Deutsche Umwelthilfe

European Monitoring Station Check

Results of NO_2 passive sampler measurements across Europe

#no2airpollution

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Summary

This report shows a compilation of measurement results conducted within the project "NO_2 Citizen Science" established by Deutsche Umwelthilfe (DUH) in 2018. Since then, more than 5,000 NO_2 measurements in 16 different countries have been carried out.

The results of the different measurements across Europe indicate to what extent the planned revision of the European Union its Ambient Air Quality Directives needs to be used to remedy obvious weaknesses in the current valid legal regulation. The report intends to explain the method of the measurements carried out, the measurement results and the recommendations for action derived from these results.

Key recommendations are:

1. **An independent review of the official monitoring networks is inevitable and, if applicable, has to lead to installation of new monitoring stations.** The results of the different measurements across Europe indicate that several official urban traffic monitoring stations are not located at the most polluted places in the assessment areas. However, according to the European Court of Justice (ECJ) ruling (C- 723/17), all traffic related monitoring stations need to be installed at the most polluted spots in the area. Some results show significantly higher NO_2 concentrations in comparison to the provided data of the official monitoring station. In addition, some of the official monitoring stations are not even in accordance with the ambient air quality directive Annex III.

2. **The Improvement of data collection on air pollution with more specific legally binding requirements in the European Ambient Air Quality Directive is essential.** The comparison of data in this report shows the necessity of a higher quantity of official monitoring stations in general and of additional data collection means, such as modeling different air pollutants (especially NO_2) or the use of passive samplers in particular. The measurements show that the results of NO_2 passive samplers are precise enough to fulfill the obligation of monitoring air quality. Especially the low-cost, easy to handle method can negate the numerous reasons given by numerous responsible authorities in the member states as to why sufficient data is not being collected.

3. **Full alignment of the revised Ambient Air Quality Directive with the recommended air quality limit values in the updated air quality guidelines of the World Health Organization is decisive for the success of the revision.** The European Commission should draft the most ambitious proposal for the revision of the ambient air quality directives not only with regard to ambitious limit values, but furthermore with regard to implement better, publicly accessible and comprehensive air quality monitoring regulations. A**ll air quality data must be available to the public.** This includes air quality modeling and projections, to ensure the comprehensible positioning of monitoring station. The results of the project "NO_2 Citizen Science" show, that these specifications and the enforcement of adequate monitoring is key for all EU citizens to enforce their right to clean and healthy air.

Introduction

Nitrogen Dioxide (NO_2) is a direct threat to human health. The major source of NO_2 in the ambient air is road traffic – diesel engines and namely diesel passenger cars, buses and trucks. Ensuring better air quality is of high relevance, as air pollution is the world's single largest environmental health risk. In order to monitor the air quality across Europe, member states of the European Union (EU) were obliged to set up an official network of monitoring stations. On the one hand, the monitoring stations are intended to be representative of the population's exposure. On the other hand, by observing the air quality at the hot spots of air pollution, they should ensure that legally binding limit values are complied with throughout the country.

Nevertheless, punctual measurements only cover a fraction of potentially polluted areas. The vast majority of municipalities in the EU does not have any, or at least qualitatively or quantitatively insufficient air quality data. Using reliable, yet easy-to-handle measuring devices, Deutsche Umwelthilfe (DUH) wants to close this gap and supports NGOs and local activists from different European countries to gain more information about the air quality on site. This information is necessary both to indicate the need for action to the competent authorities, but also to raise public awareness on the topic.

In 2018, DUH started with the project "NO_2 Citizen Science" to address the challenges outlined above. Diffusion tubes were used to determine the exposure of ambient air with NO_2 – a method that is also used by competent authorities in Germany and other EU member states. The measurement accuracy is proven and fulfills EU regulation. After initiating three cycles of measurements at more than 1,500 locations in Germany, the project was rolled out across Europe. During the last three years, in total more than 5,000 NO_2 measurements in 16 different countries have been carried out. The results underline the urgent need for action.

The European Ambient Air Quality Directive sets the limit value for NO_2 at 40 µg/m³ as an average over the calendar year. Unlike expensive measuring containers, passive samplers can only determine the average load over longer periods of time and cannot be used to record short-term changes and fluctuations in NO_2 concentration. The diffusion tubes indicate the average load of NO_2 during the time they are exposed to air. Usually, diffusion tubes are used for a period of two to four weeks.

Even relatively short exposure periods of passive samplers like one-month measurements can be used as indicative measurement and allow cautious conclusions whether the site is potentially heavily polluted or not. By comparing the measurement results with those of official monitoring stations during the same period of

DUH map with results of NO_2 measurements: **www.duh.de/no2airpollution**

time, conclusions can be drawn about an expected annual average load. However, in order to make more precise statements, it is worth measuring at the same spot over a longer period of time. For this purpose, the diffusion tubes must be replaced monthly.

During the project, many new hot spots of NO_2 pollution have been discovered. In many cities, the values measured within the project are significantly higher than the values measured by the official monitoring stations and thereby reported to the European Commission. Due to inadequate monitoring networks that fail to meet the legal requirements, NO_2 pollution is systematically underestimated in many countries. The results of the measurements published in this report, show that the diesel exhaust gas NO_2 is a problem in almost all highly frequented urban areas, regardless of the country.

In this report, special attention is paid to selected measurement results indicating that existing, official, traffic related monitoring stations do not cover the most polluted areas in some European cities. In 2019, the ECJ has confirmed in its Craeynest ruling (C-723/17) that air quality has to be monitored at the locations with the highest expected air pollution. This report focuses on official results of urban traffic related monitoring stations, because these stations are most likely to show limit value exceedances for nitrogen dioxide.

The new Air Quality Guidelines of the World Health Organization (WHO) highlight the need of massive reduction of air pollution. When revising the European Ambient Air Quality Directives, the European Commission must not only pursue timely, full implementation of the WHO recommendations as an ambitious goal in line with the Zero Pollution Action Plan, but must also homologate air quality assessment rules by setting stricter requirements for modeling and measuring various air pollutants. In order to implement everyone's right to clean air, air quality must also be monitored at the most polluted locations.

Legal Framework

The Directive 2008/50/EC on ambient air quality and cleaner air for Europe (also called the Ambient Air Quality Directive – AAQD) contains general criteria for ambient air quality assessment in Annex III).

Macro scale siting of sampling points

Annex III, Section B, provides macro scale siting criteria for sampling points, it defines how sampling points shall be located in order to comply with the air quality standards. I.e. in "the areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s) […] Sampling points shall in general be sited in such a way as to avoid measuring very small micro-environments in their immediate vicinity, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality for a street segment no less than 100 meters length at traffic-orientated sites". Macro scale criteria also provides a basis for establishing the spatial representativeness of monitoring sites, they shall, where this is possible, also be representative of similar locations not in their immediate vicinity.

The highest concentrations of Nitrogen Dioxide (NO_2) occur in narrow street canyons with buildings beside the street and extensive motorized traffic. An additional relevant aspect for NO_2 concentration is the actual traffic situation i.e. load of heavy duty vehicles and congestions.

Microscale siting of sampling points

Annex III, Section C, provides micro scale siting criteria, which provides detailed guidelines for how sampling points shall be placed in relation to roads, buildings and other obstacles within the areas identified through application of the macro scale siting criteria.

