



SDG target 3.9: by 2030 substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.



SDG target 7.1: by 2030 ensure universal access to affordable, reliable and modern energy services.



SDG target 11.6: reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Fact sheets on sustainable development goals: health targets

Air quality and health

Air pollution is the largest single environmental risk to health, responsible for an estimated 7 million premature deaths every year globally and about 556 000 in the WHO European Region (Fig. 1) (1,2). Tackling ambient (outdoor) and household (indoor) air pollution is crucial to achieving the 2030 Agenda for Sustainable Development, specifically the Sustainable Development Goals (SDGs) related to health, food security, sustainable cities, industrialization, reducing inequalities and mitigating the effects of climate change. Action is necessary across all sectors to reduce air pollution.

Overview

Air pollution is the contamination of the air we breathe, indoors or outdoors, by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (3). Air pollution is an important determinant of health. Even at relatively low concentrations, particulate matter (PM) can produce adverse effects on health, with no evidence of a safe level of exposure or a threshold below which no adverse health effects occur (3). Health effects are observed and vary with short-term (hours or days) or long-term (months or years) exposure to airborne pollutants, and depend on the variety of air pollution sources.

Small PM of diameter 10 μm (PM_{10}) or 2.5 μm or less ($\text{PM}_{2.5}$) is the most harmful air pollutant to health; ground-level ozone, nitrogen oxides and sulfur oxides are also of concern as these are the main precursors of secondary PM in the atmosphere. Exposure to these has been associated with a range of health effects, including



cardiovascular diseases (ischaemic heart disease and stroke), chronic obstructive pulmonary disease, acute lower respiratory infections and lung cancer; evidence is also growing for other health effects (4).

The WHO air quality guideline (AQG) values for PM (5) are as follows:

- for PM_{2.5}: 10 µg/m³ for the annual average and 25 µg/m³ for the 24-hour mean; and
- for PM₁₀: 20 µg/m³ for the annual average and 50 µg/m³ for the 24-hour mean.

In addition to these guideline values, the WHO AQGs provide interim targets for some air pollutants, aimed at promoting a gradual shift to lower concentrations and reducing human exposure to air pollution (5).

In Europe, emissions of the main air pollutants have been declining, but a large part of the European population is still exposed to air pollution that exceeds the WHO AQGs (6). Exposure to air pollution is largely beyond individuals' control; it affects both current and future generations and has no respect of boundaries. For these reasons, it requires action by public authorities at the national, regional and international levels, with a multisectoral and multistakeholder approach that engages sectors such as transport, housing, energy, industry and agriculture to develop and effectively implement long-term policies to reduce the risks of air pollution to health.

Air quality and SDGs: facts and figures



Reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination: while much has been done to improve air quality, evidence for adverse health effects from air pollution persists in many parts of the world including in the WHO European Region.



- Despite reductions in emissions of PM₁₀, the majority (50–92%) of the urban population in monitored European countries was exposed to concentrations above the WHO AQG annual guideline value between 2000 and 2015, as reported to the European Environment Agency (7).
- Levels of PM_{2.5} exceeded the WHO AQGs at 75% of stations in monitored countries of the WHO European Region in 2015 (7).
- Air pollution was responsible for about 556 000 premature deaths in the WHO European Region in 2016 (1).
- Exposure to PM reduces the life expectancy of every person in the WHO European Region by an average of almost 1 year, mostly because of the increased risk of cardiovascular and respiratory diseases, and lung cancer (8).
- The costs of health care for the sick and the loss of productivity caused by air pollution in the WHO European Region was estimated to be about US\$ 1.6 trillion in 2010 (9).

Ending preventable newborn and child deaths: poor indoor and outdoor air quality is among the most common environmental exposures associated with a high overall burden of disease among children and adolescents in the WHO European Region (10).

- Exposure to air pollution in children has been associated with respiratory infections, asthma and allergic symptoms, ear inflammation and deficits in lung function, as well as cognitive impairment (11).
- Exposure to PM during pregnancy has also been associated with adverse birth outcomes, such as preterm births, low birthweights and small for gestational age newborns (11).

Reducing premature mortality from noncommunicable diseases: air pollution largely contributes to the burden of disease from stroke, ischaemic heart disease, lung cancer and both chronic and acute respiratory diseases, including asthma. Air pollution has been highlighted as one of the priority action areas in the Action Plan for the Prevention and Control of Noncommunicable Diseases in the WHO European Region 2016–2025 (4, 12).

