AIR & AGRICULTURE

The impacts of nitrogen pollution on air, water and soil cost the EU between €70 and €320 billion a year.

The agricultural sector is contributing to emissions of both air pollutants and greenhouse gases, including 95% of the EU's ammonia (NH_3) emissions. It also emits methane (CH_4) and primary particulate matter (PM) [1].

Ammonia is emitted mainly from animal manure and synthetic fertilisers. It contributes to eutrophication, acidification and other changes in ecosystems. It can also turn into secondary PM which harms human health.

Ruminants, such as cows and goats, are the main sources of methane from agriculture. Methane is both a powerful greenhouse gas and an ozone precursor (see Air & Climate factsheet).

Primary PM mainly originates from the burning of agricultural waste, a practice that is illegal in most Member States, but which is still common according to satellite observations [2].

EU legislation

- Agricultural emissions are partly addressed by the National Emissions Ceilings (NEC) Directive, which sets overall caps on pollutants such as ammonia. However methane and PM are not yet covered by the existing directive.
- Although emissions from the larger poultry and pig facilities are regulated under the Industrial Emissions Directive, those from cattle (responsible for 60% of EU ammonia emissons) remain unaddressed.
- The Nitrates Directive has helped to improve nitrogen management at national level. However its primary aim is to address nitrogen pollution in water - not air pollution.

FACTS AND FIGURES

95% AMMONIA EMISSIONS IN EU ARE FROM AGRICULTURE [3].

3.2 MLN TONNES NITROGEN LOST AS NH_3 TO ATMOSPHERE EVERY YEAR IN EU [3].

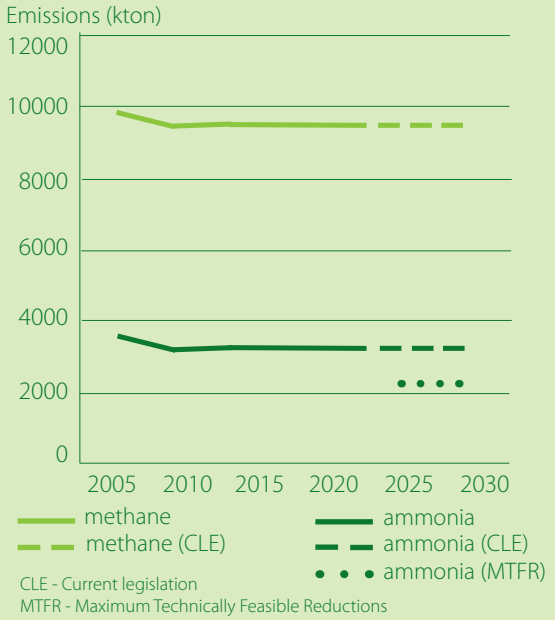
Ammonia emissions form secondary PM, which is known to provoke around 400,000 premature deaths annually in the EU, bringing down the average life expectancy of Europeans by approximately 6-12 months [4].

2/3 of EU ecosystems are currently exposed to more nitrogen deposition than they can cope with and 1 in 10 receives too much acid deposition [5].

The impacts of nitrogen pollution on air, water and soil cost the EU between 70 and 320 billion euros a year [6].

In the mid 1990s, 12% of the Mediterranean basin exceeded the threshold for nitrogen impact. In a business as usual scenario, this share will reach 69% by 2050 [7].

Baseline scenarios for agricultural emissions in the EU-28



CLE - Current legislation
MTFR - Maximum Technically Feasible Reductions

COMMON HEATHER

(Calluna vulgaris)
is one of many species that are outcompeted by grass when nitrogen depositions are high [5].

UREA-BASED FERTILISERS

Urea accounts for about 20 % of the nitrogen fertilisers used in the EU. It is popular in some regions since it is cheap and relatively safe to work with, but a big disadvantage of urea, compared to other synthetic fertilisers, is the emissions of nitrogen to the atmosphere in the form of ammonia. Losses may exceed a fifth of the applied nitrogen.

Techniques to minimise losses exist, such as direct incorporation into the soil and the use of inhibitors which restrict the conversion of urea to ammonium. Another way is to replace urea with nitrate-based fertilisers.

NITROGEN MANAGEMENT IN THE NETHERLANDS

The Netherlands has managed to reduce ammonia emissions by more than 50% in the last few decades. This has been made possible through comprehensive sector-specific legislation:

- a ban on slurry application in the season without plant growth and when the soil is frozen. Slurry silos must be covered to reduce ammonia volatilisation;
- slurry application techniques with low ammonia emission rates are compulsory on grassland and arable land on almost all soil types;
- schemes to reduce livestock numbers by licensing pig and poultry production;
- construction of green-label livestock buildings through incentives to reduce ammonia volatilisation;
- introduction of mandatory nutrient budgets for all farms.

SUSTAINABLE FOOD PRODUCTION & CONSUMPTION

More sustainable agricultural practices embracing lower stocking density, organic fertilising methods and crop rotations would help both air quality and the climate by reducing emissions of ammonia and greenhouse gases such as methane and CO_2. Changing consumption patterns is also critical. With its "Veggie Thursday", Ghent was the first city to promote one meat-free day a week.

RECOMMENDATIONS

- Adopt ambitious emission reduction commitments in the revision of the NEC Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.
- Introduce mandatory sector specific measures to limit ammonia emissions from relevant agricultural sources. This can be done via BATs (best available techniques) and/or emission limits for large farms, including cattle. The efficacy and cost-effectiveness of such measures has been very well documented.
- Include cattle in the Industrial Emissions Directive.
- Include critical levels of ammonia in the the Ambient Air Quality Directive to protect ecosystems.
- Include the Water Framework Directive and Sustainable use of pesticides in the cross compliance mechanism under the CAP as soon as possible.
- Under the Common Agricultural Policy (CAP), Member States should make use of their flexibility in order to increase the budget for rural development (pillar 2) and include measures on air pollution from agriculture within their rural development programs.

More information

- Draft guidance document for preventing and abating ammonia emissions from agricultural sources, UNECE, April 2011
- The nitrogen footprint calculator http://www.n-print.org/
- EEA Signals 2013 - Every breath we take Improving air quality in Europe, July 2013, European Environment Agency
- Reports and briefings at www.eeb.org and www.airclim.org

For footnotes, please refer to separate reference sheet and to the EEB website.

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AIR & CLIMATE

The solutions for limiting climate change are often the same as for the fight against air pollution.

Emissions of greenhouse gases (GHG) constitute a severe threat to human life on earth. Outdoor air pollution is a major problem for people's health and the environment (see Air & Health and Air & Ecosystems factsheets). Although they are addressed through separate policies, the solutions for limiting climate change are often the same as for the fight against air pollution. Ambitious and well coordinated air and climate policies can bring huge benefits to our societies and avoid hundreds of thousands of premature deaths, diseases, crop losses, weather disasters, drought and floods.

EU legislation

- The 2020 climate and energy package sets 20% targets for GHG emission reductions, share of renewables in the energy mix and energy efficiency improvement.
- The Directives for Ambient Air Quality and National Emissions Ceilings (NEC) are two major EU instruments to control air pollution. The climate and energy package and the NEC directive are now being revised and the level of ambition in both is expected to rise for 2020, 2025 and 2030.
- The EU also sets standards for specific sectors such as large industries, road vehicles or household heating. However, some sectors such as shipping or agriculture remain poorly regulated (See Air & Shipping and Air & Agriculture factsheets).

SHORT-LIVED CLIMATE POLLUTANTS

Black carbon (BC), methane (CH_4) and ground-level ozone (O_3) are called "short-lived climate pollutants" (SLCPs). SLCPs remain in the atmosphere between 1 day and 15 years and contribute to both bad air quality and climate change [4].

Black carbon (BC) is made of very small dark coloured particles which can penetrate deep into the lungs and increase the risk of respiratory and cardiovascular diseases as well as cancer [5]. BC is also an important climate forcer and contributes significantly to the melting of Arctic ice [6].

Ground level ozone (O_3) is a secondary pollutant formed mainly through emissions of nitrogen oxides (NO_x), volatile organic compounds (VOCs) and methane. In addition to being a significant GHG, it causes respiratory health problems and leads to premature deaths, as well as causing damage to natural ecosystems and crops such as wheat and rice.

Methane (CH_4), which is a precursor of ozone, is also a powerful GHG, with a 20-year global warming (GWP) potential of 72. This means that a tonne of methane has 72 times the radiative forcing of a tonne of CO_2 over 20 years.

FACTS AND FIGURES

1.3 MLN

GLOBAL GHG mitigation could help avoid 1.3 million deaths every year by 2050 [1].

-15% CO_2

In **WESTERN EUROPE**, combining climate change and air quality policies may deliver extra 15% CO_2 reduction compared to either strategy alone [2].

16 SLCPs MEASURES

- 2.5 MLN LIVES SAVED PER YEAR
- 32 MLN TONNES FEWER CROP LOSSES
- 0.5°C CLIMATE CHANGE REDUCTION

A package of sixteen selected SLCPs emission abatement measures could, if fully implemented across the globe, save close to 2.5 million lives a year, avoid crop losses amounting to 32 million tonnes annually and deliver near-term climate protection of about 0,5 °C by 2050 [3].

