

» Environment at a Glance Indicators



Air quality

Context

Issues at stake

Atmospheric pollutants from energy transformation and energy consumption, and from industrial processes, are the main contributors to regional and local air pollution. Major concerns relate to their effects on human health and ecosystems. Human exposure is particularly high in urban areas where economic activities are concentrated. Degraded air quality can have substantial economic and social consequences, from health costs and a lower quality of life to infrastructure maintenance, reduced agricultural output and forest damage.

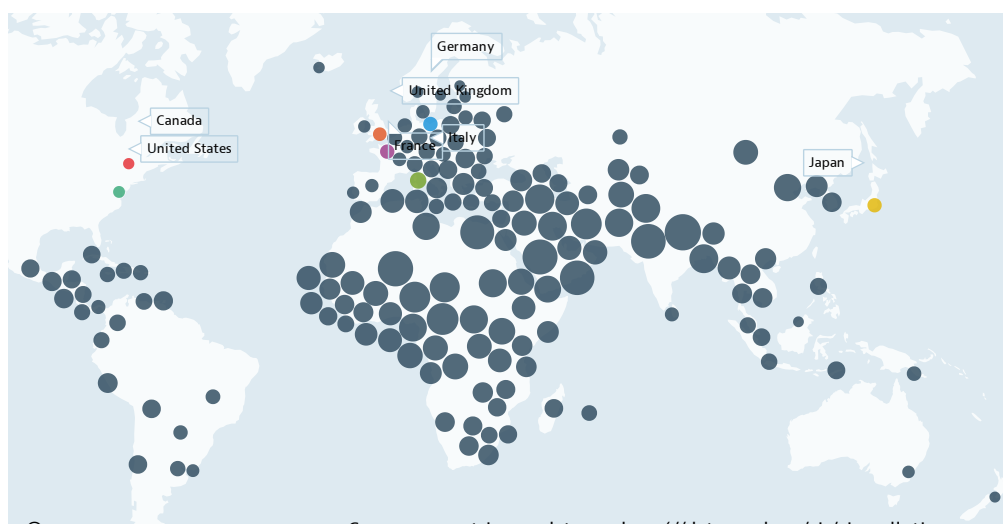
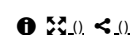
In the atmosphere, **emissions of sulphur and nitrogen** are transformed into acidifying substances such as sulphuric and nitric acid. When these substances reach the ground, acidification of soil, water and buildings occurs which cause severe environmental damage. Nitrogen oxides (NO_x) also contribute to ground-level ozone formation and are responsible for eutrophication, reduction in water quality and species richness. They are associated with adverse effects on human health because high concentrations cause respiratory diseases.

Fine particulate matter (PM_{2.5}), is another serious pollutant globally from a human health perspective. Chronic exposure even to moderate levels of PM_{2.5} substantially increases the risk of heart disease and stroke, the leading causes of death in OECD countries. It also increases the risk of respiratory diseases, including lung cancer, chronic obstructive pulmonary disease and respiratory infections. Emissions from transport, industry, electricity generation, agriculture and domestic (household) sources are the main contributors to outdoor air pollution.

Policy challenges

- Emissions can be reduced by **substituting dirty fuels for cleaner ones**, focusing development on cleaner industries, reducing consumption of polluting products and adopting cleaner technologies. Behavioural and lifestyle changes are also important.
- Policies that provide **incentives** across a broad spectrum of firms and consumers (e.g. emission or energy taxes) tend to be more cost-efficient than those that target a specific product, fuel or technology (e.g. subsidies for electric cars).
- Both the **sources of air pollution** and **severity of exposure** vary across and within countries. Hence it is important to tailor policies to specific local circumstances. For example, more stringent measures are required in densely populated areas or for emission sources located upwind from urban areas. Such spatially heterogeneous policies help achieve environmental objectives at lower costs than measures that apply uniformly to sources in all locations and to populations at all risk levels.

