Assessment of the Effectiveness of European Air Quality Policies and Measures

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FINAL REPORT FOR TASK 3.5: Lessons Learned & Recommendations for the Thematic Strategy

FINAL REPORT ON TASK 3.5
*4 October 2004**

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Abbreviations used

AQ	Air quality
AQCR	Air Quality Control Region (US)
AQFD	Air Quality Framework Directive (96/62/EC)
AQLV	Air quality limit value
CAA	Clean Air Act (US)
CLRTAP	UNECE Convention on Long-Range Transboundary Air Pollution
CO	Carbon monoxide
DG	Directorate General
EU	European Union
EU-15	The EU Member States before the 2004 enlargement
EU-25	The EU Member States after the 2004 Enlargement
GDP	Gross Development Product
HC	Hydrocarbon
ICAO	International Civil Aviation Organisation
I/M	Inspection and maintenance
IMO	International Maritime Organisation
LCP	Large Combustion Plant
MS	Member State
NAAQS	National Ambient Air Quality Standard (US)
NEC	National emissions ceiling
NH_3	Ammonia
NOx	Nitrogen oxides
OBD	On-board diagnostics
OTC	Ozone Transport Commission (US)
PM	Particulate matter
$PM_{2.5}$	Particulate matter < 2.5 µm diameter
PM_{10}	Particulate matter < 10 µm diameter
RBMP	River basin management plan
RECLAIM	REgional CLean Air Incentives Market (US)
RPOs	Regional planning organisations (US)
SIP	State Implementation Plan (US)
SO_2	Sulphur dioxide
UK	United Kingdom
UNECE	UN Economic Commission for Europe
US	United States of America
USEPA	US Environmental Protection Agency
VOC	Volatile organic compound

1. Introduction

Air quality problems came to the fore of European environmental policymaking efforts in the early 1970s, when the scope of pollution-related damages to Europe's forests and other ecosystems began to be recognised. From the 1980s on, the European Community has enacted a series of increasingly stringent controls over emissions to air from a variety of sources, achieving overall reductions in emissions while maintaining economic growth. Yet air pollution continues to pose problems to human health and the environment in a number of regions across Europe, and more actions will be needed if the EC is to achieve the air quality goals it has set for itself by 2010.

This report is the final result of a project to assess the effectiveness of the European air quality policies and measures. It reviews key lessons learned in the course of carrying out the evaluation and provides recommendations for consideration by DG Environment in its task of preparing the forthcoming Thematic Strategy on Air Pollution[1].

The scope of the *ex-post* assessment was to cover all of the EU measures with respect to air quality set in place since 1980. In order to narrow down the field of investigation somewhat and after consultation with DG Environment, it was decided to use a case study approach, and in particular to focus on the following four topics:

1. *Acidification, Eutrophication and Ground-Level Ozone*
2. *Air Quality Standards and Planning Requirements*
3. *Emissions from High-Emitting Vehicles*
4. *Particulate Matter*

In preparing this report, the team has drawn on all of the research and analysis carried out in the course of the project, including the four case studies on the above topics. This report also draws on the findings from the interviews with a cross-section of stakeholders carried out under Task 3.3, as well as from the investigation into the practical application on Member State level of the transparency principle concerning air quality and emissions data carried out as Task 3.4.

The report is structured around the themes of the four case studies, with a final section focusing on the transparency analysis. Under each theme we review the main lessons that emerged with respect to these themes, including as a result of the survey, and on that basis make a number of recommendations for input into the thematic strategy on air pollution.

These lessons are analysed in more detail in the summary case studies comparing the EU approach towards a particular air quality management problem with that of the US. At the end of each comparison are a number of key conclusions. However, in order to get a full overview of the lessons to be learned, we suggest that the reader consult the more detailed annexes that look at the specific situations in the EU, the US and to a lesser extent Japan and Canada.

[1] The project on 'Assessment of the Effectiveness of European Air Quality Policies and Measures' has been carried out for DG Environment by Milieu Ltd, Danish National Environmental Research Institute and Center for Clean Air Policy Service under Service Contract B4-3040/2003/365967/MAR/C1.

2. The Ex-Post Evaluation Process

The project on 'Assessment of the Effectiveness of European Air Quality Policies and Measures' is one of the first *ex-post* evaluations carried out for DG Environment. This section briefly describes our experiences in carrying out the *ex-post* evaluation, in the interests of identifying lessons learned that might be useful to DG Environment in future assessments of this kind.

One of the lessons learned was that great flexibility is needed. The major focus of the project was to carry out a comparative analysis of the European air quality-related policies and measures with respect to the policies and measures applied in other major industrialised countries. The original quite technical and European-centered approach we had proposed was discarded early on in favour of a more descriptive case study approach that would enable sharper comparisons between the EU experience and that of the US.

The case study approach focused largely on comparing the efforts in the EU-15 with those taken in the US. The US was selected as the main point of comparison because of the many similarities between the US and the EU-15. For a limited set of issues we also reviewed the Canadian and Japanese approaches.

The EU-15 and the US are comparable in many ways that influence the way in which the two regions design air quality policy, e.g., similar economical status, technological level, size of population and area, infrastructure, political situation and environmental problems and possible solutions. There are also important differences. The EU is a co-operation between its Member States and thus European air quality policy is a mix of country specific and EU-wide measures, while the US is a single federal country with a growing concentration in air quality policy at the federal level. At the same time, the regional nature of many air quality problems in the US has led to a number of interstate regulatory structures organised to enable the application of region-specific controls to address specific issues.

Another problem arose in the selection of criteria for comparing the EU and US approaches. The criteria selected for the case study comparisons worked well for the case studies on acidification and for particulate matter, but were less appropriate for the case studies on older motor vehicles and air quality planning systems.

Flexibility was also needed to identify what information could be compared. One of our first tasks was a literature search to identify existing *ex-post* evaluations relevant to air quality policy and to analyse their usefulness for carrying out the present study. The team quickly realised that few *ex-post* analyses of European air quality policies and measures had been carried out to date, and those that did exist covered the experiences of individual countries, rather than Europe as a whole. Moreover, almost nothing could be found on cost-effectiveness of the EU policies. On the other hand, it was possible to find more *ex-post* evaluations in the literature concerning the effectiveness of a number of US air quality policies.

However, even when studies could be found in the literature, the data on the US experience was rarely comparable to the data available for Europe. At times it was necessary to go to *ex-ante* studies for methodological guidance and then to use current figures for extrapolating to the present. This highlights the need for support for further ex-post analysis of EU environmental protection quality policies, perhaps targeting a specific measure or programme rather than the complete range of policies and measures in a particular environmental sector.

The studies reviewed included many analyses of both command-and-control approaches and economic instruments. There is no indication that one of these approaches should be abandoned in favour of the other. Both can be applied with success. Experiences with both types of instruments are mixed, and often the outcome of a policy depends heavily on the details of its implementation and the context in which it is applied. Thus, a relatively clear lesson from the analysis of existing *ex-post* studies is that a mix of instruments should be applied.