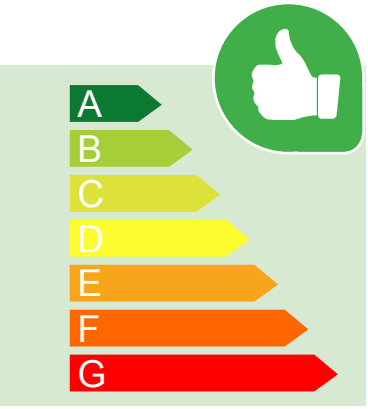
Measures to reduce the use of motor vehicles, increase the energy efficiency of buildings and generate low-carbon electricity all help to fight climate change and improve people's health through better air quality.

COAL USE

Coal is still a major source of energy in Europe, accounting for approximately a quarter of all electricity production. Coal power plants are large contributors to emissions of GHG, heavy metals, PM, SO_x, NO_x and O_3. The health impacts of coal power generation are estimated at more than 18,300 premature deaths, about 8,600 new cases of chronic bronchitis, and over 4 million lost working days each year in the EU. The economic costs of these health impacts are estimated at up to €43 billion per year. Adding Serbia and Turkey, the figures for mortality in Europe increase to 23,300 premature deaths, or 250,600 life years lost, while the total costs are up to €54.7 billion annually [7].

PROMOTION OF DIESEL

Diesel has higher energy content than petrol and is therefore broadly used. Some countries like Germany and France have even actively encouraged diesel on CO_2 grounds, for instance by applying lower taxes on diesel. However, diesel cars emit more PM and NO_x than their petrol equivalents and diesel exhaust fumes are classified as carcinogenic [8].



LESS AND CLEANER ENERGY

Reducing emissions of GHGs and air pollutants through energy efficiency and energy savings is a cost-effective way to address both problems at the same time. The greatest saving potential is associated with the building and transportation sectors [9]. Savings in this area would benefit both climate mitigation and air policy. Switching from fossil fuel to wind, solar and geothermal energy would also benefit air quality [10].

SUSTAINABLE FOOD PRODUCTION & CONSUMPTION

can also help improve air quality and halt climate change by reducing ammonia and GHG emissions (see Air & Agriculture factsheet).

For footnotes, please refer to separate reference sheet and to the EEB website.

RECOMMENDATIONS

- Adopt ambitious, coherent and binding GHG, renewable energy and energy savings targets for 2030. New EU climate objectives must be agreed as soon as possible to prepare the 2015 UNFCCC agreement and should be ambitious enough to reach at least 95% reductions by 2050.
- Adopt ambitious air pollution limits under the revision of the NEC Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030 and address both CH_4 and BC which contribute to bad air quality.
- Strictly enforce and tighten ambient air quality standards to align them with the most recent WHO recommendations and health research.
- Adopt policies to cut emissions of GHGs and air pollution at source, including CH_4 and BC.

More information

- Soot Free for the Climate Campaign: http://www.russfrei-fuers-klima.de/
- IASS Potsdam, ClimPol webpage: http://climpol.iass-potsdam.de/
- Climate and Clean Air Coalition: http://www.unep.org/ccac/
- IIASA TSAP report #11, February 2014
- Primer on Short-Lived Climate Pollutants, IGSD, April 2013
- Bounding the role of black carbon in the climate system: A scientific assessment, 2013
- Outlaws in Air City, Short Film: https://www.youtube.com/watch?v=I19M2FcfSzQ

AIR & CULTURAL HERITAGE

The cost of the deterioration of building materials due to air pollution is huge and seriously endangers our cultural heritage.

The Milan Duomo, Saint Paul's in London and Notre Dame in Paris are great icons of European culture. Yet these monuments, and many others, are heavily affected by air pollutants which attack the calcareous materials these buildings are built with. For over two centuries, the development of industry, transport and heating resulted in significant emissions of sulphur, nitrogen compounds and carbon. These compounds are either gases or particulates. They build up over the years on the surface of the buildings. The walls - made mainly of stone, bricks, cement, glass, wood and ceramic - become discoloured and suffer material loss, structural failure and soiling [1]. Of particular importance is soiling caused by particles, and corrosion caused by chemicals (mostly sulphur and nitrogen oxides as well as carbon dioxide), which decrease the pH of rainwater (acidification). Many different damage patterns are involved in chemical decay such as pulverisation, black crusts, soluble salts efflorescence and particulate matter deposits [2]. The cost of air pollution damage to building materials is enormous but difficult to estimate with great precision.

EU legislation

- Article 128 of the European Union Treaty says that actions by the Community shall be aimed at supporting conservation and safeguarding of cultural heritage of European significance.
- The Ambient Air Quality and National Emissions Ceilings (NEC) Directives are two major EU instruments to control air pollution in order to protect human health and the environment. However, they do not specifically address impacts on historic and cultural monuments and buildings.
- The Convention on Long-Range Transboundary Air Pollution (CLRTAP), to which the EU is a party, defines the term of "acceptable levels" of air pollutants damaging materials and cultural heritage and proposes the rates for certain materials [3].
- The indicators used by the European Environment Agency (EEA) for their "Integrated Assessment of Air Pollution and Climate Change" includes impacts on sea level, ecosystems, water resources and health. The impacts on cultural heritage are however not mentioned.

FACTS AND FIGURES

HISTORICAL buildings and monuments situated in EU cities are affected by air pollution. The costs of losing our precious cultural heritage forever through damage caused by air pollution would be huge.

€280 /m² **CLEANING NATURAL STONE** from soot and damage caused by SO_2 may cost on average €280 per square metre. This could add up to billions of euros to be spent cleaning affected surfaces [4].

POLYCYCLIC ORGANIC HYDROCARBONS (PAH), which are byproducts of coal, diesel and wood combustion, can cause significant degradation to buildings and monuments.

HEAVY METAL POLLUTION may accelerate the kinetic decay of construction materials.

CO_2 Raised atmospheric **CARBON DIOXIDE** (CO_2) is a major cause of corrosion of limestone facades of buildings [5].

MATERIALS used for culturally valuable objects are also the most vulnerable to air pollution. This is the case of bronze, nickel, zinc, unalloyed and galvanised steel, mortar and natural stone.

STAINED GLASS present in many European cathedrals is being damaged by polluted rain and depositions of soot. Elevated levels of sulphur and nitrogen compounds cause glass to lose its transparency.

AIR POLLUTION AFFECTS INDOOR AIR QUALITY AND WORKS OF ART

Krakow is still one of the most polluted cities in Europe. This has an impact not only on human health but also on the works of art and historical buildings that this Polish city is famous for. A study of pollutants in the chambers of the Wawel Royal Castle found that the concentration of dust in winter reaches 130 µg/m^3 [6]. These particles spoil the artefacts, their texture, provoke chemical reactions and pose microbiological hazards. This prompts more intense cleaning and treatment activities that adversely affect the works of art. The presence of sulphate and soot particles can cause the fading of paintings.

AIR QUALITY MANAGEMENT IN CITIES

Most of Europe's precious historical and modern cultural heritage is located in the heart of big cities or capitals. This is usually also where the highest concentrations of air pollutants occur, as shown by the EEA reports on air quality. However, there is a lot which can be done to improve air quality in cities, as demonstrated by several initiatives which have been implemented in recent years. Air quality management can include Low Emission Zones (LEZ), better land-use planning, congestion charges, parking management and improving public transport [7]. All of this could help protect human health and cities' most precious sights.

BETTER UNDERSTANDING HOW AIR POLLUTION DAMAGES BUILDINGS

More research is needed to better understand the extent of the damage caused by air pollution to our cultural heritage. Some research is already taking place in Paris where, on the top of the north tower of the church of Saint-Eustache, experiments are trying to determine the damage air pollution is causing [8]. Samples of Parisian limestone and glass are exposed, some sheltered from rain and some not. They are regularly analysed (sulfation and carbonation, weight gain or loss, darkening, loss of transparency) according to the different doses of pollutants measured on the site.

For footnotes, please refer to separate reference sheet and to the EEB website.

RECOMMENDATIONS

- Adopt ambitious emission reduction commitments in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.
- Control emissions from medium combustion installations by setting limits in line with current best available techniques, ensure their rapid entry into force and an adequate permitting and monitoring regime.
- Adopt sector legislation to cut emissions from all major sources of air pollution. Surveillance of compliance is also critical, as shown with road vehicles.
- Ensure that air pollution's impacts on cultural heritage are better researched and understood, including the costs associated with the damages.
- Consider specific levels for the protection of sensitive materials based on the latest research.

