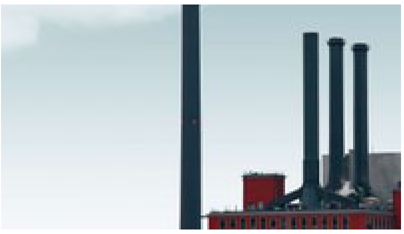
Industrial pollution in Europe



Greening the power sector: benefits of an ambitious implementation of Europe's environment and climate policies

Europe's electricity generation still relies largely on fossil fuels as an energy source and thus contributes to emissions of sulphur dioxide (SO2), dust and nitrogen oxides (NOx), among other pollutants. A new EEA assessment shows that with an ambitious implementation of new requirements under the EU Industrial Emissions Directive, Member States can significantly reduce pollutant emissions and thus minimise their potential harmful effects on the environment and human health. There is also a close link between future reductions in pollutant emissions and EU climate and energy policy, which drives growth in renewables and the switch towards cleaner fuels in the remaining power plants. A more fundamental restructuring of the power sector is, however, needed to meet the EU's long-term decarbonisation targets.

- Emissions of SO_2 and dust from power plants have decreased by more than three quarters since 2004, largely as a result of environmental regulation.
- New requirements regarding SO_2, NO_x and dust emissions from power plants were adopted in 2017 and need to be implemented by Member State authorities by 2021 at the latest.
- By 2030, the requirements are projected to lead to emission reductions of 66-91 % for SO_2, 56-82 % for dust and 51-79 % for NO_x, compared with 2016 reported emissions.
- Authorities have the opportunity to ensure an ambitious implementation that brings about significant future emission reductions.

Exploring recent trends in power sector emissions

In the EU, power plants that burn fossil fuels generated almost half of the electricity in 2016 (see Eurostat's electricity production, consumption and market overview). The fuels burned are predominantly coal or lignite, natural gas and, to a lesser extent, liquid fossil fuels such as oil. More information about recent trends regarding power plants can be found in the EEA indicator Large Combustion Plants operating in Europe.

Power plants release a wide range of pollutants as a result of burning fuel. Three substances in particular are subject to monitoring because of their potential impact on human and environmental health: SO_2, NO_x and dust. Many other pollutants, for example mercury, are also regulated. For more information about the potential impacts of these and other pollutants, please refer to the EEA air quality report 2018. The 2018 EEA report on mercury also frequently references the power sector.

Emissions from combustion plants constitute a significant proportion of all human-generated releases of these pollutants: more than half of total SO_2 emissions, some 15 % of NO_x emissions and 4 % of particulate matter (PM_{10}, particulate matter with a diameter of 10 µm or less; see the EEA indicator Industrial pollution in Europe). More information about the sources of these and other pollutants can be found on the E-PRTR website.

Figure 1 shows that emissions of SO_2, NO_x and dust from power plants have all reduced since 2004 (first year reported). This is especially the case for dust and SO_2, which had both decreased by three quarters or more by 2015.

