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**Audit brief**



# **AIR QUALITY IN THE EU**

September 2017

The European Court of Auditors is currently examining the effectiveness of EU action to reduce the health risks from air pollution.

Recent studies have found that air pollution is the main environmental cause of premature death among EU citizens: fine particulate matter was considered responsible for an estimated 436 000 premature deaths in the EU in 2013, nitrogen dioxide for 68 000 and ground-level ozone for a further 16 000. Air pollution tends to be more severe in cities than in the countryside.

The EU has established a legislative framework to reduce air pollution. The Ambient Air Quality Directive lays down common measurement techniques, criteria for assessing ambient air quality and binding limit values for the atmospheric concentration of the main air pollutants. The EU also co-finances a number of measures to improve air quality, mostly through the European Structural and Investment funds, EU research programmes and the LIFE programme. Our audit is considering whether these actions have been effective in reducing the health risks from air pollution.

In each of the six Member States sampled for this audit, we are examining in detail the situation in specific urban areas most affected by air pollution: Brussels (Belgium), Sofia (Bulgaria), Ostrava (Czech Republic), Stuttgart (Germany), Milan (Italy), and Krakow (Poland).

We are coordinating our audit with the work of 16 other supreme audit institutions in EU Member States, within the framework of the European Organisation of Supreme Audit Institutions.

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## AIR POLLUTION IN THE EU

Air pollution occurs when pollutants (gases, dust particles, smoke) are released into the atmosphere by both human activities (e.g. pollution from cars or factories) and natural phenomena (e.g. forest fires, volcanic eruptions, wind erosion, pollen dispersal or natural radioactivity). These pollutants are harmful to humans, infrastructure and the environment.

The 2016 report from the European Environment Agency (EEA) on air quality in Europe provides comprehensive information<sup>1</sup>. It shows that, overall, emissions of the main air pollutants have declined significantly since 1990 (see **Table 1**).

**Table 1 – Evolution of the main air pollutants (1990 to 2014)**

	Decrease in the EU-28 countries (1990-2014)
Nitrogen oxides (NO <sub>x</sub> )	55 %
Sulphur oxides (SO <sub>x</sub> )	88 %
Non-methane volatile organic compounds (NMVOCs)	60 %
Ammonia (NH <sub>3</sub> )	24 %
Fine particulate matter (PM <sub>2.5</sub> )	36 %

Source [EEA: emissions of the main air pollutants in Europe, 2016](#):

Nevertheless, as the EEA points out, air pollution is still responsible for a high number of premature deaths. Heart disease and strokes are the most common causes of premature death which are attributable to air pollution, followed by lung diseases and lung cancer. Fine particulate matter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>) and ground-level ozone (O<sub>3</sub>) were identified as the pollutants with the greatest impact on human health in the EU. **Table 2** provides a simple summary of the health effects of certain air pollutants. The total

<sup>1</sup> [Air quality in Europe – 2016 report – European Environment Agency](#).

external cost of these health effects is estimated to range between 330 billion euro and 940 billion euro per year<sup>2</sup>.

**Table 2 – Selected pollutants and related health effects**

		Sources	Health effects
<b>Particulate matter (PM)</b>	A complex mixture of particles of organic and inorganic substances suspended in the air. Its components include sulphate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water.	Chemical reactions, fuel combustion (e.g. burning coal, wood, diesel), industrial processes, farming, and road construction/use.	Short-term exposure can worsen heart or lung diseases and cause respiratory problems. Long-term exposure can cause cardiovascular and respiratory diseases and lung cancer.  An estimated 436 000 premature deaths per year are caused by fine PM in the EU-28.
<b>Nitrogen dioxide (NO<sub>2</sub>)</b>	A chemical compound and one of several nitrogen oxides (NO <sub>x</sub> ).	Fuel combustion processes (heating, power generation, and engines in vehicles and ships) and wood burning.	Worsens lung diseases, leading to respiratory symptoms and increased susceptibility to respiratory infection.  Causes an estimated 68 000 premature deaths per year in the EU-28.
<b>Ground-level ozone (O<sub>3</sub>)</b>	Formed by photochemical reactions between pollutants (VOCs, NO <sub>x</sub> ) in the presence of sunlight.	Volatile organic compounds (VOCs) are emitted by vehicles, solvents and industry, and NO <sub>x</sub> is derived from vehicle and industry emissions.	Can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases.  Causes an estimated 16 000 premature deaths per year in the EU-28.

<sup>2</sup> [European Commission Staff Working Document Impact Assessment \(2013\) 531 final of 18 December 2013, page 2.](#)

<b>Sulphur dioxide (SO<sub>2</sub>)</b>	Formed by the burning of sulphur or of materials containing sulphur.	The largest source of SO <sub>2</sub> in the atmosphere is the burning of fossil fuels by power plants and other industrial facilities	Short-term exposure to SO <sub>2</sub> can harm the respiratory system and make breathing difficult. SO <sub>2</sub> is also a precursor gas for PM (see above).
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Source: ECA summary of EEA annual reports on air quality and other authoritative sources.

