WORKSHOP ON

IMPLEMENTATION OF THE CLEAN AIR FOR EUROPE STRATEGY: A CHALLENGE

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Conclusions

by

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At the moment of the adoption by the European Commission of the Thematic Strategy on Air Pollution, the Syracuse Workshop has addressed a number of important challenges for the proper implementation of the strategy. The following aspects were raised and have been debated extensively:

- What are the main difficulties with implementing current and new PM directives?
- How far do we stand with the use of air quality models for the implementation of the EU air quality directives?
- What plans and measures can be efficiently applied?
- Are the outdoor air pollution levels that we monitor a good surrogate for human exposure?
- What perspectives next: new pollutants, new approaches to be considered?

This document presents the main outcomes of the various sessions collected by the rapporteurs of each session.

Challenge 1: Implementation of current and new PM directives

What is the problem?

The current levels of PM are elevated in many of the EU countries and a majority of Member States are today facing difficulties to meet the air quality standards that are imposed by the Air Quality legislation. This situation can partially been explained by the substantial contributions from natural sources and long-range transport.

Also from the measurement point of view, a number of questions still need to be answered. What are today the most appropriate PM measurement methods and what are their performances? What are the requirements of the 4th. Daughter Directive on air pollution by Heavy Metals and PAHs, and what monitoring strategy should be applied?

EU legislation affecting the control of PM levels is also evolving rapidly: the revision of the PM10/PM2.5 legislation is currently in progress and further emission reduction standards for automotive sources (Euro 5) are in preparation.

What has been said?

Concerning the state of implementation of the PM legislatiuon, Emile De Saeger (JRC), on behalf of Matti Vainio (CAFE team), made a presentation on the difficulties for Member States to meet the PM air quality standards. Xavier Querol (CSIC – Spain) gave an overview of the situation in Spain, focusing also on monitoring strategies implented to assess le levels of PM10, PM2.5, Metals and PAHs. Ivo Allegrini (CNR – Roma) presented the situation in the greater Rome area, insisting on the physico-chemical characterization of particles and meteorology for the interpretation of air pollution episodes.

Emerging policy aspects were presented by a number of talks. Martin Williams (DEFRA – UK) presented a new concept for air quality legislation that aims at reducing population exposure rather than just establishing limit values, and that is currently considered for the revision of the 1st. Daughter Directive. Hans Ulrich Pfeffer (LUA Rheinland Wesfalen – Germany) gave an overview of the requirements of the recent 4th. Daughter Directive on Heavy Metals and PAHs, including an overview of measured levels and sources. Giovanni De Santi presented the most recent developments of the EURO 5 emission standard proposal for passenger cars and vans.

Aspects concerning the PM measurement strategy were presented by Rudolf Neuroth (VDI/DIN – Germany) and Annette Borowiak (JRC). The first speaker gave an overview of the state of play of CEN standardization work, whereas the second presented the QA/QC program for the harmonization of PM measurements planned to start in 2006 in collaboration with AQUILA (Association of National Reference Laboratories for Air Quality).

Points of discussion and emerging policy / research needs

The current Limit Values for PM10 are hard to meet in all the EU Member States, but in particular in economically active regions, as well as in Southern European countries. This can be in part explained by the significant contribution from regional and long-range transport of secondary particles, from natural sources in areas around the Mediterranean (combination of Sahara dust, marine aerosols), and the re-suspension of dust and crustal material in dry areas. It appeared also that the difficulties exist for both the 24-hour and the yearly average limit value, but that the situation for the daily value is the most critical.
It was recognized that compliance with the limit values could in many cases be reached by subtracting the contribution of natural/remote sources. However this procedure would require to apply valid and comparable source attribution tools, as well as robust PM emission inventories and dispersion models that are still lacking so

far. It appeared also that PM2.5 was a better indicator for man-made sources than PM10.
Local short-term action plans did not seem to be always effective, the meteorological parameters playing a major role in the dispersion mechanisms. For all these reasons, it is difficult for local authorities to propose cost-effective plans and measures.