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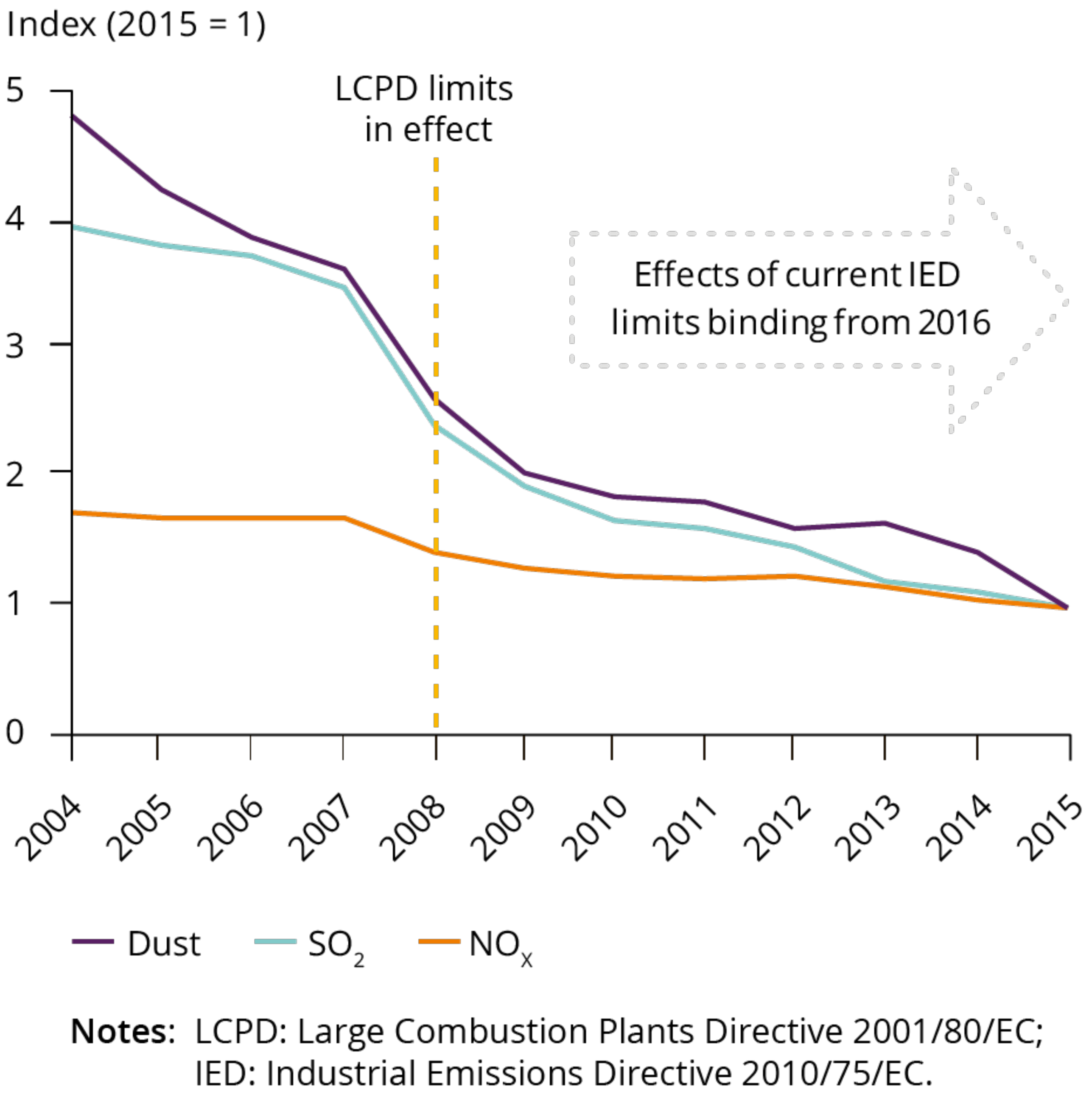
Figure 1. Indexed SO2, NOx and dust emissions from electricity generation for 2004 to 2015



Source: Data taken from the EEA Large Combustion Plant (LCP) inventory and linked to the European Pollutant Release and Transfer Register (E-PRTR) data set. Download here.

Notes: Only plants reporting NACE 35 in the E-PRTR are included.

