



EUROPEAN COMMISSION  
DIRECTORATE-GENERAL  
ENVIRONMENT  
Directorate C - Air and Chemicals  
**ENV.C.1 - Clean Air & Transport**

Brussels, 31 January 2005  
ENV-C1/AZ D(2004) 6444

**NOTE TO THE FILE**  
**CLEAN AIR FOR EUROPE (CAFE) AND RESEARCH NEED**  
**SUMMARY OF NEEDS IDENTIFIED**

The CAFE programme is the basis for the Thematic Strategy on air pollution to be communicated by the Commission in 2005 as outlined in the 6<sup>th</sup> Environmental Action Programme. The priorities in the CAFE programme are on the air pollutants ozone, particulate matter and nitrogen oxides, which are estimated to cause most of the damage on human health and the environment in Europe. The 6<sup>th</sup> EAP has a knowledge-based approach which means that the policies proposed are underpinned by scientific and technical knowledge.

This document summarises the main experiences<sup>1</sup> in the CAFE programme made up to the end of 2004. It identifies areas for which knowledge gaps exist which could be bridged in the next 5 years or so and thus relevant for the Community 7<sup>th</sup> framework programme on research, development and technology. The resources allocated to research and also their relevance to specific national aspects vary substantially over Europe and due to enlargement the variation would even be larger now than earlier. This paper on research needs has not the ambition to cover all aspects but the main research needs.

The bridging with new research results and insights would give possibilities to further improve the knowledge-based approach for the review and revision of future air pollution policies with a time horizon up to 2020. It should be noted that a part of the strategy is how to communicate the research results once these are obtained.

**CAFE research area I - Understanding changes in society and structural shift**

The emissions of air pollutants depend on both the activities in the different sectors of society and the emission control technologies applied. The emission may change over time due to improved or new technologies for production and abatement of emissions. Also the activities change over time due to European policies targeting these sectors but

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<sup>1</sup> The paper is based on a draft document produced by the CAFE Team and consulted with the CAFE Steering Group. Members of the Steering Group and other organisations have provided comments in November and December 2004.

also from global changes of trade and industry. To some extent these changes are covered in the present analysis and policy development but there is a need to improve the understanding. The research needs should be geared at a better integration of multi-scale processes from the global scale to the local scale. Such integrated approaches should be included into the framework of risk analysis and risk management, and capable of addressing changes in important sectors as transport, trade, energy and agriculture. Also methods of how to account for emerging technologies need to be developed. The changing patterns of emissions over the northern hemisphere also impacts on the air pollution over Europe due to transcontinental transport of air pollutants such as particulate matter, ozone, persistent organic pollutants and mercury.

The structural and societal changes occurring in Europe after the accession of new Member States will need to be addressed as a matter of priority, including changes in trade and industry and the enlarged trans-European networks.

### **CAFE research area II - Emission sources, atmospheric chemistry and air pollution dispersion**

The emissions of air pollutants are transformed through chemical and physical processes in the atmosphere. They may lead to exposure to humans and the environment to harmful substances such as nitrogen oxides, volatile organic compounds, persistent organic pollutants, ozone, acidifying and eutrophying substances, particulate matter and metals.

The accuracy of our assessments of the air pollution situation and of the effectiveness of policies hinges on a proper description of the chain from emission to effects. The Clean Air for Europe programme has found for some key areas where it is desirable to improve our scientific knowledge. These include research about:

- sources of particulate matter of natural and anthropogenic origin, and the chemical and physical characteristics of these emissions. Projects are presently underway to assess the influence of natural sources, such as biogenic VOCs and NO<sub>x</sub>, windblown dust and forest fires, and further research may be needed to address remaining issues.
- the formation of secondary organic aerosols and how different emission sources contribute to the particulate mass (full mass closure, source apportionment) and various fractions of PM (ultrafine, fine and coarse fraction).
- the role of long distance transport of air pollution and hemispheric air pollution There needs to be sound scientific knowledge about the role of pollution sources outside of the European Union and particularly the role of the North America and Asia in polluting Europe. This could widen the scope of European policy making and the role of EU on the international policy arena.
- The links between air pollution and climate change. There are several links concerning sources, abatement options, and effects. Additional insight is needed on these links to tackle effectively synergies between climate change mitigation and air quality improvement. This topic should also cover the role of climate variability, extreme events and air pollution.
- improved methods for assessing the present situation of air pollution, at the local scale and regional scale, including the use of monitoring data and assessment models. It also includes harmonisation of measuring techniques (including reference material) and monitoring siting. Special attention should be given to the official network of

National Air Quality Reference Laboratories (AQUILA). The item would also include research infrastructure related to the setting up and maintaining “Superstations” or “Supersites” for monitoring and evaluation of air pollution in the EU and improved research infrastructure of transboundary air pollution, closely related to the European Monitoring and Evaluation Programme (EMEP).

- improved methodologies for assessing the present and future situation of air pollution, in particular the harmonisation of modelling approaches and the QA/QC of emission inventories at scales from local to hemispheric. Attention should be given to health-relevant pollutants in the urban environment making use of the experience gained from EU RTD projects on air pollution and Member States policy plans and programmes to meet EU objectives laid down in air quality legislation.
- improved assessment through remote sensing including satellite based instrument and improved evaluation algorithms. This last activity is linked to other ongoing activities e.g. GMES (Global monitoring of environment and security).