- The estimated fraction of premature deaths attributable to ambient and household air pollution (based on 2016 data) indicates also the magnitude of the health gains of reducing air pollution towards the WHO AQG values. The burden is higher in countries of the WHO European Region

that are of low and medium income (LMIC) than in those with high income (HIC): 12% for stroke (9% in HIC), 15% for ischaemic heart disease (11% in HIC), 15% for lung cancer (8% in HIC), 22% for chronic obstructive pulmonary disease (13% in HIC) and 22% for acute lower respiratory infections (12% in HIC) (1).



Air pollution affects gender groups in different ways. Globally, harmful indoor air pollution resulting from cooking and heating with solid fuels on open fires or traditional stoves has a disproportionate effect on women and children, who receive the highest exposures (13).

In some areas of the European Region, household air pollution remains a contributor and risk factor to the burden of disease among older women (13).



Air pollution affects Member States of the WHO European Region in different ways (Box 1).

- In 2016, data from modelled exposure showed that 94% of the population in LMIC and 76% in HIC of the European Region were exposed to PM_{2.5} concentrations exceeding the WHO AQGs (16).
- Deaths from ambient air pollution occur in all countries regardless of their level of income. In the WHO European Region in 2016, nearly 205 000 deaths were attributable to ambient air pollution in HIC and 304 000 in LMIC (4, 17).
- Deaths from household air pollution are over 10 times higher in LMIC than in HIC: 52 000 and 4000, respectively (14).
- The annual economic cost of premature deaths and diseases caused by air pollution was estimated in 48 Member States of the WHO European Region in 2015 and was equivalent to more than 1% of gross domestic product for 44 countries (9).



The most common sectors contributing to air pollution are agriculture, energy, transport, industrial, commercial and waste sectors, plus household solid fuel combustion; another important source is tobacco smoke (4, 5, 7, 11, 18, 19). Data are only available for part of the WHO European Region through reports by Member States to the European Environment Agency.¹



• **Ensure sustainable food production systems:** the agricultural sector is an important source of both air pollutants and greenhouse gases, being the main emitter of ammonia (94%) and methane (54%), and the third most important source of PM₁₀ primary emissions in the 28 Member States of the European Union (EU28) in 2015 (7). A range of technically and economically viable measures to minimize emissions of air pollutants and greenhouse gases in the agricultural sector are available but have yet to be adopted at the scale and intensity necessary to deliver emission reductions.



• **Ensure universal access to affordable, reliable and modern energy services:** good progress has been made towards sustainable energy policies in the EU since 2000, with an observed downward trend in emissions from the energy production and distribution sector, apart from ammonia. However, the energy sector remains responsible for the largest releases of sulfur oxides and some heavy metals (7).



- o Commercial, institutional and household sector fuel combustion, including wood and other biomass combustion, dominated the emissions of primary PM_{2.5} and PM₁₀, black carbon, benzo[a]pyrene (result of incomplete combustion of organic matter) and carbon monoxide in the EU28 in 2015 (7).



- o Strategies and interventions recommended to reduce ambient concentrations of pollutants emitted from residential heating devices include encouraging fuel switching (away from coal and other solid fuels), the use of more efficient heating technologies, the use of filters and provision of educational campaigns addressing improved burning practices (20).

¹Thirty-three countries: 28 Member States of the European Union (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden and the United Kingdom) plus Iceland, Liechtenstein, Norway, Switzerland and Turkey). Cooperating countries are Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Kosovo, under the UN Security Council Resolution 1244/99, Montenegro and Serbia.

- **Promote inclusive and sustainable industrialization, upgrade infrastructure and retrofit industries:** industry processing and product use sectors considerably reduced emissions of air pollutants between 2000 and 2015, with the exception of benzo[a]pyrene, arsenic and ammonia (7).
- **Provide access to safe, affordable, accessible and sustainable transport systems for all:** emissions from the road transport sector have declined considerably since 2000 (except for some heavy metals) and yet the road transport sector was the largest contributor to total nitrogen oxides emissions and the second largest emitter of black carbon in 2015 (6). Transport also remains an important source of greenhouse gases within the EU.
- **Reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management:** effective measures include urban design, transportation policy and energy generation and distribution (7,9).
- **Integrate climate change measures into national policies, strategies and planning:** the relationships between air pollutants and climate change are complex and vary with local conditions. Reducing air pollution can be linked to reducing emissions of carbon dioxide and short-lived climate pollutants, and vice versa. Carbon-cutting policies that provide health benefits include those that reduce emissions of health-damaging pollutants through changes in energy production, energy efficiency, sustainable transportation and control of landfills, among others (7,21). Policy coherence in air quality and climate change mitigation need to be ensured.
 - o It is estimated that full and adequate implementation of the country-specific national determined contributions across the WHO European Region would reduce air emissions of PM_{2.5} by 17%, sulfur dioxide by 25% and nitrogen oxides by 13% from 1990 levels (21).
 - o Reducing air/climate pollutants would prevent around 74 000 premature deaths annually in the WHO European Region by 2030 (21).

