
# European Monitoring Station Check

## Results of $NO_2$ measurements across Europe

Monitoring Station Report | 2024-09-04

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## Summary

The report, titled "European Monitoring Station Check – Results of $NO_2$ Measurements Across Europe", consolidates the measurement results from various Citizen Science projects initiated by Deutsche Umwelthilfe (DUH). Since the launch of the first measurement campaign in 2018, over 5,000 Nitrogen Dioxide ($NO_2$) measurements have been conducted in 19 European countries. This report highlights the latest results from 2022 to 2024 and offers policy recommendations for implementing the newly revised Ambient Air Quality Directive (COM 2022 542).

More than a decade after being formally adopted, the Ambient Air Quality Directives (2008/50/EC and 2004/107/EC) have still not been correctly implemented across all Member States of the EU. Significant deficiencies, especially in monitoring ambient air quality, persist. In this report we identify 66 pollution hotspots across Europe that are being systematically ignored by the official monitoring network. 55 of our measurements indicate breaches of the current $NO_2$ annual limit value of 40 µg/m³. At least one official monitoring station in Sofia is clearly breaching AAQD standards by being over 40 meters away from the kerbside. Additionally, one station in Budapest measured $NO_2$ concentrations significantly lower than our recorded measurements.

Our findings show that significant efforts are necessary to safeguard the full implementation of the AAQD. Especially with the implementation of the revised and more ambitious AAQD, it is essential that the European Commission and Member States ensure that the official air quality monitoring is reliable and accurate.


### Key recommendations

1. It is essential for the **Commission to closely monitor the implementation of the ambient air quality measuring standards.** According to Article 8, par. 5a of the revised AAQD, the Commission shall provide further technical details for modeling applications and determining the spatial representativeness of sampling points within 18 months from the directive's entry into force. **These Implementing Acts must ensure that <u>all air pollution hot spots</u> are fully incorporated in the official monitoring system of each Member State.**
2. **A review of the official monitoring networks by an independent European institution, such as the European Environment Agency (EEA), is essential. If necessary, this review should lead to the installation of new monitoring stations.** The results of our measurements across Europe indicate that numerous official urban traffic monitoring stations are not located at the most polluted spots. In addition, some of the official monitoring stations evidently fail to comply with the station placement standards defined in the AAQD Annex III.
3. In the review of the AAQD by the Commission, obligatory in 2030, the consideration of tightening "timelines for the alignment with the most recent World Health Organization (WHO) Air Quality Guidelines and the latest scientific evidence" needs to be a top priority and examined carefully**. A full alignment with the WHO Air Quality Guidelines by 2035 at the latest** is necessary to protect the health of all citizens living in the EU.

## Introduction

Nitrogen Dioxide in the ambient air poses a direct threat to human health, with road traffic emissions, particularly diesel engines from passenger cars, buses, and trucks, being a major source. Ensuring better air quality is crucial, as air pollution remains the world's single largest environmental health risk. In 2021, the air pollutant $NO_2$ caused more than 142.000 premature deaths in the EU-27. Moreover, a total of 90% of the EU population living in urban areas is exposed to $NO_2$-concentrations that are highly detrimental to their health and greatly exceed the WHO recommendations.

To monitor air quality across Europe, Member States are required to establish and maintain an official network of monitoring stations. These stations should represent the population's exposure, measure air quality at pollution hot spots, ensure compliance with limit values, and inform the public about its exposure to various air pollutants.

However, punctual measurements cover only a fraction of potentially polluted areas. Most municipalities in the EU lack sufficient air quality data to cover the most relevant areas. To address this gap, DUH supports NGOs and local activists across Europe by providing reliable and easy-to-use NO2 measuring devices (diffusion tubes, a method that is also used by authorities in Germany for official measurements). This initiative aims to gather more comprehensive air quality information, which is crucial for indicating the need for action to competent authorities and raising public awareness on this issue. Moreover, to further solidify important findings, DUH carries out mobile measurements at locations of high interest.

In 2018, DUH started with the project "$NO_2$ Citizen Science" to address the challenges outlined above. After initiating three measurement campaigns at more than 1.500 locations in Germany, the project was rolled out across Europe. Since its launch, over 5.000 $NO_2$ measurements in 19 different countries have been carried out. The measurement results shed light on important blind-spots within the official monitoring system and underline urgent need for action.

This report highlights selected measurement results from 2022 to 2024, showing that many existing official traffic-related monitoring stations do not cover the most polluted areas in many European cities. The European Court of Justice confirmed in its 2019 *Craeynest* ruling that air quality must be monitored at locations with the highest expected air pollution. The revised AAQD incorporates this ruling and explicitly mandates monitoring stations to be placed at hotspots. Our focus is on the official results from urban traffic-related monitoring stations, as these are the most likely to show exceedances of nitrogen dioxide limit values.

Even relatively short measurement periods can provide indicative information about whether a site is potentially heavily polluted. By comparing the results with those from official monitoring stations within the same time period, we can make informed assumptions about the quality of the monitoring network. The longer the total measurement period at a single location, the more robust the evidence becomes.

During this project, numerous new hotspots of $NO_2$ pollution have been discovered. In many cities, the measured $NO_2$ concentrations are significantly higher than those recorded by official monitoring stations which are reported to the European Commission. Due to inadequate monitoring networks that fail to meet legal requirements, $NO_2$ pollution is systematically underestimated in many countries. The results show that the diesel exhaust gas $NO_2$ is a widespread problem in almost all urban areas in the selected countries.

## Legal Framework

The Directive 2008/50/EC on ambient air quality outlines general criteria for air quality assessment in Annex III.

Macro Scale Siting of Sampling Points

Annex III, Section B, details macro scale siting criteria for sampling points, specifying their location to comply with air quality standards. Points should be in areas with the highest concentrations where the population is exposed, avoiding very small micro-environments, and representing air quality for at least a 100m street segment.

Microscale Siting of Sampling Points

Annex III, Section C, provides micro scale siting criteria, specifying how sampling points should be placed relative to roads, buildings, and other obstacles. Stations should be at least 25m from major junctions, no more than 10m from the kerbside, and positioned to ensure unrestricted airflow. The sampling height should be between 1.5 and 4 meters above ground.

Documentation of Site Selection

Annex III, Section D, requires Member States to document site selection procedures with photographs and detailed maps, reviewing sites regularly due to changes like construction and traffic measures.

Jurisdiction of the European Court of Justice (ECJ)

The ECJ mandates that air quality must be monitored at the locations with the highest pollution levels, ensuring compliance with limit values. The ECJ ruling of June 26, 2019, reinforced citizens' right to clean air, emphasizing the Directive's mandatory nature and its importance for health and environmental protection. The ECJ also highlighted that selection criteria for sampling points must be fully documented and regularly updated.

Background monitoring stations assess pollution over several square kilometers, while traffic or industry-related hotspots show higher pollution levels. Traffic-related monitoring stations focus on $NO_2$, as 70-80% of emissions are from road traffic, particularly diesel vehicles. High $NO_2$ pollution is common narrow street canyons with heavy traffic.

Changes in revised AAQD

The revised AAQD text, adopted by the European Parliament on April 24, 2024, largely retains the current legislation for $NO_2$ monitoring stations. Notable changes include the explicit mention of "hotspots” and improved access to justice and compensation for individuals when limit values are not complied with. Given that the recent updates to the AAQD legislation now explicitly address “hotspots”, our existing critique and evidence remain highly relevant.

# The Measurement Methodology

## Passive Samplers

Passive samplers, also known as diffusion tubes, diffusive samplers, or passive diffusion tubes (PDTs), were used in the late 1970s for the first time to measure $NO_2$ in ambient air. Ever since, they have been an accepted and widely used method for spatial and temporal measurement of $NO_2$ concentrations. "The method is cheap, simple, and provides concentration data in most circumstances that are sufficiently accurate for assessing exposure and compliance with Air Quality criteria"[1]. In Germany, the state of North Rhine-Westphalia is operating most official monitoring stations for $NO_2$ with passive samplers and has published a proof of equivalence with the reference procedure of the European Directive 2008/50/EC and the German legal implementation, the 39th Bundes-Immissionsschutz-Verordnung (39th Ordinance on the Implementation of the Federal Immission Control Act). For the measurements in this project, diffusion tubes of the Swiss laboratory Passam were exclusively used, as these are exactly the passive samplers used to operate German official monitoring stations.

The accuracy of the passive samplers of Passam has been assessed in a review of the Joint Research Center of the European Commission (JRC) in 2009. The review examined the suitability of samplers for long-term monitoring of nitrogen dioxide with respect to the European Union annual limit of 40 µg/m³. The diffusion tube from the Swiss laboratory "is suitable for long-term monitoring of $NO_2$ in ambient air". The "Information about the precision of the sampler indicates that this is usually better than 5 %". Furthermore, the review states that "relative expanded uncertainties of individual results were between 20 and 25 %. When assessing measurement uncertainty by direct approaches, e.g., from parallel measurements with the reference method for measurement of $NO_2$, similar and even better results were obtained"[2].

The benefit of using these measurement devices lies in their easy operation and high-quality data collection. They are typically fixed at a height of two meters or more to street lamps, sign poles, or similar structures, which are widely available. The samplers provide average $NO_2$ concentrations over the measurement period. Due to low costs and easy handling, passive samplers are a suitable device to collect high quality data at a cost-effective price. They only need to be installed and removed after a certain period, and their handling is simplified because they do not require electricity. The placement of diffusion tubes in this project generally follows the requirements of Directive 2008/50/EC as described in Section A of Annex III.

Deutsche Umwelthilfe tested the diffusion tubes in Berlin next to four official monitoring stations. The comparative measurements prove, that the results from diffusion tubes are comparable to those from official monitoring stations. Based on these results and upon reviewing extensive research, Deutsche Umwelthilfe has confidence in the accuracy of the passive collectors. This method is widely used and recognized in Germany and has not been challenged in legal proceedings.

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[1] Cape, J.N. Review of the Use of Passive Diffusion Tubes for Measuring Concentrations of Nitrogen Dioxide in Air; DEFRA: London, UK, 2005

[2] Hafkenscheid, T.; et al. Review of the Application of Diffusive Samplers for the Measurement of Nitrogen Dioxide in Ambient Air in the European Union; EUR 23793 EN; OPOCE: Luxembourg, 2009

**Comparative measurements using passive samplers from Berlin in August 2018**

| Monitoring site | Diffusion tube $NO_2$ (µg/m3) | Official measurement $NO_2$ (µg/m3) |
|---|---|---|
| Schildhornstraße 16 | 41,0 | 43.1 |
| Mariendorfer Damm 150 | 42.2 | 40.4 |
| Karl-Marx-Straße 78 | 42.5 | 43.2 |
| Königswinterstraße 37, Karlshorst | 13.6 | 14.0 |

## Mobile Measurements

### NO2 measurements

To further validate our findings on NO2 from the use of passive samplers, we carried-out mobile on-site measurements using a portable device that measures NO2 concentrations in real time: the ICAD IN SITU NOx Monitor. This device is a high-precision instrument designed for real-time, in situ measurement of nitrogen oxides (NO and NO2) in the air. Using advanced Differential Optical Absorption Spectroscopy (DOAS) technology, it provides highly accurate and reliable data on NOx concentrations, making it particularly suitable for mobile air quality monitoring campaigns. The device is compact, robust, and capable of delivering continuous measurements with minimal maintenance, ensuring dependable performance in diverse environmental conditions.

