COMMISSION OF THE EUROPEAN COMMUNITIES

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97/0266 (SYN)

Proposal for a

COUNCIL DIRECTIVE

relating to limit values for sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air

(presented by the Commission)

EXPLANATORY MEMORANDUM

1. INTRODUCTION

Council Directive 96/62/EC of 27 September 1996[1] on ambient air quality assessment and management (the Air Quality Framework Directive) provides the framework for future EC legislation on air quality. The four objectives of the Directive are to:

- define and establish objectives for ambient air pollution in the Community designed to avoid, prevent and reduce harmful effects on human health and the environment as a whole;

- assess ambient air quality in Member States on the basis of common methods and criteria;

- obtain adequate information on ambient air quality and ensure that it is made available to the public *inter alia* by means of alert thresholds;

- maintain ambient air quality where it is good and improve it in other cases.

Annex I of the Air Quality Framework Directive lists sulphur dioxide, nitrogen dioxide, particulate matter and lead as the first priorities for action. The present proposals include limit values including target dates for attainment for these pollutants; fill in the details of requirements for assessment of concentrations, and provide for the dissemination of information about the pollutants to the public. The proposed Directive is only part of an integrated package of measures designed to combat problems of air pollution. Further proposals are now being developed for benzene, carbon monoxide and ozone, together with a strategy for reducing emissions of precursors of ozone.

2. REQUIREMENTS OF THE AIR QUALITY FRAMEWORK DIRECTIVE

Article 4 of the Air Quality Framework Directive requires that daughter legislation on sulphur dioxide, nitrogen dioxide, particulate matter and lead should include provisions:

- setting limit values, including the attainment dates by which they should be met;

- setting any temporary margins of tolerance during the period between the coming into force of the Directive and the attainment date for the limit value;

- setting alert thresholds if appropriate and listing details to be supplied to the public if an alert threshold is exceeded;

- setting out criteria and techniques for measurement;

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[1] OJ L 296, 21.11.1996, p. 55.

- setting out criteria for the use of other techniques for assessing ambient air quality, particularly modelling;

- defining upper and lower assessment thresholds for the determination of the assessment requirements applicable in an agglomeration[2] or other zone. These terms are used in the present proposal to mean the levels referred to in Articles 6(3) and 6(4) of the Air Quality Framework Directive which determine the overall framework for air quality assessment.

3. PREPARATORY WORK FOR THE PROPOSALS

3.1. Technical aspects

The Air Quality Framework Directive requires that daughter legislation be based on strong technical and scientific grounds. Accordingly a technical working group was set up for each pollutant, consisting of experts from Member States, industry, NGOs, the European Environment Agency, the World Health Organization and other representatives of international scientific groups and the Commission. Their tasks were to assess the current state of knowledge and to prepare technical position papers on each pollutant. The Working Groups on nitrogen dioxide, particulate matter and lead were chaired by experts from Member States. The Working Group on sulphur dioxide was chaired by the Commission.

3.2. Economic aspects

A separate consultancy study 'Economic evaluation of air quality targets for sulphur dioxide, nitrogen dioxide, fine and suspended particulate matter and lead' was undertaken to provide information on costs and benefits of meeting limit values. Its purpose was to determine whether additional action would be needed beyond that already planned in order to meet proposed limit values and if so, to estimate the costs using the most cost effective solutions and to assess the additional benefits which could be expected from meeting the limit values.

Implementing the proposals requires the use of some valuable inputs that could be used to produce other things. In this study the valuation of these inputs (such as capital, labour, materials and energy) is based on their market price. These market prices reflect the opportunity costs (that is the value of the input in its best alternative use) of these inputs.

One should realize, however, that even if the benefits of the strategy exceed the costs that this does not necessarily imply that the policy should be implemented, If there are constraints on financial resources the same amount of money spent on abatement costs could perhaps be spend on another policy with higher net benefits. When comparing the costs and benefits care is essential since costs are usually expressed in terms of financial expenditures whereas the benefits are usually expressed in terms of welfare gains and not necessarily in terms of financial gains.

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2 Defined by the Air Quality Framework Directive as 'a zone with a population concentration in excess of 250 000 inhabitants or, where the population is 250 000 or less, a population density per km^2 which for the Member States justifies the need for air quality to be assessed and managed'.

The study took a top-down approach, assessing air quality at regional level and focusing in to city level for those cities for which air quality information was available. The main merits of a top-down approach are its practical feasibility and consistency; its disadvantage is that is not used in the process of scaling down specific local information. Therefore, the detailed city-level results should be regarded as indicators of the scale and type of likely problems, but do not take into account local plans which might alter the outcome.

As a starting point, reference scenarios were determined for each pollutant, taking into account existing national, EC and international legislation, together with proposals adopted by the Commission up to the end of 1996. They are described in Annex I and the consultancy report (Second Interim Report).

3.2.1. *Quantification of benefits*

Where possible benefits were quantified in monetary terms to help indicate the different scales of impact which may be gained by meeting new limit values for the different pollutants. Clearly it is not possible to quantify all benefits. Reduced damage to eco-systems and to cultural heritage are examples. Some impacts on health, such as increased medicine use can be assigned a monetary value. Others cannot.

Mortality impacts are particularly difficult to assess. The present study employed the technique known as valuation of a statistical life (VOSL). This technique assesses the willingness-to-pay of individuals to reduce the risk of mortality. The result is an indicator of the importance which people attach to different types of risk, not an assessment of how valuable life is.

Willingness-to-pay estimates are derived from three types of studies: (1) wage-risk studies (reflecting wage differences between more and less risky jobs); (2) survey techniques (asking people for their willingness-to-pay to reduce certain risks); (3) market studies (analysing actual expenses that people incur to increase safety such as buying air bags). The average VOSL using these techniques has been estimated at ECU 2.6 to 4.2 million per case reflecting the average of a wide range of studies. In a recent survey the lowest estimate was ECU 0.36 million and the highest almost ECU 10 million. The DG XII research programme 'Green Accounting in Europe' uses ECU 2.8 million as average.

The choice of a value for a particular study is difficult. Although speculation is possible on the relation between age and willingness-to-pay to reduce the risk of mortality there is no convincing evidence in the literature. The lower estimates for VOSL are however likely to be appropriate in those cases where the reduction in life expectancy attributable to exposure is small. This will often be the case for example, where preexisting chronic respiratory or cardiac disease is a factor in death.

The present study considered impacts on mortality from long-term exposure to pollution (often called chronic mortality) and impacts on mortality from short-term exposure to peaks of pollution (often called acute mortality). Studies of "chronic mortality" enable estimates to be made of the extent to which life expectancy is shortened. Each case was valued at the average value described above of ECU 2.6 to 4.2 million. Studies of "acute mortality" typically look at associations between daily variations in pollution and daily death rates. It is impossible to estimate from these studies the extent to which life expectancy is reduced due to exposure. Two cases were therefore evaluated in order to test the sensitivity of results across the range of possibilities: the low estimate does not assign a value to "acute mortality"; the high estimate assigns the full VOSL[3] to all cases.

A further issue that arises in choice of values is whether valuation should be adjusted to income, living standards and the like. Within the Community one single value is employed since there is no evidence that values vary systematically across countries.

The valuations used in this study were those used in major recent research programmes such as the ExternE[4] project carried out for the Commission, the results of which were also fed into development of the proposed Council Directive on sulphur in liquid fuels.

3.3. Limit values

The recital to the Air Quality Framework Directive notes that the numerical concentrations included in limit values and alert thresholds should be based on the work of international scientific groups active in the field. Following the commitment in the fifth action plan of 1992 that future legislation on air quality would be based on World Health Organization Air Quality Guidelines for Europe[5], the Commission signed a Common Agreement with the World Health Organization's Regional Office for Europe to work cooperatively on air quality and in particular on revision of the Guidelines. Updated Air Quality Guidelines for Europe were adopted by WHO in October 1996. They will be published during 1997[6]. All relevant working documents were made available to the four Working Groups during the updating process, and experts from the WHO European Centre for Environment and Health participated in the Working Groups referred to in Section 3.1 above.

All proposed limit values in the present Directive are based on the work of WHO. Under the Commission's proposals new limit values for SO_2, NO_2, and lead will replace existing limit values for these substances. For particulate matter new limit values for PM_{10}[7] will replace existing limit values for suspended particulate matter (SPM). Annex I of the Air Quality Framework Directive lists both 'fine particulate matter including PM_{10}' and 'suspended particulate matter' as priorities for study. This dual reference reflects the fact that particulate matter is not a single pollutant. It is a complex mixture. Any method of measuring it provides an indicator of some aspects of the mixture. The two methods of measuring SPM under existing legislation (the Black Smoke Method and the Total Suspended Particulate Method) formerly provided the best indicators available. The scientific consensus is that more recently developed methods, including the PM_{10} method, are better indicators of the particulate mix as it affects human health.

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3 IVM (1997) Economic Evaluation of Air Quality Targets for Sulphur Dioxide, Nitrogen Dioxide, Fine and Suspended Particulate Matter and Lead. EC DG XI, Amsterdam, Vrije Universiteit.

4 ETSU (eds) (1995) ExternE, Externalities of Energy, Vol. 1, Summary, European Commission, DG XII, Brussels.

5 Ref: ...

6 Ref for WHO Guidelines.

7 PM_{10} is defined as the mass of particulate matter with an aerodynamic diameter of 10 microns or less. The term is therefore specific to a particular method of measuring particulate matter.

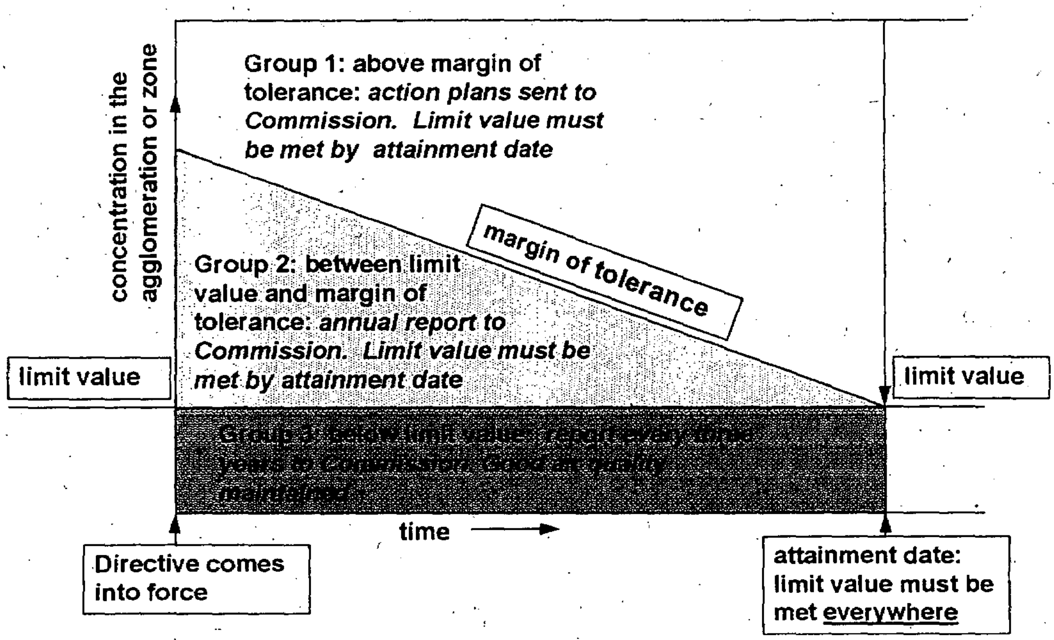
3.4. Margins of tolerance

Article 4 of the Air Quality Framework Directive enables margins of tolerance to be set in relation to a limit value and its attainment date. Despite its name, the margin of tolerance is not a temporary limit value in the sense of a level of pollution which must not be exceeded. It is a trigger level for certain types of action in the period leading to the attainment date.

A margin of tolerance, if set, is a concentration which is higher than the limit value when legislation comes into force. It decreases to meet the limit value by the attainment date. It identifies the agglomerations and other zones where current air quality is worst. These are the areas which are most likely to have to take action beyond that entailed in current legislation in order to meet the limit value on time. Detailed action plans must be prepared for these areas (Group 1 in Figure 1 below) showing how the limit value will be met. Action plans must be made available to the public and sent to the Commission, which will monitor progress.

Agglomerations and other zones where pollution levels are between the limit value and the margin of tolerance (Group 2 in Figure 1) must report annually to the Commission. They are not required to forward detailed plans but any necessary steps must be taken to ensure that the limit value is met by the attainment date.

Figure 1: effect of margins of tolerance



Member States' obligation, whether or not a margin of tolerance is set, is to see that the limit value is met everywhere by the attainment date. A margin of tolerance therefore need have no direct effect on the rate at which pollution levels are reduced. The effect if no margin of tolerance were set would be to oblige Group 2 in Figure 1 to provide detailed action plans. This is wasteful of valuable effort if the limit value will be easily met on current trends.

3.5. Alert thresholds and public information

Article 2 of the Air Quality Framework Directive defines an alert threshold as a level of pollution beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken by Member States. Article 4 recognizes that it may not be appropriate to set alert thresholds for all pollutants. The present proposals include an alert threshold for SO_2 only. This alert threshold is based on results from experiments in which asthmatic patients were exposed to SO_2 whilst exercising and is targeted at this sensitive sector of the population. Although relatively short term exposures to NO_2 and particulate matter are associated with adverse effects, there are no clear thresholds for particular effects of significance on which alert thresholds can be based. In the case of lead, effects on human health at concentrations likely to be found in ambient air are associated solely with long-term exposure.

Article 1 of the Air Quality Framework Directive envisages alert thresholds as only one element of public information strategies. The present proposals make clear that information about sulphur dioxide, nitrogen dioxide, particulate matter and lead should be regularly and actively supplied to the public, and that this information should identify when the concentrations incorporated into limit values have been exceeded.

3.6. Air quality assessment

3.6.1. Assessment methods

Air quality assessment is the term used in the Air Quality Framework Directive to cover all methods of obtaining information about air quality, including measurement, the compilation of emission inventories and air quality modelling. Previous Directives setting air quality limit values have included harmonised requirements only for measurement. However, even a relatively dense network of monitoring stations cannot represent fully the quality of the air over a large zone, particularly a complex urban area. Firstly, each station may be representative of only a small surrounding area. Furthermore, measurement alone is not sufficient to relate concentrations to sources of emissions nor to allow the likely results of actions to be predicted. These steps are an essential part of successful air quality management. Article 6 of the Air Quality Framework Directive therefore provides for the use of all appropriate tools for assessing air quality.

3.6.2. Requirements in agglomerations and other zones

Article 6 of the Air Quality Framework Directive identifies two levels of pollution, which are used to relate the intensity of assessment requirements for an agglomeration or other zone to the risk that a limit value might be exceeded. The current proposal refers to these two levels as the upper and lower assessment thresholds. Table 1 summarizes the requirements of Article 6.

Table 1: Air quality assessment and pollution levels

Maximum pollution level in agglomeration or zone	Assessment Requirements
1. greater than upper assessment threshold	High quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.
2. less than upper assessment threshold but greater than lower assessment threshold	Measurement is mandatory, but fewer measurements may be needed, or less intensive methods may be used, provided that measurement data are supplemented by reliable information from other sources
3. less than lower assessment threshold	
a. In agglomerations only for pollutants for which an alert threshold has been set:	At least one measuring site is required per agglomeration, combined with modelling, objective estimation, indicative measurements[8]
b. In non-agglomeration zones for all pollutants and in all types of zone for pollutants for which no alert threshold	Modelling, objective estimation, and indicative measurements alone are sufficient.

In developing proposals for upper and lower assessment thresholds the Commission's aim has been:

- to ensure that the most intensive assessment requirements apply in those agglomerations and other zones within which there is the highest risk of a limit value being exceeded.
- to ensure that the least intensive requirements apply only where pollution levels are sufficiently low that there is virtually no risk of an exceedance. If an alert threshold has been set for a pollutants measurements must be made within agglomerations even at these low pollution levels.

Proposed values for the upper and lower assessment thresholds have been derived by looking at the interannual variability of measured concentrations in Member States for which long series of data are available, taking into account any trend in pollution. Upper assessment thresholds are set at twice the standard deviation of annual values for the limit value in question. Lower assessment thresholds are set at three times the standard deviation.

8 Indicative measurements are measurements using simple methods, or carried out for a restricted time. They are less accurate than continuous high quality measurement but can be used to explore air quality as a check where pollution levels are relatively low, and to supplement high quality measurement in other areas.

3.6.3. *Numbers of measurement stations and use of other assessment methods*

The Commission's proposals provide criteria for calculating minimum numbers of measurement stations for agglomerations and other zones in which measurement is mandatory, if measurement is the only source of reported data. Member States will classify the stations according to the scheme set out in the Council Decision on Exchange of Information of 27 January 1997[9], which will provide a measure of comparability between different zones. The extent to which measurements are representative of air quality may however still be difficult to ascertain if no further information is provided.

Member States will often undertake a more comprehensive analysis of air quality within an area, involving other tools such as indicative measurements and air quality modelling. Where a comprehensive picture is generated, the number and siting of permanent measurement stations should be sufficient, with the additional information, to give confidence in the quality of the total package. Depending on the local situation more or fewer stations may be required than in the default case. Member States will be required to compile information to support decisions on network design. This strategy has the potential to provide a much better picture of pollution levels throughout the Community than reliance on measurement alone. It will however require care and cooperation during implementation to ensure consistency of implementation. As a first step, the Commission has worked with the European Environment Agency and other experts to develop guidance for Member States on how to undertake air quality assessment for a number of purposes, including the siting of permanent measurement stations[10]. It is anticipated that further guidance will be developed as experience grows. Article 12 of the Air Quality Framework Directive also provides for requirements for assessment and data reporting to be updated if necessary as techniques develop.

3.6.4. *Uncertainty*

All methods of air quality assessment, including measurement, are subject to uncertainty. Some of the uncertainties associated with measurement can be reduced by good quality assurance programmes as required by the Air Quality Framework Directive. The present proposals include rigorous data quality objectives - the precision and accuracy which should be achieved - for measurement and for other assessment methods for sulphur dioxide, nitrogen dioxide particulate matter and lead.

4. SULPHUR DIOXIDE

4.1. Background

Sulphur is naturally present in coal and liquid petroleum products, the sulphur being derived from the proteins present in the tissues of the plants and other organisms from which coal and oil are formed. When coal and liquid petroleum products are burnt in power stations, industry, domestic heating appliances, internal combustion engines etc., the sulphur is oxidized to sulphur dioxide and, in the absence of suitable

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9 OJ L 35 5.2.1997, p. 14.

10 Guidance on assessment of air quality: under development - to be available from the Commission.

abatement measures, released to the atmosphere. Sulphur is also present in some metallic ores and is emitted when they are smelted. Sulphur dioxide is directly toxic to humans and plants. Sulphur dioxide is one of the principal pollutants (the others being nitrogen oxides and ammonia) which cause acidification. In addition, sulphur dioxide together with these other pollutants contributes to the formation of small, suspended, atmospheric particles which are now recognized to have a significant impact upon human health.

SO_2 and its oxidation products are removed from the atmosphere by wet and dry deposition. In spite of these processes of transformation and removal, sulphur dioxide and its products can be transported over large distances, causing transboundary as well as local pollution.