**Table 3** shows pollutant emissions by sector in the EU-28 Member States in 2014. The energy production and distribution sector, particularly coal power plants, is an important emitter of sulphur oxides (SO<sub>x</sub>) and nitrogen oxides (NO<sub>x</sub>). Transport emits a large share of NO<sub>2</sub> and NO<sub>x</sub> pollution. Although NO<sub>x</sub> emissions have roughly halved since 1990, the EEA concluded in its 2016 report that NO<sub>x</sub> emissions from road transport had not decreased sufficiently to meet air quality standards in many urban areas.

**Table 3 – Emissions of pollutants by sector in the EU**

	Energy production and distribution	Energy use in industry	Road transport	Non-road transport	Commercial, institutional and households <sup>1</sup>	Industrial processes and product use	Agriculture	Waste
PM <sub>10</sub>	6 %	5 %	12 %	2 %	40 %	17 %	17 %	1 %
PM <sub>2.5</sub>	5 %	7 %	13 %	2 %	56 %	10 %	5 %	2 %
NO <sub>x</sub>	20 %	13 %	39 %	7 %	14 %	3 %	4 %	0 %
SO <sub>x</sub>	57 %	18 %	0 %	2 %	16 %	7 %	0 %	0 %
NH <sub>3</sub>	0 %	0 %	1 %	0 %	1 %	1 %	94 %	2 %
NMVOG	9 %	2 %	11 %	1 %	16 %	49 %	11 %	1 %

**Notes:**

<sup>1</sup> Most emissions are from households. The combustion of wood and other biomass in household heating is on the rise in some countries, contributing to PM emissions.

Source: [European Union emission inventory report 1990–2014 under the UNECE Convention on Long-range Transboundary Air Pollution – European Environment Agency](#)

## EU AIR QUALITY POLICY OBJECTIVES

In September 2005, the Commission issued its Thematic Strategy on Air Pollution<sup>3</sup>, as one of the seven thematic strategies under the Sixth Community Environment Action Programme<sup>4</sup>. By 2020, the Strategy aims to cut the annual number of premature deaths from air pollution-related diseases by almost 40 % compared with the 2000 level<sup>5</sup>.

The Seventh Environment Action Programme<sup>6</sup>, launched in September 2013, aims to improve outdoor air quality in the EU significantly by 2020, moving closer to the levels recommended by the World Health Organization.

In December 2013, the Commission published the Clean Air Programme for Europe<sup>7</sup>. This aims to tackle non-compliance with the EU's air quality standards and to ensure compliance with existing legislation by 2020.

## REGULATORY ENVIRONMENT

There is an extensive set of EU legislation dealing with air pollution. The two main directives are the 2008 Ambient Air Quality (AAQ) Directive, which sets common air quality measurement standards and local limit values for air pollution concentrations, and the 2016 National Emission Ceilings (NEC) Directive, which sets national ceilings and seeks to reduce emissions at source. Both directives target SO<sub>2</sub>, NO<sub>x</sub> and PM<sub>2.5</sub>.

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<sup>3</sup> [Communication from the Commission to the Council and the European Parliament - Thematic Strategy on air pollution COM\(2005\) 0446 of 21 September 2005.](#)

<sup>4</sup> [Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme.](#)

<sup>5</sup> [European Commission press release – 'Commission proposes clean air strategy to protect human health and the environment'.](#)

<sup>6</sup> [Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'.](#)

<sup>7</sup> [Communication from the Commission – 'A Clean Air Programme for Europe', COM \(2013\) 918 of 18 December 2013.](#)

The selected audit approach for the ECA air quality audit is concentrated on the major pollution hotspots, which are covered by the AAQ Directive and therefore the NEC and emission source Directives having national dimension are not in the main scope of this ECA audit.

### *The Ambient Air Quality Directive*

The AAQ Directive applies to the quality of outdoor air (i.e. not to air in workplaces without public access). It lays down common measurement techniques, criteria for assessing ambient air quality and binding limit values for the atmospheric concentration of the main air pollutants in all EU Member States<sup>8</sup>. The limit values in the Directive have been fixed so as to avoid, prevent or reduce the harmful effects on human health and/or the environment as a whole. Member States must attain these targets within a given period and should not exceed them once attained.

The Directive also requires Member States to produce air quality plans and short-term action plans when limit values are exceeded or there is a risk of a breach, and to inform the public adequately and in good time about air quality. Member States should also cooperate on transboundary issues and apply penalties for infringements of national provisions.

Currently the limit values set in this Directive (except for NO<sub>2</sub>) are less strict than recommended by the WHO. ***Table 4*** shows how both standards compare.

