CLEAN AIR FOR EUROPE - THE BASELINE ASSESSMENT

Clean air is essential for a good quality of life and it enhances the social well being of European citizens. Scientific assessments reveal a range of harmful effects from the past and present levels of air pollution in Europe:

- Human health is seriously threatened by the exposure to fine particulate matter and ground-level ozone, causing several thousands of Europeans dying prematurely and reducing the life expectancy of Europeans by five to six months.
- The vitality of European forests and natural ecosystems is significantly weakened through multiple pathways of pollution: serious damage is caused by high ozone concentrations, acid deposition ("acid rain") and by excess nitrogen deposition endangering the biodiversity of plant communities.
- Thousands of European lakes and streams were not able to cope with the increased amounts of acid deposition and thus have lost their fauna and flora.
- Damage to agricultural crops caused by ground-level ozone reaches economically important dimensions.

In its Sixth Environmental Action Programme the European Union calls for action to improve air pollution to a level that does not give rise to harmful effects on human health and the environment.

New scientific insights

Recent advances in scientific research has improved – and changed – our understanding of how air pollution damages human health and the environment:

- While early medical studies found associations between peak levels of air pollution and health effects, more refined scientific methods reveal significant impacts of life-long exposure to ozone and small particles also at lower concentrations. Such levels typically prevail throughout Europe for most of the year. Overall health impacts resulting from this long-term exposure might be larger than those from peak exposure.
- New studies show that exposure to small particles (below a diameter of 2.5 µm, PM2.5) is associated with substantially increased mortality, especially from cardio-vascular and cardio-pulmonary diseases. Present levels of PM2.5 in Europe are now estimated to reduce the statistical life expectancy in European population by approximately nine months, comparable to the impacts of traffic accidents. Thus, these newly identified impacts of fine particles by far exceed those identified earlier for ozone.
- Following the recent decline in acid deposition, initial recovery has been observed for a number of acidified lakes. However, complete chemical recovery and full restoration of wildlife can take several decades, especially for many forest soils.
- Improved understanding of the nitrogen cycle reveals serious threats for biodiversity from excess nitrogen deposition from the atmosphere throughout Europe.

There is now common scientific understanding that all the important air quality problems mentioned above are strongly interrelated. All these pollutants are subject to long-range transport in the atmosphere, so that concentrations experienced at a given site originate from a large number of diverse emission sources across Europe. Thus, effective strategies for reducing pollution levels cannot be developed solely at the local scale, but need international cooperation.

The approach: Clean Air For Europe (CAFE)

The European Union has established a comprehensive legal framework to protect Europe's air quality. In its "Clean Air For Europe" (CAFE) programme the EU is currently revisiting this legislation. As a basis for future policy initiatives, CAFE brings together information on the likely development of air quality in Europe, taking into account the full effect of all emission control legislation "in the pipeline" and future economic development.

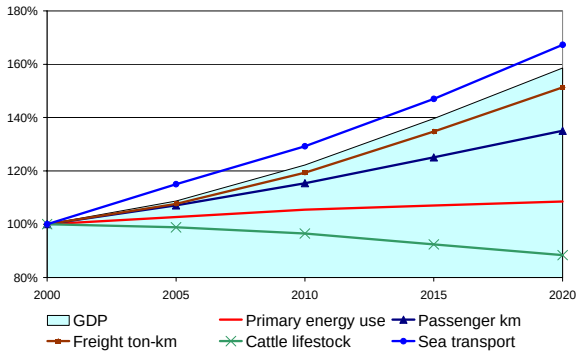
With the involvement of all major European stakeholders CAFE compiles a common knowledge base that will guide the development of future policy proposals to improve air quality in Europe.

More information: www.euro.who.int/eprise/main/WHO/Progs/AIQ/Activities/20020530_1

How will air quality develop in Europe up to 2020?

Even with accelerated economic growth …

Emissions and, consequently, air quality are critically driven by human activities in a wide range of economic sectors. Thus, assumptions on economic growth are a critical input to such an assessment, since they determine how the different emission generating activities increase or decrease in the future. Obviously, it is difficult to accurately predict the sectoral economic development for the coming two decades.