More information:

- Global Climate Change Impact on Built Heritage and Cultural Landscapes: http://noahsark.isac.cnr.it/
- Conservation, restoration and maintenance of Indoor and Outdoor Monuments, D. Camuffo, Elsevier, 2013
- International Co-operative Programme on Effects on Materials including Historic and Cultural Monument: http://www.corr-institute.se/ICP-Materials/web/page.aspx
- The Effects of Air Pollution on Cultural Heritage, J. Watt et al, 2009
- The enhanced deterioration of the cultural heritage monuments due to air pollution, C. Varotsos, C. Tzanis, A. Cracknell, 2009

AIR & DOMESTIC HEATING

Small-scale domestic combustion is the biggest source of emissions of fine particles - known for their harmful effects on human health

Small-scale domestic combustion in fireplaces, wood and coal-fired stoves as well as boilers are significant contributors to air pollution. They emit fine particulate matter ($PM_{2.5}$), sulphur oxides (SO_x), carbon monoxide (CO), poly-aromatic hydrocarbons (PAHs), dioxins, organic gaseous compounds (OGCs) and nitrogen oxides (NO_x) which form ground level ozone. These pollutants damage human health and cause premature deaths (see Air & Health factsheet). Wood and coal burning also emits black carbon (BC), known as soot, which contributes to climate change by absorbing heat from the sun.

The technical potential for cutting emissions from the burning of solid fuels in small-scale combustion appliances is huge. There is an urgent need for action.

EU legislation

- Air pollution from domestic heating boilers and stoves is addressed by the Ecodesign implementing regulations which set EU-wide rules for the marketing and use of energy using products. The EU is currently discussing emission limit values (ELVs) for biomass and fossil fuel boilers and stoves to enter into force in 2018 or later. Energy efficiency requirements will also be set. Such ELVs will only apply to new installations. This is particularly problematic due to the long life time of the units (more than 30 years) which means that existing installations will continue polluting for many years.
- Other EU instruments are there to improve air quality - in particular the National Emission Ceilings (NEC) and Ambient Air Quality Directives.
- Additional efforts may be made at national level, for instance in restricting fuel use (see Dublin and Krakow examples).

FACTS AND FIGURES

PM2.5 EMISSIONS

Small-scale domestic combustion is the biggest source sector for emissions of $PM_{2.5}$, responsible for nearly 1/3 of the total emissions in the EU [1].

BLACK CARBON

Under current legislation, domestic heating will be the largest source of black carbon (50%) in the EU by 2030 [2].

In addition to continued coal use in some countries, a major challenge is the increase of biomass use, driven partly by renewables policy which encourages the use of biomass for energy to fulfil renewables targets without necessarily taking into account the health implications or sustainability of their supply.

The economic crisis in many EU countries has had a negative effect on air pollution. There has been an increase in the burning of wood and other cheap materials which has worsened air quality.

Savings of €31.5 billion annually could be achieved if the WHO recommended limits for $PM_{2.5}$ are met in just 25 large European cities [3].

PM2.5 EMISSIONS

may be up to 250 times higher if a stove is not properly operated [4].

HEALTH PROBLEMS

Exposure to particles from biomass combustion may be associated not only with respiratory but also cardiovascular health [5].

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BAN ON SOLID FUELS IN KRAKÓW, POLAND

Today, Kraków is one of the most polluted cities in Europe. The daily limit value for PM_{10} is exceeded up to 250 times a year. During peak pollution days over the winter, levels of PM_{10} can reach up to 400 $\mu g/m^3$ – eight times over the limit. The main culprit is coal used for domestic heating. Emissions from domestic heating account for 42% of PM_{10}, 34% of $PM_{2.5}$ and 68% of benzo(a)pyrene [6] - the most harmful pollutants to health which are associated with asthma, cancer and heart disease.

Measurements methods:

- mg/m^3 - miligrams of pollutant per cubic meter of air
- g/GJ – grams of pollutant per gigajoule net heat input (comparable to power plants emissions)
- g/kg – grams of pollutant per kg of combustible solid fuel (i.e. wood).

For several years local and regional authorities have done very little to improve the situation. Only after civil society increased pressure on authorities to take strong measures to tackle air pollution was a ban on using solid fossil fuels for domestic heating introduced in Kraków. The ban will come into full force in 2018. According to experts, it is the only solution to reach the limit values [7].

DUBLIN "SMOKY COAL" BAN

A ban on smoky coal was introduced in 1990 in Dublin as a response to episodes of severe winter smog, which were caused by the widespread use of smoky coal in residential heating. The ban is estimated to have resulted in around 350 fewer annual deaths because of reduced PM, smoke and SO_2 levels. The ban has now been extended to 20 other cities in Ireland. An estimate of these benefits in monetary terms put the value at over €20 million. Householders have also benefitted from the switch from solid fuel to more efficient and less polluting gas and oil energy sources [8].

GERMAN REGULATION TO REDUCE WOOD BURNING EMISSIONS

Germany has put in place a specific law to reduce wood burning emissions. The new regulation contains a list of fuels that can be burnt, including their maximum moisture. It also sets emission limit values (ELVs) for several air pollutants – including PM – for boilers and stoves. As of January 2015, stoves will have to comply with more stringent ELVs, ranging between $20mg/m^3$ and $40mg/m^3$ depending on the type of fuel used. Inspections have been extended to all stoves above 4 KW (previously this was set at 15 KW) [9]. This is expected to significantly reduce PM emissions from domestic heating.

For footnotes, please refer to separate reference sheet and to the EEB website.

RECOMMENDATIONS

- Introduce a harmonised EU method for measuring PM (including condensates) to be used as a test standard when approving all new small combustion installations.
- Introduce an ELV for PM (including condensates) of 200 g PM/GJ heat from 2015 for new log-based combustion installations, going down to 100 g PM/GJ in 2018 and 50 g PM/GJ in 2020.
- Ensure that only appliances emitting less than 4 g of PM/kg of solid fuel are placed on the EU market (Ecodesign Regulation).
- Introduce an EU wide labelling scheme based on the PM emissions performance of new residential wood, pellet and coal fuelled installations.
- Use economic incentives (e.g. taxes or subsidies) to promote the replacement of old domestic combustion installations with better home insulation, heat pumps, new wood pellet installations or, in cities, with district heating or gas.
- Prohibit or restrict residential solid fuel burning in residential areas and promote alternatives.
- Inform consumers about the cleanest types of appliances and fuel used as well as about how to install and operate them efficiently.
- Adopt ambitious emissions reduction commitments, including for $PM_{2.5}$, under the revision of the NEC Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.

More information

- IIASA TSAP Report #11, February 2014
- WHO REVIHAAP Report, 2013
- EMEP/EEA emission inventory guidebook 2013; Small combustion

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AIR & THE ECONOMY

In 2010 the cost of air pollution to health alone amounted to between €330 and €940 billion in the EU.

Air pollution has a high human, environmental and economic cost. It is estimated that in 2010 the cost of air pollution to health alone amounted to between €330 and €940 billion in the EU. Therefore action is needed to abate the effects of air pollution. The cost of abatement can be measured against the overall health, welfare, ecological, and economic benefits of air pollution control.

Cost benefit analyses

Cost-benefit analyses (CBA) have been carried out to inform the revision of the National Emissions Ceilings (NEC) Directive. The studies investigated the health benefits from reduced exposure to particulate matter ($PM_{2.5}$) and ground-level ozone (O_3), and compared these with the estimated costs for additional pollution control measures [1,2]. The analysis looks into three scenarios:

Scenario A — **Baseline:** levels of emissions in 2025 and 2030, assuming full implementation of already adopted EU and national legislation and before any revision of the NEC Directive [3, 4].

Scenario B — **Commission proposal:** provides the basis for the revised NEC Directive as proposed by the European Commission in December 2013.

Scenario C — **Maximum technically feasible reductions (MTFR):** gradual phase-in of currently available emission abatement techniques.

There is a fourth plausible scenario, though it wasn't considered by the Commission.

Scenario D — **Maximum Possible Reductions:** this scenario would go beyond MTFR and include structural policies, such as increased cycling, public transport or energy efficiency. This would help achieve the World Health Organisation's recommended levels.

FACTS AND FIGURES

Benefits and costs of stricter national emission ceilings

REDUCE ANNUAL HEALTH DAMAGE

Moving from scenario A to scenario B would reduce annual health damage costs in 2030 by €40-140 billion in the EU, while scenario C would provide health benefits valued at €58-207 billion.

ANNUAL HEALTH IMPROVEMENTS

Annual health improvements of moving from scenario A to scenario B include avoiding 59,000 premature deaths, 20,000 respiratory hospital admissions, 44,000 cases of chronic bronchitis, and 60 million restricted activity days.

BENEFITS COSTS

The cost of moving from scenario A to scenario B was estimated at €3.3 billion per year in 2030, while scenario C was estimated to cost €50 billion/yr. If expressed as a percentage of GDP in 2030, the cost for scenario B is equivalent to 0.02%, and for scenario C 0.32% as an average for the whole EU.

HEALTH BENEFITS ALWAYS EXCEED THE COSTS

- In scenario B health benefits exceed costs by a factor of 12 (lowest health valuation) and 42 (highest health valuation).
- In scenario C health benefits are up to four times higher than the costs.

It should be noted that these monetised benefits cover only human health impacts - they do not include the value of reduced damage to ecosystems, agricultural crops, materials or the cultural heritage. Nor do they include for example less chronic effects of ozone on health.