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<sup>8</sup> [Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.](#)



**Table 4 – WHO guidelines and EU limit values**

Pollutant	Period	WHO guidelines <sup>9</sup>	EU limit values
PM <sub>2.5</sub>	1 year	10 µg/m <sup>3</sup>	20 µg/m <sup>3</sup>
	24 hours	25 µg/m <sup>3</sup>	-
PM <sub>10</sub>	1 year	20 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>
	24 hours	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>
O <sub>3</sub>	8 hours	100 µg/m <sup>3</sup>	120 µg/m <sup>3</sup>
NO <sub>2</sub>	1 year	40 µg/m <sup>3</sup>	40 µg/m <sup>3</sup>
	1 hour	200 µg/m <sup>3</sup>	200 µg/m <sup>3</sup>
SO <sub>2</sub>	24 hours	20 µg/m <sup>3</sup>	125 µg/m <sup>3</sup>
	1 hour	-	350 µg/m <sup>3</sup>
	10 minutes	500 µg/m <sup>3</sup>	-

Source: ECA Comparison of WHO and AAQ Directive limits.

The Directive sets higher values for the alert thresholds for NO<sub>2</sub>, SO<sub>2</sub> and O<sub>3</sub>. When these thresholds are exceeded, Member States must take the necessary steps to inform the public via radio, television, the press or the Internet. Member States must also routinely inform the public and any relevant organisations of the ambient concentrations of pollutants, and make easily accessible important documents such as the air quality plans and annual reports on pollutant emissions.

This Directive is under review as part of the Commission's REFIT programme<sup>10</sup>.

<sup>9</sup> [WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide - Global update 2005 - Summary of risk assessment.](#)

<sup>10</sup> REFIT is part of the Commission's better regulation agenda, which aims to make EU laws simpler and easier to understand. More details can be found here: [Fitness check of the EU Ambient Air Quality Directives.](#)

### *The National Emission Ceilings Directive and other legislation*

An EU Directive on the emission ceilings that Member States must meet has been in place since 2001<sup>11</sup>. It transposes the 1979 United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution into EU law. The 2016 NEC Directive is the most recent update to this Directive<sup>12</sup>.

In addition to the above two directives, further source-specific legislation addresses, for example, industrial emissions, road and off-road vehicle emissions and fuel quality standards.

## **ROLES AND RESPONSIBILITIES**

Member State authorities are responsible for implementing and enforcing EU legislation. They take action at national, regional and local level to reduce pollutant levels and protect citizens from the effects of air pollution.

The Commission monitors Member States to see whether they apply EU environmental law correctly; it can bring infringement procedures when required. The main Commission department responsible for this policy is the Directorate-General for Environment, although several others are also involved in air quality policy-making, particularly those responsible for related policy areas and for spending programmes funding air quality measures (such as the DGs for climate, regional policy, research and innovation, mobility and transport, and growth).

The EEA has a key role in collecting and checking data from the Member States, and publishes an annual report on air quality.

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<sup>11</sup> [Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants.](#)

<sup>12</sup> [Directive \(EU\) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC.](#)

## DIFFICULTIES FACED IN MEETING EU-WIDE LIMITS ON AIR POLLUTION

The difficulties faced in meeting the EU-wide limit values can be linked to the high rates of solid fuel burning in many Member States and, as regards NO<sub>2</sub> compliance, to diesel vehicles<sup>13</sup>. In 2014, a significant, though declining, proportion of the urban population in the EU-28 was still exposed to certain air pollutant concentrations above the EU limit values. An even greater proportion was exposed to concentrations exceeding the stricter WHO guideline values (see [Table 5](#)). The Commission has opened a number of infringement procedures against Member States for PM and NO<sub>2</sub>.

