# Costs of air pollution from European industrial facilities 2008–2012 — an updated assessment

Summary

In 2012, air pollution from European industrial facilities cost at least EUR 59 billion (and up to EUR 189 billion). A small number of industrial facilities are responsible for the majority of the damage costs — fifty per cent of the total damage cost occurs as a result of emissions from just 147 (or 1 %) of the 14 325 facilities assessed between 2008 to 2012. A new European Environment Agency (EEA) report presents updated damage cost estimates to health and the environment caused by pollutants emitted to air from Europe's industrial facilities.

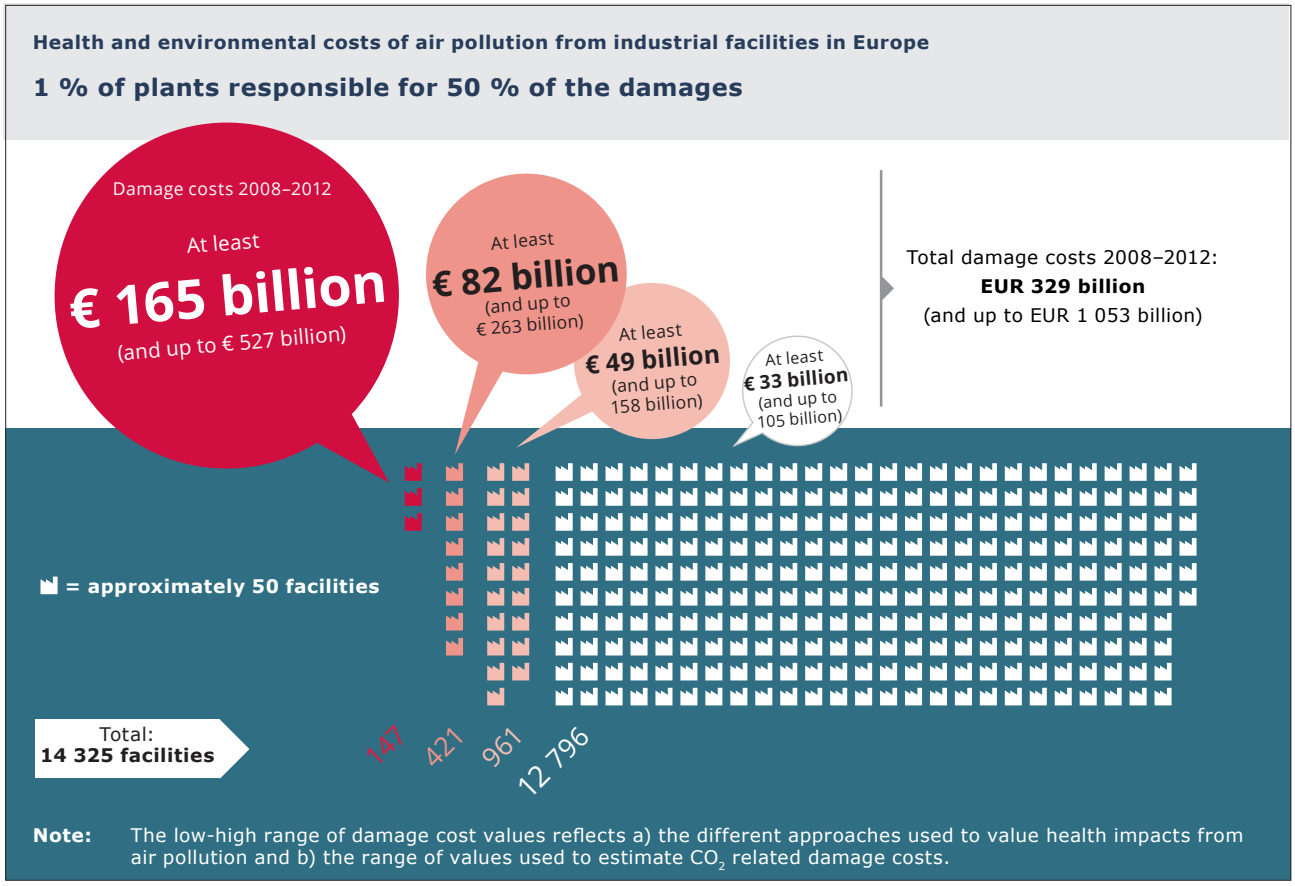

Emissions of air pollutants in Europe have declined in recent decades, but air quality still needs to improve to reduce its harm to human health and the environment. In 2011, the EEA published a first assessment of the damage costs to health and the environment caused by industrial facilities in the European Pollutant Release and Transfer Register (E-PRTR).