Air pollution exposure ([//data.oecd.org/air/air-pollution-exposure.htm](https://data.oecd.org/air/air-pollution-exposure.htm)) Exposure to PM2.5, Micrograms per cubic metre, 2017



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Measuring progress and performance

Environmental performance can be assessed against domestic objectives and international commitments. In Europe and North America, acidification has led to several international agreements among which the Convention on Long-Range Transboundary Air Pollution (1979), and its eight protocols to reduce emissions of sulphur (Helsinki 1985, Oslo 1994, Gothenburg 1999), nitrogen oxides (Sofia 1988, Gothenburg 1999), volatile organic compounds (Geneva 1991, Gothenburg 1999), and ammonia (Gothenburg 1999). Two other protocols aim at reducing emissions of heavy metals (Aarhus 1998) and persistent organic pollutants (Aarhus 1998).

Progress can be assessed by measuring the exposure of population to air pollutants, and by examining the health consequences and their economic costs. The costs of air pollution mainly arise from its detrimental impact on human health. These take the form of shorter life expectancy, increased healthcare costs and reduced labour productivity. Further consequences include reduced agricultural output and damage to ecosystems and materials.

Indicator groups

- Pollutant emissions and intensities: fine particulates (PM_{2.5}), nitrogen oxide (NO_x) and sulphur oxide (SO_x).
- Air quality and health: population exposure to fine particulates (PM_{2.5}), mortality from PM_{2.5} and welfare cost of PM_{2.5} mortality.

Pollutant emissions

Key messages

- In most OECD countries, **PM_{2.5} emission levels and intensities** are steadily decreasing since 2000 thanks to optimised combustion processes, a decrease of solid fuels in energy mix, and lower emissions from transport and agriculture.
- Compared to 2000, **SO_x emissions** have continued to decrease for the OECD as a whole.
- **NO_x emissions** have also decreased in the OECD overall since 2000, but less than SO_x emissions.
- By 2017, almost all OECD countries reached their SO_x and NO_x **emission targets** for 2020 and the other few are on track to meet them.

Main trends and recent developments

In most OECD countries, **PM_{2.5} emission levels and intensities** are steadily decreasing since 2000. These improvements can be attributed to optimised combustion processes (in industries and households heating), a decrease of solid fuels in energy mix, and lower emissions from transport and agriculture. However, in large countries (e.g. Canada, United States), emission levels and intensities remain high due to important construction sites, unpaved roads, fields and smokestacks or fire. Most particles form in the atmosphere as a result of complex reactions of chemicals such as SO_x and NO_x, which are emitted from power plants, industries and automobiles.

Compared to 2000, **SO_x emissions** have continued to decrease for the OECD as a whole as a combined result of changes in energy demand through energy savings and

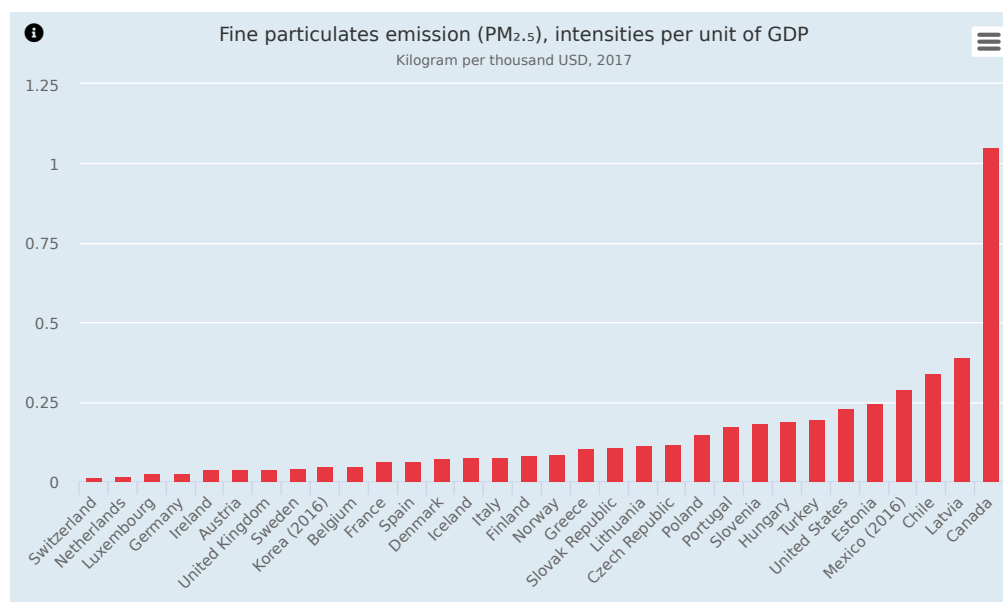
fuel substitution, pollution control policies and technical progress. All countries reached the goal they fixed under the Gothenburg protocol for 2010.

