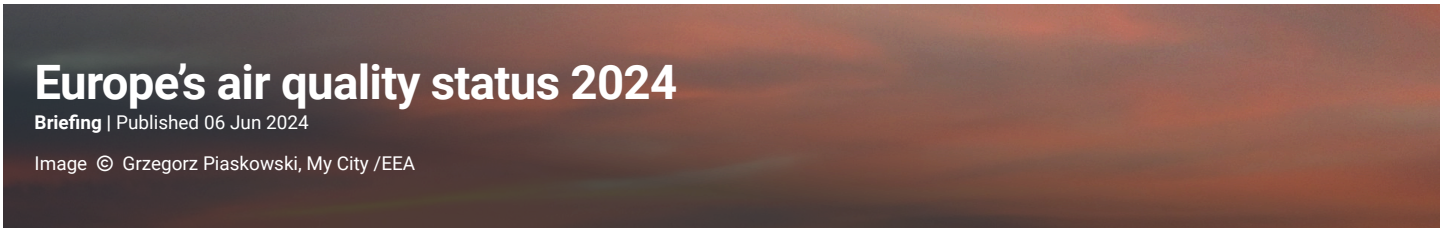
European Environment Agency

# Europe's air quality status 2024

**Briefing** | Published 06 Jun 2024



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Air pollution is Europe's largest environmental health risk, causing cardiovascular and respiratory diseases that impact health, reduce quality of life and cause preventable deaths. This briefing presents the status of regulated pollutants in ambient air in 2022 and 2023 in relation to current EU air quality standards and World Health Organization (WHO) guideline levels.

## Key messages

- Despite ongoing overall improvements in air quality, current EU standards are still not met across Europe.
- 96% of the EU's urban population is exposed to unsafe concentrations of fine particulate matter ($PM_{2.5}$).
- The new EU air quality standards introduced in the revised ambient air quality directive — proposed to come into force in 2030 — are more ambitious than the current ones.

This briefing is one in a series to be published by the EEA as part of the **Air quality in Europe 2024** package

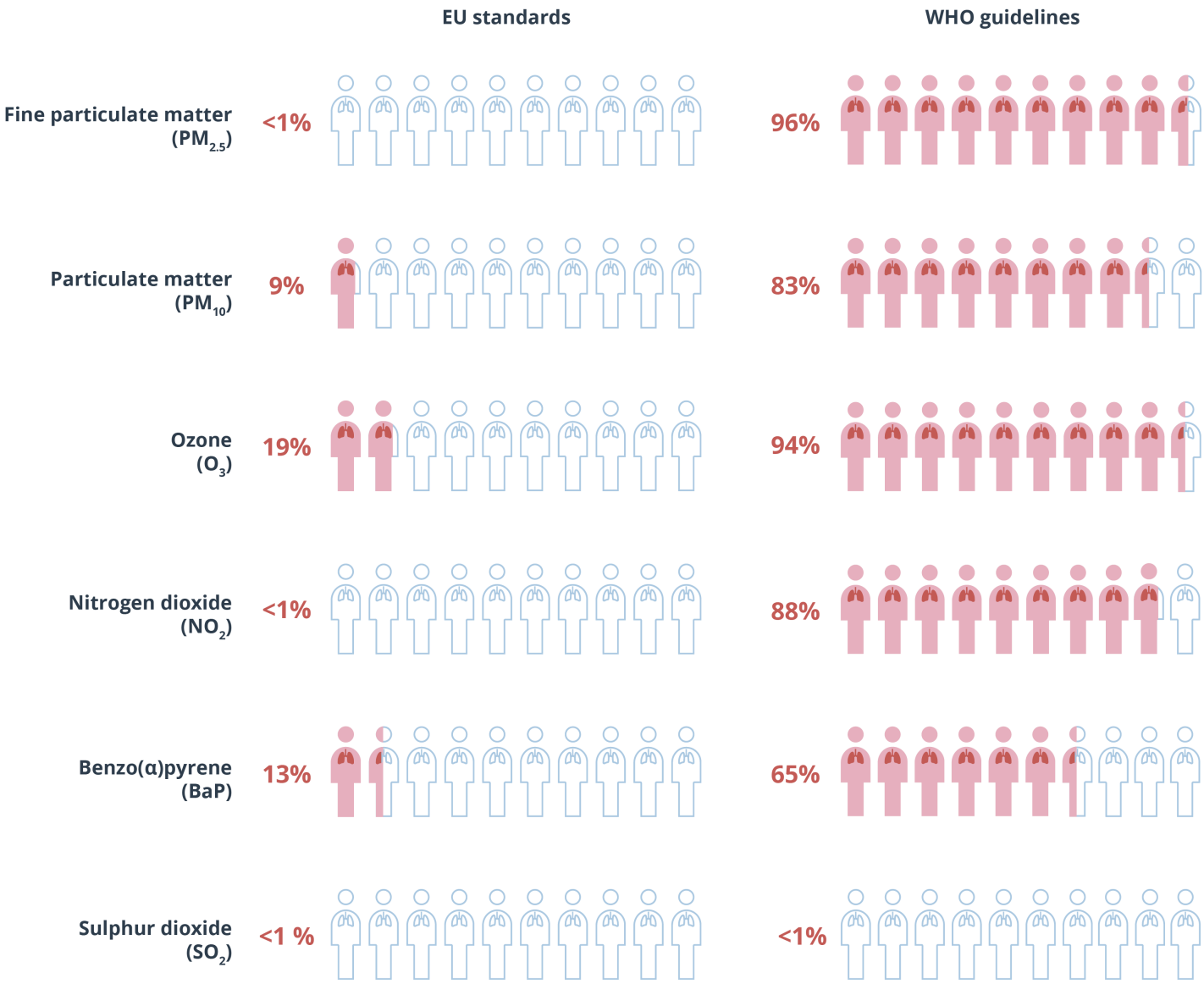
It assesses concentrations of air pollutants in ambient air across Europe, comparing them against current EU standards and the 2021 WHO global air quality guidelines. The EU standards were set out in the 2004 and 2008 ambient air quality directives.