### Ultrafine Particle measurements

The mobile device P-Trak, produced by TSI, is a state of the art ultrafine particle (UFP) monitor that measures particle number concentration. Unlike conventional particle measuring devices that focus on particle mass (e.g., PM10 or PM2.5), the P-Trak detects particles between 1 and 100 nanometers in diameter, which are particularly harmful to human health due to their ability to penetrate deep into the lungs and enter the bloodstream.

### Relevance for NO2 and WHO-Guidelines for Ultrafine Particle Concentrations

Ultrafine particles (UFP) and nitrogen dioxide (NO2) concentrations are closely linked because both pollutants are primarily generated from combustion processes, particularly from vehicle emissions. High traffic areas often exhibit elevated levels of both NO2 and UFP, as they share common sources like diesel engines. The presence of NO2 can also facilitate the formation of secondary particles, further contributing to UFP levels in the atmosphere.

The World Health Organization (WHO) provides guidelines for ultrafine particle (UFP) concentrations to assess air quality and potential health risks. According to these guidelines, a particle number concentration exceeding 20,000 particles per cubic centimeter (particles/$cm^3$) averaged over one hour is considered a high concentration. Similarly, a 24-hour mean concentration above 10,000 particles/$cm^3$ is also categorized as high, indicating significant air pollution. Conversely, a 24-hour mean concentration below 1,000 particles/$cm^3$ is regarded as low, suggesting a much cleaner air environment. These benchmarks are essential for evaluating the potential health impacts of UFP exposure.

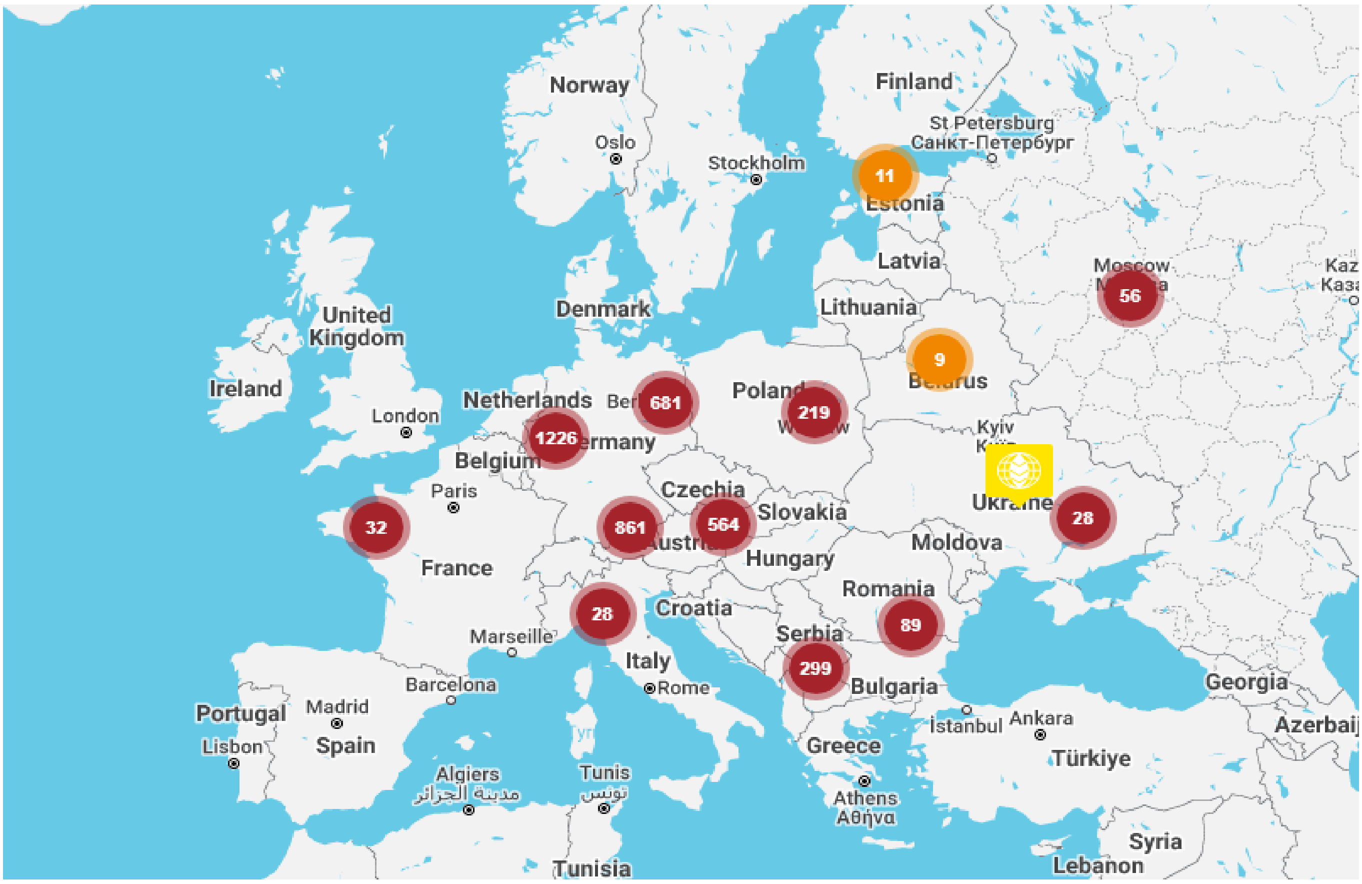
## Results of the different measurement campaigns

In the following sections, selected results of the $NO_2$ and UFP measurement campaigns in Kosovo, Romania, Bulgaria, Hungary, Slovakia, and Czech Republic are presented. The different partner organizations responsible for the measurements contributed knowledge and quotes to the following parts (see Annex II).

In this report, only a selection of passive sampler measurement results that exceed the values of the highest official monitoring station during the same period is published. In Addition to the evidence gathered with passive samplers, this report also presents the air pollution data on NO2 and UFP collected during mobile measurements, with the aim to further solidify the findings.  Illustrating that the official monitoring stations do not provide sufficient information about the actual maximum pollution levels in an assessment area and are not placed correctly.

As described in the method section, the results of the diffusion tubes are very accurate. The values determined by the passive samplers were compared to the official monitoring station averages over the same period during which the sampler was exposed. A similar approach was taken for the mobile measurements: the gathered data was compared to the values measured at the official monitoring stations. Although the mobile measurements are validated at the start of each measurement day, it is important to note, that due to the short measurement period, the data is not as robust as when using passive samplers. For a detailed overview of the measurements conducted in the respective cities and in specific streets, please view the table in the ANNEX I at the end of this document.

**Measurement campaigns of the DUH**




DUH map with results of NO2 measurements: http://www.duh.de/no2airpollution. Most recent results might not be online yet.

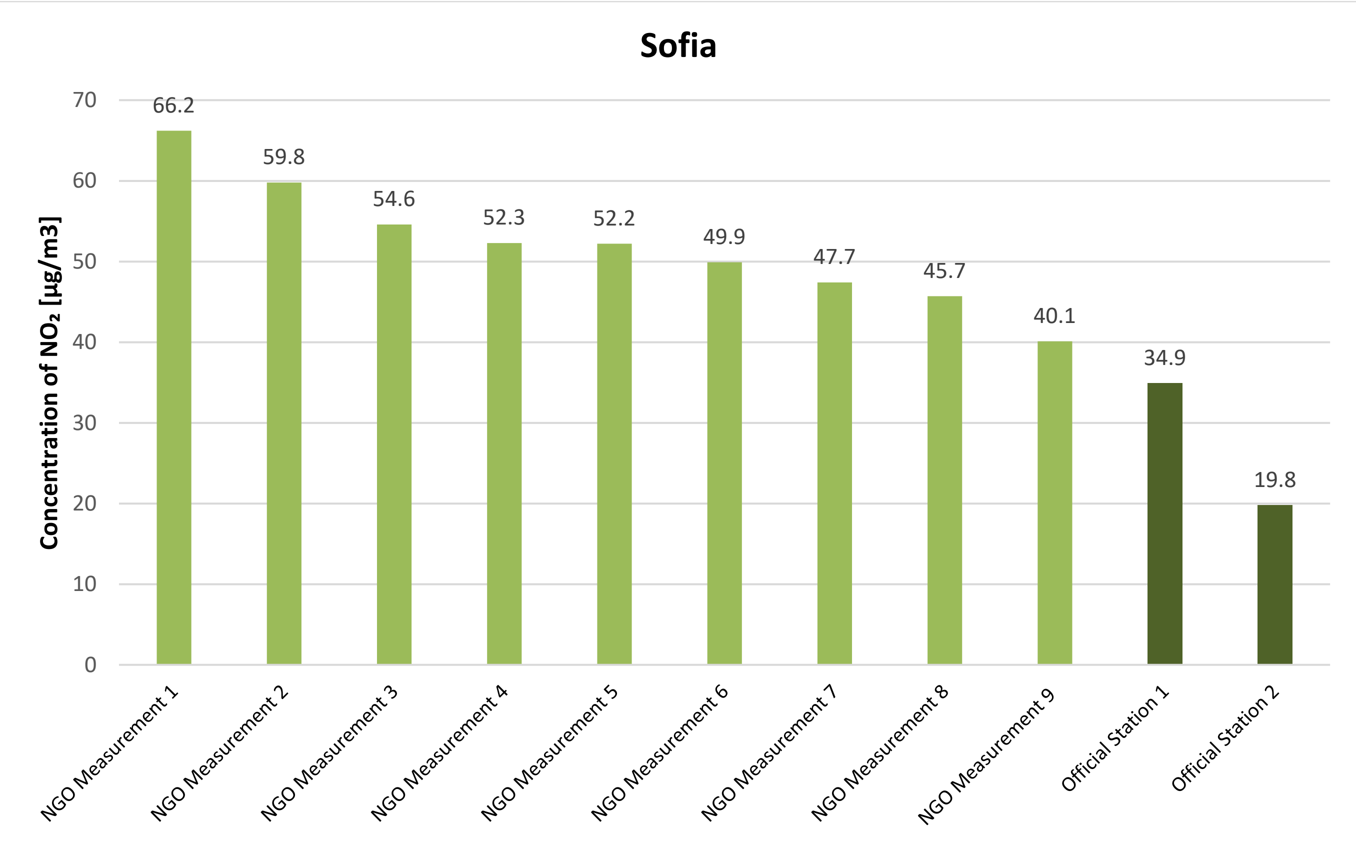
## Sofia (Bulgaria)

The measurements in Sofia were carried out by Za Zemiata with support of Deutsche Umwelthilfe. Za Zemiata is an environmental organization that has been active in Bulgaria for the past 26 years, with a strong record of work and expertise in energy, climate, waste, GMOs, and, more recently, clean air. They have been working consistently on improving air quality since 2016. Za Zemiata measured the $NO_2$ pollution in Sofia for a total of six months in 2023 and 2024 at 9 spots to obtain annual mean values. The relevant results are listed in the table below (see result section).