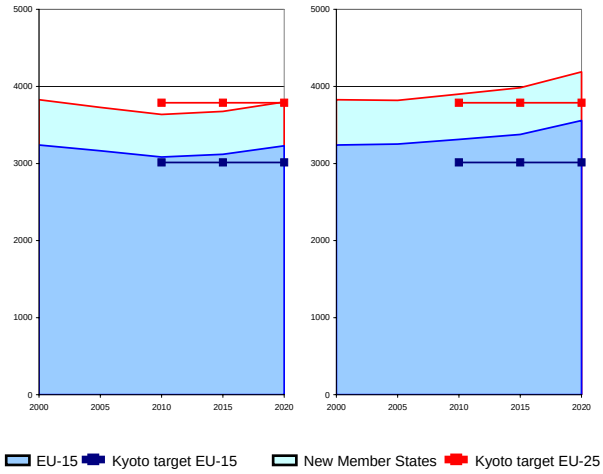


Economic development pathway of the EU-25 assumed for the CAFE baseline air quality projection

Reflecting this fundamental uncertainty, CAFE adopts multiple (and sometimes conflicting) projections of economic development to illustrate the possible range of future air quality in Europe.

One CAFE baseline projection assumes further measures to reduce greenhouse gas emissions in Europe, corresponding to an increasing carbon price from 12 €/tCO_2 in 2010 to 20 €/t SO_2 in 2020. With the assumptions on economic development, this projection would comply with the Kyoto targets up to 2020.

Alternatively, a second scenario relies on the baseline energy projection of the 'European energy and transport – Trends to 2030' outlook of the Directorate General for Energy and Transport of the European Commission (CEC, 2003). This extrapolates current trends in the energy sector in the absence of further greenhouse gas control measures in the EU. A third projection has been compiled reflecting the national perspectives on future energy consumption.



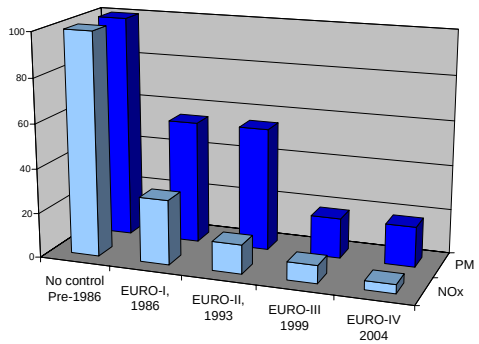
CO_2 emissions of the two PRIMES energy projections (Mt). Left panel: "with additional climate measures" projection, right panel: "no further climate measures" projection. The indicated "Kyoto target" assumes for CO2 the same reduction as for the other greenhouse gases and refers to the Marrakech accords allowing for carbon sinks.

… with present emission control legislation in force …

The European Union has established a comprehensive legislative framework that allows for economic development while moving towards sustainable air quality. A large number of directives specify minimum requirements for emission controls from specific sources, such as large combustion plants, vehicles, off-road machinery, solvents use, paints, etc.

Many of these emission sources are now strictly controlled, so that individual vehicles or power plants now typically emit 90-95 percent less than 20 years ago.

For each country overall emissions are constrained through national emission ceilings, demanding for 2010 EU-wide cuts between 50 and 70 percent compared to 1990, depending on the pollutant. In addition, local authorities must manage to comply with the EU air quality limit values to avoid local pollution "hot spots". After certain transition periods, all this legislation is fully applicable also to the New Member States.



Evolution of EU emissions limit values for passenger cars relative to the uncontrolled emissions

The CAFE baseline assessment quantifies for each Member State the impacts of the legislation on future emissions.

More information: http://europa.eu.int/eur-lex/en/lif/reg/en_register_15102030.html

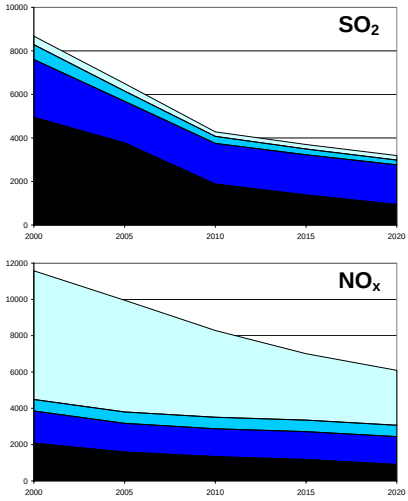
… emissions are projected to decline up to 2020 …