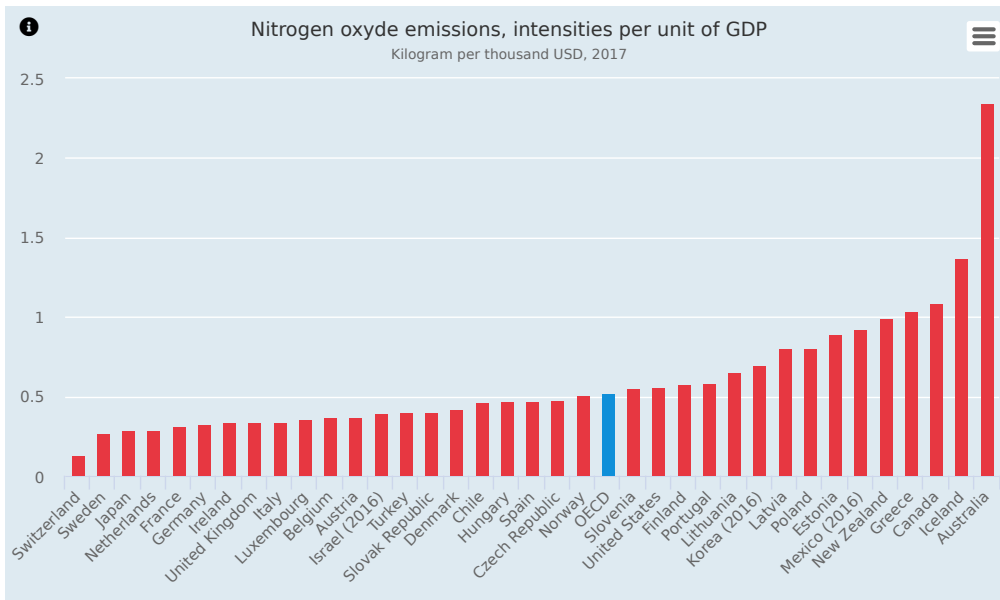
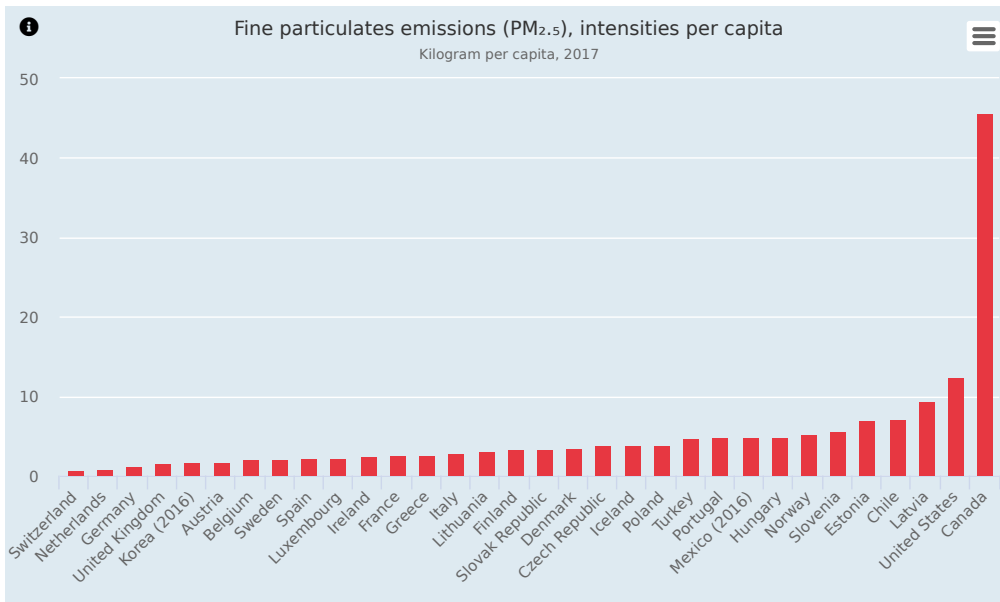
NO_x emissions have also decreased in the OECD overall since 2000, but less than SO_x emissions. This was mainly due to changes in energy demand, pollution control policies and technical progress. In the late 2000s, the slowdown in economic activity following the 2008 economic crisis further contributed to reduce emissions. However, these results have not compensated in all countries for steady growth in road traffic, fossil fuel use and other activities generating NO_x. Several countries attained the emission ceilings of the Gothenburg Protocol for 2010, but other countries had difficulties in doing so.