### Results from passive samplers

There are two official traffic-related monitoring stations in the Bulgarian capital, Sofia (dark green): AMS Mladost and AMS IAOS/Pavlovo. When examining the official $NO_2$ values, it becomes apparent that the concentration values are very low for traffic-related monitoring stations in a metropolitan area. The values from the NGO measurements (light green) are significantly higher than those of the official monitoring stations for the same period. While the highest NGO measured value is more than 66.2 µg/m³ in Sofia Center, the $NO_2$ level at the official monitoring station AMS Mladost is only 19.8 µg/m³.

This clearly documents that the concentration at hot spots in Sofia is up to three times higher than reported by the official figures and that the official monitoring stations are not placed where the highest pollution is expected.



## Results from mobile measurements & placement of monitoring station

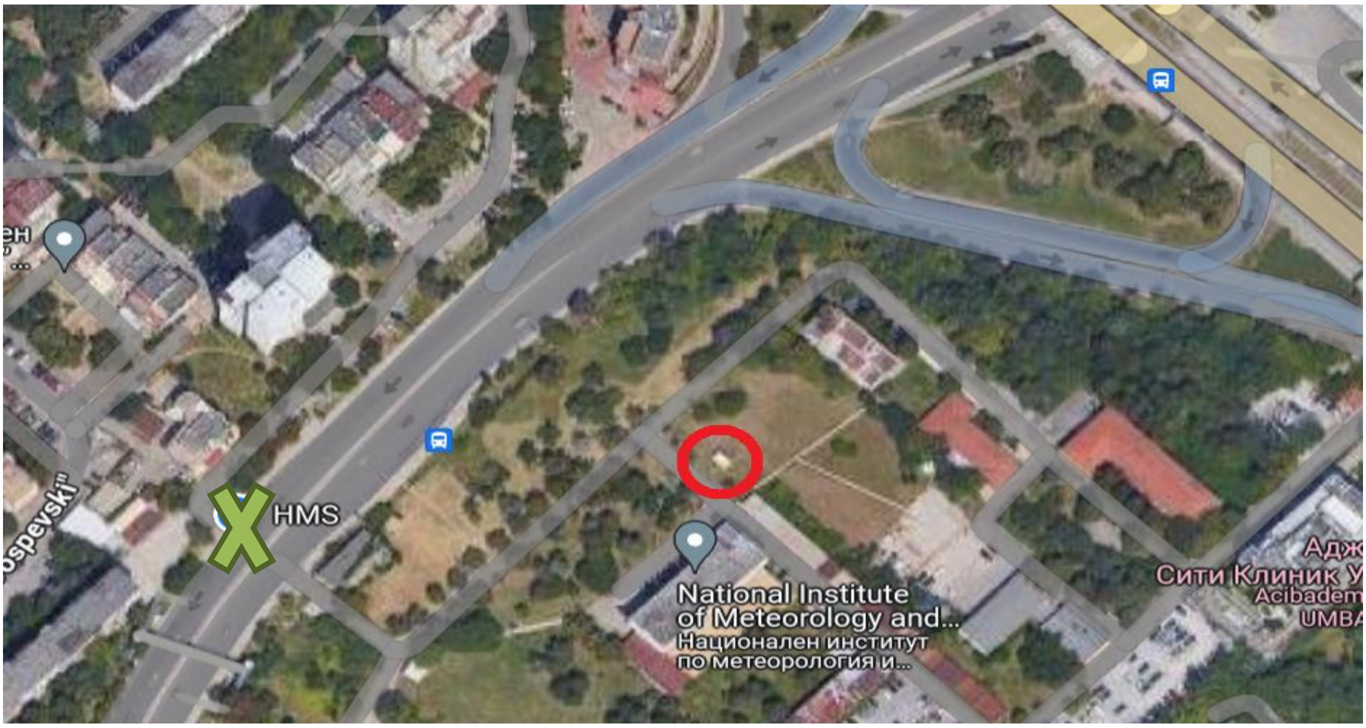
The official traffic-related monitoring station AMS Mladost does not comply with the siting criteria defined in the AAQD. AMS Mladost is situated in the backyard of the National Institute for Meteorology and Hydrology. Instead of being within the legally defined 10 meters of the kerbside, the official monitoring station is placed over 40 meters from any road in an open green field, elevated by about 3 meters above street level (see image below).

From all mobile measurements taken within this measurement campaign, the location of the official measuring station (circled in red in the image below) was the least polluted. We measured the highest pollution levels for UFP at the road that the official station is supposed to measure (see green cross in the image below). Here, the UFP-concentrations were more than 1100% higher than where the official monitoring station is located (see table below).

The evidence gathered from passive samplers and mobile measurements clearly shows that the official traffic-related monitoring station does not comply with the siting criteria defined in the AAQD and that the annual limit value for NO2 is being exceeded in many other locations. Specifically, the station is located more than 40 meters from the nearest kerbside, meaning it is not positioned where pollution levels are expected to be highest. Our mobile measurements demonstrate that the monitoring station would meet the AAQD siting criteria if it was moved 30-40 meters closer to the kerbside and that the measured air pollution concentrations would be significantly higher.

| Sofia Particulate Number (04.- 05.03.2024) | | |
|---|---|---|
| **Site** | **Time Period** | **Average Value (PN)** |
| AMS Mladost/ IAOS Opposite roadside | 11:40 - 12:00 | 37,561 |
| AMS Mladost/ IAOS | 09:06 - 11:13 | 3,328 |

**Misplaced Monitoring Station: AMS Mladost/ IAOS**




The **red circle** indicates the location of the official traffic related monitoring station AMS Mladost/IAOS. The **green cross** indicates the location at which the comparative measurement was made.

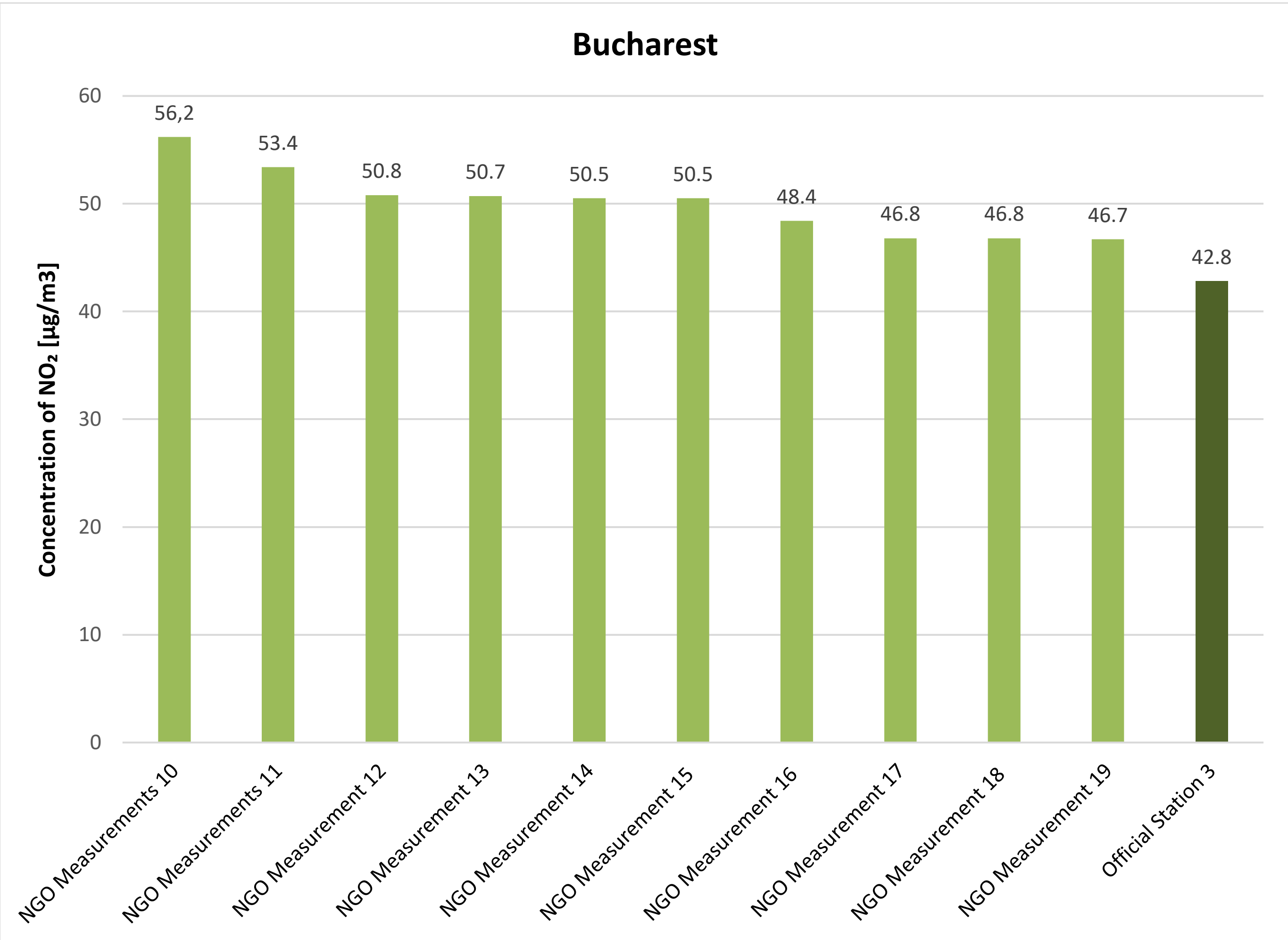
## Bucharest (Romania)

The measurements in Bucharest were carried out by 2Celsius with support of Deutsche Umwelthilfe. 2Celsius is a European climate centered advocacy and research organization from Central and Eastern Europe, registered in Romania. The organization took measurements at 16 spots from May 2023 until October 2023 in Bucharest. The relevant results are shown in the table below (see results below).

### Results from passive samplers

Notable discrepancies between the $NO_2$ measurements from our measurements and the official monitoring stations can be observed in Bucharest. From January to February 2023, the NGO measurement at Banu Manta recorded an $NO_2$ concentration of 56.2 µg/m³, while the official monitoring station at Calea Victoriei, No. 32.34 (B6) reported 42.8 µg/m³.

Our measurements show that there are multiple hotspots with significantly higher NO2 pollution levels than those recorded by the official monitoring stations in Bucharest. The official stations are not placed correctly, as they are not located where the highest NO2 concentrations are expected. Additionally, all documented values from our measurements using passive samplers are significantly above the AAQD annual limit of 40 µg/m³. Our evidence thereby indicates a breach of the siting criteria and a breach of the annual limit value for NO2 set in the AAQD.



