COMMISSION OF THE EUROPEAN COMMUNITIES

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Proposal for a
COUNCIL DIRECTIVE

relating to limit values for benzene and carbon monoxide 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.

The proposed Directive is only part of an integrated package of measures designed to combat problems of air pollution. Annex I of the Air Quality Framework Directive lists atmospheric pollutants to be taken into consideration in the assessment and management of ambient air quality. A common position on limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead was reached on 24 September 1998. Benzene and carbon monoxide are listed in Annex I of the Air Quality Framework Directive among "other air pollutants". The present proposal fixes limit values including attainment dates for these two pollutants, gives requirements for assessment of concentrations, and provides for the dissemination of information about the pollutants to the public. Another proposal is now being developed for ozone, together with a strategy for reducing emissions of precursors of ozone. This will include provisional national emission ceilings for NOx and VOCs. Further proposals will be made for poly-aromatic hydrocarbons, cadmium, arsenic, nickel and mercury.

2. REQUIREMENTS OF THE AIR QUALITY FRAMEWORK DIRECTIVE

Article 4 of the Air Quality Framework Directive requires that daughter legislation on benzene and carbon monoxide 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 values;
- 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, Non Governmental Organisations, the European Environment Agency, the World Health Organisation 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 Group on benzene was chaired by an expert from a Member State. The Working Group on carbon monoxide was chaired by the Commission.

3.2 Economic aspects

A separate study entitled "Economic evaluation of air quality targets for carbon monoxide and benzene" was undertaken by consultants to the Commission. The study took as its baseline the measures already agreed under the Auto-Oil Programme for the year 2000, and the first daughter Directive on SO_2, NO_x, particulate matter and lead. Its purpose was to determine what additional action would be needed in order to meet limit values for CO and benzene, and to estimate the additional costs and the likely benefits.

It is important to note that the implementation of policy proposals requires the use of valuable resources that could be used for other purposes. The money spent on abatement costs could perhaps be spent on another policy with higher benefits. That is, there are always opportunity costs of implementing a proposal. The cost-benefit analysis of a particular proposal is limited because it does not explicitly consider these opportunity costs. Nevertheless, the cost-benefit analysis does provide an estimate of the effects on overall welfare of adopting the proposed targets.

The study of CO and benzene took the work of the Auto-Oil Programme as a starting point, as this programme provided considerable information on pollution levels and trends in a number of European cities. Three case study cities were selected, and for each an analysis of the costs and benefits of controlling benzene and CO pollution was performed. These results were then extrapolated to the European level. This approach has the advantage of making best use of city level

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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'.

information. However, it has the disadvantage that the extrapolation to the EC level requires simplifying assumptions.

The Auto-Oil Programme did not consider the relationship between peak and background concentrations, and how these affect overall exposure to these pollutants. The merit of the study carried out here is that the relationship between urban background and "hot spots" is explicitly taken into account. Despite this advance there remain considerable uncertainties surrounding the analysis. In particular, there are significant uncertainties about the risk to health posed by these pollutants. In addition, current and future concentrations and exposure are difficult to estimate, particularly in the hotspots in which concentrations are highest.

Reference scenarios for each city 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 1997 (including standards agreed for the year 2000 in the Common position of Auto-Oil). These scenarios were based on modelling work undertaken in Auto-Oil, amended where necessary to reflect improvements in available information. The scenarios are described in Annex I, and in the consultant's report.

Quantification of benefits

The present study considered impacts on mortality from exposure to benzene pollution and impacts on health from exposure to CO pollution. Where possible, benefits were quantified in monetary terms in order to allow them to be compared with the costs of meeting the limit values.

The value in monetary terms that should be attached to the benefits of reducing effects of pollution on health is a subject of considerable debate. The benefit estimates reported here (for benzene only) make use of the Value of Statistical Life (VOSL) approach. This is a well-established approach that assesses benefits by using an estimate of what people are willing to pay to reduce risks of mortality. A VOSL of ECU 3.1 million was used for each fatality. This figure is in line with work done to synthesise research on benefit estimation under the DG XII EXTERNE programme.

There has been some debate about the appropriateness of using the VOSL for cases where the reduction in life expectancy attributable to exposure to pollution is small. This is often the case for acute effects associated with pollutants such as SO2 and NOx, where pre-existing chronic respiratory or cardiac disease is a factor in death. However, in the case of benzene pollution it is evident that the pollutant has a more fundamental role in premature mortality than might be the case for acute health affects associated with other air pollutants. The benefit estimates reported here are therefore based on the VOSL approach.

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 Organisation Air Quality Guidelines for Europe, the Commission signed a Common Agreement with the World Health Organisation'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 and will shortly be published[3]. All relevant working documents were made available to the two 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. The proposed limit value for carbon monoxide is equal to the WHO eight-hour guideline of 10μg/m^3. The WHO guideline for benzene was also taken into account when proposing a limit value for benzene (see Section 4.2).

According to the Article 7 of the Directive, the Commission shall submit to the European Parliament and the Council, no later than 31 December 2004, a report which will be accompanied by proposals for amendment if appropriate. Any updating of the limit values will be based on sound science, considering also the results of research implemented within the Environment and Climate Programme of DG XII, particularly in relation to air quality, both chemistry, modelling and impacts of air pollutants on human health and environment. The Scientific Committee for Toxicity, Ecotoxicity and Environment will be consulted early in the process for the review foreseen in 2004 and in the meantime, it will assist the Commission in monitoring scientific developments in order to signal any new data relevant for the establishment of air quality limit values.

The report will be presented as an integral part of an air quality strategy, designed to review and propose Community air quality objectives and develop implementing strategies to ensure the achievement of those objectives (see Section 4.8 below).

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

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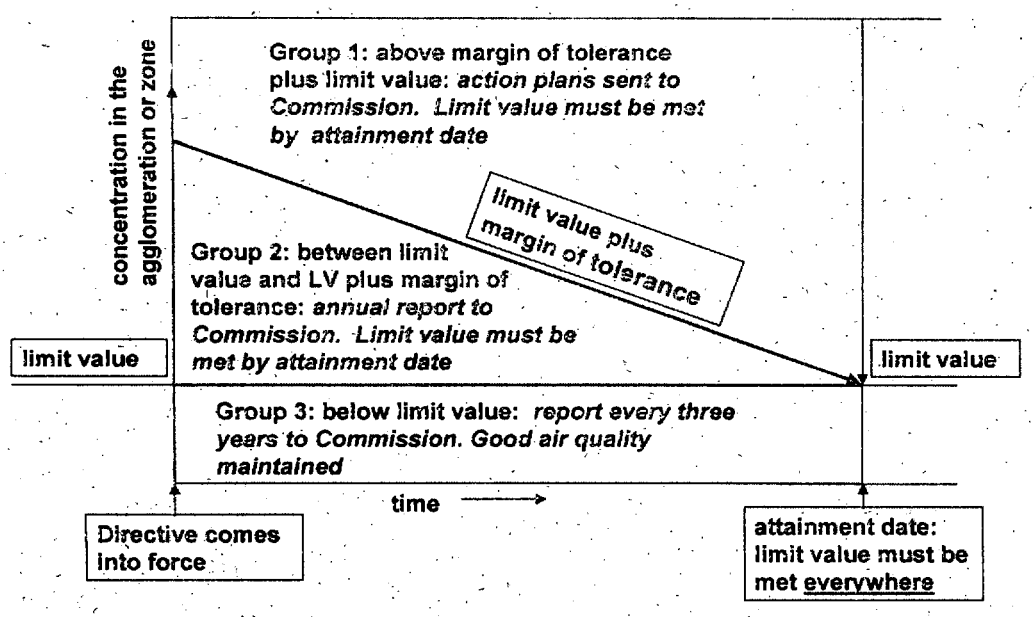
3 Second edition of the WHO Air Quality Guidelines for Europe, WHO, Copenhagen, Denmark, 1998, in press.

(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 recognises that it may not be appropriate to set alert thresholds for all pollutants.

The present proposal does not include an alert threshold for benzene. Benzene is a human genotoxic carcinogen; its effects on human health at concentrations likely to be found in ambient air are associated with long-term exposure.