The project required a database to be established which allows comparisons of air quality standards, emission limit values, and other parameters relevant for air quality management. The comparisons show, for example, that the EU air quality standards are more stringent than those in the US (with the reservation that EU does not have a standard for $PM_{2.5}$). Conversely, the US has more stringent emission limit values for motor vehicles. These limit values are progressively reduced in both the US and EU, with the US typically a few years ahead of the EU.

However, it is often difficult, and sometimes even impossible, to compare different standards. Often the reference conditions underlying the standard are too dissimilar for comparison. This is the case with emission limit values for particulate matter in the cement industry. In the EU, values are defined in terms of pollutant mass per unit of exhaust gas (mg/Nm3), whereas in the US values are expressed as pollutant mass per unit of raw material (kg per ton of feed to the kiln). In such cases, it is not possible to get a clear picture of the difference between the EU and US standards.

Recommendation

Support additional *ex-post* analyses of EU-level air quality-related policies in areas where existing studies are scarce, in particular, cost-effectiveness studies.

3. Acidification, Eutrophication, and Ozone Formation

Observed acid rain damages and ozone formation in the EU and US led scientists and policymakers to conclude that these air pollution problems were a regional problem due to long-range transport of pollutants like SO_2 and NO_x. Both regions, therefore, have introduced a number of measures in specific locations, as well as regional efforts to address emissions that contribute to these problems. The EU-15 has implemented a variety of measures to address acidification, eutrophication, and ozone formation through the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP) and its Protocols, EU directives and different national laws. Similarly, the US has pursued SO_2 and NO_x emissions reductions through such efforts as the Acid Rain Trading program and the NO_x SIP (State

Implementation Plan) Call. In both regions, these efforts have been introduced at various points since the 1980s.

One of the case studies therefore reviewed the efforts in the EU-15 to address acidification, eutrophication, and ozone formation and compared them to the efforts in the US (see case study 1), with the aim of identifying elements that could be used to improve the EU system. It was found to be difficult to fully assess the specific success or failure of individual efforts, since it is often complicated to separate the impacts of a particular control strategy with that of the entire effort. Nevertheless, the comparison of efforts in the EU-15 with those in the US elucidated a number of options that have been undertaken and lessons learned that could support several recommendations for the EU air quality management regime.

One finding is that the EU-15 has achieved a more significant overall reduction in the emissions that contribute to acidification, eutrophication, and ozone formation than the US, achieving particularly strong reductions in SO_2 emissions (see Figure 1 and Table 1). Even when considering emissions per capita and per GDP, the EU-15 is found to have lower emissions of all pollutants.

Figure 1. Total Emissions of NO_x, SO_2 and VOCs, EU-15 and US, 1980 to 2001

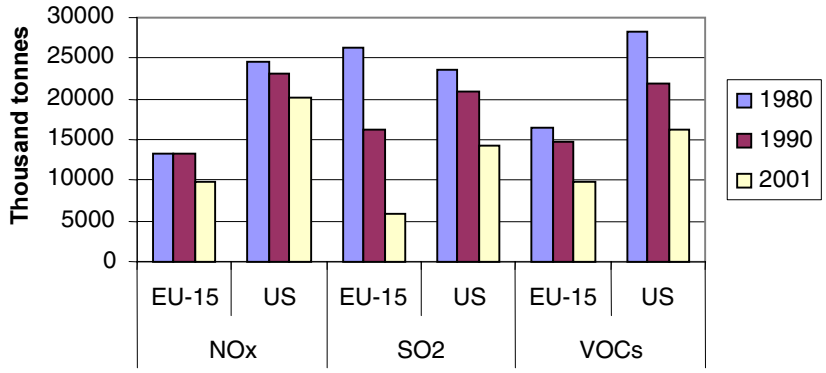

Table 1. Emissions Reductions, EU-15 & US, 1980 - 2001			
	NO_x	SO_2	VOCs
	%	%	%
EU-15	-26.4	-77.6	-40.3
US	-17.5	-39.1	-42.3

In both regions, further progress in reducing SO_2 and NO_x emissions is expected between 2001 and 2010 and possibly beyond. Achieving the national emission ceilings for SO_2, NOx, VOC and NH_3 set under the NEC Directive will require larger reductions between now and 2010 in the EU. In the US, greater SO_2 reductions as outlined in current legislative and regulatory proposals will likely be achieved as a part of new efforts to control PM, ozone, and acidification. NH_3 contributes to eutrophication and acidification in the EU-15, but is not considered an important issue in the US.

The critical loads concept has been at the heart of much of the EU goals-setting process. The US, on the other hand, has no such formal concept for establishing emissions reduction goals but has used a variety of separate concepts. One reason for choosing the critical loads concept in Europe was that the uncertainties in the relationship between deposition and effects were so large that the role of cost-benefit analysis has been limited. The critical loads concept was used for negotiating national emission reduction targets under the Gothenburg Protocol and the NEC Directive.

In both the EU and the US, greater NO_x reductions have been achieved in the energy industry sector than the transport sector. Since 1980, energy industry NO_x emissions have been reduced by 50 percent in the EU-15, while transport sector NO_x emissions have declined by 18 percent. A similar situation has occurred in the US, where energy industry emissions of NO_x have declined by 30 percent and transport by 16 percent. This could be the result of the type of program introduced in these sectors, but also as a result of other factors, such as cost-effectiveness, ease of implementation, and availability of technology. Another part of the explanation could be the greater increase in road transport in both regions, in comparison to energy. From the analysis reviewed for this project it is difficult to fully assess the relative weights of these factors.

The US has achieved greater reductions in NO_x emissions from transport, but total transport emissions are higher than those in the EU-15 as well as emissions per unit of travel for road vehicles (kt/km/vehicle) — 0,39 and 0,30 for NO_x, respectively. Both regions have achieved greater NO_x reductions from road transport than other transport since 1980 (for the EU-15, a 23 percent reduction compared to less than 1 percent for other transport emissions, and for the US, a 28 percent reduction compared to an increase of 28 percent for other transport emissions). This is partly because in both regions most efforts to date have focused on road transport emissions, and efforts to address other transport sources are relatively recent and still at an early stage of implementation. Nonetheless, there appears to be considerable room still for the EU to cut NO_x emissions in the transport sector.

These policies and emissions reduction measures have led to large reductions in sulphate and nitrate deposition since the late 1980s. In both the EU-15 and US, the largest impact has been on sulphur deposition, since SO_2 reductions were a major focus of efforts to reduce acidification in both jurisdictions. Nitrate deposition was reduced to a lower extent, mainly due to lower reduction in NO_x emissions, as mentioned above. Ammonia (NH_3) emissions – primarily from agriculture -- have not decreased significantly in the EU-15.

While it is impossible to completely compare the level of acidification between the EU-15 and US, there are still areas in both regions where wet deposition of sulphate and nitrate is occurring in high concentration levels, implying that greater reductions may be needed in the future. In both the EU-15 and the US, targets and regulations are being developed for the 2000-2020 timeframe that will likely have an impact in this regard.

