SCIENCE FOR ENVIRONMENT POLICY

Progress made on European air quality since 2000: most pollutants falling, but further action needed

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In a new overview of air quality in the European Union (EU) and the United Kingdom (UK), researchers have revealed downward trends in key pollutant emissions from 2000 to 2017. Despite significant progress, they found that urban exposure to fine particulate matter and ozone — which have some of the greatest health impacts — still exceeded the World Health Organization (WHO) limit values in 2017, suggesting that intensified actions are urgently needed.

Targets for improving air quality are set out in the EU Ambient Air Quality Directive (Directive 2008/50/EC) and WHO Air Quality Guidelines. The Industrial Emissions Directive (2010/75/EU) is the main EU instrument regulating pollution from industrial installations. Meanwhile, the Clean Air Programme for Europe[1] aims to reduce the number of premature deaths by half in 2030 compared to 2005.

Since the introduction of standards and emission control policies, the number of air-quality monitoring stations in Europe has rapidly grown, to about 5 000 in 2020. Databases such as the European Environment Agency's AirBase permit analysis of the evolution of ambient concentrations of pollutants over time. In this study, the researchers looked at trends in national emissions of seven main pollutants, urban population exposure to air pollution, and mortality linked to exposure to $PM_{2.5}$ and ozone.

They collected official national data from the European Monitoring and Evaluation Programme's Centre on Emission Inventories and Projections. They then estimated urban population exposure above air pollution limit values by comparing concentration maps with population density. They sourced the number of premature deaths attributed to exposure to $PM_{2.5}$ and ozone from the Organisation for Economic Co-operation and Development, based on the method in the Global Burden of Disease study (2017)[2] (this compares population exposure, based on concentration maps from satellite and modelled data, with epidemiological data to infer the health impacts that can be related to exposure). The researchers also carried out a literature survey of 50 articles and technical reports.

European Commission

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Progress made on European air quality since 2000: most pollutants falling, but further action needed (continued)

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The study[3] found that between 2000 and 2017, significant reductions were observed for all primary pollutants in all countries. Sulphur oxides fell by about 80%; nitrogen oxides by 46%; non-methane volatile organic compounds (NMVOCs) by 44%; ammonia by 10%; carbon monoxide by 49%; $PM_{2.5}$ by 31% and PM10 by 29%.

The percentage of the population exposed to nitrogen dioxide (NO2) concentrations above EU and WHO limits decreased from 14–31% before 2006, to less than 10% since 2012. For sulphur dioxide, exposure exceeding WHO guidelines decreased from over 70% before 2006 to below 40% since 2013.

Many of the achievements are a result of technologies developed in line with stringent EC Directives such as the Large Combustion Plants Directive (2001/80/EC), National Emission Reduction commitments Directive (2001/81/EC) and new road and non-road vehicle standards. However, current levels of air pollutants in many cities continue to exceed EU and WHO standards4.

For example, the researchers observed a decrease in emissions of $PM_{2.5}$ in all countries except Bulgaria, Hungary and Romania. Average concentrations of $PM_{2.5}$ decreased by 0.42 micrograms per cubic metre (µg per m^3) per year, and urban population exposure to levels above WHO guidelines dropped from more than 90% before 2006 to 74–80% in 2014–2017. It was nevertheless linked to 374 000 excess deaths in EU cities in 2016.

Meanwhile, rising ozone (O_3) levels in cities have become a major public health issue: ozone-related deaths in EU cities stood at 14 600 in 2016. More than 80% of urban monitoring stations recorded annual increases in ozone concentrations between 2005 and 2014, the researchers highlight. In 2015–2017, 95–-98% of the EU urban population were exposed to concentrations exceeding WHO limit values and ozone-related deaths have slightly increased since 2000. The researchers note that reduced nitrogen oxides, which counteract ozone, are one of the factors behind rising levels.

Despite the partial effectiveness of the EU clean air policy, it is imperative to take further action to meet air quality goals. The researchers endorse the concept of **greening cities** as set out in the EU Biodiversity Strategy for 2030, and in particular suggest that urban reforestation and fresh air corridors help improve air quality and provide social amenities. They also suggest that city planners need to select **appropriate tree species** that are adapted to local conditions.

Finally, the researchers highlight the importance of rethinking mobility in line with air quality goals. Although outside the period studied, reduced nitrogen oxide and dioxide levels observed in southern European cities during COVID-19 lockdowns in 2020 have demonstrated how reduced vehicle use could improve urban air quality. As a result of complex interactions of pollutants in the atmosphere, this reduction is, however, also linked to increased ozone.

1. European Commission COM (2013) 918 final. *A Clean Air Programme for Europe*. Brussels. Available from: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0918:FIN:EN:PDF

2. Global Burden of Disease (2018). *Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017*. *Lancet* 392: 1923–1994.

3. This work was carried out with funding from the EU's LIFE programme within the project: 'Air pollution removal by urban forests for a better human well-being' (AIRFRESH) (LIFE19 ENV/FR/000086).

4. In 2015–2017, 42–52% of the EU's urban population was exposed to PM_{10} above WHO limit values; and 21–31% to sulphur dioxide and 7–8% to nitrogen dioxide above WHO guidelines.