The proposal does not include an alert threshold carbon monoxide either. Brief exposure to high concentrations of CO can cause serious health damage, even death. But the concentrations needed to cause damage are almost unimaginable in outdoor air. An alert threshold would therefore have no practical effect.

Article 1 of the Air Quality Framework Directive envisages alert thresholds as only one element of public information strategies. The present proposal requires that up-to-date information about benzene and carbon monoxide should be regularly and actively supplied to the public and appropriate organisations, and that this information should identify when concentrations in the limit values have been exceeded, and should be clear, comprehensible and accessible.

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. 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 present proposal refers to these two levels as the upper and lower assessment thresholds. Table 1 summarises 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[4]
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 pollutant, 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.

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4 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[5], 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[6]. It is anticipated that further guidance will be developed as experience grows. A Working group on the implementation of the Article 6 of the "Air quality framework Directive" will be set up. 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 Article 3 of 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 benzene and carbon monoxide.

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5 OJ L 35, 5.2.1997, p. 14.

6 Guidance on assessment of air quality: available from the Commission.

4. BENZENE

4.1 Background

Benzene is a volatile organic compound, with a very stable chemical ring structure (C_6H_6) that constitutes the base of the aromatic hydrocarbon family. A colourless liquid at ambient temperature, benzene has, however, an appreciable evaporation rate, being easily identified at high concentrations by its aromatic odour.

Benzene is a typical solvent in certain organic chemical industries, and due to its carcinogenic effect on humans its concentration level is strictly regulated in workplace areas. Benzene is also found in ambient air at high concentrations in urban conglomerations. The largest source of benzene in outdoor air is vehicle traffic. Benzene is presently found in gasoline at concentrations ranging from 1 to 5%, and is emitted in the atmosphere due to evaporative processes during refuelling and transport, and to incomplete combustion processes by automotive traffic. Benzene is a chemical that people may also be exposed to in the vicinity of certain industrial workplaces.

Benzene is a known human genotoxic carcingon: it is classified by the International Association on the Risks of Cancer (IARC) as a Class 1 carcinogen. Therefore the protection of human health plays a particularly prominent role in setting a limit value for benzene in ambient air.

4.2 Existing legislation

There is at present no EC ambient air quality limit value for benzene.

There are however a number of instruments controlling emissions of benzene from stationary and mobile sources. In particular the IPPC Directive 96/61/EC will bring 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. As a result of the Auto-Oil conciliation agreement reached on 29 June 1998, the Council and the European Parliament have decided to limit the percentage of benzene in petrol to 1% in 2000.

In the field of health and safety at work, a directive, related to carcinogenic agents, includes a limit value for benzene[7].

4.3 Sources of benzene

Natural sources of benzene are very minor and all the benzene observed at ground level in the northern hemisphere is likely to have resulted from human activities, in particular the use of petrol and oil.

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7 Directive 97/42/EC adopted on 27 June 1997 – OJ L 179, 8.7.1997, p. 4.

Benzene is present in petrol and can escape into the air, for example at filling stations. While people working with petrol, in its manufacture and distribution, might be expected to derive their main exposure from this source, the major part of benzene is produced by chemical reactions occurring during combustion of petrol in the engine. Within the EC, road transport accounts to 80/85% of the benzene emissions. The contribution from traffic is seen to vary considerably between the Member States (from 38 to 93%).

4.4 Trends in emissions and in air quality

Existing and proposed legislation across the European Union, in particular on vehicle emissions and fuel standards, will lead to substantial reductions in benzene emissions in the next years. The Air Quality Report of the first Auto-Oil Programme estimated in 1996 a 56% reduction in urban emissions of benzene between 1990 and 2010. The effects of the Auto-Oil Agreement reached on 29 June 1998, on the basis of which the percentage of benzene will be limited to 1% by 2000, was also taken into account in the preparation of this proposal.

This downward trend is confirmed by results of EC modelled estimates of benzene concentrations in seven cities, in 1990 and 2010. The results of this analysis indicate, with regard to benzene, that the impact of the three way catalyst will result in a marked improvement of urban background concentrations over the coming years. Three values were investigated (2, 5 and 10 $\mu g/m^3$ as annual average). Only in the case where an air quality standard of 2 $\mu g/m^3$ is used as a basis for comparison are additional emission reductions foreseen to be necessary in a number of the most polluted cities.

The European Council and Parliament reached on 24 September 1998 a common position on a first daughter Directive relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. This Directive, due to be finally adopted early in 1999, sets limit values to protect human health for sulphur dioxide, particulate matter and lead to be met by 2005, and for nitrogen oxide to be met by 2010. Measures taken to attain these limit values, and to reduce congestion and other transport-sector problems will also reduce benzene emissions. Some of these measures will be enacted throughout the EU, others only locally.

4.5 Impact of benzene on human health and the environment

Benzene in ambient air may have particularly important impacts on human health. The most significant adverse effects from prolonged exposure to benzene are haematoxicity, genotoxicity and carcinogenicity. In particular, an increased mortality from leukaemia has been demonstrated in workers occupationally exposed.

There is no threshold below which effects can be assumed not to occur, however a precise estimate of the risks of benzene is difficult to establish. WHO in 1996 adopted as a guideline a unit risk of 6×10^{-6}. This unit risk is the extra risk of contracting leukaemia, if continuously exposed to $1 \mu g/m^3$ for a lifetime. It is derived by extrapolating data on exposure chemical workers in the 1940's. WHO

identified important uncertainties when carrying out their analysis. An ad hoc meeting of experts including representatives of WHO was organised to assess evidence that has emerged since WHO updated its guideline and to consider whether risk estimates should be revised. This Group advised that uncertainties remained. However, the WHO estimate could with confidence be taken as the upper end of a range of plausible risk estimates. (Since the Group provided its advice the US-EPA has re-examined benzene and calculated a similar risk – see Annex II.) The Group felt that a risk estimate two orders of magnitude lower (5×10^{-8}) was the lowest plausible risk estimate. They were unable to determine where in this range the "correct" risk estimate is.

WHO provide no recommendation as to what level of risk is tolerable. The benzene Working Group, including experts from Member States, industry and NGOs, noted that the Council and the European Parliament have recently agreed a proposal on drinking water[8] which takes an additional lifetime risk of one in a million as the starting point for determining limit values. Translating the range of unit risks given above into an annual average concentration which equates to a lifetime risk of one in a million gives a range of concentrations of 0.2[9] to 20 $\mu g/m^3$.

Given this scientific uncertainty, the Commission has applied a precautionary approach to the risk posed by benzene when proposing a limit value for ambient air.

4.6 The Commission's proposals

4.6.1 Protection of human health

In its proposals, the Commission took different parameters into account, in particular:

- the objectives of Community policy on the environment, including the protection of human health;
- the risks of benzene to human health and the high sensitivity of public opinion on cancer risks;
- the WHO guideline for benzene, derived by extrapolating data on exposure of chemical workers;
- the conclusions of an ad hoc Working group of experts, which was set up by Commission in order to assess evidence that has emerged since WHO carried out its assessment. The group was of the view that this evidence does not allow the uncertainties which WHO identified in their analysis to be removed. In particular, it is still not possible to identify the best model for extrapolating from worker exposure to environmental exposure of the whole population;

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8 COM(94) 612 final.

9 The result has been rounded from 0.17 $\mu g/m^3$.

- the obligation under the Treaty to apply the precautionary principle to protection of human health and the environment and the principle that exposure to pollutants for which there is no identified threshold for effects should be as low as reasonably achievable;

- the conclusions of the economic evaluation (see below: § 4.6.2.) and the most recent analyses, showing that benzene levels are declining faster than suggested by Auto-Oil data, particularly in hotspot areas, in some Member States;

- uncertainties due to the present lack of comprehensive data on benzene across the Community;

- the final recommendations by the Working group on benzene and the Steering Group on ambient air quality, including an extrapolation from the context of drinking water (see above: § 4.5.).

4.6.2 Costs and environmental benefits of the limit values for benzene

The economic evaluation of a limit value for benzene took the air quality work done under the Auto-Oil Programme as a starting point. Three of the cities used in the Auto-Oil Programme were taken here as case studies. The results from the analysis of these three cities were then extrapolated to the EC level as a whole. The cities chosen were Athens, London and Cologne. The Auto-Oil work indicated that none of these cities were expected to have exceedances of per $5\mu/m^3$ for urban background concentrations by 2010. However, exceedances were expected in so-called "hot spots".