The EU requirements to situate monitoring stations in cities consider the impact of road traffic on air quality. The Directive 2008/50/EC specifies that the monitoring station in street canyons shall be installed at a distance of at least 25 meters from the edge of major junctions and no more than 10 meters from the kerbside. The flow around the inlet sampling probe shall be unrestricted without any obstructions affecting the airflow and at least 0.5 meters from the nearest building (also balconies, trees and other obstacles) in the case of sampling points representing air quality at the building line. The measurement height shall be between 1.5 meters (the typical breathing level) and 4 meters above the ground.

Documentation of Site Selection

Annex III, Section D., requires that member states shall fully document the site selection procedures through photographs of the surrounding area and detailed maps. It also states that "sites shall be reviewed at regular intervals with repeated documentation". While the regularity of intervals is at the discretion of Member states, this paragraph shall insure that stations are evaluated regularly since cities change due to construction, traffic measures etc.

Jurisdiction of the European Court of Justice

Due to the jurisdiction of the European Court of Justice, citizens have a right to have air quality monitored at the locations with the highest expected air pollution load – and the limit values must also be compulsorily complied with at these locations. With its ruling of 26 June 2019 (reference number: C-723/17), the ECJ has strengthened the right of all European citizens to "clean air". It emphasizes that the Directive is of a mandatory nature, i.e. it must be strictly implemented (recitals 31-32). The Court also emphasizes more strongly than before the special importance of the Directive for the protection of health and the environment (para. 33). It notes that the regulations on ambient air quality specify the Union's obligations to protect the environment and public health. The obligations thus even have a primary legal basis (ECJ quotes here "inter alia Art. 3 para. 3 TEU and Art. 191 paras. 1 and 2 TFEU"). Also with the statement that the NO_2 load of different measuring points may not be averaged, but that it depends on the pollution concentration at each sampling point (margin 66), the ECJ shows that the limit value is to be taken seriously. Furthermore, the ECJ confirms that the selection criteria for sampling points must not only be fully documented, but also regularly updated.

Background measuring stations are intended to determine a load that is representative for an area of several square kilometers. In the case of traffic- or industry-related hot spot measurements, there is an additional local source of pollution in addition to the background load, which is why the pollution concentration for both particulate matter and NO_2 is higher in these cases than in the background. The measurements of the background pollution are essential to allow statements about the composition of the pollution and to estimate the extent of the pollution. However, limit value exceedances are mostly detected at hot-spot measurements.

Regarding possible breaches of the NO_2 limit value, the focus of our measurements on traffic related monitoring stations is most plausible, because the majority of nitrogen oxide emissions originate from road traffic, namely diesel passenger cars as well as diesel light and heavy duty vehicles. The gas fluctuates quickly, and is diluted and transmitted very quickly in sparsely built-up areas. The concentration varies from road to road depending on the height of the buildings and the average number of cars passing by. High pollution of NO_2 occurs where there are busy roads in narrow street canyons. The Directive defines an urban canyon (also known as a street canyon) as "a place where the street is flanked by buildings on both sides creating a canyon-like environment".

The measurement method

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. Even institutions of governments, like the Department for Environment, Food and Rural Affairs in the United Kingdom, officially state: "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 therefore published a proof of equivalence with the reference procedure of the European Directive 2008/50/EC and the German legal implementation, the 39th BlmSchV (39th Ordinance on the Implementation of the Federal Immission Control Act). For the measurements in this project, exclusively diffusion tubes of the Swiss laboratory Passam were used, as exactly these passive samplers are also used to operate German official monitoring stations. Combined with the use of the same measurement method as for the official measurements from Germany, the proof of equivalence with the reference procedure of the European Directive is valid for the measurements conducted within the project.

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 percent". Furthermore the review states "relative expanded uncertainties of individual results were between 20 and 25 percent. 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 tubes is their easy to use operation with simultaneous high-quality data collection. They are usually fixed at a height of two meters or more to street lamps, signs or similar structures, which are nearly everywhere to find.

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*

The samplers provide average NO_2 concentrations, and the data can be collected over a large geographical area at a cost-effective price. The samplers only need to be installed and removed after a certain time. Handling is facilitated above all by the fact that no electricity is required for operation. The placement of diffusion tubes in this project generally follows the requirements of the Directive 2008/50/EC as described in Section A. of Annex III.

Before starting with the first measurements, Deutsche Umwelthilfe has tested the diffusion tubes in Berlin in 2018. The tubes where mounted next to four official monitoring station.

measuring 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

Comparative NO_2 measurements from Berlin in August 2018

The comparative measurements show that the results of the diffusion tubes are comparable to those of the official measuring stations. In light of these results, Deutsche Umwelthilfe does not doubt the measurement results of the passive collectors. In Germany, the method is widely used and recognized. The method has not been challenged in legal proceedings.

NO_2 diffusion tubes

Results of the different measurement campaigns

In the following sections, selected results of the NO_2 measurements campaigns in different countries are presented. The different European organizations responsible for the measurements contributed information and in some cases quotes to the following parts.

This report only contains passive sampler measurement results that are higher than the highest values of the official monitoring station during the same period of time. If there was no official mean value for the same time period, a mean value for the period was formed from the raw data. To illustrate the results, they are presented in graphs on the following pages. The measurement locations (street name) and exact measured values can be taken from the tables in the annex of this report. The results show that the official monitoring stations do not provide any information about the actual, maximum pollution in an assessment area. Additionally, further data of NO_2 measurements within the scope of this project can be accessed and downloaded at the Website of Deutsche Umwelthilfe: **www.duh.de/no2airpollution**

We additionally point out, that in some cases, passive samplers were removed or dropped off by accident, so that individual measurements from longer measurement series are missing. This report is mainly based on complete measurement data series.

Considering the results of the passive collectors, it is important to know that these are raw data from the laboratory. For the calculation of the results, the laboratory calculates with an average outside temperature. As already 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 average over the same period during which the sampler was exposed.

Results from Sofia (Bulgaria)