**Table 5 – Percentage of EU urban population overexposed to PM and NO<sub>2</sub> (2007 to 2014)**

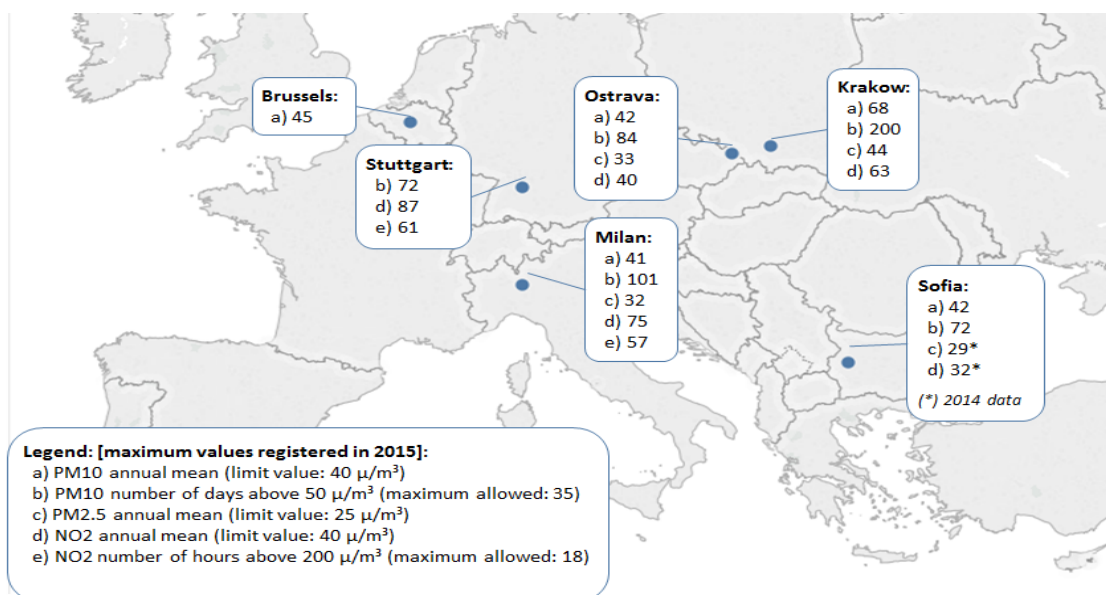
Year	PM <sub>2.5</sub>		PM <sub>10</sub>		NO <sub>2</sub>	
	EU	WHO	EU	WHO	EU	WHO
2007	11.6	90.8	30.2	85.6	22.0	22.0
2008	12.9	87.3	23.3	73.9	12.1	12.1
2009	8.8	90.7	23.6	73.5	15.0	15.0
2010	10.6	88.4	23.5	75.4	12.6	12.6
2011	13.6	92.1	28.9	81.8	12.0	12.0
2012	11.5	90.5	21.2	62.7	9.3	9.3
2013	8.6	85.0	18.9	61.3	9.3	9.3
2014	8.0	85.3	16.0	49.7	7.2	7.2

Source: [Exceedance of air quality limit values in urban areas – European Environment Agency](#)

In each of the six Member States sampled for this audit, we are examining in more detail the situation in specific urban areas most affected by air pollution: Brussels (Belgium), Sofia (Bulgaria), Ostrava (Czech Republic), Stuttgart (Germany), Milan (Italy), and Krakow (Poland). [Box 1](#) shows 2015 pollution levels in these urban areas.

<sup>13</sup> [European Commission: 'The EU Environmental Implementation Review: Common Challenges And How To Combine Efforts To Deliver Better Results'. COM \(2017\) 63 6 February 2017.](#)

### **Box 1 – Pollution in selected urban areas compared with limit values in the AAQ Directive**



Source: ECA based on EEA data

## **EU AIR QUALITY FUNDING**

The main EU instruments funding air quality projects are the European Structural and Investment funds, EU research programmes and the LIFE programme.

- The European Regional Development Fund and the Cohesion Fund include specific allocations for air quality, and also provide funding which indirectly improves air quality (in areas such as renewable energy and clean urban transport). We estimate that almost 0.9 billion euro in specific allocations was available during the 2007–2013 programme period, and another 1.6 billion euro is available during the 2014–2020 period.
- EU research programmes, in particular the Seventh Framework Programme (2007–2013) and Horizon 2020 (2014–2020), fund projects relating to air quality. We estimate that up to 13 billion euro from the Horizon 2020 programme is available for projects dealing directly or indirectly with air quality. Projects funded under the EU

research programmes are not part of the scope of the ECA audit on air quality, as they are not necessarily part of local strategies to tackle air pollution.

- The LIFE programme<sup>14</sup> is the EU's funding instrument for the environment and climate action. For the period 2014-2017, LIFE allocated 1.1 billion euro to its "Environment" sub-programme, which co-finances grants for action relevant to air quality.

## **AIR POLLUTION'S RISKS TO SOUND EU FINANCIAL MANAGEMENT**

When preparing our audits, we carry out a risk analysis of the policy area or programmes that we intend to examine. For this audit, we aim to test risks identified in the areas of

- policy design, implementation and enforcement;
- data reporting by Member States; and
- the effectiveness of EU-funded projects.

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<sup>14</sup> [Regulation \(EU\) No 1293/2013 of the European Parliament and of the Council of 11 December 2013 on the establishment of a Programme for the Environment and Climate Action \(LIFE\) and repealing Regulation \(EC\) No 614/2007.](#)

## **ABOUT ECA SPECIAL REPORTS AND AUDIT BRIEFS**

Our special reports set out the results of audits of EU policies and programmes or management topics related to specific budgetary areas.

Audit briefs provide background information based on preparatory work undertaken before the start of an ongoing audit task. They are intended as a source of information for those interested in the audited policy and/or programme.

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