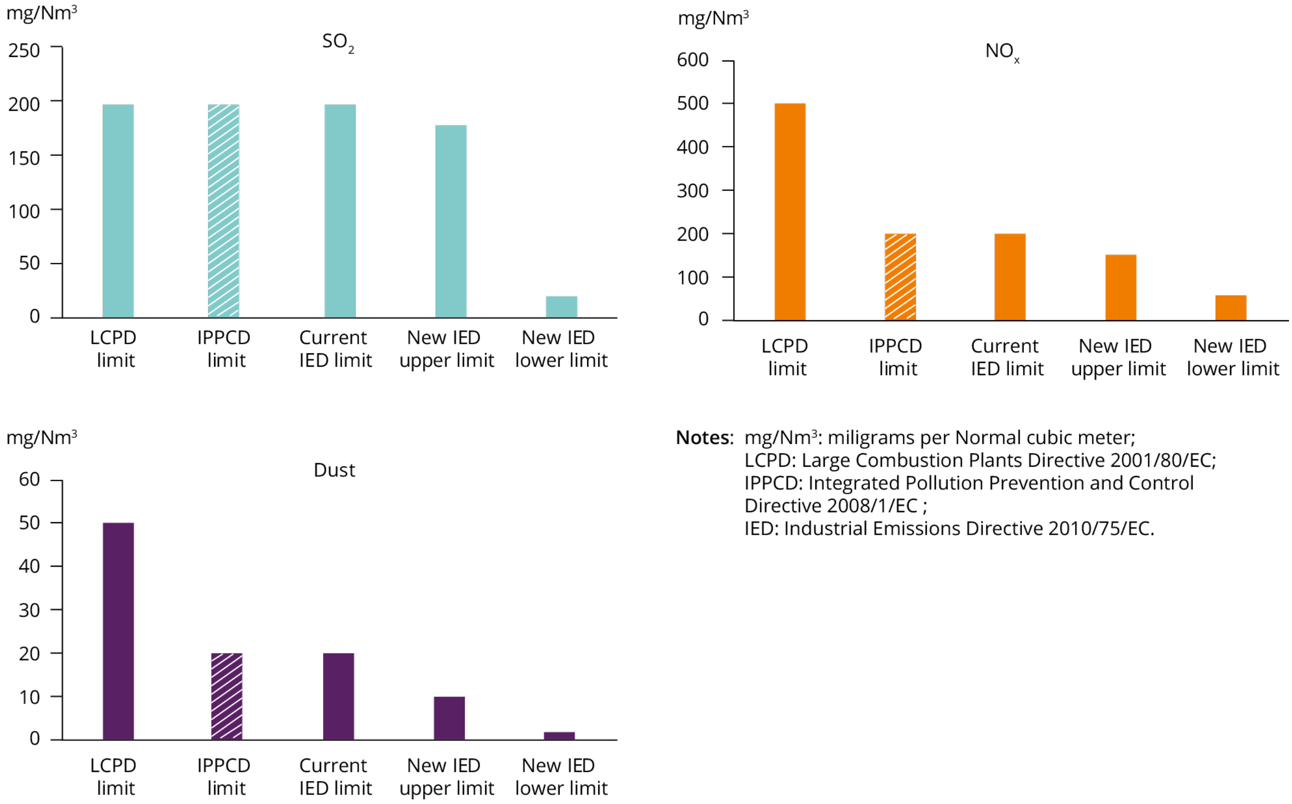
A recent study for the EEA clearly identified European environmental policy as the main driver behind these emission reductions. The different phases of the emission trends in Figure 1 can therefore be described as follows:

- The sharp decline in emissions in 2007 and 2008 is partially explained by the emission limits imposed by the Large Combustion Plants Directive (LCPD; 2001/80/EC), which were binding from 2008 onwards.
- The economic crisis also had an effect on the emission trends, while the development of the fuel mix during the following years improved the environmental performance of power plants irrespective of the change in economic activity (see, for example, a recent EEA report on trends in the EU Emissions Trading System).
- Emissions then levelled off around 2010 and began to decrease again only in anticipation of the stricter emission limit values imposed by the Industrial Emissions Directive (IED; 2010/75/EU), which fully come into force in 2016.
- Each iteration of environmental regulation either triggers investments in state-of-the-art pollution reduction measures, such as pre-treatment of fuels, efficiency gains in the process and end-of-pipe pollution abatement techniques, or operators switch to newer, less polluting plants altogether. Other less prominent drivers in the past have been changes in the fuel mix, resulting from EU climate policy, and fuel pricing.
- Investments in the power sector are long term because of the cost of upgrading or of decommissioning and replacing plants. These investment decisions are influenced by many factors, such as fuel pricing, climate and energy policy driving alternatives into the power sector, technical progress, changes in the economic structure and the requirements imposed by the integrated environment permits introduced in EU legislation in the mid-1990s.
- Legislation has allowed national authorities and operators many years to comply with the new emission limit values and other requirements, and this is reflected in the observed emission trends.

What new requirements are coming into force in the power sector?

The IED takes an integrated approach to industrial emissions and regulates the entire environmental performance of an industrial plant, including emissions to air, water and land, waste generation, use of raw materials, energy efficiency, noise generation, prevention of accidents and restoration of the site upon closure. All installations are required to operate in accordance with a permit issued by the relevant Member State authorities. These permits, in turn, must reflect the requirements set out by the IED.