While progress has been made in reducing ground level ozone formation, it remains a problem in many parts of the EU-15 and US. Average ozone concentrations for the EU were nearly constant between 1995 and 2001 and the same is the case for the peak values (episodes). This trend is complex as annual average ozone concentrations have been increasing (about 8 % since 1996, averaged over all station types), while maximum and high

percentiles of hourly concentrations have been decreasing over the decade. The air quality limit and target values for ozone to be met by 2005–2010 are currently exceeded extensively in European cities and in rural areas as well, and several areas of the EU are still exposed to relatively high episodic concentrations of ozone. However, ozone episodes were less frequent in recent years in Northern Europe, probably due to reductions of NO_x and VOC, and some decline in ozone concentrations was seen in certain regions of the EU-15.

A similar situation has occurred in the US where average ozone concentrations have remained relatively constant since the mid-1990s. Further, a number of areas in the US have ozone concentrations in excess of the ambient air quality limit values. The general ozone level is affected by the high hemispheric background, which is 30-40 ppb as annual average. Intercontinental and hemispheric transport of ozone and its precursors, which adds to local background pollution[2], is well-documented. Any further increase in Northern Hemispheric emissions will make it more difficult to reach local air-quality objectives through local or national measures alone.

The EU achieved remarkable emission reduction results through a command-and-control approach while the US has opted to utilize market-based mechanisms to a greater extent than in the EU-15. The US emissions trading programmes have provided flexibility in achieving emissions reductions at the lowest cost. Each programme has been uniquely tailored to the given emission of concern and the impacts associated with those emissions. For example, the Acid Rain Trading Program establishes a national cap due to the transport of acidifying pollution, while the NOx SIP Call was focused on a particular region based upon assessments of pollutant transport associated with ozone formation.

A limited number of EU countries have utilized market-based mechanisms to help control polluting emissions, including emissions taxes and charges. These measures have been found to lead to relative cost-effective reductions and technological innovation. The most successful tax/charge programmes in Europe (e.g. Sweden) were based on relatively high rates and returned most of the money to the companies in relation to the production achieved. Market-based instruments typically also have administrative, enforcement and monitoring advantages, compared with traditional regulatory approaches. European countries do not yet have experience with emissions trading of pollutants, but the Netherlands will launch trading of NO_x in 2005, ant the EU has established emissions trading for CO_2.

Analyses in both Europe and the US have found that the benefits (in economic valuation) have outweighed the costs of a number of air quality controls. For example, the total cost of reaching the EU national emission ceilings is expected to be some 70 billion euros a year compared to the benefits, estimated at roughly 200 billion euros a year.

While other studies and processes are being conducted to evaluate the extent of the acidification, eutrophication, and ozone formation problem and the level of emissions reductions required to address these issues in the coming years, we highlight some specific additional approaches that could be utilized. It should be noted that emissions of SO_2 and NOx are also precursors for secondary particulates. While this question is addressed in

[2] Emissions from Asia, North America and Europe have increased the hemispheric burden of ozone by at least 50% since the Industrial Revolution. The UNECE stated in 2002 that current emissions create pollution levels that exceed air-quality objectives throughout the Northern Hemisphere.

Section 4 (Case Study 4), it is important to remember the importance of emissions control policies taking an integrated approach in addressing the range of air quality problems.

Recommendations

Explore possibilities for an EU-level structure to tailor regional level programmes to address air pollution transport problems particular to a specific transboundary area. At this point, the NEC Directive is the primary EU mechanism for addressing regional level air pollution transport problems. There is a need for more tailored regional level programmes for different geographic regions to reflect air dispersion patterns. For example, one programme could cover the region north of the Alps including the new Member States, and another south of the Alps. The experiences of MS cooperating to set up river basin management structures for international rivers under the Water Framework Directive, as well as the US experiences in setting up regional planning organisations, could provide lessons for such an effort.

Consider regional application of market-based instruments where transport of emissions is within the region and the MS concerned are willing to cooperate with each other. The Treaty allows for enhanced cooperation[3] among countries willing to adopt certain measures together that would be blocked at EU-level because of failures to reach unanimity where required (e.g., for EU-level environmental taxes and charges). While it was impossible to fully evaluate the use of such market-based mechanisms for specific pollutants within the EU context as a part of this study, such measures have proven to be an effective approach in a number of Member States and the US. For example, taxes have been introduced in Sweden and France for NO_x emissions with varying designs. It may be possible to develop market-based measures that meet the various needs and issues of the different regions of the EU.

Think about possibilities for establishing emissions trading within regions that have significant remaining emissions from stationary sources and where substantial transport of the emissions is within the region. In the absence of robust comparative information on the cost effectiveness of market-based mechanisms in addressing EU air quality problems, we can only look at the US experience. The US has had well-documented success in implementing a variety of emissions trading programs tailored to address air quality issues at regional level, e.g., the Ozone Transport Commission's trading program, and for select metropolitan areas (e.g., the California RECLAIM program and Illinois VOC program). Emissions trading could for example target specific pollutants of regional concern, e.g., NH_3 in intensive livestock rearing countries such as Denmark and northwestern Germany.

Consider ways to achieve greater reductions of NO_x emissions from mobile sources. Our analysis indicates that there is still scope for reductions of NO_x. This would serve to address all three of the regional air pollution problems analysed in Case Study 1 -- acidification, eutrophication, and ground-level ozone -- simultaneously, and the transport sector seem to be one sector where reductions might be achieved, e.g., through economic instruments.

[3] See Article 11 of the Treaty of the European Communities and Articles 43-45 of the Treaty of the European Union.

4. Particulate Matter

The case study on particulate air pollution focuses mostly on the effectiveness of measures taken in the EU and the US regarding PM_{10}, since $PM_{2.5}$ has only recently become a pressing issue, as scientific evidence mounts concerning health impacts from smaller particulates. PM pollution is a local problem in relation to primary particles (those emitted directly by sources) and a regional problem in relation to secondary particles (which are the result of atmospheric reactions among sulphur and nitrogen oxides, ammonia, and organic compounds).

EU-level efforts to reduce PM pollution in Europe began in 1980 with standards for black smoke or soot and later standards for PM_{10}. Currently, PM_{10} is regulated by the first daughter directive under the Air Quality Framework Directive. The EU also has legislation to control emissions from different industrial sources, such as LCP and IPPC, both of which have impact on particulate pollution. The EU's control of mobile sources (especially road traffic) is based on emission limits for vehicles and fuel quality standards. Overall, almost 70% of survey respondents thought that EU legislation has had a positive impact on ambient concentrations of PM_{10} and $PM_{2.5}$ (as well as ozone). However, the PM_{10} limit values are still exceeded in many parts of Europe.