A number of up-coming policy perspectives were presented and discussed. The planned revision of the PM directive will combine the usual limit value approach (cap value) with a further relative decrease of the ambient PM levels. This new approach will allow to further limit the exposure of the population.
The 4th. Daughter Directive (HM, PAHs) is the first step towards the speciation of toxic particulate substances, the so-called fuming bullets. Getting rid of the PM global indicator approach (PM10, PM2.5) and tackling those components responsible for major health effects, will lead to more effective abatement measures at lower cost.
Finally, further PM emission reduction directives, like the coming EURO 5 standard for cars and vans, will clearly reduce PM and NOx emissions in the future. Joining forces at global level (EU, USA, Japan, Korea, China) to harmonize the emission reduction strategies is also seen as a very positive development where the Commission and JRC in particular should continue its efforts.

The harmonized implementation of the directive is still hampered by a number of difficulties. The network design (siting and number of monitoring stations) still responds to different criteria among the Member States. The gravimetric reference method has been validated and standardized, yet PM automated monitors providing on-line data are very often preferred in the monitoring networks. Automated monitors may underestimate PM levels to a large extend (up to 50 %), when the air sample is heated during the measurement and in the presence of volatile particles. So far, the demonstration of equivalence between the various automated methods and the reference method is still lacking, and constitutes a matter of serious concern. It should be noted that the gravimetric reference method is needed for sampling the PM10 fraction for the analysis of Heavy Metals and PAHs. Also to this respect, the need for a Certified Reference Method for Heavy Metals and PAHs was underlined. Difficulties with the CEN standardization efforts, and in particular with the sampling of PAHs (interferences of PAHs with O3 during ampling) and the needed revision of the PM10 reference method along the lines of the new PM2.5 standard, were also presented. Finally the importance and the need for continuous QA/QC programs was stressed, underlining the role of National Reference Laboratories (AQUILA association) and of the JRC ERLAP laboratory.

Challenge 2: Assessment of Air Quality by Modelling

What is the problem?

Aim of this session was to point out both the present status of model tools, widely used in air quality assessment, and the need of a correct application of these tools as reliable support for air quality managers and policy makers. What are the performances of the currently available atmospheric dispersion models? In how far can we rely on Integrated Assessment Models for the analysis of abatement scenarios and cost/benefit analysis? What do we mean by "reliable" simulation and forecast of air pollutant transport in the atmosphere, starting from a local scale up to regional, national and continental scales?

What has been said?

The speakers stressed the need for a good knowledge of input data to models (garbage in, garbage out), in particular referring to emission and meteorological scenarios, as well as the need of the output validation versus fields, remote sensing and satellite measurements.

Kees Cuvelier (JRC) started the session focusing his presentation on the harmonization of air quality models. He underlined the relevance of evaluating the robustness of models in terms of uncertainties of outputs as well as of their consistency when used on different space scales, by means of nesting procedure going from larger to finer spatial scales. His main question was: "Do models produce consistent responses to emission reduction policy scenarios?" To give reliable answers to this question, JRC co-ordinated the CITY-DELTA model inter-comparison in the frame of the CAFÉ programme, consisting in an inter-comparison and evaluation of urban-regional scale dispersion models, focusing on 8 European metropolitan areas and on exposure indicators related to PM2.5 and O3 pollutants. Moreover a new model inter-comparison, called MEDI-DELTA is planned to start in the second half of 2006, focused on the peculiar air quality problems of the Mediterranean urban areas..

The need for such a scientific investigation has been well evidenced by Giorgos Kallos (University of Athens) in his presentation; he showed the relevant role played by natural sources (as Saharan dusts and marine aerosols) and local climatology in long-range transport phenomena conducting to critical pollution episodes in Mediterranean regions.

The presentation of Giuseppe Brusasca (ARIANET) and Agatino Gambadoro (CIPA), and of Giovanni Vialetto (ENEA) showed the application of integrated modelling systems in Italy to the industrial area of Siracusa and Sicily region. In particular, Giuseppe Brusasca showed how lagrangian models, when driven by reliable meteorological fields and emission scenarios may help in understanding both the evolution of industrial emissions in the atmosphere and the apportionment of

critical episodes back to their respective sources. The design of a real time forecast system based on local meteorological forecast is also in progress.

Finally Giovanni Vialetto illustrated the MINNI project and an integrated assessment model aimed to evaluate Italian regional plans and measures of remediation. He stressed the relevant use of this tool in the frame of international negotiations for atmospheric pollution abatement strategies, starting from an Italian nested RAINS model assessing the best way to transfer European strategies and guidelines into regional and local Italian emission control scenarios.