To assess the costs and benefit of a limit value requires an estimate of the extent of these hot spots and the costs and benefits of taking action to eliminate them. Estimating exceedances is in itself an uncertain exercise, as it is difficult to predict precisely what emissions of benzene are likely to be in 2010. This is partly because current concentrations are often not known with any real accuracy - there is no current EC legislation on benzene in ambient air and relatively little monitoring. Assumptions also have to be made for the rate of penetrations of cleaner technologies, as well as the rate of traffic growth. In addition, it is difficult to predict how emissions translate into concentrations in hot spots.

Estimating the benefits of reducing exceedances is even more uncertain. The risk posed by hot spots depends on how much time people spend exposed to those areas of high pollution. However, the most important uncertainty concerns the actual risk posed by benzene pollution. Current risk estimates are obtained by extrapolating from the effects of high levels of occupational exposure to effects at much lower concentrations. At present the highest estimate of risk is 100 bigger than the low estimate. All benefits estimates are therefore given as a range, using these two extremes.

Urban background concentrations in 2010 were calculated for each city for each cell in a grid of 2km by 2 km squares. These estimates were based on Auto-Oil work, updated where necessary. Peak concentrations for each grid cell were estimated using a statistical estimate for the background/peak concentration ratio derived from data on carbon monoxide. Exposure of the population to the areas of exceedance was estimated using a model of how people spend their time between areas of low and high concentration. This allowed the overall effects of benzene pollution to be estimated, and hence the benefits of abatement.

The costs of reducing exceedances (and also benefits) will vary with the abatement strategy that is adopted. If policy options are chosen that limit action to the area where there are exceedances (e.g. local traffic management schemes) then the costs and benefits are likely to be lower than policy options which reduce concentrations over a wider area (e.g. using petrol with a lower benzene content). Two different scenarios were considered for each city - one where reductions are targeted to area of exceedance ("optimised" scenario), and one where they are not ("generalised" scenario).

The figures obtained for the three cities were then extrapolated to the EC level by assuming, along the lines of Auto-Oil, that each city is representative of a particular portion of the EC's urban population. This extrapolation introduces another possible source of error into the analysis, although it is likely to affect the overall estimate of costs and benefits rather than the relationship between them. The results for the EC are given in the table below. All figures are in ECU million/year.

	limit value of 5 ug/m^3	
	Costs	**Benefits**
Current concentrations:		
	Generalised abatement scenario	
Low	280 - 1 300	0.28 – 78
Mid	910 - 4 700	0.38 – 103
High	1 800 - 9 200	0.54 – 150
	Optimised abatement scenario	
Low	110 - 600	0.15 – 41
Mid	490 - 2 300	0.26 – 68
High	1 400 - 7 000	0.54 – 150

High, medium and low estimates are given for each abatement approach, reflecting uncertainty about current concentrations. For the benefit estimates, the top end of the range uses the high estimate of the risk posed by benzene. In addition, all cancers are assumed fatal, with each fatality is valued at ECU 3.35 million (a VOSL of ECU 3.1 million plus ECU 250 000 medical costs). The bottom of the range takes the low risk estimate. In addition, only half of cancers are assumed fatal, so the average

cost of a cancer falls to ECU 1.8 million (ECU 3.1 million divided by two, plus ECU 250 000 medical costs).

There are some qualifications that should be made to the figures quoted above:

- The figures do not include the effects of a mandatory halving of hydrocarbon emissions per kilometre for new vehicles from the year 2005 that was agreed during the Auto-Oil conciliation process. This is because the bulk of the analysis was performed before conciliation process was complete. These tighter standards will help reduce benzene emissions and concentrations as the vehicle stock turns over. An estimate is that benzene concentrations in 2010 may drop by a further 10-20%, depending on scrappage rates. This will reduce exceedances and could significantly reduce the costs of complying with the proposed limit value.

- The benefits estimates do not include the many of the secondary benefits that will arise from measures to reduce benzene pollution. The benefit figures above can therefore be considered to be an underestimate. For example, measures related to traffic management could have benefits in terms of reduction of other pollutants, reduced accidents and overall amenity. However, the extent to which there are secondary benefits was not subject to a detailed analysis and will depend on the precise measures taken to achieve compliance.

4.6.3 Additional sensitivity analysis

Comments from experts during preparation of this proposal (see Section 4.7 below) suggested additional reasons why the actual costs of implementing this proposal may be somewhat lower than in the table given above:

- Recent measurement data from some Member States indicate that benzene concentrations are declining faster than predicted by the Auto-Oil calculations used as a basis for this analysis.

- There are indications that the ratio of hotspot concentrations to background concentrations is declining more quickly than was assumed in the cost benefit analysis above. That is, concentrations in hotspots are falling faster than in the urban background. This is because of the declining importance of traffic-related emissions relative to other sources. An analysis by RIVM suggests that the ratio between hotspots and urban background may fall to 3 in 2010 rather than the ratio of 3:9 that was assumed for the cost-benefit analysis.

This decline in the hotspots to background ratio could have a significant impact on exceedances. The Commission's consultants have carried out some further sensitivity analysis to test the extent to which this trend could change results.. Indications are that hotspot levels in Cologne would only exceed 5 $\mu g/m^3$ at the high end of the range of emissions estimates. In London hotspot levels would be below 5 at the low end of range of

emission estimates. In Athens exceedances of 5 would still be significant, but much lower than predicted above.

- Member States' experts suggested that many of the measures which would reduce concentrations of benzene will in any case need to be undertaken for other reasons, in particular to meet limit values for sulphur dioxide, nitrogen dioxide, particulate matter and lead agreed in the first Air Quality Daughter Directive. For the cost benefit analysis of CO and benzene the consultants took into account as far as possible the effect of the proposal for the Directive setting limit values for sulphur dioxide, nitrogen dioxide, particulate matter and lead. However, work published by CEN during negotiations in Council and European Parliament for that Directive indicated that methods commonly used by Member States to measure particulate matter can underestimate concentrations relative to the reference method included in the proposal, in some conditions by up to 30%.

The result of this is that in some cases Member States will have to undertake more action than originally anticipated to meet limit values for PM agreed under the first Daughter Directive. A second separate sensitivity analysis gives an indication of the effect on benzene emissions that further reducing traffic-related PM emissions might have. The result depends on the assumptions made about the relative contribution of traffic to emissions of the two pollutants. The analysis shows that elimination of exceedances of a 5 $\mu g/m^3$ limit value for benzene would be achieved with further reductions in PM emissions of from 5-20% in the case of Cologne, from 5 to 40% in the case of London, and from 6 to 60% in the case of Athens.

On the other hand, however, there are some recent data which indicate that present day concentrations are higher than previously recorded in some Member States, particularly in southern Europe. These data are preliminary, based on only a few weeks' results and far from comprehensive. But it is possible, that despite the factors explained above, meeting the proposed limit value could be difficult in some circumstances.

These uncertainties cannot be resolved with presently available data. This proposal will itself be the main trigger for the gathering of the necessary data.

Furthermore, it is the Commission's view is that if there are areas of the Community where benzene levels are much higher than previously recorded, then this problem should be addressed with all possible speed. Benzene is a Class I carcinogen and the risk to human health should be reduced as far as possible.

The Commission recognises nevertheless the need to allow flexibility for reconsideration when more data are available. The Commission's proposal does this in two ways:

- Where it can be demonstrated that meeting the proposed limit value of 5 $\mu g/m^3$ would lead to severe socio-economic problems the Commission, assisted by the Committee set up under Article 12 of the Air Quality Framework Directive, may agree time limited extensions for periods of up to five years. The proposal leaves open at present the possibility that Member States could request further extensions to follow an initial five year extension. The Commission intends however to propose an absolute deadline for all extensions when it reports in due course on implementation of this proposal (see below). The margin of tolerance will not be increased for areas with an extended timetable. It is essential that any problem areas begin serious planning and implement any possible measures as soon as possible;

- A provision is included requiring the Commission to report to the European Parliament and Council by 2004 at the latest. The Commission will, at that point, bring forward any further proposals adding to, or amending, the present proposal, including the limit values and/or dates for compliance (see Section 4.8 below). In particular, the Commission will propose an absolute deadline beyond which there shall be no further extensions to the timetable for meeting the limit value for benzene.