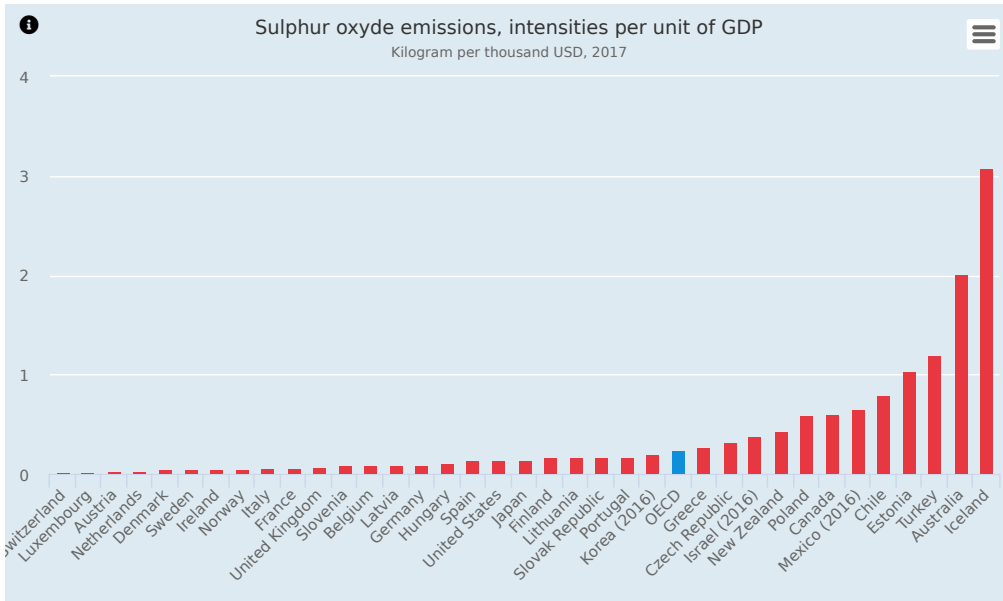
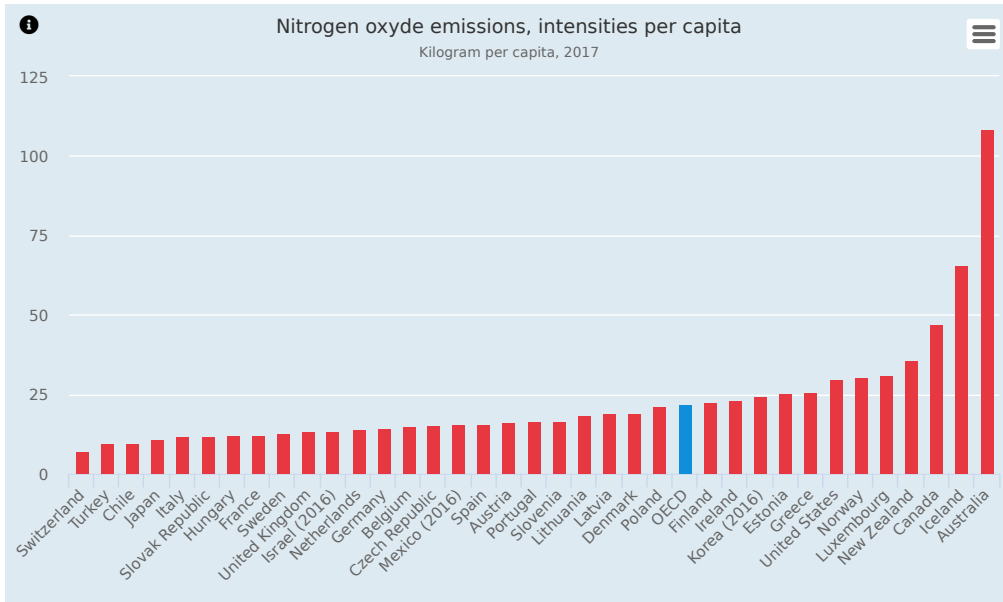
By 2017, almost all OECD countries reached their SO_x and NO_x **emission targets** for 2020 and the other few are on track to meet them. However, some OECD countries with the highest levels of emissions have not ratified the protocol (Australia, Japan, the United States, Turkey).

