

Revealing the costs of air pollution from industrial facilities in Europe — a summary for policymakers

A new European Environment Agency (EEA) report, *Revealing the costs of air pollution from industrial facilities in Europe*, assesses the damage costs to health and the environment caused by pollutants emitted from industrial facilities. Using the latest information publicly available from the European Pollutant Release and Transfer Register (E-PRTR), the report provides valuable insights into the countries, sectors and individual facilities whose air pollution causes most harm in Europe. The cost in 2009 of damage caused by emissions from E-PRTR industrial facilities is estimated as being at least EUR 102–169 billion.



In 2005, the Clean Air for Europe (CAFE) programme estimated that emissions of regional air pollutants across all sectors of the EU-25 economy caused damage to human health and the environment worth EUR 280–794 billion in the year 2000.

Today, air pollution continues to harm human health and the environment. A key finding of the EEA's report 'The European environment — state and outlook 2010' was that, despite past cuts in emissions, air quality still needs to improve — concentrations of certain air pollutants still pose a threat.

In addition to estimating the damage costs from the 'traditional' regional air pollutants (e.g. nitrogen oxides, sulphur dioxide, particulate matter, etc.) based upon the CAFE programme's approach, the EEA's new report also estimates the damage costs caused by emissions of heavy metals, organic micro-pollutants and the greenhouse gas CO₂.

This makes it possible to address a variety of questions, for example:

- which industrial sectors and countries contribute most to the estimated damage costs of air pollution in Europe?
- how many facilities account for the largest share of air pollution's estimated damage costs?
- which individual facilities reporting to the E-PRTR pollutant register are responsible for the highest estimated damage costs?

This summary for policymakers sets out the scope of the EEA report and its main findings, and briefly describes the methods applied and their limitations.

It is important to note that the report does not assess whether a facility's emissions are consistent with its legal requirements to operate. Nor does it address air pollutants released from 'diffuse' sources, such as transport, and consequently it does not assess the total damage costs caused by air pollution across Europe.

Finally, the report focuses on the air pollution costs caused by industrial facilities. The recognised economic and social benefits that they generate (such as products, employment and tax revenues) are not addressed.



Key findings

The report quantifies in monetary terms the cost of damage to health and the environment from air pollution released in 2009 from European industrial facilities reporting to the E-PRTR (Box 1). The main findings are as follows:

- The cost in 2009 of damage caused by emissions from E-PRTR industrial facilities is estimated as being at least EUR 102–169 billion.
- A small number of individual facilities cause the majority of damage costs (see Figure 1 and Map 1). Fifty per cent of the total damage cost occurs as a result of emissions from just 191 or 2 % of the approximately 10 000 facilities that reported data for releases to air. Three quarters of the total damage costs are caused by the emissions of 622 facilities — 6 % of the total number.
- Of the industrial sectors included in the pollutant register, emissions from power generation contribute the largest share of the total damage costs (estimated as at least EUR 66–112 billion). Excluding CO₂, the estimated damage costs from this sector are EUR 26–71 billion.
- Countries such as Germany, Poland, the United Kingdom, France and Italy, which have many