Under the European Green Deal (EGD)'s zero pollution action plan, the European Commission set the interim 2030 goal of reducing the number of premature deaths caused by fine particulate matter ($PM_{2.5}$, a key air pollutant) by at least 55% compared with 2005 levels. The ultimate objective is for air pollution to have no significant impact on health by 2050. To this end, the Commission published a proposal to review the ambient air quality directives in 2022. Among other things, it aimed to align the air quality standards more closely with WHO recommendations.

Co-legislators agreed to more ambitious EU air quality standards in February 2024. However, they are still less strict for all pollutants than what the WHO outlines in their air quality guideline levels.

In 2022, despite ongoing reductions in emissions, most of the EU's urban population continued to be exposed to levels of key air pollutants that are damaging to health (see Figure 1). In particular, almost all of the urban population was exposed to concentrations of $PM_{2.5}$ above the 2021 WHO annual guideline level of 5µg/m$^3$ and to concentrations of ozone ($O_3$) above the short-term guideline level of 100µg/m$^3$.

Figure 1. Share of the EU urban population exposed to air pollutant concentrations above certain EU standards and WHO guidelines in 2022




## Methodology

This analysis highlights pollutants deemed most harmful to human health and those that most frequently exceed the current EU air quality standards and WHO guideline levels.

The concentrations are obtained from monitoring station measurements and are officially reported to the EEA by its members and other collaborating countries[1]. The classification of the monitoring stations and the criteria used to determine their inclusion in the analysis are described here. The number of countries that submitted data and the number of monitoring stations with the minimum data coverage required vary for each pollutant. This is summarised in Table 1 for 2022 and Table 2 for 2023. When referring to countries reporting data above certain levels, it means that they reported at least one station with concentrations that surpassed them.

Data for 2022 and 2023 were extracted from the EEA's reporting system on 5 March 2024.

The analysis for 2022 is based on officially validated data reported by countries. The analysis for 2023 is based on provisional up-to-date (UTD) data. It may change once fully validated data is received by the EEA and more countries are considered. Validated data for 2023 will only be available later in 2024 and will be presented in the 2025 briefing.

Additional information and further analysis are available in the Eionet status reports ETC/HE 2024/3 (Targa et al., 2024a) and ETC/HE 2024/5 (Targa et al., 2024b), prepared by the European Topic Centre on Human Health and the Environment

(ETC HE).

Further information on the concentrations of air pollutants, including those for previous years, can be found at the EEA's statistics viewer. Data can be downloaded here.

Apart from the measurements from monitoring stations, some countries also reported 2022 official data from modelling applications, which are available from the Air Quality Modelling Viewer. The results from these modelling applications have been included in this analysis where they implied concentrations above the EU standards.

## Navigate the tabs for information on each pollutant:

PM10

$PM_{10}$ stands for particulate matter with a diameter of 10µm or less. $PM_{10}$ is emitted mainly by the combustion of solid fuels for domestic heating, although industrial activities, agriculture and road transport are also important sources. Some also come from natural sources such as sea salt, Saharan dust or volcanoes, and some (secondary PM) form in the atmosphere as a combination of different gases (for instance, ammonia and nitrogen dioxide). Member States can discount the contribution of natural sources to the total concentrations for compliance assessments as these sources are out of their control, but we do not exclude these sources in this status analysis.

Concentrations above the EU daily limit value for $PM_{10}$ are seen mainly in Italy and some eastern European countries (Map 1 and Figure 3). In most central and eastern European countries, solid fuels such as coal and wood are widely used for heating households and in some industrial facilities and power plants. The Po Valley in northern Italy is a densely populated and industrialised area with specific meteorological and geographical conditions that favour the accumulation of air pollutants in the atmosphere. Some concentrations are also above the EU daily limit value in southern Spain and the Canary Islands, mainly due to the natural contributions of Saharan dust (MITECO, 2023).

Map 1. Concentrations of $PM_{10}$ in 2022 and 2023 in relation to the EU daily limit value

Table 3. Country status for $PM_{10}$ in 2022 and 2023

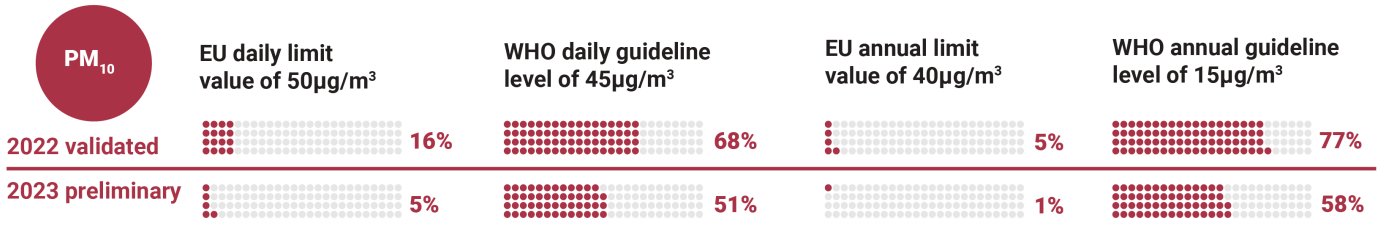
| | | |
|---|---|---|
| Number of countries/Member States > EU daily limit value (50µg/m3) | 23/16 | 15/12 |
| Number of countries/Member States > EU annual limit value (40µg/m3) | 9/4 | 6/3 |
| Number of countries/Member States > WHO daily guideline level (45µg/m3) | 37 (a)/27 | 34 (c)/26 |

| | | |
|---|---|---|
| Number of countries/Member States > WHO annual guideline level (15µg/m3) | 35 (b)/26 | 35 (a)/27 |

**Note:** ([a]) all the reporting countries; ([b]) all the reporting countries except Estonia and Iceland; ([c]) all the reporting countries except Luxembourg.

**Source:** EEA's AQ e-reporting database.

Figure 2. Percentage of reporting monitoring stations registering $PM_{10}$ concentrations above the EU limit values and the WHO guideline levels in 2022 and 2023




In 2022, 16% of monitoring stations measured concentrations of $PM_{10}$ above the EU daily limit value (Figure 2), 84% of which were urban and 12% suburban.

Furthermore, Italy and Poland reported 2022 exceedances of the $PM_{10}$ daily limit value based on assessment models for 7 and 13 air quality zones, respectively.

