years, the deviation from the current recommendation of the World Health Organization (WHO) is clear.³

WHAT IS THE SITUATION IN RESIDENTIAL AREAS AWAY FROM BIG CITIES?

As part of a research project, Professor Achim Dittler of the Karlsruhe Institute of Technology has taken measurements with equipment from Palas GmbH in a residential area in Stutensee near Karlsruhe since 2020. The result: If comfort stoves are operated in the evening and night hours, the pollution of the air inhaled with respirable fine dust is several times higher on an hourly average than at Stuttgart's Neckartor.

¹ Norbert Klippel, Thomas Nussbaumer: Wirkung von Verbrennungspartikeln - Vergleich der Gesundheitsrelevanz von Holzfeuerungen und Dieselmotoren. Schlussbericht (<https://www.verenum.ch/Publikationen/SBPartikelw.pdf>).

² Deutsche Akademie der Naturforscher Leopoldina e. V.: Ad-hoc-Stellungnahme: Saubere Luft - Stickstoffoxide und Feinstaub in der Atemluft: Grundlagen und Empfehlungen (https://www.leopoldina.org/uploads/tx_leopublication/Leo_Stellungnahme_SaubereLuft_2019_Web_03.pdf).

³ World Health Organization: WHO global air quality guidelines: particulate matter (PM_{2.5} and PM₁₀), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide: executive summary (<https://apps.who.int/iris/handle/10665/345334>).

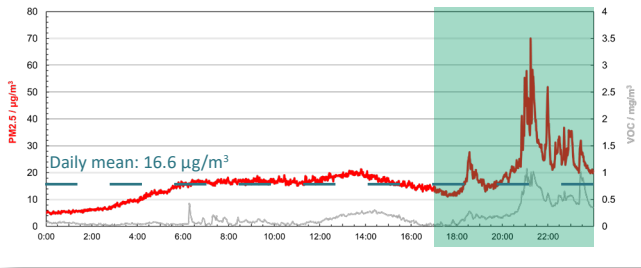


Figure 3: Daily variation PM_{2.5}/VOC immissions Feb. 7, 2023

On February 7, 2023, values of up to 70 µg/m³ were measured in the evening hours, with a daily mean of 16.6 µg/m³. The WHO daily guideline value is 15 µg/m³. (Figure 3)

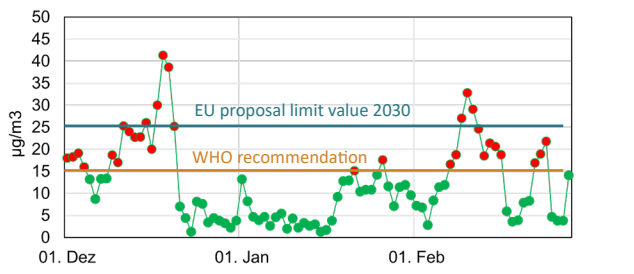


Figure 4: PM_{2.5} daily mean value in winter 2022/2023

The observation of the daily mean values (Figure 4) in winter 2022/2023 shows the recurring exceedance of WHO recommendations and planned EU limit values during the heating period.⁴ On more than 30 of 90 days, the measured value exceeded the guideline value.

The research project exemplifies how important it is to measure local air quality, such as supporting administrative decisions or transparent communication. In residential areas, in particular, air quality needs to be more adequately recorded. In small and medium-sized cities, no official measuring stations usually continuously record data in the relevant measuring range over the day.

IN USE: CERTIFIED MEASUREMENT TECHNOLOGY FROM PALAS

The **AQ GUARD SMART 1000** and **2000** are used in Professor Dittler's research project. The AQ Guard Smart family is particularly compact and robust, making it ideal for monitoring outdoor air quality. The simple installation and virtually maintenance-free operation allow municipalities to set up small "pools" of measuring devices that can be used flexibly in different locations in a cost- and resource-saving manner.

The **AQ GUARD SMART 1000** is MCERTS certified and measures fine dust fractions PM₁, PM_{2.5}, PM₄, PM₁₀, and particle number concentration, among others. The **AQ GUARD SMART 2000** specifically monitors ultrafine particles. Unlike traditional and costly condensation particle counters, it requires no additional operating equipment.

All AQ Guard Smart system variants also allow data management via the **MyATMOSPHERE** Cloud. This platform enables measuring devices and users to be managed, and measurement data can be visualized, documented, and shared with others.



<https://www.palas.de/en/product/aq-guard-smart-system>

⁴ European Commission: Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on ambient air quality and cleaner air for Europe (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A542%3AFIN>).