Emissions of sulphur dioxide have declined substantially over the last twenty years and will continue to decline. The object of this Directive with respect to sulphur dioxide is to reduce the remaining risk direct damage to human health and the environment from exposure to sulphur dioxide in ambient air. Reductions in emissions of sulphur dioxide to meet the proposed limit value will also contribute to meeting the limit values for particulate matter which form part of this proposal.

4.2. Existing legislation

Council Directive 80/779/EEC of July 15, 1980 on Air Quality Limit Values and Guide Values for Sulphur Dioxide and Suspended Particulates[11] and its amendment Directive 89/427/EEC[12] were adopted to protect human health and the environment against adverse effects from SO_2 and Suspended Particulates.

For this purpose, the Directive lays down limit values for SO_2 and Suspended Particulates which are mandatory throughout the territory of Member States. These limit values are linked - that is, permitted concentrations of SO_2 depend on the simultaneous concentration of particulate matter and vice versa. The Directive also sets long term guide values.

Member States are required to measure SO_2 and particulate matter, to ensure that the limit values are met and in the long run, meet the guide values and to inform the Commission of any breaches of the limit value(s) and to undertake any necessary abatement measures.

4.3. Sources of SO_2

The largest single source of emissions of SO_2 within the Community at present is power generation (around 50%)[13], with the industrial sector in second place. Emissions from large sources such as power stations are normally dispersed through high stacks. Whilst they are at present important contributors to problems of long-range transport they are relatively unlikely to cause local exceedances of health-based limit values. Smaller industrial sources, and in some regions, coal-fired domestic heating are more likely causes of present-day local exceedances.

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11 OJ L 229, 30.8.1980, pp. 30-48.

12 OJ L 201, 14.7.1989.

13 Source: CORINAIR 90 ....

4.4. Trends in emissions and in air quality

Emissions of SO_2 have declined markedly over the last twenty years. Air quality has improved as a result. The two figures below show results from the database (APIS) built up under the Council Decision on Exchange of Information.

Figure 2: Annual average concentrations of sulphur dioxide in Member States

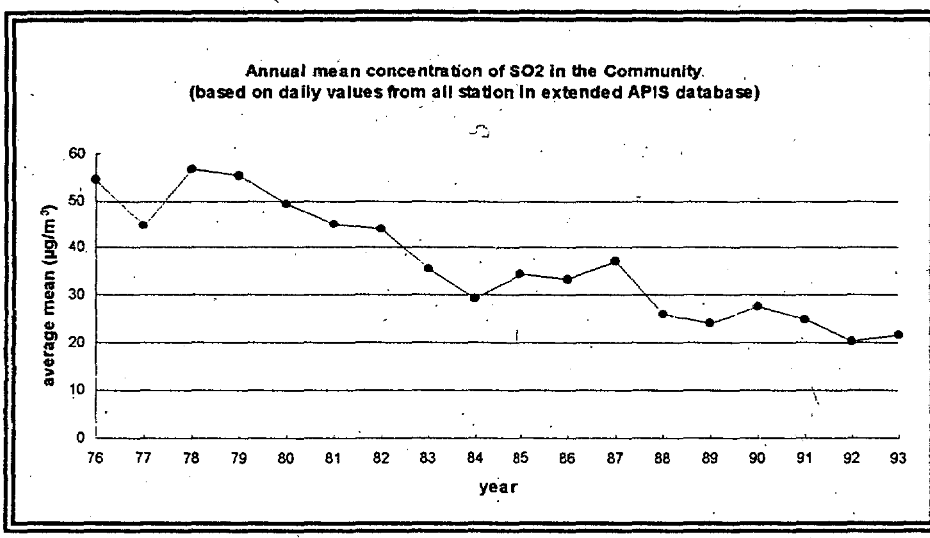
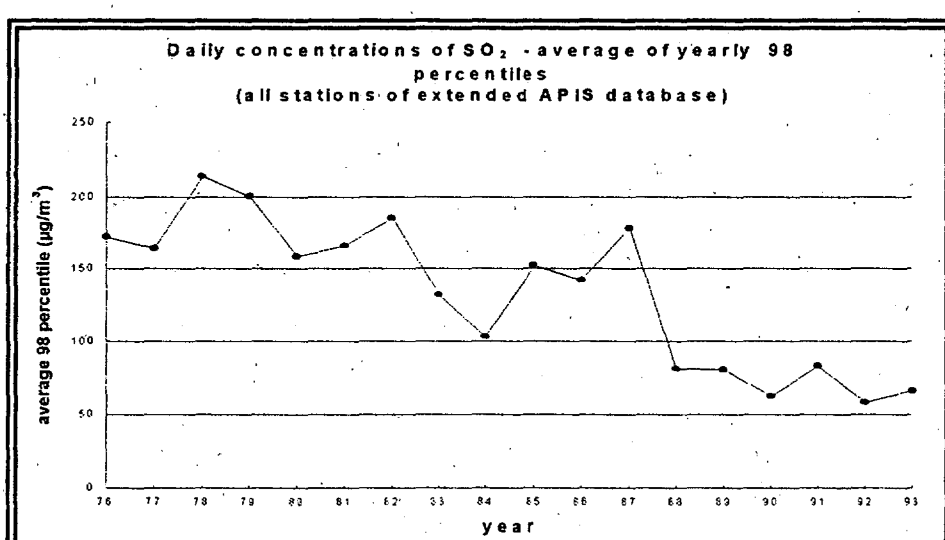


Figure 3: Average 98th percentile of daily values in Member States



Peak concentrations can be much higher. Hourly maxima of over 1000 $\mu g/m^3$ were recorded in several Member States in 1993 and 1994.

The downward trend will continue, particularly in the case of large stationary sources. Measures such as the existing Large Combustion Plants Directive, the IPPC Directive, proposals to combat acidification within the Community and commitments entered into by Member States and others in the framework of the UN-ECE will result in further substantial reductions in the period to 2010. Table 2 shows the projected decline in emissions according to the reference scenario.

Table 2: Expected trends in emissions of SO2 (kilotons)

Country	1990	2010
Austria	90	57
Belgium	317	215
Denmark	180	71
Finland	260	116
France	1 298	691
Germany	5 331	740
Greece	510	361
Ireland	178	155
Italy	1 687	847
Luxembourg	14	4
Netherlands	205	56
Portugal	283	194
Spain	2 266	1 035
Sweden	136	97
UK	3 752	980
EC15	**16 497**	**5 619**

4.5. Impact of sulphur dioxide on human health and the environment

4.5.1. Damage to human health

Sulphur dioxide is directly toxic to humans. It acts upon the mucous membranes of the mouth, nose and lungs and its main impact is on respiratory function. Asthmatics are particularly sensitive. Sulphur dioxide can, through its impact upon respiratory function, also aggravate cardiovascular conditions. In addition, there is evidence of indirect effects due to the formation of small acidic particles resulting from the interaction of oxides of sulphur with other pollutants and small water droplets. These small particles are associated with further effects on public health, including respiratory and cardiovascular problems among vulnerable sectors of the population.

Historically sulphur dioxide and particulate matter derived from the combustion of fossil fuels were the main components of air pollution in many parts of the Community. They were dealt with collectively, drawing on epidemiological studies done several decades ago in areas which were then heavily polluted, such as London. In its latest revision to the Air Quality Guidelines for Europe, the World Health Organization has drawn on more recent work to derive guidelines for sulphur dioxide alone whether or not accompanied by high concentrations of particulate matter. Despite the notable progress of recent decades a significant proportion of the inhabitants of towns and cities in the Community are presently exposed to concentrations of sulphur dioxide exceeding the WHO 1996 annual guideline for human health protection (50µg/m^3). Exposure will reduce as emissions continue to decline (see Table 2 above).

Table 3: WHO Guidelines (1996) for SO_2: human health

Averaging period	Concentrations (µg/m^3)
10 minutes	**500**
24 hours	**125**
one year	**50**

4.5.2. Damage to vegetation

Declining emissions have reduced the importance of SO_2 as a phytotoxic pollutant relative to other pollutants such as ozone and nitrogen compounds. Nevertheless it still plays a role in damage, particularly in combination with other stresses such as cold. Potential effects include the degradation of chlorophyll, reduced photosynthesis, raised respiration rates, and changes in protein metabolism. The sensitivity of different types of plants varies considerably, with lichens the most susceptible.

The 1996 WHO Air Quality Guidelines for Europe include a range of values for different degrees of protection of vegetation from exposure to gaseous SO_2. They are based on the critical levels for SO_2 developed within the framework of the United Nations Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution.

Target Affected	Annual and winter mean value (µg/m^3)
Crops	**30**
Forests / Natural. Vegetation.	**20**
Sensitive forests / Natural. Vegetation.	**15**
Lichens	**10**

4.5.3. Damage to buildings, materials and cultural heritage

Sulphur dioxide accelerates the natural weathering and corrosion of buildings and building materials. It is the most important pollutant in determining the rate of deterioration of a number of materials, including stonework. The old buildings and monuments which form part of Europe's rich cultural heritage are especially susceptible to attack.

4.5.4. The damage costs of sulphur dioxide pollution

A number of studies[14, 15] have been carried out on the costs of sulphur dioxide and other acidifying emissions. In general, these studies provided relatively good estimates of the economic cost of the impact on human health, buildings and building materials. However, the damage to the structure and functioning of ecosystems and in particular to biodiversity have not been quantified. While the impact of SO_2 emissions varies from region to region in relation to the population which is exposed and the sensitivity of the environment, it is estimated that, on average, the economic cost of the damage resulting from 1 tonne of SO_2 emissions in the Community is approximately ECU 4 000: the major part (80+ %) of these costs is attributable to damage to human health.

4.6. The Commission's proposals

4.6.1. Protection of human health

The present proposals will set two limit values for the protection of human health, based on WHO 1996 Air Quality guidelines.

	Averaging period	**Limit value**	**Margin of tolerance**	**Date by which limit value is to be met**
1. hourly limit value for the protection of human health	1 hour	350µg/m³ not to be exceeded more than 24 times per calendar year	150µg/m³ (43%) on entry into force of the Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 2005.	1 January 2005
2. daily limit value for the protection of human health	24 hours	125µg/m³ not to be exceeded more than 3 times per calendar year	none	1 January 2005

14 Case Study 2: Benefits of an Acidification Strategy for the Community. ExternE Project. European Commission, DG XII, JOULE programme.

15 Cost Benefit Analyses of the Different Municipal Solid Waste Management Systems. Objectives and Instruments for the year 2000. Carried out for DG XI by Coopers and Lybrand, Final Report 1996.

Hourly limit value

WHO 1996 Guidelines for SO_2 include a concentration of 500 µg/m³ averaged over ten minutes. This is derived from experiments on asthmatic subjects undertaking exercise. It is not practical to assess and manage air quality over ten-minute periods. The Commission considers nevertheless that risks from short-term exposure to high peaks of SO_2 should be guarded against and is proposing an hourly limit value which has been developed from the WHO Guideline.

The relationship between short peak concentrations and hourly averages varies from place to place according to the nature of local sources. There is therefore no single factor that can be applied to the ten-minute Guideline to produce an hourly value which would be equivalent at all possible sites. The proposed hourly limit value of 350 µg/m³ has been derived from data provided by Member States on short-term peaks in industrial areas as one which should provide a good degree of protection in such locations. Under the Commission's proposals Member States will report data on ten-minute concentrations alongside hourly concentrations in order to enable the effectiveness of the hourly limit value to be checked.

In principal it is undesirable to allow any exceedances of health based guidelines. However it has been found that in practice it is not possible to base compliance regimes and management plans for limit values with short averaging times on maximum measured values. The maximum few values in a year are highly variable from year to year because of weather conditions. They are bad indicators of trends and not susceptible to management steps. It is therefore normal to define short period limit values either as percentiles or as concentrations with a certain number of exceedances allowed in a given time before an area is deemed out of compliance. It is proposed that the hourly limit value should not be exceeded for more than 24 hours out of 8 760 in a calendar year. It should be noted that percentiles are not used in these proposals to allow for inevitable measurement inaccuracies. These are dealt with by the definition of data quality objectives and the setting up of rigorous quality assurance programmes to minimize error and to weed out incorrect and unrepresentative data.

24-hour limit value

The Commission proposes to incorporate the WHO 1996 Guideline for 24-hour exposure into a limit value of 125 µg/m³, not to be exceeded on more than three days out of 365 per calendar year.

Examination of data from Member States[16] shows that if this 24-hour limit value is met, annual average concentrations will be well below the WHO Guideline for annual exposure of 50 µg/m³. A separate annual limit value is therefore unnecessary.

16 See consultancy study 'Economic evaluation of air quality targets for sulphur dioxide, nitrogen dioxide, fine and suspended particulate matter and lead.' Second Interim Report, April 1997, Institute for Environmental Studies, Amsterdam.

Ongoing research

In deriving revised guidelines WHO examined results from a number of recent epidemiological studies which looked at associations between daily concentrations of SO_2 and health outcomes, including hospital admissions and daily mortality rates. These include the APHEA study financed by the DG XII's ENVIRONMENT and CLIMATE Programme[17]. Associations have been found at concentrations below the WHO 1996 Guidelines. WHO concluded that the data are not yet sufficient to determine whether there is a causal connection, or whether, for example SO_2 is a surrogate for another pollutant or for some other factor. The date of 2005 proposed by the Commission for meeting limit values based on the guidelines and the absence of a margin of tolerance for the 24-hour limit value, take into account the desirability of reducing SO_2 concentrations quickly on precautionary grounds. Research in this area continues to be supported by the ENVIRONMENT and CLIMATE Programme. Under Article 4 of the Air Quality Framework Directive the Commission will keep under review the results of this and other scientific research on the health effects of SO_2 and other pollutants. The present proposals include specific provision for the Commission to report progress on the effects of SO_2 to Council and the European Parliament by 31 December 2003 at the latest.

4.6.2. Protection of ecosystems

A single concentration of 20 $\mu g/m^3$ is proposed, to be measured over two averaging periods: the calendar year and the winter period of October to March. Certain plants, including some forest trees, are most susceptible to damage SO_2 when exposure is combined with the stress of low temperature. The proposed concentration will protect against direct ecotoxic effects in all but the most sensitive species.

It is not feasible to attain these annual and winter limit values within the immediate influence of agglomerations and other built-up areas throughout the Community, even given very substantial reductions in emissions. Compliance will therefore initially be assessed away from such situations, in locations similar to those at which EMEP[18] stations are located. On the basis of data from the EMEP network[19] and from Member States it would appear that the annual limit value is already generally met in such situations. In contrast the winter limit value is at present exceeded in some Member States. In view of the expected further decline in emissions of SO_2 it is proposed that both the annual and winter limit values should be met two years after entry into force of the Directive.

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17 Katsouyanni et al (1997): Short term effects of ambient sulphur dioxide and particulate matter on mortality in 12 European cities: results from time series data from the APHEA project: British Medical Journal Volume 314, 7 June 1997.
See also Journal of Empidemiology and Community Health, April 1996, Vol. 50 Supplement 1

18 EMEP: the Cooperative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe. Set up in support of the requirements of the United Nations Geneva Convention on Long Range Transboundary Air Pollution, 1979.

19 EMEP - MSC/W Report 1/95.

4.6.3. *Costs and environmental benefits of the limit values for SO_2*

The costs and environmental benefits of the proposal have been estimated for the year 2010 for those cities for which air quality data were available. These are the additional costs and benefits compared to the reference scenario which reflects current policy including legislative proposals accepted by the Commission end 1996 (thus excluding the acidification strategy). For SO_2 the database covers 151 cities with 75 million inhabitants. This represents 22% of the population in the Community, and about half the population in cities with more than 75 000 inhabitants.

To meet the proposed limit values in the 151 cities an additional emissions reduction of 10 percent would be needed compared to the reference scenario. This totals around 46 ktons. This is a small additional reduction in Community-wide terms since overall emissions are expected to decline from 16 497 ktons in 1990 to 5619 ktons by 2010 as a result of current policy (reference scenario).

The average estimate of the costs of meeting the proposed limit values in the 151 cities is ECU 21 million per year. The highest estimate ECU 48 million. These estimates do not take into account the recently adopted acidification strategy. The lowest estimate of the costs (ECU 4 million) results if emissions reductions aim at reducing the average concentration in the cities below the limit values proposed. The higher value pertains to the reductions needed to meet the limit value at that location in the cities ("hot spots") which shows the highest exceedance of the proposed limit value. The average cost estimate bases the costs on the average of the emission reduction needed to meet the limit value for the average city concentration and to meet the limit value at the location with the highest exceedance.

The distribution of costs over the Member States for the average estimate for the cities studied is as follows: Austria, Denmark, Finland, Italy, Ireland, Luxembourg, the Netherlands and Sweden would not face additional costs. Costs for Belgium would be ECU 3.9 million, for France ECU 0.4 million, for Greece ECU 2.4 million, for Germany ECU 0.8 million for Portugal ECU 0.6 million, for Spain ECU 8.3 million and for the UK ECU 4.7 million. The costs are due to measures to reduce process emissions form stationary sources and the use of low sulphur fuels. These already low figures represent an overestimate since the reference scenario does not include the significant emission reductions foreseen under the acidification strategy and the Council Directive relating to the Sulphur Content of Liquid Fuels. Taking these into account would reduce the costs of this proposal substantially, with any remaining problem areas most likely to be found in southern Member States.

Because of the absence of air quality data for other cities it is difficult to make a reliable estimate of the costs of meeting standards everywhere in the Community. According to EUROSTAT[20] around 195 million people (of a total Community population of 362 million) live in cities with more than 25 000 inhabitants. On the assumption that the air quality data of the 151 cities are representative for cities with more than 25 000 inhabitants, the annual costs would be a factor of 3 higher and amount to around 60 million ECU/year for the average estimate.

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[20] EUROSTAT digital population database.

The costs of meeting the limit values by 2005 would be higher than those of 2010 in a number of countries since the emissions in 2005 under the reference scenario will be higher than in 2010. Conversely, however, the benefits would also be higher. Due to the lack of data on the impact of current legislation on the emissions in 2005 it was not possible to estimate the (additional) costs of meeting the limit values in 2005.

It is expected that in the cities investigated 18 of the 75 million inhabitants would be at risk of exposure to ambient concentrations exceeding the limit values if no further action were taken beyond current plans. Achieving the proposed limit values would lead to reduced effects on mortality, morbidity, materials damage and damage to ecosystems as well as cultural heritage compared to the reference scenario. Mortality from short-term exposure to peaks of pollution (often called acute mortality) would decrease by around 330-826 cases. Hospital emergency room admissions would come down by some 170-300 cases per year. The proposal would also reduce mortality and respiratory morbidity due to long-term exposure to elevated concentrations of pollution (often called chronic mortality). These effects occur indirectly through the reductions in secondary particulate matter formed as a result of emissions of SO_2. The reduction in mortality from long-term exposure that would result from meeting the limit values has been estimated at 10-60 cases per year. Meeting the limit values in the cities would also lead to improvements outside the cities which have not been quantified. In addition, damage to materials, buildings, crops and ecosystems will be reduced.