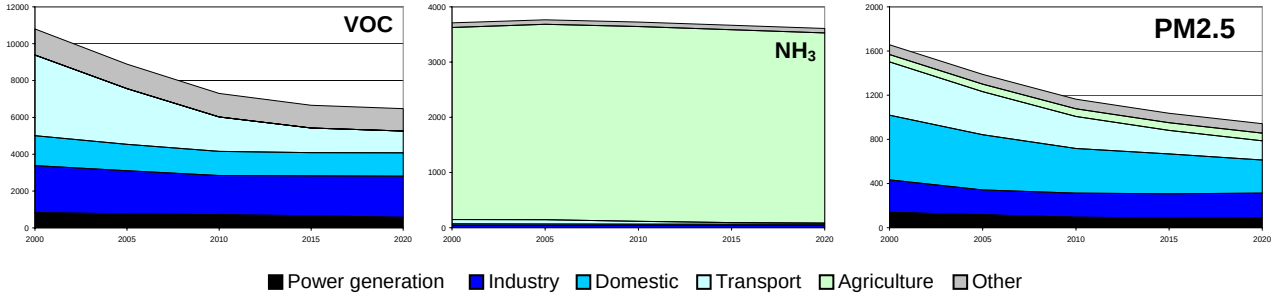
Emissions of most air pollutants are expected to decline in the EU-25 even under the assumption of accelerated economic growth. Particularly large reductions are foreseen for sulfur dioxide (SO_2) as a consequence of the Large Combustion Plant Directive, while ammonia (NH_3) emissions, which originate predominantly from agricultural activities, will hardly change.

For the pollutants that were in the focus of EU legislation for a long time, i.e., sulfur dioxide, nitrogen oxides (NO_x) and volatile organic compounds (VOC), the contributions from the traditionally dominating source sectors will significantly decrease. Thus, in the future, other sectors, for which there is currently less strict legislation, will cause the majority of emissions.

Although there is no specific legislation to control fine particles (PM2.5), which are now recognized as a major health threat, PM2.5 emissions are expected to decline as a side impact of regulations targeted at other pollutants.

Particularly large reductions of all emissions are foreseen in the New Member States following full implementation of EU air quality legislation. In contrast, particularly large emission increases are to be expected from maritime activities, which will most likely surpass land-based emissions in the EU-25.

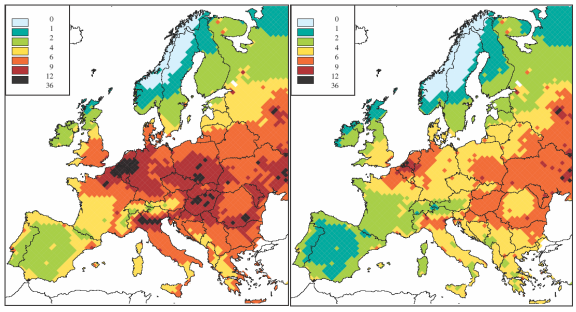




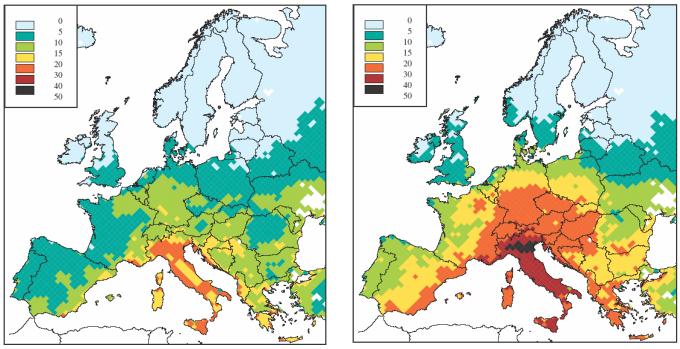
Projected baseline development of emissions in the EU-25

… air quality will improve, but risks remain.

The anticipated decline in emissions will improve air quality throughout Europe and alleviate major air pollution problems. It will increase the livelihood of European citizens (see chart below) and reduce present risks to terrestrial and aquatic environments. However, emissions will not decline sufficiently much to entirely eliminate harmful impacts of air pollution. Significant threats will remain for human health with life shortening attributable to the exposure to fine particulate matter and ground-level ozone still reaching six months on average.



Estimated losses in life expectancy (in months) attributable to exposure to fine particulate matter (PM2.5) from man-made emissions. Left panel: 2000, right panel: 2020.