In the USA, controls were initially focused on total suspended particles and then PM_{10} through National Ambient Air Quality Standards (NAAQS). The Environmental Protection Agency revised its PM standards in 1997, adding a new NAAQS for $PM_{2.5}$, which is not yet in effect. Regional haze from PM is considered a problem in the USA and measures have been introduced at regional level to address this. The measures do not regulate PM_{10} or $_{PM2.5}$ directly; rather, the EPA's proposed Clean Air Interstate Rule will set SO_2 and NO_x ceilings in 28 states and the District of Columbia to reduce transport of secondary particles to aid in meeting standards for fine particulates (the ceilings will also reduce ozone transport). The USA also has emissions controls for specific sources, such as engine emissions and fuel standards for heavy-duty vehicles.

In terms of emissions, both the EU-15 and the US have achieved significant reductions of PM precursors - SO_2, NO_x, and NH_3 – and of primary PM_{10}. Overall PM_{10} emissions in the EU-15 and the US are relatively similar, with slightly higher levels in the US since 1990. The EU-15 has achieved greater emissions reductions of primary PM_{10} since 1990 than the US.

Both regions had similar emissions rates for the energy industry—about or over 0.1 kg/MWh – in 1990. The EU-15, however, has achieved a reduction in the emissions rate—25 percent—while the US has seen its emissions rate remain essentially unchanged. Both regions have witnessed a decline in transport PM_{10} emissions since 1990—25 percent in the US and 30 percent in the EU-15.

While $PM_{2.5}$ trends are not available for the EU-15, the US has witnessed an increase in primary $PM_{2.5}$ emissions since 1990 of 19 percent.

The significant decrease in EU PM_{10} emissions largely took place as a result of reductions of precursors, especially sulphur related particles. Reductions of SO_2 and NO_x precursors will be further reduced when the legislation for these emissions is fully implemented. Non-regulated emissions from ships and wood burning as well as from non-exhaust particles from

traffic have been found to be important contributors to particle pollution in Europe. Currently, particles emitted from shipping, domestic heating (solid fuel), aviation, off-road machinery, farming, forestry, and construction are not controlled in the EU, though several Member countries have developed national legislation to address these sectors.

The EU and US efforts to address fine particulates ($PM_{2.5}$ and smaller) are both at a relatively early status of implementation. For this reason, it is difficult to evaluate the effectiveness of these policies. One of the major issues that arose during our comparison was the relative lack of information available on PM concentrations, especially in the EU. This was more pronounced for $PM_{2.5}$, where the US began collecting data on $PM_{2.5}$ a number of years ago, while the EU is just at the beginning of putting a systematic data collection system in place for $PM_{2.5}$. Because data on the trends of emissions for fine particle parameters ($PM_{2.5}$, PM_1, ultrafine particles) are not available for EU-15, comparison of EU emissions levels and progress with that of the US is not yet possible.

In terms of ambient air quality, the EU-15 has witnessed an overall decline in PM_{10} concentrations. However, there are still areas where limit values are exceeded. While some areas in the US have experienced reduced concentrations of PM_{10}, several areas still have concentrations that exceed the national limit values. For the data that is available, it appears that large areas of the EU have $PM_{2.5}$ concentrations in excess of 15 $\mu g/m^3$ -- the US three-year mean limit value and a value within the range that has been proposed for EU annual averages (see case studies 2 and 4).

Recommendations

The lack of data in the EU-15 highlights the need to ***collect better and more systematic PM data with respect to emissions sources and sectors, across key PM dimensions and chemical/physical properties***. The need for better data, including on health effects, was confirmed by a majority of survey respondents.

In particular, the EU should consider the ***early development of a comprehensive monitoring strategy for $PM_{2.5}$***, taking into account lessons from $PM_{2.5}$ monitoring in the US. For example, monitoring stations should be sited to ensure monitoring in areas of high exposure. This strategy should also include monitoring of PM emissions from brakes and other non-exhaust PM from road traffic, a potentially important local source identified in the case study. Steps could be taken to reconsider the current monitoring strategy and supplement measurements of ambient air quality limit values with assessments of population exposure (gap closure), especially in relation to primary particles.

Better monitoring, in particular for $PM_{2.5}$, should be considered a first step in ***the development of EU-wide $PM_{2.5}$ air quality limit values.***

Finally, consider more explicit links between the national emissions ceilings under the NEC Directive and efforts to address the regional transport nature of primary and secondary PM. Experience in both the EU-15 and US has highlighted the transport nature of PM emissions. In the US for example, both the SIP mechanism and the proposed Clean Air Interstate Rule link emissions to air quality, and early proposed efforts to address $PM_{2.5}$ have

clearly focused on controlling regionally transported emissions. The EU could consider similar mechanisms to link NEC requirements to PM_{10} and $PM_{2.5}$ air quality levels.

5. Emissions from High-Emitting Vehicles

Within both the EU-15 and US, less progress has been made in addressing mobile source emissions than those from energy and other major industries. In both the EU and the US, efforts have focussed on establishing increasingly stringent emissions standards for new vehicles. The US has generally preceded the EU in vehicle standards; in some cases – notably for petrol fuel automobiles – US standards are more comprehensive in terms of pollutants controlled. In both EU and US, however, growth in vehicle use has offset the vehicle emissions reductions achieved.

In both EU-15 and US, a small fraction of the car fleet accounts for a significant share of vehicle emissions. Since more is known about efforts to address new vehicles, our *ex-post* review focused on efforts to address emissions from high-emitting vehicles. We considered two types of programmes – inspection and maintenance, and scrappage – and evaluated the approaches taken in the EU and USA. The experiences of Canada and Japan were also reviewed.

Though the problem of high-emitters seems to be less pronounced in Europe than in the US, high emitters nonetheless remain a concern for some EU-15 countries. However, in the case studies we were able to pull out only limited lessons learned, because of the scarcity of information on the cost-effectiveness of programmes to control emissions from "gross emitters".

In the survey, EU automobile emissions standards and roadworthiness requirements received the top scores among all air pollution instruments in terms of benefits achieved in relation to costs. At the same time, some respondents noted that the shift from petrol to diesel automobiles has increased particulates emissions. Many survey respondents also called for further local action to address transport-related pollution, and for the EU to consider how to promote best practice at local level. Finally, many survey respondents underlined the need to address the growth of road-based freight, and called for continued efforts to integrate sustainability issues in EU transport policy.

Inspection and Maintenance Programmes

The EU requirements with respect to inspection and maintenance (I/M) are set forth in the EU Roadworthiness Framework Directive, which requires Member States to implement compulsory vehicle inspection to ensure that owners of both private and commercial vehicles have carried out necessary maintenance. Non-catalyst petrol vehicles must be tested for carbon monoxide. Since 2003, the roadworthiness test for heavy commercial vehicles is to be supplemented with roadside inspections.

Case Study 3 describes how the US has established inspection and maintenance programmes implemented by the individual states. Since there are no required guidelines for designing I/M programs under the Clean Air Act, the approaches that have been introduced vary by

state and often between cities within the same state. However, as a part of EPA's review of SIPs (see section 3, above, and Case Study 2), the I/M program in each area is subject to approval by EPA. Thus, the SIP review system results in stronger I/M programmes in areas with poor air quality. The USEPA considers the I/M programme in Phoenix, Arizona as the one that most closely resembles the EPA's recommendations. The Phoenix programme can thus be viewed as an example of "best practice".

