COMMISSION OF THE EUROPEAN COMMUNITIES

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# COMMUNICATION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT
on a Community strategy to combat acidification

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Proposal for a
## COUNCIL DIRECTIVE
relating to a reduction of the sulphur content of certain liquid fuels
and amending Directive 93/12/EEC

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Proposal for a
## COUNCIL DECISION
on the conclusion by the European Community of the Protocol to the 1979 Convention
on long-range transboundary air pollution on further reductions of sulphur emissions

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(presented by the Commission)

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**Communication to the Council and the European Parliament on a Community strategy to combat acidification**

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## 1. INTRODUCTION

In December 1995, the Environment Council requested the Commission to develop a coherent acidification strategy, to be presented to the Council in the beginning of 1997. This decision followed the publication in November 1995 of a Commission staff working paper on acidification (SEC(95) 2057). The working paper showed that, while considerable progress has been made, current and planned legislation was not sufficient to achieve the long-term goal of "no exceeding ever of critical loads and levels" of the Fifth Environmental Action Programme.

This Communication is a response to the request from the Council. It briefly reviews the problem of acidification and the methodology which the Commission has used to develop a cost-effective strategy to combat acidification. It then goes on to describe the major elements in that strategy.

## 2. BACKGROUND

### 2.1 The problem of acidification

For the purpose of this strategy, acidification means effects of the introduction of acidifying substances into the environment by means of atmospheric deposition. The primary air pollutants contributing to acidification are:

- sulphur dioxide ($SO_2$), emitted mainly from the combustion of coal and oil;
- nitrogen oxides (NOx), chiefly from motor vehicles and other combustion processes; and
- ammonia ($NH_3$), principally from agricultural activities.

The emissions divided by sector for the EC15 are shown in Table 1, and the emissions country-by-country in 1990 are given in Table 2.

**Table 1: Emissions of acidifying pollutants, by sector, 1990, European Community**

| Sector | % of $SO_2$ | % of $NO_x$ | % of $NH_3$ |
|---|---|---|---|
| Large combustion plants (LCP) > 300 MW | 56 | 19 | 0 |
| LCP 50-300 MW | 7 | 2 | 0 |
| Other combustion plant | 24 | 13 | 0 |
| Industrial processes | 4 | 2 | 3 |
| Road transport | 3 | 51 | 0 |
| Other transport | 2 | 12 | 0 |
| Waste | 0 | 1 | 1 |
| Agriculture | 0 | 0 | 94 |
| Natural | 3 | 0 | 2 |
| | 100% | 100% | 100% |

*Source: CORINAIR 1990*

These acidifying substances can be carried by winds for hundreds and even thousands of kilometres before being deposited in the environment. While still in the atmosphere, the sulphur dioxide can be transformed into sulphuric acid, and the nitrogen oxides to nitric acid. When deposited on vegetation, soil, and water, they cause acidification, which has extensive biological effects on both aquatic and terrestrial ecosystems, greatly changing and impoverishing them by reducing the diversity of plant and animal species.

Acidification of the soil leads to the leaching out of plant nutrients, such as potassium, calcium, and magnesium, which in the long term may cause nutrient deficiencies, thus threatening the productivity of forest soils. The process of acidification also results in increased concentrations of aluminium and other toxic metals in the soils, ground water, and surface waters. The biodiversity of lakes and rivers is drastically impoverished in areas affected by surface water acidification. Acidified ground water can cause problems, for instance by corroding pipe-work, but also by creating health risks as the acidification increases the mobility of various harmful metals, such as aluminium, mercury, copper, zinc, cadmium, and lead. Acid deposition accelerates the rate of deterioration of building materials as well as objects of art and cultural heritage, particularly in urban areas.