Box 1. Leaving no one behind...

Improving air quality is among the measures that have the greatest potential impact on health

equity: deaths associated with household air pollution related to the combustion of solid fuels for heating and cooking, which disproportionately affects the socially disadvantaged and the most vulnerable population groups, are more than 10 times greater in LMIC than in HIC in the WHO European Region (14).

Some vulnerable groups (e.g. older adults, children, pregnant women and people with an underlying disease, such as asthma) may be more at risk and may develop more severe health effects when exposed to air pollution. Countries can help to implement WHO's indoor AQGs by creating incentives and opportunities to ensure citizens have access to sustainable, clean and healthy energy solutions in homes and public places and to ensure a healthy indoor environment, especially in child care facilities, kindergartens, schools and public recreational settings (15).

Commitment to act

At the Rio+20 Conference of the United Nations in 2012, Member States committed themselves to promote sustainable development policies that support healthy air quality in the context of sustainable cities and human settlements, recognizing that reducing air pollution leads to positive effects on health (22).

In May 2015, at the 68th World Health Assembly, Member States adopted resolution WHA68.8 (Health and the Environment: Addressing the Health Impact of Air Pollution), which recognized clean outdoor and indoor air as a basic right and the urgent need for involvement of the health sector in responses to the effects on health from air pollution (23). The draft roadmap for an enhanced global response to the adverse health effects of air pollution, adopted at the 69th World Health Assembly (24), provided a global framework to guide actions by Member States, WHO and stakeholders.

The roadmap enables the health sector, supported by WHO, to take a leading role in raising awareness of both the impact of air pollution on health and the opportunities for public health. It covers the period 2016–2019 and articulates the path towards an enhanced global response to the adverse health effects of air pollution around four categories: expanding the knowledge base, monitoring and reporting, global leadership and coordination, and institutional capacity strengthening. It also focuses on building and disseminating global evidence and knowledge relating to the impacts on health of air pollution, and on the effectiveness (in health terms) of policies to address air pollution.

In the WHO European Region, air quality and health continue to be high on the agenda of the European Environment and Health Process, as reflected in the outcome documents of the Ministerial Conferences on Environment and Health (15,25,26), including at the Sixth Ministerial Conference, in 2017 in Ostrava, where the 53 Member States of the WHO European Region committed to improving indoor and outdoor air quality for all (26).

Annex I to the Ostrava Declaration offers a compendium of possible actions for the improvement of air quality under strong leadership of the health sector, with emphasis on the importance of cross-sectoral cooperation (Boxes 2 and 3) (27).

Box 2. Possible actions to improve indoor and outdoor air quality for all

Annex I to the Ostrava Declaration (27) lists the following actions.