The 2014 report *Costs of air pollution from European industrial facilities 2008–2012* presents an updated assessment of the damage costs to health and the environment from air pollution released in the years 2008 to 2012 by 14 325 industrial facilities in the EU-27, Norway and Switzerland.

## Key findings

- The aggregated cost of damage over the period 2008–2012 caused by emissions from the E-PRTR industrial facilities is estimated as being at least $EUR_{2005}$ 329 billion (and up to $EUR_{2005}$ 1 053 billion).
- A small number of individual facilities cause the majority of damage costs. Fifty per cent of the total damage cost occurs as a result of emissions from just 147 or 1 % of the 14 325 facilities assessed. Three quarters of the total damage costs were caused by the emissions of 568 facilities — 4 % of the total number.
- The report lists the top 30 facilities identified as causing the highest damage. Of these, 29 are power-generating facilities, mainly fuelled by coal/lignite and located predominantly in Germany and eastern Europe.
- Eight of these top 30 facilities are located in Germany; six are in Poland; four are in Romania; three are in Bulgaria and the United Kingdom, two are located in Greece; and one is located in each of the Czech Republic, Estonia, Italy and Slovakia.
- Of the industrial sectors included in the E-PRTR register, emissions from the power generating sector contribute the largest share of the damage costs across the five year period assessed. Sectors involving production processes and combustion used in manufacturing are responsible for most of the remaining estimated damage costs.
- Countries such as Germany, Poland, the United Kingdom, France and Italy, which have many large facilities, contribute the most to total damage costs. However, the ordering of countries changes significantly if damage costs are corrected to reflect the output of national economies. Emissions from a number of eastern European countries (Bulgaria, Romania, Estonia and Poland) are then more important.

European Environment Agency




## Updated assessment: new data, new science and approaches

The 2014 report includes a number of new elements, including:

- *Application of new science*: an updated methodology takes into account recent advances in air quality modelling and estimating associated costs.
- *Data for five consecutive years*: the updated methodology has been applied to E-PRTR data from five years – 2008 to 2012.
- *Carbon pricing approaches:* A range for $CO_2$ related damage costs is now applied, based upon modelled carbon price forecasts for the EU greenhouse gas Emissions Trading System (ETS).
- *Accounting for efficiency*: The 2011 report highlighted the importance of considering operating efficiencies when damage costs from individual facilities are compared. Several methods of normalising damage costs to take into account differences of efficiency between facilities are explored.
- *Potential damage cost savings:* The report uses the results of a recent EEA assessment, which investigated the hypothetical future emission reduction potential of $NO_x$, $SO_2$ and dust from more than 1 500 of Europe's large combustion plants, to illustrate the scale of associated benefits in terms of reduced damage costs.

The findings of the report can contribute to European initiatives to reduce pollution from industrial facilities, but also in Europe's current discussions on how best to move towards a resource-efficient and low-carbon economy.