Figure 3. $PM_{10}$ concentrations in 2022 by country in relation to the EU daily limit value

## PM2.5

$PM_{2.5}$ stands for particulate matter with a diameter of 2.5µm or less. These particles are emitted mainly from the combustion of solid fuels for domestic heating, industrial activities and road transport. As with $PM_{10}$, they can also come from natural sources and can form in the atmosphere. For compliance assessments, Member States can discount the contribution of natural sources to the total concentrations as these sources are out of their control, but in this status analysis, we do not exclude them. Agricultural emissions of ammonia significantly contribute to forming fine particulate matter in the atmosphere.

$PM_{2.5}$ concentrations above the EU annual limit value were seen in Italy and some eastern European countries (Map 2 and Figure 5). As for $PM_{10}$, solid fuel use is the main reason for the situation in central and eastern Europe, together with an older vehicle fleet. In northern Italy, the high concentrations are due to the combination of a high density of anthropogenic emissions and also meteorological and geographical conditions that favour the accumulation of air pollutants in the atmosphere and the formation of secondary particles.

Map 2. Concentrations of $PM_{2.5}$ in 2022 and 2023 in relation to the EU annual limit value and the WHO annual guideline level


Table 4. Country status for $PM_{2.5}$ in 2022 and 2023

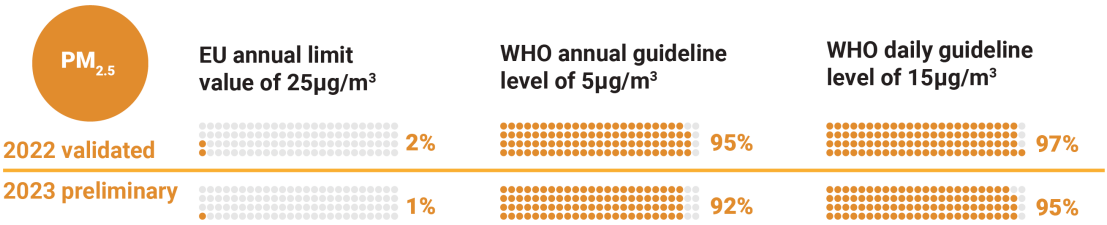
| | | |
|---|---|---|
| Number of countries/Member States > EU annual limit value (25µg/m3) | 6/3 | 5/2 |
| Number of countries/Member States > WHO annual guideline level (5µg/m3) | 36 (a)/27 | 34 (a)/27 |

| | | |
|---|---|---|
| Number of countries/Member States > WHO daily guideline level (15µg/m3) | 37 (b)/27 | 35 (b)/27 |

**Notes**: ([a]) all the reporting countries, except Iceland; ([b]) all the reporting countries.

**Source:** EEA's AQ e-reporting database.

## Figure 4. Percentage of reporting monitoring stations registering $PM_{2.5}$ concentrations above the EU annual limit value and the WHO guideline levels in 2022 and 2023




In 2022, 2% of monitoring stations registered concentrations of $PM_{2.5}$ above the EU annual limit value (Figure 4), 78% of which were urban and 15% suburban. In contrast, 95% of the $PM_{2.5}$ reporting stations registered concentrations above the WHO annual guideline level, 76% of which were urban and 20% suburban.

Furthermore, Italy and Poland reported exceedances of the $PM_{2.5}$ annual limit value based on assessment models for three and one air quality zones, respectively.

Regarding the EU standards related to the Average Exposure Indicator[2] for $PM_{2.5}$, which assesses the general population's long-term exposure in urban areas, all EU Member States continued to meet the exposure concentration obligation of 20µg/m$^3$ in 2022, set as a 2015 target under the ambient air quality directive[3]. Furthermore, for the first time, all Member States[4] met the national exposure reduction target set for 2020.

## Figure 5. $PM_{2.5}$ concentrations in 2022 by country in relation to the EU annual limit value and the WHO annual guideline level

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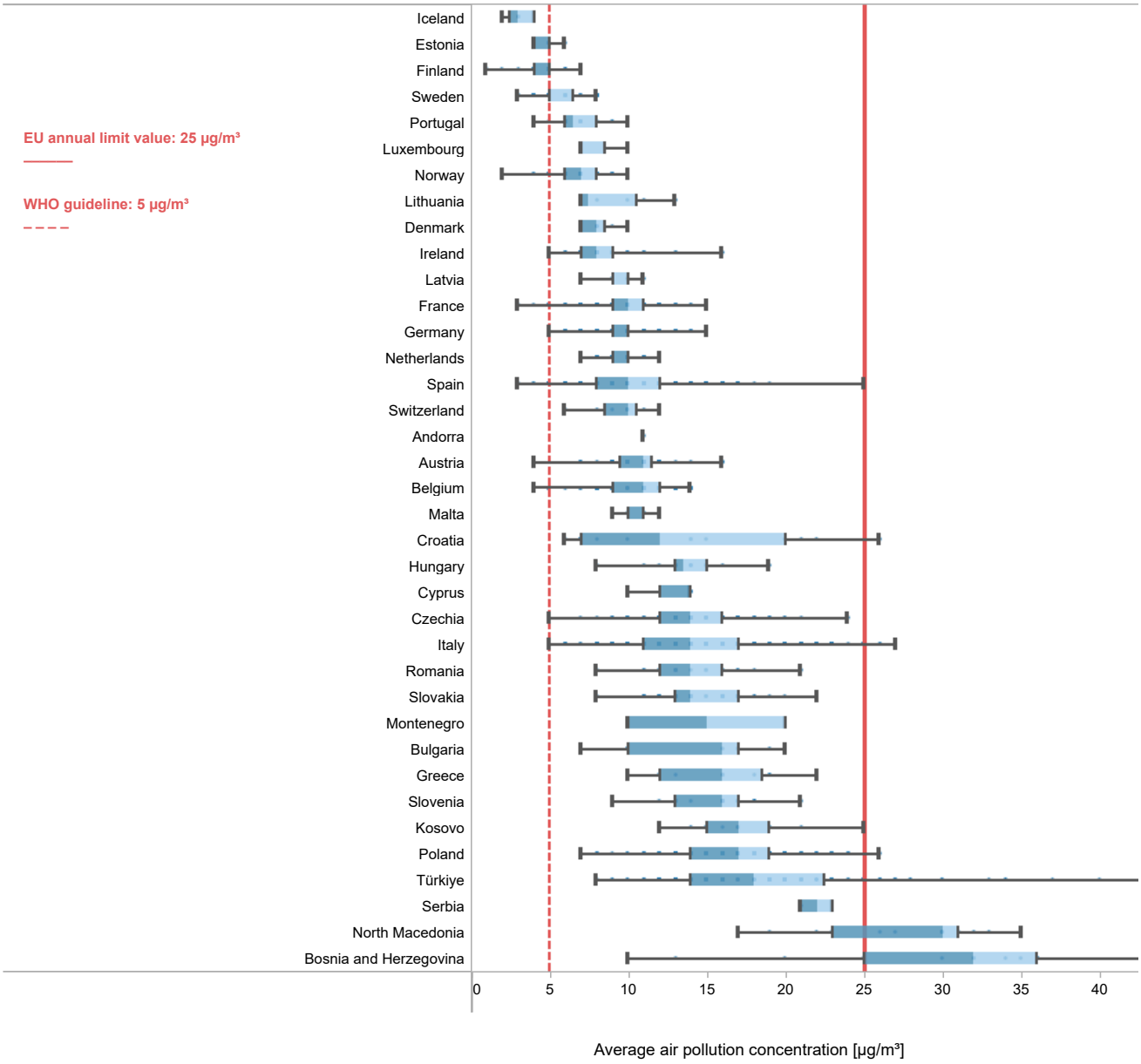