A part of the environmental benefits from meeting limit values in the cities studied compared to present air quality (health benefits and materials) has been quantified in monetary terms. The results show that the monetary benefits of the proposed limit values for those cities ranges from ECU 85 to 3 784 million per year. The large range is mainly due to the uncertainty in dose-effect functions and the uncertainty in valuation of mortality due to short term peaks. The monetary benefits are clearly dominated by the mortality impacts which range from ECU 26 to 3723 million/year, of which 26 to 255 relates to mortality from chronic exposure and ECU 0 to 3 468 million to mortality associated with short term peaks. (Section 3.2.1 above explains how these estimates were derived.) Damage to materials is estimated at ECU 58 million whereas morbidity impacts are estimated at only ECU 1 to 2 million per year.

A comparison of the costs and benefits of meeting the proposed limit values needs to be done carefully (see Section 3.2.1). In so far as benefits are quantifiable and bearing in mind the limitations inherent in the estimation, monetary benefits, (ECU 85 to 3 784 million), are expected significantly to exceed the costs (ECU 4 to 48 million) for the cities studied. This conclusion holds under a range of different test cases, including assigning no value to short term mortality and using the lowest estimate for chronic mortality, and taking at the same time the highest estimates of the costs.

4.7. Opinions of affected parties

Meeting the limit values for the protection of human health is considered by Member States to be generally achievable without undue difficulty. A number of Member States are concerned about management aspects of the small numbers of exceedances allowed each year. The highest few measurements per year can be highly variable and unpredictable owing to weather conditions, and therefore unsuitable for assessing trends and progress. Austria would prefer a more stringent hourly limit value.

Member States with dense patterns of urban settlement are concerned that assessment relating to the limit value for protection of ecosystems should be limited to locations outside the immediate influence of urban areas. Industry is concerned that it should also not apply in the vicinity of industrial development.

Industry considers also that 2010 would be a more appropriate attainment date for meeting limit values.

5. NITROGEN DIOXIDE

5.1. Background

There are many different oxides of nitrogen, formed chiefly by the oxidation of nitrogen in the air during combustion. The air pollutant species of most interest from the point of view of human health is nitrogen dioxide (NO_2). It is associated with a number of adverse effects, including increased risk of respiratory infection in children and effects on lung function, particularly in those with pre-existing lung disease. Nitrogen dioxide acts together additively with nitric oxide (NO) to cause damage to vegetation. NO_2 and NO together are known as NO_x.

The air chemistry of NO_2 is complex. In most situations primary emissions from combustion consist predominantly of NO. This then reacts with oxygen or ozone to produce NO_2, the proportion converted depending on atmospheric conditions. Once formed NO_2 can react further in a number of different ways.

Some NO_2 will be removed from the air by dry deposition. Some will eventually be removed as acid deposition. NO_2 is an important precursor of ozone. It is also one of the pollutants which leads to the formation of small suspended atmospheric particles, which are themselves associated with adverse effects on human health.

The object of the present directive with respect to nitrogen dioxide is to reduce damage to human health and the environment from direct exposure to NO_2, and in the case of vegetation from exposure to the combination of NO_2 and NO. Reductions in emissions to meet the proposed limit values will also contribute to meeting the limit values for particulate matter which form part of this Directive, and to meeting separate targets for combating acidification. The Commission intends to bring forward next year a strategy for reducing concentrations of ozone, which will also require reductions in emissions of NO_2.

5.2. Legislation

Council Directive 85/203/EEC of 20 December 1985 on air quality standards for nitrogen dioxide was adopted to protect human health and the environment against adverse effects from exposure to NO_2. It lays down a limit value for NO_2 of 200 $\mu g/m^3$ as the 98th percentile of hourly values recorded throughout a year, not to be exceeded throughout the territory of Member States. The Directive also sets guide values for NO_2, as reference points for special schemes within zones established by Member States. Member States are required to set up measuring stations for NO_2, and to report to the Commission any exceedances of the limit value and the steps that have been taken to deal with them.

There are a number of instruments controlling emissions of NO_x (NO_2 plus NO) from stationary and mobile sources. The Large Combustion Plant Directive has reduced emissions from power generations. Its revision and the IPPC Directive will being about further reductions from stationary sources over the next decade. There is an extensive body of legislation dealing with control of emissions from vehicles. In June 1996, following the completion of the first stage of the Auto-Oil programme the Commission adopted a strategy for further control of vehicles emissions, aimed at meeting air quality targets by 2010.

5.3. Sources of nitrogen dioxide

Within the Community as a whole mobile sources contribute over 60% of emissions of NO_2. Point combustion sources, including power generation and manufacturing combustion take second place at over 30%[21]. The contribution of different source types to ambient concentrations varies from place to place. In general however within urban areas, emissions and therefore exposure are due mainly to road transport. Other sources are important for long-range transport, for exposure of ecosystems and for formation of other pollutants such as ozone and secondary particulate matter.

5.4. Trends in emissions and air concentrations

The most recent international figures show that emissions of oxides of nitrogen decreased by only 3% over the Community as a whole between 1980 and 1993[22]. Within the Community there is wide variability between countries. Emissions have increased substantially in some whilst decreasing in others.

Although no trend in total emissions is discernible, emissions from point sources have declined in many areas because of measures such as the large combustion plant directive. The introduction of catalytic converters and other improvements to vehicle technology means that emissions from this sector are now also decreasing, despite continued growth in transport activity.

Table 4 shows emissions of NOx in Member States during 1990 and projected emissions for 2010 under the reference scenario described in Annex I.

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21 CORINAIR 1990.

22 EMEP.

Table 4: Projected emissions of NOx (thousand tonnes)

Country	1990	2010
Austria	222	116
Belgium	352	196
Denmark	269	119
Finland	300	163
France	1 585	895
Germany	3 071	1 279
Greece	306	282
Ireland	115	73
Italy	2 047	1 160
Luxembourg	23	10
Netherlands	575	140
Portugal	215	206
Spain	1 178	851
Sweden	411	207
UK	2 702	1 244
EC15	13 370	6 921

Trends in ambient concentrations emerge more slowly than trends in emissions. Long series of data are needed, particularly in the case of pollutants such as NO_2 whose air chemistry is complex and dependant on weather conditions. Decreases in urban concentrations can however be seen in Member States such as Austria, Denmark, Germany and Sweden which have made substantial reductions in emissions of NO_x through early introduction of catalyst technologies or other steps. As part of the of the Auto-Oil I programme detailed air quality modelling was carried out for seven European cities to determine the cost-effectiveness of new vehicle and fuel technologies needed to meet air quality targets including targets for NO_2. This showed that substantial reductions in ambient concentrations of NO_2 would be achieved due to legislation already in place and resulted in proposals for legislation which will improve air quality even further.

5.5. Impact of NO_2 on human health and the environment

5.5.1. Damage to human health

Exposure to nitrogen dioxide can bring about reversible effects on lung function and airway responsiveness, particularly in those with pre-existing lung diseases. It may also increase reactivity to natural allergens. The WHO 1996 Guidelines include an hourly concentration of 200 $\mu g/m^3$, derived from chamber studies on these effects using subjects with asthma and chronic obstructive pulmonary disease.

Long-term exposure to NO_2 is associated with increased risk of respiratory infection in children. The quantitative studies which have looked at these effects relate to indoor concentrations, which are high in homes with gas cookers. They cannot be directly extrapolated to outdoor concentrations. The effects are however of concern because repeated lung infections in early life can result in lung damage later in life. Repetitive exposure in animals can produce non-reversible changes in lung structure and metabolism and in susceptibility to infection. WHO have, as a result, adopted a precautionary annual guideline of 40 $\mu g/m^3$.

Table 5: WHO Guidelines (1996) for NO_2: human health

Averaging period	Concentrations ($\mu g/m^3$)
1 hour	**200**
one year	**40**

Present-day exposure above the new guidelines cannot be accurately estimated. There are few data from hotspot situations (relevant to the hourly value) nor on annual concentrations (for which there is no present limit value). A study carried out for WHO on exposure to daily concentrations of NO_2 in 1993 suggested that in urban areas at least 21 million people were exposed to concentrations in excess of the then Guideline (1987) of 150 $\mu g/m^3$. Taking the exposed population only, WHO estimated that 17 000 to 29 000 cases of lower respiratory illnesses (LRI) requiring medical visits could be attributed to these elevated levels of NO_2. If the exposure situation in other urban areas is comparable, 58 000 to 99 000 cases of LRI could be ascribed to high NO_2 levels.

5.5.2. Damage to vegetation

Both NO_2 and NO (together known as NO_x) are absorbed by vegetation. Their effects on plants are additive and the scientific consensus is that they should be treated together. Nitrogen is an essential plant nutrient. Low exposures to NO_x can promote growth. Higher exposures can cause adverse effects including leaf or needle damage and reduced growth. The point at which damage begins to occur depends on the species, on its nutritional state and on other environmental factors. Work within the UN-ECE has resulted in development of a critical level at which the majority of species should be protected. WHO has adopted this critical level as a Guideline.

Table 6: WHO Guidelines (1996) for NO_x: ecotoxic effects

Target Protected	Annual mean value NO + NO_2. ($\mu g/m^3$)
Majority of plant species	**30**

5.5.3. *Damage to buildings, materials and cultural heritage*

Nitrogen oxides have been shown to damage or to accelerate damage to materials. However, whilst the contributions of different pollutants to such damage are difficult to separate from each other, it seems likely that the role of nitrogen oxides is secondary compared to that of other pollutants such as ozone and SO_2.

5.6. The Commission's proposals

5.6.1. *Protection of human health*

The present Directive proposes two limit values to protect human health. The short term limit value will be a concentration of 200 $\mu g/m^3$ averaged over one hour and not to be exceeded during more than 8 out of 8760 hours per calendar year. The long term limit value will be 40 $\mu g/m^3$ averaged over a calendar year

	Averaging period	**Limit value**	**Margin of tolerance**	**Date by which limit value is to be met**
Hourly limit value for the protection of human health	1 hour	200$\mu g/m^3$ NO_2 not to be exceeded more than 8 times per calendar year	50% reducing linearly on 1 January 2001 and every 12 months thereafter to zero by 2010	1 January 2010
Annual limit value for the protection of human health	calendar year	40$\mu g/m^3$ NO_2	50% reducing linearly on 1 January 2001 and every 12 months thereafter to zero by 2010	1 January 2010

5.6.2. *Protection of eco-systems*

Following the work of UNECE and WHO on the additive ecotoxic effects of NO_2 and NO (NO_x), the Directive proposes a joint limit value of 30 $\mu g/m^3$ for the total concentration of the two substances, measured over a calendar year. As in the case of SO_2, compliance with this limit value will initially be assessed away from the immediate influence of agglomerations and other development. The situations to be assessed will therefore be similar to those at EMEP stations. On the basis of data from the EMEP network[23] it is proposed that the limit value should be met two years from entry into force of the Directive.

5.6.3. *Costs and environmental benefits of meeting the limit values for NO_2*

The costs and environmental benefits of the proposal compared to the reference case have been estimated for those cities for which air quality data were available. The database covers 142 cities with 74 million inhabitants.

23 Hjellbrekke A.-G., Schaug J, Skjelmoen J.E: EMEP Data Report 1994.

To meet the proposed limit values in the cities covered an additional emissions reduction of nearly 10 percent would be needed compared to the reference scenario. This totals around 76ktons for all cities covered. This is a small addition to Community wide emissions which are expected to decline from 13,370 ktons in 1990 to 6 921 ktons in 2010 as a result of current policy (reference scenario).

The average estimate of the costs of meeting the limit values in the 142 cities is ECU 80 million per year. The upper estimate of the costs is ECU 285 million. The lower estimate of the cost (ECU 5 million) is obtained if reductions aim at reducing the average concentration in the cities below the proposed limit values. The higher value pertains to the reductions needed to meet the limit value at the location in the city showing the highest exceedance of the proposed limit value. The average estimate bases the costs on the average of these two emission reductions. Owing to the large reductions in emissions from road transport built into the reference scenario as a result of the Auto-Oil I programme, the majority (90%) of the costs for eliminating remaining problems are due to measures to be taken at (low stack) stationary sources. There are also additional costs for road transport in implementing road-pricing schemes and the introduction of LPG/CNG buses. Both these measures also lead to the reduction of other pollutants such as PM_{10}, carbon monoxide and benzene, and of the greenhouse gas carbon dioxide. All costs have been allocated to NO_2 control which implies a small overestimation (less than 5%) of the costs.

The distribution of costs over the Member States for the average estimate for the cities studied is as follows: Belgium, Denmark, Finland, Ireland, Luxembourg, the Netherlands, Sweden and the UK would not face additional costs. Costs for the other countries would be the following: Austria ECU 0.1 million; France ECU 7.3 million, Germany ECU 0.4 million and Portugal ECU 5.0 million. Costs for Greece would be ECU 18.3 million; for Italy ECU 38.2 million; and for Spain ECU 10.9 million. These results were prefigured by the results of the Auto-oil programme. This found that it would not be cost-effective to meet targets similar to the proposed limit values in Athens, Madrid and Milan through application of new vehicle and fuel standards alone. Further local action would be needed. Note that the costs in general represent an overestimate since the reference scenario does not include the significant emission reductions foreseen under the acidification strategy.

Because of the absence of air quality data for other cities it is difficult to make a reliable estimate of the costs of meeting standards everywhere in the Community. If the air quality data of the 142 cities were representative for cities with more than 25 000 inhabitants, the annual costs would be a factor of 3 higher.

The physical and monetary benefits of the proposal compared to current policy (the reference case) have been analysed for the 142 cities. Of the cities investigated 23 million out of the 74 million inhabitants would be at risk of exposure to ambient concentrations exceeding the limit values. Meeting the limit values reduce mortality, morbidity, materials damage and damage to ecosystems as well as damage to cultural heritage compared to the reference case. As a result of the proposed standards short-term mortality would decrease by 140-465 cases a year. Hospital emergency room admissions would drop by up to 496 cases each year. The number of cases of reduced long-term respiratory morbidity of children would be reduced by up to 1 050 cases. The number of restricted activity days would fall by some 600 cases per year. The proposal would also reduce chronic mortality by 157-939 cases as a result of the indirect reduction in secondary (nitrate) particles. Finally, meeting the proposed limit values would lead to positive, but not quantified impacts on materials, crops and vegetation.

As far as possible the health benefits in the cities studied have been quantified in monetary terms since health impacts were expected to be the dominating ones in monetary terms. The analysis suggests that the monetary benefits of the proposed limit values ranges from ECU 408 to 5 900 million per year. Section 3.2.1 above explains how these values are derived. The large range is due to the uncertainty in dose-effect functions and the uncertainty in valuation of mortality due to short term peaks. The monetary benefits are clearly dominated by the mortality impacts which amount to ECU 407 to 5 899 million/year (of which 407 to 3 944 relates to mortality from chronic exposure and ECU 0 to 1955 million to mortality associated with short-term peaks). Morbidity impacts are estimated at ECU 1 million per year. The highest estimates are obtained if the impact on chronic mortality is high and the impacts on acute mortality are valued at a full VOSL.

A comparison of the expected monetary benefits with the costs of meeting the proposed limit values in the cities under study needs to be done carefully (see Section 3.2.1). In so far as benefits are quantifiable and bearing in mind the limitations inherent in the estimation, benefits (ECU 408 to 5 900 million), are expected to exceed the costs (ECU 5 to 285 million). This conclusion is relatively robust. It holds when the lowest estimate is made of benefits (benefits ECU 407 million) and costs are put at the high end of range. This case is overly pessimistic since a number of benefit categories have been ignored (vegetation, materials) and benefits due to reduced impacts on people outside cities (resulting from emission reductions in the cities) have also been excluded.

5.7. Opinions of affected parties

Member States are generally of the opinion that it should be possible to meet hourly limit values to protect human health in most urban areas, largely as a result of new vehicle emission standards and new fuel quality standards. Local action will be required if it is to be met in the busiest streets in urban areas. The study on economic aspects of meeting limit values found that the hourly limit value was the determinant of the need for action when average concentrations in cities were considered. More detailed modelling was not possible. Some Member States consider that additional local action will be needed to meet the proposed annual health based limit value of 40 $\mu g/m^3$ in urban hotspots.

Italy anticipates that both limit values will continue to be exceeded in some Italian cities even if emissions are reduced by a large percentage, because of the atmospheric chemistry of NO_2 under local weather conditions. Spain also anticipates difficulties in some areas.

Member States and industry are concerned that assessment for compliance with the limit value to protect vegetation should be confined to locations outside the immediate influence of urban areas and other development.

6. PARTICULATE MATTER

6.1. Background

Particulate matter (PM) differs fundamentally from the other pollutants dealt with in the present proposal. It is a complex mixture, rather than a single chemical compound, emitted into the air by a wide range of anthropogenic and natural sources. The sizes, other physical characteristics and chemical composition of the particles which these sources emit are very diverse.

Anthropogenic particulate matter falls into two major categories. Primary PM is emitted directly into the atmosphere from combustion of fossil and non-fossil fuels, from a wide variety of non-combustion industrial processes, and from other human activities. Secondary PM is formed in the atmosphere by chemical reactions amongst other pollutants, especially SO_2, NO_2 volatile organic compounds (VOCs) and ammonia. The main natural sources of particles are sea spray and wind blown dust. Particles of all types may be carried great distances and therefore contribute to transboundary pollution.

Until recently, particulate matter was studied and controlled in conjunction with SO_2. Interest centred on industrial and domestic combustion of coal and other sulphur-rich fossil fuels, which can give rise to simultaneous high concentrations of both pollutants. Particulate matter was usually measured by either to the Black Smoke method, which relies on the blackness of particles, or by the Total Suspended Particulate (TSP) method. This collects particles of many sizes including those too large to be inhaled.

In recent years attention has moved to the effects of PM alone, and new methods of measurement have been developed. There are many different possible methods of measuring PM. Each provides an indicator only of the total particulate mix. Black Smoke and TSP were the best indicators available until recently. The newer methods are considered by medical opinion to provide better indicators for future use. The most common is the PM_{10} method, which measures the mass of particles with a diameter of 10 microns or less. These particles are small enough to be inhaled into the lung. A number of the most recent studies have used the $PM_{2.5}$ method, which measures the mass of particles with a diameter of 2.5 microns or less. These are the particles which can penetrate most deeply into the lung. Outdoor particles in these size ranges penetrate easily into the indoor environment.

Neither PM_{10} nor $PM_{2.5}$ is a new pollutant. The particles produced by coal burning lie wholly within the PM_{10} range, with most within the $PM_{2.5}$ fraction. (The Black Smoke method collects particles which are typically 4.5 microns or less in size.) Historic levels of PM_{10} and $PM_{2.5}$ in many urban areas are therefore likely to have been far higher than today's concentrations. However, recent studies using the new indicators have demonstrated consistent associations between changes in daily levels of PM_{10} from diverse sources and adverse effects on human health even at concentrations commonly encountered now within the Community. Studies in the United States have also found associations between concentrations of $PM_{2.5}$ and health outcomes, but there is little information on $PM_{2.5}$ within the Community. Some studies, again in the United States, have suggested that long-term exposure to

PM is associated with reduced life expectancy and with chronic effects on lung function.