Figure 2. Level of ambition with respect to SO_2, dust and NO_x emission levels in the LCPD, the IPPCD and the IED



Notes: mg/Nm³: miligrams per Normal cubic meter;
LCPD: Large Combustion Plants Directive 2001/80/EC;
IPPCD: Integrated Pollution Prevention and Control Directive 2008/1/EC ;
IED: Industrial Emissions Directive 2010/75/EC.

Source: The figures represent emission limits for large existing power plants taken from the Large Combustion Plants Directive (LCPD; 2001/80/EC), the 2006 Large Combustion Plant best available technique reference document under the Integrated Pollution Prevention and Control Directive (IPPCD; 2008/1/EC), the Industrial Emissions Directive (2010/75/EU) and the 2017 best available technique conclusion under the IED. Download here.

New IED requirements for the power sector were adopted in 2017. These include a range of emission limits for pollutants, including SO_2, dust and NO_x, that must be used to set permit conditions by 2021 at the latest. The lower limit is the level of ambition that Member States should strive for when setting permit conditions. These limits are, in the majority of cases, technically and economically achievable.

Specific requirements exist for a number of processes in a range of different power plants. Figure 2 shows how emission limits for SO_2, dust and NO_x have changed over time for large power plants (> 300 thermal megawatts) burning coal and lignite. Although policies to curb acidifying emissions from power plants in Europe date back to the 1980s, binding emission limits for existing plants were first set in 2001 by the LCPD. These limits were ambitious for SO_2, which was perceived as a priority — still largely to address the acid rain issue — but less so for dust and NO_x. These limits had to be reflected in permits by 2008, which explains their impact on the emission trends in Figure 1 around that time.

Aspirational non-binding emission limits set under the Integrated Pollution Prevention and Control

Directive (IPPCD; 2008/1/EC) in 2006 (cross-hatched columns in Figure 2) raised the limit of ambition for dust and NO_x emission limits. Equally ambitious limits for dust and NO_x were finally adopted in 2010 under the IED, while limits for SO_2 were not strengthened at that time. The new requirements, adopted in 2017, reduce the emission limits further for all three pollutants. They also regulate mercury emissions from the power sector for the first time (see also the EEA report Mercury in Europe's environment).

What are the benefits of an ambitious implementation?

A recent assessment for the EEA projected SO_2, NO_x and dust emissions until 2030 (Figure 3). It examines the effect that different levels of implementation of the new requirements will have on these future emissions. The results show that implementing the new requirements across the power sector will result in significant emission reductions compared with the emissions reported in 2016 (the latest year available).

Even if only the upper emission limits of the new requirements are implemented (see also Figure 2), emissions are projected to fall by more than two thirds (compared with 2016) in 2030 for SO_2 and dust and by more than half for NO_x.

The results, however, also show that fully implementing the lower emission limits of the new requirements would lead to significant further emission reductions: a total reduction of 91 % by 2030 (from 2016 levels) for SO_2, an 82 % reduction for dust and a 79 % reduction for NO_x. For example, in terms of NO_x emissions, these additional reductions in 2030 alone are comparable to the lifetime NO_x emissions of 220 000 modern diesel cars (average Euro 6 car with 507 mg NO_x/km) on European roads (assuming a lifetime mileage of 150 000 km). Reducing emissions from the power sector would have important positive environmental and human health implications (see, for example, a 2014 EEA study on the costs of air pollution from industry).