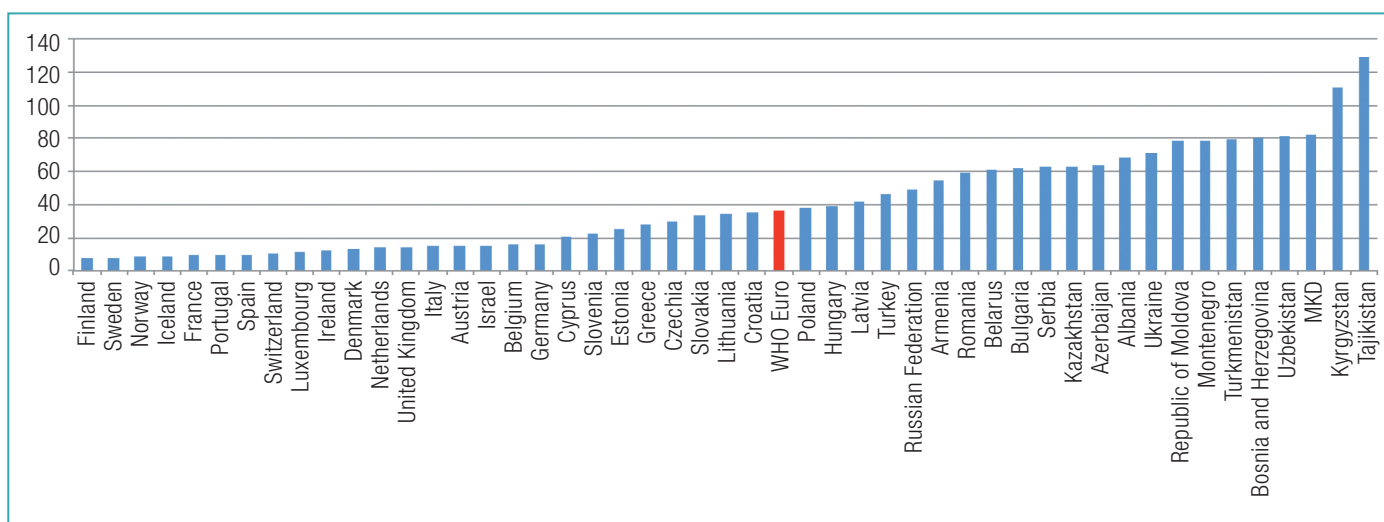
- Develop, in line with the Batumi Action for Cleaner Air and World Health Assembly resolution WHA68.8, comprehensive national and local strategies and actions that reduce air pollution, peoples' exposure to it and its health impacts with the engagement of the environment, health and other relevant sectors.
- Encourage the implementation of the UNECE Convention on Long-range Transboundary Air Pollution and promote ratification and implementation of its relevant protocols to bring about further improvements in air quality and health across the Region.
- Develop and strengthen cross-sectoral and multistakeholder cooperation on air quality improvement at national and regional levels, including on sharing of monitoring data.
- Ensure that public health and environment authorities take a leading role in raising public awareness of issues related to air quality and health, including through collaboration with stakeholders through appropriate communication, dissemination and advocacy activities.
- Improve air quality monitoring at national and local levels, linking it to health surveillance and data management for diseases related to air pollution using harmonized data collection for health impact assessment.
- Develop and/or strengthen a national emission inventory and monitoring system to collect data on air pollutants emitted by various sources.
- Provide training opportunities and facilitate research on air quality and health, and develop tools and guidance targeting public health, environment and other authorities at national and local levels to encourage actions to address air pollution through evidence-based policy-making.
- Reduce indoor air pollution caused by, inter alia, cooking, heating, tobacco smoke, inadequate ventilation, mould and chemicals in indoor air. This reduction should be achieved by promoting and applying clean energy, appropriate ventilation, measures described in the WHO Framework Convention on Tobacco Control and other appropriate actions.
- When taking national and local actions on improving indoor and ambient air quality, pay special attention to vulnerable populations including children, youth, women and the chronically ill.
- Take into account the WHO air quality guidelines and indoor air quality guidelines in the policy-making process, including in the development or updating of national air quality standards and air quality management policies.

Box 3. Intersectoral action

Engagement of the environment, health and other relevant sectors is necessary to reduce air pollution: available evidence on sources of air pollution emissions suggests that several sectors should be targeted across the WHO European Region. Motorized road transport, household fuel combustion, together with agriculture and industrial coal burning, are emission sources of special concern in terms of their contribution to air quality and the health impacts of ambient and household air pollution, as well as the consequent societal costs (7,9).

Effective action to reduce air pollution requires a good understanding of its causes, the transport and transformation of pollutants in the atmosphere, and how air pollution can affect humans, ecosystems, climate and, subsequently, society and the economy. Therefore, quantitative estimates of the health impact of air pollution are increasingly important to allow policy-makers and other stakeholders to devise and implement more effective local, national, and global policies aimed at its reduction. An assessment of the health risks of air pollution, for which there are a number of tools available (28), can aid this process by answering specific policy questions.

Fig.1. Age-standardized mortality rate attributed to household and ambient air pollution (per 100 000 population), 2016



Note: MKD: The former Yugoslav Republic of Macedonia; WHO Euro: WHO European Region.

Source: Global Health Observatory (2).

Monitoring progress

As proposed in the Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development of the United Nations Economic and Social Council (ECOSOC), the following will support monitoring progress in improving air quality (29).

ECOSOC indicators

3.9.1. Mortality rate attributed to household and ambient air pollution

7.1.2. Percentage of population with primary reliance on clean fuels and technology

11.6.2. Mean urban air pollution of particulate matter (PM₁₀ and PM_{2.5})

Health 2020 core indicators

(1) 1.1.a. Age-standardized overall premature mortality rate (from age 30 to under 70 years) for four major noncommunicable diseases (cardiovascular diseases (ICD-10 codes I00–I99), cancer (ICD-10 codes C00–C97), diabetes mellitus (ICD-10 codes E10–E14) and chronic respiratory diseases (ICD-10 codes J40–47) (30)) disaggregated by sex

The monitoring of both ambient and indoor air quality and the health impacts of air pollution is very important, especially to bridge the monitoring gap between HIC and LMIC. New developments, such as modelling and satellite data, need to be incorporated to generate information about air quality and to reduce the monitoring gap wisely.