### **CAFE research area III - Effects of air pollution**

Air pollution still causes severe damage on human health. The priority pollutants are ozone and PM. Presently the assessment of the risks depend largely on epidemiology of ozone and PM mass, although some specific information is available on the hazardness of different constituents of PM. In order to develop and refine strategies to avoid health impact we need new research or updated information on

- how the changing sources and composition of air pollution in Europe impacts on the human population, and perform health-related studies on exposure patterns and effects of air pollution abatement and policies (*ex post* evaluations).
- the sensitivity and vulnerability of the population and different population groups, which may also change with time. It is equally important to identify contributing sources of exposure, such as outdoor and indoor sources, to the different groups of population.
- the health effects of long term exposure to ozone, nitrogen oxides and particulate matter (and their different size fractions). For airborne particles, we are specifically concerned of fuel-source specific risks (e.g emissions from diesel engines and combustion sources) including also ultra-fine particles. Further research is also needed to understand the composition specific effects of particulate matter (e.g. secondary organic and inorganic aerosols, metals). The research would include both air pollution epidemiology and toxicology.
- Specifically it is necessary to start long term studies of air pollution impact on different European population groups including children, and to follow this group (cohort) over substantial time. Also other population groups would be followed in epidemiological studies. This is also very closely linked with the Environment and health strategy of the Commission (jointly between DG ENV, DG SANCO and DG RTD).

These activities should be complemented by setting up a research infrastructure for health impact monitoring and evaluation. Such an infrastructure would provide information in the long term that would feed into future policy development.

The environmental effects of air pollution are large through acidification and eutrophication of waters and soils and high levels of ground-level ozone. Priority areas for further research would include:

- improved methods to quantify effects of ozone damage to crops and other vegetation (including forest species), such as methods to quantify the ozone flux and vegetation damage functions.
- improved understanding of the dynamic effects of ecosystem recovery
- the effects of eutrophying and acidifying air pollution on biodiversity and ecosystem sustainability
- the key role of nitrogen in acidification, eutrophication and also on other effects such as biodiversity, carbon sequestration, nitrous gas emissions, transformation and transport in the environment (biogeochemical cycling of nitrogen). Research on the role of nitrogen should cover widely different environments, representative for the large variety of ecosystems in Europe.

#### **CAFE research area IV - Assessment tools and policy instruments and abatement strategies and technologies**

Various sources contribute to the emissions of air pollution. The present pollution policy is a main driver to further development of abatement technologies for those sectors and sources that contribute such as energy, transport, industry and agriculture. This development is a continued effort for research and technology development. The technology development is also closely linked with the economic aspects, it is therefore also important to give support to introduction of new technologies and abatement techniques for bench/feasibility test, pilot scale and full scale early introduction.

For new vehicles and other mobile sources future on-board diagnostics and portable emissions monitoring equipment of air pollution would be requested to assess and further control such emissions. Further in the transport sector the ERTRAC network investigates the medium research needs.

Also other combustion sources give rise to high emissions of nitrogen oxides and particulate matter and cost-effective technologies are needed to reduce emissions. A major research effort is needed to develop integrated approaches to facilitate the development and implementation of existing effective emission abatement strategies in EU Member states. This requires a deep knowledge about the origin and interplay of all major pollution sources and to take into account the cost associated and the benefits and other possible factors arising from the adoption of the designed abatement strategies. Another aspect of integrated assessment is the downscaling of large-scale Integrated assessment to be relevant for the Member State, regions and even at the local scale.

#### *Risk assessment, risk communication and risk management*

Comprehensive tools for integrated assessment of air pollution and policy options should be further developed. These assessment and management tools need to be further developed both for the regional scale and the local urban scale problems, and integrating also the influence between air pollution policy and other sector policies, such as

transport, energy, industry agriculture, households, but also water and soils protection, and land use policy. Such assessment tools should include the use of technical and non-technical measures and tools to evaluate various policy instruments, including market based instruments, legislation and voluntary agreement. The integrated assessment should be further developed to be suited to assess the effectiveness of measures and benefits and disbenefits for the different sectors of society, and also be able to assess more in depth the effects of sustainable development of all three aspects (economic, social and environmental).

*Ex ante* evaluations needs also to be more systematically compared with *ex post* evaluations of policy effectiveness, both for the costs of measures and the assessment of benefits.

Risk communication would include the development of indicators to be used to communicate with non-experts. The indicators should be easy to understand and could be related to long term and interim objectives. These indicators could be based on monitoring of air pollution and its effects (environment and health) monitoring and complemented by other assessment techniques such as modelling. (One important step in this direction is the development of the health relevant Strategic Development Indicator.) Also the development of EU-wide air quality indices could be envisaged.

### **Environmental noise, assessment of risk and abatement**

Noise is an important local environmental problem in urban areas and in the vicinity of transport infrastructures. The implementation of the Environmental Noise Directive 2002/49/EC, providing harmonised data on noise exposure across Europe in 2007-2008, will be a major driver for research on noise reduction. FP7 should build on the priorities identified by DG RTD's CALM Network in its October 2004 strategy paper<sup>2</sup>, which addresses research needs for noise reduction at both the emission and reception sides.

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<sup>2</sup> [http://www.calm-network.com/SP\\_2020\\_Final.pdf](http://www.calm-network.com/SP_2020_Final.pdf)