## Differences in plant operating efficiencies

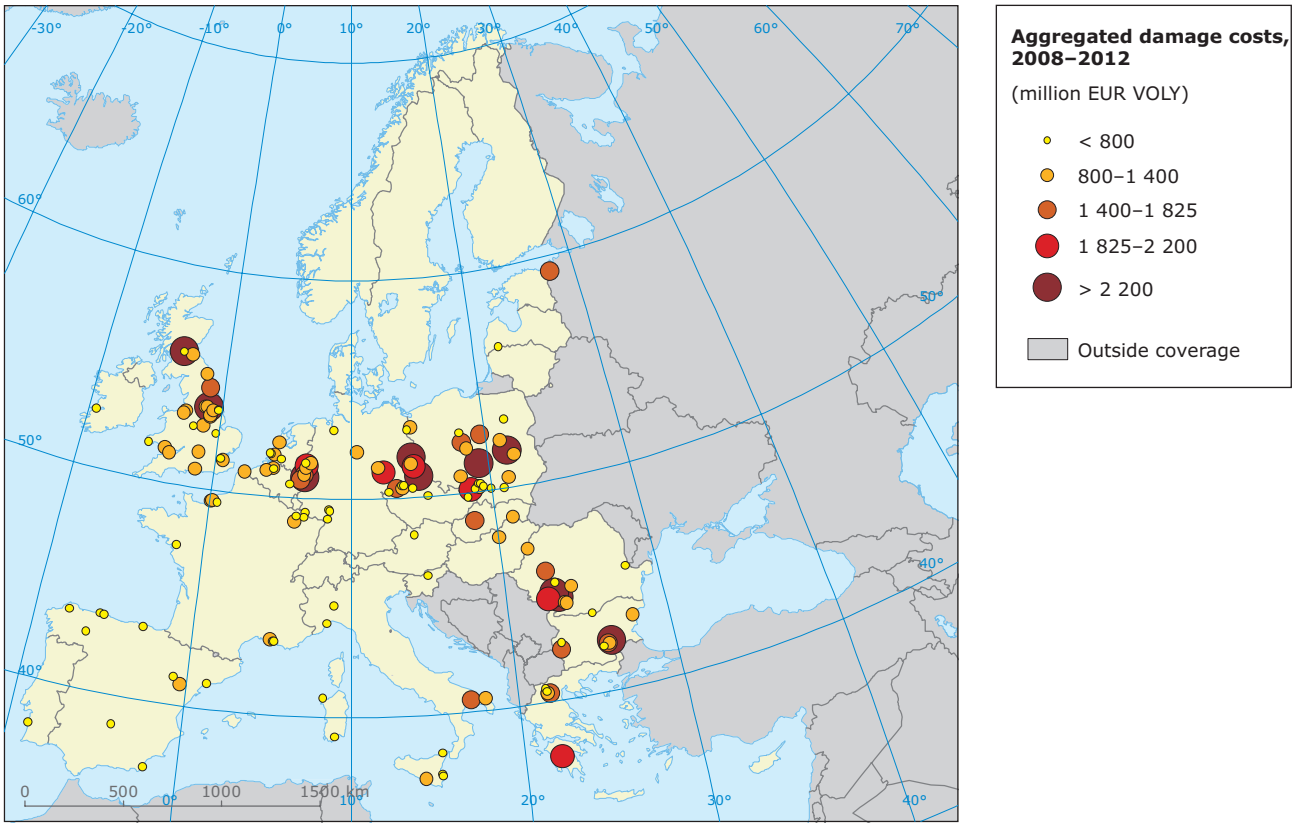
Presenting a list of facilities according to their aggregate damage costs provides little indication of their respective operating efficiencies. One large facility can operate more efficiently and pollute relatively less compared to several smaller ones that generate the same level of service or output.

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

directly a facility's environmental impacts relative to its fuel input or economic output. The report seeks to get around this shortcoming and illustrate the potential differences in facility efficiency by using $CO_2$ emissions as a proxy for fuel consumption. The most obvious difference noted when damage costs from individual facilities are normalised by $CO_2$ emissions is that more facilities from eastern Europe appear at the top of the results, suggesting that they contribute more damage cost per unit of fuel consumption. In other words, they are less environmentally efficient and relatively more damaging to health and the environment.

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

**Location of the 147 E-PRTR facilities that contributed 50 % of the total damage costs estimated for 2008–2012**




**Box 1 About E-PRTR**

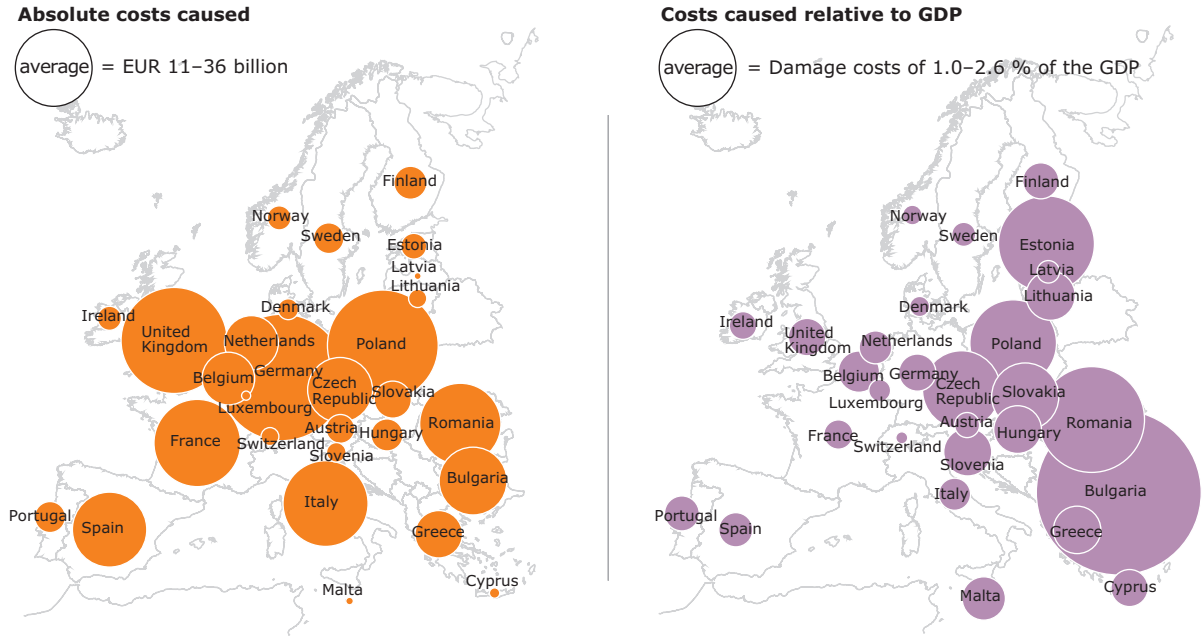
The European Pollutant Release and Transfer Register (E-PRTR) was established to improve European public access to environmental information and to implement the Kiev protocol to the UNECE Aarhus Convention on access to environmental information. Annually updated since 2009, E-PRTR contains information about the quantity and location of pollutants released to air, water and land, reported by around 24 000 of the largest industrial facilities throughout Europe. It includes the 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.