## Results from mobile measurements & placement of monitoring station

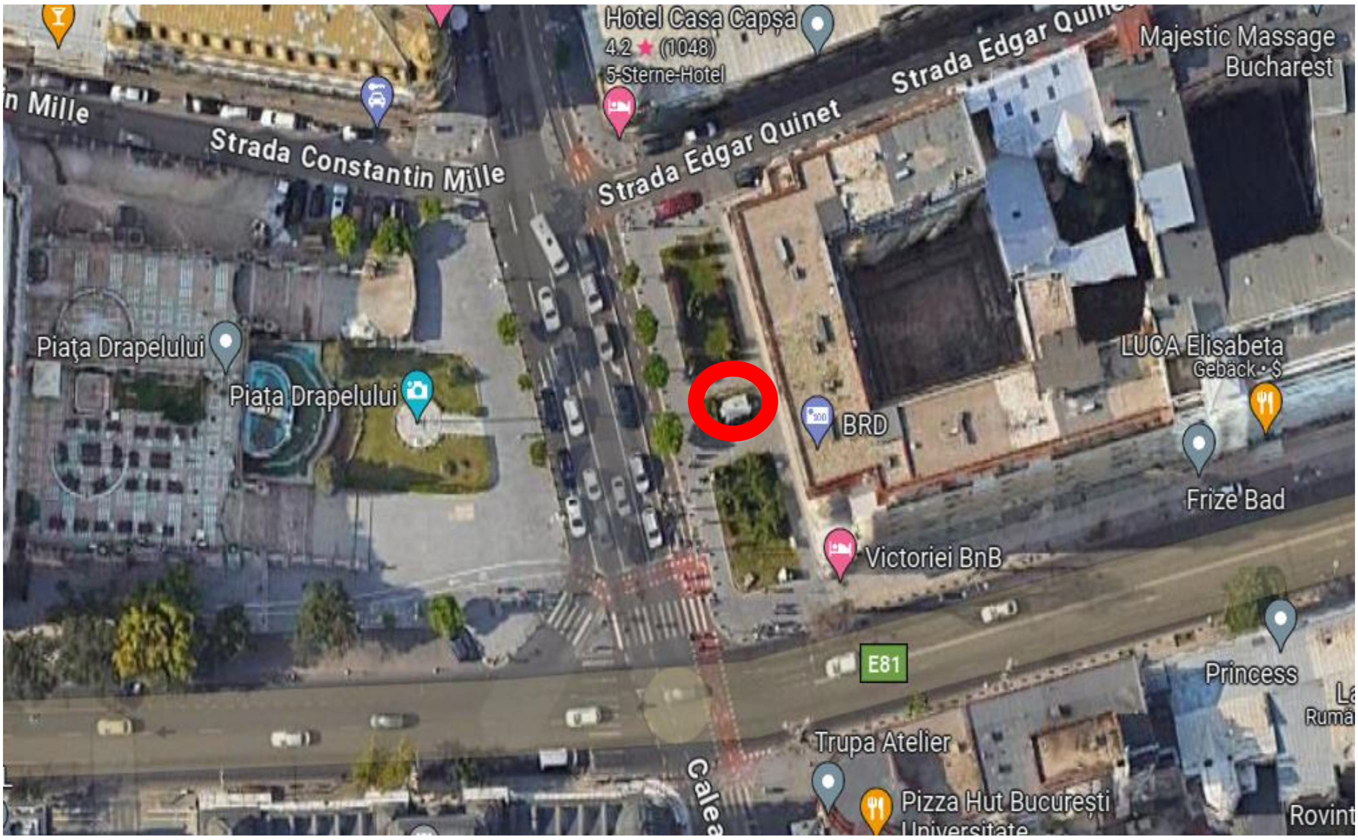
The urban traffic monitoring station on Stefan cel Mare (B3) is not positioned correctly. The station is located in an open space with good ventilation and not within a street canyon—an environment typically associated with elevated pollution levels. The placement of the monitoring station provides a strong indication that it may significantly underestimate the city's pollution levels.

While the NO2 concentration at the official monitoring station on Stefan cel Mare was recorded at 48.2 µg/m³ during rush hour, other more congested areas, such as Strada Stirbei Voda, Bulevardul Nicolae Bălcescu, and Calea Griviței, exhibited much higher concentrations, with levels exceeding 70 µg/m³.

The results highlight that nitrogen dioxide pollution is significantly higher than official data suggests, emphasizing the need for more accurate urban monitoring. Our mobile measurements and passive samplers confirm numerous hotspots with elevated pollution that are not being monitored by the official stations and that document breaches of the annual limit value for NO2. The official monitoring station's location in an open field with good air circulation likely contributes to lower recorded pollution levels compared to hotspots. The location of station Stefan cel Mare (B3) needs to be critically reevaluated.

| Bucharest NO2 Measurements (05.12.2022) | | |
|---|---|---|
| **Site** | **Time Period** | **Average Value NO2 (µg/m3)** |
| Bulevardul Nicolae Balcescu | 13:15-13:45 | 69.9 |
| Bulevardul Corneliu Coposu | 14:15-14:35 | 52.8 |
| Strada Stirbei Voda | 17:45-18:15 | 74.6 |
| Calea Grivitei | 18:25-18:40 | 60.2 |
| Calea Victoriei (B6) | 08:00-09:00 | 48.2 |

**Misplaced Monitoring Station: Calea Victoriei (B6)**




The **red circle** indicates the location of the official traffic related monitoring station Stefan cel Mare (B3).

## Budapest (Hungary)

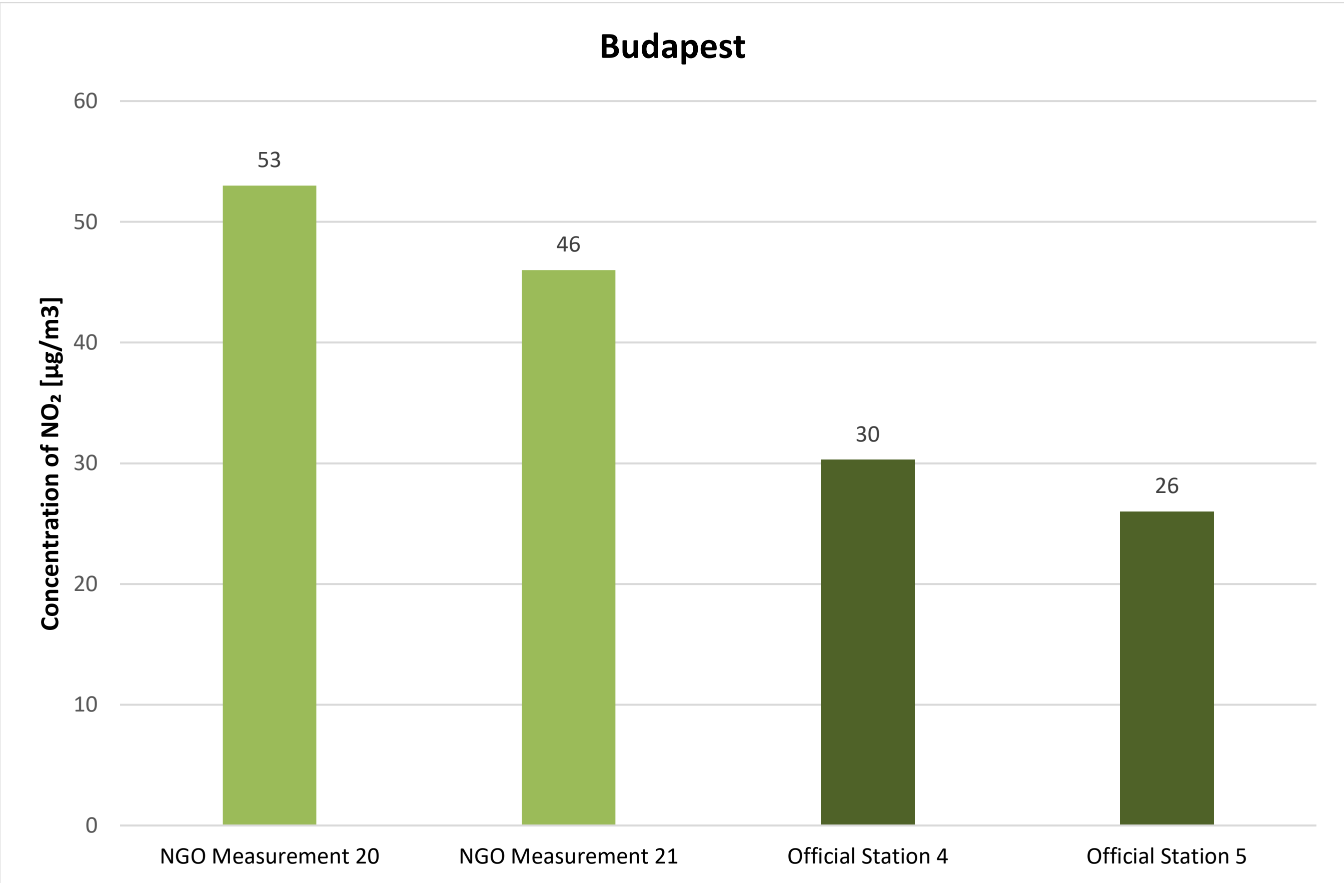
The measurements in Budapest were carried out by the Clean Air Action Group (CAAG) with the support of Deutsche Umwelthilfe. CAAG is one of the best-known environmental NGOs in Hungary. Founded in 1988 by three local green groups, it is now a national federation of more than 60 NGOs.

### Results from passive samplers

CAAG measured the $NO_2$ concentration from March 2024 until April 2024 at 30 locations in the Hungarian capital. The detailed results using passive samplers are listed in the table found in the Annex I. Budapest has four urban traffic monitoring stations: Teleki tér, Elisabeth tér, Kosztolányi tér, and Széna tér. Those with the highest $NO_2$ values, Széna tér and Teleki tér (dark green background), are used for the comparison with the passive samplers.

In March 2024, the highest $NO_2$ value of the passive sampler measurements was at Blaha Lujza tér, recording an average concentration of 53 µg/m³. In the same period, the $NO_2$ concentration at the official monitoring station nearby Teleki tér was 26 µg/m³, which is 27 µg/m³ lower than the passive sampler measurement.

Our measurements in Budapest reveal several hotspots with NO2 levels significantly higher than those recorded by the official monitoring stations, indicating they are not correctly placed. All values from our passive samplers exceed the AAQD annual limit of 40 µg/m³, pointing to a breach of both the siting criteria and the NO2 limit.