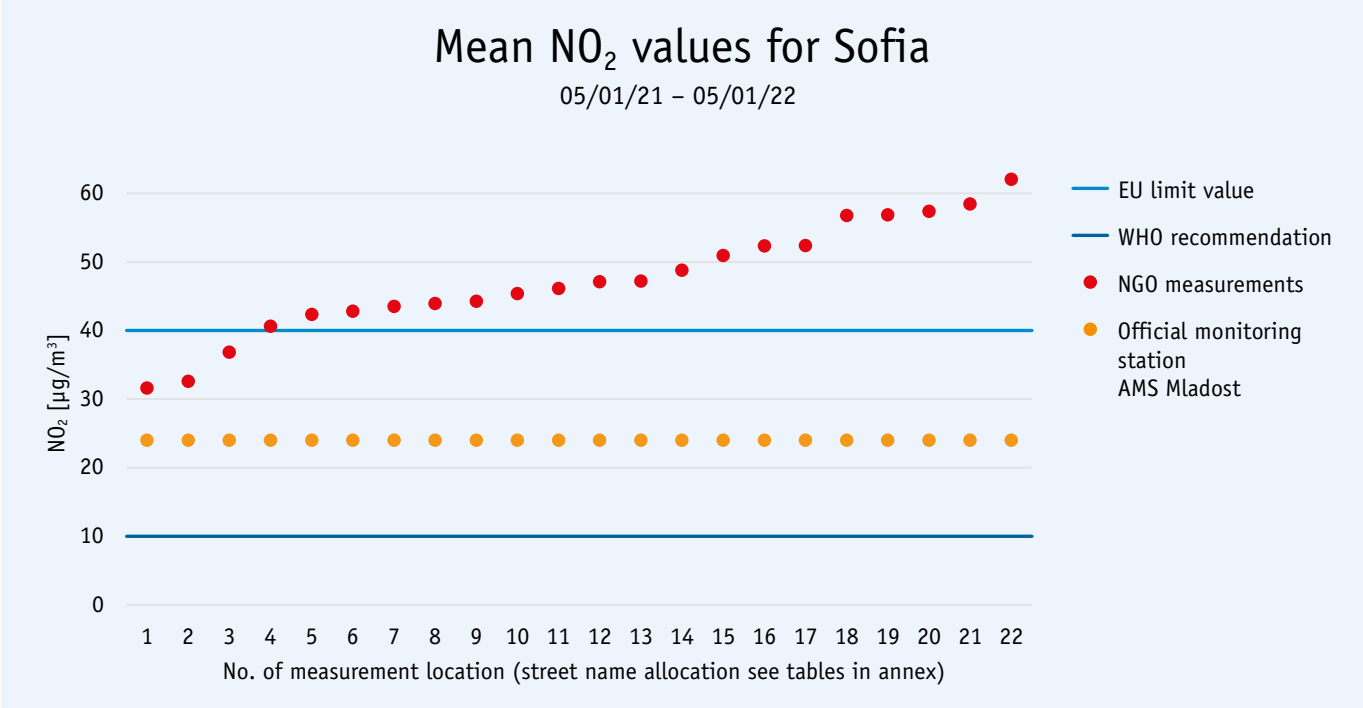
The measurements in Sofia were carried out by Za Zemiata with support of Deutsche Umwelthilfe. Za Zemiata is an environmental organization, active for 26 years in Bulgaria with a strong record of work and expertise in energy, climate, waste, GMOs and more recently clean air. Za Zemiata is working consistently on improving air quality since 2016. Za Zemiata measured the NO_2 pollution in Sofia for the whole year 2021 at 27 Spots in order to obtain annual mean values.

There are two official traffic related monitoring stations in the Bulgarian capital Sofia: "AMS Mladost" (see graphic 1) and "AMS IAOS/Pavlovo". Looking at the official NO_2 values it becomes apparent, that they are very low for traffic related monitoring station in a metropolitan area. There are even two official urban background stations "AMS Nadezhda" and "AMS Hipodruma" (see annex/table 1) that show higher values in 2021 than the two traffic related ones. The values of the NGO measurements are significantly higher than the values of the official monitoring stations for the same period of time. While the highest NGO measured value is more than 62 µg/m³ in Sofia Center ("Mladost 1" – graphic 1/No. 22), the NO_2-load at the official monitoring station "AMS Mladost" is only 24 µg/m³. This means that the actual maximum level of NO_2 pollution is almost about three times higher than indicated by the official numbers. In 19 of the 22 listed NGO measurements, the NO_2 limit value in 2021 was exceeded.

The two official traffic related monitoring stations "AMS Mladost" and "AMS IAOS/Pavlovo" do not comply with the siting criteria according to the AAQD. "AMS IAOS/Pavlovo" is 12 meters from the kerbsite of the closest local lane and 27 meters away from the big boulevard with heavy traffic parallel to the local lane. "AMS Mladost" is located in the backyard of the National Institute for Meteorology and Hydrology, it is 89 meters away from the next boulevard.

Officially, there is no exceedance of the annual limit value for NO_2 in Sofia. The findings of the measurements from Za Zemiata and DUH show a different picture. Ivaylo Hlebarov, Clean Air Team Leader in Za Zemiata, assesses the situation as follows:

"Data from our measurements in Sofia indicate, NO_2 pollution might be a bigger problem since the official network does not recognize it all. The only two traffic stations cannot capture the pollution of almost a million vehicles circulating the city. There is an urgent need for adequate monitoring to inform decision making especially in Eastern Europe. A revised directive is the right tool for that."



Graphic 1 – Mean values of NO_2 for the year 2021 for Sofia

Results from Vienna (Austria)

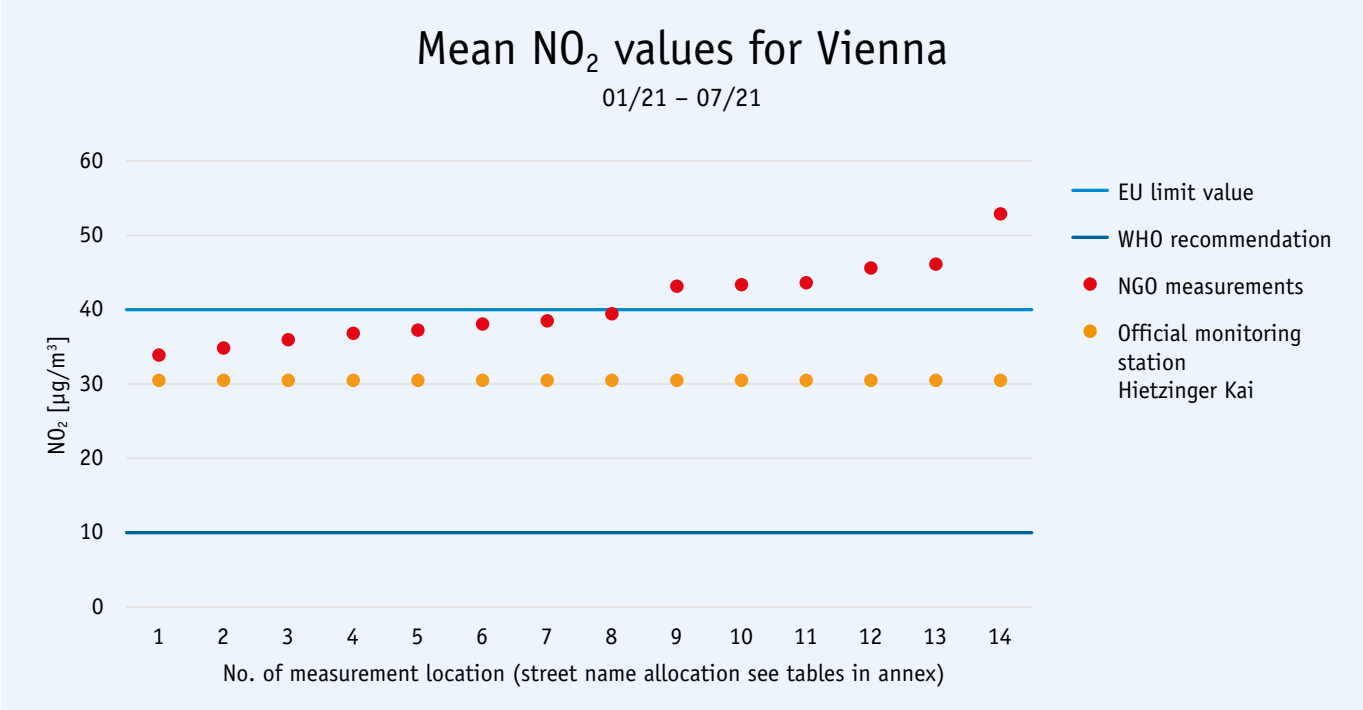
The measurements in Vienna were carried out by Luftdaten.at with support of Deutsche Umwelthilfe. Luftdaten.at belongs to the measurement network "Sensor.Community", a group of voluntary citizens. Luftdaten.at measured the NO_2 pollution in Vienna for the whole year 2021 at 10 Spots in order to obtain annual mean values.