**Table 2: Emissions of $SO_2$, NOx and $NH_3$ 1990 (thousand tonnes)**

| Country | $SO_2$ | NOx | $NH_3$ |
|---|---|---|---|
| Austria | 90 | 222 | 91 |
| Belgium | 317 | 352 | 95 |
| Denmark | 180 | 269 | 140 |
| Finland | 260 | 300 | 41 |
| France | 1 298 | 1 585 | 700 |
| Germany | 5 331 | 3 071 | 759 |
| Greece | 510 | 306 | 78 |
| Ireland | 178 | 115 | 126 |
| Italy | 1 678 | 2 047 | 416 |
| Luxembourg | 14 | 23 | 7 |
| Netherlands | 205 | 575 | 236 |
| Portugal | 283 | 215 | 93 |
| Spain | 2 266 | 1 178 | 353 |
| Sweden | 136 | 411 | 61 |
| UK | 3 752 | 2 702 | 320 |
| EC15 | 16 498 | 13 371 | 3 516 |

The effects of acid deposition vary geographically, depending primarily on the sensitivity of the receptor (e.g. an ecosystem) in question, and the amount of acid deposition. The critical load indicates the sensitivity of a particular environment by defining how much exposure to pollution it can tolerate before long-lasting or other significant damage occurs. Critical loads are set for natural and semi-natural ecosystems, such as forest soils, heathlands, and surface waters, i.e. excluding e.g. managed farmland and built-up areas. The concept of critical loads is science-based. Consequently, the data used reflects current best knowledge and includes a certain level of uncertainty. Critical loads have a significance for sustainable development, since depositions above the critical loads are not sustainable in the long term.

The sensitivity to acid deposition varies greatly between different areas and ecosystems. The areas in the European Community where critical loads for acidity are the lowest - i.e. those containing the most sensitive ecosystems - tend to be in the northern part of the region, including Sweden, Finland, the United Kingdom, the Netherlands and Germany.

Acidification is determined by the total deposition of acidifying pollutants relative to the critical load for a particular environment. Any reduction in acidifying depositions will reduce acidification, but acidification will not stop, and thus sustainable recovery will not take place, until depositions are brought down to levels where the critical loads no longer are exceeded. In fact, as a result of the historically accumulated acidification effects in soils, recovery may for some areas take decades or even hundreds of years. The speed of recovery is dependent primarily on ecosystem characteristics and on how quickly the depositions are reduced - the sooner depositions are brought down to below critical loads, the quicker the recovery.

In 1990, the critical loads for acidification were exceeded over an area of more than 32 million hectares in the Member States. In terms of absolute area exceeded, the countries worst affected were Sweden (10 million hectares), Germany (7 million hectares), and Finland (5 million hectares) (see Table 5). As indicated above, the damage caused by acidification involves reduced biodiversity in terrestrial and freshwater ecosystems, which in turn affects e.g. amenity and recreational values. The impoverishment of the soil nutrient status may in the longer term result in reduced forest productivity. While it is possible to identify and quantify the areas affected or at risk with a relative high level of certainty, there is still large uncertainty as regards the quantification in economic terms of the damage and the long-term risks caused by acidification.

## 2.2 Other effects of acidifying pollutants

Although the focus of this strategy is on acidification (as acid deposition), it is important to note that airborne emissions of the mentioned acidifying pollutants have other detrimental effects on the environment. In particular, ambient concentrations of sulphur dioxide and nitrogen dioxide have been shown to have deleterious effects on human health, especially for people susceptible to respiratory problems, such as asthma, bronchitis and emphysema. They also contribute to corrosion of buildings and materials. There is increasing evidence that small acid particles, which are secondary products of emissions of sulphur and nitrogen oxides, affect lung function. Nitrogen oxides are also a major precursor of ground-level ozone ($O_3$), an aggressive pollutant which can damage human health, vegetation, and organic materials, and reduce visibility. Deposition of nitrogen compounds, emanating from emissions of nitrogen oxides and ammonia, can act as fertilizer, thus contributing to eutrophication of terrestrial, freshwater, and marine ecosystems, affecting among others the biological diversity of these ecosystems.

Consequently, the benefits of reducing emissions of acidifying air pollutants relate not solely to reduced acidification damage, but are substantially wider, i.e. includes improved health, reduced mortality and/or morbidity, lessened corrosion of buildings and material, better protection of the cultural heritage, less eutrophication, improved visibility, etc. Some of these benefits (e.g. impacts on health and corrosion) can with some degree of certainty be quantified in monetary terms (see section 6), while others (e.g. the ecological impacts) can not that easily be monetized. In order to show the ecological benefits of emission reductions, the change in the area of sensitive ecosystems where critical loads are no longer being exceeded can be estimated.