6.2. Legislation

Ambient concentrations of particulate matter are presently controlled under Council Directive 80/779/EEC of 15 July 1980 on Air Quality Limit Values and Guide Values for Sulphur Dioxide and Suspended Particulates. It is described in Section 4.2 above. Under the Directive, limit values were set for suspended particulate matter measured according to the Black Smoke or TSP method. The limit values for Suspended Particulates are dependant on the simultaneous concentrations of SO_2.

6.3. Sources of particulate matter

Emission sources of primary anthropogenic particles are similar throughout the Community. The most significant primary sources are traffic, power plants, other combustion sources (industrial and residential), industrial fugitive dust, loading/unloading of bulk goods, mining activities, human-started forest fires and, in some local cases non-combustion sources such as building demolition or construction and quarrying.

Detailed inventories are available for Germany, the Netherlands and the UK. Data from these can be found in the position paper prepared by the Working Group on Particulate Matter[24]. An inventory has also been developed by TNO[25] for the Government of the Netherlands covering primary emissions of PM throughout the Community. The Government of the Netherlands made work in progress on this available to the Commission's consultants on the economic aspects of meeting limit values.

National figures do not reflect the fact that the relative importance of different sources can vary significantly from one area to another. For instance, in the 1990 inventory for the UK, road transport accounted for 25% of primary PM_{10} emissions, while in London road transport accounted for 85% of such emissions. Similarly, the relative importance of sources during episodes can vary from the annual picture. Again in the UK, studies have shown that during winter episodes road traffic may contribute some 75-85% of total PM_{10}. Nationally insignificant sources, such as wood burning, may be locally very important in some places.

Secondary particles are formed from reactions between other pollutants such as SO_2, NO_2, volatile organic compounds and ammonia. They are therefore predominantly man-made in origin. The inventories described above do not include source estimates for secondary particulate matter. Secondary PM has been found to be an important contributor to concentrations of PM in the United States. This is likely also to be the case within the Community, though proportions may be different. The formation of secondary particulate matter will tend to be favoured during the hot summer

24 Available from the Commission.

25 Berdowski, J.M.M., W. Mulder, C. Veldt, A.J.H. Visschedijk and P.Y.J. Zandveld (1997 - forthcoming), Particulate emissions (PM10-PM2.5-PM0.1) in Europe in 1990 and 1993, TNO, Apeldoorn.

conditions which give rise to high concentrations of ozone and as with ozone may occur on a regional scale.

The main natural sources of local airborne PM in the Community are sea-spray and soil resuspension by the wind. In the Mediterranean basin volcanic ash and long-range transport of Saharan dust may be important natural sources. Biogenic particles such as pollens and fungal spores add to the mass, particularly in rural areas.

6.4. Trends in emissions and air concentrations

Ambient levels of PM_{10} have been monitored within the Community in some urban networks since 1990. However, there is no coherent PM_{10} data set since there is no standardized method for monitoring PM_{10} across the Community and there are only a few cities across the Community where monitoring has been carried out for a significant length of time using continuous instruments. There are no good series of $PM_{2.5}$ concentrations.

The Working Group on Particulate Matter has summarized available information on PM_{10} in the Community. Levels vary considerably across the Community and within individual countries from 10 $\mu g/m^3$ in remote areas to above 100 $\mu g/m^3$ as an annual average in some urban industrial areas. There is however a less consistent pattern of concentrations across different types of location than might be expected.

Table 7 shows concentrations found at different types of urban measurement site, as classified by Member States. There is no clear pattern of variation between site types. A recent study (PEACE[26]) which measured PM_{10} concentrations for six winter weeks at matched sites in a number of European countries found also that urban background and rural differences in concentration tended to be small or even absent. This may be in part due to differences in classification of site types and to the small amount of information available. It may also be that PM displays less spatial variation than other pollutants over both short and long distances. The smallest particles can persist for long periods in suspension, and may travel hundreds or even thousands of kilometres in that time.

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26 PEACE.

Table 7: Average concentrations of PM_{10} at Urban, Traffic and Industrial Sites in the Community 1992 - 1994

Country	Number of Sites	Annual Mean µg/m³	98th Percentile of Daily Means µg/m³
Urban Background (UB) Sites			
France	3	41 - 67	68 - 136
Luxembourg			
Netherlands	4	37 - 41	92 - 126
Portugal	1	72 - 75	144 - 146 (95th%ile)
Sweden	5	12 - 16	
United Kingdom	13	20 - 34	41 - 95
Urban Traffic (UT) Sites			
Finland	5	13 - 145	43 - 204
France	2	51 - 54	94 - 136
Germany	2	36 - 65	77 -98
Luxembourg	1	30	61
Netherlands	4	39 - 43	90 -129
Sweden	1	35	
Urban Industrial (UI) Sites			
France	9	43 - 78	58 - 143
Germany	1	50 - 58	128
Luxembourg	1	32	71

UB = Urban Background: a site in a central urban area not influenced by a single major source (including a road), and not necessarily mainly residential.
UT = Urban Traffic: a site in a central urban area influenced by and close to a major road.
UI = Urban Industrial: A site in a central urban area influenced by industrial sources.

Both Table 7 and PEACE do show, however, a reasonably consistent pattern of lower concentrations in the far north of Europe and higher concentrations in the southern countries. There are also suggestions from PEACE of an increasing slope from west to east. It should be noted that similar concentrations of PM may have very different composition, depending on the dominating local source. Little information is available at present on the composition of the PM mix at different types of site or in different regions of the Community.

The emission inventories for the UK, Germany and the Netherlands suggest that there has been a decline in particulate matter emissions over time, although the picture varies from country to country and the period covered is short. Measurements of Black Smoke and TSP indicate that concentrations of PM_{10} due to traditional sources have declined markedly in many areas, but cannot be used to give accurate estimates of overall trends, especially where new sources have appeared. The relationship between these Black Smoke or TSP and PM_{10} varies from site to site and will change if the dominant source changes, for example from coal to traffic or to secondary particulate matter.

Some reduction in concentrations of both primary and secondary PM is anticipated in future years due to improvements in diesel engine standards, in industrial combustion standards, the continuing decrease in domestic coal use, and the anticipated reductions in emissions of precursors of secondary PM. Table 8 shows projections of primary emissions only of PM_{10} for Member States for which air quality data are available. There are large uncertainties in these projections; they should be treated with caution.

Table 8: Projected emissions of (primary) particulate matter (ktons)

Country	1990	2010
Austria	37.5	-
Belgium	83.2	-
Denmark	51	-
Finland	45.7	-
France	402.4	296.7
Germany	1326.4	932.7
Greece	55.1	-
Ireland	32.3	-
Italy	292.1	-
Luxembourg	6	5.4
Netherlands	24.5	23.5
Portugal	31.3	27.9
Spain	183.1	133.3
Sweden	40.8	34.4
UK	273.3	181.5
EC15	2884.7	1365.4

6.5. Impact on human health and the environment

6.5.1. Damage to human health

Effects of short-term exposure

A large body of recent studies shows that short-term variations in concentrations of PM_{10} are associated with health effects even at low ambient levels. Effects include increases in daily mortality rates, in hospital admissions, use of bronchodilators amongst asthmatics, lower respiratory symptoms and changes in Peak Expiratory Flow. The data do not allow determination of a threshold below which these effects would be unlikely to occur.

The many studies which have looked at short-term variations in PM_{10} show risk estimates which are reasonably consistent despite likely differences in the composition of PM from study area to study area. Particle composition and size distribution may be nevertheless be important. Some of the most recent studies suggest that health effects may be more closely associated with smaller fractions of PM, strong aerosol acidity or sulphates. A few studies on dust storms and volcanic ash suggest that these natural particles are less toxic than primary particles associated with combustion sources or secondary particles[27].

Quantification of the effects of short-term exposure to PM is extremely difficult. No thresholds can be identified from present data. It is not possible to test zero exposure since there is a natural background of PM. Within the range of concentrations normally measured within the Community the associations between concentration and effect seem linear but this relationship may or may not remain linear at lower concentrations. These two factors mean that the baseline from which numbers of additional effects should be calculated cannot be known. For the mortality results there is the additional difficulty that the studies do not enable an estimate to be made of the extent to which life has been shortened. If some or all of the deaths occur in people who are already in poor health effects on age at death may not be large.

For these and other reasons the World Health Organization in revising the Air Quality Guidelines for Europe did not derive guideline values for short term exposure to PM. Instead they provide, with considerable reservations, summaries of relative risk estimates for different effects of PM_{10} and $PM_{2.5}$, together with a table showing the estimated number of subjects experiencing effects of a period of three days characterized by a mean PM_{10} concentration of 50 or 100 $\mu g/m^3$ (see Annex II). These tables give an indication of the potential magnitude of effects on public health. They show that although individual relative risks are small compared with the effects of such factors as smoking (an important source of indoor PM), changes in weather, or epidemics of influenza, the total effect on public health can be large because of near universal potential exposure.

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27 Ref. WHO/EPA.

Effects of long-term exposure

Evidence is emerging from studies in the United States that long-term exposure to low concentrations of PM in air is associated with increased rates of bronchitis, reduced lung function and reduction in life-expectancy of the order of one to two years. Risk estimate tables based on these studies have been derived by WHO and are provided in Annex II

6.5.2. *Damage to buildings, materials and cultural heritage*

Primary particulate matter from combustion is responsible for the soiling of buildings and other materials. Although the rate of soiling is much reduced in comparison with that experienced when coal was a major source of energy it may still be locally significant in some urban centres.

6.5.3. *The damage costs of PM pollution*

A survey of studies[28] has been completed on the damage costs of PM_{10}. That survey indicates that the damage costs are attributable chiefly to health damage. Estimates for human health damage range from a low ECU 2 900/ton PM_{10} to a high ECU 59 000/ton. Estimates of total damage to buildings and materials are as low as ECU 180/ton PM_{10}.

6.6. The Commission's proposals

Since it is not possible from the evidence presently available to identify no-effect thresholds for particulate matter the Commission has adopted a risk management approach to the definition of limit values. This seeks to identify concentrations at which effects on the population as a whole would be small.

In line with the most recent scientific advice the Commission proposes that there should no longer be a limit value for Suspended Particulate Matter, as measured under the existing Directive on Sulphur Dioxide and Suspended Particulate Matter.

The Commission believes that it is necessary to set new limit values for PM in the Community in order to achieve speedy reduction in concentrations arising from the wide range of man-made sources which emit particles. The most recent data on health effects and concentrations of PM in the Community and the largest body of studies world-wide relate to PM_{10}. The Commission has concluded that limit values should therefore be set for PM_{10}. It is aware however of theoretical reasons for believing that $PM_{2.5}$ is a more accurate surrogate for human exposure than PM_{10}. $PM_{2.5}$ measurements are also likely to be linked more strongly with anthropogenic sources. However, it is not at present clear that associations with the coarse fraction of PM_{10} can be ignored; there are at present almost no data on concentrations of $PM_{2.5}$ and none on any associated health outcomes in the Community. It should also be borne in mind that $PM_{2.5}$ is itself a mixture in which the causal component has not been identified.

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[28] Ozdemiroglu, E and D. Pearce (1995) Economic Evaluation of benefits of abating nitrogen oxides and related substances, United Nations Economic Commission for Europe. EB.AIR./WG.5/R.56, 20 June 1995, Geneva.

The Commission's proposals recognize that the concentrations, sources and effects of PM within the Community should be the subject of further investigation. Limit values for PM_{10} will be introduced in two stages, to ensure that action is taken quickly and that room is allowed for adaptation to further development of the knowledge base.

	Averaging period	Limit value	Date by which limit value is to be met
Stage 1			
1. 24-hour limit value for the protection of human health	24 hours	50µg/m³ PM_{10} not to be exceeded more than two times per year	1 January 2005
2. Annual limit value for the protection of human health	calendar year	30µg/m³ PM_{10}	1 January 2005
Stage 2			
1. 24-hour limit value for the protection of human health	24 hours	50µg/m³ PM_{10} not to be exceeded more than seven times per year	1 January 2010
2. Annual limit value for the protection of human health	calendar year	20µg/m³ PM_{10}	1 January 2010

During Stage 1 Member States will be required to reduce both maximum daily concentrations and annual average concentrations of PM_{10} from their present levels. During this phase measurements will be made also of $PM_{2.5}$ and plans for reducing concentrations of PM_{10} should explicitly include reductions of $PM_{2.5}$ as part of the total. The proposed limit values for PM_{10} to be met in 2010 represent a further tightening, to concentrations which, according to the best evidence available should present small risks to public health. The Commission is promoting further research into the health effects of PM, including the funding of a second APHEA study[29]. It will report to Council and the European Parliament at the latest by 31 December 2003 on further developments in scientific and technical understanding of PM. The report will be accompanied by any proposals which the Commission considers necessary in the light of those developments.

The Commission has taken account also of possible difficulties in the drier parts of the Community due to natural sources of PM_{10}. There are no systematic analyses available of particles sizes and sources in these parts of the Community. However, it is known that high concentrations of mineral dusts can occur in such areas and that such dusts tend to fall within the coarse fraction of PM_{10}, that is PM_{10} - $PM_{2.5}$. Where a Member State can demonstrate that limit values for attainment in Stage 1 cannot be met owing to persistent high concentrations of natural dusts, they shall

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29 Katsouyanni et al (1997): Short term effects of ambient sulphur dioxide and particulate matter on mortality in 12 European cities: results from time series data from the APHEA project: British Medical Journal Volume 314 7 June 1997.
See also Journal of Empidemiology and Community Health, April 1996, Vol. 50 Supplement 1.

adopt action levels for $PM_{2.5}$ as reporting levels, as test levels to determine whether action plans should be developed and as indicative targets for any such action plans. These action levels will not be mandatory goals, but Member States should make best efforts to see that they are met as far as possible.

The action levels proposed in the accompanying Directive are derived from data on the proportion of PM_{10} made up of particles less than 2.5 microns in diameter in Member States where concentrations of natural dusts tend to be low. It is intended that they should be reviewed when the Commission reports to Council and the European Parliament on PM as described above.

6.6.1. *Costs and environmental benefits of meeting the limit values for particulate matter*

The costs and environmental benefits of the proposal have been estimated for cities for which air quality data were available. For PM_{10}, the air quality database covered only 35 cities with a total of 27 million inhabitants.

The average reduction in city emissions that is expected to be necessary to meet the proposed limit values is around 50 percent. This equals a reduction of around 15 ktons for all cities covered. Overall Community-wide emissions have been estimated at roughly 2 880 ktons in 1990 and are projected to decrease to some 1 365 ktons by 2010 as a result of current policy (reference scenario). The results should be regarded with caution since the uncertainties in the emission data are large (50%), the emission inventory does not capture all sources and sufficient air quality data to allow projections to be made were available for only a limited number of countries. Consequently, the cost estimates should be evaluated with caution .

For the cities covered, the mid point estimate of the annual costs of attaining the limit values in the 35 cities ranges from ECU 87 to 225 million per year. The range is due to the uncertainty surrounding both the actual emission levels and the cost of controlling stationary sources. Taking into account the further uncertainties of air quality modelling the costs could range from ECU 50 to 300 million. The lower estimate of the cost occurs if reductions aim at reducing the average concentration in the cities below the (daily average) limit value proposed. The higher value pertains to the reductions needed to meet the limit value at the location in the city showing the highest exceedance of the proposed limit value. As with NO_2, large reductions in emissions from road transport are built into the reference scenario owing to proposals resulting from the Auto-Oil I programme. The majority (90%) of the costs of achieving further reductions are due to measures to be taken at (low stack) stationary sources. There are also some additional costs for road transport for implementing road-pricing schemes and the introduction of LPG/CNG buses. Both these measures also lead to the reduction of other pollutants. All costs have been allocated to PM_{10} control which implies a insignificant overestimate (less than 5%) of the costs. The benefits of reducing non-PM10 emissions are, however, not accounted for.

An estimate of the distribution of costs over the Member States is hampered by the lack of air quality data for a number of countries. For those countries for which data for several cities were available mid-point cost estimates for those cities are as follows: France ECU 24-57 million; Germany ECU 35-105 million; Luxembourg ECU 0.6-1.1; the Netherlands ECU 1.3-3.2; Spain ECU 25-57 million and the UK, no cost. For countries with only one city covered estimates are: Portugal ECU 0.3-0.8 million and Sweden ECU 0.8 million.

Because of the absence of air quality data for other cities it is virtually impossible to make a reliable estimate of the costs of meeting standards everywhere in the Community. If the air quality data of the 35 cities covered is representative for cities with more than 25 000 inhabitants, the annual costs for the Community as a whole might be a factor 5 to 6 higher.

An analysis has been made of the physical and monetary benefits of the proposal compared to current policy (the reference case) for the cities in the database. In these cities 16 million out of 38 million inhabitants are expected to be at risk in the year 2010 of exposure to ambient concentrations exceeding the limit values. If the proposed standards were attained, mortality from short-term exposure to peaks in PM pollution would decrease by 470-650 cases a year compared to the reference case representing current policy. Admissions to hospital emergency rooms would drop by 240-560 cases per year. The number of cases of respiratory symptoms would fall by 500-540 cases. The number of restricted activity days would fall by 7 500. The proposal would also reduce long-term (chronic) mortality by 5 000-48 500 cases, respiratory morbidity of children by around 4 500 cases and the number of cases with respiratory symptom prevalence by some 6 500 each year. Other impacts such as materials damage have not been quantified. The indirect positive health impacts for people living outside cities have also been neglected.

The monetary valuation has been restricted to the health benefits. Section 3.2.1 above explains how the valuation was done. The available results suggests that the monetary benefits of the proposed limit values in the cities for which data are available range from ECU 5 000 to 51 250 million per year. The large range is chiefly caused by the uncertainty in dose-effect functions for mortality due to long-term exposure. The monetary benefits are clearly dominated by these chronic mortality impacts (ECU 5 000 - 48 500 million). Acute mortality is less significant, at ECU 0-1 500 million/year. Morbidity impacts are estimated at ECU 2-5 million per year. The highest estimates are obtained if the impact on chronic mortality is high and the impacts on acute mortality are valued at a full VOSL (see Section 3.2.1). Impacts on materials damage have not been assessed but are expected to be small. Positive impacts resulting from emission reductions in the cities on the health of population living outside cities are probably more important but have not been quantified.

The available estimates of the costs and benefits need to be compared with care (see Section 3.2.1). They show clearly show that in so far as benefits are quantifiable and bearing in mind the limitations inherent in estimation, the monetary benefits of meeting the proposed limit values (ECU 5 000 to 51 250 million per annum) are expected significantly to exceed the costs (ECU 50 to 300 million) for the cities at risk. In view of the large difference between costs and benefits the conclusion would also be valid if short-term mortality effects were not valued at all and the impact on chronic mortality were in the lower range of the estimate.

6.7. Opinions of affected parties

The principal of a two-stage process, with limit values defined at present only for PM_{10} is supported by many Member States as a way of ensuring early action whilst allowing review and adjustment if necessary as knowledge develops. Industry agrees that targets can only be set for PM_{10} at present. They would prefer indicative targets only. Spain would prefer limit values for $PM_{2.5}$. The Netherlands are concerned that the action levels for $PM_{2.5}$ for areas subject to high concentrations of natural dusts may be too lenient. Industry suggests that it is premature to set action levels for $PM_{2.5}$ and proposes that simple derogations should be allowed until further data are available.