At the time this report was prepared, it was only possible to access official data until July 2021. In order to compare the passive sampler measurement results with the official data, only the time period from January until July, was considered in this report. In Vienna the highest polluted official traffic related monitoring station is called "Hietzinger Kai". The station "Hietzinger Kai" shows an average NO_2 load of 30.5 µg/m³. The values of the NGO measurements are significantly higher than the values of the official monitoring station for the same period of time. As shown in the graphic below, there are 14 spots which show higher NO_2 pollution than the official monitoring station. The highest measured value at the "Hadikgasse" (graphic 2/No. 14) with a preliminary result of 52.9 µg /m³ is more than 70 percent higher than the NO_2 load at "Hietzinger Kai".

The measurement results of the passive samplers seem to indicate that the official traffic related monitoring station "Hietzinger Kai" is not located in the most polluted location of the city. The official measured values show an overall compliance with the annual limit value for NO_2, whereas the measurements within this project show significantly higher pollution loads. Eight of the measured values imply a possible exceeding of the limit value applicable in Austria.

Fabian Setznagel from Luftdaten.at is happy to have the opportunity to investigate the actual air quality in Vienna:

"I lived in 6 European countries in 13 years and was shocked by the air quality in Vienna after moving here from Northern Sweden. Luckily I learned about DUH's initiative in 2020, started measurements in January 2021 and expect to go public with our data in March 2022."



Graphic 2 – Mean values of NO_2 measurements for seven months for Vienna

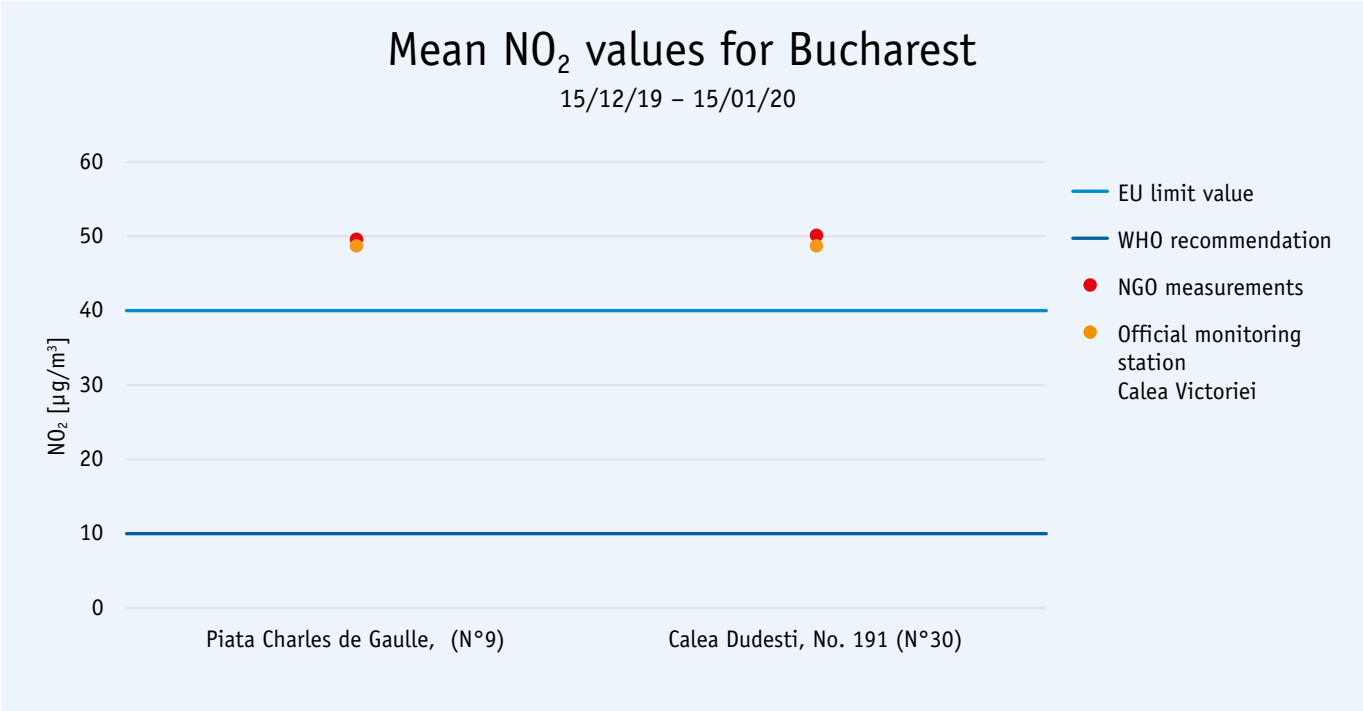
Results from Bucharest (Romania)

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 four-week-measurements at 30 spots from mid-December 2019 until mid-January 2020 in Bucharest.

In Bucharest there are two official traffic related monitoring stations: "Șoseaua Mihai Bravu" and "Calea Victoriei". "Calea Victoriei" shows a higher NO_2-concentration and is therefore used as comparison station. Two of the passive sampler results showed higher NO_2 levels than the official monitoring station "Calea Victoriei". In order to be able to make more precise statements, longer measurements would be necessary.

Both urban traffic stations are located in highly transited and therefore polluted places in Bucharest. Nevertheless, the monitoring station "Șoseaua Mihai Bravu" is less than 25 meters away from the major junction and therefore should be reviewed to determine if it is consistent with the regulations of the AAQD.

In the opinion of 2Celsius, the monitoring stations are technically insufficient and need upgrade and maintenance, as daily values are often missing or unusable data is generated. More traffic monitoring stations are needed, while monitoring stations that no longer have any industrial emissions to measure have to be degraded.



Graphic 3 – Mean value for NO_2 measurements for four weeks from Bucharest

Results from Ljubljana (Slovenia)

The measurements in Ljubljana were carried out by Focus Association for Sustainable Development with support of Deutsche Umwelthilfe. Focus is a Slovenian environmental NGO founded in 2003, covering climate change, energy, sustainable mobility, global responsibility, ethical consumption and degrowth. Focus is committed to promoting comprehensive socio-economic changes that enable well-being for all within the limits of the planet. Focus has started in 2019 with a one month NO_2 measurement campaign in Ljubljana at 50 locations. In February 2021, a large Citizen Science measurement campaign with over 150 measurement locations was organized in Ljubljana. The results of the measurement campaign in February 2021 are considered in this report. The relevant results are listed in table 4 in the annex, the highest 30 values are shown in graphic 4 on the right. There is one official traffic related monitoring stations in the Slovenian capital, located at the "Vošnjakova Tivolska junction".