**Health and environmental costs of air pollution from industrial facilities in Europe**

## Damage costs caused by facilities in countries (2008–2012)

Countries such as Germany, Poland, the United Kingdom, France and Italy, which have many large facilities, contribute the most to total damage costs. However, the ordering of countries changes significantly if damage costs are corrected to reflect the output of national economies. Emissions from a number of eastern European countries (Bulgaria, Romania, Estonia and Poland) are then more important.




**Note:** The low-high range of damage cost values reflects a) the different approaches used to value health impacts from air pollution and b) the range of values used to estimate $CO_2$ related damage costs.

## Data sources and methods

The report builds on existing policy tools and methods, such as those used during the recent review of the European Union's (EU) air pollution policies. It also employs other existing models and approaches used by policymakers to inform about the damage costs of heavy metals, persistent organic pollutants and $CO_2$.

Damage costs resulting from the air pollutant releases reported by 14 325 facilities reporting to the E-PRTR between 2008–2012 are estimated. The pollutants included are the main air pollutants (ammonia, nitrogen oxides, particulate matter ($PM_{10}$), sulphur dioxide and non-methane volatile organic compounds), carbon dioxide, heavy metals (arsenic, cadmium, chromium, lead, mercury and nickel), and persistent organic pollutants (benzene, PAHs and dioxins and furans).

A number of acknowledged uncertainties exist in assessing the 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 notes instances where caution is needed in interpreting the results.

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 non-industrial sources, such as transport, and consequently it does not reflect the total damage costs caused by air pollution across Europe. The recognised significant economic and social benefits generated by industry (such as products, employment and tax revenues) are also not addressed.

### Further information

EEA report: *Costs of air pollution from European industrial facilities 2008–2012* (EEA Technical report No 20/2014)

E-PRTR website: http://prtr.ec.europa.eu

**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 $NO_2$ that causes adverse effects on health; high concentrations can cause airway inflammation and reduced lung function.

**Sulphur oxides/sulphur dioxide ($SO_x$/$SO_2$)**

Sulphur dioxide is emitted when fuels containing sulphur are burned. As with $NO_x$, $SO_2$ contributes to acidification, with potentially significant impacts including adverse effects on aquatic ecosystems in rivers and lakes, and damage to forests. High concentrations of $SO_2$ can affect airway function and inflame the respiratory tract. $SO_2$ also contributes to the formation of particulate matter in the atmosphere.

**Ammonia ($NH_3$)**

Ammonia, as for $NO_x$, contributes to both eutrophication and acidification. The vast majority of $NH_3$ emissions — around 93 % in Europe — come from the agricultural sector. A relatively small amount is also released from various industrial processes, transportation and waste management.

**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 ($C_6H_6$) 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 and cancers. PM is emitted from many sources and is a complex mixture comprising of 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 $SO_2$, $NO_x$, $NH_3$ and some NMVOCs).

**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 build up in soils and sediments. Heavy metals can also bio-accumulate in food chains. They are typically toxic to both terrestrial and aquatic ecosystems.

**Organic pollutants**

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

**Carbon dioxide ($CO_2$)**

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. $CO_2$ is the most significant greenhouse gas influencing climate change, thereby posing a threat to public health and the environment.

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