Excess ozone concentrations harmful to forest trees (AOT40 above the critical level of 5 ppm.hours). Left panel: 2000, right panel: 2020.

Risks also remain for vegetation and aquatic ecosystems. 150,000 km^2 of forests will continue to receive unsustainable amounts of acid deposition from the atmosphere and many Scandinavian lakes will not be able to recover from past acidification. Biodiversity will remain endangered at more than 650.000 km^2 (45 percent of European ecosystems) due to excessive nitrogen deposition.

More information: www.iiasa.ac.at/rains

Particulate matter and ozone remain future challenges

Present legislation on air pollution will not be sufficient to reach the environmental objectives established iny the EU Sixth Environmental Action Programme. Especially fine particles and ozone will remain serious risk factors for human health and the environment. Effective reductions of these problems will need to address the following sources with priority:

For particulate matter pollution:

- Traffic emissions including diesel engines
- Small combustion sources burning coal and wood
- Further reductions in precursor emissions of PM, i.e., SO_2, NO_x NH_3 and VOC.

For ground-level ozone:

- Further VOC controls to reduce ozone in cities
- Further NO_x reductions from traffic and stationary combustion sources to reduce regional scale ozone
- Control of NO_x emissions from ships
- Methane (CH_4) reductions to decrease the hemispheric background level of ozone.

For acid deposition and eutrophication:

- NH_3 emissions from agricultural sources
- Further NO_x control from mobile and stationary sources.
- Control of SO_2 and NO_x emissions from ships

Many of the traditionally important emission sources will have implemented costly control measures. Proposals for further improvements must carefully analyze the cost-effectiveness of additional measures at these sources while considering the role of other sectors that will gain increasing importance.

In designing effective control strategies, it is important to recognize that the different air quality problems are not uniform over Europe. Many pollution problems coincide with high population and industrial densities and thus show large variations over Europe. Acidification is most relevant in central and northern Europe, while ozone is a serious problem in southern and central Europe.

It will be a challenge to design emission control legislation that leads to effective improvements of the most pressing air pollution problems while not jeopardizing further economic development. The CAFE programme aims at a comprehensive assessment of the remaining emission control potentials from all sectors to facilitate a balance of measures that will reach the environmental targets in the most cost-effective way. To take full account of the interactions between pollutants, CAFE will apply a multi-pollutant/multi-effect concept.

	SO_2	NO_x	NH_3	VOC	Primary PM
Health impacts from fine particles	√	√	√	√	√
	(via secondary aerosols)				
Acidification	√	√	√		
Eutrophication		√	√		
Ground-level ozone (health + vegetation)		√		√	

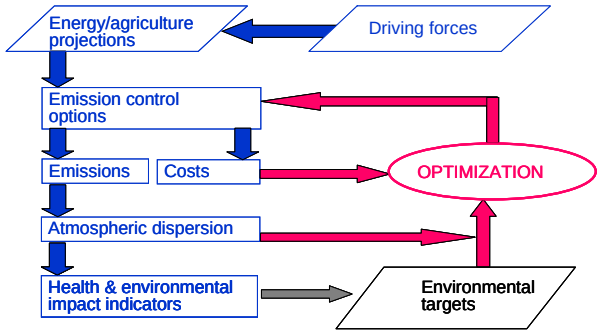
The multi-pollutant/multi-effect concept used for the CAFE assessment

State-of-the-art tools are used for the analysis

To assist the cost-effectiveness analysis of policy proposals for revised air quality legislation, the Clean Air For Europe programme is now preparing a toolset for policy analysis by combining state-of-the-art scientific models dealing with the various relevant aspects with validated databases representing the situations of all Member States and economic sectors:

- The RAINS integrated assessment model for air pollution and greenhouse gases (www.iiasa.ac.at/rain)
- The PRIMES model of the energy sectors in the EU Member States (www.e3mlab.ntua.gr)
- The TREMOVE transport model (www.tremove.org)
- The CAFE cost-benefit analysis (**http://europa.eu.int/comm/environment/air/cafe/index.htm**)

These assessment tools will be applied to search for cost-effective packages of measures that will move Europe closer to its environmental objectives.



The analysis cycle of CAFE

With close involvement of the stakeholders, CAFE will explore balanced policy packages to reach Europe's environmental policy targets and assess their effectiveness as well as their distributional implications for different Member States and economic sectors.

More information: **http://europa.eu.int/comm/environment/air/cafe/index.htm**