COSTS ARE OVERESTIMATED

Current estimates of the cost of implementing EU air quality policies are calculated using the GAINS computer model and are based primarily on technical "end-of-pipe" abatement measures [5]. This means that a number of structural measures and behavioural changes are not included, in spite of the fact that some of these measures can reduce emissions at zero or low net cost, and many of them will also reduce emissions of greenhouse gases. Examples of such measures include those aimed at improving energy and transport efficiency, fuel switching, increased use of renewable sources of energy and greening of the agricultural policy.

In addition, the cost estimates are based on existing available technologies and current cost data, which mean that innovation and improvement in abatement techniques that can be expected to take place up to 2030 are not accounted for.

BENEFITS ARE UNDERESTIMATED

The CBAs used so far to evaluate EU air pollution control policies clearly underestimate the benefits of air pollution control. This is because the monetised benefits generally do not include reduced damage to ecosystems and cultural heritage. Nor do they include the full range of health benefits. Some of them include reduced damage to agricultural crops and modern materials, but these estimates are limited by the shortage of data on, for example, stock-at-risk, exposure-response functions and valuation [5].

IT PAYS TO CUT AIR POLLUTION IN EUROPE

Despite the fact that current CBAs systematically overestimate the costs and underestimate the benefits of air pollution control, virtually all such analyses carried out at EU or European level to date show that monetised benefits far exceed costs. Moreover, CBA studies on air pollution prepared for the European Commission have repeatedly shown that benefits exceed costs even when going for the highest level of ambition of technical emission control (scenario C).

AIR POLLUTION CONTROL WORKS

A retrospective study has shown that the economic benefits of air pollution control between 1970 and 1990 in the United States were 42 times greater than its costs [6]. More recently, the U.S. Environmental Protection Agency estimated that the annual benefits of reducing air pollution under the 1990 Clean Air Act amendments will reach approximately $2,000 billion in 2020 and save 230,000 people from early death in that year alone [7]. The costs for that same year were estimated to amount to $65 billion. In other words, the benefits exceed the costs by more than 30 times.

For footnotes, please refer to separate reference sheet and to the EEB website.

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RECOMMENDATIONS

- The overall level of ambition for the EU's air pollution policy proposals must be guided by the objective of the EU's 6th and 7th Environmental Action Programmes, i.e. to achieve "levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment." Because current CBAs systematically overestimate the costs and underestimate the benefits, they should be used to provide additional information, not for determining levels of ambition.
- CBAs should include calculations of the cumulative health benefits that show how benefits accumulate over time, and how much higher the benefits will be if action to control emissions is taken earlier rather than later. This would provide important additional information to policy-makers when deciding on target years for e.g. the revised NEC Directive and for additional source-sector measures.
- While investigating the "marginal cost versus marginal benefits" of air pollution abatement may provide some additional information for decision-makers, this approach is clearly not acceptable for establishing suitable levels of ambition. The reason being that it focuses solely on those air pollution impacts that can currently be monetised and totally disregards the damage air pollution causes to natural ecosystems, crops, materials and cultural monuments.

More information

- EU air pollution policy review 2011-2013: http://ec.europa.eu/environment/air/review_air_policy.htm
- US economic analyses of the Clean Air Act: http://www.epa.gov/air/sect812/economy.html

AIR & ECOSYSTEMS

In 2010, the area of ecosystems affected by eutrophication amounted to 1.1 million km² which represents 2/3 of EU ecosystems.

Two-thirds of EU ecosystems are currently exposed to higher nitrogen levels than they can cope with and one-tenth are over-exposed to acidifying air pollutants. Elevated concentrations of ground-level ozone also threaten biodiversity and the functioning of ecosystems. While the area of ecosystems in the EU at risk from excess acid deposition is expected to shrink further by the year 2020, the area at risk of eutrophication from excess nitrogen deposition is expected to come down only marginally, and will still exceed 1 million km². According to longer-term scenarios, up to 61% of EU ecosystems will remain at risk of eutrophication by 2050 [1].

EU legislation

- The Ambient Air Quality Directive 2008/50/EC sets an EU-wide target value for O_3 for the protection of vegetation. This target is three times higher than the long-term objective set already in 2002 (Directive 2002/3/EC) to protect vegetation from adverse effects. The Directive lacks critical levels for ammonia.
- The National Emissions Ceilings (NEC) Directive sets overall caps on pollutants in order to limit acidification, eutrophication and ground-level ozone pollution. The Directive is currently being revised.
- Significant additional emission reductions are required to achieve the long-term objective of the 6th and 7th Environmental Action Programmes of no exceedance of critical loads and levels.

Ozone changes the composition of species of sensitive plant communities such as acid grasslands. All the other parts of an ecosystem are also potentially impacted by ozone, including animals, fungi, bacteria and insects that live in close association with plants or in nearby soils.

FACTS AND FIGURES

LESS ACIDIFICATION

Following significant SO_2 emission reductions over the last 40 years, the area of sensitive ecosystems at risk of acidification in the EU is now less than 200,000 km².

TOO MUCH EUTROPHICATION

Excess levels of nitrogen lead to eutrophication (over-fertilisation) of ecosystems. Nitrogen-loving species, such as many grasses, out-compete sensitive lichens, mosses, forbs and dwarf shrubs in grasslands or on the forest floor.

DAMAGING AIR POLLUTANTS

The main air pollutants damaging the structure and function of grassland, forest, fresh water and other natural ecosystems in Europe today are reactive nitrogen compounds (especially NO_x and NH_3) and ozone (O_3).

The maximum level of nitrogen that can be supported without harming the most sensitive ecosystems (e.g. permanent nutrient poor lakes, tundra) is exceeded in most parts of Europe [2].

O_3 may worsen the effects of other stress factors such as high acid levels and drought.

1.1 MLN KM² = **2/3 OF EUROPEAN ECOSYSTEMS** = **5xUK**

In 2010, the area of ecosystems affected by eutrophication in the EU amounted to 1.1 million km², which is equal to more than two-thirds of the EU's ecosystems and corresponds to more than the size of Poland, the UK and Spain put together [3].

OZONE DAMAGES FOREST TREES

The current ambient ozone levels are dangerously high, as shown by the growth reductions in mature beech and Scots pine in Switzerland and Lithuania, respectively [4].

Reduced tree growth means reduced carbon storage in wood biomass. The estimated losses in forest carbon stocks average about 10% across ten northern European countries, with the highest losses predicted for the Czech Republic, Germany and Poland [5].

If additional measures to reduce emissions of ozone precursor pollutants (primarily NO_x and volatile organic compounds) are not taken by 2020, vegetation over large areas in Europe will remain at risk from ozone damage. Areas in parts of western, central and southern Europe will be at highest risk [1].

LICHEN DIVERSITY

In London, lichen diversity has increased by an order of magnitude since 1970. The current diversity of lichens on non-acidic tree bark is due to the ubiquitous distribution of nitrogen pollution tolerant species associated with eutrophication. In contrast to SO_2, NO_x concentration in the air in London has changed very little since 1970s and still exceeds the EU critical level of 30 µg/m^3 of NO_2 for sensitive vegetation and ecosystems [6].

Eutrophication due to excess nitrogen deposition is also apparent in rural areas in the vicinity of large poultry, pig and cattle farms.

For footnotes, please refer to separate reference sheet and to the EEB website.

RECOMMENDATIONS

Urgent action at EU level is required to minimise the effects of air pollutants on biodiversity and to ensure the ability of species and ecosystems to provide us with vital ecosystem services. In particular the EU should:

- Adopt ambitious emission reduction commitments in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.
- Control emissions from medium combustion installations by setting limits in line with current best available techniques, ensure their rapid entry into force and an adequate permitting and monitoring regime.
- Adopt sector legislation to cut emissions from all major sources of air pollution including e.g. NO_x emissions from international shipping and NH_3 emissions from agriculture.
- Extend the EU Air Quality Directive 2008/50/EC to include critical levels for NH_3 to protect lichens and bryophytes, heathlands, grasslands and forest ground flora.

More information

- Ozone Injury in European Forest Species: www.ozoneinjury.org
- CLRTAP Working Group on Effects: http://icpvegetation.ceh.ac.uk/publications/wge_documents.html
- Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads & Levels and Air Pollution Effects, UNECE, 2004
- NGO reports and briefings: www.eeb.org and www.airclim.org

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AIR & HEALTH

Around 90 % of Europeans living in cities are exposed to levels of air pollution deemed damaging for human health.

Although air pollution is rarely visible nowadays, Europe's air quality is still a huge problem. Air pollution is responsible for more than 400,000 early deaths in the EU each year [1]. Sensitive and vulnerable groups such as pregnant women, children, the elderly and those already suffering from respiratory and other serious illnesses or from low income groups are particularly affected [2].

The health effects of air pollution are well documented: not only is poor air quality a risk factor for heart and respiratory diseases such as asthma and chronic bronchitis, but it is also increasingly linked with harm to children's nervous systems and brain development, and even with diabetes.

The World Health Organization's Cancer Agency (IARC) also confirmed that outdoor air pollution can cause lung cancer [3].