The main difference between the EU and Phoenix programmes is the type of exhaust test. The EU tests take place under idle conditions whereas the Phoenix tests use a test more related to normal driving conditions. In addition, the Phoenix programme includes motorcycles, which the EU I/M programme does not.

Thus, there is an important potential in terms of emissions reduction in the EU through a more stringent I/M programme for cars with three-way catalytic converters: this has been estimated to be around 35% emissions reductions for CO, 25% for HC and 5% for NO_x, though under real-world conditions this potential would probably be half of that. An evaluation of the Phoenix programme found emissions of vehicles after testing and repair to have been reduced by 15-36% for CO, 15-37 % for HC, and 7-29 % for NO_x.

The cost of the more advanced tests used in Phoenix and other US programmes is higher. In some regions, these I/M programmes have been found to be relatively cost-effective. Nonetheless, there are a variety of design issues of concern that could influence the emissions reductions benefits and therefore the cost-effectiveness. For example, several *ex-post* studies have indicated that efforts to identify the highest emitters for special control via, e.g., remote sensing, could significantly improve the cost-effectiveness of these programs. US studies have identified, as a key area for improvement, the problem of adequate enforcement to ensure that vehicles failing the test undergo necessary repairs or are not driven. . While I/M studies in the EU did not highlight this issue, it should be considered to ensure effective I/M programmes.

I/M Recommendations

Consider improving I/M requirements. Here, the case studies of the US – in particular "best practice" programmes such as the Phoenix programme – as well as of British Columbia, Canada, indicate areas for attention. These include: tests that address hydrocarbon and NO_x emissions; dynamic testing over a short driving cycle, to better simulate actual driving conditions; and the inclusion of motorcycles among vehicles required for testing. The systematic use of remote sensing to identify the highest polluters on the road should be considered. Finally, I/M requirements should be linked to on-board diagnostics (OBP) for new vehicles.

The EU should consider encouraging Member countries to develop more stringent I/M Programmes in urban areas and regions where air quality standards are exceeded. More stringent programmes could be pilots for future EU-wide requirements; their results and cost-effectiveness thus should be reviewed.

Scrappage Programmes

Scrappage schemes have also been implemented in several European countries. There are basically two different types of scrappage schemes: the first type (cash-for-scrappage) gives a certain reward for any scrapped car, whatever the subsequent replacement decision taken by the consumer, whereas the second type (cash-for-replacement) gives a bonus conditional upon a specific kind of replacement vehicle.

The US has implemented vehicle scrappage programmes to a much more limited extent than the EU. California has run a "voluntary accelerated vehicle retirement" programme for the South Coast, but this programme has yet to be fully funded. An *ex-ante* analysis of a hypothetical California programme estimated that scrappage of 75,000 light duty vehicles older than 15 years per year would achieve reductions of over 4%. It also estimated that the programme would lead to an increase in vehicle prices and an in-migration of vehicles into the region.

The cash for scrappage programmes are considered more cost-effective than the cash-for-replacement programmes and small scale programmes more cost-effective than the large programs, especially if they are focused on technology shifts. A variety of other economic incentives, in particular tax instruments, have been applied in European countries with some success. The project did not find in-depth studies of tax incentives to discourage the use of older, highly emitting vehicles, but these appear to be a cost-effective approach that can be easily adapted to vehicle tax systems in EU countries.

In both the US and the EU, the effectiveness of scrappage programmes both in terms of emissions reductions and costs has varied from one programme to the next. While such programmes may be encouraged in highly polluted urban areas, they need to be designed carefully to ensure cost-effective emissions reductions.

Japan has taken a different approach to the problem of high-emitting vehicles. Since 2000, Tokyo's Diesel Retrofit Requirement has required that existing diesel buses, trucks, and special category vehicles operating in the city be retrofitted with particulate matter emissions control systems. This suggests that retrofitting requirements for heavy-duty vehicles above a certain age, as developed in Japan, could be a useful approach**.** While no review of the effectiveness of the Japanese program was available during the course of this project, such a review could prove useful in understanding the possibilities for effective application within the EU.

Scrappage Recommendations

There is not enough positive evidence, in particular regarding cost-effectiveness, to warrant the consideration of EU-wide cash-for-scrappage programmes. The ex-post studies we found in fact concluded that small scale programs are more cost-effective than the large programs, especially if they are focussed on technology shifts. We therefore recommend that ***scrappage programs or other economic incentives be targeted at specific areas and portions of the fleet in order to promote renewal of the car fleets.*** In addition, ***further study is necessary to identify the most cost-effective approaches.***

Cash-for-replacement programmes appear to have a lower cost-effectiveness than cash-for-scrappage programmes, and should not be implemented or encouraged at EU level.

The EU should consider the technical and cost requirements of a diesel retrofit programme for heavy-duty vehicles, and evaluate potential benefits, such as PM reductions. A close review of the Tokyo experience will be important here. While diesel retrofits may be most important in highly polluted areas, diesel-powered freight travels across Europe, and an EU-wide programme may be warranted.

6. Air Quality Planning

Air quality (AQ) planning is an important element of both the EU and US air quality protection regimes. While the AQ planning process does not necessarily determine the specific emissions control measures introduced, it can lay a potentially important foundation for those measures. When AQ planning is combined with the use of modelling to arrive at projections of future AQ, it becomes an important tool for determining the measures most likely to have the desired impact on ensuring attainment of specific AQ goals.

One of the project case studies therefore reviewed the air quality planning programs in the EU-15 and compared them to the efforts in the US (see case study 2), with the aim of identifying elements that could be used to improve the EU system. The EU has two planning processes relevant to AQ management -- the emission reduction plans required under the National Emissions Ceilings (NEC) Directive, and the plans or programmes required under the Air Quality Framework Directive (AQFD) to show the measures that will be taken to bring a zone that has been in exceedence into compliance with AQLVs. The US Clean Air Act (CAA) requires States to prepare State Implementation Plans (SIP) to show how air quality will be maintained or improved, depending on current status of compliance.

It proved impossible to fully assess the success or failure of these planning processes, since it is difficult to separate out which emissions control measures were implemented as a result of these planning requirements alone, and not for other reasons. Nonetheless, the comparison of systems in place in the US with those of the EU-15 did enable identification of a number of options tried and lessons learned, from which several recommendations can be drawn for the EU air quality management regime.

In general, the US air quality management regime appears to have a higher level of integration between its AQ planning requirements and the federal-level measures taken with a view to reducing polluting emissions, as well as more effective mechanisms for addressing regional (multi-state) air pollution problems through implementation of joint mitigation strategies, e.g., for ozone formation. The state officials who prepare State Implementation Plans (SIPs) benefit from detailed guidance, including air quality models, from the USEPA concerning how to develop emissions inventories, project future emissions, and calculate the impact on AQ objectives of federal controls over emissions sources.