7. LEAD

7.1. Background

Lead is one of the most widely used non-ferrous metals. When ambient air quality standards for lead were first developed it was a ubiquitous pollutant in urban air. With the decline in the use of leaded petrol urban concentrations have also declined markedly. When leaded petrol is no longer in use, locally elevated concentrations of lead in air will be a potential problem only in the immediate vicinity of certain non-ferrous metal plants. Long-range transport of lead in air can result in deposition to waters and accumulation in soils, even in remote areas. Deposition rates will also be substantially reduced as emissions from petrol decline, but may still be sufficient to result in accumulation.

Most of the lead in air exists in the form of particles less than one micron in diameter except in the immediate vicinity of smelters where larger particles predominate. It is removed from the air by dry or wet deposition. It contributes to human exposure by direct inhalation, and via intake of food, water, and dust and soil. For low-level long-term exposure the most critical effects of lead on human health include those on blood metabolism, on the nervous system, including the development of intelligence, on foetal development and on blood pressure.

7.2. Legislation

Council Directive 82/884/EEC of 3 December 1982 on a limit value for lead in air set a maximum annual concentration for lead in air of 2 $\mu g/m^3$. Member States are required to install and operate measuring stations at places where individuals may be exposed continually for long periods and where they consider that the limit value might be exceeded.

7.3. Sources of lead

Lead is released into the environment during the mining and smelting of lead and other ores, during the production, use, recycling and disposal of lead-containing products and during the combustion of fossil fuels and wood. Emissions from industry are becoming predominant as the use of leaded petrol declines. The ferrous metal industry is the largest source of industrial emissions, taken as a whole within the Community. The non-ferrous metal sector is smaller in total, but at a local level, smelters of non-ferrous metals (lead, zinc, copper) are the most likely sources of elevated ambient concentrations of lead.

7.4. Trends in emissions, air concentrations and deposition

Ambient concentrations in urban areas in the Community are now generally well below the present limit value of 2 µg/m^3. In most places they are below the WHO 1996 Guideline of 0.5 µg/m^3. In some urban centres concentrations are already below 0.1 µg/m^3. General urban concentrations throughout the Community will drop to this low level when leaded petrol is no longer used.

Concentrations in excess of 1 µg/m^3 still occur in the immediate vicinity of some non-ferrous metal smelting plants.

Deposition measurements are carried out in the immediate vicinity of industrial plants in some Member States. Deposition measurements are also carried out in remote areas with a view to assessing potential damage to ecosystems. A number of methods are used and their intercomparability is unclear.

7.5. Impact on human health and the environment

7.5.1. Damage to human health

Most people receive the largest portion of their daily lead intake from food. The most important pathway by which lead enters the food chain is believed to be fallout from air onto the foliage of plants. Exposure through water is lower except in old houses with lead pipes. Some lead is directly inhaled from the air. The WHO 1996 Guideline of 0.5 µg/m^3 as an annual average allows for uptake of lead emitted into air by the various different routes described above.

Amongst pre-school children ingestion of lead-containing dust and soil during outdoor activity is thought to be an important exposure route. WHO recognized the importance of deposition to soil for this route but were not able on current evidence to develop a numerical guideline.

7.5.2. Damage to ecosystems.

Deposition of lead from air to water and soils can have direct toxic effects on animals, plants and micro-organisms. In sufficient doses lead can inhibit plant growth and microbial decomposition of organic matter. Animals high in the food chain may be especially affected owing to accumulation from repeated intake of low doses in organisms further down the chain. Work aimed at reducing bioaccumulation of lead and other heavy metals is presently underway within the framework of the UNECE Convention on Long-Range Transboundary Air Pollution. Negotiations should complete soon on a heavy metals protocol setting national emission ceilings. Work will then continue on the development of critical loads.

7.5.3. *The damage costs of lead pollution*

EFTEC[30] has recently completed an overview of damage valuation estimates for heavy metals. That overview reports that the following impacts of inhalation of lead require valuation: IQ points loss in children, increased blood pressure, which is associated with hypertension, and premature mortality of babies (neonatal death). EFTEC reports the following damage costs attributed to lead (Pb) in billion ecu per microgram Pb/m^3 air for the UK as a whole:

-	IQ losses	2.2	(95% confidence levels: 0.7-3.6)
-	hypertension	21	(95% confidence levels: 10.8.-31.7)
-	neonatal deaths	97	(95% confidence levels: 64.5-129.6)
-	TOTAL	120	(95% confidence levels: 85-156)

The economic value of an IQ point is based on the expected value of the lifetime earnings of a child rather than the Willingness-to-Pay to avoid such IQ losses. Both hypertension and neonatal death are based on Willingness-to-Pay. On the basis of the total UK population the above calculation suggest a damage costs per microgram Pb/m^3 of ECU 2 080 per person, of which ECU 1 681 would be attributed to neonatal death.

7.6. The Commission's proposals

7.6.1. *Protection of human health*

Populations living in the immediate vicinity of industrial sources should be afforded a high degree of protection against the effects of lead emissions. The study carried out for the Commission on the economic aspects of meeting limit values found that concentrations are already below the WHO Guideline of 0.5 µg/m^3 in the vicinity of some lead-emitting industrial sources. It is proposed that a limit value of 0.5 µg/m^3 should be met in remaining problem areas by 2005.

Measurements of lead in air are likely to underestimate potential exposure in the immediate vicinity of industrial sources, particularly for young children. The Commission will keep under review developments in measurement techniques for heavy metals, including lead. It will report to the Council at the latest by 31 December 2003 on the feasibility of developing deposition limit values for lead in addition to, or in substitution for limit values for lead in air in the immediate vicinity of industrial plants.

30 EFTEC(1996) Research into damage valuation estimates for nitrogen based pollutants; heavy metals and persistent organic pollutants. Main report 1: nitrogen oxides. Final report - August 1996; EFTEC, London.

7.6.2. Costs and benefits of meeting the limit value for lead

It is estimated that 10 000 to 30 000 people living around lead producing plants are currently at risk of exposure to concentrations exceeding the proposed limit value, despite the fact that ambient concentrations around these plants have decreased as a result of economic-technological developments. The costs and environmental benefits of the proposal have been estimated for those primary lead smelters for which additional measures are expected to be needed to meet the proposed limit values. The cost data have been collected for a restricted number of plants by the Lead Development Association. The cost data vary from plant to plant mainly as a result of the particular lead producing technology in place. In view of the uncertainty an upper and lower range of the cost-estimates is given. The annual costs are estimated at ECU 12.3 to 41.2 million on the basis of available literature data for the capacity of primary smelters, where it is assumed that in only half of the smelters additional investments would be needed to meet the proposed standard of 0.5 $\mu g/m^3$. Estimates on the basis of data on the necessary investments supplied by the Lead Development Association for both primary and secondary smelters suggest that annual costs range from ECU 24 to 31 million per year. The distribution of these costs over the Member States is as follows: Belgium: ECU 5.2-12.4 million; Germany ECU 10.2 million; France ECU 4.9 million and the United Kingdom ECU 3.8 million.

Data supplied by the Lead Development Association for a small number of smelters indicates that the expected costs vary between 0.5 to 3 % of the value of the lead sales. Depending on the plant the annual costs can vary between 1.5 and 58% of the net profits for those companies that make profits. Some companies for which data were reported, however, were making losses over the last few years.

The scarce data available suggest that the proposal would on average cut the lead concentrations around the smelters from 0.75 to 0.5 $\mu g/m^3$. The consultancy study conducted indicates benefits of ECU 3.5 to 5.8 million per year. The benefits consist of a reduction in IQ point losses and decreased mortality due to high blood pressure. The loss of benefits due to IQ point losses is underestimated since the loss of benefits is based on the loss of expected earnings rather than Willingness-to-Pay. Neonatal deaths were not included in the mortality figures. A study by EFTEC[7] suggested an increase in damage costs of ECU 2 080/person exposed for an increase in the lead concentration of 1 microgram/m^3. Using the EFTEC value suggest benefits (decrease in damage costs) of ECU 5.2 - 15.6 million per year. This includes neonatal mortality but still bases IQ point losses only on the earnings lost. The available evidence suggests that in so far as benefits are quantifiable and bearing in mind the care that needs to be exercised in comparing costs and benefits (see Section 3.2.1), benefits (ECU 3 to 16 million) would tend to be lower than the costs (ECU 12-41 million). The benefits, however, are underestimated since the loss of earnings rather than individual willingness-to-pay (WTP) was used to estimated the loss of IQ points. The relatively low costs seem to justify the limit value.

7.7. Opinions of affected parties

Member States and industry are agreed that concentrations in most locations will fall well below the limit value in coming years. Some Member States and NGOs would prefer to see this reflected in a more stringent limit value. Member States in which lead emitting industries are located are generally in agreement with the proposed limit value of 0.5 $\mu g/m^3$. Belgium would prefer to see a limit value of 1.0 $\mu g/m^3$, to be supplemented or replaced in due course by a deposition limit value in the immediate vicinity of point sources. Industry argue for the setting of a limit value of 1.0 $\mu g/m^3$ in the region of point sources, pending development of a deposition limit value.

8. THE NEED FOR COMMUNITY ACTION - SUBSIDIARITY

The present proposal amends existing EC legislation on sulphur dioxide, nitrogen dioxide, particulate matter and lead in fulfilment of obligations under Directive 96/62/EC. The explanatory memorandum accompanying that Directive (COM(94) 109 final) sets out reasons for and the scope of the new framework for action on ambient air quality. The present proposal adheres to the principals of the framework by setting broad Community-wide ambient air quality objectives but leaving to the Member States the responsibility for determining and taking the specific actions which are most appropriate to local circumstance.

9. LEGAL BASE

The legal basis for the proposal is Article 130S of the Treaty. This is also the legal basis of Directive 96/62/EC. The objectives of the framework Directive and daughter legislation relate to conservation, protection, and improvement of the quality of the environment, and the protection of health.

10. DESCRIPTION OF THE LEGISLATIVE SITUATION IN MEMBER STATES

All Member States have informed the Commission that they have transposed existing EC legislation on ambient air quality standards for sulphur dioxide, nitrogen dioxide, particulate matter and lead into national legislation. Additional legislation is in force in some. Details are given in the position papers prepared by Working Groups on individual pollutants[31] and in the Commission's recent[32] report on implementation of existing air quality Directives.

A table showing standards for sulphur dioxide, nitrogen dioxide, particulate matter and lead in the United States and Japan is included for information purposes as Annex IV to this document.

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[31] Available from the Commission.

[32] In preparation. Reference to be added when available.

11. Explanation Of The Detailed Provisions Of The Proposal

Article 1

This Article sets out the aims of the present proposals.

Article 2

All the definitions of the Air Quality Framework Directive also apply within the daughter legislation accompanying this Explanatory Memorandum. Article 2 adds further definitions necessary for the interpretation of the present Directive.

Article 3

Under this Article new limit values will be set for sulphur dioxide, to protect human health and the environment. The limit values for the protection of human health are to be met by 1 January 2005. The limit values for the protection of the environment are to be met two years from the date on which the Directive comes into force. Annex I sets out full details. The Article will also set an alert threshold for sulphur dioxide. The public must be informed if it is exceeded.

Information will also be compiled on concentrations measured over ten minutes to enable an assessment to be made of the extent, if any, to which the WHO Guideline of 500 $\mu g/m^3$ is exceeded.

Article 4

Under this Article new limit values will be set for nitrogen dioxide, to protect human health and for the sum of nitrogen dioxide and nitric oxide to protect ecosystems. The limit values for the protection of human health are to be met by 1 January 2010. This is the same timetable as that of proposals to combat acidification. The limit values for the protection of vegetation are to be met two years from the date on which the Directive comes into force. Annex II sets out full details.

Article 5

Article 5 will set new limit values for PM_{10} to be met by 2005 and a further set of limit values to be met by 2010. Member States will be required to measure $PM_{2.5}$ as well as PM_{10}. Plans for reducing concentrations of PM_{10} must aim also to reduce the $PM_{2.5}$ fraction of PM_{10}. This Article also provides for the use of action levels for $PM_{2.5}$ as targets in places where high concentrations of natural dusts make it impossible to meet the limit values.. The $PM_{2.5}$ fraction of particulate matter is believed to be less influenced by natural sources. Action levels are less binding than limit values and are seen by the Commission as a first step, in the absence of data on concentrations of $PM_{2.5}$ in the Community, towards the future development of limit values for $PM_{2.5}$ for areas subject to natural dusts and, if appropriate, for more general application.

Under Article 10 of this Directive the Commission will report to the Council and the European Parliament at the latest by 31 December 2003 on the latest developments in knowledge of particulate matter and its effects. The Commission will accompany the report by any proposals for amendments to limit values and/or action levels for particulate matter.

Article 6

This Article sets a new limit value for lead in air and a date for its attainment of 1 January 2005.

Article 7

This Article deals with assessment of concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead. It is supplemented by a number of Annexes.

Annex V sets out the thresholds which determine which methods of assessment (continuous measurement, indicative measurement, modelling, objective assessment) should be used in an agglomeration or other zone.

Article 7(2) refers to Annex VI, which deals with siting of measurement points, and Annex VII which specifies the minimum number of measurement stations which should be installed in a zone or agglomeration if information from these stations is the sole source of data reported to the Commission. However, the Air Quality Framework Directive enables other methods, such as indicative measurement and air quality modelling to be used in all zones and agglomerations even where continuous measurement is mandatory. Where a full analysis has been carried out the number of continuous stations required depends on the overall quality of the information available. It may be more or less than the number specified in Annex VII. The Commission is working with Member States, the Environment Agency and other experts to develop guidance on the assessment of air quality in order to ensure consistency of implementation and comparability of results.

Article 7(4) deals with reference methods for air quality measurement. The European standards organization CEN is presently working on harmonisation of measurement methods for all the pollutants dealt with in these proposals. It is anticipated that new standards will be available in time for the implementation of the present Directive. This Article provides for existing reference methods for sulphur dioxide, nitrogen dioxide and lead to be carried forward and for a draft CEN standard for sampling PM_{10} to be adopted as a first step. The Air Quality Framework Directive (Article 12) includes procedures for adapting measurement methods to technical progress when the new CEN standards are available for consideration. The same procedures will enable criteria and techniques for other assessment methods also to be adapted as necessary to technical progress.

Article 8

This Article requires Member States to ensure that up to date information on concentrations of sulphur dioxide, nitrogen dioxide, particulate matter and lead is easily available to the public.

Article 9

This Article sets out the timetable for replacing the requirements of Directive 80/779/EEC (sulphur dioxide and suspended particulates), 82/884/EEC (lead), and 85/203/EEC (nitrogen dioxide) by the new provisions of the Air Quality Framework Directive and the present proposals. Limit values set by Directives 80/779/EEC, 82/884/EEC and 85/203/EEC will remain in force until the dates on which the new limit values of these proposals must be met. Most of the provisions of Directives 80/779/EEC, 82/884/EEC and 85/203/EEC concerning air quality measurement will however be replaced immediately by the more comprehensive requirements of the Air Quality Framework Directive and the present proposals. These new requirements will take effect from the date by which the present proposals must be transcribed by Member States into national law. An exception is made for the measurement of particulate matter.

The methods for measuring particulate matter under Directive 80/779/EEC are entirely different from the methods proposed under this Directive. It is not possible to use the new methods to assess compliance with existing limit values with any accuracy. The assessment requirements of Directive 80/779/EEC with respect to PM will therefore remain in force until 1 January 2005, the proposed attainment date for first stage limit values for PM_{10}. Under Article 6 of Directive 80/779/EEC Member States will be required to monitor using the old methods in particular where limit values are likely to be approached or exceeded.

Annex III to this document provides full details.

Article 10

This Article requires the Commission to report to Council and the European Parliament no later than 31 December 2003 on implementation of this Directive and progress in understanding of the pollutants with which it deals. Particular attention will be paid to the results of ongoing research into the health effects of sulphur dioxide and particulate matter and to the feasibility of developing deposition limit values for lead.

Articles 11, 12, 13, 14

These are standard provisions.

Annex I

This Annex sets out limit values, attainment dates and margins of tolerance for sulphur dioxide. It also sets out an alert threshold.

Annex II

This Annex sets out limit values, attainment dates and margins of tolerance for nitrogen dioxide and, in the case of the limit value related to protection of vegetation, for the sum of nitrogen dioxide and nitric oxide (known as NO_x).

Annex III

This Annex sets out limit values, action levels, attainment dates and margins of tolerance for particulate matter.

Annex IV

This Annex sets out a limit value, attainment dates and margin of tolerance for lead in air.

Annex V

This Annex sets out the upper and lower assessment thresholds for the four pollutants for which limit values are being set. These thresholds determine the intensity of monitoring activity required in an agglomeration or other zone. Annex VII is linked. It sets out the default requirement for different types of zone.

Annex VI

This Annex deals with siting of sampling points for measurement of sulphur dioxide, nitrogen dioxide, particulate matter and lead. It has two sections. The first deals with macroscale siting, which relates to the type of location at which measurement should be undertaken to fulfil the aims of the proposed Directive. The second deals with microscale siting - details for setting up of measurement points at suitable types of location.

Annex VII

This Annex sets out the criteria for determining default numbers of measurement sites in agglomerations or other zones. Where the aim of a limit value is the protection of human health the number of sampling points is related to population. The strategy will have to be modified in the case of measurement near industrial sources, according to emission density, the way in which emissions are dispersed at a particular locality and the potential for exposure of the population.

The number of sampling points for the assessment of compliance with limit values which aim to protect ecosystems or other vegetation is dependant on area.

Annex VIII

All methods of air quality assessment are subject to uncertainty, because of technical limitations, because of operational limitations or the absence of data. Some of the uncertainties can be reduced, for example in the case of measurement by rigorous programmes of quality assurance.

Part I of this Annex sets out guidelines for the quality of the results which Member States should aim to achieve as a result of different air quality assessment methods.

Part II sets out a minimum dataset which should be compiled where methods other than measurement are used to assess air quality. This dataset includes the level of any uncertainties.

Annex IX

Annex IX deals with reference methods for monitoring and modelling. These requirements will be adapted to technical progress in accordance with Article 12 of the Air Quality Framework Directive.

Annex X

This Annex lists indicator levels for sulphur dioxide, nitrogen dioxide, particulate matter and lead. Information supplied to the public should note when the indicators are exceeded.

Annex I Reference scenarios for assessment of economic aspects of meeting limit values

1. Reference scenario for SO_2 and NO_2

For SO_2 and NO_2 the analysis was based on energy projections provided by DG XVII, extracted from the so-called Conventional Wisdom Scenario. In this scenario, a 20 per cent increase in energy consumption and a 10 per cent increase in the emissions of CO_2 between 1990 and 2010, is envisaged.

The emission levels resulting from current national, EC, and international legislation were estimated, given the projections for future energy use. The scenario includes the directive on large combustion plants (88/609/EEC), the directive on sulphur in liquid fuels (93/12/EEC), the IPPC-directive (96/61/EEC), and directives related to emissions from road vehicles as well as non-road vehicles. Proposals on vehicle emission standards and fuel quality (the auto-oil programme (COM(96) 248 final, 96/0163 (COD), 96/0164 (COD)) were also included. Mandatory technical requirements in protocols of the UNECE Convention on Long-Range Transboundary Air Pollution and firm commitments by Member States under these protocols were taken into account. The scenario shows that if current, and planned, legislation is fully implemented in all European countries, emissions of SO_2 and NO_x will be reduced by 66 and 48 per cent, respectively, between the base year 1990 and 2010.