Clearly the quality of indoor and outdoor air plays a major role in many chronic diseases in Europe with high costs for the individuals affected, national health services and the economy at large.

FACTS AND FIGURES

Air pollution will become the top cause of environmental-related deaths worldwide by 2050 if no action is taken [5].

AIR POLLUTION KILLS

over 10 times more people than road traffic accidents in the EU [6].

9 OUT OF 10

European city dwellers still breathe air that the World Health Organisation (WHO) considers to be harmful to health [7].

HEALTH DAMAGE

In the year 2010 alone, the health damage from air pollution in the EU amounted to between €330 and €940 billion, that is 3-9% of the EU's GDP [4].

FINANCIAL BENEFIT

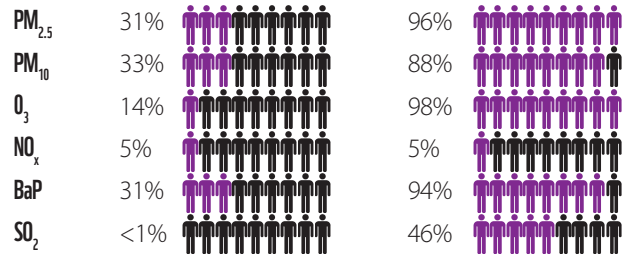
Reducing concentrations of fine particulate matter ($PM_{2.5}$) to WHO recommended levels in 25 European cities would add up to 22 months to the average life expectancy of their inhabitants, resulting in financial benefits of €31 billion per year [8].

ASSESSING THE HEALTH COSTS OF AIR POLLUTION

One method for putting a price tag on the health effects of air pollution has been developed under the Clean Air for Europe Programme [9]. First, emissions of air pollutants and concentrations are assessed, using modelled and monitored data. Second, people's exposure and the associated health impacts are quantified. Third, these impacts are valued using agreed amounts (see Air & the Economy factsheet).

Such assessments draw on hundreds of studies that are published on the health effects of air pollution. New evidence is now available from large population-based assessments, such as ESCAPE [10]. These epidemiological studies trace the effects of one or more pollutants in people over a certain time. Researchers make sure that health impacts are due to air pollution and not to other factors such as smoking or physical inactivity.

EU urban population exposed to harmful levels of air pollution



Source: EEA Report, 2013

HEALTH EFFECTS OF AIR POLLUTANTS

PARTICULATE MATTER (PM): short and long-term exposure to PM causes respiratory and cardiovascular disease, atherosclerosis (thickening of the arteries), adverse birth outcomes, impacts on children's development of the brain and nervous system, diabetes, and can result in death. PM is also linked to respiratory infections and asthma in young children. Depending on their size, PM are referred to as either PM_{10}, which are coarser particles, or $PM_{2.5}$, which are finer particles. The smaller the particles, the greater the harm to human health.

OZONE: short-term exposure can lead to more frequent hospital admissions and increases the risk of death from heart and respiratory disease. Ozone is also suspected to harm children's cognitive development and contribute to premature births.

NO_2: short and long-term exposure has impacts on mortality and morbidity (mainly through cardiovascular and respiratory disease). NO_2 also contributes to the formation of ozone and PM.

SO_2: impacts respiratory function and contributes to PM formation.

METHANE (CH_4): a powerful climate gas which also contributes to the formation of ozone which is harmful to health.

MERCURY: a highly toxic pollutant damaging the nervous system at even relatively low levels of exposure, and of particular concern for children.

BLACK CARBON (BC): a major component of $PM_{2.5}$ and a short-lived climate pollutant. Has similar health effects to PM.

EU LEGISLATION

Current EU air quality standards to limit harmful air pollution were agreed in the late 1990s. However, in many places in Europe, especially in cities, people are exposed to concentrations that are above the legal limits. These EU limit values are 'informed' by World Health Organisation guidelines, but in some cases are much less stringent [11]. For example, allowing Member States to exceed the daily PM concentrations up to 35 times a year has no scientific basis at all. The WHO also recently announced that they will make their guidelines even stricter, following a comprehensive review of the scientific evidence. This assessment showed that serious health effects occur at levels lower than current guidelines and that the range of effects is broader than previously thought.

EU HEALTH STANDARDS LAGGING BEHIND

$25\mu g/m^3$

EU $PM_{2.5}$ ANNUAL LIMIT

$15\mu g/m^3$

JAPAN $PM_{2.5}$ ANNUAL LIMIT

$12\mu g/m^3$

US $PM_{2.5}$ ANNUAL LIMIT

$10\mu g/m^3$

WHO $PM_{2.5}$ RECOMMENDATION

For footnotes, please refer to separate reference sheet and to the EEB website.

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RECOMMENDATIONS

- Adopt ambitious emission reduction commitments in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.
- Control emissions from medium combustion installations by setting limits in line with current best available techniques, ensure their rapid entry into force and an adequate permitting and monitoring regime.
- Adopt sector legislation to cut emissions from all major sources of air pollution. Surveillance of compliance is also critical, as shown with road vehicles.
- Enforce current EU ambient air quality limit values so they are met throughout the EU as soon as possible.
- Align EU ambient air quality limit values with the most recent WHO recommendations and health research by 2020.

More information

- World Health Organization Europe: http://www.euro.who.int/en/health-topics/environment-and-health/air-quality
- European Environment Agency: http://www.eea.europa.eu/themes/air
- APHEKOM project: www.aphekom.org
- Health and Environment Alliance (HEAL): http://www.env-health.org/policies/air-quality/

AIR & INDUSTRY

The health impacts of coal power generation are estimated at more than 18,300 premature deaths, about 8,600 extra cases of chronic bronchitis, and over 4 million lost working days each year in the EU.

Industrial installations – in particular the biggest ones – emit large amounts of air pollutants in Europe. Emissions of sulphur dioxide (SO_2), particulate matter (PM), nitrogen oxides (NO_x), carbon dioxide (CO_2), volatile organic compounds (VOCs), mercury (Hg), cadmium, lead, nickel and dioxins are of particular concern both for human health and ecosystems (see Air & Health and Air & Ecosystems factsheets).

EU legislation

- The Industrial Emissions Directive (IED) aims to both prevent and control pollution from around 50,000 large installations operating in many fields including energy, the production and processing of metals, minerals and chemicals, waste management and the intensive rearing of pigs and poultry [1].
- Installations are granted a permit based on the Best Available Techniques (BATs) in their field. BATs constitute "state of the art" environmental performance and are detailed in BAT Reference Documents (BREFs) which are developed at EU level by EU Member States, industry and environmental NGOs.
- The conclusions of these documents are formally adopted by EU Member States and need to be complied with within 4 years after publication.
- The IED also sets specific minimum binding emission limit values (ELVs) for certain air pollutants and certain sectors such as for Large Combustion Plants (LCPs) and Waste (Co)Incineration - the so-called "safety net".
- Some sectors are exempted from the IED despite their significant contribution to air pollution, for example cattle farms (see Air & Agriculture factsheet).

E-PRTR register
The European Pollutant Release and Transfer Register (E-PRTR) [2] was established to improve public access to environmental data. The register contains information about the quantity of 91 types of pollutants emitted annually by more than 28 000 of the largest industrial facilities in Europe. Unfortunately, the register does not give information about emissions concentrations or other parameters that allow the comparison of environmental performance.

Medium scale combustion plants (1-50MWth)
In December 2013, the European Commission proposed a Directive to limit emissions from combustion plants between 1 and 50 megawatts thermal (MWth). It proposes EU wide limits for three air pollutants (PM, SO_x, NO_x). The ambition level and entry into force of the limits differ according to the type of installations (engines or boilers, existing or new). The Commission did not propose a permitting regime despite this already being in place in several Member States [3].

FACTS AND FIGURES

THE COST OF AIR POLLUTION

from the **10,000** largest polluting facilities in Europe amounted to between **€102** and **169 billion** in 2009. This amounts to **€200-330** a year for every European [4].

6% OF INSTALLATIONS = 3/4 OF DAMAGE

94% OF INSTALLATIONS = 1/4 OF DAMAGE [4]

BAT IMPLEMENTATION

The benefits of applying BATs to industrial activities outweigh the costs by a ratio of between 3 to 1 (low estimate) and 10 to 1 (high estimate), even without taking into account damage to ecosystems. It could reduce the number of cases of chronic bronchitis by 14.000 each year and the number of days on which people have to limit their activity for health reasons by 24 million. The annual net benefits are estimated between €28-59 billion [5].

BENEFITS COSTS

BEST AVAILABLE TECHNIQUES

In most cases, just making sure that industry complies with the current BAT could significantly improve air quality. The LCP BREF was developed between 2000 and 2003 (adopted in 2006), which is more than ten years ago. LCPs' emission reduction potential compared to 2009 levels through rigorous BAT implementation is as follows [6]:

Pollutant	Emission reduction	Instruments to achieve reductions
NO_x	-36%	IED safety net
	-69%	Stricter BAT associated levels
SO_2	-66%	IED safety net
	-94%	Stricter BAT associated levels
Dust / PM	-64%	IED safety net
	-94%	Stricter BAT associated levels

Even more reductions are expected if the LCP BREF currently under negotiation provides for stricter BAT associated emission levels, more ambitious energy performance requirements and new pollutants (i.e. mercury) are subject for controls.