In contrast, the EU AQ planning requirements are not well linked to measures aimed at controlling or reducing emissions. While the IPPC Directive does require integrated permits to impose stricter conditions than best available techniques, if necessary to comply with

environmental quality standards, there is no EU-level guidance concerning how local AQ planners should take into account future reductions in emissions due to EU actions, e.g., setting of new Euro standards for motor vehicles.

Moreover, there is no formal link between the national emissions reduction plans required under the NEC Directive and the local AQ planning process. While each MS is required to show how it will comply with its NEC by the interim target date of 2010, there is no requirement to show how measures taken to reduce overall emissions will support that MS's efforts to comply with the AQ limit values set under the AQFD and its daughter Directives[4]. This seems to be a significant gap in that the emissions reductions foreseen under the NEC Directive are likely to have an impact on background concentrations of pollutants. Better integration between AQ planning and legislation aimed at emissions reduction could make AQ plans more transparent and help to ensure that emissions reduction is carried out in such a way as to support attainment of the AQLVs throughout a MS's territory.

Another lesson is that the way in which air quality planning is triggered can be important in terms of the result to be achieved. In the US, States must prepare new State Implementation Plans (SIP) whenever the federal government revises the air quality standards for a criteria air pollutant. The SIP covers the entire territory of a state, whether a particular zone is in attainment with the NAAQSs or not, and the emphasis is on planning to demonstrate how attainment will be achieved within a given time period (where the region is not in attainment), or maintained (where the region is already in attainment).

Contrast this with the EU planning requirement under the AQFD, which is only triggered when a zone is reported at the end of the year as in exceedence of the AQLV plus the margin of tolerance, and which therefore acts as a kind of sanction for non-attainment, rather than as a stimulus for best practices in AQ management.

Another lesson is that formally designating a zone as a non-attainment area can provide important incentive to improve local air quality. Under the US system, states nominate which areas are not in attainment for the NAAQS set for a particular pollutant and the SIP for that area must show how attainment will be achieved by a specific target date. A region's designation as a non-attainment area lasts for several years and can have important consequences for, e.g., the future decisions of investors. Redesignation as a region in attainment requires another formal process and a showing that the measures taken have been and will be effective in meeting the NAAQS.

Under the EU system, however, there is little practical consequence if a zone is considered to have been in exceedence. Each year the Commission publishes a list of the zones where exceedences occurred, and MS are to forward AQ plans to show the measures they will take to attain compliance with the AQLVs. If the zone has no exceedences the following year, the zone falls off the list. If the zone remains in exceedence in subsequent years, there are no additional planning measures required to demonstrate how the zone will achieve compliance in the future.

[4] Note that the Ozone Daughter Directive under the EU AQFD recognises the link between the emission reduction measures required under the NEC Directive and meeting ozone target values.

Under the US system, the degree of non-attainment also has consequences, which can serve to provide impetus to the planning process. For example, the US system classifies ozone nonattainment areas as either marginal, moderate, serious, severe-15, severe-17, or extreme. The more severe the classification of the nonattainment, the more stringent the planning and control requirements to which the SIP for a particular area must comply.

However, the EU AQFD regime provides only for a differentiation between concentrations above the LV plus the margin of tolerance (Art. 8(1) versus concentrations above the LV but within the margin of tolerance (Art. 8(2)). A zone with very high concentrations of a particular pollutant is not required to carry out any additional planning and control requirements than a zone where concentrations are only slightly above the LV plus the margin of tolerance. The US system of differentiation according to the severity of the AQ problem could prove useful within the EU to help focus efforts on areas according to the degree of their AQ problems.

Another lesson is the usefulness of a system that can address sub-regions within a political territory as well as create regional AQ planning organisations for control of AQ problems that cross borders. For example, the US AQ management system is based on a number of air quality control regions (AQCR) designated under the Clean Air Act (CAA), including some major intrastate areas grouped into one AQCR where necessary or appropriate for AQ management purposes. The 1990 CAA amendments expanded on this by providing for the creation of regional planning organisations (RPO) for the purpose of implementing multistate air pollution mitigation strategies, e.g., to address ozone formation and regional haze. The USEPA can issue rules and regulations for RPOs that will, if voluntarily adopted by the respective states, count as part of the attainment-demonstration strategy.

Under the EU system, the major instrument for dealing with transboundary transport of pollution is the NEC Directive, which sets regional NEC regime, which sets national emissions ceilings (NEC) with a view to protecting sensitive ecosystems, i.e., sub-regions. Each NEC covers the entire national territory of the MS concerned, and the MS is only required to achieve an overall emission reduction. There is no requirement that a MS reduce emissions in the region where the emission reduction is most needed to protect specific ecosystems, or to address air quality problems for particular cross-border (multi-country) regions.

Both areas have in place mechanisms to enforce states to properly develop plans. However, the EU powers of enforcement over the MS apply to all areas of EU law, and there is no power of enforcement specifically linked to AQ or other environmental goals. On the other hand, the US Clean Air Act gives the federal government specific powers over the states if they fail to meet the NAAQSs. These powers include: (1) a *"bump-up" provision* for reclassifying an ozone nonattainment area that failed to achieve attainment within a given period to the next higher classification; this subjects the area to more stringent pollution control measures; (2) *sanctions* when a nonattainment area fails to submit an adequate SIP or to demonstrate attainment by the deadline: ("2-to-1" emission offset requirements for new or expanding installations, and withholding of funds for highway projects within the nonattainment area; (3) a *penalty fee* that can be collected by local governments of the severe and extreme ozone nonattainment areas from major stationary sources that fail to attain

emission limits. Moreover, the US system of compliance appears to have been used to a greater extent in cases of non-attainment.

In addition, the US system allows for any state or political subdivision to petition USEPA for a finding that emissions from upwind states contribute significantly to nonattainment in that petitioning state. If the USEPA makes such a finding, it can impose additional regulatory measures on the emitting state. Under the EU system, if there is an exceedence in one MS due in part to significant pollution originating in another MS, the AQFD provides only that the MS shall consult each other with a view to finding a solution.

The US efforts to address regional (multistate) pollution problems are a success story, but at the same time debate has shifted to a growing realisation that more federal actions are needed to reduce source emissions, if regional pollutant transport issues are to be addressed effectively and to alleviate competitiveness concerns on the part of some States. In the EU context, it may well be that there is a similar need for continuing centralised regulatory actions to reduce emissions in order to support local and regional air quality planning efforts.

Recommendations

Our first recommendation is to focus efforts on areas according to the degree of their AQ problems, by setting in place a mechanism to ***formally designate zones where exceedences occur as non-attainment zones***. This should be coupled with a system (criteria) to ***differentiate among non-attainment zones according to the degree or severity of the exceedence of the AQLV,*** and ***make the planning and control requirements more stringent accordingly.*** This might require setting in place new terminology to reflect the relative seriousness of the exceedences, e.g., "marginal and severe nonattainment areas" rather than the current one-size-fits-all term of "Article 8(1) zone".