Points of discussion and emerging policy / research needs

During the following discussion other questions were evidenced, claiming for further scientific investigations:

- How to assess the uncertainty of simulation results and the robustness of models to uncertainties in input data?
- Are canyon models reliable to assess hot spots and local urban pollution control strategies?
- Which next model generation has to be driven?

The need to start harmonizing the models that are used for the implementation of the EC Air Quality directives was recognized. These models are used for checking compliance with the air quality standards, for the analysis and forecast of episodes and for the evaluation of abatement scenarios. It was agreed that imposing a European standard model, or set of models, to be used by all Member States would not be acceptable. Instead, developing quality criteria for model input and output parameters, as well as the assessment of the model uncertainty through the organization of inter-comparisons with validated emission inventories and field measurements, was a strong priority for the future.

Challenge 3: Plans and Measures for Remediation

What is the problem?

What plans and what measures can be efficiently applied for remediation and at what cost? What are the positive experiences at national, regional and local level? So far, a large number of Member States have failed to apply remediation plans as foreseen by the Air Quality directives. Why is it that plans and measures are so slow to develop?

What has been said?

A number of presentations were given to reflect the situation on the implementation of plans and measures in a number of Member States. The Italian situation, and the particular case of the Milano area was presented by Mario Cirillo (APAT – Italy) and Ennio Rota (Regione Lombardia – Italy) respectively, followed by the case in Poland and Cyprus by Andrej Jagusiewics (Poland) and Savvas Kleanthous (Cyprus). The following conclusions emerged from the presentations.

Plans and measures have been adopted in the past with very good results. Several "old fashioned" pollutants are today not a problem anymore (SO2, Lead and others are just good examples). Most of the achievements in the abatement of air pollution levels were stimulated by technical developments for the control of emissions. The availability of cleaner fuels, the improvement of industrial plants and even the reduction of automotive emissions are good examples of this. As a consequence, the past approach to pollution control was based upon the availability of better technologies. Such an approach has been very successful in the past and has been day adopted by modern legislation, such as IPCC (Best Available Technologies) or the NEC Directive.

Despite the clear success of this option, control of primary and secondary pollution, especially for Ozone and fine particles, requires efforts that need to be targeted to specific sources and to specific precursor pollutants. This is raising problems that may be solved with management tools, rather than by a mere technical approach. However, options for control measures are often very limited in nature and number, and expensive in cost, thus better strategies to the adoption of control options need to be pursued.

One of the most important requirements for the development of effective reduction plans is a good knowledge of the processes responsible for atmospheric pollution. This is particularly true for PM where natural sources may play an important role and where unexpected sources may in certain areas give rise to high pollution levels (re-suspension). In addition, the contribution from long range and hemispheric transport, in particular for pollutants deriving from secondary formation processes, may be significant. Natural sources and long-range transport of air pollutants may therefore reduce the effectiveness of established abatement strategies at local/regional level.

Integrated assessment methods and similar tools for the interpretation of pollution events and the assessment of air pollution distribution in time and space are not well developed and not well tested for applications to management processes everywhere in Europe. This is especially true in the Mediterranean area. This is probably the reason why several action plans are setting targets on reduction of emissions, but not targets on the reduction of exposures.

Despite of these difficulties, a significant number of responsible authorities prepared action plans. The task was not simple because, very often, economic and social development is strongly involved. This is certainly true for new member States and accession Countries. However, it seems that such plans are sometimes missing the opportunity for an extensive collaboration between different technical and administrative bodies responsible for air quality management. Regions, provinces, local communities, academic communities and research bodies are called to a joint effort for the identification of significant sources and the identification of suitable action plans in a full spirit of collaboration. Positive experiences should be exchanged especially among homogeneous regions such as the Mediterranean area or the eastern part of Europe.

Points of discussion and emerging policy / research needs

However, it seems that one of the most urgent needs, beyond reliable modelling tools, is the availability of assessment methods able to monitor the real effects of the action plans. In fact, such plans are often extended over a number of years and therefore are expected to influence the current concentration levels by just a tiny amount per year. This may be easily confused into the inter-annual meteorological variability. The lack of tools for the rapid evaluation of the reduction measures may constitute a major risk: the risk to undertake very expensive measures but with little effect on the exposure of population. Such an “on-the road” evaluation should be part of any action plan.