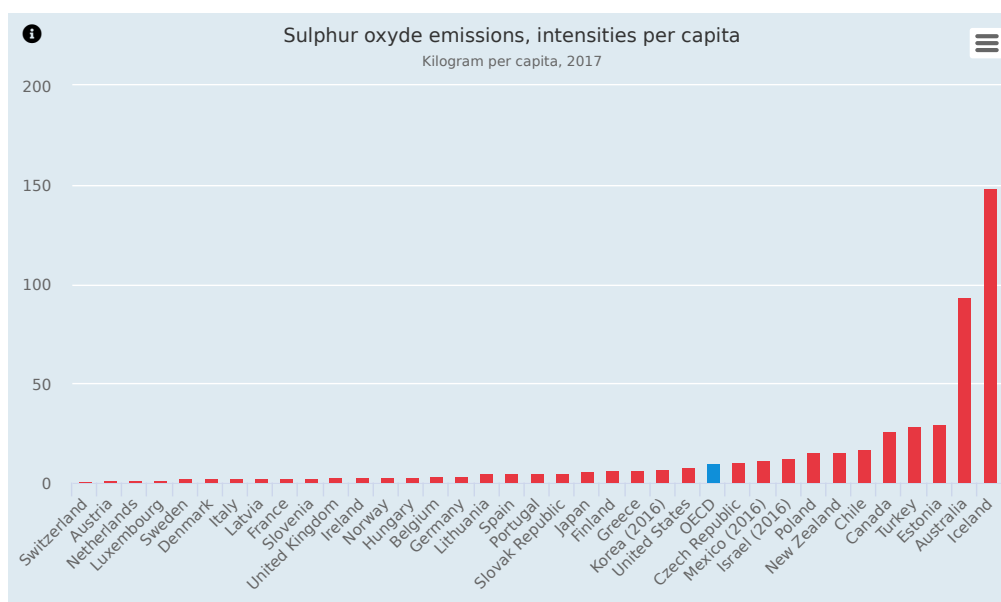
Emission intensities per capita and per unit of GDP show significant variations among OECD countries. Almost all OECD countries have achieved a strong decoupling from economic growth since 2000. High levels and rise of NO_x emissions in Australia are due to industrial combustion, power stations and growing vehicle ownership.

Indicators









Comparability and interpretation

International data on emissions are available for almost all OECD countries. The details of estimation methods for emissions such as emission factors and reliability, extent of sources and pollutants included in estimation, etc., may differ from one country to another. The high emission levels of SO_x for Iceland are due to H₂S emissions from geothermal power plants (expressed as SO₂). The high emission levels of PM_{2.5} for Canada is due to dust from construction operations and unpaved and paved roads (around 60% of total emissions in 2017). OECD totals do not include Chile and Mexico.

For further details see the metadata in the source databases listed under *Sources* below.

Air quality and health

Key messages

- Despite some progress, **exposure to fine particulate matter** (PM_{2.5}) remains high. Mean population exposure to PM_{2.5} has decreased in all OECD countries, however exposure remains above the WHO guideline of 10 µg/m³ in two out of three members.
- **Premature deaths due to PM_{2.5} pollution** have increased worldwide whereas they dropped in the OECD area. East European countries are the most affected (Czech Republic, Hungary, Lithuania, Latvia, Poland, Slovak Republic), with more than 500 estimated deaths per million inhabitants.
- The **welfare costs** associated to PM_{2.5} pollution represent about 3% of GDP equivalent on average in the OECD area, compared to about 4% worldwide. They have decreased in almost all OECD countries while they have increased in the rest of the world.