## Ozone

Ozone ($O_3$) is a pollutant formed in the atmosphere when heat and light cause chemical reactions between nitrogen oxides and volatile organic compounds (VOCs), including methane (which is also a powerful greenhouse gas). Emissions of these gases occur from anthropogenic sources and, in the case of VOCs, also biogenic. Ozone is also transported to Europe from other parts of the northern hemisphere and the upper atmosphere. Meteorology plays an important role in forming and dispersing air pollution, and interannual variations in concentrations. This effect is especially significant for ozone.

### Map 3. Concentrations of $O_3$ in 2022 and 2023 in relation to the EU target value

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The highest concentrations in 2022 were found in some Mediterranean and central European countries (Map 3 and Figure 7).

## Table 5. Country status for $O_3$ in 2022 and 2023

| | | |
|---|---|---|
| Number of countries/Member States > EU target value threshold (120µg/m3) | 22/18 | 20/16 |
| Number of countries/Member States > EU long-term objective (120µg/m3) | 35 (a)/27 | 33 (a)/27 |

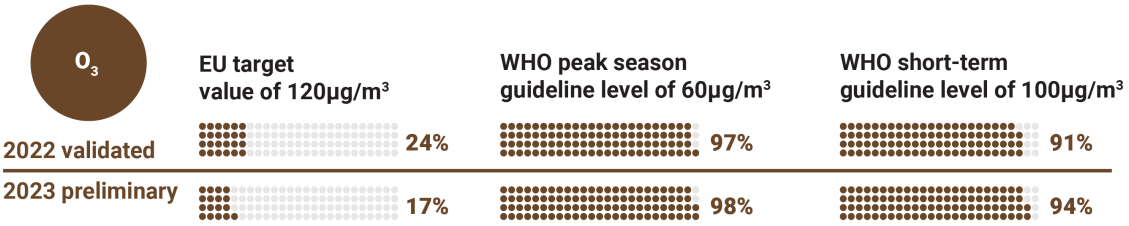
| | | |
|---|---|---|
| Number of countries/Member States > WHO short-term guideline level (100µg/m3) | 35 (a)/27 | 33 (a)/27 |
| Number of countries/Member States > WHO peak season guideline level (60µg/m3) | 35 (a)/27 | 33 (a)/27 |

**Notes**: ([a]) all the reporting countries.

The stations in Kosovo, although reported, did not get the minimum data coverage to estimate the relevant ozone statistics.

**Source**: EEA's AQ e-reporting database.

## Figure 6. Percentage of reporting monitoring stations registering $O_3$ concentrations above the EU target value and the WHO guideline levels in 2022 and 2023




The long-term EU objective for ozone of 120µg/$m^3$ was met at 16% of monitoring stations in 2022.

Italy reported exceedances of the $O_3$ target value for the protection of health based on assessment models for three air quality zones. Italy and Poland reported exceedances of the $O_3$ long-term objective for the protection of health in 9 and 46 air quality zones, respectively.