It should be noted of course that use of extensions would lower the cost of the proposal.

4.7 Opinions of affected parties

Considering the diversity of the parameters described in § 4.6.1., the Working Group on benzene has not been able to reach unanimous agreement on a recommendation for a limit value. It agreed however that, given that benzene is a human genotoxic carcinogen and that no threshold for effects can be identified, the principle of "as low as it is reasonably achievable" (ALARA) should be applied and that limit values for benzene should be reconsidered in due course to determine whether further progress was then necessary and practical.

The Group set out three illustrative options, all consistent with the ALARA principle, but giving different weight to different parameters. These have been thoroughly discussed with Member States, the industry and Non Governmental Organisations. The proposal for a limit value of 5 $\mu g/m^3$ to be met in 2010 was strongly supported by experts from ten Member States and NGOs. They are of the view that the Auto-Oil Agreement reached on 29 June 1998 plus action that will be needed to meet other environmental targets will enable a high rate of compliance with the chosen value. Some consider that it would be met throughout their territory without further measures. A few would prefer a lower limit value or failing that a commitment to going further in future. Experts from three Member States and industry consider that a two stage approach should be adopted, with a limit value of 10 $\mu g/m^3$ to be met by 2007 and a second more ambitious stage to be determined at a future review, preferably in association with a review of other pollutants. There is general agreement that limit values should apply in hotspots as well as in the urban background.

Given the potential risks posed by benzene and the need for precaution, the Commission took these opinions into account when proposing the limit value of 5μg/m³ for benzene. The Commission considers that on the basis of the available information this is the limit value that is consistent with providing a level of protection of human health which is both high and generally achievable.

4.8 Proposed report on the implementation of this proposal

As explained above, the Commission considers its proposal both ambitious and practical in the light of the balance of evidence available. It is intended to ensure that all steps which can reasonably be taken by Member States to reduce concentrations of benzene are taken as quickly as possible. The Commission considers it essential however that objectives for benzene should be reviewed in due course, as suggested by the Working Group on benzene.

On the one hand, there is much research presently underway on the risks associated with benzene. It is expected that new data will become available over the next five years or so and they should be taken considered with a view to determining whether further reductions in benzene concentrations should be achieved in the longer term.

On the other hand Commission is mindful also of the uncertainties in the database of information concerning benzene concentrations across the Community and therefore of likely future trends and of the possibility that the limit value might prove difficult to meet in certain circumstances. It considers that these uncertainties can only be remedied by application of this proposal, and in particular its requirement for comparable measurement networks to be set up across the Community.

This proposal will require the Commission to report by 2004 at the latest on implementation of this Directive. Since many of the measures which would reduce concentrations of benzene would also reduce concentrations of other air pollutants, the report will be presented as an integral part of an air quality strategy, designed to review and propose Community air quality objectives and develop implementing strategies to ensure the achievement of those all objectives.

5. CARBON MONOXIDE

5.1 Background

Carbon monoxide is one of the most common toxic air pollutants. It has no colour, odour or taste, it has a low reactivity and a low water solubility. It is mainly emitted into the atmosphere as a product of incomplete combustion. Annually, a large number of individuals die as a result of exposure to very high indoor CO levels, far above ambient outdoor levels.

In terms of absolute concentrations CO is the most prevalent of the toxic air pollutants. Its concentrations are expressed in mg/m^3, in contrast to many other pollutants, which are measured in $\mu g/m^3$ or even smaller units.

CO is not only directly emitted into the air, but can also be formed by chemical reactions from organic air pollutants, such as methane. CO has a residence time in the atmosphere of about three months. Since CO formation from organic air pollutants takes place everywhere in the atmosphere, a global background level of CO exists, ranging between 0.05 and 0.15 ppm (0.06 and 0.17 mg/m^3). At EC latitudes the global background level is at the high end of this range.

5.2 Existing Legislation

At a European level, no air quality standards have yet been fixed for carbon monoxide.

There are however a number of instruments controlling emissions of CO from stationary and mobile sources. In particular, the IPPC Directive 96/61/EC will bring 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. As a result of the Auto-Oil conciliation agreement reached on 29 September 1998, the Council and the European Parliament agreed on fixing carbon monoxide limit values, by 2000, at the level of 2.3 g/km for petrol vehicles and 0.64 g/km for diesel vehicles.

5.3 Sources of carbon monoxide

CO is brought into the atmosphere by two different mechanisms: emission of CO and chemical formation of other pollutants. Burning of forest, savannah and agricultural waste accounts for half the global CO emissions. The chemical formation of CO is due to the oxidation of hydrocarbons. Two-third of it stems from methane. It is a slow process, and does not give rise to local peak concentrations. However, being a source of the same magnitude of the direct emission, CO formation contributes considerably to the global background level. It is estimated that about one-third of CO results from natural sources, including that derived from hydrocarbon oxidation.

As far as the EC is concerned: the largest source of CO emissions is road transport, which accounts for two-thirds. The contribution from traffic is seen to vary considerably between the Member States (from 30 to 89%).

5.4 Trends in emissions and air concentrations

The trend in emissions is downward, though not in all Member States. The emissions in the most important source category, road transport, have gone down as a result of emission reduction measures, such as Inspection and Maintenance and the introduction of the 3-way catalyst, although the effect was partly offset by the growth of the number of vehicle-kilometres. The recent Auto-Oil Agreement will reinforce this trend.

5.5 Impact of CO on human health and the environment

5.5.1 Health

Carbon monoxide affects human health by reducing the oxygen carrying capacity of the blood and therefore the supply of oxygen available to the body. Its toxic effects are most evident in organs and tissues with high oxygen consumption such as the brain and the heart. At very high levels, such as those which can occur indoors owing to faulty heating appliances, CO is lethal. Outdoor concentrations are much lower. At lower concentrations effects can include impaired coordination, tracking, driving ability, vigilance and cognitive performance, headache and nausea.

Those with coronary artery disease and the developing foetus are most vulnerable to the effects of CO.

WHO Guidelines

In order to protect non-smoking, middle-aged, and elderly population groups with documented or latent coronary artery disease from acute ischaemic heart attacks, and to protect foetuses of non-smoking pregnant mothers from untoward effects owing to reduced oxygen availability, the World Health Organisation (WHO) adopted in 1996 four Guidelines for maximum CO concentrations outdoors:

- 100 mg/m^3 (90 ppm) for 15 minutes;

- 60 mg/m^3 for 30 minutes;

- 30 mg/m^3 for 1 hour;

- 10 mg/m^3 for eight hours.

5.5.2 Environment

Adverse impacts on vegetation by carbon monoxide at ambient concentrations have not been reported.

As a precursor of carbon dioxide and ozone, carbon monoxide indirectly contributes to global warming and to direct effects by ozone to vegetation and materials.

5.6 The Commission's proposals

5.6.1 Protection of human health

In its proposals, the Commission took different parameters into account, in particular:

- the objectives of Community policy on the environment, including the protection of human health;

- the risks of carbon monoxide to human health;

- the WHO guideline for carbon monoxide. Available data show that if the WHO Guideline for eight hours is met in ambient outdoor air then all other WHO Guidelines will also be met. The present directive therefore includes one limit value only;

- the conclusions of the economic evaluation (see below: § 5.6.2.)

- the final recommendations by the Working group on carbon monoxide and the Steering Group on ambient air quality.

5.6.2 Costs and environmental benefits of meeting the limit values for CO

The approach taken to estimating the costs and benefits of CO reduction was similar to that adopted for benzene. Auto-Oil data was used to estimate urban concentrations in 2010 for the case-study cities using a grid of 2km by 2km cells. Estimate of the ratio of urban background to peak concentrations were used to estimate the number of grid cells where exceedances were likely. The costs and benefits of eliminating these exceedances were then calculated, and extrapolated to the EC level.

The main sensitivities surrounding the results given below are very similar to those for benzene. They relate to the accuracy of measured CO concentrations, the relationship between background and peak concentrations, the actual physical effects of exposure to CO, and uncertainty about the appropriate way to value some of the possible effects of CO pollution. Of these uncertainties the most important relates to health effects.