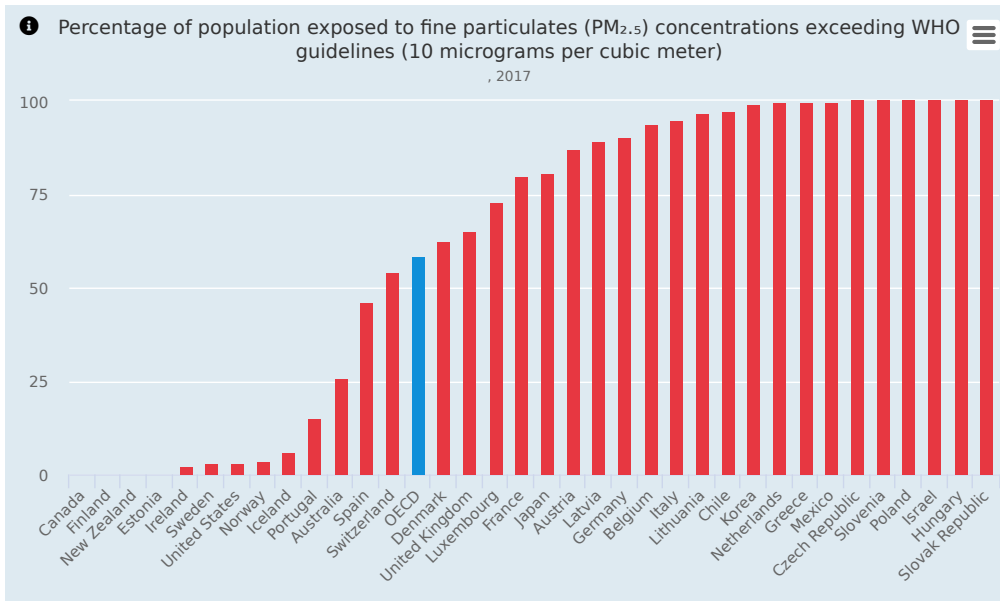
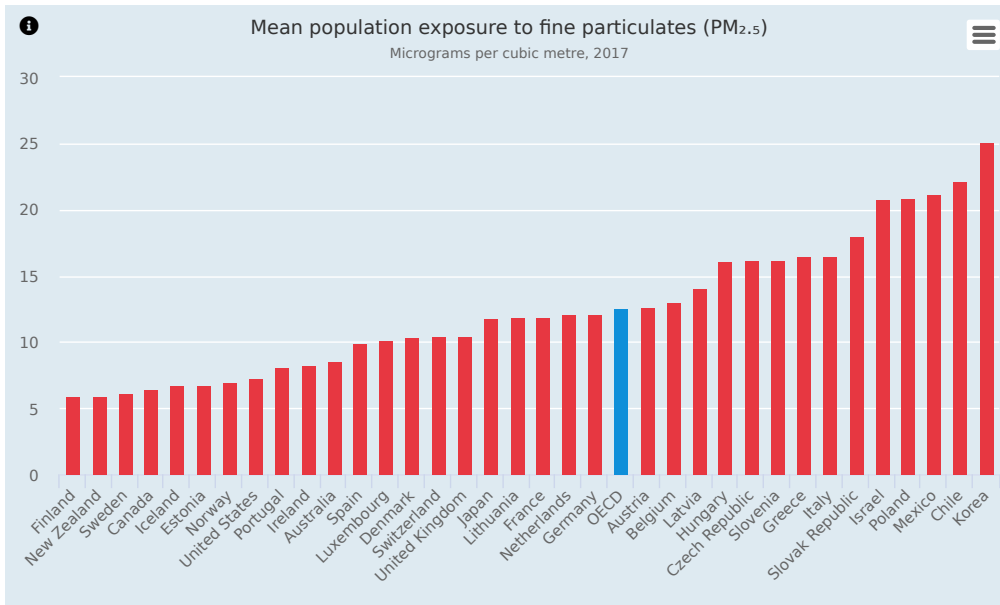
Main trends and recent developments