Another important factor to be taken into account is that action plans should reduce the concentration levels, but also the exposure levels of population. A better knowledge of processes and sources leading to increased human exposure levels is thus required to evaluate the real effectiveness of the plans in terms of reduction of health risks. It should however be pointed out that human health is the most important element to be considered when preparing action plans, but that other environmental effects such as acid rain, eutrophication, the protection of vegetation and crops and the protection of cultural heritage should also be taken into account.

Source-apportionment studies, aiming at understanding the respective impact of natural sources and long-range transport of air pollutants versus anthropogenic emissions sources should be carried out, in order to understand the origin of the pollutants and to identify the most effective abatement strategies.

Challenge 4: Assessment of Human Exposure

What is the problem?

Our surrounding environment is varying a lot, with different micro-environments such as outdoor ambient air, including traffic environments, work places and in the indoor home environment and people move between these environments and are exposed to very different levels due to their individual activity patterns. The assessment of human exposure to air pollution is both an issue for science and for risk management.

For science the issue of human exposure is to correctly assess the pollution exposure and dose taken up by an individual/population group in order to relate the uptake to health effects and other conditions of the exposed group. Important factors to account for are the type of pollutant, the mixtures, the levels and individual sensitivities related to age, sex, health status, life style and culture and other environmental factors of importance. Much of the epidemiological research is geared at establishing the risk factors and understanding the role of co-factors and confounders. Also important is to understand the underlying toxicological mechanisms of the air pollutants health damage and to establish causality.

The risk manager has to deal with using various policy instruments to reduce the risks and maintaining them manageable and relevant. The main instruments may be regulatory (laws and regulations) as for the work environment and for ambient air through setting quality standards. These air quality standards need to be designed so that they reflect population exposure or otherwise give some desired level of protection for the population.
For the indoor home environment only a few policy instruments - such as information campaigns and education – would be available. Part of the risk management is to focus on the important contributions to air pollution and public health concerns. The risk manager is also facing accountability for his action or inaction. This would include the correct assessment of the policy options and a need to follow-up the policies through monitoring programs on air pollution and its health effects.

What has been said?

The APHEIS project – Air Pollution and Health: A European Information System – , presented by Emile de Saeger from the JRC), aims at using local air pollution information to assess the exposure to the general population, and assess the risk to the general population as well as evaluating the benefits of various abatement scenarios. The project has involved 26 European in 12 EU Member States cities and is currently being extended to the full European Community.

Thomas Kuhlbush (IUTA – Germany) presented the outcome of a study on the validity of outdoor air pollution levels for the assessment of exposure, insisting on the spatial representativity of monitoring sites, and concluding that outdoor air was a reasonable and feasible surrogate for exposure.
The results of the PEOPLE project (Population Exposure to Air Pollutants in Europe) were presented by Pascual Ballesta (JRC), confirming indeed that personal exposure levels of Benzene assessed experimentally in 6 European capital cities, showed a linear relationship with outdoor levels measured in hotspots and urban background sites. The study further showed the impact of personal behaviour and life style on personal exposure and the importance of automotive emissions and smoking as major sources of pollution to this respect.
Ioannis Drossinos presented the preliminary results of the integrated Krakow project, presenting the outcome of the outdoor/indoor PM10 measurements in coal heated versus central heated appartments and the associated prevalence of respiratory symptoms.
A contribution to a new concept development was given by Peter Rombout, proposing exposure assessment as a prerequisite for risk assessment and management.

Points of discussion and emerging policy / research needs

The main discussion took place on the new approach to set air quality standards for particulate matter related to population exposure as complementary to limit values. This would require new systems for monitoring and evaluating the achievements of the objectives though a comprehensive quality assurance program to ensure comparable data between the countries and new methods to derive the population weighted average concentration or exposure. In addition new research is needed to derive risk coefficients/factors for the long-term effects of important air pollutants like fine particles relevant for the present air pollution situation in Europe. This would require a EU wide long-term study on environment and health to establish a basis for future policies. An integrated approach to improved exposure assessment and access to health data is key to meet this goal. Air pollution health toxicology research would also be needed to establish the casual link between air pollutants and health damage, such as effects of the cardio-vascular and cardio-respiratory systems. The major damage (mortality and morbidity) is likely to be caused by long-term exposure to fine particulate matter and ozone and much of the efforts should be done in this field.
Action would be needed to reduce the emissions and exposure to the general public and sensitive groups based on detailed source apportionment from model studies and field studies. In this way the sources most relevant for the health damage may be identified and addressed in policies. Improved assessment of risks and benefits of taking action is needed as well as the follow-up of measures taken.