It has been known for many years that high levels of CO have an effect on human health by affecting the oxygen carrying capacity of the blood. However, there is relatively little information on the health effects of CO at the type of concentrations typically found in ambient air. There is very little work on the epidemiological effects of CO pollution, and such work as there is has difficulty in disentangling the effects of CO from the effects of other air pollutants.

In the study for this proposal only congestive heart failure (CHF) was included as a health effect of CO for the purpose of the benefit estimation. Each case of congestive heart failure was valued at around ECU 8 000, based on work done for the DG XII EXTERNE programme. No mortality effects were included. Omitting mortality may seem internally inconsistent given the inclusion of a function for CHF, but mortality effects were not statistically significant when adjustments were made for the effects of other pollutants.

The results of the benefits analysis here should however be treated with considerable caution, given the sparsity of the epidemiological evidence. A more robust benefit assessment would require more analysis and data on the extent and severity of health effects of CO. If further work were to demonstrate a significant effect on mortality at current levels of CO pollution then this would almost certainly change the net cost of the l limit value of the proposal to a net benefit.

For simplicity, it was assumed for CO that a generalised approach to abatement would be taken. That is, it was assumed that measure would be adopted which reduced concentrations in all grid cells in a city, and not just those where there are exceedances. This assumption tends to increase the estimated costs and benefits, but should not fundamentally affect the relationship between the two. A more targeted approach would tend to lead to lower figures for both costs and benefits. Costs and benefits for the EC as a whole are given in the table below.

	Limit	**Benefits ECU million /year**	**Costs ECU million /year**
Carbon monoxide	10 mg/m^3 max	39.3	105 - 122

The figures for the EC are derived by extrapolating from the three case study cities, assuming that each represents a portion of the EC's urban population. This introduces an additional possible source of error, though this is likely to affect the overall magnitude of both costs and benefits, rather than the relationship between them

5.7 Opinions of affected parties

A majority of Member States and experts have shared the opinion that a limit value was desirable and should be based on the new World Health Organisation Guideline of 10 mg/m^3. They are of the view that the Auto-Oil Agreement reached on 29 June 1998 plus action that will be needed to meet other environmental targets will enable a high rate of compliance with this value, to be met in 2005. Only one Member State expressed a preference for a 98-percentile of 6 mg/m^3. A large majority of Member States and experts were also of the opinion that it was not appropriate to allow exceedances of the limit value fixed for carbon monoxide. Two Member States asked for an alert threshold, but this wish was not supported by other Member States and experts.

The Commission took these opinions into account when proposing the limit value of 10 mg/m^3 for carbon monoxide.

6. THE NEED FOR COMMUNITY ACTION – SUBSIDIARITY

The present proposal introduces EC legislation on benzene and carbon monoxide 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 principles 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 circumstances.

In doing so, the Commission has taken into account the precautionary principle and the need to provide a high level of protection of the environment and human health.

The proposed Directive is only part of an integrated package of measures designed to combat problems of air pollution, which also need to be considered in the frame of the on going revision of the Community policies related to urban development and Structural Funds.

7. LEGAL BASE

The legal basis for the proposal is Article 130 S paragraph 1 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 human health.

8. DESCRIPTION OF THE LEGISLATIVE SITUATION IN MEMBER STATES

Details are given in the position papers prepared by Working Groups on individual pollutants[10].

A table showing standards for benzene and carbon monoxide in the United States and Japan is included for information purposes as Annex II to this document.

9. EXPLANATION OF THE DETAILED PROVISIONS OF THE PROPOSAL

Article 1

This Article sets out the aims of the present proposal.

Article 2

This Article sets out definitions necessary for the interpretation of the present Directive.

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10 Available from the Commission.

Article 3

Under this Article a new limit value will be set for benzene, to protect human health. The limit value is to be met by 1 January 2010. Annex I sets out full details. Exceptionally, extensions may be agreed for periods of up to five years for areas where it can be demonstrated that meeting the limit value by 2010 would cause severe socio-economic difficulties.

Article 4

Under this Article a new limit value will be set for carbon monoxide, to protect human health. The limit value is to be met by 1 January 2005. Annex II sets out full details.

Article 5

This Article deals with assessment of concentrations of benzene and carbon monoxide. It is supplemented by a number of Annexes.

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

Article 5(2) refers to Annex IV, which deals with siting of measurement points, and Annex V 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 V. 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 5(5) deals with reference methods for air quality measurement. The European standards organisation 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 benzene and carbon monoxide to be carried forward. 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 6

This Article requires Member States to supply regular and up-to-date information about benzene and carbon monoxide to the public and appropriate organisations.

Article 7

This Article requires the Commission to report to Council and the European Parliament no later than 31 December 2004 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 benzene and carbon monoxide.

Articles 8, 9, 10, 11

These are standard provisions.

Annex I

This Annex sets out a limit value, attainment date and margin of tolerance for benzene.

Annex II

This Annex sets out a limit value, attainment date and margin of tolerance for carbon monoxide.

Annex III

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

Annex IV

This Annex deals with siting of sampling points for measurement of benzene and carbon monoxide. 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 V

This Annex sets out the criteria for determining default numbers of measurement sites in agglomerations or other zones. 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.

Annex VI

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 VII

This Annex sets out 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 I: Reference scenarios for assessment of economic aspects of meeting limit values -

The methodology for the air quality assessment within this study is largely based on extrapolation of the results of the Auto-Oil Programme. Auto-Oil provided detailed modelled assessments of urban background air quality across 7 cities, these cities being broadly representative with respect to air quality of all cities in the European Union. Auto-Oil also provides a set of data and assumptions that have been widely reviewed, discussed and agreed by European decision makers and other interested parties already. Accordingly it forms a good position from which to start.

The analysis for CO and benzene considered three cities in detail, Athens, Cologne and London, and then extrapolated results for these three cities to the level of the EU as a whole. The reference scenario used in the economic evaluation includes the effects of the draft Auto-Oil directives on fuel quality and vehicle emissions, as well as the effects of the previous four daughter Directives on SO_2, NO_X, lead and particulates.

The table below identifies cases where exceedences are predicted of the limit values of 2, 5 and 10 $\mu g/m^3$ for the estimated range of benzene concentrations in Athens, Cologne and London in 2010. Exceedence is marked by the letter 'E'. Blank cells represent no exceedence. The column headed 'Range point' relates to uncertainty in emission estimates.

		Urban background			Hot spot		
City	Range point	2 $\mu g/m^3$	5 $\mu g/m^3$	10 $\mu g/m^3$	2 $\mu g/m^3$	5 $\mu g/m^3$	10 $\mu g/m^3$
Athens	Low	E			E	E	
	Mid	E			E	E	E
	High	E			E	E	E
Cologne	Low				E		
	Mid				E	E	
	High	E			E	E	
London	Low				E	E	
	Mid	E			E	E	
	High	E			E	E	E

All cities would meet the limits of 5 or 10 $\mu g/m^3$ in the urban background without further action. The sensitivity analysis identifies further possibilities in the absence of new legislation:

- Urban background levels in London could meet the 2 $\mu g/m^3$ limit, though it is similarly possible that levels in Cologne will not in some locations;
- It is possible that levels in Cologne could meet a 5 $\mu g/m^3$ limit in hot spots;
- It is possible that all three cities could meet a 10 $\mu g/m^3$ limit in hot spots, though it is also possible that levels in some parts of London would not.

Given the earlier results of the Auto-Oil Programme there was little point in investigating CO purely from the perspective of urban background concentrations. This indicated that proposed limits would not be exceeded anywhere in the EC in 2005. Hence the study focused on the hot-spots where high concentrations are most likely to be found (for example close to busy roads).