The same emissions basis was used in parallel work on acidification. The Commission has now adopted a strategy to combat acidification and legislation which proposes further reductions in the sulphur content of liquid fuels. These proposals will result in further reductions of emissions of both SO_2 and NO_2 by the 2010.

2. Reference scenario for particulate matter

The sources of airborne PM_{10} are much more diverse than those of SO_2 and NO_2 and vary greatly from place to place. This complicates greatly the process of developing emissions scenarios for air quality modelling.

The reference scenario for PM_{10} was based on the emissions inventory for primary emissions compiled by TNO. City-specific emission inventories were built by apportioning each country's PM_{10} emission data to cities in proportion to their emissions of NO_x. The calculations of emissions from fuel combustion were made using the same energy scenario on which the SO_2 and NO_2 scenarios were based. The expected development in NO_x emissions was used as a proxy for expected developments in primary PM_{10} emissions. It was assumed that primary PM emissions from non-combustion industrial sources and from other categories such as mining and quarrying, construction, agriculture and natural sources would remain unchanged.

Secondary PM_{10} concentrations are dependent on emissions of SO_2 and NO_2. The contribution of secondary PM_{10} was estimated according to the reference scenarios for SO_2 and NO_2 described above.

3. Reference scenario for lead

The reference scenario for lead assumes that leaded petrol will be banned in the Community from 2000. There is little information in the public domain about ambient air concentrations of lead around point sources. Information about air quality in such locations and future abatement plans was obtained from the industries concerned via the Lead Development Association.

Annex II: WHO Air Quality Guidelines for Europe 1996: Risk estimates for particulate matter

Table 9: Summary of relative risk estimates associated with increases of 10 µg/m³ in concentration of PM_{10} and $PM_{2.5}$

Endpoint	Relative Risk for $PM_{2.5}$ (95% confidence interval)	Relative Risk for PM_{10} (95% confidence interval)
Bronchodilator use	...	1.0337 (1.0205-10470)
Cough	...	1.0455 (1.0227-1.0687)
Lower respiratory symptoms	...	1.0345 (1.0184-1.0508)
Respiratory hospital Admissions	...	1.0084 (1.0050-1.0117)
Mortality	1.0151 (1.0112-1.01910)	1.0070 (1.0059-1.0082)

Table 10: Estimated number of subjects experiencing health effects over a period of three days characterized by a mean PM_{10} concentration of 50 or 100 µg/m³

Health effect indicator	number of subjects affected by a three-day episode of PM_{10} at	
	50 µg/m³	100 µg/m³
Mortality	3.5	7
Respiratory hospital admissions	3	6
Person-days of bronchodilator use	5 100	10 200
Person-days of symptom exacerbations	6 000	12 000

Table 11: Summary of relative risk estimate for effects of long-term exposure to PM on morbidity and mortality, associated with a 10 μg/m³ increase in the concentration of PM_{10} or $PM_{2.5}$

Endpoint	Relative risk for $PM_{2.5}$ (95% confidence interval)	Relative risk for PM_{10} (95% confidence interval)
Mortality	**1.14 (1.04, 1.24)**	**1.10 (1.03, 1.18)**
Bronchitis Symptoms	**1.34 (0.94, 1.99)**	**1.29 (0.96, 1.83)**

Table 12: Estimated number of subject experiencing health effects due to long term exposure to a $PM_{2.5}$ concentration of 10 or 20 μg/m³ over a background of 10 μg/m³

Health effect indicator	Number of subjects affected per year at $PM_{2.5}$ concentration over background of:	
	10 μg/m³	**20μg/m³**
Mortality	**1 200**	**2 400**
Number of additional children with bronchitis symptoms	**3 350**	**6 700**
Number of addition children with lung function (FVC or FEV1) below 85% of predicted	**4 000**	**8 000**

assumes population of 1 000 000 with annual death rate of 12 000, a baseline prevalence of 5% for bronchitis symptoms among children, assumed to make up 20% of the population and a baseline prevalence of 3% of children having a lung function lower than 85% of predicted.

Annex III: Schedules for repeal

1. **Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates as amended by Council Directive 89/427/EEC**

Provisions to be repealed from 1 January 2005	
Article 1	Purpose
Article 2.1	definition of limit value
Article 3.1	Member States' obligation to respect limit values
Article 6	Requirement to establish measuring stations in particular where limit values are likely to be approached or exceeded
Article 7.1, 7.2	Member States' obligation to report exceedances of limit values to the Commission
Article 8	Obligation of the Commission to publish an annual report
Article 9	Prevention of transboundary pollution
Article 10.1 - 10.3	Measurement methods
Article 15	Bringing into force of provisions
Article 16	Directive is addressed to Member States
Annex I	Limit values
Annex IIIb	Reference method for measurement of suspended particulates by the black smoke method
Annex IV	Limit values measured by gravimetric method
Provisions to be repealed on date by which present proposals should be brought into force in Member States	
Article 2.2	Definition of guide values
Article 3.2	Provision for derogations for identified zones
Article 4	Requirement to set lower limit values in certain zones
Article 5	Obligations of Member States with respect to guide values
Article 7.3	Reporting of concentrations in zones notified under Article 4.
Article 10.4	Obligation for Commission to report to the Council on measurement methods
Article 10.5	Promotion of harmonisation of measurement methods
Article 11	Provisions respecting limit values in Article 4 zones near international borders

Article 12	Adaptation to technical progress
Article 13	Setting up of Committee for purposes of Article 12
Article 14	Procedures of Committee established under Article 13
Annex II	Guide values
Annex IIIa	Reference methods for sampling and analysis of SO_2
Annex V	Reference method of analysis for SO_2
Annex B	Standardization of the sodium bisulphite stock solution

2. Council Directive 85/203/EEC of 7 March 1985 on air quality standards for nitrogen dioxide

Provisions to be repealed from 1 January 2010	
Article 1	Purpose and scope
Article 2	Definitions
Article 3.1	Member States' obligation to respect limit values
Article 5	Enables Member States to set lower limit values
Article 7.1 - 7.2	Member States' reporting obligations
Article 8	Obligation of the Commission to publish an annual report
Article 9	Prevention of trans-boundary pollution
Article 15	Bringing into force of provisions
Article 16	The Directive is addressed to Member States
Annex I	Limit value
Provisions to be repealed on date by which present proposals should be brought into force in Member States	
Article 3.2	Provision for derogations in identified zones
Article 4	Provision for Member States to set lower limit values in identified zones
Article 6	Obligation for Member States to establish measuring stations
Article 7.3	Member States' reporting obligations with respect to Article 4 zones
Article 10	Measurement methods
Article 11	Provisions applicable in Article 4 zones
Article 12	Adaptation to technical progress

Article 13	Setting up of Committee for the purposes of Article 12
Article 14	Procedures of Article 13 Committee
Annex II	Guide values
Annex III	Measurement requirements
Annex IV	Reference method of analysis

3. Council Directive 82/884/EEC of 3 December 1982 on lead in ambient air

Provisions to be repealed from 1 January 2005	
Article 1	Aim and scope
Article 2	Setting of limit values
Article 3.1	Member States' obligation to respect limit values
Article 5	Members States' reporting obligations
Article 6	Commission's obligation to publish a report
Article 7	Application of Directive should not bring about significant deterioration where air quality is good
Article 12	Bringing into force of provisions
Article 13	Directive is addressed to Member States
Provisions to be repealed on date by which present proposals should be brought into force in Member States	
Article 3.2, 3.3	Derogations
Article 4	Location of measurement stations
Article 8	Measurement methods
Article 9	Adaptation to technical progress
Article 10	Setting up of Committee for the purposes of Article 9
Article 11	Procedures of Article 10 Committee
Annex	Reference methods for sampling and analysis

ANNEX IV

Comparable ambient air quality standards in the United States and Japan

	United States		Japan		Proposal	
Pollutant	**Time**	**Level**	**Time**	**Level**	**Time**	**Level**
SO_2						
	-	-	1 hour	260 µg/m³	1 hour	350 µg/m³ 24 exceedances
	24 hours	365 µg/m³ 1 exceedance	24 hours	104 µg/m³	24 hours	125 µg/m³ 3 exceedances
	annual	80 µg/m³	-	-	-	-
NO_2						
	-	-	-	-	1 hour	200 µg/m³ 8 exceedances
	-	-	24 hour	80-120 µg/m³	-	-
	annual	100 µg/m³	-	-	annual	40 µg/m³
Lead						
	annual	1.5 µg/m³	-	-	annual	0.5 µg/m³
Particulate matter						
	-	-	1 hour	200 µg/m³ PM_{10}	-	-
	-	-	24 hours	100 µg/m³ PM_{10}	24 hours by 2005	50 µg/m³ PM_{10} 25 exceedances
	-	-	-	-	annual by 2005	30 µg/m³ PM_{10}
	24 hours	65 µg/m³ $PM_{2.5}$ (approx. 7 exceedances) 150 µg/m³ PM_{10} (approx. 3 exceedances)	-	-	24 hours by 2010	50 µg/m³ PM_{10} 7 exceedances
	annual	15 µg/m³ $PM_{2.5}$ 50 µg/m³ PM_{10}	-	-	annual by 2010	20 µg/m³ PM_{10}

PM standards

Primary standards for particulate matter in the US employ a different measurement method - $PM_{2.5}$ - from that proposed in the EC. The relationship between the results of different measurement methods varies from site to site and the standards are difficult to compare.

However, the proposed primary annual average US standard for $PM_{2.5}$ is likely to be of the same order of stringency as the proposed EC annual average limit value for PM_{10} to be met by 2010. The timescale for meeting the US standard is also comparable. The US **24-hour** standard is less demanding. It is anticipated however that emission reductions will generally be determined by the annual average standard. The daily standard is expected to provide extra leeway only for local sources with intermittent emissions. The US standards for PM_{10} are secondary standards to tackle remaining problems of visibility. A lower degree of legal obligation attaches to these standards.

The Japanese standards do refer to PM_{10}, as proposed for the new EC standards. However they were put in place in 1973, well before the emergence of recent evidence on the health effects of particles. The Japan Clean Air Programme will shortly begin a major study of motor vehicle environmental pollution. It will include detailed investigation of particulate matter in the light of present concerns.

Proposal for a

COUNCIL DIRECTIVE

relating to limit values for sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air

(Text with EEA relevance)

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community,

Having regard to Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management[33], and in particular Article 4(1) thereof,

Having regard to the proposal from the Commission[34],

Having regard to the opinion of the Economic and Social Committee[35],

Acting in accordance with the procedure laid down in Article 189c of the Treaty, in cooperation with the European Parliament[36],

Whereas, on the basis of principles enshrined in Article 130r of the Treaty, the European Community programme of policy and action in relation to the environment and sustainable development (the fifth Environment Action Programme[37]) envisages in particular amendments to existing legislation on air pollutants; whereas the said programme recommends the establishment of long-term air quality objectives;

Whereas Article 129 of the Treaty provides that health protection requirements are to form a constituent part of the Community's other policies; whereas Article 3(o) of the Treaty provides that the activities of the Community are to include a contribution to the attainment of a high level of health protection;

Whereas particles which can be inhaled and may penetrate deeply into the lungs are a matter of public health concern; whereas information should be collected on concentrations of particulate matter which may penetrate most deeply into the lung; whereas there is evidence that risks to human health associated with exposure to man-made particulate matter are higher than risks associated with exposure to naturally occurring particles in ambient air; whereas the best means of preventing diseases associated with exposure to man-made particulate matter is to reduce concentrations thereof in ambient air;

Whereas vegetation should be protected against the adverse effects of nitrogen dioxide and of nitric oxide;

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33 OJ L 296, 21.11.1996, p. 55.

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37 OJ C 138, 17.5.1993, p. 5.

Whereas Directive 96/62/EC provides that the numerical limit values and alert thresholds are to be based on the findings of work carried out by international scientific groups active in the field; whereas the Commission is to take account of the most recent scientific research data in the epidemiological and environmental fields concerned and of the most recent advances in metrology for re-examining the elements on which limit values and alert thresholds are based;

Whereas Directive 96/62/EC requires action plans to be developed for zones within which concentrations of pollutants in ambient air exceed limit values plus applicable temporary margins of tolerance in order to ensure compliance with limit values by the date(s) specified; whereas in so far as they relate to particulate matter such action plans and other reduction strategies should aim to reduce concentrations of fine particles as part of the total reduction in concentrations of particulate matter;

Whereas limit values for the protection of ecosystems or vegetation should not apply in the immediate vicinity of agglomerations and other developments;

Whereas standardized accurate measurement techniques are an important element of assessment of ambient air quality;

Whereas up-to-date information on concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air should be readily available to the public;

Whereas Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates[38], Council Directive 82/884/EEC of 3 December 1982 on a limit value for lead in the air[39] and Council Directive 85/203/EEC of 7 March 1985 on air quality standards for nitrogen dioxide[40]; all those Directives, as last amended by the Act of Accession of Austria, Finland and Sweden, should be repealed,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Objectives

The aims of this Directive are:

- to establish limit values and, as appropriate, alert thresholds for concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole;

- to assess concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air on the basis of common methods and criteria;

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38 OJ L 229, 30.8.1980, p. 30.
39 OJ L 378, 31.12.1982, p. 15.
40 OJ L 87, 27.3.1985, p. 1.

- to obtain adequate information on concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air and ensure that it is made available to the public;

- to maintain ambient air quality where it is good and improve it in other cases with respect to sulphur dioxide, oxides of nitrogen, particulate matter and lead.

Article 2

Definitions

The definitions in Article 2 of Directive 96/62/EC shall apply.

For the purposes of this Directive:

(1) "oxides of nitrogen" shall mean nitric oxide and nitrogen dioxide;

(2) "PM_{10}" shall mean particles which pass through a size selective inlet with a 50% efficiency cut-off at 10 μm aerodynamic diameter;

(3) "$PM_{2.5}$" shall mean particles which pass through a size selective inlet with a 50% efficiency cut-off at 2.5 μm aerodynamic diameter;

(4) "upper assessment threshold" shall mean the level of pollution referred to in Article 6(3) of Directive 96/62/EC;

(5) "lower assessment threshold' shall mean the level of pollution referred to in Article 6(4) of Directive 96/62/EC;

(6) "public information indicator" shall mean a level of pollution such that, if it is exceeded over a given period, this fact shall be recorded in information disseminated pursuant to Article 8 of this Directive.

Article 3

Sulphur dioxide

1. Member States shall take the necessary measures to ensure that concentrations of sulphur dioxide in ambient air, as assessed in accordance with Article 7, do not exceed the limit values set out in Section I of Annex I as from the dates specified therein.

   The margins of tolerance set out in Section I of Annex I shall apply in accordance with Article 8 of Directive 96/62/EC.

2. The alert threshold for concentrations of sulphur dioxide in ambient air is set out in Section II of Annex I. Details supplied to the public in accordance with Article 10 of Directive 96/62/EC shall include as a minimum the items listed in Section III of Annex I.

3. Member States shall record data on concentrations of sulphur dioxide averaged over ten minutes from measuring stations at which hourly concentrations are measured. Member States shall report to the Commission the 98th and 99th percentile of 10-minute concentrations measured within the calendar year at the same time as data are supplied on hourly concentrations.

Article 4

Oxides of nitrogen

Member States shall take the necessary measures to ensure that concentrations of nitrogen dioxide, and where applicable of nitrogen dioxide plus nitric oxide, in ambient air, as assessed in accordance with Article 7, do not exceed the limit values set out in Section I of Annex II as from the dates specified therein.

The margins of tolerance set out in Section I of Annex II shall apply in accordance with Article 8 of Directive 96/62/EC.

Article 5

Particulate matter

1. Member States shall take the necessary measures to ensure that concentrations of PM_{10} in ambient air, as assessed in accordance with Article 7, do not exceed the limit values set out in Section I of Annex III as from the dates specified therein.

   The margins of tolerance set out in Section I of Annex III shall apply in accordance with Article 8 of Directive 96/62/EC.

2. Member States shall install and operate measuring stations to supply data on concentrations of $PM_{2.5}$. Where possible sampling points should be collocated with sampling points for PM_{10}. The number and the siting of stations at which $PM_{2.5}$ is measured shall be chosen by each Member State to be representative of concentrations of $PM_{2.5}$ at local and regional level within that Member State.

   Member States shall forward to the Commission annually, no later than nine months after the end of each year, the arithmetic mean, the median, the 98th percentile and the maximum concentration calculated from measurements of $PM_{2.5}$ over 24 hours within that year. The 98th percentile shall be calculated according to the procedure set out in Annex I, Section 4, to Council Decision 97/101/EC[41].

3. Action plans for PM_{10} prepared in accordance with Article 8 of Directive 96/62/EC and general strategies for decreasing concentrations of PM_{10} shall aim to reduce concentrations of $PM_{2.5}$ as part of the total reduction.

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[41] OJ L 35, 5.2.1997, p. 14.

4. Exceptionally, Member States may designate zones or agglomerations within which limit values for PM_{10} are exceeded owing to significant concentrations of particulate matter in ambient air due to natural sources. Member States shall send to the Commission a first list of any such zones or agglomerations together with information on concentrations and sources of PM_{10} and $PM_{2.5}$ therein within two years of the entry into force of this Directive.

   Within such zones or agglomerations Member States shall apply the action levels and margins of tolerance for $PM_{2.5}$ set out in Section II of Annex III in place of the limit values and margins of tolerance for PM_{10} in determining whether action plans should be prepared in accordance with Article 8 of Directive 96/62/EC. The action levels for $PM_{2.5}$ shall be used as indicative targets, to be met as far as possible by the relevant attainment date.

   Within such zones or agglomerations the upper and lower assessment thresholds for PM_{10} set out in Section I of Annex V shall determine assessment requirements. Continuous measurement stations for particulate matter shall measure PM_{10} and $PM_{2.5}$.

   Within such zones or agglomerations information shall be supplied to the public on concentrations of $PM_{2.5}$ instead of concentrations of PM_{10}.

Article 6

Lead

Member States shall take the necessary measures to ensure that concentrations of lead in ambient air, as assessed in accordance with Article 7, do not exceed the limit values set out in Section I of Annex IV as from the dates specified therein.

The margins of tolerance set out in Section I of Annex IV shall apply in accordance with Article 8 of Directive 96/62/EC.

Article 7

Assessment of concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air

1. Upper and lower assessment thresholds for sulphur dioxide, particulate matter and lead for the purposes of Article 6 of Directive 96/62/EC are set out in Section I of Annex V.

   The classification of each zone or agglomeration for the purposes of the said Article 6 should be reviewed at least every five years in accordance with the procedure set out in Section II of Annex V. Classification should be reviewed earlier in case of significant change to activities relevant to ambient concentrations of sulphur dioxide, nitrogen dioxide or where relevant nitrogen dioxide plus nitric oxide, particulate matter or lead.

