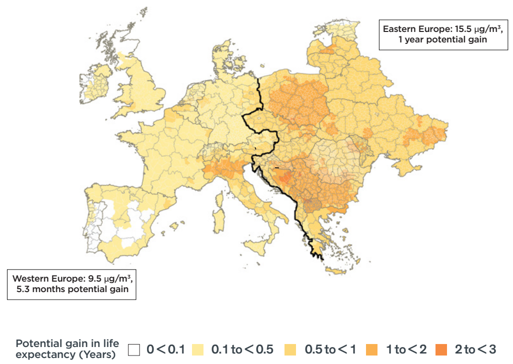
AQLI Air Quality Life Index® | Europe Fact Sheet

Thanks to sustained enforcement of strong policies, European residents are exposed to 23.5 percent less fine particulate pollution ($PM_{2.5}$) than they were in 1998, gaining 4.5 months of life expectancy because of it.[1] Despite this success, the latest scientific evidence on the impact of particulate pollution at even the low levels that exist in much of Europe reveals that 98.4 percent of the population are now living in areas with unsafe levels of pollution.[2]

KEY TAKEAWAYS

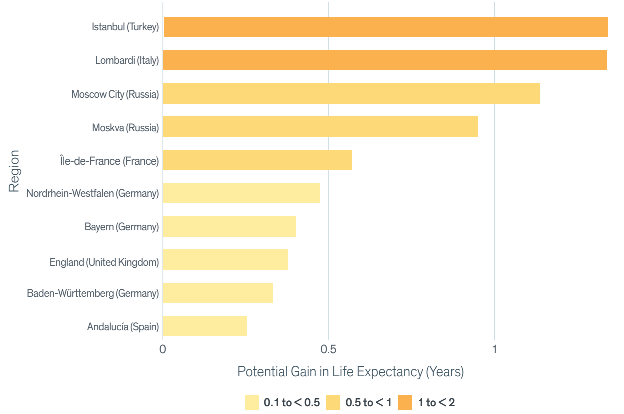
- While Europe meets its own air pollution standard of 25 µg/m³, pollution levels are still more than twice the WHO revised guideline.[3] If Europe's particulate pollution were to meet the WHO guideline, the average resident would gain 8.4 months of life expectancy, or a total of 602.4 million life years for its 860.5 million residents.
- Ninety-eight percent of Europeans, 52 out of the 53 countries for which data was available, are exposed to pollution levels that do not meet the WHO guideline. Eastern Europe is on average more polluted than Western Europe. An average Eastern European stands to lose 1 year of life expectancy relative to the WHO guideline compared to 5.3 months of life lost in Western Europe.[4]
- Bosnia and Herzegovina is the most polluted country in Europe. Particularly, the cities of Tuzla and Zenica-Doboj, and their surrounding areas, see high levels of particulate pollution. If pollution were to improve to meet the WHO guideline, residents in Tuzla (the most polluted region in the country) would add 2.5 years onto their lives.
- Italy's Po Valley is also a highly polluted part of Europe. In the most polluted city of Milano residents would gain 1.6 years if particulate pollution levels met the WHO guideline.
- In Turkey's most polluted region of Akköy, an average resident would stand to gain 2.7 years of life expectancy if pollution were reduced to meet the WHO guideline.

Figure 1 · Potential gain in life expectancy from permanently reducing $PM_{2.5}$ from 2021 concentration to the WHO guideline, comparing Eastern Europe versus Western Europe (demarcated by heavy black line)



Note: This map excludes the regions of Islas Canarias (in Spain) and Azores (in Portugal) due to space limitations. But, all underlying calculations include these regions. Refer footnote 4 for our definition of Eastern and Western Europe.