The occurrence of exceedence in the three cities is summarised in the following Table, considering the most restrictive scenario for each:

Limit	Athens	Cologne	London
CO: urban background			
10 mg/m^3 highest eight-hour mean	no exceedence	no exceedence	no exceedence
10 mg/m^3 second highest eight-hour mean	no exceedence	no exceedence	no exceedence
CO: hot-spots			
10 mg/m^3 highest eight-hour mean	Exceedence	no exceedence	exceedence
10 mg/m^3 second highest eight-hour mean	Exceedence	no exceedence	exceedence

Annex H: Comparable ambient air quality standards in the United States and Japan

Pollutant	United States	Japan
Benzene	No limit values – unit risk for 1$\mu g/m^3$ assessed as 2.5 x 10^{-6} to 7.1 x 10^{-6}. Industry must employ maximum available technology	No limit value
Carbon monoxide	eight hours: 9 ppm (10 mg/m^3) one hour: 35 ppm (40 mg/m^3)	Daily average of one hour value: under 0.04 ppm eight-hour average of one hour value: under 20 ppm Daily average of one hour value: under 10 ppm

Proposal for a
COUNCIL DIRECTIVE

relating to limit values for benzene and carbon monoxide in ambient air

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 130s(1) thereof,

Having regard to the proposal from the Commission[11],

Having regard to the opinion of the Economic and Social Committee[12],

Having regard to the opinion of the Committee of the Regions[13],

Acting in accordance with the procedure laid down in Article 189c of the Treaty, in cooperation with the European Parliament[14],

1. 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)[15] envisages in particular amendments to legislation on air pollutants; whereas that programme recommends the establishment of long-term objectives on air quality; whereas Article 130r of the Treaty requires the precautionary principle to be applied in relation to the protection of human health and the environment;

2. Whereas Article 129 of the Treaty provides that health-protection requirements shall form a constituent part of the Community's other policies; whereas point (o) of Article 3 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;

3. Whereas, pursuant to Article 4(5) of Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management[16], the Council is to adopt the legislation provided for in paragraph 1 as well as the provisions laid down in paragraphs 3 and 4 of that Article;

4. Whereas Article 8 of Directive 96/62/EC requires that action plans be developed for zones within which concentrations of pollutants in ambient air exceed limit values, plus any temporary margins of tolerance applicable in order to ensure compliance with limit values by the date or dates laid down;

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11 OJ C

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15 OJ C 138, 17.5.1993, p. 5.

16 OJ L 296, 21.11.1996, p. 55.

5. Whereas Directive 96/62/EC provides that the numerical values for limit values 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 are based;

6. Whereas in order to facilitate the review of this Directive, the Commission and the Member States should consider encouraging research into the effects of the pollutants referred to herein, namely benzene and carbon monoxide;

7. Whereas standardized accurate measurement techniques and common criteria for the location of measuring stations are an important element in the assessment of ambient air quality with a view to obtaining comparable information across the Community;

8. Whereas up-to-date information on concentrations of benzene and carbon monoxide in ambient air should be readily available to the public,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Objectives

The objectives of this Directive shall be to:

(a) establish limit values for concentrations of benzene and carbon monoxide in ambient air intended to avoid, prevent or reduce harmful effects on human health and the environment as a whole;

(b) assess concentrations of benzene and carbon monoxide in ambient air on the basis of common methods and criteria;

(c) obtain adequate information on concentrations of benzene and carbon monoxide in ambient air and ensure that it is made available to the public;

(d) maintain ambient air quality where it is good and improve it in other cases with respect to benzene and carbon monoxide.

Article 2

Definitions

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

For the purposes of this Directive:

1. "upper assessment threshold" shall mean a level specified in Annex III, below which a combination of measurements and modelling techniques may be used to assess ambient air quality, in accordance with Article 6(3) of Directive 96/62/EC;

2. "lower assessment threshold" shall mean a level specified in Annex III, below which modelling or objective estimation techniques alone may be used to assess ambient air quality in accordance with Article 6(4) of Directive 96/62/EC;

3. "fixed measurements" shall mean measurements taken in accordance with Article 6(5) of Directive 96/62/EC.

Article 3

Benzene

1. Member States shall take the measures necessary to ensure that concentrations of benzene in ambient air, as assessed in accordance with Article 5, do not exceed the limit value laid down in Annex I.

   The margin of tolerance laid down in Annex I shall apply in accordance with Article 8 of Directive 96/62/EC.

2. Within zones and agglomerations within which Member States can demonstrate that the application of measures to meet the limit value laid down in Annex I would result in severe socio-economic problems, the Commission may, acting in accordance with the procedure laid down in Article 12(2) of Directive 96/62/EC, grant time-limited extensions for meeting the limit value for periods of up to five years.

Article 4

Carbon monoxide

Member States shall take the measures necessary to ensure that concentrations of carbon monoxide in ambient air, as assessed in accordance with Article 5, do not exceed the limit value laid down in Annex II.

The margin of tolerance laid down in Annex II shall apply in accordance with Article 8 of Directive 96/62/EC.

Article 5

Assessment of concentrations

1. The upper and lower assessment thresholds for benzene and carbon monoxide for the purposes of Article 6 of Directive 96/62/EC shall be those laid down in Section I of Annex III.

   The classification of each zone or agglomeration for the purposes of the same Article 6 shall be reviewed at least every five years in accordance with the procedure laid down in Section II of Annex III. Classification should be reviewed earlier in the event of significant change in activities relevant to ambient concentrations of benzene and carbon monoxide.

2. The criteria for determining the location of sampling points for the measurement of benzene and carbon monoxide in ambient air shall be those listed in Annex IV. The minimum number of sampling points for fixed measurements of

concentrations of each relevant pollutant shall be as laid down in Annex V and they shall be installed in each zone or agglomeration within which measurement is required if fixed measurement is the sole source of data on concentrations within it.

3. For zones and agglomerations within which information from fixed measurement stations is supplemented by information from other sources, such as emission inventories, indicative measurement methods and air quality modelling, the number of fixed measuring stations to be installed and the spatial resolution of other techniques shall be sufficient for the concentrations of air pollutants to be established in accordance with Section I of Annex IV, and Section I of Annex VI.

4. For zones and agglomerations within which measurement is not required, modelling or objective-estimation techniques may be used.

5. The reference methods for the analysis and the sampling of benzene and carbon monoxide shall be as laid down in Sections I and II of Annex VII. Section III of Annex VII sets out reference techniques for air quality modelling.

6. The date by which Member States shall inform the Commission of the methods used for the preliminary assessment of air quality under point (d) of Article 11(1) of Directive 96/62/EC shall be the date set out in Article 9.

7. Any amendments necessary to adapt the provisions of this Article and Annexes III to VII to scientific and technical progress shall be adopted in accordance with the procedure laid down in Article 12 of Directive 96/62/EC.

Article 6

Public information

1. Member States shall ensure that up-to-date information on ambient concentrations of benzene and carbon monoxide is routinely made available to the public as well as to appropriate organisations such as environmental organisations, consumer organisations, organisations representing the interests of sensitive populations and other relevant health-care bodies by means, for example, of broadcast media, press, information screens or computer-network services.

   Information on ambient concentrations of benzene shall be updated on at least a monthly basis. Information on ambient concentrations of carbon monoxide shall be updated on at least a daily basis.

   Such information shall at least indicate any exceedances of the concentrations stated in the limit values over the averaging periods laid down in Annexes I and II. It shall also provide a short assessment in relation to limit values and appropriate information regarding effects on health.

2. 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 the organisations referred to in paragraph 1 of this Article.

3. Information made available to the public and to organisations under paragraphs 1 and 2 shall be clear, comprehensible and accessible.

Article 7

Report

1. No later than 31 December 2004 the Commission shall submit to the European Parliament and the Council a report based on the experience acquired in the application of this Directive and, in particular, on the results of the most recent scientific research concerning the effects on human health and ecosystems of exposure to benzene and carbon monoxide, and on technological developments including the progress achieved in methods of measuring and otherwise assessing concentrations of benzene and carbon monoxide in ambient air.

2. The report shall be presented as an integral part of an air quality strategy, designed to review and propose Community air quality objectives and develop implementing strategies to ensure the achievement of those objectives. The strategy shall take into account:

   (a) the implementation of existing requirements relating to air quality, acidification and eutrophication, including progress in implementing limit values and target values established in accordance with Article 4 of Directive 96/62/EC;

   (b) transport of pollution across national boundaries;

   (c) the need for new or revised objectives relating to air quality, acidification and eutrophication;

   (d) current air quality and trends up to and beyond the year 2010;

   (e) the broad scope for making further reductions to polluting emissions across all relevant sources, taking account of their technical feasibility and cost-effectiveness;

   (f) the relationships between pollutants and opportunities for combined strategies for achieving Community air quality and related objectives;

   (g) current and future requirements for informing the public and for the exchange information between Member States and Commission;

   (h) the experience acquired in the application of this Directive in Member States including, in particular, the conditions as laid down in Annex IV under which measurement has been carried out.