WHO support to its Member States

The WHO Regional Office for Europe supports Member States in their efforts and actions to prevent and reduce the health effects of air pollution, under the European Environment and Health Process, by developing guidelines, providing technical support and tools to facilitate assessment and quantification of the health impacts of air pollution, as well as through capacity-building and advocacy (24). In order to facilitate more harmonized data collection and reporting on air pollution exposure and associated health impacts, WHO and partners are refining and developing monitoring and reporting tools (31).

WHO is currently working on updating the global AQGs in order to provide revised values for several air pollutants as well as formulating public health recommendations intended to assist policy-makers, health care providers and other relevant stakeholders in making informed policy decisions regarding air quality and the protection of health from the adverse effects of air pollution.

Partners

WHO collaborates with a range of partners to reduce the burden of disease caused by air pollution and to improve air quality, such as the EU, its institutions and agencies; other United Nations organizations; and stakeholders. The work is implemented also through intersectoral networks, such as the Joint Convention/WHO Task Force on the Health Aspects of Long-range Transboundary Air Pollution, chaired by the WHO European Centre for Environment and Health (32). Moreover, the WHO collaborating centres support WHO activities.

Resources

- BreatheLife campaign: a joint campaign led by WHO, United Nations Environment and the Climate & Clean Air Coalition (CCAC)
<http://breathelife2030.org/>
- Compendium of possible actions to advance the implementation of the Ostrava Declaration
http://www.euro.who.int/__data/assets/pdf_file/0008/341945/Annex1_13June.pdf?ua=1
- European Health Information Gateway theme page: air quality
<https://gateway.euro.who.int/en/themes/air-quality/>
- Health aspects of long-range transboundary air pollution
<http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/activities/health-aspects-of-long-range-transboundary-air-pollution>
- WHO air quality guidelines: global update 2005
http://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf
- WHO guidelines for indoor air quality: household fuel combustion
<http://www.who.int/airpollution/guidelines/household-fuel-combustion/en/>
- WHO guidelines for indoor air quality: selected pollutants
http://www.euro.who.int/__data/assets/pdf_file/0009/128169/e94535.pdf
- WHO guidelines on indoor air quality: dampness and mould
http://www.euro.who.int/__data/assets/pdf_file/0017/43325/E92645.pdf

Key definitions

- **Benzo[a]pyrene.** A polycyclic aromatic hydrocarbon (5) that is produced through the incomplete combustion of solid fuels (coal, wood and biomass) and agricultural waste (7).
- **Black carbon.** A PM mainly produced by combustion engines (especially diesel), residential burning of wood and coal, power stations using heavy oil or coal, field burning of agricultural wastes, and forest and vegetation fires (7,33). Black carbon is a short-lived climate forcer, which contributes to warming the Earth's atmosphere (5).
- **Ground-level ozone.** A colourless, reactive oxidant gas in the atmosphere formed through a series of complex reactions between nitrogen dioxide and solar radiation, facilitated by a variety of volatile organic compounds (5). The ambient concentrations of ozone depend on factors such as sunshine intensity and atmospheric convection, among others.
- **Nitrogen oxides.** These are produced by combustion of fuel and are generally found in the atmosphere in close association with other primary pollutants (5). They are also a precursor of ozone and, therefore, coexist in photochemically generated oxidant pollution. Road traffic and electricity generation tend to be among the main sources of this pollutant.

- **Particulate matter.** A complex mixture of solid and liquid particles of organic and inorganic substances suspended in air that can penetrate and lodge deep inside the lungs (5).
 - o PM₁₀ refers to the mass concentration of particles with a diameter of less than 10 µm; and
 - o PM_{2.5} refers to the mass concentration of particles with a diameter of less than 2.5 µm (often called fine particulate matter); in most locations in Europe, PM_{2.5} constitutes 50–70% of PM₁₀.
- **Sulfur dioxide.** A primary air pollutant derived from the combustion of fossil fuels containing sulfur, most notably coal and oil. Nowadays, in developed countries, much of the sulfur is removed from fuels in the refining process and from stack gases prior to emission (5).

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