## Figure 7. $O_3$ concentrations in 2022 by country in relation to the EU target value

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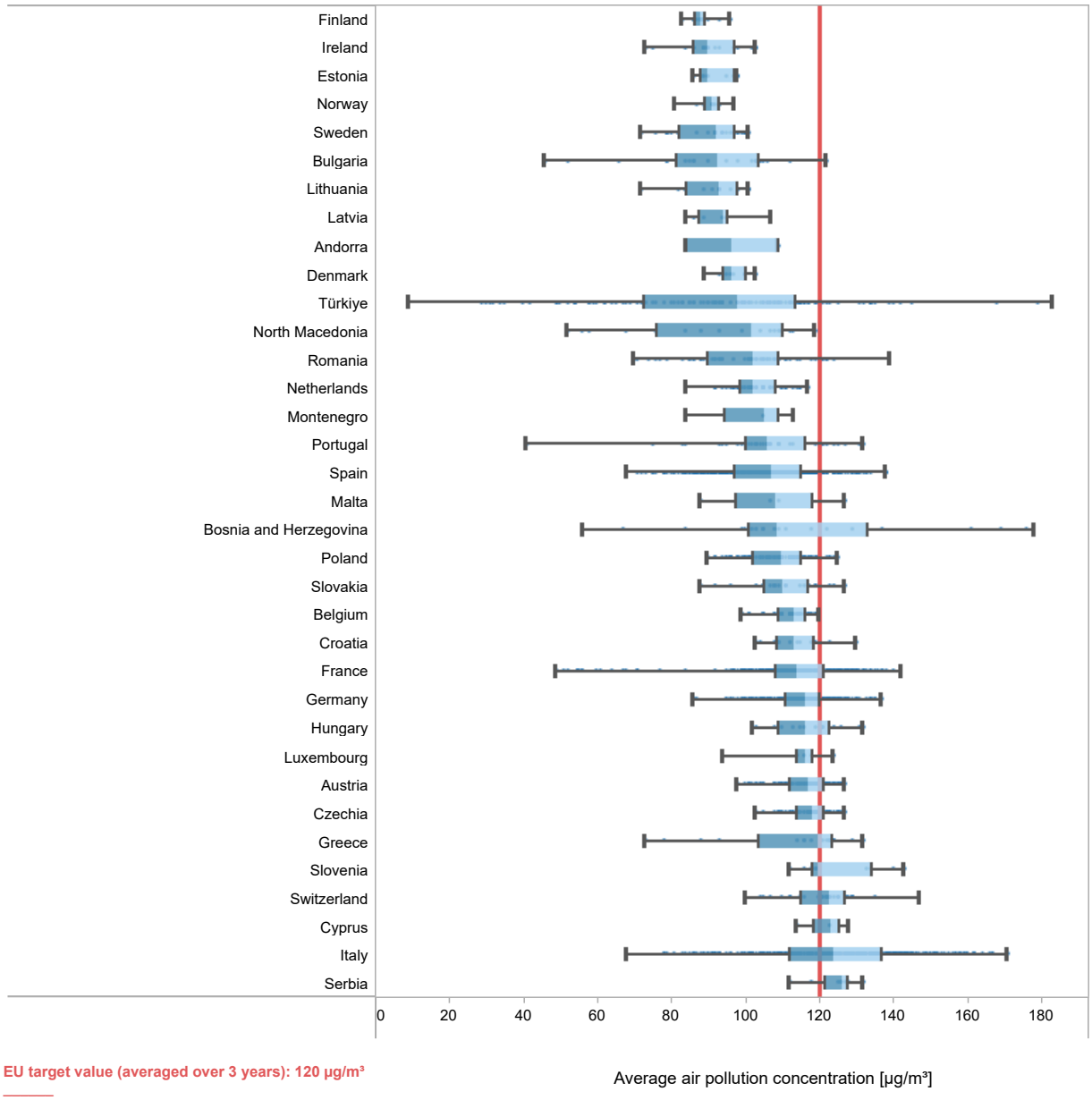


In 2023, the long-term EU objective for ozone was met at 14% of monitoring stations.

## NO2

The leading source of nitrogen dioxide ($NO_2$) is road transport, which emits $NO_2$ close to the ground, mostly in densely populated areas, contributing to population exposure. Other important sources are combustion processes in industry and energy supply.

Concentrations above the annual limit value were found in many Turkish cities and some big cities with a high volume of traffic (Map 4 and Figure 9).

### Map 4. Concentrations of $NO_2$ in 2022 and 2023 in relation to the EU annual limit value and the WHO annual guideline level

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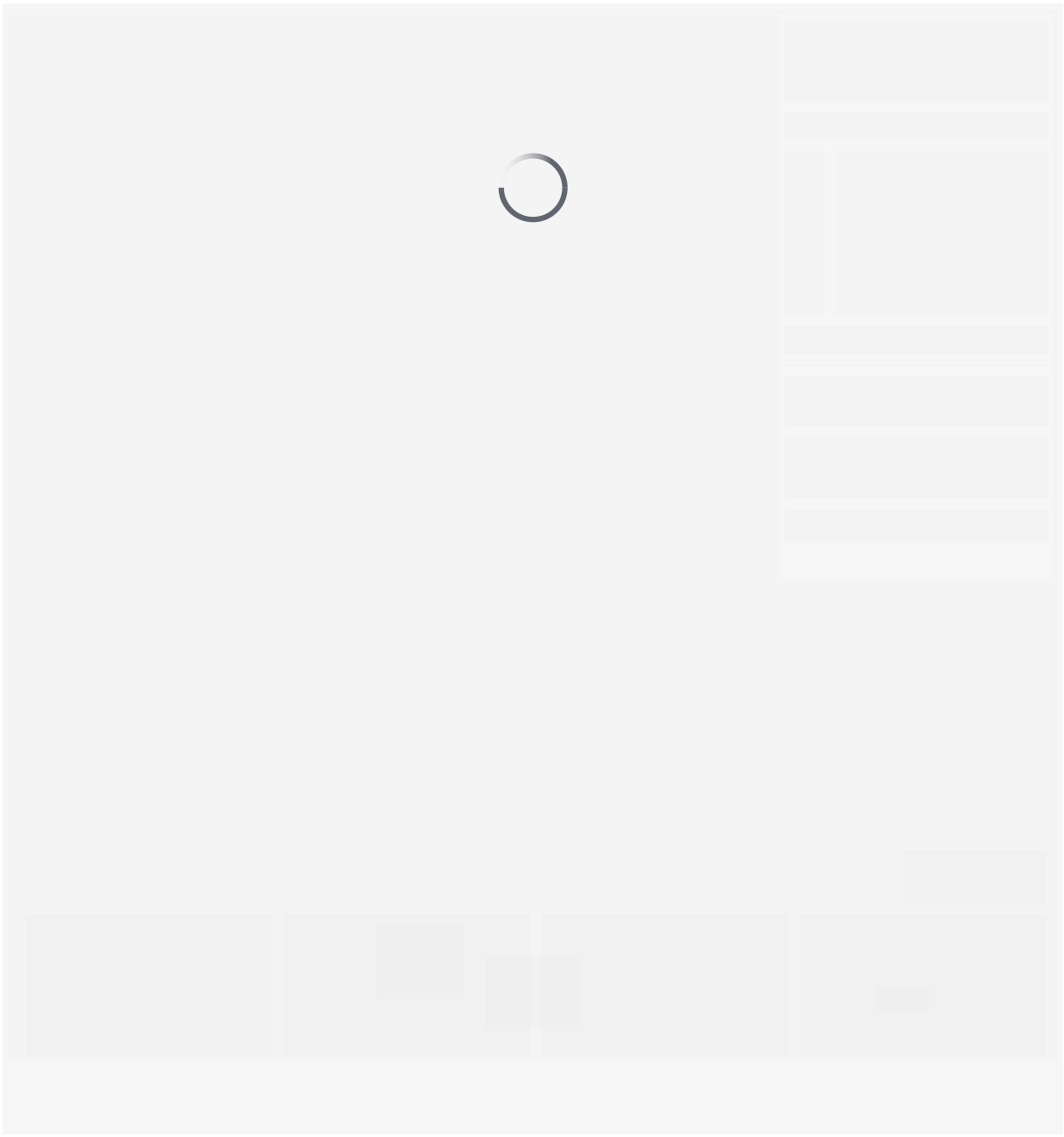