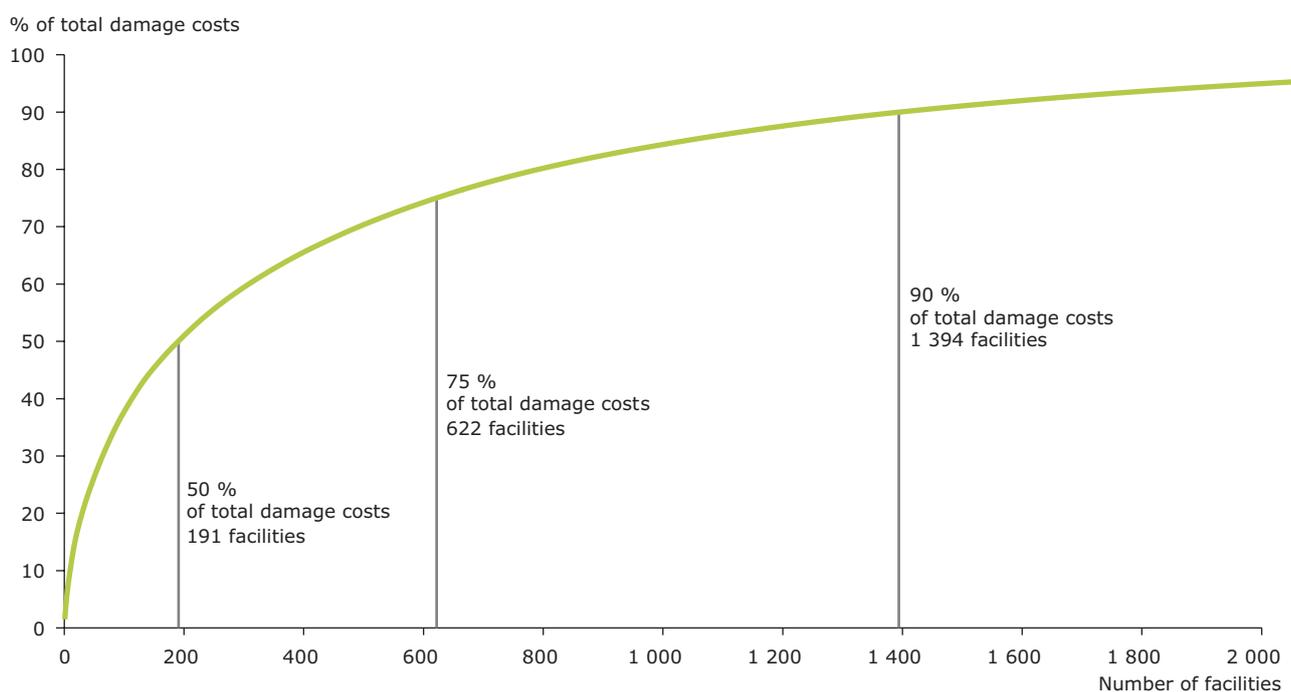
large facilities, contribute the most to total damage costs. However, when damage costs are corrected to reflect the output of national economies, the ordering of countries changes significantly. The emissions from a number of eastern European countries (Bulgaria, Romania, Estonia, Poland and the Czech Republic) are then more important in terms of their damage costs.

- The damage cost resulting from emitting one kg of organic micro-pollutants (e.g. dioxins and furans) is significantly higher than the damage cost from releasing one kg of CO₂. The enormously larger amount of CO₂ emitted (around a trillion times greater) means, however, that CO₂ emissions contribute the most to total damage costs (followed by regional air pollutants, heavy metals and organic micro-pollutants).

The report provides a list of the most polluting individual facilities. Not surprisingly, the facilities whose emissions impose the highest damage costs are generally among the largest facilities in Europe, releasing the greatest amount of pollutants.

Clearly, ranking facilities according to their aggregate damage costs provides little indication of the efficiency of production at a facility. One large facility could pollute less than several smaller ones

Figure 1 Cumulative distribution of the 2000 E-PRTR facilities with the highest damage costs



that generate the same level of service or output. Equally, the opposite could also be true.

One weakness of the E-PRTR is the lack of fuel consumption or production data for individual facilities, making it impossible to assess directly

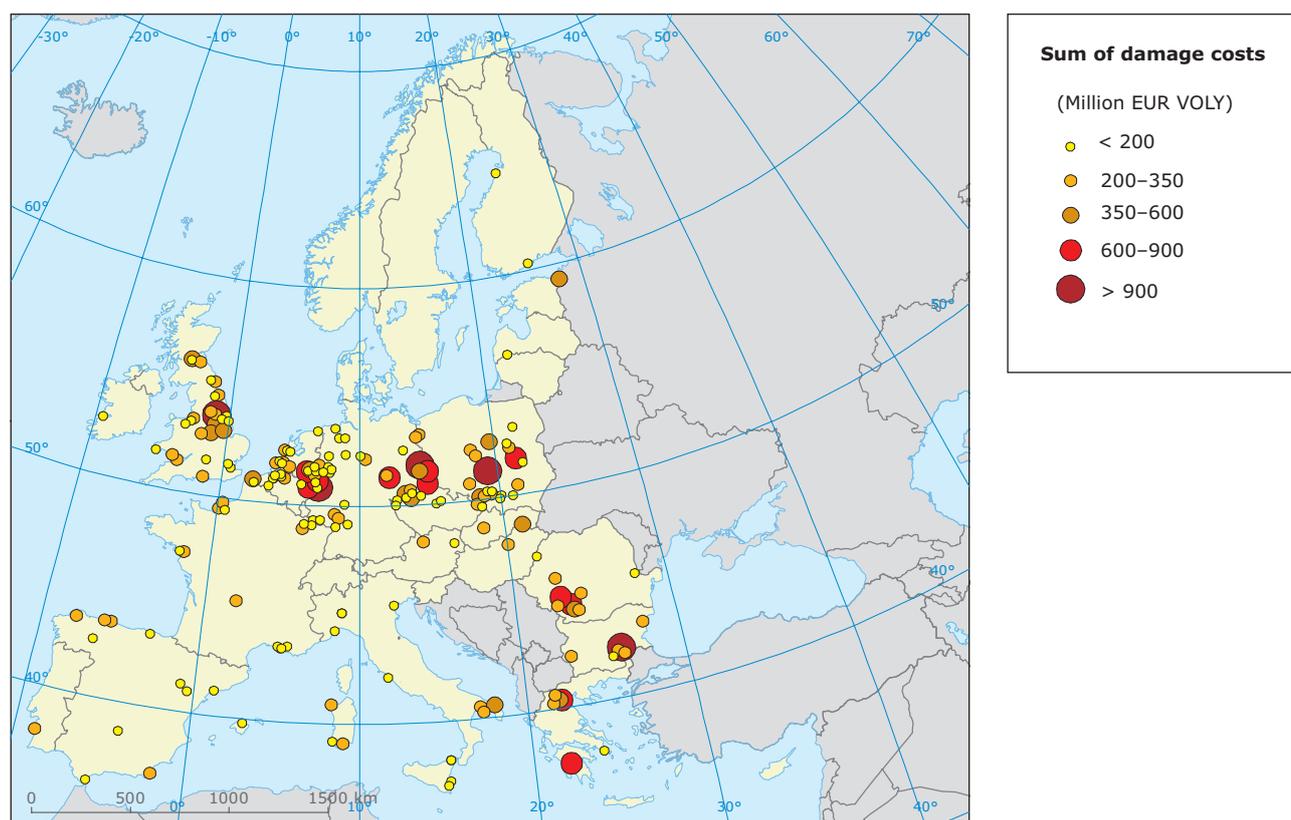
a facility's environmental impacts relative to its output. The report seeks to get around this shortcoming and illustrate the potential differences in facility efficiency by using CO₂ emissions as a proxy for fuel consumption.

