

## European briefings

# Air pollution



Despite considerable improvements in past decades, air pollution is still responsible for more than 400 000 premature deaths in Europe each year. It also continues to damage vegetation and ecosystems.

Continued improvements in air pollution levels are expected under current legislation, but beyond 2030 only slow progress is expected. Additional measures are needed if Europe is to achieve the long-term objective of air pollution levels that do not lead to unacceptable harm to human health and the environment.

## Context

Poor air quality adversely affects human health, the environment, and the climate. Both short-term and long-term exposure to air pollution harms health. This harm occurs either via direct exposure to air pollutants, or indirectly via pollutants transported through the air, deposited, and then accumulated in the food chain. Air pollution also harms ecosystems by contributing to eutrophication and acidification of water and soil, leading to loss of flora and fauna. Air pollution can also harm agricultural crops and forests causing yield losses. Furthermore, certain air pollutants affect the climate system by triggering positive or negative changes in global radiative forcing (see SOER 2015 briefing on the air and climate system).

Current European Union (EU) air pollution policy is underpinned by the 2005 Thematic Strategy on air pollution (TSAP).<sup>[1]</sup> This strategy established interim objectives for air quality and also established measures to ensure progress toward the goals of the 6th Environment Action Programme (6th EAP), which ran from 2002 to 2012. The 6th EAP's goal was to attain 'levels of air quality that do not give rise to significant negative impacts on, and risks to human health and the environment'. To move toward achieving the TSAP objectives, EU air legislation follows a twin-track approach of implementing both local air quality standards and source-based mitigation controls. These source-based mitigation controls include binding national limits for emissions of the most important pollutants.

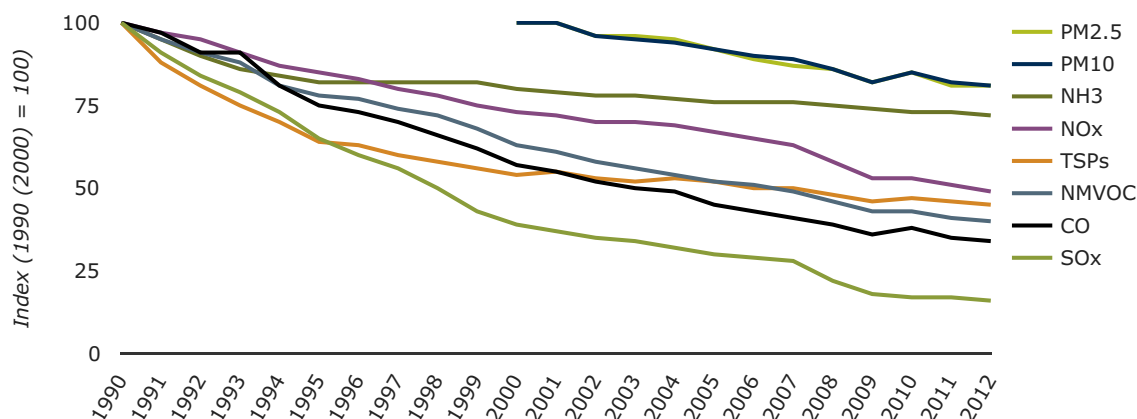
The main policy instruments on air pollution within the EU include the Ambient Air Quality Directives,<sup>[2][3]</sup> and the National Emission Ceilings (NEC) Directive,<sup>[4]</sup> which contains emission ceilings for 2010 and years thereafter. In addition, there is source-specific legislation addressing industrial emissions, road and off-road vehicle emissions, fuel quality standards etc. Emissions are also addressed internationally under the 1979 Convention on Long-range Transboundary Air Pollution.

At the local level, the EU requires air quality management plans to be implemented in areas where exceedances of air quality standards occur. These plans are required to bring concentrations of air pollutants to levels below the EU legislative limit and target values.

## Key trends

Vehicles, industry, power plants, agriculture, households, and waste contribute to Europe's air pollution. Emissions of the main air pollutants in Europe have declined in recent decades (Figure 1), resulting in generally improved air quality across the region. However, certain sectors have not followed this trend, and have seen emissions of some pollutants increase. For example, fine particulate matter (PM<sub>2.5</sub>) emitted directly into the air from coal and biomass combustion in households and from commercial and institutional buildings, have risen in the EU by around 9% and 11% respectively over the period 2003 to 2012.<sup>[5]</sup> These sources are now the most important contributors to total PM emissions in the EU.