We also recommend that the planning requirements under the Air Quality Framework Directive be strengthened to ***require air quality management plans for <u>all</u> zones and agglomerations*** as a best practices measure, whether in attainment (maintenance plan) or not (attainment demonstration plan).

We also recommend ***establishing more targeted mechanisms for addressing cross-border or regional air quality problems, including financial incentives.*** The NEC Directive is an important mechanism for controlling regional pollutant transport by reducing overall emissions within each MS, but it is not geared to address specific cross-border pollution problems. There is a clear need for more coordinated efforts in certain transboundary regions if AQLVs are to be achieved. The EU could explore a range of possible mechanisms, e.g.,

> (1) establishing ***more detailed guidelines on how to delineate "zones" and "agglomerations"*** for managing AQ in areas where regional transport is a problem;
> (2) ***requiring MS to coordinate relevant AQ management plans among each other, with the aim or producing a single AQ management plan*** for a cross-border region with shared AQ problems (similar to the Water Framework Directive's provision concerning MS to co-ordinate river basin management plans (RBMP) for international rivers).

(3) a ***Community role in bringing individual Member States together into regional air quality planning structures*** to develop collaborative approaches, drawing on the experience of setting up international river management structures, e.g., a regional program with respect to ammonia from agricultural sources that links the Netherlands, Denmark, Southern Sweden, Northern Germany and Poland;
(4) ***enhanced use of EU regional funds*** to provide financial incentives specifically for cross-border cooperation on AQ management.

The current lack of enforcement measures if zones fail to meet AQLVs is also a concern. We suggest exploring possibilities for strengthening powers to pressure Member States to take appropriate measures to achieve AQLVs within the dates agreed under the EU legislation. These additional enforcement powers could include:

(1) requirement that the ***AQ plan or programme for a non-attainment area is subject to review by the Commission***, which is charged with determining if the plan has sufficient measures to achieve the AQLVs over time;
(2) ***imposition of more stringent planning and reporting requirements*** if a zone remains in exceedence of the EU AQLVs;
(3) ***withholding of EU funds*** for any projects that might contribute to increased emissions in zones where AQLVs are exceeded, e.g., structural funds for transportation infrastructure projects, CAP support for livestock production.

Finally, there is a strong need to better integrate the planning requirements under the ***National Emissions Ceiling (NEC) Directive*** with those under the ***Air Quality Framework Directive*** so that they become mutually supportive. In particular, ***national emissions reduction plans should be required to demonstrate that the reductions will be made in such a way as to facilitate the attainment of AQLVs*** in zones where exceedences occur or are likely to occur. In addition, the Directives aimed at reducing emissions for specific sources, including non-IPPC installations and motor vehicle emissions, should be better integrated with the Directives aimed at achieving air quality standards. One way to achieve this is to develop ***more detailed guidelines on what should be included in air quality plans, including common modelling of air quality and impacts of given EU measures on emissions***. This would enable better review procedures to determine adequacy of plans and programs for achieving the air quality objectives.

7. Transparency and Public Participation

Providing the public with access to environmental information in Europe has been a requirement since 1993 when the very first directive on the topic came into force (Directive 90/313/EEC). It was only after the 1996 Air Quality Framework Directive and the subsequent Daughter Directives, however, that these requirements were made specific to the area of air quality and emissions. Together these pieces of legislation require that the public is routinely provided with information on pollutant levels in a clear, comprehensive and accessible manner, and also that they are informed when any alert thresholds are exceeded.

This project has provided the first opportunity to test how Member States are implementing these obligations to provide information to the public. This test comes at an important time.

The new Directive 2003/4/EC on public access to environmental information will repeal Directive 90/313/EEC and introduce a set of tougher and more precise rules on the systems that Member States should be putting in place to provide information to the public. If Member States have not already set in place the basic principles of information provision, they will find it hard to deal with the tighter requirements.

Our work on this part of the project had three components. First of all, we used national contacts in nine case study countries (EU-15 & EU-25) to assess how and what information is supplied on air quality to citizens. We designed a questionnaire for each national contact to complete and ensured that it covered all of the public information requirements of the three Daughter Directives.

The second component was sending out letters requesting information on air quality to authorities in each of the nine case study countries. Again we used the national contacts so that the letters were translated into the national language and were sent locally. We then analysed the number and speed of responses in each country and also – importantly - the quality of the responses. Lastly, we interviewed two persons who had been heavily involved in carrying out public consultations on two very different types of air quality strategies to find out how the consultation had been approached and how successful it had been.

Our case studies showed that the UK, Czech Republic, Denmark, Greece and Lithuania currently provide air quality information to the public through a completely centralised system, i.e. where one body is appointed with responsibility for providing and disseminating air quality information for the entire country. In contrast, Italy, Spain and France provide information on a decentralised basis – i.e. responsibility for information provision and dissemination is delegated to each region.

It cannot be said that one of these options is better than others since the proficiency of each system depends on the skill of the bodies appointed and the amount of funding provided, but it can safely be said that the decentralised system contains the most pitfalls. The main difficulty with decentralised systems is that of ensuring consistency – i.e. that the same range of pollutants are monitored and the same depth of information is made available to the public in each of the regions.

The decentralised systems in place in Spain, Italy and France that we analysed did not appear to be providing a consistent depth of information region by region. The capital regions of each country benefited from very in-depth, sophisticated and clearly well-funded information services, whereas it was considerably more difficult to find precise information in some of the other regions, especially those that do not operate active dissemination policies. A lesson learnt from this project is that Member States operating a decentralised system need to ensure that the baseline of information required to be disseminated by law can be found consistently in each region. This could be achieved by the introduction of a common pollution index that will be used by each region.

Before looking at the *content* of the air quality information that is provided to the public in various Member States, there is the important issue of *increasing the public's awareness* of the availability of that information. Half of the stakeholders surveyed for Task 3.3 said that not enough had been done to make the public sufficiently aware of the information that is

available on air quality. Member States need to be actively making the public aware of the air quality information that exists and promoting their use of it, as there is little point in having information when no-one knows about it. The UK's brochure published by the Department for Environment, Food & Rural Affairs, "*Air Pollution: What it means for your health*" is an excellent example of what is needed. It explains the methods of information available to the public on air pollution. Another of the clear lessons learnt from this task was that concrete steps need to be taken by the responsible authorities in Member States to inform the public about the existence of the information officer and the availability of the information.

Both the Task 3.3 survey of stakeholders and the work of our national contacts shows that today the internet is the most common source of information on air quality and emissions. Whilst the internet can be a great source of information, not all members of the public have access to this source. The lesson learned is that rather than relying on the internet as the sole media for disseminating information, it is preferable to have a range of information media, including, for example, weather forecasts or information screens in urban centres.

Our test of the application of transparency through the sample letters gave some interesting results. It showed that presently three of the nine Member States analysed have extremely good systems in place and are consistently and quickly responding to requests for information and, two other Member States have satisfactory systems in place, the remaining four Member States do not seem to have systems in place at all. This shows that EU should periodically check MS' implementation of access to information requirements.