Figure 2 · Potential gain in life expectancy from reducing $PM_{2.5}$ from 2021 levels to the WHO guideline in the 10 most populous regions of Europe



1 Europe is defined as the 53 countries listed in the following file: https://drive.google.com/file/d/1CpDGkKu96HcKr5×CZ3QozldnozJMetrH/view?usp=drive_link
2 This data is based on the AQLI 2021 dataset. All annual average $PM_{2.5}$ values (measured in micrograms per cubic meter: µg/m³) are population weighted.
3 Although the EU $PM_{2.5}$ standard only applies to a subset of the countries in Europe that are in the EU, we use it as a reference point for all of Europe's 53 countries in this factsheet.
4 Western Europe is defined as the following countries: Germany, Switzerland, Italy, Monaco, Luxembourg, Belgium, France, Netherlands, Andorra, Spain, United Kingdom, Portugal, Denmark, Ireland, Iceland, Austria. Eastern Europe is defined as the countries listed in the following file: https://drive.google.com/file/d/1k7Tel92GdulJsoSl06JG2wzQdHD8qKQH/view. This definition is used only when comparing Eastern and Western Europe in this factsheet (both in text and figure 1). All other types of calculations follow the original definition of Europe (which includes a couple more countries) as listed under footnote 1.

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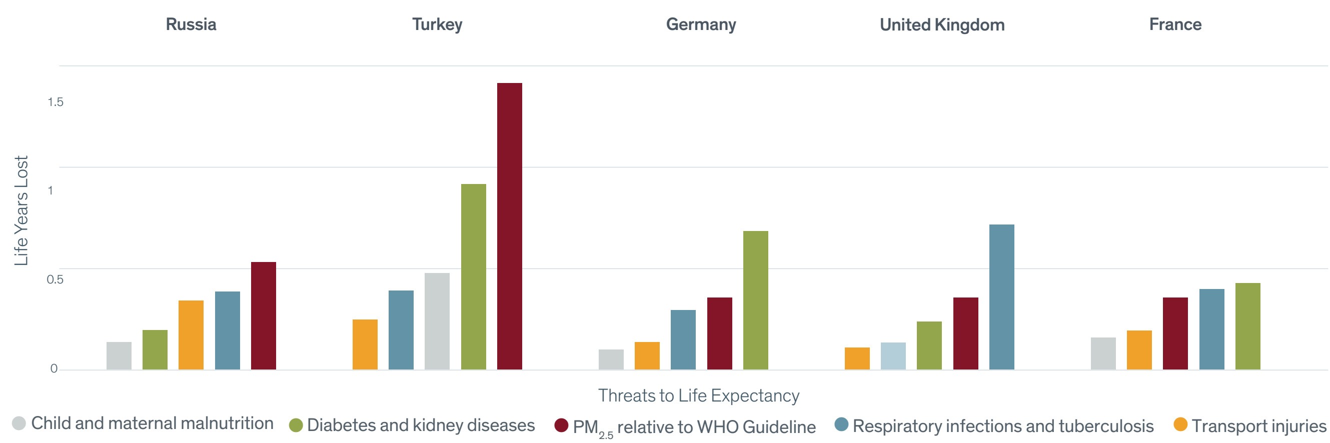
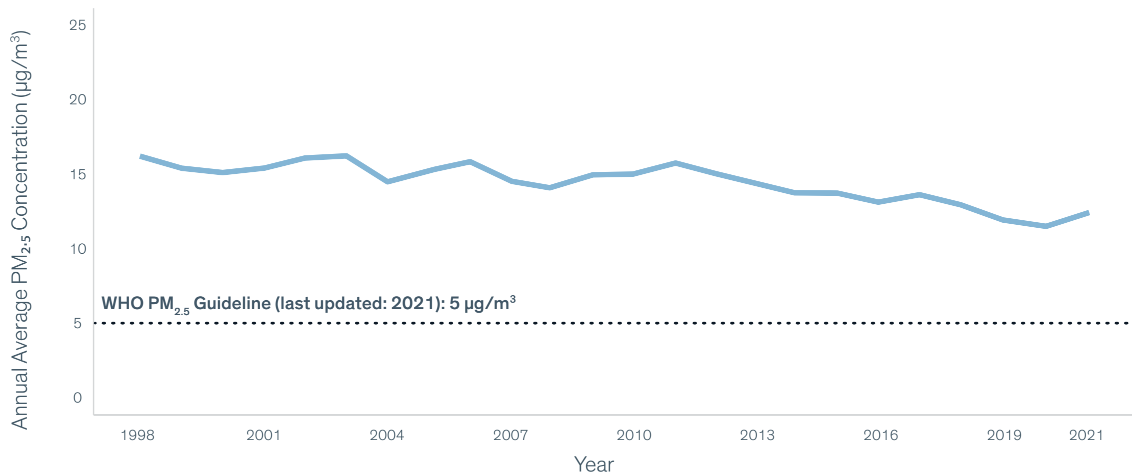
Figure 3 · Comparison of selected major global threats to life expectancy in the 5 most populous countries in Europe