## Results from mobile measurements & placement of monitoring station

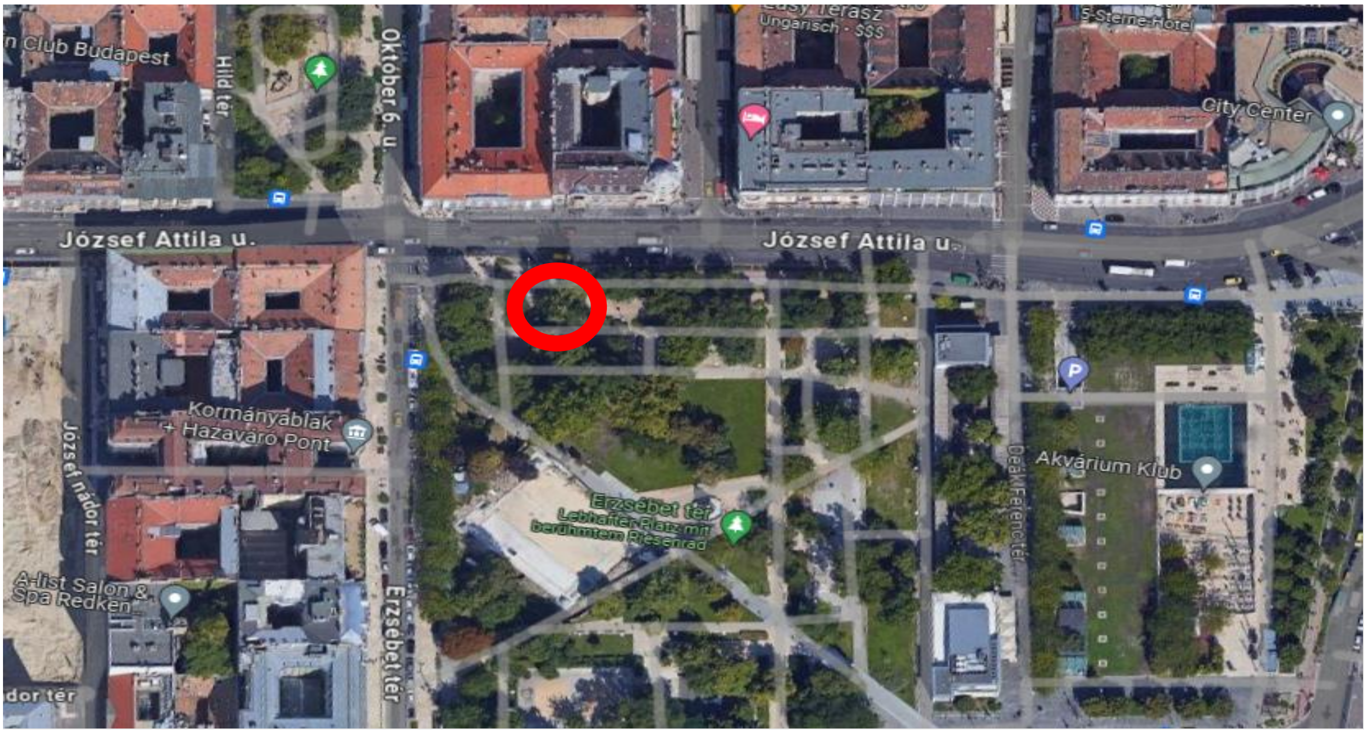
The official monitoring station at Erzsébet tér is located within a city park, which offers excellent air circulation (see image below). Given our results, along with the fact that most air pollution hotspots occur in areas with poor circulation, the placement of this station needs reevaluation.

Our real-time $NO_2$ measurements in Budapest documented significant issues, not only with the station's placement but also with the accuracy of its data. Under identical conditions (same location, height, and time), our measurements showed actual $NO_2$ concentrations at Erzsébet tér were over 100% higher than the official data. The average discrepancy was around 12 µg/m³, far too large to be due to measurement device uncertainty (see table below). The measuring devices used in the measuring station are either fundamentally unsuitable or poorly maintained and prone to errors and therefore unsuitable for use in assessing air quality.

These findings clearly document both the placement and accuracy issues with the official monitoring station, particularly as it is located in an open green space. The unusually low official readings in recent years further challenge the reliability of the city's monitoring network. The proper functioning of the monitoring station should be thoroughly evaluated to ensure accurate and reliable air quality measurements.

| **Budapest: NO2-Values at official station (11.03.2024)** | | |
|---|---|---|
| **Site** | **Time Period** | **Average Value NO2 (µg/m3)** |
| Erzsébet tér. - Own measurements | 11:00 – 12:00 | 30.1 |
| Erzsébet tér. - Official Values | 11:00 – 12:00 | 17.9 |
| Erzsébet tér. - Own measurements | 09:30 – 10:30 | 32.6 |
| Erzsébet tér. - Official Values | 09:30 – 10:30 | 20.2 |
| Erzsébet tér. - Own measurements | 12:00 – 13:00 | 28.7 |
| Erzsébet tér. - Official Values | 12:00 – 13:00 | 16.7 |

### Misplaced Monitoring Station: Erzsébet tér




The **red circle** indicates the location of the official traffic related monitoring station Erzsébet tér.

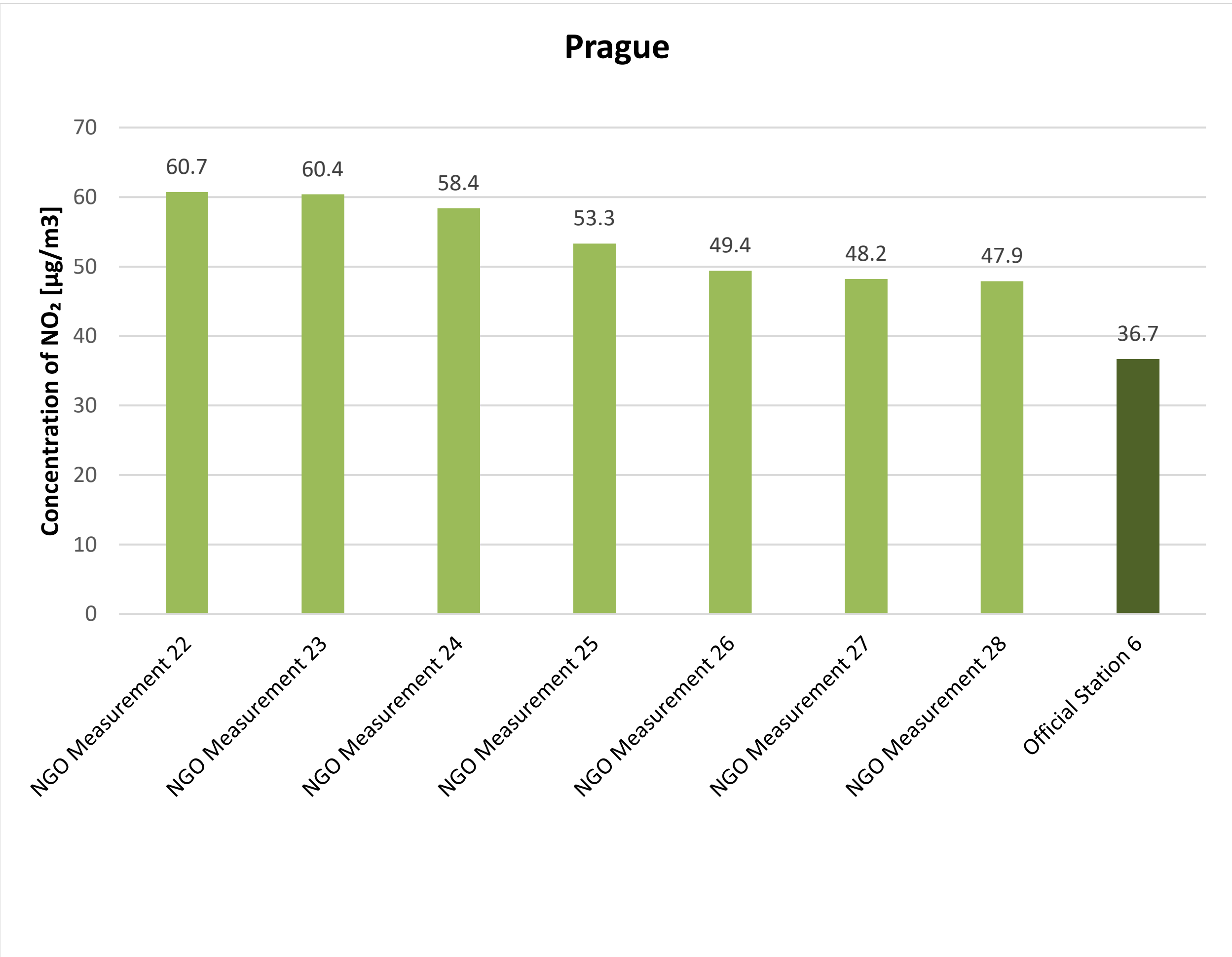
## Prague (Czech Republic)

Two measurement campaigns in the Czech Republic were conducted by the NGO Senzorvzduchu in 2022 and 2024, with support from Deutsche Umwelthilfe. Their work focuses on developing low-cost air quality sensors and using citizen science projects to raise awareness about environmental issues. They have created air sampling and measurement methods, increased public awareness, collaborated with the media, and engaged with decision-makers.

### Results from passive samplers

The 2024 campaign is planned for a full calendar year, in cooperation with the Czech Hydrometeorological Institute (CHMI). Measurements include traffic sites, schools, and background locations. Since January 2024, $NO_2$ levels at 7 monitoring sites in Prague have been recorded at annual values four times higher than those recommended by the WHO, ranging from 47.9 µg/m³ up to 60.7 µg/m³. Four of the measurements recorded averages above 50 µg/m³, five times the recommended level by the WHO. Measurements also exceeded the EU $NO_2$ limit of 40 µg/m³ at all 7 locations.

The results show nitrogen dioxide levels in Prague consistently above the EU's annual limit, emphasizing the flaws in the current official monitoring network. The data also highlights that the official monitoring station Legerova is not positioned at a pollution hotspot, pointing to the need for more accurately placed monitoring in critical urban areas and to reevaluate the official monitoring station.