Table 6. Country status for $NO_2$ in 2022 and 2023

| | | |
|---|---|---|
| Number of countries/Member States > EU annual limit value (40µg/m3) | 11/10 | 8/8 |
| Number of countries/Member States > EU hourly limit value (200µg/m3) | 2/1 | 2/1 |
| Number of countries/Member States > WHO annual guideline level (10µg/m3) | 37 (a)/27 | 34 (b)/27 |

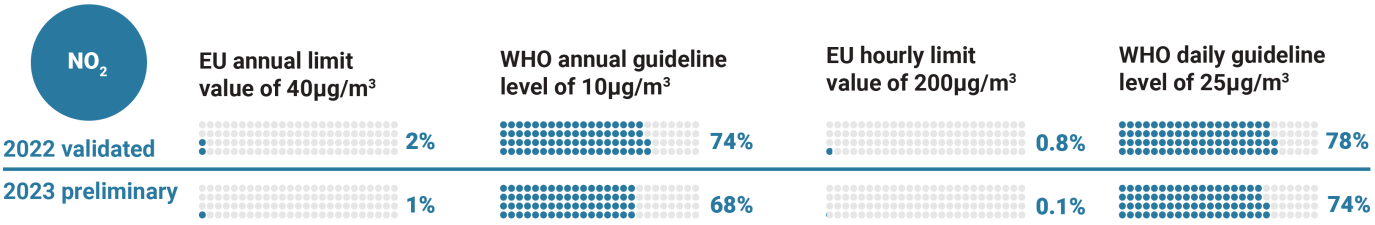
| | | |
|---|---|---|
| Number of countries/Member States > WHO daily guideline level (25µg/m3) | 37 (a)/27 | 34 (c)/27 |

**Notes**: ([a]) all the reporting countries; ([b]) all the reporting countries, except Kosovo; ([c]): all the reporting countries.

The stations from Kosovo, although reported, did not get the minimum data coverage to estimate the $NO_2$ statistics related to the WHO air quality daily guideline level.

**Source**: EEA's AQ e-reporting database.

## Figure 8. Percentage of reporting monitoring stations registering $NO_2$ concentrations above the EU limit values and the WHO guideline levels in 2022 and 2023




In 2022, 2% of monitoring stations registered concentrations of $NO_2$ above the EU annual limit value (Figure 8), 76% of which were traffic stations. Concentrations above the $NO_2$ WHO annual guideline level were registered at 74% of all monitoring stations, 45% of which were traffic stations.

Belgium, Italy and Poland reported exceedances of the $NO_2$ annual limit value based on assessment models for three, two and four air quality zones, respectively.

## Figure 9. $NO_2$ concentrations in 2022 by country and in relation to the EU annual limit value and the WHO annual guideline level

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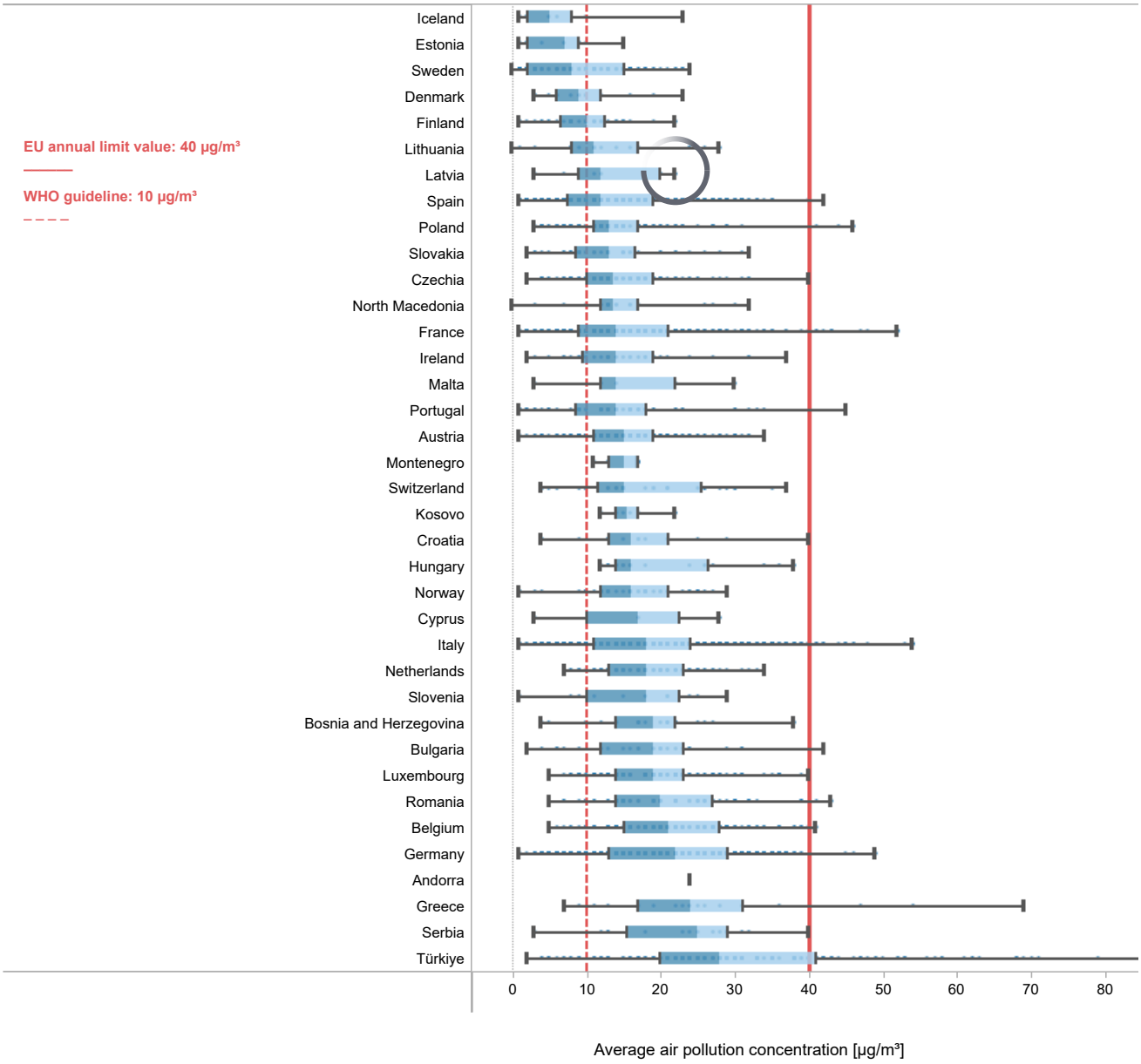


**Note:** The figure shows, per country, the concentrations of each reported station, the minimum and maximum concentrations, the median and the 25th and 75$^{th}$ percentiles of all the measurements (annual mean $NO_2$ concentrations).