2. Annex VI sets out criteria for determining locations of sampling points for the measurement of sulphur dioxide, oxides of nitrogen, particulate matter and lead. Annex VII sets out the minimum number of continuous measurement stations for each relevant pollutant to be installed in each zone or agglomeration within which measurement is required, if measurement is the sole source of data on concentrations within it. The method used to measure each relevant pollutant shall be the reference method specified in accordance with paragraph 4 or a method which can be demonstrated by the Member State concerned to give equivalent results.

3. For zones and agglomerations within which information from continuous measurement stations is supplemented by information from other sources, such as emission inventories, indicative measurement methods and air quality modelling, the number of continuous measuring stations to be installed and the spatial resolution of other techniques shall be sufficient to enable the concentrations of air pollutants to be established at the types of location defined in Section I of Annex VI, within the achievable limits of accuracy set out in the guidelines to be found in Section I of Annex VIII.

4. Reference methods for analysis of sulphur dioxide, oxides of nitrogen and lead, and for sampling of lead, PM_{10} and $PM_{2.5}$ are set out in Sections I to V of Annex IX. Section VI of Annex IX sets out reference techniques for air quality modelling.

5. The date by which Member States shall inform the Commission of the methods used for the preliminary assessment of air quality under Article 11(1)(d) of Directive 96/62/EC shall be 31 December 1999.

6. Any amendments necessary to adapt this Article and Annexes V to IX to scientific and technical progress shall be adopted in accordance with the procedure set out in Article 12 of Directive 96/62/EC.

Article 8

Dissemination of information to the public

1. Member States shall take appropriate steps to disseminate up-to-date information on ambient concentrations of sulphur dioxide, oxides of nitrogen, particulate matter and lead to the public by means, for example, of broadcast media, press, information screens or computer network services and by notification of appropriate organizations such as environmental organizations, consumer organizations, organizations representing the interests of sensitive populations and other pertinent health care bodies. A list of the organizations notified shall be sent to the Commission at the same time as information transmitted under Article 11 of Directive 96/62/EC.

Such information shall indicate exceedances of the public information indicators listed in Sections I to IV of Annex X.

2. The public information indicators of Section V of Annex X shall apply for the purposes of Article 5(4) above.

3. When making plans or programmes available to the public under Article 8(3) of Directive 96/62/EC Member States shall also make them available to appropriate organizations such as environmental organizations, consumer organizations, organizations representing the interests of sensitive populations and other pertinent health care bodies. A list of the organizations notified shall be sent to the Commission at the same time as the plan or programme.

Article 9

Repeals and transitional arrangements

1. Directive 80/779/EEC shall be repealed as follows:

- Articles 2(2), 3(2), 4, 5, 7(3), 10(4), 10(5), 11 to 14, and Annexes II, IIIa and V shall be repealed with effect from 1 January 2000;

- Articles 1, 2(1), 3(1), 6, 7(1), 7(2), 8, 9, 10(1), 10(2), 10(3), 15, and 16, and Annexes I, IIIb and IV shall be repealed with effect from 1 January 2005.

2. Directive 82/884/EEC shall be repealed as follows:

- Articles 3(2), 3(3), 4, 8 to 11 and the Annex shall be repealed with effect from 1 January 2000;

- Articles 1, 2, 3(1), 5, 6, 7, 12 and, 13 shall be repealed with effect from 1 January 2005.

3. Directive 85/203/EEC shall be repealed as follows:

- Articles 3(2), 4, 6, 7(3) 10 to 14, and Annexes II, III and IV shall be repealed with effect from 1 January 2000;

- Articles 1, 2, 3(1), 5, 7(1), 7(2), 8, 9, 15 and 16 and Annex I shall be repealed with effect from 1 January 2010.

4 From 1 January 2000 Member States shall employ measurement stations and other methods of air quality assessment conforming to the requirements of this Directive to assess concentrations of sulphur dioxide, oxides of nitrogen and lead in ambinet air to obtain data for the purpose of demonstrating compliance with the limit values established by Directive 80/779/EEC, Directive 82/884/EEC and Directive 85/203/EEC until such time as the limit values established by those Directives are repealed.

Article 10

Report

The Commission shall submit to the European Parliament and the Council not later than 31 December 2003 a report based on experience of the application of this Directive, and in particular on the results of the most recent scientific research concerning the effects on human health of exposure to sulphur dioxide, to different fractions of particulate matter and to lead, and on progress achieved in methods of measuring and otherwise assessing concentrations of particulate matter in ambient air and the deposition of lead on surfaces.

Article 11

Implementation

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 1999 at the latest. They shall forthwith inform the Commission thereof.

   When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted by Member States.

2. Member States shall communicate to the Commission the text of the main provisions of national law which they adopt in the field covered by this Directive.

Article 12

Penalties

The Member States shall lay down the system of penalties for infringement of the national provisions adopted pursuant to this Directive and shall take all necessary measures to ensure that they are applied. The penalties thus provided for must be effective, proportionate and dissuasive. The Member States shall notify the relevant provisions to the Commission by 31 December 1999 at the latest and shall notify it of any amendments to them without delay.

Article 13

Entry into force

This Directive shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Communities*.

Article 14

Addressees

This Directive is addressed to the Member States.

Done at Brussels,

For the Council
The President

LIMIT VALUES AND ALERT THRESHOLDS FOR SULPHUR DIOXIDE

I. Limit values for sulphur dioxide

Limit values shall be expressed in µg/m^3. The volume must be standardized at the following conditions of temperature and pressure: 293°K and 101.3 kPa

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
1. Hourly limit value for the protection of human health	1 hour	350µg/m^3 not to be exceeded more than 24 times per calendar year	150µg/m^3 (43%) on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2005.	1 January 2005
2. Daily limit value for the protection of human health	24 hours	125µg/m^3 not to be exceeded more than 3 times per calendar year	none	1 January 2005
3. Limit value for the protection of ecosystems, to apply away from the immediate vicinity of sources	calendar year and winter (1 October to 31 March)	20µg/m^3	none	two years from entry into force of the Directive

II. Alert threshold for sulphur dioxide

350µg/m^3 measured over three consecutive hours at locations representative of air quality over at least 100km^2 or an entire zone or agglomeration, whichever is the smaller.

III. Minimum details to be supplied to the public when the alert threshold for sulphur dioxide is exceeded

Details to be supplied to the public should include as a minimum:

- date, hour and place of the occurrence
- forecasts:
  - change in concentrations (improvement, stabilisation, or deterioration)
  - reason for occurrence and expected change
  - geographical area concerned
  - duration
- type of population potentially sensitive to the occurrence
- precautions to be taken by the sensitive population concerned.

LIMIT VALUES FOR NITROGEN DIOXIDE AND NITRIC OXIDE

I. Limit values for nitrogen dioxide and nitric oxide

Limit values shall be expressed in µg/m^3. The volume must be standardized at the following conditions of temperature and pressure: 293°K and 101.3 kPa

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
1. Hourly limit value for the protection of human health	1 hour	200µg/m^3 NO_2 not to be exceeded more than 8 times per calendar year	50% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2010	1 January 2010
2. Annual limit value for the protection of human health	calendar year	40µg/m^3 NO_2	50% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2010	1 January 2010
3. Annual limit value for the protection of vegetation to apply away from the immediate vicinity of sources	calendar year	30µg/m^3 NO + NO_2	none	two years from entry into force of the Directive

ANNEX III

LIMIT VALUES AND ACTION LEVELS FOR PARTICULATE MATTER

I. Limit values for particulate matter

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Stage 1				
1. 24-hour limit value for the protection of human health	24 hours	50µg/m^3 PM_{10} not to be exceeded more than 25* times per year	50% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2005	1 January 2005
2. Annual limit value for the protection of human health	calendar year	30µg/m^3 PM_{10}	50% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2005	1 January 2005
Stage 2				
1. 24-hour limit value for the protection of human health	24 hours	50µg/m^3 PM_{10} not to be exceeded more than 7 times per year	[to be derived from data and to be equivalent to the Stage 1 limit value]	1 January 2010
2. Annual limit value for the protection of human health	calendar year	20µg/m^3 PM_{10}	50% on 1 January 2005 reducing linearly every 12 months thereafter to reach 0% by 1 January 2010	1 January 2010

* Where exceedances are associated with unusual acute effects, the number of exceedances permitted shall be reduced to 14 times per year.

II. $PM_{2.5}$ action levels for the purposes of Article 5(4)

	Averaging period	Action level	Margin of tolerance	Date by which action level should be met as far as possible
1. 24-hour action level for the protection of human health	24 hours	40µg/m³ $PM_{2.5}$ not to be exceeded more than 14 times per year	50% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2005	1 January 2005
2. Annual action level for the protection of human health	calendar year	20µg/m³ $PM_{2.5}$	50% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2005	1 January 2005

ANNEX IV

LIMIT VALUE FOR LEAD

I. Limit values for lead

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Annual limit value for the protection of human health	calendar year	0.5µg/m^3	100% on entry into force of this Directive, reducing linearly on 1 January 2001 and every 12 months thereafter to reach 0% by 1 January 2005	1 January 2005

DETERMINATION OF REQUIREMENTS FOR ASSESSMENT OF CONCENTRATIONS OF SULPHUR DIOXIDE, OXIDES OF NITROGEN, PARTICULATE MATTER AND LEAD IN AMBIENT AIR WITHIN A ZONE OR AGGLOMERATION

I. Upper and lower assessment thresholds

The following upper and lower assessment thresholds shall apply:

a. Sulphur dioxide

	Health protection	Ecosystem protection
Upper assessment threshold	60% of **24-hour** limit value, (75 μg/m^3 not to be exceeded more than 3 times per calendar year)	60% of winter limit value (12 μg/m^3)
Lower assessment threshold	40% of **24-hour** limit value (50 μg/m^3 not to be exceeded more than 3 times per calendar year)	40% of winter limit value (8 μg/m^3)

b. Nitrogen dioxide

	Hourly limit value for the protection of human health	Annual limit value for the protection of human health	Annual limit value for the protection of the vegetation
Upper assessment threshold	60% of limit value (120 μg/m^3 not to be exceeded more than 8 times per calendar year)	70% of limit value (32 μg/m^3)	70% of limit value (21 μg/m^3)
Lower assessment threshold	50% of limit value (100 μg/m^3 not to be exceeded more than 8 times per calendar year)	65% of limit value (26 μg/m^3)	65% of limit value (19.5 μg/m^3)

c. **Particulate matter**

The upper and lower assessment thresholds for PM_{10} are based on the limit values to be met by 1 January 2010.

	24-hour average	Annual average
Upper assessment threshold	60% of limit value (30 µg/m^3 not to be exceeded more than 7 times per calendar year)	70% of limit value (14 µg/m^3)
Lower assessment threshold	40% of limit value (20µg/m^3 not to be exceeded more than 7 times per calendar year)	50% of limit value (10 µg/m^3)

d: **Lead**

	Annual average
Upper assessment threshold	70% of limit value (0.35 µg/m^3)
Lower assessment threshold	50% of limit value (0.25 µg/m^3)

II. Determination of exceedance of upper and lower assessment threshold

Exceedance of upper and lower assessment thresholds shall be determined on the basis of concentrations during the previous five years where sufficient data are available. An assessment threshold shall be judged to have been exceeded if the total number of exceedances of the numerical concentration of the threshold during those five years exceeds three times number of exceedances allowed per year.

Where fewer than five years' data are available Member States may combine measurement campaigns of short duration during the period of the year and at locations likely to be typical of the highest pollution levels with results obtained with information from emission inventories and modelling to determine exceedances of the upper and lower assessment thresholds.

LOCATION OF SAMPLING POINTS FOR ASSESSMENT OF CONCENTRATIONS OF SULPHUR DIOXIDE, OXIDES OF NITROGEN, PARTICULATE MATTER AND LEAD IN AMBIENT AIR

The following considerations apply to continuous and quasi-continuous measurement.

I. Macroscale siting

a. Protection of human health

Sampling points directed at the protection of human health should be sited:

(i) to provide data on the areas within zones and agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s);

(ii) to provide data on levels in other areas within the zones and agglomerations which are representative of the exposure of the general population, and which provide information for air quality management purposes.

Sampling points should in general be sited to avoid measurement of very small microenvironments in their immediate vicinity.

Sampling points may be representative of similar locations not in their immediate vicinity.

b. Protection of ecosystems and other vegetation

Sampling points targeted at the protection of ecosystems or other vegetation should be sited to be representative of air quality away from the immediate vicinity of sources such as agglomerations and other built-up areas, industrial installations and roads. As a guideline a sampling point should be sited to be representative of air quality in a surrounding area of at least 1 000km^2.

II. Microscale siting

As a minimum the following guidelines should be met as far as practicable:

- The flow around the inlet sampling probe should be unrestricted without any obstructions affecting the air flow in the vicinity of the sampler (normally some metres away from buildings, balconies, trees, and other obstacles and at least 0.5 metres from the nearest building in the case of sampling points representing air quality at the building line);

- In general, the inlet sampling point should be between 1.5m (the breathing zone) and 4m above the ground. Higher positions (up to 8m) may be necessary in some circumstances. Higher siting may also be appropriate if the station is representative of a large area;

- the inlet probe should not be positioned in the very near vicinity of sources in order to avoid direct intake of emissions unmixed with ambient air;

- the sampler's exhaust outlet should be positioned so that recirculation of exhaust air to the sample inlet is avoided;

- traffic-orientated samplers should be at least 25 metres from major junctions and should be no less than 4m from the centre of the nearest traffic lane;

- traffic-orientated samplers for the measurement of NO_2 should be sited less than 5 metres from the kerb side;

- in built-up areas, traffic-orientated samplers for the measurement of particulate matter or lead should be sited to be representative of air quality close to the building line.

The following factors may also be taken into account:

- interfering sources;
- security;
- access;
- availability of electrical power and telephone communications;
- visibility of the site in relation to its surroundings;
- safety of public and operators;
- the desirability of collocating sampling points for different pollutants;
- planning requirements.

III. Documentation and review of site selection

The site selection procedures should be fully documented at the classification stage by such means as compass point photographs of the surrounding and a detailed map. Sites should be reviewed at regular intervals with repeated documentation to ensure that selection criteria remain valid over time.

Member States intending to close or move measurement stations established under Directives 80/779/EEC, 82/884/EEC and 85/203/EEC for the assessment of concentrations of sulphur dioxide, nitrogen dioxide and lead shall supply information to support this decision to the Commission.

CRITERIA FOR DETERMINING NUMBERS OF SAMPLING POINTS FOR CONTINUOUS MEASUREMENT OF CONCENTRATIONS OF SULPHUR DIOXIDE, OXIDES OF NITROGEN, PARTICULATE MATTER AND LEAD IN AMBIENT AIR

I. Minimum number of sampling points for continuous measurement to assess compliance with limit values for the protection of human health and alert thresholds in zones and agglomerations where continuous measurement is the sole source of information

a. Diffuse sources

Population of agglomeration or zone	If concentrations exceed the upper assessment threshold	If maximum concentrations are between the upper and lower assessment thresholds	For SO_2, in agglomerations where maximum concentrations are below the lower assessment threshold
250 000	2	1	1
500 000	2	1	1
750 000	3	1	1
1 000 000	4	2	1
1 500 000	5	2	1
2 000 000	6	3	2
2 750 000	7	3	2
3 750 000	8	4	2
4 750 000	9	4	2
6 000 000	10	5	3
	For NO_2 and particulate matter: to include at least one urban background station and one traffic-orientated station		

b. Point sources

For the assessment of pollution in the vicinity of point sources, the number of sampling points for continuous measurement should be calculated taking into account emission densities, the likely distribution patterns of ambient air pollution and potential exposure of the population.

II. Minimum number of sampling points for continuous measurement to assess compliance with limit values for the protection of ecosystems or other vegetation in zones other than agglomerations

If maximum concentrations exceed the upper assessment threshold	If maximum concentrations are between the upper and lower assessment threshold
1 station per 20 000km^2	1 station per 40 000km^2

DATA QUALITY OBJECTIVES AND COMPILATION OF RESULTS OF AIR QUALITY ASSESSMENT

I. Data quality objectives

The following data quality objectives, for required precision and accuracy of assessment methods, and of minimum time coverage and data capture of measurement provided to guide quality assurance programmes.

	Nitrogen dioxide and sulphur dioxide	Particulate matter and lead
Continuous measurement		
Accuracy and precision of individual measurements	15%	25%
Minimum data capture	90%	90%
Minimum time coverage	100%	100%
Indicative measurement		
Accuracy and precision of individual measurements	25%	50%
Minimum data capture	90%	90%
Mminimum time coverage	20% (every fifth day, or ten weeks evenly distributed over the year, or at random throughout the year)	20% (every fifth day, or ten weeks evenly distributed over the year, or at random throughout the year)
Modelling		
Daily averages	50%	p.m.
Monthly averages	40%	-
Annual averages	30%	50%
Objective estimation	75%	100%

II. Results of air quality assessment

The following information should be compiled for zones or agglomerations within which sources other than measurement are employed to supplement information from measurement, or as the sole means of air quality assessment:

- a description of assessment activities carried out;
- specific methods used, with references to descriptions of the method;
- sources of data and information;
- a description of results, including uncertainties and in particular, the extent of any area or, if relevant the length of road within the zone or agglomeration over which concentrations exceed limit value(s), or as may be limit value(s) plus applicable margin(s) of tolerance and of any area within which concentrations exceed the upper assessment threshold or the lower assessment area;
- for limit values whose object is the protection of human health, the population potentially exposed to concentrations in excess of the limit value.

Where possible Member States should compile maps showing concentration distributions within each zone and agglomeration.

ANNEX IX

REFERENCE METHODS FOR ASSESSMENT OF CONCENTRATIONS OF SULPHUR DIOXIDE, OXIDES OF NITROGEN, PARTICULATE MATTER AND LEAD

I. Analysis of sulphur dioxide

[Annex V of Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates]

II. Reference method of analysis of oxides of nitrogen

[Annex IV of Council Directive 85/203/EEC of 7 March 1985 on air quality standards for nitrogen dioxide]

III. Sampling method and reference method of analysing the concentration of lead in air

[Annex of Council Directive 82/884/EEC of 3 December 1982 on lead in ambient air]

IV. Reference method for sampling PM_{10}

The reference method used to sample PM_{10} shall be the method described in prEN 12341[42].

V. Reference method for sampling $PM_{2.5}$

p.m.

VI. Reference modelling techniques

p.m.

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42 "Air Quality - Field test Procedure to demonstrate reference equivalence of sampling methods for the PM_{10} fraction of particulate matter".

PUBLIC INFORMATION INDICATORS

I. Public information indicators for sulphur dioxide

Concentration	Averaging time	Type of station
Hourly health protection indicator: 350µg/m^3	1 hour	any
Daily health protection indicator: 125µg/m^3	24 hours	any
Vegetation protection indicator: 20µg/m^3	one year	station targeted at protection of vegetation

II. Public information indicators for oxides of nitrogennitrogen dioxide

Concentration	Averaging time	Type of station
Short-term health indicator: 200 µg/m^3 NO_2	**1 hour**	**any**
Long-term health indicator: 40µg/m^3 NO_2	**one year**	**any**
Vegetation indicator: 30 µg/m^3 $NO + NO_2$	**one year**	**station targeted at protection of vegetation**

III Public information indicators for PM_{10}

Concentration	Averaging time	Type of station
Short-term health indicator: 50µg/m3	**24 hours**	**any**
Long-term health indicator: 30µg/m3	**one year**	**any**

IV. Public information indicator for lead

0.5µg/m^3 measured over a calendar year

V. Public information indicators for $PM_{2.5}$ for the purposes of Article 5(4)

Concentration	Averaging time	Type of station
Short-term health indicator: 40 µg/m3	**24 hours**	**any**
Long-term health indicator: 20 µ/gm3	**one year**	**any**

VI. Standardization

For sulphur dioxide and oxides of nitrogen the volume must be standardized at the following conditions of temperature and pressure: 293°K and 101.3 kPa.