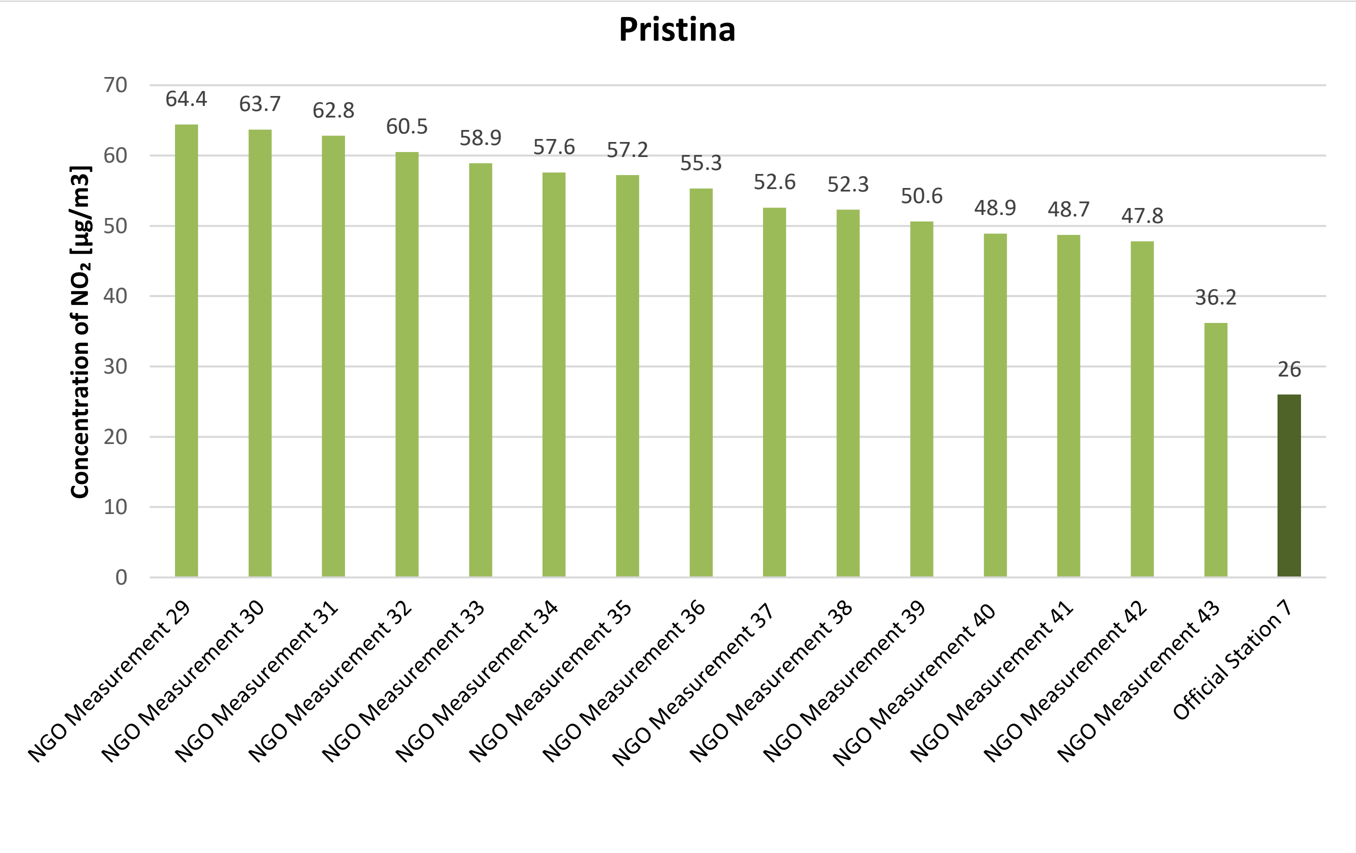
## Pristina (Kosovo)

As Kosovo is an EU candidate country, it is subject to the EU limit values for $NO_2$, making it relevant for this report. Monitoring and addressing air quality issues in Kosovo is crucial as the country works towards aligning its environmental policies and standards with those of the European Union. The measurements in Kosovo were conducted by the NGO Kosovo Advocacy & Development Centre (KADC) with the support of Deutsche Umwelthilfe. KADC is heavily involved in advocacy and policy work, collaborating closely with the municipality of Pristina to tackle air pollution. Their efforts include monitoring environmental health, developing air sampling methods, conducting public awareness campaigns, and engaging with media and decision-makers to drive impactful change.

### Results from passive samplers

Throughout 2023, from January to December, diffusion tubes were installed across more than 10 locations in Pristina. The passive samplers on Boulevard Deshmoret Street recorded high average concentrations of $NO_2$, ranging from 60.5 µg/m³ to 63.7 µg/m³. The highest concentration, 64.4 µg/m³, was measured on Fehmi Lladrovci Street, home to an elementary school in the city center. These values are significantly higher than the official monitoring data, which shows an average $NO_2$ concentration of 26 µg/m³ for 2023, and they exceed the WHO guideline of 10 µg/m³.

The measurements in Pristina reveal much higher nitrogen dioxide levels than the official data suggests, with concentrations far exceeding both EU limits and WHO guidelines. Notably, critical urban areas, including a street with an elementary school, experienced some of the highest pollution levels. These findings highlight the urgent need for more accurate monitoring in the city's most affected areas and a reevaluation of the official monitoring station's placement.



## Results from mobile measurements & placement of monitoring station

The only traffic-related monitoring station in the center of the capital city is not located where the highest $NO_2$ levels can be measured. It is situated on Kosta Novakoviq Street, an open area with excellent air circulation. This location does not represent the city's most polluted zones, which are typically found in areas with poor air circulation, such as street canyons, where pollution tends to concentrate. Additionally, the station does not meet the official siting criteria (AAQD), as it is within 25 meters of a major junction.

Significant discrepancies between the air quality at the official monitoring station and other nearby locations were documented by our mobile measurement devices. Among all the monitored sites, the official station on Kosta Novakoviq Street consistently recorded the lowest nitrogen dioxide levels. For example, during the morning rush hour, the $NO_2$ concentration at this station was 30.8 µg/m³ (see table below). In contrast, more congested areas such as Bulevardi Deshmoret e Kombit and UCK Street showed much higher concentrations, with $NO_2$ levels reaching up to 109 µg/m³.

These findings from mobile measurements and passive samplers demonstrate that the current placement of the official monitoring station, in an open green space and within less than 25 meters of a major junction, does not accurately capture the true extent of traffic-related air pollution at hotspots. With nitrogen dioxide concentration far above the EU annual limit value and a clear breach of the siting criteria outlined in the Ambient Air Quality Directive (AAQD), it is essential that the location of the official monitoring station is critically reevaluated.

| Pristina: NO2 Measurements (05.12.2022) | | |
|---|---|---|
| **Site** | **Time Period** | **Average Value NO2 (µg/m3)** |
| Bulevardi Bill Klinton | 11:37 - 11:48 | 87.8 |
| Agim Ramadani | 12:21 - 12:31 | 99.5 |
| UCK | 16:31 - 17:04 | 109.6 |
| Official monitoring station, Kosta Novakoviq | 07:00 - 08:00 | 30.8 |

**Misplaced Monitoring Station: Kosta Novakoviq**


The **red circle** indicates the location of the official traffic related monitoring station Kosta Novakoviq.

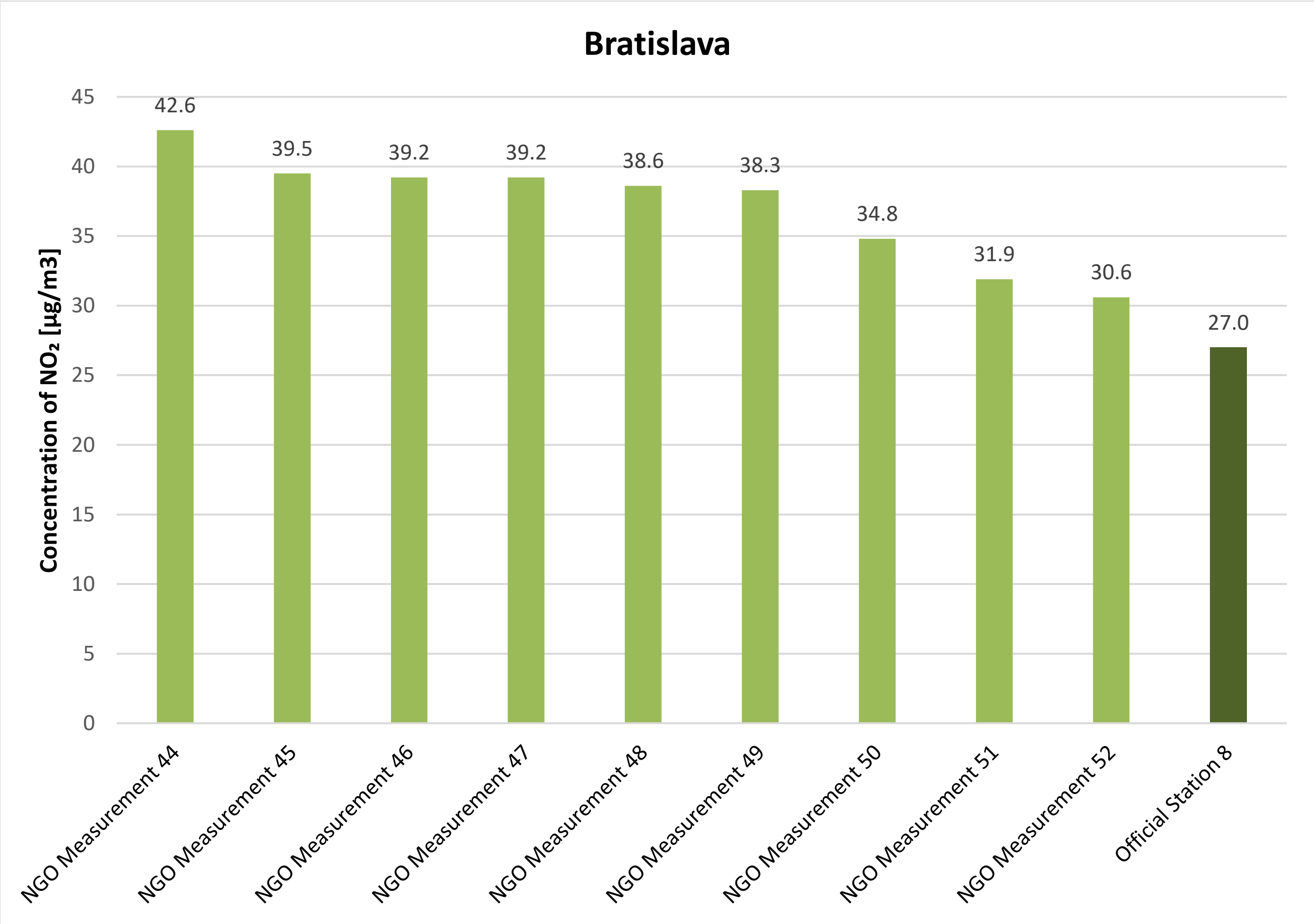
## Bratislava (Slovak Republic)

The measurements conducted in the Slovak Republic were carried out by the NGO Cyklokoalícia, with support from Deutsche Umwelthilfe. Cyklokoalícia is one of the largest and most active advocacy NGOs in the field of sustainable mobility. They have also been influential in the area of air quality, shaping both national and regional policies, and operating their own air quality measurement stations.

### Results from passive samplers

Passive samplers were installed at over 11 different locations over the course of 4 to 5 months. The measured discrepancy between the official station and our measurements is significant. For instance, the passive samplers located on Mickiewiczova Street recorded an average concentration of 42.6 µg/m³ over five months, whereas the official traffic-related monitoring station measured only 27.5 µg/m³. This represents a difference of 55%.

The graph below shows that the vast majority of the concentration values measured range from 34 to 39 µg/m³, representing concentrations 24% to 42% higher than those recorded by the official monitoring system. These differences are substantial and clearly indicate the misplacement of the official monitoring system.