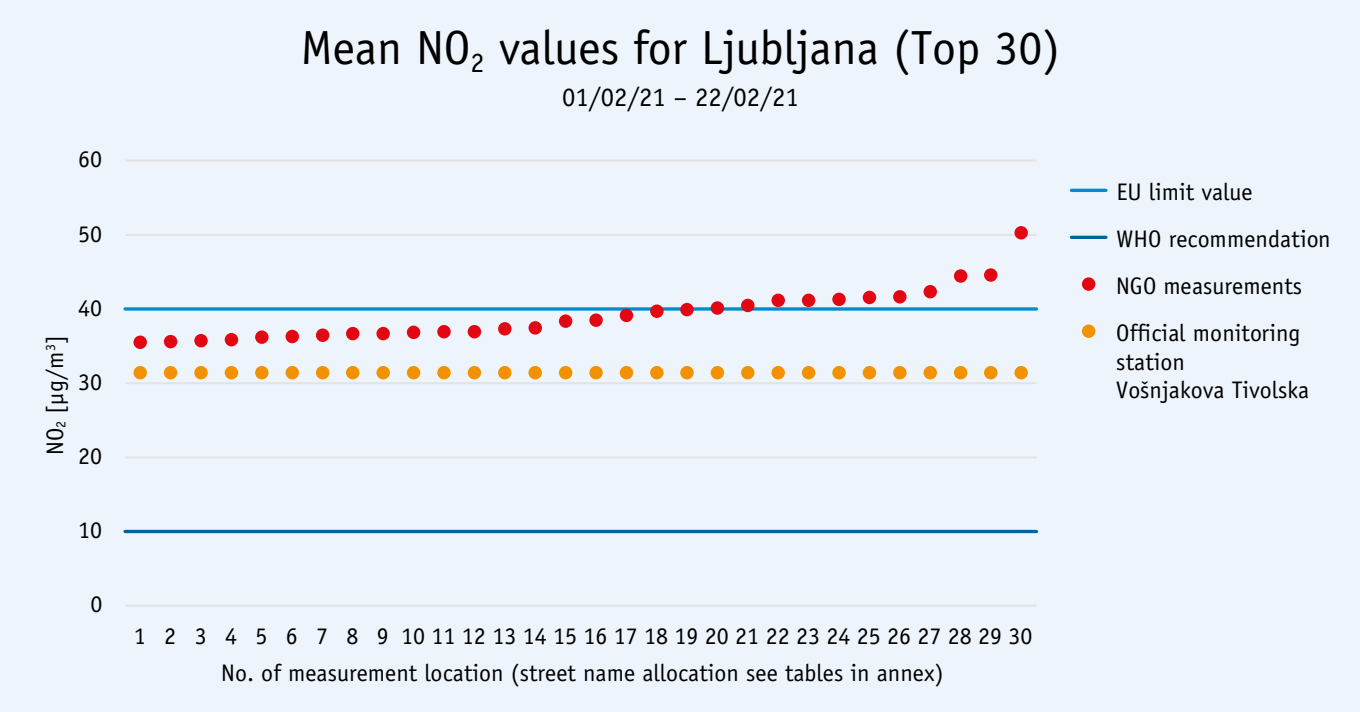
During the measurement campaign, 54 sites were identified with higher pollution values than the official monitoring station (see annex/table 4). During the period of examination, the NO_2 pollution at the official monitoring station was 31.4 µg/m³, while the exposure at "Šmartinska 22" (graphic 4/No. 30) was more than 60 percent higher, with an NO_2-load of 50.3 µg/m³. Currently, the organization measures at highly exposed sites for several months to provide more data and be able to draw a more precise conclusion about the pollution situation.

Measurements were continued at four high polluted locations in Ljubljana (multi-months measurements), based on the revealed values of the measurements in January 2021 (graphic 5). The multi-months measurements were carried out for three weeks each month and therefore compared with the values of the official monitoring station within the respective same three-week-period. Two of the four measurements were interrupted because of missing diffusion tubes. The values measured by the NGO are constantly above those of the official measuring station.

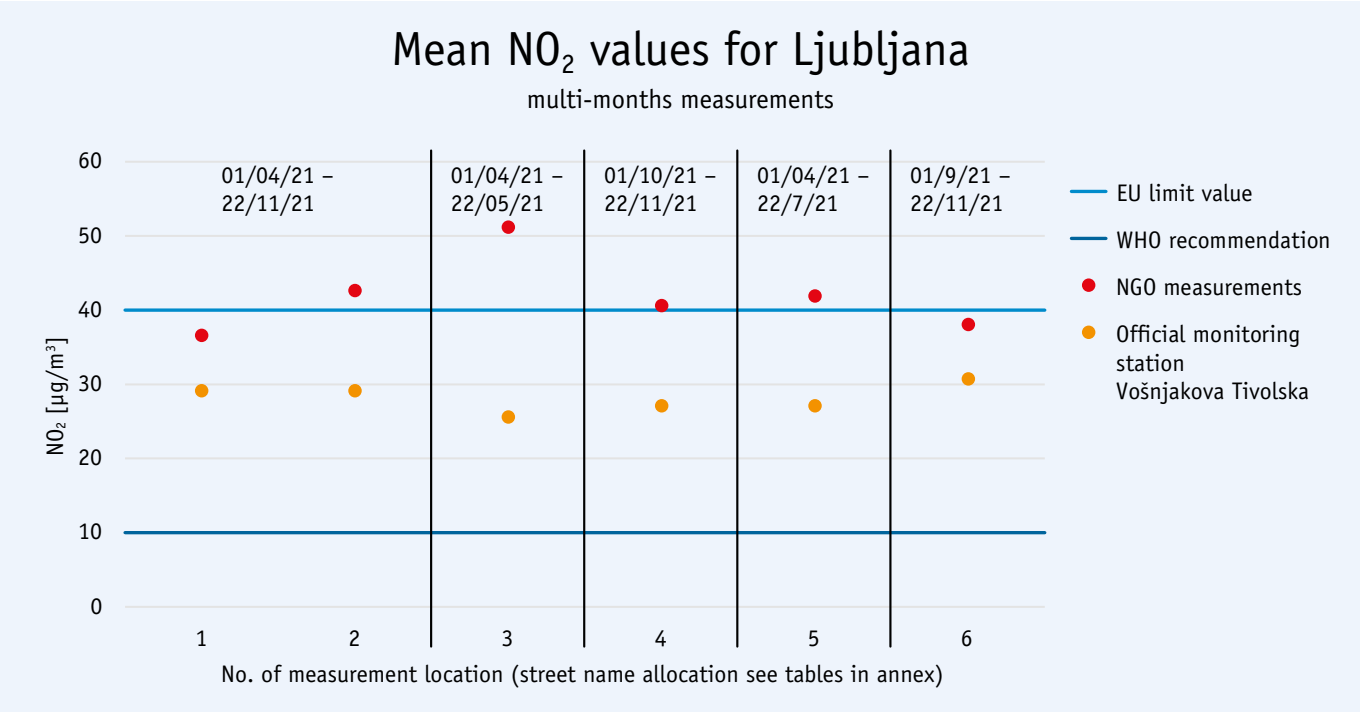
The urban traffic-related monitoring station at the "Vošnjakova Tivolska junction" is more than 10 meters away from the kerbside (11 meters respectively 13 meters) and less than 25 meters distant from the intersection and therefore should be reviewed to determine if it is consistent with the regulations of the AAQD. Although the station is located on a major street, the road is very wide and there is no typical house canyon situation.