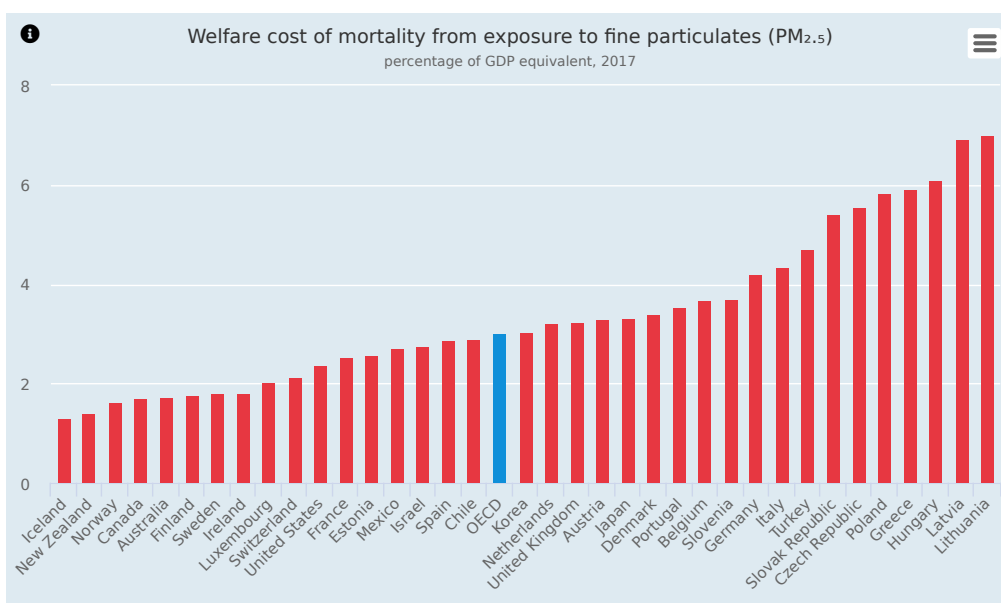
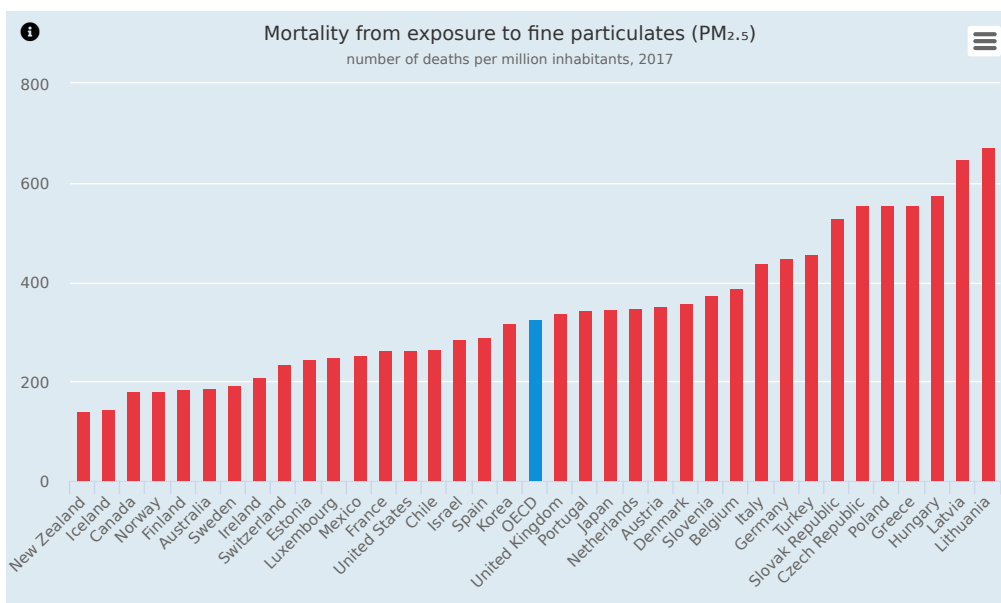
Despite some progress, **exposure to fine particulate matter** (PM_{2.5}) remains high. Mean population exposure to fine particulate matter has decreased in all OECD countries; however, two out of three still exceed the WHO guideline of 10 µg/m³. Worldwide, population **exposure to air pollution** has on average recently stabilised but is particularly severe in some countries in Asia, the Middle East and Africa.

Premature deaths due to PM_{2.5} pollution have increased worldwide whereas they dropped in the OECD area. East European countries are the most affected (Czech Republic, Hungary, Lithuania, Latvia, Poland, Slovak Republic), with more than 500 estimated deaths per million inhabitants.

In OECD countries, **associated welfare costs of premature deaths due to PM_{2.5} pollution**, represent on average about 3% of GDP equivalent, compared to about 4% worldwide. They have decreased in almost all OECD countries while they have increased in the rest of the world. The welfare costs associated to PM_{2.5} pollution are higher in Europe than in other OECD regions.

Indicators





Comparability and interpretation

International data on particulate emissions are available for many but not all OECD countries. The estimation methods for emissions, the extent of sources and particles included in estimation, may differ from one country to another.