## Results from mobile measurements & placement of monitoring station

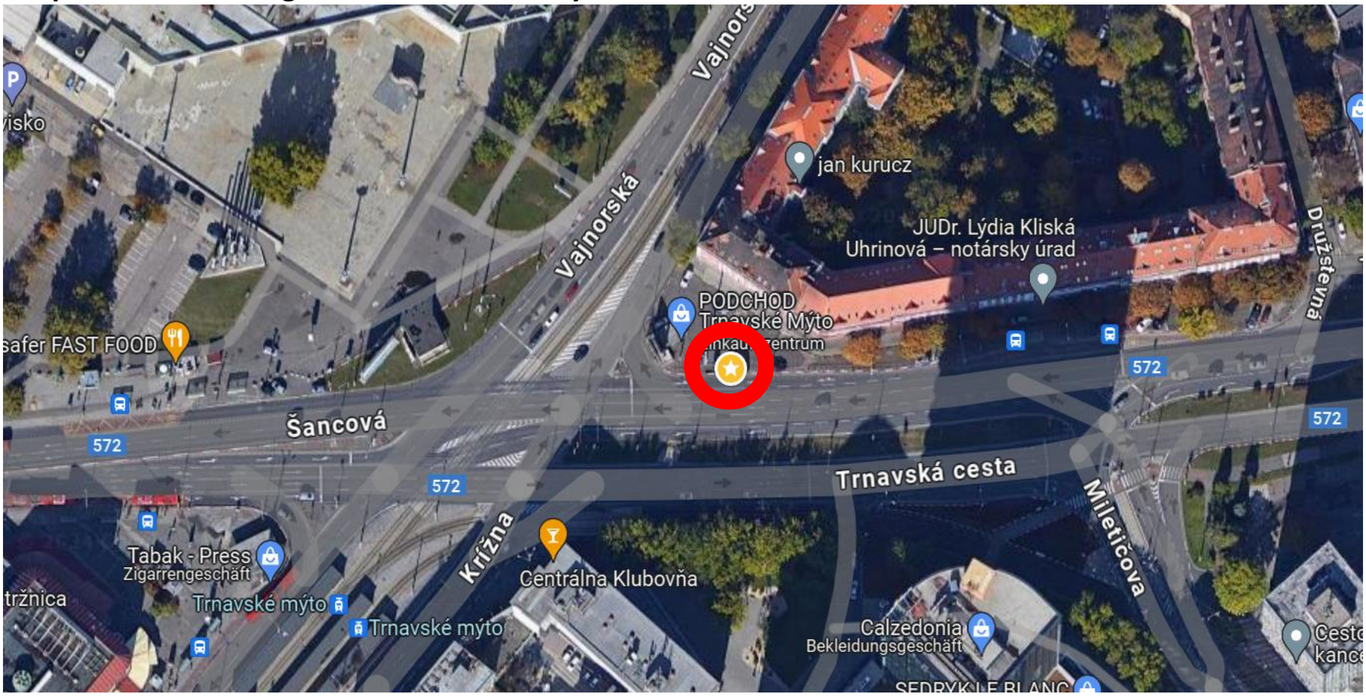
As in the other cities mentioned in this report, the mobile measurements further confirm that the official traffic-related station is not optimally positioned. Instead of being located where the highest $NO_2$ concentrations are expected—areas with high traffic density and poor air circulation, such as street canyons—we found the official station OMS Trnavské mýto situated on an open street with favorable conditions for good air circulation (see map below). Additionally, this station does not meet the siting criteria defined in the AAQD, as it is within 25 meters of a major junction.

The official station OMS Trnavské mýto recorded an average concentration of just 36 µg/m³. In contrast, we identified several hotspots with alarmingly high $NO_2$ concentrations. For example, we measured hourly averages of 64 µg/m³ at Základná škola and 71 µg/m³ at Nivy centrum. Not only were the $NO_2$ levels at these hotspots almost 100% higher than those at the official station, but these areas also have more vulnerable populations, such as children and the elderly, compared to the location of the official station.

Our measurements demonstrate that the official station's placement too close to a well-ventilated intersection leads to the low recorded NO2-values. The mobile measurements and passive samplers confirm that the station is not located at a pollution hotspot, and many areas with significantly higher concentrations are going undetected. This underscores the critical need for compliance with the AAQD siting criteria, which require a minimum distance of 25 meters from a major junction.

| Bratislava: NO2 Measurements (08.02.2024) | | |
|---|---|---|
| **Site** | **Time Period** | **Average Value NO2 (µg/m3)** |
| Základná škola | 07:45 - 08:00 | 64 |
| Šancová 3574/21 | 08:23 - 08:48 | 56 |
| Bus Station Nivy centrum | 10:57 - 11:18 | 71 |
| Prezidentský palác | 15:22 - 15:48 | 67 |
| Štefánikova 867 | 16:15 - 16:45 | 66 |
| Trnavské Myto AMS Official | 09:08 - 10:12 | 36 |

**Misplaced Monitoring Station: Trnavské Myto**

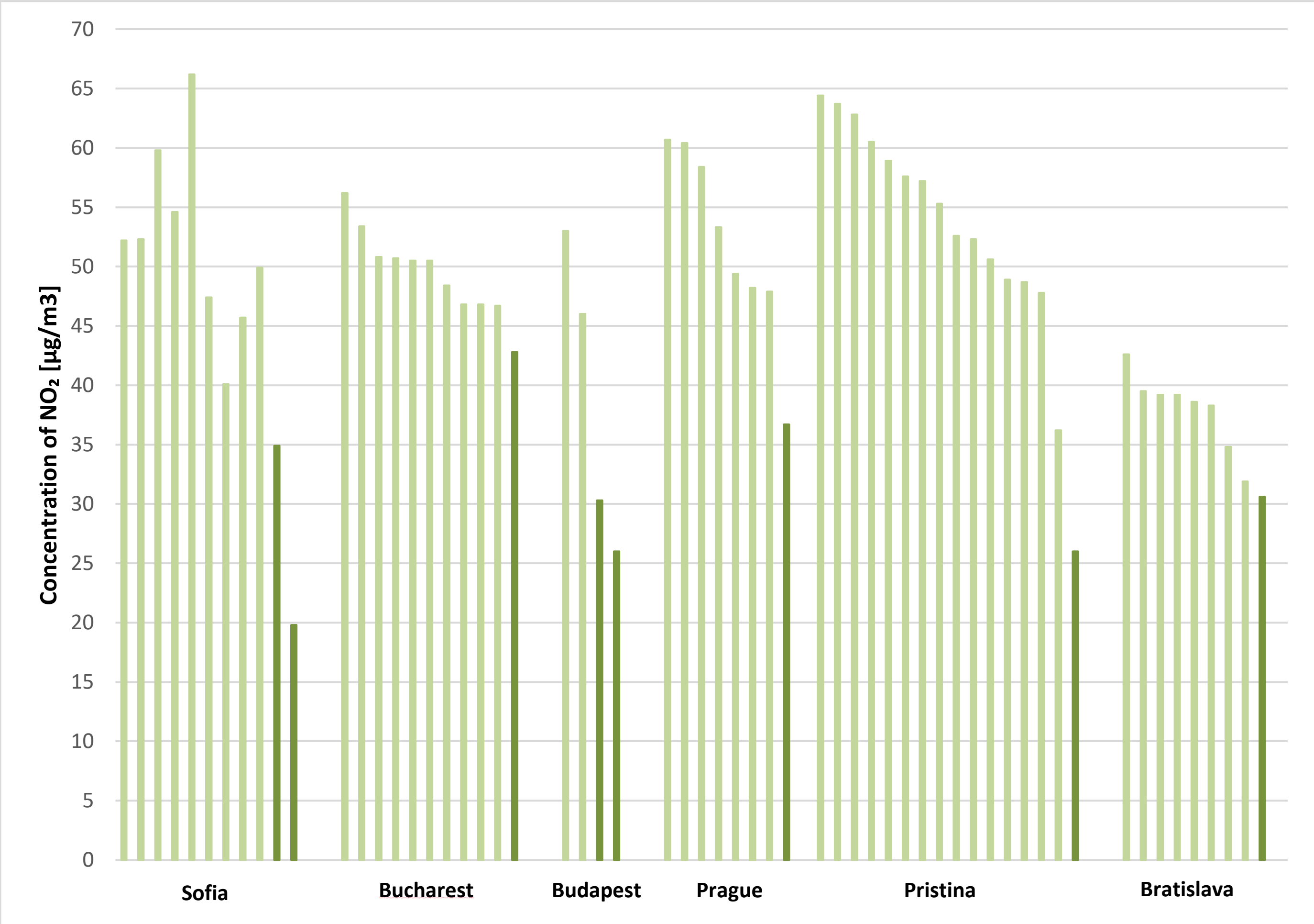



The **red circle** indicates the location of the official traffic related monitoring station Trnavské Myto.

## Results and Recommendations

Accurate official air quality monitoring is essential for tackling air pollution for two main reasons. First, without precise local air quality data, municipalities struggle to identify pollution sources or recognize high pollution levels, making it difficult to develop adequate plans and prioritize the issue politically. Second, the European Environmental Agency's official statistics on the health impacts of air pollution in the EU rely on data from Member States' official monitoring networks. If Member States systematically underestimate reported air pollution, as our data clearly documents, the burden of disease due to air pollution in the EU, including the number of premature deaths, is significantly underestimated.

**1) Graph: overview of the NO2-results from passive samplers**




**Light green lines** represent $NO_2$ results from NGO measurements. **Darker green lines** represent $NO_2$ data from official monitoring stations.

## Three main findings

1. The results of the measurements across Europe indicate that a significant number of official urban traffic-related monitoring stations are not located at the most polluted locations. According to the ECJ (C-723/17), all traffic-related monitoring stations need to be installed at the most polluted spots in the respective assessment zones and agglomerations. **66 $NO_2$ measurements** that were conducted over the span of several months to a year clearly indicate that Sofia, Budapest, Pristina, Bratislava, and Prague **have flawed monitoring networks** with numerous significant pollution hot spots going unnoticed by the official monitoring networks.
2. Moreover, in Prague, Budapest, Pristina, Bucharest, and Sofia, a total of **55 $NO_2$ measurements** (conducted over several months to a year) document **concentrations above the annual limit value** set at 40 µg/m³ in the current AAQD for $NO_2$. This strongly suggests potential breaches within the official monitoring standards and the current limit value for $NO_2$ in the AAQD.
3. In addition, the positioning of official monitoring stations in Sofia indicates clear breaches of AAQD standards as defined in Annex III. This is particularly evident with the urban traffic station located **40 meters away from the kerbside**, instead of a maximum of 10 meters (see page 8-10). Meanwhile, the official station at Erzsébet tér in Budapest is reporting $NO_2$ concentration values that are **100% lower than those documented by several of our measurements at the same location** (see page 11). Both of these official stations urgently require a detailed review by an independent European institution.

## Three policy recommendations

1. It is crucial for the Commission to closely monitor the implementation of ambient air quality measuring standards. According to Article 8, paragraph 5a of the revised AAQD, the Commission must provide further technical details for modeling applications and determining the spatial representativeness of sampling points within 18 months of the directive's entry into force. With these Implementing Acts, the **Commission must ensure that air pollution hot spots are fully integrated into the modeling and measuring systems of each Member State.**
2. A **review by an independent European institution, such as the EEA, of existing monitoring networks** is crucial. Current measurements indicate a need for more official monitoring stations to better understand Europe's pollution situation. Screening-modeling of various pollutants, especially $NO_2$, is crucial for placing stations where pollution is highest. This data, including modeling and projections, must be publicly accessible to ensure transparency.
3. **Full alignment of the revised AAQD with the recommended air quality limit values set in the updated air quality guidelines of the WHO latest by 2035**. In the review of the AAQD by the Commission, obligatory in 2030 (AAQD, Art. 1 & 3), the consideration of tightening "timelines for the alignment with the most recent World Health Organization Air Quality Guidelines and the latest scientific evidence" needs to be a top priority and examined carefully. A full alignment with the WHO Guidelines as soon as possible and by 2035 at the latest is necessary for achieving the goal of protecting human health and reaching the EU zero pollution objective by 2050 as set out in Article 1 of the revised AAQD.