Sources: Global Burden of Disease (https://vizhub.healthdata.org/gbd-results/) level-2 causes and risks data and WHO Life Tables (https://apps.who.int/gho/data/node.main.LIFECOUNTRY?lang=en) were combined with the Life table method to arrive at these results. "PM2.5 relative to WHO Guideline" bar displays the reduction in life expectancy relative to the WHO guideline as calculated by latest AQLI (2021) data.

Figure 4 · Annual average $PM_{2.5}$ concentrations in Europe, 1998-2021



POLICY IMPACTS

Much progress has been made in Europe in reducing particulate pollution. Over the last 24 years, particulate pollution has declined by 23.5 percent on average across the continent as a whole. This improvement came with the introduction of strong pollution policies starting with the creation of the European Environment Agency in the mid-1990's. In the subsequent years, the European Union set emissions targets, created a pollution standard, and introduced a comprehensive clean air program to reduce the effect of air pollution on human health.

Much work still remains to further improve air quality across Europe. Thirteen out of 53 countries (24.5 percent of the countries in this region) still don't have a national $PM_{2.5}$ standard. And although on average, countries (as a whole) are in compliance with the EU standard, there are still 24.9 million people that are breathing air that is not in compliance with the EU standard and 847.2 million people that are breathing air that does not meet the WHO guideline.

Europe is taking several active steps towards air pollution mitigation, which if continued has the potential to significantly add to the lives of its residents. Some of these actions include increasingly stricter emission standards for vehicles (Euro-6), promotion of electric vehicles, low emission zones, actively phasing out coal power, improving public transportation, etc.

Potential life expectancy impacts of particulate pollution reductions in European countries and the most polluted region in each country

Country	Annual average $PM_{2.5}$ concentration (in μg/m³)	Life expectancy gains from reducing $PM_{2.5}$ from 2021 concentrations to the WHO guideline of 5 μg/m³ in the given country (years)	Percent of population above WHO guideline	Region with highest $PM_{2.5}$ concentration in 2021	Annual average $PM_{2.5}$ concentration in most polluted region (in μg/m³)	Life expectancy gains from reducing $PM_{2.5}$ from 2021 concentrations to the WHO guideline of 5 μg/m³ in the most polluted region (years)
Albania	13.5	0.8	100	Kukësit	20.3	1.5
Andorra	7.6	0.3	100	NA	7.9	0.3
Armenia	19.5	1.4	100	NA	23.4	1.8
Austria	10.7	0.6	100	Graz Stadt	13.3	0.8
Azerbaijan	12.4	0.7	100	Sadarak	18.4	1.3
Belarus	12.8	0.8	100	Kamyanyets	15.1	1
Belgium	10.1	0.5	100	West-Vlaanderen	11.6	0.6
Bosnia and Herzegovina	23.7	1.8	100	Tuzla	30.6	2.5
Bulgaria	19	1.4	100	Asenovgrad	23.9	1.9
Croatia	14.9	1	100	Gunja	26.5	2.1
Cyprus	12.3	0.7	100	NA	12.7	0.8
Czechia	13.2	0.8	100	Karviná	21.2	1.6
Denmark	8.1	0.3	100	Lolland	9.1	0.4
Estonia	6.7	0.2	100	Mõniste	11.2	0.6
Finland	5.1	0	70.9	Eastern Uusimaa	5.7	0.1
France	9.2	0.4	100	Paris	12.7	0.8
Georgia	14.5	0.9	100	Marneuli	17.1	1.2
Germany	9.3	0.4	100	Berlin	11.7	0.7
Greece	11.8	0.7	100	East Macedonia and Thrace	15.4	1
Hungary	14.1	0.9	100	Makó	17.8	1.2
Iceland	4.1	0	0	Grindavík	4.7	0
Ireland	6.4	0.1	98.1	Dundalk	7.4	0.2
Italy	13	0.8	100	Milano	21.3	1.6
Kazakhstan	13.3	0.8	100	Saryagashskiy	30.5	2.5
Kosovo	20.8	1.5	100	Prizren	25.7	2
Latvia	14.1	0.9	100	Riga	16	1.1
Liechtenstein	11.1	0.6	100	NA	11.4	0.6
Lithuania	12.2	0.7	100	Joniškio	15.1	1
Luxembourg	8.6	0.4	100	Remich	9.1	0.4
Macedonia	22.9	1.8	100	NA	27.8	2.2
Malta	6.3	0.1	100	Xgħajra	6.8	0.2
Moldova	14.7	1	100	NA	16.2	1.1
Monaco	10.1	0.5	100	NA	10.1	0.5
Montenegro	17	1.2	100	NA	19.4	1.4
Netherlands	9.7	0.5	100	Sluis	11.3	0.6
Northern Cyprus	12.3	0.7	100	NA	13	0.8
Norway	5.6	0.1	65.9	Rolvsoey	7.7	0.3
Poland	17.9	1.3	100	Kraków (City)	26.5	2.1
Portugal	6.3	0.1	89.4	São João da Madeira	9.1	0.4
Romania	15	1	100	Timisoara	22.9	1.8
Russia	11.3	0.6	99.2	Kobyayskiy rayon	45.5	4
San Marino	10.9	0.6	100	NA	11.4	0.6
Serbia	20.2	1.5	100	Pećinci	26	2.1
Slovakia	14.5	0.9	100	Námestovo	18.7	1.3
Slovenia	13.4	0.8	100	Celje	15	1
Spain	7.5	0.2	93.1	Ceuta	11.7	0.7
Svalbard and Jan Mayen	NA	NA	NA	NA	NA	NA
Sweden	5.5	0	65.2	Karlskrona	7.4	0.2
Switzerland	9.4	0.4	100	Mendrisio	13.1	0.8
Turkey	21.8	1.6	100	Akköy	33	2.7
Ukraine	14.6	0.9	100		21	1.6
United Kingdom	8.7	0.4	99	Caerphilly	14.9	1