Challenge 5: Further Perspectives: New Pollutants - New Approaches

What is the problem?

What non-regulated pollutants are still a matter of concern? What will be the impact of new technologies on air pollution? What new approaches are available to assess, to forecast, to prevent and to control the Air Quality?

What has been said?

Gerard Kuipers and Angelo Stoli addressed the problem of odor nuisance. The first paper was devoted to possible options for control, whereas the second presentation was dedicated to the situation in the Syracuse industrial area. The impact of ammonia from automotive emission in urban areas and their contribution to ambient air levels of gaseous and particulate ammonia was the subject of the talk of Cinzia Perrino. Alois Krasenbrink presented two projects related to new approaches for assessing the emissions of particles from automotive emissions: the Particle Measurement Program (PMP) and the Portable Emission Measurement System (PEMS). Bo Larsen presented a source apportionment approach that was applied in support to the establishment of abatement measures during the Krakow integrated measurement campaign. Peter Rombout finally gave his views on the need for a "third generation of air quality directives", combining the limit value approach (cap) with the gradual reduction of human exposure and extended to the ensemble of pollutants. The presentations resulted in the following main conclusions.

Odor nuisance has been clearly identified as a local problem where EC legislation has no competence. However, there is a clear link between the regulations on a European scale (EU Directives), even the continental dimension (the Gothenburg Protocol) and their effective implementation locally. In that respect the revision of the NEC Directive (stringent emission ceilings on ammonia and VOCs), the IPPC Directive (inclusion of intensive animal and poultry farming) and in parallel of the Gothenburg Protocol can contribute significantly to lowering odor nuisance. In order to control effectively odour nuisance locally a combination of measures can be useful, including inter alia less costly end-of-pipe techniques (VOCs) and full implementation of a code of good agriculture practice (ammonia). In some cases the dilution of odours through higher stack is still useful. Odour monitoring should be also a part of a regional/local measurement network supplemented by the use of "odor panelists" in areas of odorous industrial emissions or intensive farming.

There is a growing concern related to ammonia emissions from vehicles equipped with three-way catalysts. Ammonia can contribute directly to the formation of PM 2.5, mainly in larger cities. The Roma example has shown a contribution

amounting to 20% of PM2.5, while the ratio between CO and NH3 emissions was identified for the city at the level of 300. Transport can be considered as a new source category for the ammonia emission inventory together with agriculture, industry and waste.

The PMP and PEMS projects that are currently in progress at the JRC for the assessment of automotive emissions of particulate matter are important for the preparation of the coming Euro 5 and 6 emission standards. These new standards were considered when developing the Maximum Feasible Technical Reduction (MFTR) scenario for the Thematic Strategy on Air Pollution (TSAP). Once these studies are completed, these new approaches will become efficient instruments to check and enforce compliance with these new standards.
In order to implement the TSAP effectively, the regulations concerning non-road vehicles and machinery should be reinforced. They increasingly contribute together with shipping to NOx and VOC emissions and aggravate human exposure to PM.
More scientific evidence is needed before regulating separately nitrogen dioxide NO2. Its share in total NOx depends on one hand on changing vehicle fleet and on the other on changing chemical composition of the air. However, their trade-off is still not sufficiently known.

The Krakow project approach, that also integrates the source apportionment component, will allow to elaborate guidelines for the preparation of plans and programs in areas where the present PM10 limit values are exceeded. Although the methodology based on the identification of the chemical mass balance and subsequent positive matrix factorisation (attributing chemical substance in PM to concrete emission sources) is costly, the approach will allow to establish cost-effective and well-targeted measures to reduce PM exposure.

However, new approach to control efficiently the ensemble of pollutants contributing to the PM, and particularly to human exposure on PM 2,5 needs a new and quite complex approach. The latter has been called “A third generation air quality management” combining at once EU-wide limit value (cap) on PM 2,5 with gradual reduction of human exposure to it. Its concept is included in the Thematic Strategy on Air Pollution (TSAP) and related to it legislative package proposal. Moreover, new fractions and/or chemical species of the already regulated pollutants and their sources have emerged as concern with respect to international action.