## 2.3 Existing EC legislation on acidifying air pollutants

There is a large range of instruments by which emissions of sulphur dioxide and nitrogen oxides are controlled at Community level, but so far none dealing specifically with emissions of ammonia. Some of the existing instruments were largely designed to help combat acidification, while others have been developed primarily for other reasons. The key instruments, either in force or proposed, are shown in figure 1 on the next page.

In addition to the measures adopted at the level of the Community, many Member States have introduced national measures to bring about even further reductions in acidifying emissions.

## 2.4 The UN ECE/CLRTAP

The Convention on Long-Range Transboundary Air Pollution (CLRTAP) was signed in 1979. The secretariat of the Convention is run by and located at the United Nations Economic Commission for Europe (UN ECE), in Geneva. Of the present 55 member states of the UN ECE, 40 are parties to the convention, including all the member states as well as the European Community. Since coming into force in 1983, the convention has been extended by five specific protocols, four of which prescribe objectives and measures to control and reduce emissions of transboundary air pollution. Three of these relate to acidifying air pollutants: The two sulphur protocols, from 1985 and 1994, and the 1988 NOx Protocol. The fourth aims at reducing emissions of volatile organic compounds (VOCs), with the aim of lowering concentrations of ground-level ozone.

In 1993, the Community acceded to the 1988 NOx Protocol[1]. Twelve Member States have ratified, two have signed but not ratified, and one has not signed this protocol. As regards the 1994 Sulphur Protocol, fourteen member states, as well as the Community has signed it. As yet only four member states have ratified it (see section 4.2).

In the late 1980s, the convention started to develop the so-called critical loads approach as a tool for developing effects-based and cost-effective abatement strategies. This approach was used when negotiating the 1994 sulphur protocol, and is also being used for the ongoing negotiations on a new multi-effects and multi-pollutants protocol - an agreement that addresses the effects of ground-level ozone, acidification, and eutrophication, and the pollutants nitrogen oxides, volatile organic compounds, and ammonia. This new protocol is

[1] OJ No L 149, 21.6.1993, p. 14.

expected to be finalized during 1998, and once it enters into force will supersede the existing VOC and NOx Protocols. In practice, however, the basic obligations of existing protocols are being maintained. Moreover, the CLRTAP process plays an important role in generating information, exchanging of data, and in raising knowledge and awareness.

**Figure 1: Existing Community legislation relevant to the reduction of acidifying emissions**

- The Council Directive 88/609/EEC on the limitation of emission of certain pollutants into the air from large combustion plants: This was adopted by the Council in November 1988, and applies to combustion plants with a thermal input of 50 megawatts (MW) or more. It includes emission limit values for new (post-1987) plants, and country-by-country ceilings for national total emissions from existing (pre-1987) plants. These emission ceilings are gradually reduced in several steps over time. Presently, the Commission is preparing a revision of the Directive, as requested by provisions in the original Directive. The proposal for revision is expected to be finalized by the Commission by autumn 1997.

- The Council Directive 93/12/EEC relating to the sulphur content of certain liquid fuels: This sets limits of the maximum sulphur content, to 0.2% for gas oils used in stationary combustion sources, and to 0.05% for diesel fuels used in mobile sources. A provision for the revision, prescribing a lower limit for gas oils used for stationary combustion, is contained in the original Directive.

- Legislation relating to control of emissions from mobile sources: There exists an extensive body of Community legislation for the control of atmospheric emissions from passenger cars and light commercial vehicles (Directive 70/220/EEC as amended) and heavy duty vehicles (Directive 88/77/EEC as amended). In June 1996 the Commission adopted a strategy for the further control of road transport emissions (COM(96)248 final). This strategy foresees that NOx emissions from road transport will be reduced by 65% in 2010 as compared to 1995. With regard to other mobile sources of acidifying emissions, in 1995 the Commission put forward a proposal for the control of emissions from non-road mobile machinery (COM(95) 350 final).

- The framework Directive 96/61/EC on integrated pollution prevention and control (IPPC): This was adopted by the Council in September 1996, and will require the application of best available techniques (BATs), as defined in this Directive, adapted to local circumstances and taking into account contribution to transboundary air pollution, at every existing installation covered by the Directive by the year 2007, and at new installations as from 1999.

- Air quality Directives for among others $SO_2$, $NO_2$, particulates, and ozone: Under the framework of Directive 96/62/EC on ambient air quality assessment and management, the Commission is currently preparing new air quality limit values for $SO_2$, $NO_2$, and particulates, and a proposal for a new Directive for these is expected in the first half of 1997. A proposal for revision of Council Directive 92/72/EEC on air pollution by ozone, as well as a Community strategy to reduce ozone precursors, is due early 1998.