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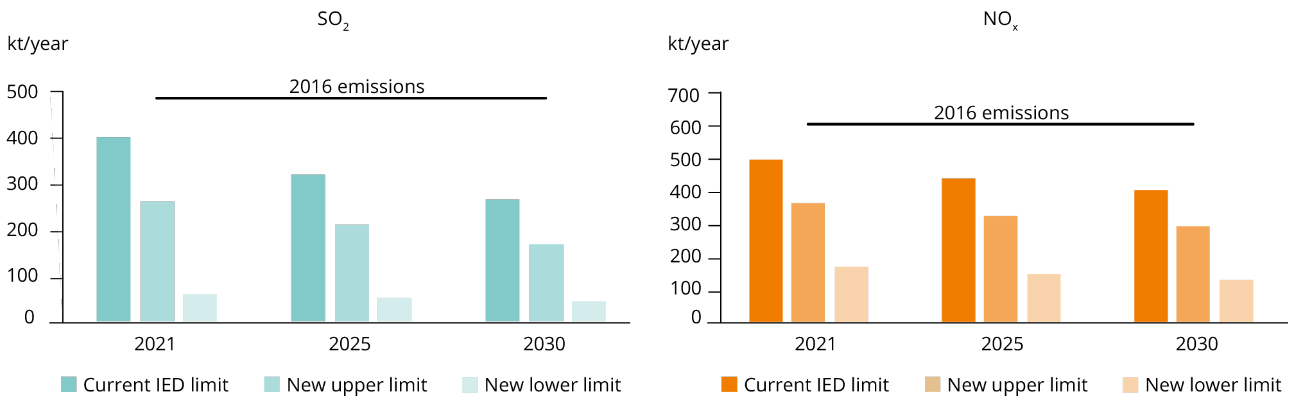
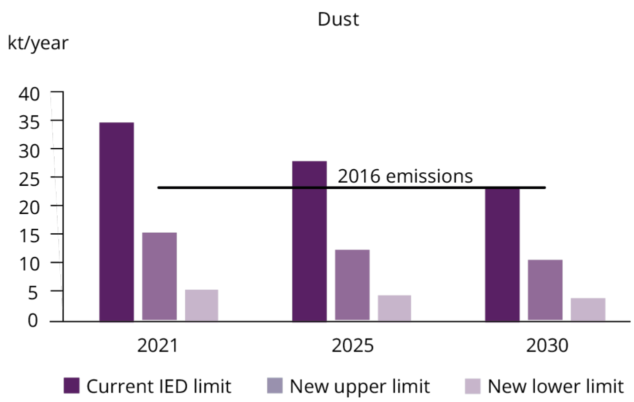
Figure 3. Total projected annual emissions (in kilotonnes per year) in 2021, 2025 and 2030 for SO2, NOx and dust in the event that current IED limits, upper or lower levels of the new requirements are used to set permit conditions





Notes: kt/year: kilotonnes per year;
IED: Industrial Emissions Directive 2010/75/EC.

Source: Data taken from the EEA Large Combustion Plant (LCP) inventory and Eionet Report – ETC/ACM 2018/16. Download here.

The results of the study further suggest that in 2016 the power sector had, on average, already performed better than required under the IED with respect to SO_2 and dust emissions, and is expected to continue to do so until 2021, when the new requirements must be implemented. This, in turn, suggests that IED emission limits for these pollutants were not as ambitious as they could have been. However, there are still individual plants that do not fully meet the current requirements. To better predict future emission trends, the study utilises trend estimates of electricity generation, fuel consumption and investments in the power sector, as described in the EU energy reference scenario 2016. It is therefore possible to determine the effect that these assumptions about the future have on the results of the study. Approximately one third of the reductions in pollutant emissions by 2030 associated with the upper emission limits of the new measures are due to economic factors such as switching from coal to gas over the next decade and a general trend away from large-scale thermal power generation by burning fossil fuels towards renewable energy. Only 6-12 % of the emission reductions (depending on the pollutant in question) associated with the lower emission limits, however, depend on these assumptions and trends.

These economic factors are driven by EU climate and energy policy, including, for example, the EU Emissions Trading System (Directive 2003/87/EC) or the Renewable Energy Directive (2009/28/EC). In the event that these assumptions and/or underlying trends change, for example because climate and energy policies are not fully implemented, pollutant emission reductions may not be as large, especially in the case of the upper emission limits. Implementing the lower emission limits therefore leads to plants with fewer pollutant emissions per unit of fuel burnt, regardless of future decisions on which fuel type is used and how much electricity will come from large-scale thermal power plants.
While pollutant emission limits set by EU industrial emission policy may be met by retrofitting a number of existing plants and replacing others with new, more efficient ones, meeting climate and energy policy targets will require some of these plants to be decommissioned instead. The EEA report Transforming the EU power sector: avoiding a carbon lock-inoffers a critical analysis of how the power sector needs to be restructured and incentivised to meet EU targets for decarbonisation.

Member States now have the chance to decide on the emission limits they set in operating permits by 2021 at the latest in order to comply with the new pollutant emission requirements. The results presented here suggest that there will be substantial environmental and human health benefits from an ambitious implementation.

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Identifiers

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