In 2023, 1% of monitoring stations registered concentrations of $NO_2$ above the annual limit value, all of which were traffic stations. 68% of monitoring stations registered concentrations above the WHO annual guideline level, 46% of which were traffic stations.

## BaP

**Benzo(a)pyrene (BaP)** is a carcinogenic pollutant emitted mainly from the combustion of coal and wood for heating and, to a lesser extent, from industrial installations and the combustion of agricultural waste.

**The highest concentrations** were found in Italy and eastern Europe (Map 5 and Figure 10), where the use of coal and other solid fuels for residential heating is widespread.

## Map 5. Concentrations of BaP in 2022

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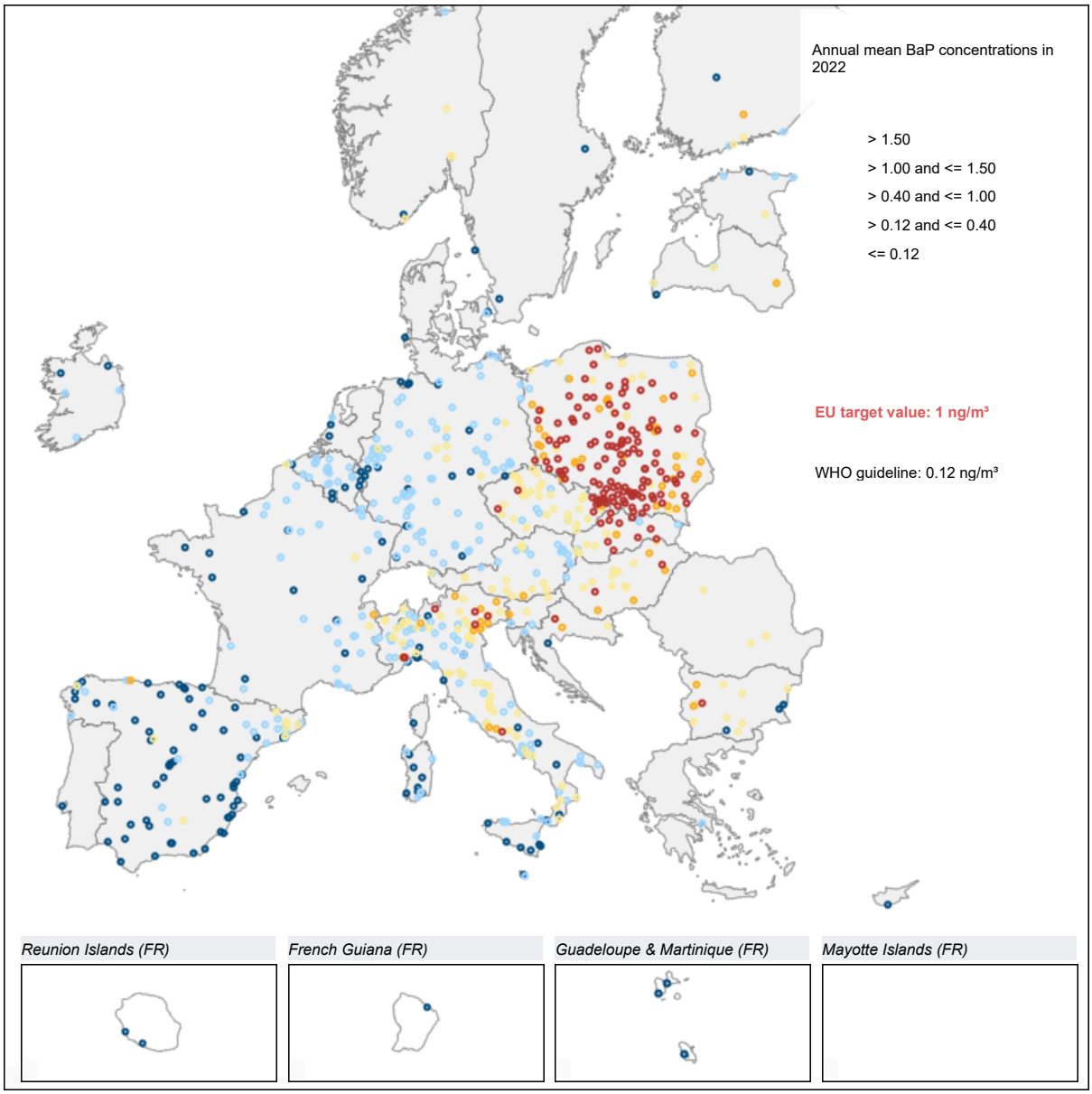


**Country status for BaP in 2022:** 12 out of 27 reporting countries, all of which were EU Member States, registered values above 1.0 ng/m$^3$. Concentrations above 1.0 ng/m$^3$ were registered at 25% of the reported monitoring stations, the majority of which were urban (78%) or suburban (18%). Greece and Poland reported exceedances of the BaP target value based on assessment models for one and 32 air quality zones, respectively.