Figure 1: EU-28 emission trends for the main air pollutants



**Note:** Parties to the Convention on Long-range Transboundary Air Pollution (LRTAP) are formally requested to report emissions of PM only for the year 2000 and onwards. Hence emission trends for these years only are shown. PM<sub>10</sub>: particulate matter with a diameter of 10 µm or less; PM<sub>2.5</sub>: particulate matter with a diameter of 2.5 µm or less; TSP: Total suspended particulate; NMVOC: Non-methane volatile organic compounds; NH<sub>3</sub>: ammonia; NO<sub>x</sub>: nitrogen oxides; CO: carbon monoxide; SO<sub>x</sub>: sulphur oxides.

**Data sources:** EEA. National emissions reported to the Convention on Long-range Transboundary Air Pollution (LRTAP Convention)

Emission reductions of certain pollutants have resulted in a notable decrease of ambient concentrations of sulphur dioxide (SO<sub>2</sub>), carbon monoxide (CO), benzene (C<sub>6</sub>H<sub>6</sub>), lead (Pb) and mercury (Hg). However, due to the complex chemistry undergone by certain pollutants in the atmosphere, emission reductions have not always produced a corresponding drop in concentrations. For example, there have been substantial reductions in emissions of many of the precursors for PM and O<sub>3</sub> in Europe, but concentrations of these have generally decreased only slowly.

Emissions from wood burning and coal burning are an important source of directly emitted PM and carcinogenic substances such as polycyclic aromatic hydrocarbons (PAHs). These emissions come from households, and commercial and institutional facilities. Emissions of benzo(a)pyrene (BaP), a PAH formed mainly from the burning of organic material, have increased by 11% between 2003 and 2012. Population exposure to BaP concentrations is significant and widespread, especially in central and eastern Europe.<sup>[5][6]</sup>

## Main air pollutants affecting human health: PM, O<sub>3</sub> and NO<sub>2</sub>

- EU limit values for PM<sub>10</sub> (Map 1) and NO<sub>2</sub> were exceeded widely in Europe in 2012. The target value for O<sub>3</sub> was also exceeded at a large number of measuring stations.
- 21% of the EU urban population lives in areas where the EU air quality 24-hour limit value for PM<sub>10</sub> was exceeded in 2012. For EEA-33 countries the estimate is 38% of the urban population. Exposure to PM<sub>10</sub> levels exceeding the stricter World Health Organization (WHO) air quality guidelines (AQGs) is significantly higher, comprising 64% of the total EU urban population in 2012.
- 14% of the urban population of both the EU and EEA-32 live in areas where the EU O<sub>3</sub> target value for protecting human health was exceeded in 2012. The percentage exposed to O<sub>3</sub> levels exceeding the WHO AQG standard is significantly higher, comprising 98% of the EU's total urban population.

### Map 1: Concentrations of PM<sub>10</sub> in 2012 at traffic, urban, industrial and rural sites

□

Source: AirBase — The European air quality database v. 8 .

Note: The red and dark red dots indicate stations reporting exceedances of the 2005 daily limit value ( $50 \mu\text{g}/\text{m}^3$ ), as set out in the Air Quality Directive (EU, 2008).

### Air pollution impacts on ecosystems

- Significant improvements in reducing ecosystem exposure to excess levels of acidification have been made over past decades, largely due to declines in emissions of sulphur dioxide, one of the main acidifying compounds. However, this improvement has not been matched with a parallel improvement in eutrophication levels. This is because emissions of pollutants containing nitrogen — which can lead to eutrophication — have not fallen as much as emissions of sulphur.<sup>[7]</sup>
- Ammonia (NH<sub>3</sub>) emitted from agricultural activities, and nitrogen oxides (NO<sub>x</sub>) from combustion processes are the predominant eutrophying air pollutants. Exceedances of eutrophication critical loads occur across most of continental Europe. It is estimated that around 63% of European ecosystem areas — and 73% of the area covered by Natura 2000-protected sites — were exposed to air-pollution levels exceeding eutrophication limits in 2010.<sup>[7]</sup>
- The EU target value for protection of vegetation from O<sub>3</sub> has been exceeded in a substantial part of the agricultural area in Europe, notably in southern and central Europe. The long-term objective for vegetation protection from O<sub>3</sub> was exceeded in 88% of the total agricultural area in 2011.<sup>[7]</sup>