## Conclusion

According to the most recent EEA report, 142,409 people within the EU died prematurely due to $NO_2$ exposure in 2021. The negative health impacts extend beyond these fatalities, encompassing millions of cases of respiratory, cognitive, and cardiac diseases. The primary aim of this report is not only to inform EU representatives of potential legal breaches but to uphold every EU citizen's right to clean air and good health.

The WHO Air Quality Guidelines published in 2021 recommend an annual limit of 10 µg/m³ for $NO_2$. However, the $NO_2$ measurements documented in this report reveal that this standard is far from being met. In many urban locations, overlooked by official monitoring systems, residents have been exposed to average $NO_2$ concentrations of 60 µg/m³ — 500 % above the WHO recommended levels. Such high concentrations pose a severe health hazard that has escaped the notice of local municipalities, national entities, and EU representatives because the monitoring standards were not being met. It is crucial to address these alarmingly stark discrepancies between the official measurements and our measurements to ensure that such severe deviations from the norm are exceptions rather than common occurrences.

## ANNEX I: Tabular overview of the passive sampler results for all cities

| Sofia | | | |
|---|---|---|---|
| Nr | Site | Time Period | Concentration of $NO_2$ [µg/m3] |
| 1 | Todor Alexandrov, Hristo Botev 63 | 11/23 - 05/24 | 66.2 |
| 2 | Vasil Levski Sofia 128 | 11/23 - 05/24 | 59.8 |
| 3 | General Mihail D Skobelev" 58 | 11/23 - 05/24 | 54.6 |
| 4 | Todor Alexandrov Sofia 175 | 11/23 - 05/24 | 52.3 |
| 5 | Bulgaria Sofia 43 | 11/23 - 05/24 | 52.2 |
| 6 | Knyaz Alexander Dondukov Sofia 60 | 11/23 - 05/24 | 49.9 |
| 7 | Tsar Simeon Sofia 135 | 11/23 - 05/24 | 47.4 |
| 8 | Oborishte Sofia 17 | 11/23 - 05/24 | 45.7 |
| 9 | Evlogi i Hristo Georgiev Sofia | 11/23 - 05/24 | 40.1 |
| 1 | AMS Pavlovo/ IAOS | 11/23 - 05/24 | 34.9 |
| 2 | AMS Mladost/ IAOS | 11/23 - 05/24 | 19.8 |

| Bucharest | | | |
|---|---|---|---|
| Nr | Site | Time Period | Concentration of $NO_2$ [µg/m3] |
| 10 | Banu Manta | 01/23 - 02/23 | 56.2 |
| 11 | Cristi Mocanu Șos. Giurgiului | 01/23 - 02/23 | 53.4 |
| 12 | Charles du Gaulle | 01/23 - 02/23 | 50.8 |
| 13 | Metrou Titan | 01/23 - 02/23 | 50.7 |
| 14 | Liceul Bolintineanu | 01/23 - 02/23 | 50.5 |
| 15 | Petre Ispirescu/13 Septembrie | 01/23 - 02/23 | 50.5 |
| 16 | Piata Rahova | 01/23 - 02/23 | 48.4 |
| 17 | Nicolae Grigorescu | 01/23 - 02/23 | 46.8 |
| 18 | Spital Colentina | 01/23 - 02/23 | 46.8 |
| 19 | Gh. Șincai (liceu) | 01/23 - 02/23 | 46.7 |
| 3 | Calea Victoriei. No. 32.34 (B6) | 01/23 - 02/23 | 42.8 |

| Budapest | | | |
|---|---|---|---|
| Nr | Site | Time Period | Concentration of $NO_2$ [µg/m3] |
| 20 | Blaha Lujza tér | 03/24 - 04/24 | 53.0 |
| 21 | Keleti Railway | 03/24 - 04/24 | 46.0 |
| 4 | Official Pécs | 03/24 - 04/24 | 30.3 |
| 5 | Official Teleki tér | 03/24 - 04/24 | 26.0 |

| Prague | | | |
|---|---|---|---|
| Nr | Site | Time Period | Concentration of $NO_2$ [µg/m3] |
| 22 | Ječná 39 | 01/24 - 05/24 | 60.7 |
| 23 | V Holešovičkách 36 | 01/24 - 05/24 | 60.4 |
| 24 | Plzeňská 38a | 01/24 - 05/24 | 58.4 |
| 25 | Ječná / Štěpánská | 01/24 - 05/24 | 53.3 |
| 26 | V Botanice 4 (KÚ) | 01/24 - 05/24 | 49.4 |
| 27 | J.Želivského / Biskupcova | 01/24 - 05/24 | 48.2 |
| 28 | Florenc | 01/24 - 05/24 | 47.9 |
| 6 | Prag 2-Legerova | 01/24 - 05/24 | 36.7 |

| Pristina | | | |
|---|---|---|---|
| Nr | Site | Time Period | Concentration of $NO_2$ [µg/m3] |
| 29 | Fehmi Lladrovci | 01/23 - 12/23 | 64.4 |
| 30 | Bulevardi Deshmoret e Kombit - Albi | 01/23 - 12/23 | 63.7 |
| 31 | Muharrem Fejza | 01/23 - 12/23 | 62.8 |
| 32 | Bulevardi Deshmoret e Kombit. Libraria | 01/23 - 12/23 | 60.5 |
| 33 | Agim Ramadani | 01/23 - 12/23 | 58.9 |
| 34 | Rruga B | 01/23 - 12/23 | 57.6 |
| 35 | Lidhja Pejes (IHMK) | 01/23 - 12/23 | 57.2 |
| 36 | Xheladin Rekaliu 20 | 01/23 - 12/23 | 55.3 |
| 37 | Bill Klinton | 01/23 - 12/23 | 52.6 |
| 38 | Kosta Novakovic - Ish Rilindja | 01/23 - 12/23 | 52.3 |
| 39 | Rrustem Statovci | 01/23 - 12/23 | 50.6 |
| 40 | UÇK 46 - Lah Nimani | 01/23 - 12/23 | 48.9 |
| 41 | UÇK - Buka | 01/23 - 12/23 | 48.7 |
| 42 | Enver Maloku | 01/23 - 12/23 | 47.8 |
| 43 | Kosta Novakovic - Ish Rilindja 2 | 01/23 - 12/23 | 36.2 |
| 7 | Kosta Novakik | 01/23 - 12/23 | 26.0 |

| Bratislava | | | |
|---|---|---|---|
| Nr | Site | Time Period | Concentration of $NO_2$ [µg/m3] |
| 44 | Mickiewiczova street | 01/24 - 05/24 | 42.6 |
| 45 | Staromestská on bus stop Zochova | 01/24 - 05/24 | 39.5 |
| 46 | Štefánikova street | 01/24 - 05/24 | 39.2 |
| 47 | Šancová place no. 2 - number 92 | 01/24 - 05/24 | 39.2 |
| 48 | Sokolská bus stop | 01/24 - 05/24 | 38.6 |
| 49 | Šancová place no. 1 - number 68 | 01/24 - 05/24 | 38.3 |
| 50 | Mickiewiczova Univerzitná nemocnica - hospital | 01/24 - 05/24 | 34.8 |
| 51 | Trnavské mýto SHMU station | 01/24 - 05/24 | 31.9 |
| 52 | Most SNP na priechode | 01/24 - 05/24 | 30.6 |
| 8 | Trnavske Myto | 01/24 - 05/24 | 27.0 |

**Legend:**

| |
|---|
| NGO measurements (above official value) |
| Official monitoring station (urban, traffic related) |

## ANNEX II: Quotes from Local NGOs

*"Despite improvements in the legal framework for clean air at the EU level, enforcement an Implementation lag behind, putting millions of people in Bulgaria at unnecessary risk for their health. A clear example is the undetected high levels of $NO_2$ in Sofia by the official monitoring system. Traffic-designated monitoring stations continue to be non-compliant with legal requirements. However, for years, they have been providing data claiming to ensure Sofia's compliance with legal limits. Citizens have been waiting too long for institutions to acknowledge the $NO_2$ problem and take action."*

***Ivaylo Hlebarov Clean Air Team Leader in Za Zemiata***

*"The air quality monitoring network in Bucharest and in Romania at large is not properly scaled or designated - some stations are designated as industrial, where no industry exists, and instead urban traffic is the most important source. Further investments are needed to service the existing network, so that it provides reliable and actionable data. During our measurement campaign, we could not compare average $NO_2$ emissions over the same months with the station we planned on comparing against because measurements from the official station were missing during the same period."*

***Mihai Stoica, Executive Director 2Celsius.***

*"After some measurements made by DUH) in Budapest it is clearly backed that the highest levels of air pollution are mainly found in narrower streets where high buildings block ventilation - especially if the street is not facing the wind. It leaves a question mark as people are living in these streets mainly and still none of the official Hungarian air quality monitoring stations are placed in there."*

**Judit Szegő project manager in Clean Air Action Group.**

*"For our initiative, the primary goal is to complete the annual measurements to conduct the Test of Equivalence. The further use of the samplers, whether for hotspot monitoring or for monitoring compliance with immission limits, will be decided by ČHMÚ (Czech Hydrometeorological Institute) after the current measurement campaign is completed and the measurement uncertainties have been evaluated. Additionally, we want to initiate a discussion about the positioning of monitoring stations. Our previous and current campaigns indicate that Prague's most polluted official traffic station, ALEGA - Legerova, is situated in a location where the concentrations do not accurately represent the real concentrations in other areas without an official station."*

**Michael Lažan, founder of Senzorvzduchu.**

*"Prishtina's air quality suffers due to heavy reliance on diesel cars, leading to $NO_2$ levels exceeding WHO and EU limits. This serious public health concern is made worse by the neglect of public transportation infrastructure over the past two decades. Kosovo authorities must prioritize establishing a modern, affordable public transport system. This, alongside a city vision that discourages car dependence through measures like parking restrictions and green spaces, offers a path towards a healthier and more livable Prishtina."*

**Arben Lila, Program Manager, Kosovo Advocacy & Development Centre.**

*"Our measurements have shown that many streets in Bratislava with a residential function and high levels of pedestrian traffic, for example around schools, have higher $NO_2$ levels than official monitoring stations. This shows the need for a more conscientious approach to air quality measurement in order to protect the health of residents. At the same time, the lack of such data means fewer arguments in favour of developing sustainable transport, which would bring additional societal benefits. The current situation regarding air protection policy in Slovakia is worrying. This is evidenced by the stalled process of adoption of the Slovak Republic's Air Protection Strategy and the dismissal of leading experts from the responsible institutions. Increased emphasis on this issue by the public, private and tertiary sectors at both national and European level is essential to move forward."*

***Dan Kollár President at Cyklokoalícia.***

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