BURNING COAL

The health impacts of coal power generation are estimated at more than 18,300 premature deaths, about 8,600 extra cases of chronic bronchitis, and over 4 million lost working days each year in the EU [7]. Switching energy sources from fossil fuel to wind, solar and geothermal energy would help air quality [8].

For footnotes, please refer to separate reference sheet and to the EEB website.

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RECOMMENDATIONS

- Control emissions of medium combustion installations by setting limits in line with current best available techniques, ensure their rapid entry into force and an adequate permitting and monitoring regime.
- Extend the IED's "safety net" to new pollutants emitted by key sectors such as emissions of heavy metals from LCPs.
- Ensure the rigourous enforcement of permits based on the stricter BAT emission levels contained in the BREFs and reject derogations.
- Include cattle under the scope of the IED.
- Review the E-PRTR in order to extend its scope and enable comparison of environmental performance of industrial activities. Data should include flue gas volumes and concentrations as well as input data (e.g. type and amount of fuels used).
- Introduce economic instruments such as pollutant taxes / levies or charges. The revenues could be re-invested in cleaner techniques or to stimulate innovation. They could also serve to finance monitoring and inspection activities.
- Adopt ambitious emission reduction commitments in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.

More information

- E-PRTR register http://prtr.ec.europa.eu/
- Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control): http://eur-lex.europa.eu/
- New Features under the Industrial Emissions Directive, EEB, 2011: http://www.eeb.org/index.cfm/library/

AIR & NON-ROAD MACHINES

Non Road Mobile Machinery (NRMM) or diesel machines [1] refer to any machinery or vehicle with an engine that is not used for carrying passengers or goods on the road. Examples include construction machinery, inland ships, diesel locomotives, and garden equipment.

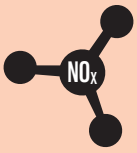
Diesel machines use the same type of engines as road vehicles and therefore emit similar pollutants. They emit nitrogen oxides (NO_x), particulate matter (PM), hydrocarbons (HC) and carbon monoxide (CO). All of these have negative effects on human health which include causing respiratory and cardiovascular diseases and even cancer. As well as harming humans, they damage our environment, causing acid rain and eutrophication.

Diesel machines emit significant levels of nitrogen oxides and particulate matter which have negative effects on human health and on the environment.

EU legislation

- In order to protect the health of European citizens and the environment, the EU has established emission limits for road transport and diesel machines [2]. Emission standards from diesel machines have become stricter over time. However, they have not proven efficient in tackling NO_x and PM emissions, both of which are particularly dangerous for human health and for the environment. These emissions have continued to grow in spite of the efforts made to reduce them because standards are not strict enough; the number of diesel machines in service has increased; certain categories of machines are not covered by legislation; and older machines, in use before the entry into force of relevant legislation, do not have to comply with the rules.
- Another problem with the existing legislation is the inadequate method used to calculate and therefore reduce PM emissions.
- The European Commission is expected to table a legislative proposal that aims to solve the shortcomings of diesel machine legislation.

FACTS AND FIGURES

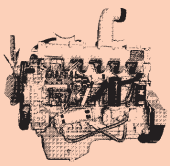


15% NO_x EMISSIONS

In 2010 diesel machines accounted for around 15% of NO_x emissions in the EU-27

5% PM EMISSIONS

In 2010 diesel machines emitted approximately 5% of total PM emissions in the EU-27



DIESEL MACHINE EMISSIONS

became more important as emissions from other sources, such as road vehicles, are reduced.

INCREASE

in the number of diesel machines in use

NO_x AND PM EMISSIONS

are dangerous for human health and the environment

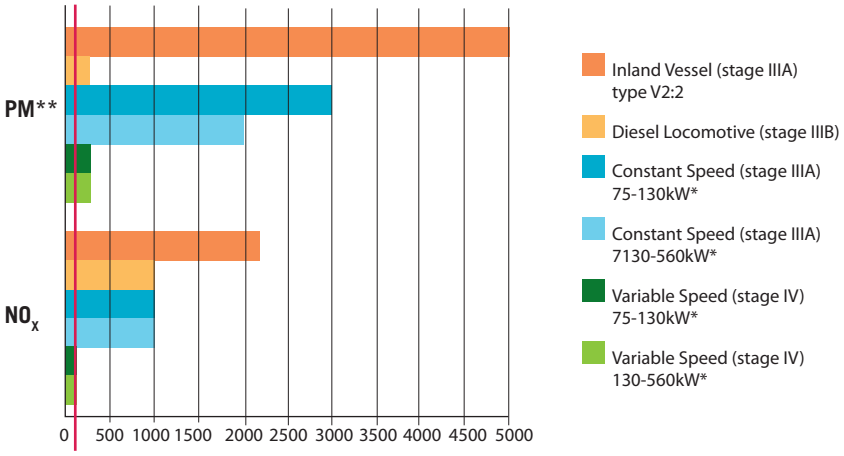
STANDARD FOR PARTICLES NUMBER

Particulate matter (PM) is the general term used for a mixture of airborne particles. They are classified according to their diameter. For example, PM_{10} refers to PM with a diameter up to 10 micrometers (µm). The smaller, ultrafine particles (below 2.5µm) are the most dangerous as they can penetrate deep into the lungs, enter the bloodstream and even reach the brain.

Historically the EU has only set standards to reduce the weight of total PM from road and non road machinery emissions. Unsurprisingly, that approach led to manufacturers choosing the cheapest and easiest option of reducing the bigger PM while ignoring the smaller, more dangerous ones.

In order to properly account for ultrafine particles, the EU has also introduced particle number (PN) limits in the legislation for road vehicles, both for cars and vans (also known as 'light duty' vehicles) and for trucks and buses ('heavy duty' vehicles). PN limits do not currently exist in diesel machine legislation.

Comparison between heavy duty vehicles standards (Euro VI) and diesel machine standards



Euro VI emission limits

* These standards are expected to be reviewed in the next revision of the Directive

** Euro VI limits on particulate matter include a PN limit value!

NATIONAL BEST PRACTICE

Some cities and countries are taking the lead in retrofitting diesel machines. Retrofitting involves installing devices such as diesel particulate filters (DPF) to old machines in order to cut down their emissions of pollutants and fulfil the newer and stricter emission limits.

- From 2014 all machinery used in public construction sites in Berlin should meet the requirements of Stage IIIB [2]. This requirement will oblige older construction machinery to be retrofitted in order to meet the stricter Stage IIIB emission limits.

- In Switzerland all construction machinery with an engine of more than 18 kW must be equipped with DPFs. Strict controls ensure compliance.

For footnotes, please refer to separate reference sheet and to the EEB website.

RECOMMENDATIONS

- Enlarge the scope of the legislation to cover machines currently excluded: diesel machines with engines above 560 kW and below 19 kW [3] and stationary engines (i.e. diesel generators, air conditioning engines).
- Introduce PN limits for all categories and align them with Euro VI.
- Align PM and NO_x emission limits with Euro VI.
- Remove flexibility and derogations. The transitional period before the entry into force of the new stage of emissions limits (Stage V) will provide manufacturers with ample time to comply with the new standards.
- Introduce in-service conformity for all machines, including those over 560 kW.
- Set stricter emissions limits from inland water vessels, locomotives and railway machinery. Their emissions limits should be consistent with their image as green transport systems.
- Address emissions from existing machines. They have a slow turnover rate meaning that if their emissions are not addressed they will continue to pollute for a long time.
- The EU should promote the application of UNECE standards across Europe. Member states should introduce retrofitting obligations for diesel machines used in their territory.
- Ensure compliance of real world driving emissions through regular controls by independent authorities.
- Adopt ambitious targets in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.

More information:

- Transport & Environment position on diesel machines http://www.transportenvironment.org/publications/tackling-emissions-diesel-machines
- Soot Free Cities City Ranking http://sootfreecities.eu/measure/non-road-mobile

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AIR & ROAD VEHICLES

EU citizens in urban areas are exposed to dangerous levels of air pollution through the air they breathe. Passenger cars and vans are a major cause of this pollution.

Road transport is a major source of air pollution that harms human health and the environment. Vehicles emit a range of pollutants including nitrogen oxides (NO_x) and particulate matter (PM). The EU has set limit values for the maximum amount of air pollution citizens should breathe, but people in urban areas are still exposed to levels of NO_2 and PM well above these limits, mainly due to high concentrations of passenger cars and vans in these areas [1].

EU legislation

- In order to reduce urban air pollution the EU has set limits for the maximum amount of pollution that can be emitted from vehicles [2]. Vehicles are therefore laboratory-tested before the car can be put on the market to ensure compliance. However real emissions on the road are much higher than emissions measured in the laboratory tests.
- This is because passenger cars and vans are tested in a laboratory on a rolling road, with the level of emissions measured over a drive cycle that is intended to reproduce real world driving conditions. Unfortunately the current test cycle fails to accurately reproduce these conditions and is therefore not representative of how European citizens drive their cars in their everyday life. The so called "cycle beating" techniques developed by carmakers enable vehicles to meet the limits during tests. This gap between the emissions measured in the laboratory and the emissions in real life driving conditions means non compliance in the real world with emissions limits.

