

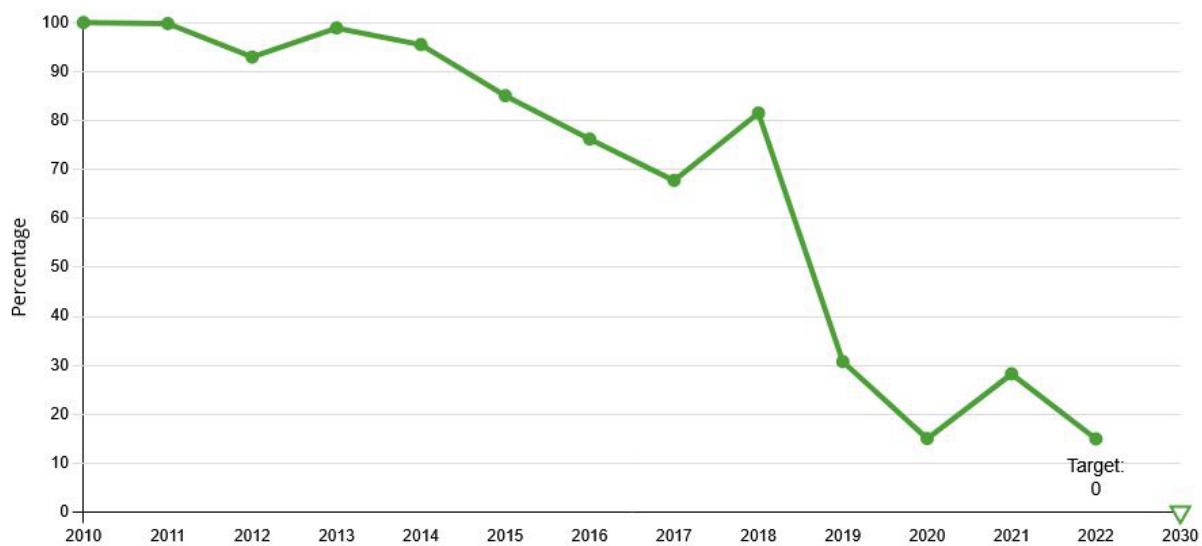


3 GOOD HEALTH AND WELL-BEING

Air pollution – Keeping the environment healthy

3.2.b Share of the population with excessive exposure to fine particulate matter (PM_{2.5})

Population with excessive exposure to fine particulate matter (PM_{2.5}) at the place of residence



Data source(s):

German Environment Agency, World Health Organization

Definition

The indicator represents the proportion of people (in %) who were exposed to more than 10 micrograms (μg) of particulate matter PM_{2.5} (dust particles with a diameter of less than 2.5 micrometres) per cubic metre (m^3) of air at their place of residence on an annual average (background pollution only, excluding local sources).

Intention

Long-term human exposure to particulate matter can lead to respiratory and cardiovascular diseases as well as an increased risk of type 2 diabetes mellitus and neurodegenerative diseases. In order to better protect health, the aim is therefore to ensure that no person in Germany is exposed to an annual average concentration of particulate matter (PM_{2.5}) of more than 10 micrograms (μg) per cubic metre (m^3) of air at their place of residence by 2030. The target value of 10 $\mu\text{g}/\text{m}^3$ corresponds to intermediate target 4 from the recommendations of the World Health Organisation (WHO) in the Air Quality Guidelines. In addition, this value was defined in the European Union's updated Air Quality Directive as a legal limit value to be complied with from 2030. The indicator enables continuous monitoring of development trends with regard to target achievement.



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Target

Fall in the share of the population with an annual mean PM_{2.5} exposure of more than 10 micrograms per cubic metre (equivalent to the level of the new EU limit value for PM_{2.5} from 2030) to 0% by 2030

Content and progress

The indicator measures the proportion of the population whose place of residence is, on an annual average, exposed to fine particulate matter (PM) concentrations exceeding 10 micrograms per cubic metre of air. Fine particulate matter consists of airborne particles that can be inhaled and – depending on their size – penetrate deep into the lungs or even enter the bloodstream. Until 2021, the indicator referred to particles with a diameter of no more than 10 micrometres (PM₁₀). With the revision of the German Sustainable Development Strategy 2025, the focus shifted to smaller particles of up to 2.5 micrometres in diameter (PM_{2.5}), as these are considered particularly relevant in terms of adverse health impacts.

The politically defined target stipulates that, by 2030 at the latest, no one should be exposed at their place of residence to PM_{2.5} concentrations exceeding 10 micrograms per cubic metre of air on an annual mean basis. This threshold corresponds to interim target 4 of the air quality guidelines published by the World Health Organization (WHO) in 2021. However, the WHO's recommended limit value for PM_{2.5} is lower, at 5 micrograms per cubic metre annual mean.

PM_{2.5} originates partly from primary emissions – for example, from industrial processes for energy and heat generation, agriculture, road transport, and residential heating using solid fuels such as wood stoves or fireplaces. It can also form indirectly through so-called secondary particle formation: this occurs when fine particulate matter develops as a result of chemical reactions involving gaseous precursors such as sulphur and nitrogen oxides, ammonia, or hydrocarbons.

PM_{2.5} exposure levels are determined using a combination of modelling outputs and measurement data provided by the German Environment Agency (UBA) and the Länder. For the purposes of this indicator, only data from background monitoring stations in urban and rural areas are included – stations not directly influenced by local emission sources such as traffic or industrial facilities. This ensures a representative depiction of large-scale exposure patterns without distortion from localised hot spots of pollution.

The indicator does not represent full spatial compliance with the limit value; rather, it reflects residential locations away from significant emission sources. It therefore does not quantify the absolute exposure level of the entire population or capture seasonal variations. Since localised high-exposure areas are not incorporated into the model, the actual number of individuals with PM_{2.5} exposure above 10 micrograms per cubic metre is likely to be higher than the indicator suggests.

In 2010, the entire population was exposed to PM_{2.5} levels exceeding the threshold of 10 micrograms per cubic metre. In the following years, this share decreased markedly: by 2021, only 28.2% of the population was affected, compared with 15.0% in the previous



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year. If, however, the WHO guideline value of 5 micrograms per cubic metre were applied as the reference, almost the entire population would still be considered exposed.

In addition to the decline in the share of the population with elevated exposure, the population-weighted annual mean PM_{2.5} concentration has also fallen significantly since 2010. In 2021, the population-weighted mean was 9.3 micrograms per cubic metre – representing a reduction of approximately 42% compared with 2010 (15.9 micrograms per cubic metre).

Type of target

Target with specific target value

Assessment

The proportion of the population exposed to annual mean concentrations of PM_{2.5} above 10 micrograms per cubic metre should be reduced to 0% by 2030.

According to the target formulation, the average trend since 2016 – despite the increase in 2021 – suggests that the politically defined target could be achieved well before 2030. Indicator 3.2.b is therefore assessed as sun for 2021.