## 3. DEVELOPING THE STRATEGY

### 3.1 The scientific basis for the strategy

Responding to the mandate given by the Council, the Commission working together with its contractor (the International Institute for Applied Systems Analysis (IIASA)), has carried out a detailed scientific assessment to provide a sound technical foundation upon which to build a strategy for combatting acidification in the European Community. The data used in carrying out the analysis as well as the models for integrated assessment are the same as those used to support the development of protocols under the UN ECE/CLRTAP. In this way it was assured that the Commission's strategy would be consistent with ongoing work in the UN ECE. The assessment carried out by the Commission has taken into account *inter alia:*

(1) the predicted evolution in the emissions of acidifying substances, taking into account the impact of existing and forthcoming legislation at the level of the Community as well as legislative actions and plans announced by the individual Member States;

(2) the transboundary nature of the acidification problem, by using internationally agreed data on emissions, transboundary fluxes, and depositions of the acidifying air pollutants;

(3) the identification of cost-effective strategies to combat acidification taking into account changing patterns in emissions, the differences in critical loads across the Community and the cost of different abatement measures;

(4) the potential impact of abatement measures taken outside the territory of the EC;

(5) the impact on related environmental phenomena such as eutrophication and tropospheric ozone formation.

A description of the scientific analysis which was carried out to support the development of the acidification strategy is presented in the Annex to this Communication. However, before going on to describe the elements in the Commission's proposed strategy it is necessary to draw attention to a number of important considerations.

### 3.2 The ultimate target of no exceedance of critical loads and need for interim targets

The Council conclusions of December 1995 recognized the difficulty of meeting the ultimate objective of no exceedance of critical loads in the immediate future. It therefore invited the Commission to identify interim targets on the path to reaching that goal. The analysis verified the need for setting interim targets. A given policy constraint for the strategy is that measures to reduce emissions must primarily take place within the EC, since the EC can not impose legally binding commitments/measures outside of its territory. The analysis showed that even when assuming the application of current best available technologies to all emission sources in the whole of Europe, it would not be possible to reach the long-term environmental quality target for the whole of the EC by 2010.

Using a so-called gap-closure approach, various possible interim targets were analysed. A similar approach was used in the negotiations for the 1994 Sulphur Protocol under the Convention on Long-Range Transboundary Air Pollution. Due to the more complex critical loads now used - involving both sulphur and nitrogen compounds, as compared to sulphur only in the sulphur protocol - the gap closure now applied is based on ecosystem protection data.

Consequently, the concept applied aims at a stepwise closing of the gap, that is the difference, between the level of ecosystem protection in 1990 and the ultimate target of 100% ecosystem protection, by a certain percentage.

After thorough analysis of several options, it was found appropriate to aim at a 50% gap closure. This should, with present knowledge, in the most cost-effective manner for the EC as a whole, reduce the area of sensitive ecosystems in which critical loads were exceeded in 1990, by at least 50% in the different regions of the member states. The main motive for selecting this interim environmental quality target is that it represents a good balance between ecosystem protection and costs: at levels of gap closure above 50% the additional costs of emission reduction increase very rapidly. The Commission considers that the interim environmental target of 50% gap closure should be achieved by 2010. The interim target will be reviewed in 2004, as part of the review process (see section 4.12).

A more detailed explanation of the concept of gap closure and the rationale for selecting an interim target of 50% gap closure are presented in the Annex.

### 3.3 Preliminary assessment of the emission reductions necessary to achieve the 50% gap closure target

The Commission, working with IIASA, has carried out an analysis of the most cost-effective approach for achieving the interim target of 50% gap closure by 2010. This analysis takes into account the transboundary fluxes in atmospheric pollutants across the Community and the costs for each country associated with reducing the emissions of the three pollutants $SO_2$, NOx, and $NH_3$. The output from the analysis is the global, least-cost solution for the whole Community in order to achieve the 50% gap closure target. A summary of the preliminary results from the analysis are shown in Table 3, and more detailed results are presented in the Annex.