FACTS AND FIGURES

NO_x comprises a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a toxic gas harmful for health. NO_x emissions also contribute to acidification and eutrophication, causing serious damage to ecosystems.

40% NO_x EMISSIONS

Road transport is the main source of NO_x emissions [3] and accounts for 40% of emissions in urban areas.

The average contribution of local traffic to urban NO_2 and PM_{10} concentrations is estimated at 64 % and 34 %, respectively [4].

80% It is estimated that 6-12% of the EU urban population is exposed to NO_2 levels above the EU limit value and that approximately 80% of the urban population is exposed to PM_{10} levels exceeding the WHO guidelines

DIESEL CARS: REAL-WORLD VS. TEST NO_x EMISSIONS

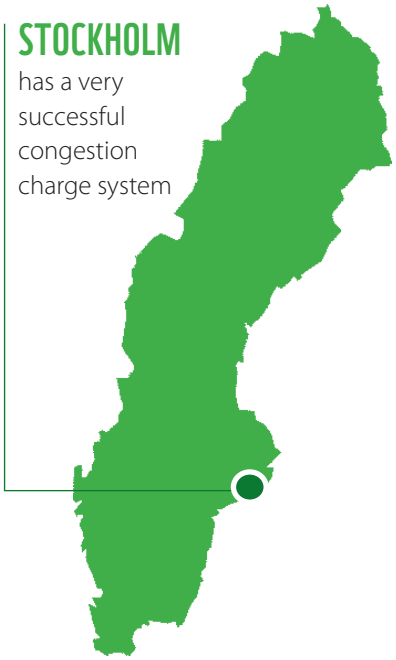
PASSENGER CARS IN THE US: NO DISCRIMINATION AND STRICTER STANDARDS

US Tier II emissions standards for NO_x are the same for both diesel and for petrol cars and are stricter than European standards (although measured on a different test cycle). The NO_x emissions limit for cars in the US is 0.04 g/km, while in the EU limits are 0.08 g/km for diesel cars and 0.06 g/Km for petrol cars [5]. What is more, the US is set to adopt stricter Tier III standards.

The European Commission should introduce real world emissions testing that reflect actual driving conditions and include the most polluting driving patterns.

CUTTING POLLUTION WITH NON-TECHNICAL MEASURES

STOCKHOLM has a very successful congestion charge system



Some European cities have implemented non-technical measures to further cut down air pollution from transport [6]. Stockholm has a very successful congestion charge system. In 2011 there were 20% less cars on the roads than before its introduction in 2005. The traffic reduction was 29% [7]. PM_{10} levels in the city centre were 15 to 20% lower in the first two years of the measure than compared to before its introduction and NO_x emissions decreased by approximately 10%. There are other policy measures that cities can use to improve air quality. Examples include Low Emission Zones (LEZ), better urban planning as well as the promotion of cycling, walking and public transport.

For footnotes, please refer to separate reference sheet and to the EEB website.

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RECOMMENDATIONS

- Introduce an improved test cycle at the latest by 2016. It should be based on the Worldwide harmonized Light vehicles Test Procedures (WLTP).
- Introduce real world emissions testing using Portable Emissions Measurement Systems (PEMS). This ensures that emission limits are not only respected during tests in laboratory conditions but also outside the lab.
- Make the system of Type Approval more consistent through the establishment of an EU-wide Type Approval Authority that would delegate testing services to accredited national organisations and require uniform standards and procedures.
- Carefully monitor if Euro 6 standards, which will introduce a reduction of NO_x emissions limits to new vehicles from 2015, effectively achieve a reduction of emissions in real world driving.
- Develop Euro 7 standards to achieve further emission reductions. New emission limits for diesel cars should be strengthened and aligned with those for petrol cars.
- Create a European framework to help Member States and cities to implement non-technical measures and cut down road vehicle pollution in a harmonised and coherent way.
- Adopt ambitious emission reduction commitments in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.

More information

- Emission standards for light and heavy road vehicles, Factsheet, AirClim, 2012: http://www.airclim.org/publications/briefings
- Laboratory versus real world: Discrepancies in NO_x emissions in the EU, ICCT, 2012: www.theicct.org/blogs/staff/laboratory-versus-real-world-discrepancies-nox-emissions-eu

AIR & SHIPPING

Air pollution from international shipping is estimated to cause about 50,000 premature deaths per year in Europe at an annual cost to society of more than €58 billion.

Although generally considered as the most carbon efficient mode of transport, shipping is a growing source of dangerous air pollution. Emissions of sulphur oxides (SO_x), nitrogen oxides (NO_x) and particulate matter (PM) (including Black Carbon) are of particular concern. They are due mainly to the poor quality fuel used in maritime transport and to the weak emission standards applicable to ship engines.

Because these emissions have been left unregulated for too long, the share of shipping emissions is growing dramatically as the pollution from other sectors is decreasing: if the trend is not reversed NO_x emissions from ships around Europe are likely to exceed all emissions from all EU land-based sources by 2020 [1]. Because shipping emissions often take place in coastal areas and large city ports, they impact greatly on human health and our environment [2].

With the exception of SO_x, emissions from international shipping are poorly regulated in Europe and the EU heavily relies on the standards adopted at international level under the MARPOL Convention on the prevention of air pollution from ships. However, these international standards are either too weak to address the issue or are simply not implemented by EU Member States.

EU legislation

At the moment, only the MARPOL provisions on SO_x emissions are covered by EU law. Emissions of primary PM and NO_x from international shipping are not regulated by the EU. In addition to adopting specific EU standards for the regulation of shipping emissions, Member States can request the International Maritime Organisation (IMO), the UN body regulating shipping activities, to recognise their seas as Emission Control Areas, which are zones where stricter emissions standards apply.

FACTS AND FIGURES

AIR POLLUTION FROM INTERNATIONAL SHIPPING

is estimated to cause about 50,000 premature deaths per year in Europe at an annual cost to society of more than €58 billion [3].

2700 TIMES MORE SULPHUR

The fuel used in international shipping contains on average 2700 times more sulphur than the fuel used for road vehicles.

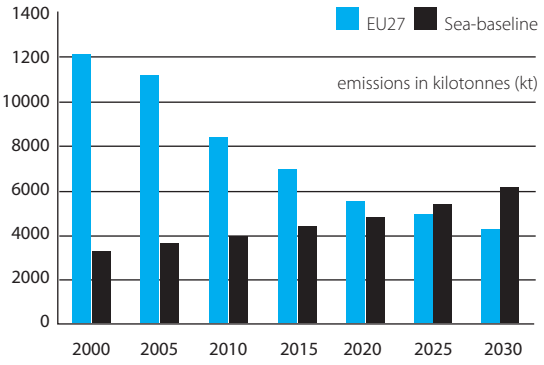
It is estimated that implementing the stricter ship fuel sulphur standards agreed by the IMO in 2008 will save up to 26,000 lives per year in the EU by 2020 [4].

In parts of Northern Europe ship emissions are responsible for more than 90% of the exceeding of critical loads for eutrophication and for acidity [5].

NO_x emissions Projections - Land vs Shipping

Figure: Projected emissions up to 2030 of NO_x from international shipping in the sea areas surrounding Europe (black) and total from land-based emission sources in the EU's 27 member states (blue).

Source: IIASA 2010



Because these emissions have been left unregulated for too long, the share of shipping emissions is growing dramatically as the pollution from other sectors is decreasing

WHY IS THE EU LAGGING BEHIND ON EMISSION CONTROL?

Emissions from international shipping can be controlled by the IMO, but also by regional/national measures or regulation. One of the key elements of IMO regulations on air pollution is the Emission Control Areas (ECAs), the "low emissions zones of the seas" designated by the IMO upon request of Member States. The strictest IMO regulations apply in these zones. Until now, only the Baltic Sea and the North Sea (incl. the Channel) have been designated as SO_x ECAs in Europe. The Irish Sea, the Atlantic, the Mediterranean and the Black Sea remain left out. Overall, the EU compares very poorly with the US on shipping emission control. In 2010, the United States and Canada requested the designation of a full SO_x and NO_x ECA along the North American coastline (extending to 200 nautical miles into the sea).

PRICING EMISSIONS TO INCENTIVISE EFFICIENCY: THE EXAMPLE OF THE NORWEGIAN NO_x FUND

NORWAY

decided to put a price on emissions to incentivise companies to reduce them.

The NO_x fund prices emissions at a a level of €0,5/kg of NO_x emitted.

Confronted with the important problem of NO_x emissions, Norway decided to put a price on emissions to incentivise companies to reduce their emissions. Industry stakeholders are in essence left with two choices, either pay a tax on their NO_x emissions or pay a lower amount as a contribution to a fund (the so called NO_x fund) which is ultimately used to finance cost-effective NO_x emission control measures. Shipping operators have mostly decided to take part in the NO_x fund and most of them were in return given subsidies to retrofit abatement technologies or to adapt their engines and operations to less emitting fuels such as liquefied natural gas. This measure contributed to emissions reductions in the Norwegian shipping sector.