Box 1 About E-PRTR

The European Pollutant Release and Transfer Register (E-PRTR) was established to improve European public access to environmental information and to implement the Kiev protocol to the Aarhus Convention on access to environmental information. An important objective of the E-PRTR is to encourage improvements in environmental performance by providing public access to information on the releases of pollutants. First published in 2009, the register contains information about the quantity and location of pollutants released to air, water and land, reported by more than 24 000 of the largest industrial facilities throughout Europe. Around 10 000 of these facilities report emissions to air. E-PRTR includes annual data for 91 substances and covers 65 detailed economic activities. The activities cover the main sectors:

- energy;
- production and processing of metals;
- mineral industry;
- chemical industry;
- waste and waste water management;
- paper and wood production and processing;
- intensive livestock production and aquaculture;
- animal and vegetable products from the food and beverage sector, etc.

Map 1 Location of the 191 E-PRTR facilities that contributed 50 % of the total damage costs estimated for 2009



Similarly, to capture the relative environmental efficiency of the countries addressed in the study, the report assesses each country's aggregated national damage costs against its gross domestic product (GDP).

Data sources and methods

The report builds on existing policy tools and methods, such as those developed under the EU's CAFE programme. The CAFE methods are regularly applied in cost-benefit analyses to support EU and international policymaking on air pollution. The report also employs other existing models and approaches used to inform policymakers about the damage costs of heavy metals, organic micro-pollutants and CO₂.

The methods are used to estimate the damage costs resulting from the air pollutant releases reported by nearly 10 000 individual facilities to the E-PRTR. The pollutants examined are regional air pollutants (ammonia, nitrogen oxides, particulate matter (PM₁₀), sulphur dioxide and volatile organic compounds), heavy metals (arsenic, cadmium, chromium, lead, mercury and nickel), organic micro-pollutants (benzene, PAHs and dioxins and furans) and carbon dioxide. The impacts of these pollutants on human health and the environment are described in Box 2.

Uncertainties and limitations of the methodology

There are acknowledged uncertainties in assessing air pollution damage costs. These extend from the scientific knowledge about impacts of a given pollutant, to the exposure methods applied and the models used. The report therefore notes various instances where caution is needed in interpreting the results:

- The EEA analysis addresses only emissions from facilities reporting to the E-PRTR. As such, the cost of damage to health and the environment from all sectors of the economy (including e.g. road transport and households) and from all pollutants will be higher than the estimates presented.
- There is no single method available to estimate the damage costs for all the pollutant groups addressed in the report (regional air pollutants, heavy metals, organic micro-pollutants and carbon dioxide). Aggregating results derived

from the different approaches therefore poses challenges. However, one of the key advantages of assessing damage costs using a common measure (money) is that it enables different types of damage to be aggregated, providing an insight into the total costs to health and the environment caused by air pollutant emissions.