IMPACT ASSESSMENT FORM

The Impact of the Proposal on Business with Special Reference to Small and Medium-Sized Enterprises (SMEs)

TITLE OF THE PROPOSAL

Proposal for a Directive of the Council Relating to Ambient Air Quality Limit Values for Sulphur Dioxide, Oxides of Nitrogen Dioxide, Particulate Matter and Lead.

Reference Number (Repertoire):

1. TAKING INTO ACCOUNT THE PRINCIPLE OF SUBSIDIARITY, WHY IS COMMUNITY LEGISLATION NECESSARY IN THIS AREA AND WHAT ARE ITS MAIN AIMS?

On 27 September the Council adopted Directive 96/62/EC 1996 on Ambient Air Quality Assessment and Management (the Air Quality Framework Directive). As the Explanatory Memorandum to this Directive explained[43], it provides a framework for future EC legislation on air quality. It is fully in line with objectives of Article 130r of the Treaty, which include preservation, protection and improvement of the quality of the environment and protection of human health. It is aimed in particular at fulfilling the objectives of the 5th Action Programme for ambient air quality. These are the effective protection of the population of the Community against recognized risks from air pollution and the establishment of permitted concentrations of air pollutants which take into account the protection of the environment.

Article 4 of the Air Quality Framework Directive requires the Commission to bring forward daughter proposals filling in the framework which it provides for individual pollutants. Daughter proposals will, amongst other things, establish air quality limit values and elaborate requirements for assessing levels of pollution. The first pollutants to be dealt with are those for which EC legislation already exists. They are:

- sulphur dioxide (Council Directive 80/779/EEC of 15 July 1980);
- nitrogen dioxide (Council Directive 85/203/EEC of 20 December 1985);
- particulate matter (Council Directive 80/779/EEC of 15 July 1980);
- lead (Council Directive 82/884/EEC of 3 December 1982).

Limit values were established early for these substances owing to their ubiquity in the atmosphere and the importance of their potential effects on human health and the environment. They remain the first priority for further action under the Air Quality Framework Directive. Implementation of the existing legislation has revealed a number of areas, including harmonisation of assessment strategies and reporting of information, which require further attention. In addition, research into

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43 COM(94) 109 final, 4 July 1994.

the effects of air pollution has continued since the above legislation came into force. The present proposals will update limit values in the light of the results of this research.

2. WHO WILL BE AFFECTED BY THE PROPOSAL?

- Which Sectors of industry?

The present proposals fix objectives for ambient air concentrations of sulphur dioxide, nitrogen dioxide (or, in some circumstances, the sum of nitrogen dioxide and nitric oxide), particulate matter and lead. Existing and planned EC legislation on emissions from vehicles and industry, and other internationally agreed action will go a long way towards meeting these targets. It is left to Member States to determine what further local action should be taken in order to improve air quality in those places where there is a risk that limit values may still not be met. The Directive does not therefore directly impose requirements on industry and the impact may vary from place to place depending on Member States' decisions about suitable measures.

Clearly however some sectors are more likely to be affected than others by the proposed limit values for the various substances. A study carried out for the Commission by the Institute for Environmental Studies (IVM) at Vrije Universiteit Amsterdam[44] has evaluated economic impacts including the measures most likely to be cost-effective as part of local action plans. The study looked at regional level air quality and at cities for which air quality data were available. It took into account expected reductions in emissions as a result of existing EC legislation, the proposals resulting from the Auto-Oil I programme and firm commitments by Member States to reduce sulphur emissions within the framework of the United Nations Economic Commission for Europe Convention on Long-Range Transport of Air Pollution. It did not take account of the strategy subsequently developed by the Commission to combat acidification.

Sulphur dioxide

The economic evaluation carried out for the Commission found that some 9% of cities studied, containing 23% of the population analysed, remain at risk of not meeting proposed limit values by 2010 on current trends. A further reduction in emissions of some 10% over current trends would be needed to meet the limit values. This would in general be achieved most cost-effectively by reductions in emissions from industrial processes and by use of low sulphur fuels.

Since the study was carried out the Commission has brought forward a strategy for combating acidification, accompanied by proposals to reduce the sulphur content of heavy fuel oil from 1 January 2000 and of gas oil from 1 January 1999[45]. This measure will contribute greatly to meeting the proposed limit values by the earlier date of 1 January 2005. Further local action may be required in some areas, depending on patterns of local fuel use and of industrial and domestic emissions.

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44 Economic Evaluation of Air Quality Targets for Sulphur Dioxide, Nitrogen Dioxide, Fine and Suspended Particulate Matter and Lead: Second Interim Report.

45 COM(97) 88 final, 12.3.1997.

These proposals are not expected to have any significant effect on the importation of heavy fuel oil from countries outside the EC.

Oxides of Nitrogen

Of the cities investigated some 31%, including 33% of the population covered by the analysis, remain at risk of not meeting proposed limit values by 2010 after new emission limits for road vehicles and other trends in emissions are taken into account. A further reduction in emissions of some 8% would be needed to meet limit values in these cities. The options for achieving these reductions are:

- traffic management (i.e. road pricing) - the most cost-effective action;

- the introduction of buses fuelled with Liquid Petroleum Gas (LPG) or Compressed Natural Gas (CNG);

- further measures to control emissions from stationary sources. (This is generally the least cost-effective option because such many sources are located away from the areas most at risk.)

Traffic management would impact on all road users within a locality. The introduction of alternative fuels for buses would affect transport providers, bus manufacturers and fuel providers. No estimate can be given of the sectors affected by measures to reduce emissions from stationary sources. This will depend on the pattern of industrial development in localities at risk.

Particulate matter

Particulate matter is a complex mixture rather than a single pollutant. There are many ways of measuring it, each of which provides a different indicator of the mix. The present Directive proposes limit values for particulate matter measured as PM_{10}[46]. Many different sources contribute to concentrations of PM_{10}. PM_{10} is emitted directly by combustion sources. Road transport is an important contributor in population centres. Domestic and industrial combustion can also be locally important. Many industrial processes emit PM_{10} and there are a number of natural sources such as sea salt and wind-blown dusts. PM_{10} is also formed as a secondary pollutant from reactions between emissions of other pollutants, primarily SO_2, NO_2, ammonia and volatile organic compounds.

Data on future trends in emissions are available only for combustion sources. The study carried out for the Commission took these trends into account for both primary and secondary PM_{10}. On this basis some 70% of the cities included in the analysis, with 60% of the study population, are at risk of not meeting proposed limit values by 2010.

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46 The mass of particulate matter less than 10 microns in diameter. This method of measuring particles is relatively new. Existing EC legislation uses older methods to indicate concentrations of particles.

If limit values are to be met throughout the Community further measures will be necessary at EC and local level. The Auto-Oil II programme is presently looking at the cost-effectiveness of further measures to reduce emissions of PM_{10} from mobile and stationary sources. The Commission will bring forward proposals for vehicle emission standards and fuel quality standards resulting from the programme by the end of 1998. Measures taken under the IPPC Directive will further reduce emissions from industrial installations. Additional local action will be determined by Member States and will depend on the pattern of sources in a given locality.

Lead

With the phasing out of lead in petrol concentrations of lead in ambient air are expected to fall to well below the proposed limit value of $0.5\mu g/m^3$ everywhere except in the immediate vicinity of certain industrial sources. The main sector affected is lead smelting. Smelters of other non-ferrous metals may also give rise to relatively high emissions of lead. It has been suggested by industry that some manufacturers of lead-acid batteries may also be affected by the proposals but data are not available.

- **Which Sizes of Business?**

It is not possible to analyse in detail the size of business potentially affected for SO_2, NO_2, and PM_{10}, since local action plans will depend on the distribution of emission sources in the particular area at risk. It is likely however that small and medium enterprises will bear control costs for these pollutants. In the case of SO_2 in particular, reductions in process emissions have been identified as part of the most cost-effective package for meeting proposed limit values. Larger industries are already tightly regulated and costs in some areas may therefore fall mainly on small and medium enterprises. Case studies carried out using information on lead plants supplied by the Lead Development Association cover about half the European production capacity. It is expected that action beyond that already planned will be necessary mainly at some primary and secondary non-ferrous smelters. Sales and employment figures supplied to the Commission suggest that none of these falls within the definition of a small or medium-sized enterprise.

- **Overall impact**

A study of economic impacts carried out for the Commission indicated that exceedances of proposed limit values for SO_2, NO_2, and particulate were likely to be confined to cities. Exceedances of the proposed limit value for lead would be confined to the immediate vicinity of certain industrial plants. For the cities for which air quality data are available, and for industrial plants which emit lead, overall costs have been estimated at ECU 0.1 to 0.7 billion per year. Benefits for these locations have been estimated and where possible a monetary value has been assigned to them. The total is ECU 5.5 - 60 billion per year[47].

The low estimates for costs are those for emissions reductions needed to reduce the average city concentration to meet the limit values. The high estimates make allowance for further reductions to deal with peak concentrations. The large range for particulate matter reflects uncertainties in data on both emissions and abatement costs. The ranges for benefit estimates reflect uncertainties in dose-effect functions and in valuation of mortality.

If the cities studied are representative of the cities in the EC as a whole, extrapolation suggests that overall costs may vary between ECU 0.3 and 2.9 billion per year. Benefit estimates have not been extrapolated. Dose-response relationships for some health outcomes appear to be linear. Additional reductions in emissions within cities should reduce impacts on populations in neighbouring regions. These cannot be captured by extrapolating the estimates for cities alone. (See Table 1).

Table1. Costs and benefits (ECU million/year)

Pollutant	Estimated costs for cities with data	Estimated benefits for cities with data	Estimated Community-wide costs
Sulphur dioxide	4 - 48	85 - 3 784	12 - 150
Nitrogen oxides	5 - 285	408 - 5 900	15 - 855
Particulate matter	50 - 300	5 000 - 5 1250	250 - 1 500
Lead	12 - 40	3.5 - 5.8	12 - 40[48]
Total	**71 - 673**	**5497 - 60940**	**299 - 2 875**

47 Estimated benefits relate mainly to human health and are derived partly by use of the concept of Value of Statistical Life (VOSL). This is a measure of Willingness to Pay to avoid certain risks. It is not a measure of the value of life. Benefit figures do not such items as damage to valuable ecosystems or cultural heritage, to which monetary values cannot be easily assigned. Estimated costs include control costs only. See Section 3 of the explanatory memorandum accompanying the proposals for a full discussion.

48 Costs for lead relate to specific industrial sites, not to the general urban environment and are therefore not extrapolated.

- **Are There Particular Geographical Areas of the Community Where These Businesses Are Found?**

Sulphur dioxide

Problem areas are most likely to be found in southern Member States. Some cities in northern Europe in which coal is still an important source of domestic heating may also remain at risk.

Oxides of Nitrogen

Of the cities studied those most at risk of not meeting limit values are concentrated in southern Member States. More limited local action may also be required elsewhere.

Particulate matter

For PM_{10} the database on present air quality covers only 35 cities. No data are available for Austria, Belgium, Denmark, Ireland, Italy, Greece and Finland. This limits the possibilities for extrapolating results and for analysis of geographical differences in impact. Available data suggest increasing trends in concentrations within the Community from north to south and from west to east. Some of this trend may be due to the greater contribution from natural sources in the drier southern Member States. The Commission's proposals include special provisions for areas where there are high concentrations of natural PM_{10}.

Lead

The concentration of lead in air in the immediate vicinity of an industrial installation depends on a number of factors, including the capacity and design of the plant. Case-by-case information obtained from industry suggests that the proposed limit value will not be met by the application of BAT alone near certain industrial installations in Belgium, Germany, France and the United Kingdom.

3. WHAT WILL BUSINESS HAVE TO DO TO COMPLY WITH THE PROPOSAL?

Existing EC legislation on emissions from vehicles and industry, and other internationally agreed action will do much to ensure that limit values are met in many parts of the Community. The cost-effectiveness of further EC measures in respect of mobile sources and, where appropriate, stationary sources also, will be considered during the Auto-Oil II programme. It is left to Member States to determine the most appropriate additional according to local circumstance where this is still necessary. For sulphur dioxide, nitrogen dioxide, and particulate matter a range of options is likely to be available. For lead, it will be necessary to reduce emissions from some industrial plant, particularly fugitive emissions from certain primary and secondary non-ferrous metal smelters.

4. WHICH ECONOMIC EFFECTS IS THE PROPOSAL LIKELY TO HAVE?

- On Employment and Investment and the Creation of New Businesses

The additional costs entailed in meeting proposed new limit values for SO_2 and NO_2 are small and are not expected to have a large impact on business. The additional costs for meeting limit values for PM_{10} are low relative to the GDP of the Community as a whole, but are subject to greater uncertainty. The Commission's proposal for a two-stage strategy takes account of this uncertainty. The limit values for the vehicle related pollutants (NO_2 and particulate matter) will encourage the wider use of vehicles fuelled by cleaner fuels such as CNG and LPG, and the development of new technologies, such as particle traps, for reducing exhaust emissions from conventionally fuelled vehicles. Estimated investment costs for individual lead production plants vary from 0.5 to 3% of the lead sales. Additional costs for the sources of pollution should be offset against increased sales, value added and employment for those sectors which supply the abatement technologies. The positive effects on employment, investment and the creation of new business will be amplified by the quality of the value added, since in it based on newly developed technologies, thereby stimulating technical progress.

- On the Competitiveness of Business

The proposals are not expected to affect the competitiveness of most sectors. Individual lead production plants, particularly older plants which tend to have most difficulty in managing fugitive emissions and those plants which are already making losses are most likely to be adversely affected.

5. DOES THE PROPOSAL CONTAIN MEASURES TO TAKE INTO ACCOUNT THE SPECIFIC SITUATION OF SMALL AND MEDIUM SIZED FIRMS (REDUCED OR DIFFERENT REQUIREMENTS, ETC)?

Given that the proposals set ambient air quality standards, rather than imposing direct requirements on business, no explicit provisions are made for small and medium-sized enterprises.

However, the framework of the Air Quality Framework Directive is designed to limit the impact of actions resulting from daughter legislation, with the major effort in terms of monitoring and remedial measures concentrated in the areas where pollution levels are highest.

Of the four pollutants dealt with in the present proposals, particulate matter has the greatest potential impact on human health. The emissions database and possible abatement options for particulate matter are however less well-developed for particulate matter than for other pollutants. The present proposals therefore set up a two stage process for particulate matter, with a first set of limit values to be met by 1 January 2005 and a second more stringent set to be met by 1 January 2010. The Commission will report to Council and Parliament by 31 December 2003 at the latest on the most recent advances in scientific and technical knowledge of particulate matter and its effects and may propose amendments to the second stage targets if appropriate. The two stage process will provide Member States with the flexibility to set different timetables for any local requirements for different sectors or different sizes of business.

6. CONSULTATION

In preparing its proposals the Commission has drawn on position papers prepared by small technical working group, consisting of experts from five or six Member States, industry, NGOs, the European Environment Agency, the World Health Organization, representatives of other international scientific groups and the Commission. During 1996 and 1997 the Commission held four meetings of the Steering Group on Ambient Air Pollution to discuss the progress of this work and of the separate economic evaluation (8-9 February 1996, 2-3 May 1996, 17-18 December 1996, 13-14 February 1997). The following is a summary of the position of the Industry organizations as expressed at the last meeting held on 13-14 February and in subsequent correspondence.

Sulphur dioxide

UNICE considers that the attainment date for meeting the new limit values should be 2010 in view of the investments that industry is already making to reduce emissions under previously agreed measures. These previously agreed measures do not include proposals to reduce the sulphur content of certain liquid fuels from 1999 and 2000. These further measures will result in early additional reductions in emissions of SO_2 in the areas where the population is most at risk of exposure to concentrations above the proposed limit values. In the light of this, and of recent studies in Europe and the United States which suggest associations between health outcomes and changes in concentration of SO_2 at concentrations below the WHO Guidelines on which the proposed limit values are based, the Commission believes that an attainment date of 2005 is desirable and practical.

Nitrogen dioxide

UNICE considers that the proposed hourly limit value 200 $\mu g/m^3$ as a 99.9th percentile of values measured throughout the year will be difficult to meet, particularly around point sources. 200 $\mu g/m^3$ is the hourly WHO Guideline for NO_2 for the protection of human health. A limit value of 200 $\mu g/m^3$ as a 98th percentile of hourly values measured throughout the year has been in force since 1 July 1987 under Council Directive 85/203/EEC. This means that the concentration may be exceeded for 178 hours during the year. Information supplied by Member States shows that this existing limit value is widely met, with problems remaining only in some southern Member States owing, to local climatic conditions.. Emissions of NO_2 are expected to decline across the Community from 13 370 ktons in 1990 to 6 291 ktons by 2010 as a result of actions agreed or adopted by the Commission prior to 1997. The acidification strategy subsequently adopted by the Commission will result in further reductions beyond this. The Commission considers that the proposed new limit value for NO_2 is a practical advance in the protection of human health against air pollution.

Particulate matter

UNICE's general concern about uncertainties with respect to the effects of pollution and costs of abatement is strongest for particulate matter. They agree that a two stage process to particulate matter is sensible. They suggest however that provisional limit values only should be set until further data are available.

The Air Quality Framework Directive does not envisage the setting of such provisional limit values. Action both to reduce concentrations and to gather the data which will enable goals and strategies to be further refined as progress is made is linked to binding limit values. The Commission considers that the two stage process which will be initiated by the present Directive provides the necessary platform for progress. It believes, in the light of recent studies on health effects of particulate matter that practical first steps must be taken to reduce concentrations of as soon as possible. It agrees that the strategy for dealing with this pollutant in the Community must nevertheless provide for the further refinement of goals and measures once more information has become available as a result of these first steps. The two stage strategy which will be initiated by the present proposals is a sound basis for both immediate action and adaptation to developing knowledge.

Lead

UNICE argue that special conditions should be established for lead in air in the immediate vicinity of identified industrial plants, which can be shown to be unable to meet the proposed limit value of 0.5 $\mu g/m^3$ by 2005 by application of BAT alone. They suggest a limit value of 1.0 $\mu g/m^3$, to be reviewed in 2003. The review would consider whether revised standards could be set for 2010, and in particular whether a setting a deposition limit value might better address lead in the immediate vicinity of such plants. The Commission notes that concentrations in the vicinity of some lead smelters are already below 0.5 /μgm^3. It is not therefore persuaded of the necessity to set a higher limit value for others. It agrees that the technical feasibility of developing a deposition limit value for lead should be kept under review. It therefore proposes to report further on lead to Council and the European Parliament by 31 December 2003 at the latest.

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