3. With a view to maintaining a high level of protection of human health and the environment the report shall be accompanied by proposals for the amendment of this Directive if appropriate. In particular the Commission shall propose an absolute limit to the length of any further extensions to the timetable for meeting the limit value for benzene in Annex I which may be agreed under Article 3(2).

Article 8

Penalties

Member States shall determine the penalties applicable to breaches of the national provisions adopted pursuant to this Directive. The penalties shall be effective, proportionate and dissuasive.

Article 9

Implementation

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 2001 at the latest. They shall forthwith inform the Commission thereof.

   When Member States adopt those provisions, they shall contain a reference to this Directive or shall be accompanied by such a reference on the occasion of their official publication. Member States shall determine how such reference is to be made.

2. The 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 10

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 11

Addressees

This Directive is addressed to the Member States.

Done at Brussels,

For the Council

The President

ANNEX I

LIMIT VALUE FOR BENZENE

The limit value must be expressed in $\mu g/m^3$. The volume must be standardised at a temperature of 293K and a pressure of 101.3 kPa

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Limit value for the protection of human health	Calendar year	5 $\mu g/m^3$	5 $\mu g/m^3$ (100%) on the entry into force of this Directive, reducing on 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2010	1 January 2010*

* Except within zones and agglomerations within which a time-limited extension has been agreed in accordance with Article 3(2).

ANNEX II

LIMIT VALUE FOR CARBON MONOXIDE

The limit value must be expressed in mg/m^3. The volume must be standardised at a temperature of 293K and a pressure of 101.3 kPa

	Averaging period	Limit value	Margin of tolerance	Date by which limit value is to be met
Limit value for the protection of human health	eight hours (on a rolling basis)	10 mg/m^3	5mg/m^3 (50%) on the entry into force of this Directive, reducing on 1 January 2003 and every 12 months thereafter by equal annual percentages to reach 0% by 1 January 2005	1 January 2005

DETERMINATION OF REQUIREMENTS FOR ASSESSMENT OF CONCENTRATIONS OF BENZENE AND CARBON MONOXIDE IN AMBIENT AIR WITHIN A ZONE OR AGGLOMERATION

I. Upper and lower assessment thresholds

The following upper and lower assessment thresholds will apply:

a. Benzene

	Annual average
Upper assessment threshold	70% of limit value ($3.5\ \mu g/m^3$)
Lower assessment threshold	40% of limit value ($2\ \mu g/m^3$)

b. Carbon Monoxide

	Eight-hour average
Upper assessment threshold	70% of limit value ($7\ mg/m^3$)
Lower assessment threshold	50% of limit value ($5\ mg/m^3$)

II. Determination of exceedances of upper and lower assessment thresholds

Exceedances of upper and lower assessment thresholds must be determined on the basis of concentrations during the previous five years where sufficient data are available. An assessment threshold will be deemed to have been exceeded if during those five years the total number of exceedances of the numerical concentration of the threshold is more than three times the number of exceedances allowed each 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 from information from emission inventories and modelling to determine exceedances of the upper and lower assessment thresholds.

LOCATION OF SAMPLING POINTS FOR THE MEASUREMENT OF CONCENTRATIONS OF BENZENE AND CARBON MONOXIDE IN AMBIENT AIR

The following considerations will apply to fixed measurement.

I. Macroscale siting

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.

Sampling points should in general be sited to avoid measuring very small micro-environments in their immediate vicinity. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of no less than 200 m^2 at traffic-orientated sites and of several square kilometres at urban-background sites.

Sampling points should also, where possible, be representative of similar locations not in their immediate vicinity.

Account should be taken of the need to locate sampling points on islands, where that is necessary for the protection of human health.

II. Microscale siting

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 airflow in the vicinity of the sampler (normally some metres away from buildings, balconies, trees, and other obstacles and at least 0.5 m 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 1.5 m (the breathing zone) and 4m above the ground. Higher positions (up to 8 m) 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 immediate 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;
- location of traffic-orientated samplers:
  - for all pollutants, such sampling points should be at least 25 metres from the edge of major junctions and at least 4m from the centre of the nearest traffic lane;
  - for carbon monoxide, inlets should be no more than 5m from the kerbside;
  - for benzene, inlets should be sited so as to be representative of air quality near 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 co-locating 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 area and a detailed map. Sites should be reviewed at regular intervals with repeated documentation to ensure that selection criteria remain valid over time.

ANNEX V

CRITERIA FOR DETERMINING NUMBERS OF SAMPLING POINTS FOR FIXED MEASUREMENT OF CONCENTRATIONS OF BENZENE AND CARBON MONOXIDE IN AMBIENT AIR

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

a. Diffuse sources

Population of agglomeration or zone (thousands)	If concentrations exceed the upper assessment threshold	If maximum concentrations are between the upper and lower assessment thresholds
0 - 250	1	1
250 - 499	2	1
500 - 749	2	1
750 - 999	3	1
1 000 - 1 499	4	2
1 500 - 1 999	5	2
2 000 - 2 749	6	3
2 750 - 3 749	7	3
3 750 - 4 749	8	4
4 750 - 5 999	9	4
> 6 000	10	5

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.

DATA QUALITY OBJECTIVES AND COMPILATION OF RESULTS OF AIR QUALITY ASSESSMENT

I. Data quality objectives

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

	Benzene	Carbon Monoxide
Continuous measurement Accuracy Minimum data capture	 25% 90%	 15% 90%
Indicative measurement Accuracy Minimum data capture Minimum time coverage	 30% 90% 14% (one measurement a week at random, evenly distributed over the year, or 8 weeks evenly distributed over the year)	 25% 90% 14% (one measurement a week at random, evenly distributed over the year, or 8 weeks evenly distributed over the year)
Modelling Accuracy: eight-hour averages Annual averages	 --- 50%	 50% ---
Objective estimation Accuracy:	 100%	 75%

The accuracy of the measurement is defined as laid down in the "Guide to the Expression of Uncertainty of Measurements (ISO 1993), or in ISO 5725-1 "Accuracy (trueness and precision) of measurement methods and results" (1994). The percentages in the table are given for individual measurements averaged, over the period considered, by the limit value, for a 95% confidence interval (bias + two times the standard deviation). The accuracy for continuous measurements should be interpreted as being applicable in the region of the appropriate limit value.

The accuracy for modelling and objective estimation is defined as the maximum deviation of the measured and calculated concentration levels, over the period considered by the limit value, without taking into account the timing of the events.

The requirements for minimum data capture and time coverage do not include losses of data due to the regular calibration or the normal maintenance of the instrumentation.

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;
- the specific methods used, with references to descriptions of the method;
- the sources of data and information;
- a description of results, including accuracies 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 threshold;
- for limit values the object of which 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.

III. Standardisation

For benzene and carbon monoxide the volume must be standardised at a temperature of 293K and a pressure of 101.3 kPa.

REFERENCE METHODS FOR ASSESSMENT OF CONCENTRATIONS OF BENZENE AND CARBON MONOXIDE

I. Reference method for the sampling /analysis of benzene

The reference method for the measurement of benzene will be the pumped sampling method on a sorbent cartridge followed by gas chromatographic determination that is currently being standardized by CEN. In the absence of a CEN standardized method, the Member States are allowed to use national standard methods based on the same measurement method.

A Member State may also use any other method which it can demonstrate gives results equivalent to the above method.

II. Reference method for the analysis of carbon monoxide

The reference method for the measurement of carbon monoxide will be the non-dispersive infrared spectometric (NDIR) method, that is currently being standardized by CEN. In the absence of a CEN standardized method, the Member States are allowed to use national standard methods based on the same measurement method.

A Member State may also use any other method which it can demonstrate gives results equivalent to the above method.

III. Reference modelling techniques

Reference modelling techniques cannot be specified at present.