- The ranking of individual facilities is likely to be more certain than the absolute damage costs estimated in euros for each facility. However, the reporting of data to the pollutant register appears more complete for certain facilities and countries than for others.
- Certain aspects of harm to health and the environment are outside the scope of this study. For the regional air pollutants, for example, the model framework underpinning the assessment needs to be extended to include aspects such as a valuation of ecological impacts and acid damage to cultural heritage.
- For greenhouse gases a wider debate is required on how best to estimate the economic impacts of emissions on environment and health. The approach used in the EEA report uses a different approach to quantify the damage costs arising from CO₂ (based on estimated marginal abatement) than for the other pollutants.

Next steps

Future assessments could include more advanced quantification of air pollution damage costs from industrial facilities in Europe. However, while the EEA will continue to improve its assessment methodology, the results presented in *'Revealing the costs of air pollution from industrial facilities in Europe'* already provide new insights and transparency regarding the damage costs resulting from air pollution.

Such insights are particularly valuable in the context of Europe's current discussions on how best to move towards a resource-efficient and low-carbon economy. And the analysis can be further strengthened by integrating efficiency and productivity data for individual facilities into future analysis of damage costs.

In 2012 the EEA plans to publish an assessment of the potential for large combustion plants in Europe to reduce their emissions of selected air pollutants further. Another EEA report will investigate the extent to which the EU National Emission Ceilings Directive's environmental objectives for 2010 have been attained.

Box 2 Air pollutants included in this study and their effects on human health and the environment

Nitrogen oxides (NO_x)

Nitrogen oxides are emitted from fuel combustion, such as from power plants and other industrial facilities. NO_x contributes to acidification and eutrophication of waters and soils, and can lead to the formation of particulate matter and ground-level ozone. Of the chemical species that comprise NO_x, it is NO₂ that causes adverse effects on health; high concentrations can cause airway inflammation and reduced lung function.

Sulphur dioxide (SO₂)

Sulphur dioxide is emitted when fuels containing sulphur are burned. As with NO_x, SO₂ contributes to acidification, with potentially significant impacts including adverse effects on aquatic ecosystems in rivers and lakes, and damage to forests. High concentrations of SO₂ can affect airway function and inflame the respiratory tract. SO₂ also contributes to the formation of particulate matter in the atmosphere.

Ammonia (NH₃)

Ammonia, like NO_x, contributes to both eutrophication and acidification. The vast majority of NH₃ emissions – around 94 % in Europe – come from the agricultural sector. A relatively small amount is also released from various industrial processes.

Non-methane volatile organic compounds (NMVOCs)

NMVOCs, important ground-level ozone precursors, are emitted from a large number of sources including industry, paint application, road transport, dry-cleaning and other solvent uses. Certain NMVOC species, such as benzene (C₆H₆) and 1,3-butadiene, are directly hazardous to human health.

Particulate matter (PM)

In terms of potential to harm human health, PM is one of the most important pollutants as it penetrates into sensitive regions of the respiratory system, and can cause or aggravate cardiovascular and lung diseases. PM is emitted from many sources and is a complex mixture comprising both primary and secondary PM; primary PM is the fraction of PM that is emitted directly into the atmosphere, whereas secondary PM forms in the atmosphere following the release of precursor gases (mainly SO₂, NO_x, NH₃ and some volatile organic compounds (VOCs)).

Heavy metals

The heavy metals arsenic (As), cadmium (Cd), chromium (Cr) lead (Pb), mercury (Hg) and nickel (Ni) are emitted mainly as a result of various combustion processes and from industrial activities. As well as polluting the air, heavy metals can be deposited on terrestrial or water surfaces and subsequently buildup in soils and sediments, and can bio-accumulate in food chains. They are typically toxic to both terrestrial and aquatic ecosystems.

Organic micro-pollutants

Benzene, polycyclic aromatic hydrocarbons (PAHs), and dioxins and furans are categorised as organic pollutants. They cause different harmful effects to human health and to ecosystems, and each of these pollutants is a known or suspected human carcinogen; dioxins and furans and PAHs also bioaccumulate in the environment. Emissions of these substances commonly occur from the combustion of fuels and wastes and from various industrial processes.

Carbon dioxide (CO₂)

Carbon dioxide is emitted as a result of the combustion of fuels such as coal, oil, natural gas and biomass for industrial, domestic and transport purposes. CO₂ is the most significant greenhouse gas influencing climate change.

Further information

EEA report: *Revealing the costs of air pollution from industrial facilities in Europe*
(EEA Technical report No 15/2011)
E-PRTR website: <http://prtr.ec.europa.eu>

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ISBN 978-92-9213-239-2



Publications Office