## Figure 10. BaP concentrations in 2022 by country

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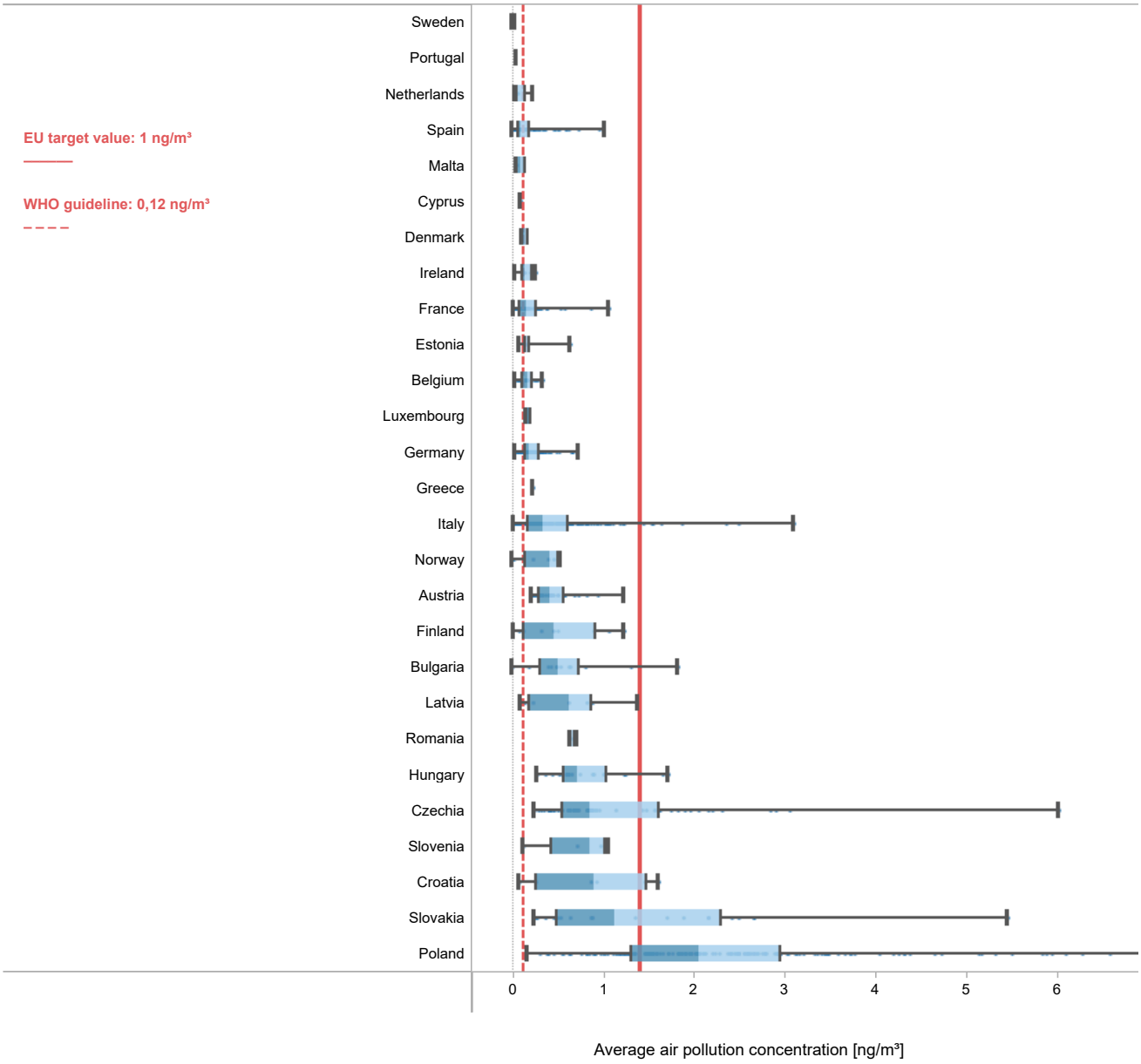


## Other pollutants

Country status for **sulphur dioxide ($SO_2$)** in 2022:

- 4 out of 37 reporting countries (Bosnia and Herzegovina, Türkiye, North Macedonia and Serbia) — none of them EU Member States — registered levels above the EU daily limit value of 125µg/m$^3$;
- 17 countries, including nine EU Member States, registered values above the WHO daily guideline level of 40µg/m$^3$[5].

In 2022, 1% of reporting monitoring stations registered concentrations above the EU daily limit value and 6% of stations registered concentrations above the WHO daily guideline level.

In 2023, 11 reporting stations outside the EU (nine in Bosnia and Herzegovina and two in North Macedonia) registered concentrations of $SO_2$ above the EU daily limit value. In the same year, concentrations above the WHO daily guideline level were registered in 13 countries (including 10 EU Member States) out of 33 reporting countries.

Concentrations above the corresponding EU limit or target values were also registered in 2022 for the following pollutants:

- carbon monoxide (CO) at one station, located in the non-EU Member State of Serbia, out of 35 reporting countries;
- for benzene and lead, no stations reported concentrations above EU annual limit values in the 28 and 30 reporting countries, respectively. Italy reported exceedances of the benzene annual limit value based on assessment models for one air quality zone;
- arsenic in six stations across three EU Member States (Belgium, Finland and Poland, with two stations each) out of 29 reporting countries. Poland reported exceedances of the arsenic annual target value based on assessment models for two air quality zones;
- cadmium at one station, located in the EU Member State of Bulgaria, out of 30 reporting countries;
- nickel in four stations located in four EU Member States (Finland, France, Germany and Italy) out of 29 reporting countries.

## Identifiers

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## Notes

1. The 27 European Union Member States, plus Iceland, Liechtenstein, Norway, Switzerland and Türkiye. The six West Balkan countries are cooperating countries. These include Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia and Kosovo (the designation is without prejudice to position on status, and is in line with UNSCR 1244/99 and the ICJ Opinion on the Kosovo Declaration of Independence). Andorra reports data on a voluntary basis. ↲
2. The Average Exposure Indicator (AEI) is based on a three-year average measured at urban background stations. The AEI for 2022 is based on 2020-2022. It assesses the general population's long-term exposure in urban areas. ↲
3. As well as the EU-27, Iceland and Norway also reported an AEI2022 below the exposure concentration obligation. The AEI2022 estimated for Switzerland, Andorra, Kosovo, Türkiye and Montenegro was also below the exposure concentration obligation. On the contrary, the estimated AEI2022 for Serbia, North Macedonia, and Bosnia and Herzegovina was above the exposure concentration obligation. ↲
4. Plus Iceland and Norway. ↲
5. The 99.18th percentile of the daily values has been considered, meaning three days of exceedance per year. ↲

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