Exposure indicators provide only a partial view of air pollution severity and consequences aggregated across the entire population. Importantly, there is generally no “safe level” of exposure for many pollutants. Even where guideline or target exposures are met, substantial public health and economic benefits can be realised through further improvements in air quality. Better estimates are needed for exposure to

both outdoor and indoor air pollution. Particular attention should be paid to exposure of sensitive groups and quantitative impact on human health (and associated distributional and equity issues). Although many important gaps remain, available data are improving. For further details see the metadata in the source databases listed under *Sources* below.

Glossary

Fine particulates (PM _{2.5}) emissions	National man-made emissions only. Emissions from international transport (aviation, marine) are excluded. Fine particulates (PM _{2.5}) refer to suspended particulates smaller than 2.5 microns in diameter that are capable of penetrating very deep into the respiratory tract and causing severe health effects. Fine particulates are potentially more toxic than small particulates (PM ₁₀) and may include heavy metals and toxic organic substances.
Mean population exposure to fine particulates (PM _{2.5})	Expressed as the mass of PM _{2.5} per cubic metre. Calculated as the mean annual outdoor PM _{2.5} concentration weighted by population living in the relevant area, that is, the concentration level, expressed in µg/m ³ , to which a typical resident is exposed throughout a year. The guideline set by the World Health Organization (WHO) for PM _{2.5} is that annual mean concentrations should not exceed 10 micrograms per cubic meter, representing the lower range over which adverse health effects have been observed. The WHO has also recommended guideline values for emissions of PM _{2.5} from burning fuels in households.
Mortality from exposure to fine particulates (PM _{2.5})	Estimated number of premature deaths attributed to exposure to environmental risks, expressed per million inhabitants.
Percentage of population exposed to more than 10 micrograms per cubic meter	The proportion of people living in areas with annual PM _{2.5} concentrations exceeding the WHO Air Quality Guideline value of 10 micrograms per cubic meter.
Nitrogen oxide (NO _x) emissions	National man-made emissions only, expressed as NO ₂ . Emissions from international transport (aviation, marine) are excluded.
Sulphur oxide (SO _x) emissions	National man-made emissions only, expressed as SO ₂ . Emissions from international transport (aviation, marine) are excluded.
Welfare cost of mortality from exposure to fine particulates (PM _{2.5})	Expressed in millions constant 2010 USD using PPP as percentage points of GDP equivalent. The cost of the health impact of air pollution is evaluated in terms of what the population at large would be "willing to pay" to avoid the fatalities.

Data sources

OECD, "Air and climate: Air emissions by source", *OECD Environment Statistics* (database), <https://doi.org/10.1787/data-00598-en>.

OECD, "Air quality and health: Mortality and welfare cost from exposure to air pollution", *OECD Environment Statistics* (database), <https://doi.org/10.1787/c14fb169-en>.

References and further reading

OECD Data Portal, <https://data.oecd.org/environment.htm>.

European Monitoring and Evaluation Programme, <https://www.emep.int/index.html>.

GBD (2017), "Global Burden of Disease Study 2017 Results", Institute for Health Metrics and Evaluation, Seattle, United States, <http://ghdx.healthdata.org/gbd-results-tool>.

Mackie, A., I. Haščic and M. Cárdenas Rodríguez (2016), "Population Exposure to Fine Particles: Methodology and Results for OECD and G20 Countries", OECD Green Growth Papers, No. 2016/02, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5jlsqs8g1t9r-en>.

Roy, R. and N. Braathen (2017), "The Rising Cost of Ambient Air Pollution thus far in the 21st Century: Results from the BRIICS and the OECD Countries", *OECD Environment Working Papers*, No. 124, OECD Publishing, Paris, <https://doi.org/10.1787/d1b2b844-en>.

United Nations Framework Convention on Climate Change, <https://unfccc.int/>.

UNECE, "Convention on Long-Range Transboundary Air Pollution", https://www.unece.org/env/lrtap/multi_h1.html.

WHO Guidelines for Air Quality, <https://www.who.int/airpollution/guidelines/en/>.

Citation

OECD, "Environment at a Glance: Climate change", *Environment at a Glance: Indicators*, <http://www.oecd.org/environment/env-at-a-glance>.

Metadata, Legal and Rights

<https://doi.org/10.1787/ac4b8b89-en>

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