For footnotes, please refer to separate reference sheet and to the EEB website.

RECOMMENDATIONS

- Ensure at the very least the full implementation of the provisions contained in MARPOL Annex VI in particular on SO_x and NO_x emissions.
- Make all European sea areas combined SO_x and NO_x Emission Control Areas.
- Incentivise further reduction of NO_x emissions from the entire fleet (i.e. not only new ships) by establishing mandatory NO_x emission standards or by pricing NO_x emissions for all ships entering EU ports.
- Ensure existing emissions limits in Europe are complied with - in particular the EU sulphur in marine fuels directive. Make sure that sufficient checks are made in ports and that the compliance with the standards is respected.
- Adopt ambitious emission reduction commitments in the revised National Emissions Ceilings Directive. Emission reduction commitments must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.

More information

- Air Pollution from Ships (2011) by AirClim, Seas At Risk, Bellona Foundation, North Sea Foundation, Transport & Environment and the EEB
- T&E's activities on shipping: T&E website
- Publications by the Air Pollution & Climate Secretariat: www.airclim.org
- Cleaner shipping (2011) by the Danish Eco Council
- NABU's website: campaign on emissions from cruise ships and clean air in ports campaign

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AIR & SOLVENTS

Many everyday products contain solvents, for instance paints, varnishes, deodorants and nail polish. When produced, used or disposed such products release volatile organic compounds (VOCs) into the environment. VOCs react to form ground level ozone which is harmful to human health vegetation and crops. Ozone also contributes to climate change (see Air & Climate factsheet). In indoor environments VOCs can lead to higher rates of allergies and asthma in children.

Solvents and products are the major cause of VOC emissions which lead to a variety of health problems through ozone formation.

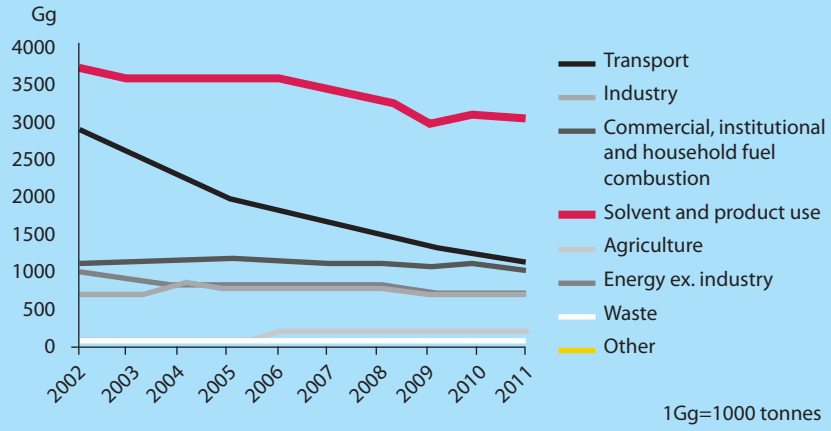
EU legislation

- The EU regulates VOC emissions from industrial activities under the Industrial Emissions Directive (see Air & Industry factsheet). This includes dry cleaning, shoe making, advertisement and magazine printing, surface cleaning, vehicle coating, and certain pharmaceutical production. Above a certain amount of solvent use, such activities have to comply with specific emission limits at their site [1].
- The EU also addresses VOC emissions from products such as paints and varnishes in order to limit their negative effects on human health and the environment. The EU's Paints Directive 2004/42/EC obliges producers to gradually reduce the amount of solvents in certain paints and varnishes [2].
- Other products such as coatings for corrosion protection, road markings, hairsprays and deodorants are not covered by EU legislation despite their contribution to VOC emissions.
- The overall VOC emissions of each EU Member State are also limited via the National Emissions Ceilings (NEC) Directive. The NEC Directive is a critical instrument to reduce overall levels of air pollution – including VOCs - and to limit the effects of transboundary air pollution [3].

FACTS AND FIGURES

Solvents and products are the major cause of VOC emissions in the EU [3]

Source: EEA, 2013



1Gg=1000 tonnes

When using products containing **VOCs**, people can expose themselves and others to very high pollutant levels. Elevated concentrations can persist in the air long after the activity is completed.

In the presence of sunlight, VOCs react with nitrogen oxides to create ground level ozone. Ground level ozone triggers a variety of health problems and can lead to more frequent hospital admissions and even increased deaths from heart and respiratory diseases.

There is currently not enough data at EU level showing the share of VOC emissions from household products and cosmetics.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PROMOTING ALTERNATIVES TO VOC-BASED PRODUCTS

Air quality can be improved by reducing the use of solvents in products and promoting the use of bio-based solvents that are VOC free. For many products, alternatives exist and are being developed.

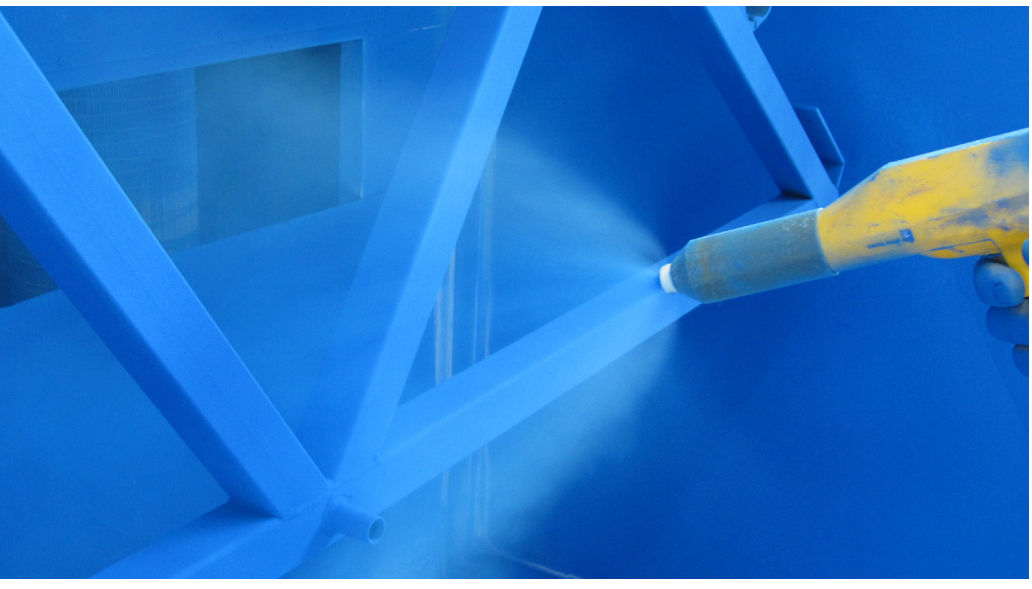
For instance:

- Hairsprays containing 95% VOCs can be replaced by hairsprays using CO_2 pressure;
- VOC-based deodorants can be replaced by VOC-free solid ones and rollers;
- Water-based paints and varnishes are already on the market and are appreciated for their odourless and environmental characteristics.

Some public authorities actively promote the use of such alternatives through public procurement, for instance by commissioning water-based road markings for motorways [4].

ALTERNATIVES TO VOC-BASED PRODUCTION PROCESSES

Air quality can be improved by reducing the use of solvents in production processes. Companies can either use end of pipe abatement techniques or modify the actual industrial processes, for instance by using coatings based on powder or water. Some industries already use low-VOC corrosive products, electrostatic application techniques, or powder coating (instead of conventional spraying) to reduce their VOC emissions.



For footnotes, please refer to separate reference sheet and to the EEB website.

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RECOMMENDATIONS

- Set ambitious VOC emission reduction commitments under the revision of the NEC Directive. Ceilings must go beyond the Gothenburg Protocol and aim to achieve the health and environmental objectives of the EU's 6th and 7th Environment Action Programmes by 2030.
- Extend the scope of the Paints Directive to corrosion protection coatings, road markings and households' products such as hairsprays and deodorants.
- Ensure adequate information for consumers by extending labelling requirements regarding VOC solvent content to all everyday products placed on the EU market.
- Improve information about emissions from household products (nail polish, deodorants, hairsprays, cleaning agents, etc.).
- Set ambitious Best Available Techniques (BATs) and Best Available Techniques associated emission levels (BATAELs) for relevant production processes including refineries (REF BREF), large volume organic chemicals (LVOC BREF) and surface treatments using solvents (STS BREF).

More information:

- Summary of the (old) VOC Solvents Emissions Directive and (existing) Paints Directive: http://europa.eu/legislation_summaries/environment/air_pollution/l28029b_en.htm
- Summary of EU industrial emissions legislation (includes VOC Solvents Emissions Directive): http://europa.eu/legislation_summaries/environment/air_pollution/ev0027_en.htm
- ÖKOPOL studies on the implementation and review of Directive 2004/42/EC: http://ec.europa.eu/environment/air/pollutants/pdf/paints_report.pdf http://ec.europa.eu/environment/air/pollutants/pdf/paints_report_2.pdf

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