**Table 3: Summary of the emission levels for the Community which will be necessary to achieve the 50% gap closure target as compared to 1990 and the predicted situation in 2010 on the basis of current plans (million tonnes)**

| | 1990 | 2010 (current plans) | 2010 (in order to achieve the interim target) |
|---|---|---|---|
| $SO_2$ | 16.5 | 5.6 | 2.7 |
| NOx | 13.4 | 6.9 | 6.0 |
| $NH_3$ | 3.5 | 3.0 | 2.5 |

### 3.4 Assumptions concerning energy use and $CO_2$ emissions

In carrying out the scientific analysis underlying the strategy, certain assumptions had to be made with regard to energy use. Given that energy production and the associated combustion of coal and liquid petroleum products is one of the most important sources of acidifying emissions, these assumptions had a significant impact upon the acidification strategy, particularly in relation to the identification of least-cost solutions. It was also clear that assumptions concerning energy consumption should take into account the need to reduce $CO_2$ emissions in the light of concerns relating to global warming.

The analysis upon which the acidification strategy was developed, is based on the so-called conventional wisdom scenario, which envisages a 20% increase in energy consumption and a 10% increase in $CO_2$ emissions between 1990 and 2010. However, an additional analysis was also carried out using an alternative scenario based on the assumption that $CO_2$ emissions would be reduced by 10% in 2010, as compared to 1990. The results show that under such assumptions the expenditures on abatement measures for attaining the interim target of a 50% gap closure could be substantially reduced (see Annex).

### 3.5 Collaboration with the UN ECE/CLRTAP

The Council recognized that international cooperation and coordination were necessary to reach the goal of no exceedance of critical loads, and considered it essential that future Community strategies were developed taking full account of the work of the UN ECE/CLRTAP. The Council also stated that when preparing the acidification strategy, the Commission should have regular contact with among others the UN ECE/CLRTAP.

Following bilateral consultations between the Commission and the UN ECE/CLRTAP in April 1996, a steering group of key people from the two institutions was formed, with the main task to facilitate coordination. Formal meetings of the steering group have taken place in July and November, and informal consultations are carried out on a continuous basis.

## 4. THE STRATEGY

On the basis of the results from the scientific analysis described above, taking into account the observations made by member states, and noting those made by the industry and the NGOs, during the course of three meetings held on 29 May 1996, 31 October 1996, and 16 January 1997, the Commission has developed a strategy for combatting acidification in the European Community.

If the measures which are proposed as part of the strategy are implemented, this will allow the attainment by 2010 of the interim target of 50% gap closure, as described in section 3.2. The proposed measures will lead to further emission reductions as compared to those expected to result from current legislation and commitments, which are estimated to reduce Community-wide emissions of $SO_2$, NOx, and $NH_3$ by 66, 48, and 15% respectively, between 1990 and 2010. However, the long-term environmental objective is no exceeding ever

of critical loads. With this in mind, the Commission's proposed strategy also foresees an ongoing review process to both monitor the impact of the measures to be introduced and to assess the need for and the nature of additional measures to reduce acidifying emissions. The key elements in the strategy are as follows:

### 4.1 Proposal for national emission ceilings

The Commission considers that the Community's future policy with regard to acidification and related transboundary phenomena, such as tropospheric ozone, should be based on national emission ceilings for a number of key pollutants. These national emission ceilings should be compatible with the achievement of agreed environmental objectives. The elaboration of national emission ceilings is consistent with the approach which has been taken in the context of the UN ECE Convention on Long-Range Transboundary Air Pollution. One of the advantages of a policy which is based upon emission ceilings is that it allows a significant degree of flexibility for member states to determine how the ceilings are to be achieved in the most cost-effective way. It is understood that measures taken by member states would need to be compatible with Community rules governing the functioning of the internal market and competition. Member states could for example implement economic instruments or other non-technical measures as additional tools as part of their national strategies to meet the emission ceilings.

As stated above, the quantification of national emission ceilings is dependent upon the prior definition of the environmental objective. With regard to acidification, the Commission considers that an appropriate medium-term objective is the achievement by 2010 of the 50% gap closure interim target (see section 3.2).

The scientific analysis carried out by the Commission has provided preliminary information concerning the emission reductions which would be necessary to achieve the interim target of 50% gap closure (see section 3.3 and the Annex). The Commission would stress the preliminary nature of these figures which will be reviewed in the light of the ozone strategy (see below) and further refinements to the scientific analysis. However, it is clear that the achievement of the 50% gap closure target will present a significant challenge over and above the efforts that the member states are already making to reduce their acidifying emissions.