ABOUT THE AIR QUALITY LIFE INDEX (AQLI)

The AQLI is a pollution index that translates particulate air pollution into perhaps the most important metric that exists: its impact on life expectancy. Developed by the University of Chicago's Milton Friedman Distinguished Service Professor in Economics Michael Greenstone and his team at the Energy Policy Institute at the University of Chicago (EPIC), the AQLI is rooted in research that quantifies the causal relationship between long-term human exposure to air pollution and life expectancy. The Index then combines this research with hyper-localized, satellite measurements of global particulate matter ($PM_{2.5}$), yielding unprecedented insight into the true cost of pollution in communities around the world. The Index also illustrates how air pollution policies can increase life expectancy when they meet the World Health Organization's guideline for what is considered a safe level of exposure, existing national air quality standards, or user-defined air quality levels. This information can help to inform local communities and policymakers about the importance of air pollution policies in concrete terms.

Methodology: The life expectancy calculations made by the AQLI are based on a pair of peer-reviewed studies, Chen et al. (2013) and Ebenstein et al. (2017), co-authored by Michael Greenstone, that exploit a unique natural experiment in China. By comparing two subgroups of the population that experienced prolonged exposure to different levels of particulate air pollution, the studies were able to plausibly isolate the effect of particulate air pollution from other factors that affect health. Ebenstein et al. (2017) found that sustained exposure to an additional 10 μg/m³ of PM_{10} reduces life expectancy by 0.64 years. In terms of $PM_{2.5}$, this translates to the relationship that an additional 10 μg/m³ of $PM_{2.5}$ reduces life expectancy by 0.98 years. This metric is then combined with sea-salt and mineral dust removed satellite-derived $PM_{2.5}$ data. All 2021 annual average $PM_{2.5}$ values are population-weighted and AQLI's source of population data is https://landscan.ornl.gov/. We are grateful to the Atmospheric Composition Analysis Group, based at the Washington University in St. Louis for providing us with the satellite data. The original dataset can be found here: https://sites.wustl.edu/acag/datasets/surface-pm2-5/. To learn more deeply about the methodology used by the AQLI, visit: aqli.epic.uchicago.edu/about/methodology.

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