Marjeta Benčina from Focus is convinced that more official monitoring stations are required:

"Occasional measurements by CSOs using the citizen science method are welcome, but citizens are entitled to regular official measurements where the highest values are expected and in the vicinity of institutions where vulnerable groups stay. In Ljubljana, our measurements in February 2021 showed that there are quite a few locations where NO_2 concentrations are higher than at the official measuring station."



Graphic 4 – Top 30 mean value of NO_2 for three weeks from Ljubljana



Graphic 5 – Mean value of NO_2 for different time periods from Ljubljana

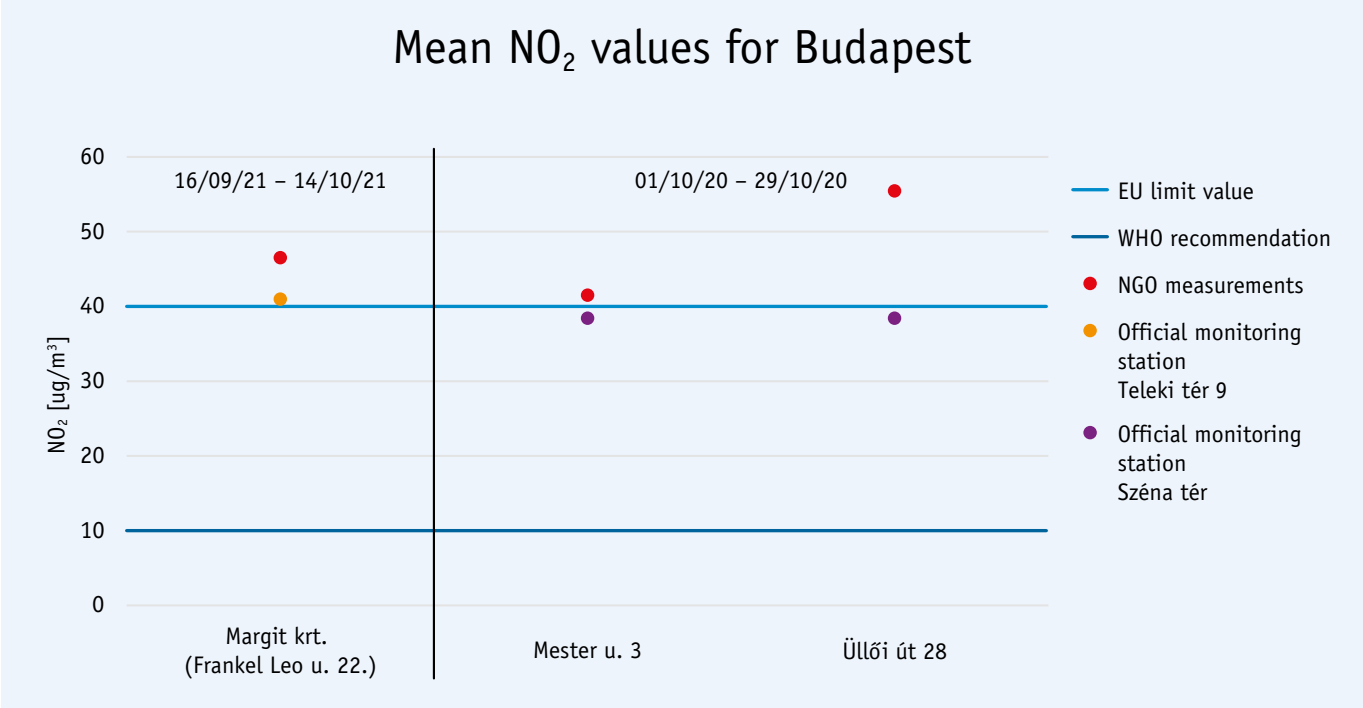
Results from Budapest (Hungary)

The measurements in Budapest were carried by the Clean Air Action Group (CAAG) with 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. CAAG measured the NO_2 concentration in October 2020 and from mid-September until mid-October 2021 at 30 locations in the Hungarian capital. The relevant results are shown in graphic 6. Budapest has four urban traffic monitoring stations: "Teleki Square", "Elisabeth Square", "Kosztolányi Square" and "Széna tér". Those with the highest NO_2 values, "Széna tér" and "Teleki Square" are taken into account for the comparison with the passive samplers. In October 2020, the highest NO_2 value of the passive sampler measurements at "Üllői út 28" was 55.5 µg/m³. In the same period, the NO_2-load at the official monitoring station "Széna tér" (38.4 µg/m³), was 17 µg/m³ lower. For the second measurement period in 2021, the difference between official monitoring station and passive sampler results is slightly smaller, but NGO measurements still show more than 13 percent higher values than the highest polluted official monitoring station.

The monitoring station at "Teleki Square" used to be around Keleti Train station, but because of constructions it was moved. Since Keleti Train is higher frequented of traffic, it is recommended to move the station back to its original site, hence to an expected less polluted location.

Judit Szegő, climate and residential air pollution project manager at the Clean Air Action Group states:

"The location of the monitoring stations should be reviewed, not least because the traffic and pollution in a city changes over time […]. Considering the cost of installing new stations we recommend a more frequent use of mobile monitoring stations and the purchase of more of them."