Our interviews on public consultations revealed the different purposes that these consultations can have. Sometimes a public consultation aims to target as many members of the public as possible and sometimes to target only the relevant stakeholders. Whatever the aim of the consultation, we learnt that three elements are indispensable for achieving extensive public involvement and a good quality of responses from the public. These are broad publication, flexibility and timeliness and ease of participation.

Recommendations on transparency and air quality information

In several countries (notably France, Italy and Spain) our national experts complained that when they contacted the authorities they were passed from department to department and/or were told to contact persons whom they found very difficult to get hold of. It is possible that the average member of the public would have given up when faced with these difficulties. ***Authorities in the Member States must, as required by the new Access to Information Directive 2003/4, put in place dedicated information officers to assist the public find the information they need.***

One criticism that was frequently heard from stakeholders, especially the NGOs, was that the air quality information provided was too complicated for the lay person to understand. All of the Daughter Directives require that information on pollutants is provided to the public in a clear and comprehensive manner. In order to comply with these requirements, many of the countries have introduced colour-coded systems of indicating where the level of a *specific* pollutant is extremely high, normal or very low.

Three of the countries analysed, Belgium, France and the UK, have introduced *composite* indexes in which they roll together several of the main pollutants and then provide a colour-coded indication of pollution levels. This approach was easy to understand by the general public, and a number of respondents to the Task 3.3 survey noted that a ***common European air pollution index (i.e., colour-coded and composite) would make it much easier for the average citizen to get comprehensible information on pollutant levels in whichever Member State they happened to be***.

Recommendations on public consultations

When the aim of the consultation is to hear the opinions of as many members of the public as possible, ***consultation organisers should take steps to ensure that the consultation is well publicised, and to make sure that the consultation documents are user-friendly.*** They should explain difficult topics in simple language and – if possible – contain standard reply-forms to facilitate responses.

8. Stakeholder Views on Emissions from Transport

Although the case studies did not look specifically at efforts to address emissions from transport, except in the case of high-emitting vehicles, this is one area where the stakeholders polled in the Task 3.3 survey offered their views.

Most of the interviewees noted that the current EU approach towards limiting emissions from motor vehicles via use of product standards was not sufficient. Though the Euro-standards for cars and fuel quality standards were considered to have been very effective at reducing emissions from motor vehicles, the gains had been consistently offset by increases in overall motor vehicle traffic. In particular, there is a need to reverse the current trend towards more use of road transport rather than rail, for shipments over land.

Shipping and aviation emissions were singled out as being among the last major sources of emissions still not regulated under EU law, and here EU action was considered appropriate. The Swedish use of differentiated port fees is worth looking at in more detail. Moreover, because of international competitiveness concerns, it was recognised that international action through the IMO or ICAO was needed, and some respondents thought that the EU should take a more aggressive leadership role towards that end.

During the interviews, we found significant support for a system of road fees, particularly for heavy duty and light duty vehicles. The Swiss system of road charging for freight was considered particularly interesting, in that it differentiates among types of vehicles depending on their age, level of emissions, and other factors. London's system of road charges was also noted as a good local model. While the use of charges and fees to control road use was widely supported, at the same time it was considered best applied at national or local level. Many survey respondents also called for further local action to address transport-related pollution, and for the EU to consider how to promote best practice at local level.

Recommendations

Explore use of (economic) incentives to reduce the truck transport through Europe and provide incentive for more use of rail.

Facilitate an EU-wide road charging system by setting in place a common legal framework while letting the Member States decide how much to charge. The suggestion here is to develop a harmonized structure for road charging systems throughout the EU, but to leave it up to the national and local governments to decide how much road traffic was acceptable and to charge for road use at the rates that would achieve the desired levels of traffic for that locality.

Set up a programme to promote best practice in local and regional initiatives to manage road traffic, including funding for pilot measures and technologies.

9. Conclusions

The policy comparison between the EU and the US has proved valuable. While this review has focused on conclusions for EU air quality (AQ) management policy, there are clearly lessons to be learned on both sides.

The EU-15 has succeeded in dramatically reducing emissions of SO_2 and NO_x since 1980, and has achieved greater reductions in terms of both overall quantities of emissions and emissions per unit of GDP than the US. Moreover, EU air pollution policies appear to have had strong net economic benefits and to have had no adverse effects on EU global competitiveness. Nonetheless, more emission reductions will be required to protect human health and the environment, in particular in zones in exceedence of AQLVs plus margin of tolerance and for sensitive ecosystems where sulphate or nitrate deposition levels remain high.

The US AQ management system has more powerful tools for focusing attention on the areas with the most severe air quality problems, integrating emission reduction measures with plans for managing air quality, and addressing regional (multi-state) air pollution problems through implementation of joint mitigation strategies, e.g., for ozone formation. On the other hand, the EU has pioneered the critical load approach for addressing region-specific problems via the setting of national emission ceilings for cost-effective distribution of the emissions reduction burden among the MS.

The EU will face a series of challenges in developing policies to achieve further emissions reductions, but opportunities for progress are available. For example, though the EU has achieved lower total EU transport-related NOx emissions as well as NOx emissions per unit of travel for road vehicles (kt/km/vehicle) than those in the US, there nonetheless appears to be considerable room and need for the EU to cut NO_x emissions in the transport sector.

The success of the US – and some European countries – in achieving cost-effective reductions using economic instruments indicates that these approaches deserve broad use. Moreover, it should be possible to enhance some of the positive interrelationships between different policy instruments for air quality protection, and to pay greater attention to opportunities for further policy integration, as underlined in the Cardiff process. In this context, several core recommendations emerge from this study.

- ***More regular and consistent ex-post and ex-ante evaluations of air pollution policies and instruments are needed***. Such studies should include economic evaluation, health impact assessment, and ecosystem assessment. Comparisons across EU countries and with other systems will also prove valuable. Broad discussion of evaluation results is also needed.
- Though our case study focused on measures to reduce pollution from high-emitting vehicles, it is clear that a broader ***EU strategy to address transport and environment is needed***. This strategy should provide room for national and local governments to play a leading role developing innovative solutions and for strong public participation since the measures will directly affect EU citizens.
- The planning requirements under the AQFD should be further strengthened to ***make AQ management planning mandatory for all zones and agglomerations,*** whether in compliance with AQLVs or not, and by setting in place ***more stringent planning requirements for non-compliant zones.***
- The ***AQFD and the NEC Directive should be interlinked*** by requiring that national emission reduction plans demonstrate how they will facilitate the attainment of AQLVs in zones with air quality problems, and conversely by supporting the AQ planning process with modelling tools to track how national (and EU-level) emissions reductions measures will affect the background pollution levels forming part of the local air quality problem.
- Finally, given the regional nature of outstanding problems, the EU should explore how to ***organise regional air quality management***, including establishing cross-border organisations when appropriate, ***with a view to applying market-based mechanisms*** for reducing polluting emissions within the target region.