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

REFERENCE N° 98020

TITLE OF THE PROPOSAL

Proposal for a Directive of the Council Relating to Ambient Air Quality Limit Values for benzene and carbon monoxide:

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 1996 the Council adopted Directive 96/62/EC on Ambient Air Quality Assessment and Management (the Air Quality Framework Directive). As the Explanatory Memorandum to this Directive explained, it provides a framework for future EC legislation on air quality. It is fully in line with objectives of Article 130 R 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. A common position on limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead was reached on 24 September 1998. This proposal, fixing limit values for benzene and carbon monoxide, is the next "daughter Directive".

2. WHO WILL BE AFFECTED BY THE PROPOSAL?

- Which Sectors of industry?

The present proposal fixes objectives for ambient air concentrations of benzene and carbon monoxide. 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. For both CO and benzene the principal source is road transport. Vehicular traffic represents in the EC about 80-85% of the emissions of benzene. Other emissions derive mainly from fuel distribution, petroleum refineries, the

chemical industry and from domestic use. CO emissions are associated mainly with road transport (about 65%) and combustion (nearly 20%). This combustion is mainly linked with a domestic use. Industrial emissions of CO have fallen both because of a decline of some sectors in Europe (ex steelmaking) and the increasing use of less polluting technologies.

A study carried out for the Commission by AEA Technology has evaluated the economic impacts of meeting the proposed targets.. The study examined three case study cities for which information collected during the Auto-Oil Programme was available. The analysis of these cities was then extrapolated to the EC level to provide an overall estimate of the costs and benefits of meeting the proposed limit values. The study took into account expected reductions in emissions as a result of existing EC legislation and standards for the year 2000 resulting from the Auto-Oil I programme.

The economic evaluation carried out for the Commission considered a range of possible policy options that might be used to limit CO and benzene emissions from vehicles. These included technical options, such as alternative fuels or tailpipe treatment technologies; demand management options and congestion reduction ; and economic instruments to promote the use of cleaner vehicle and more efficient vehicle use. It is to be expected that a range of different options will be employed, depending on local considerations.

For measures related to fleet composition and vehicle technology the most immediately affected will be owners and drivers, including small and large business. For traffic management measures there will be a direct effect on users, but also those businesses (such as retailers) who might be affected by changed patterns of vehicle use in urban areas. In such cases it is likely that there will be both winners and losers, but the precise distribution of the burden cannot be assessed. It is therefore difficult to reach general conclusions as to who will be affected by measures taken to ensure compliance.

- **Which Sizes of Business?**

As above, It is not possible to analyse in detail the size of business potentially affected for benzene and carbon monoxide 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 some of the costs of controlling these pollutants.

- **Overall impact**

A study of economic impacts carried out for the Commission indicated that exceedances of proposed limit values benzene and carbon monoxide were likely to be confined to cities. The economic evaluation of a limit values for benzene and CO took the air quality work done under the Auto-Oil Programme as a starting point. Three of the Auto-Oil cities were taken as case studies. The Auto-Oil work indicated that none of these cities were expected to have exceedances of per 5$\mu g/m^3$ for urban background concentrations by 2010. However, exceedances were expected in so-called "hot spots".

Urban background concentrations in 2010 were calculated for each city for each cell in a grid of 2km by 2 km squares, and peak concentrations were estimated for each cell to provide an indication of likely « hot spots ». The costs and benefits of reducing these exceedances were then estimated. The costs of reducing exceedances (and also benefits) will vary with the abatement strategy that is adopted. If policy options are chosen that

limit action to the area where there are exceedances (e.g. local traffic management schemes) then the costs and benefits are likely to be lower than policy options which reduce concentrations over a wider area.

For benzene two different scenarios were considered for each city - one where reductions are targeted to area of exceedance ("optimised" scenario), and one where they are not ("generalised" scenario). The figures obtained for the three cities were then extrapolated to the EU level by assuming that each city is representative of a particular portion of the EU's urban population. This extrapolation introduces another possible source of error into the analysis, although it is likely to affect the overall estimate of costs and benefits rather than the relationship between them. The results for the EU are given in the table below. All figures are in ECU million/year.

	Limit value of 5 ug/m^3	
	Costs	**Benefits**
Current concentrations:		
	Generalised abatement scenario	
Low	280 - 1 300	0.28 - 78
Mid	910 - 4 700	0.38 - 103
High	1 800 - 9 200	0.54 - 150
	Optimised abatement scenario	
Low	110 - 600	0.15 - 41
Mid	490 - 2 300	0.26 - 68
High	1 400 - 7 000	0.54 - 150

High, medium and low estimates are given for each abatement approach, reflecting uncertainty about current concentrations. For the benefit estimates, the top end of the range uses the high estimate of the risk posed by benzene. In addition, all cancers are assumed fatal, with each fatality is valued at ECU 3.35 million (a VOSL of ECU 3.1 million plus ECU 250 000 medical costs). The bottom of the range takes the low risk estimate. In addition, only half of cancers are assumed fatal, so the average cost of a cancer falls to ECU 1.8 million (ECU 3.1 million divided by two, plus ECU 250 000 medical costs).

It should be noted that for several reasons the actual costs of implementing the proposal may be somewhat lower than suggested by the table above. First, the figures do not include emission standards agreed for the year 2005 during the recently completed Auto-Oil concilation process.

And recent measurement data from some Member States indicate that benzene concentrations are declining faster than predicted by the Auto-Oil calculations used as a basis for this analysis, especially in hotspots where traffic is the dominant source. Furthermore, Member States' experts suggest that many of the measures which would reduce concentrations of benzene will in any case need to be undertaken for other reasons.

Finally, it should be noted that the Commission's proposal includes the possibility of agreeing an extension to the timetable for meeting the benzene limit value in areas where it is shown that meeting it by 2010 would cause severe socio-economic problems. Extending the timetable would also reduce costs.

Secondary benefits, which could be substantial, are not included in the calculations.

For CO a simpler approach was taken, assuming only a « generalised » abatement approach. Costs and benefits for the EU as a whole are given in the table below.

	Limit	Benefits ECU million /year	Costs ECU million/year
Carbon monoxide	10 mg/m^3 max	39.3	105 - 122

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

Not really. Problem areas are most likely to be found in southern Member States, mainly because the economic development will not allow a sufficiently rapid turnover of existing car fleets.

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.

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 CO are relatively small and are not expected to have a large impact on business. Costs for benzene will be somewhat higher, but the actual burden will depend on the cost effectiveness of the approach taken to abatement by the Member States. 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.

- **On the Competitiveness of Business**

The proposal is not expected to affect the competitiveness of most sectors.

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 by competent authorities and remedial measures concentrated in the areas where pollution levels are highest. As a further safeguard, as noted above, the Commission's proposal includes the possibility of extending the timetable for meeting the limit value for benzene in areas where there is exceptional difficulty.

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 1997 and 1998 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. The following is a summary of the position of the Industry organizations as expressed in the meetings and in subsequent correspondence.

Benzene

UNICE agrees that the limit value for benzene should be set within the given range of 0.2 – 20 $\mu g/m^3$ as low as it is practically achievable. It also considered the economic impact assessment. UNICE supports a limit value of 10 $\mu g/m^3$ (annual average), compatible with a mid-range estimate of additional risk of one in a million for lifetime to be reached in 2005. In 2005 a further evaluation should in its opinion be carried out to determine whether there are any health risk related reasons or cost-benefit considerations that merit further reduction of the limit value. In the "benzene Working group", UNICE supported the option aiming at setting up a limit value at the level of 10 $\mu g/m^3$, to be reviewed only in 2007. This point of view was supported by a small number of Member States. A majority supported a stricter limit value.

Carbon monoxide

The proposal of an 8-hour limit value of 10 mg/m^3 with no allowed exceedances, to be met by 2005, was supported by all members of the Working group, including industry, even though UNICE considered the WHO guideline, on the base of which the proposed limit value has been fixed, as highly conservative. UNICE also recommended the inclusion of a paragraph addressing the issue of specific locations, such as tunnels, where the eight-hour air quality standard might be inappropriate. It was suggested that a standard based on the WHO-EU 15-minute Guideline value of 100 mg/m^3 might be more appropriate for such circumstances.

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