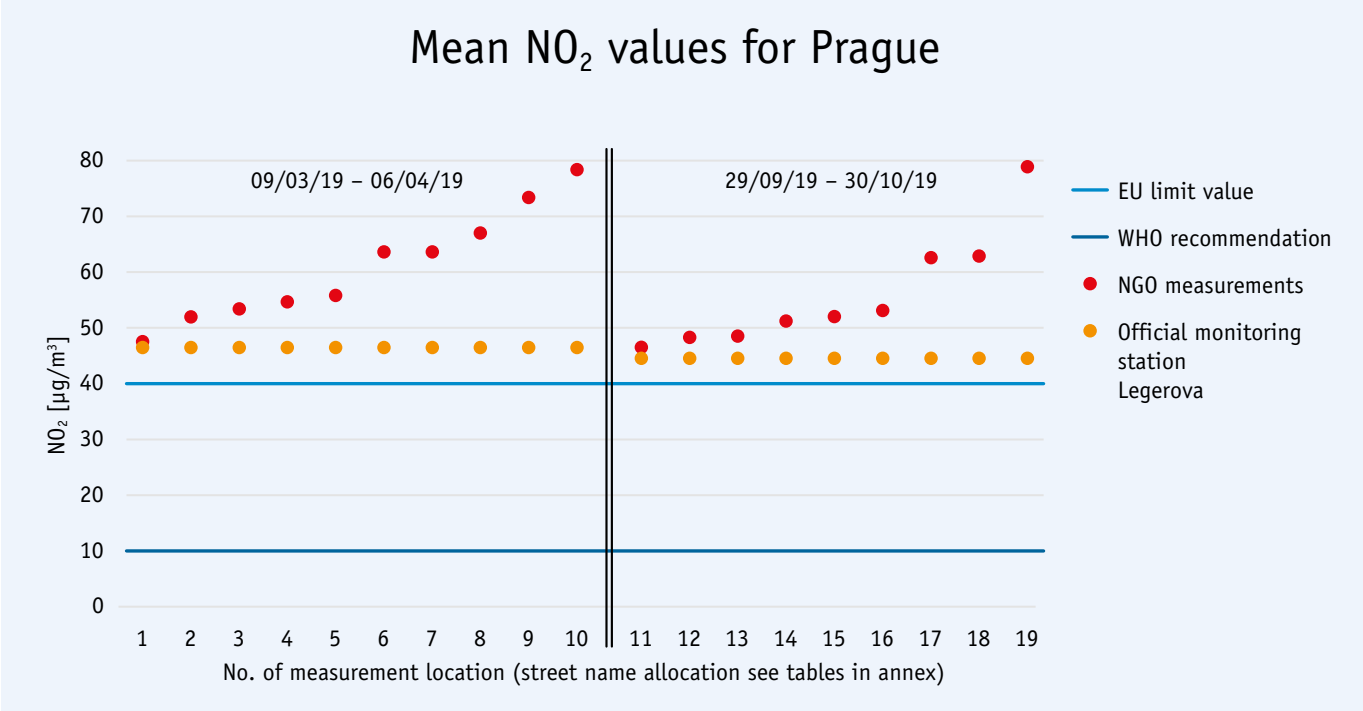
Graphic 6 – Mean value of NO_2 for October 2020 and mid-September until mid-October 2021 from Budapest

Results from Prague (Czech Republic)

The measurements in Czech Republic were carried out by the NGO Center for Environment and Health with support of Deutsche Umwelthilfe. Their expert work is aimed at monitoring and assessment of the latest knowledge in the environmental health, mainly from exposure to indoor and outdoor air pollution. Among other activities, air sampling and measurement methods as well as public awareness, collaboration with media and work with decision makers have been developed.

From March until April 2019, 200 diffusion tubes where installed across the country. The tubes were placed in nine different regions, of which Prague, Brno, Ostrava, Usti where priority regions. Another measurement round with 200 diffusion tubes in the same nine regions took place in October 2019. In this report, only Prague is taken into account. NO_2 was measured at 65 locations in Prague.

The passive sampler measurement by Center were compared with the most polluted official monitoring station in Prague: "Legerova". During both measurement campaigns, NO_2 values of almost 80 µg/m³ were revealed with the passive samplers. While the official station "Legerova" showed an exposure of 46 µg/m³ in march 2019, the passive sampler at "Sokolská/Ječná" (graphic 7/ No. 10) showed an NO_2 concentration of 78.4 µg/m³. Almost the same picture occurs in October, when the official monitoring station "Legerova" showed an exposure of 45 µg/m³ and the passive sampler at "Mezibranská" (graphic 7/No. 19) showed an NO_2 concentration of 78.9 µg/m³. The passive sampler values are thus almost twice as high as the legal annual limit value for NO_2 allows and more than 30 µg/m³ higher than the results from the official station.



Graphic 7 – Mean value of NO_2 for March 2019 and October 2019 from Prague

Results and Recommendations

Reliable air quality data is the basis for effective air quality plans with appropriate measures to protect people´s health. The results of the different measurements across Europe indicate that some of the official urban traffic monitoring stations are not located at the most polluted places in the cities. However, 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. While in some cases, the NO_2 concentration measured by the passive samplers is only slightly higher than the official data, this is not the case in Sofia, Vienna, Ljubljana, or Prague. These measurement results are significantly higher in comparison to the provided data of the official monitoring station. In addition, some of the official monitoring stations not only seem not to be located in the most polluted locations, but it appears that their positions are not in accordance with the AAQD Annex III. In the case of Sofia this is most obvious with an urban traffic station 89 meters away from the kerbside, but also in Ljubljana and Bucharest it is becoming apparent that the positioning of individual monitoring stations should be reviewed.

The results of the different measurements highlight a clear finding and derived recommendation for the European Commission: **a review of existing monitoring networks is inevitable and, if necessary, has to lead to installation of new monitoring stations.** Furthermore, the measurements show the necessity of a higher quantity of official monitoring stations in general, to get a better overview of the pollution situation in Europe. To be able to install monitoring stations at places where the highest air pollution is expected, screening-modeling of different air pollutants (especially NO_2) is an inevitable tool for air quality assessment and should be implemented as mandatory in the revised AAQD. All air quality data must be available to the public, this includes air quality modeling and projections, to ensure the comprehensible positioning of monitoring stations. The updated WHO guidelines, published last year, just confirmed the scientific evidence that there are no safe levels of air pollution for human health. Reduction of air pollution to the minimum will prevent thousands of premature deaths and avoid even more diseases.

In the course of this project many consultations with responsible authorities were initiated, to point out the inadequate positioning and thus inadequate data collection of the official monitoring stations. We have been repeatedly informed by officials, that there would not have been enough space to install a monitoring station in probably higher polluted street sections or that a higher number of official monitoring stations would be too expensive. Both problems can be solved by using passive collectors. Therefore, we advocate that use of passive samplers is recognized as an official method to assess NO_2 pollution and the use becomes mandatory for narrow street canyons with high traffic volumes. In Germany, the equivalence with reference method has been proven, which is why official monitoring stations operate also with passive collectors. With this method, the database on air quality in Europe can be significantly increased at low financial costs.

The results of the project show, that air quality across Europe is partially worse than official data indicate. With regard to the updated WHO air quality guidelines and the significantly lowered recommended air quality limit values, the European Commission should draft the most ambitious proposal for the revision of the Ambient Air Quality Directives. Not only with regard to ambitious limit values, but furthermore with regard to implement better regulations for publicly accessible and comprehensive air quality monitoring. The results of the project show, that these specifications and the enforcement of adequate monitoring is key for all EU citizens to enforce their right to clean and healthy air.

Annex

Mean NO_2 values for Sofia 05/01/21 – 05/01/22						
Site number	**Site**	**NGO measurements**	**Official monitoring station**			
			AMS Mladost	**AMS Pavlovo**	**AMS Nadezhda**	**AMS Hipodruma**
			(urban, traffic related)		**(urban, background)**	
1	bul. "Tsar Boris III", kv. Ovcha kupel 1	31.6	24.0	24.2	27.6	30.1
2	ul. "General Kosta Georgiev" kv. Orlandovtsi	32.6				
3	ul. "Montevideo" g.k. Ovcha kupel 1	36.8				
4	bul. "Hristo Botev", Sofia Center	40.6				
5	bul. "Nikola Petkov" g.k. Ovcha kupel	42.3				
6	bulevard "Cherni vrah" , Hladilnika	42.8				
7	g.k. Lyulin 10	43.5				
8	bulevard "Sveti Kliment Ohridski", g.k. Mladost 1	43.9				
9	bul. "Gotse Delchev"	44.2				
10	Boulevard "Tsarigradsko shose", Geo Milev	45.4				
11	bul. "Vasil Levski"	46.1				
12	bul. "Aleksandar Stamboliyski"	47.1				
13	bul. "General Mihail D. Skobelev"	47.2				
14	bul. "Tsar Boris III" , g.k. Slavia	48.8				
15	ul. Tsaribrodska, Sofia Center	50.9				
16	bul. "Nikola Mushanov", Krasna polyana 2	52.3				
17	bul. "Lomsko Shose", g.k. Nadezhda 1	52.4				
18	pl. "Nezavisimost", Sofia Center	56.8				
19	bul. "Sitnyakovo", Oborishte	56.8				
20	bul. "Slivnitsa"	57.4				
21	Boulevard "Tsarigradsko shose", Yavorov	58.4				
22	g.k. Mladost 1	62.0				