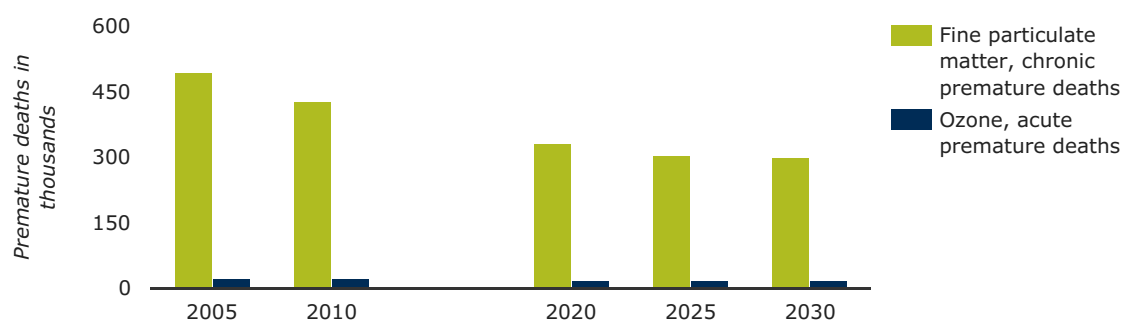
## Prospects

Air pollution is projected to further decline in future years, but beyond 2030 only slow progress is expected. In late 2013, the European Commission proposed a Clean Air Policy Package for Europe, which aims at achieving full compliance with existing air quality legislation by 2020, and at further improving Europe's air quality by 2030 and beyond.<sup>[8]</sup> The package proposes strengthening the implementation of existing legislation; introducing stricter national emission-reduction commitments; and reducing emissions from medium-size combustion plants.

As part of this package, the Commission has put forward a revised NEC Directive, which proposes new national emission-reduction commitments for 2020 and 2030. This revised NEC Directive would apply to the pollutants currently covered (NO<sub>x</sub>, NMVOC, SO<sub>2</sub>, and NH<sub>3</sub>) and would add two new pollutants, PM<sub>2.5</sub> and methane (CH<sub>4</sub>). It would also promote mitigation measures for black carbon.

The proposals — if agreed and fully implemented — are projected to reduce health impacts (premature mortality due to PM and O<sub>3</sub> pollution) by 53% in the EU by 2030 relative to 2005. 40% of this is estimated to be delivered by a full implementation of existing legislation.

**Figure 2: Estimated future air pollution health impacts of fine particulate matter and ozone under a current legislation scenario**



**Note:** The current legislation or 'baseline' scenario assumes full implementation of current air-related policies. It is based on recent energy projections used as a reference for climate, energy and transport policy analysis as well as on agricultural projections.

**Data sources:** European Commission. *A Clean Air Programme for Europe*

However, even with the implementation of these proposals, about 50% of the EU's ecosystem area is projected to exceed eutrophication critical loads in 2030.

Beyond 2030, a time horizon of 2050 has been suggested as an aspirational year to achieve Europe's long-term objectives of achieving levels of air pollution that do not lead to unacceptable harm to human health and the environment.<sup>[9]</sup> To achieve such longer-term air quality objectives, it will become increasingly important that air pollution and climate-change policy are considered in an integrated manner. Measures to abate air pollution and GHGs often target the same sources. Factoring air quality into decisions about how to reach climate change targets, and vice-versa, can deliver greater benefits to society.

SOER 2015 European briefings present the state, recent trends and prospects in 25 key environmental themes. They are part of the EEA's report SOER 2015, addressing the state of, trends in and prospects for the environment in Europe. The EEA's task is to provide timely, targeted, relevant and reliable information on Europe's environment.

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