Table 1 – Sofia

Mean NO_2 values for Vienna 01/21 – 07/21			
Site number	**Site**	**NGO measurements**	**Official monitoring station Hietzinger Kai**
1	Gumpendorfer Str.	33.9	30.5
2	Neustiftgasse	34.8	
3	Wattgasse	36.0	
4	Favoritenstraße	36.8	
5	Währinger Gürtel 150	37.2	
6	Alserbachstr.	38.1	
7	Hörlgasse	38.5	
8	Währinger Gürtel 6	39.5	
9	Johnstraße	43.1	
10	Prager Str.	43.4	
11	Margaretengürtel	43.6	
12	Neubaugürtel	45.6	
13	Triester Str	46.1	
14	Hadikgasse	52.9	

Table 2 – Vienna

Mean NO_2 values for Bucharest 15/12/19 – 15/01/20			
Site number	**Site**	**NGO measurements**	**Official monitoring station Calea Victoriei**
–	Piata Charles de Gaulle, (N°9)	48.9	48.7
–	Calea Dudesti, No. 191 (N°30)	50.1	

Table 3 – Bucharest

Annex

Mean NO_2 values for Ljubljana (Top 30) 01/02/21 – 22/02/21			
Site number	**Site**	**NGO measurements**	**Official monitoring station Vošnjakova Tivolska**
–	križišče Slovenska Šubičeva	31.7	31.4
–	Bleiweisova cesta	31.9	
–	Celovška cesta 280	31.9	
–	Šmartinska cesta 28	32.0	
–	križišče Celovška cesta Drenikova ulica	32.2	
–	Zaloška 2	32.5	
–	Krekov trg 2	32.7	
–	Cesta v Mestni log 46	33.0	
–	Aškerčeva cesta 2	33.1	
–	križišče Podmilščakova Samova	33.2	
–	Dunajska cesta 47	33.4	
–	križišče Linhartova	33.5	
–	Križišče Šmartinske ceste in Ulice Gradnikove brigade	33.7	
–	Celovška cesta 3	33.7	
–	Šmartinska cesta 152g	34.1	
–	Letališka cesta 14	34.1	
–	Trubarjeva cesta & Resljeva cesta	34.3	
–	križišče Štajerska cesta Brnčičeva ulica	34.3	
–	Zoisova cesta	34.5	
–	Celovška cesta (Pavšičeva)	34.7	
–	Tržaška cesta 47a	34.8	
–	Slovenska cesta 3 (Rimska cesta)	35.1	
–	Tbilisijska ulica 63	35.1	
–	Regentova cesta 32-34	35.4	
1	križišče Predor pod Gradom Karlovška cesta	35.5	
2	križišče Prušnikova ulica Tacenska cesta	35.6	
3	Celovška cesta 68	35.7	
4	Žale	35.9	
5	MP NO2 Tivolska cesta - Vošnjakova ulica	36.2	
6	križišče Šmartinska cesta Kajuhova ulica	36.3	
7	križišče Masarykova cesta Resljeva cesta	36.5	
8	križišče Šmartinska cesta Pokopališka	36.7	
9	Tržaška cesta & Tbilisijska ulica	36.7	
10	Celovška cesta 41	36.8	
11	Križišče Kajuhova Letališka	36.9	
12	Levstikov trg 4	37.0	
13	Prešernova cesta 15	37.3	
14	križišče Gosposvetska Tivolska	37.4	
15	Dunajska cesta 156	38.3	
16	Clevelandska ulica	38.5	
17	Karlovška cesta 18	39.1	
18	Komanova ulica 1	39.7	
19	Slovenčeva ulica	39.9	
20	Roška cesta 2	40.1	
21	Križišče Litostrojska Celovška	40.5	
22	Zaloška & Grablovičeva	41.2	
23	Drenikova 32	41.2	
24	Zaloška cesta	41.3	
25	Trg Osvobodilne fronte	41.5	
26	križišče Dunajska ceste Topniška cesta	41.6	
27	Tržaška cesta Cesta v Gorice	42.3	
28	Trg mladinskih delovnih brigad 8	44.4	
29	Trg Osvobodilne fronte	44.6	
30	Šmartinska 22	50.3	

Table 4 – Ljubljana (Top 30)

Annex

Mean NO_2 values for Ljubljana multi-months measurements				
Site number	**Site**	**NGO measure-ments**	**Official monitoring station Vošnjakova Tivolska**	**Time period**
1	Drenikova 32	36.6	29.1	01/04/2021 - 22/11/2021
2	Tivolska Vošnjakova, blizu merilnega kontejnerja	42.6	29.1	
3	Šmartinska 22	51.2	25.6	01/04/2021 - 22/05/2021
4	Šmartinska 22	40.6	27.1	01/10/2021 - 22/11/2021
5	Trg MDB	41.9	27.1	01/04/2021 - 22/07/2021
6	Trg MDB	38.1	30.7	01/09/2021 - 22/11/2021

Table 5 – Ljubljana (multi-month measurements)

Mean NO_2 values for Budapest					
Site number	**Site**	**NGO measure-ments**	**Official monitoring station Teleki tér 9**	**Official monitoring station Széna tér**	**Time period**
–	Margit krt. (Frankel Leo u. 22.)	46.6	41.0		16/09/2021 - 14/10/2021
–	Mester u. 3	41.5		38.4	01/10/2020 - 29/10/2020
–	Üllői út 28	55.5			

Table 6 – Budapest

Mean NO_2 values for Prague				
Site number	**Site**	**NGO measure-ments**	**Official monitoring station Legerova**	**Time period**
1	Margit krt. (Frankel Leo u. 22.)	46.6	46.0	09/03/2019 - 06/04/2019
2	Kafkova/Svatovítská podchod	52.0		
3	Na Veselí	53.4		
4	Veletržní/Sochařská	54.7		
5	Bělocerkevská	55.8		
6	Rumunská/Sokolská	63.6		
7	Na Veselí	63.6		
8	Ječná/Štěpánská	67.0		
9	Dejvice	73.4		
10	Sokolská/Ječná	78.4		
11	Bělocerkevská (bus stup)	46.5	45.0	29/09/2019 - 30/10/2019
12	Radlická / Klicperova	48.3		
13	Vychovatelna (bus)	48.5		
14	Spořilov	51.3		
15	Rumunská / Legerova	52.1		
16	Rokoska (podchod)	53.1		
17	Sokolská/Ječná	62.6		
18	V Botanice 4 (regional government)	62.9		
19	Mezibranská 3	78.9		

Table 7 – Prague

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