Tropospheric ozone is another type of transboundary pollution which requires an integrated response at the level of the Community. It is foreseen that by the beginning of 1998 the Commission will come forward with a proposal for a Community strategy to combat this type of pollution. The Commission, working with its contractor IIASA, is currently carrying out the scientific analyses necessary to develop its proposed strategy. These analyses will be based on the same methodology which has been used to develop the present strategy to combat acidification. It is foreseen that the scientific analysis will allow the definition of national emission ceilings for NOx and Volatile Organic Compounds, which are the pollutants primarily responsible for the formation of tropospheric ozone.

During the course of 1998, and on the basis:

(1) of the refinements to the analysis relating to acidification;

(2) the completion of the analysis relating to tropospheric ozone;

(3) further discussions with experts from the Member States, industry and NGOs;

(4) the progress of discussions related to the finalization of a new protocol in the context of the UN ECE Convention on Long-Range Transboundary Air Pollution, as well as the planned revision of the International Maritime Organization's (IMO) Convention on Maritime Pollution (MARPOL),

the Commission will come forward with a proposal for a Directive establishing national emission ceilings for $SO_2$, NOx, $NH_3$, and VOCs, consistent with the attainment of the 50% gap closure target for acidification and the achievement of agreed air quality objectives for tropospheric ozone. In drawing up these emission ceilings, the Commission will have regard to the consequences of the proposed ceilings for the economic and social development of specific regions in the Community.

Even though the introduction of binding national emissions ceilings is a major new initiative, it is only one part of the acidification strategy. It is proposed that the emission ceilings are complemented by a number of other actions (see below), that will help ensure both that the emission ceilings will be attained in practice, and that cost-effective technical measures to reduce emissions are taken within and outside the European Community.

### 4.2 Ratification of the 1994 Sulphur Protocol

With the exception of Portugal, all member states, as well as the European Community, have signed the 1994 Sulphur Protocol to the Convention on Long-Range Transboundary Air Pollution. Moreover, the following non-EC countries have so far signed it: Bulgaria, Canada, Croatia, Czech Republic, Hungary, Liechtenstein, Norway, Poland, Russia, Slovakia, Slovenia, Switzerland, and Ukraine. By December 1996, however, only four Member States (Sweden, Netherlands, Luxembourg, and the UK), and one non-EC country (Norway) had ratified it. For the protocol to enter into force it must be ratified by 16 of the signatories.

If the Community is intent upon the development of an ambitious policy to combat acidification, then one of the first steps which should be taken is the ratification of the 1994 Sulphur Protocol: before deciding upon additional measures to reduce acidifying emissions the Community should demonstrate its commitment with regard to existing international undertakings. Moreover, the protocol contains provisions for future reviews, which provide the opportunity for more far-reaching commitments that could further contribute to meet the environmental quality targets of the Community.

In addition to the political significance of the Community ratifying the 1994 Sulphur Protocol, there is a clear benefit to be gained for the Community in that the Convention on Long-Range Transboundary Air Pollution is currently the most effective mechanism for bringing about emission reductions in those non-EC countries which contribute significantly to acid deposition within the EC.

It is therefore proposed that the Council should decide that the European Community ratify the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions. A proposal for a Council decision on the conclusion by the European Community of the 1994 Sulphur Protocol is attached.

## 4.3 Proposal for revision of the Directive on the sulphur content of certain liquid fuels

In March 1993, the Council adopted Directive 93/12/EEC relating to the sulphur content of certain liquid fuels. Here, the maximum sulphur content of diesel fuels was set at 0.2% by weight as from 1 October 1994, and reduced to a maximum of 0.05% as from 1 October 1996. The maximum sulphur content of gas oils other than diesel fuels was set at 0.2% by weight as from 1 October 1994. In Article 2 of that Directive, the Commission was requested to report on progress made in controlling sulphur dioxide emissions, and to submit a proposal prescribing a lower limit for the sulphur content of gas oils, other than diesel fuels. This proposal was postponed pending the outcome of the acidification strategy.

In the analysis carried out for the purpose of developing the acidification strategy, it was found that a further reduction in the sulphur content of gas oils used in stationary combustion sources was a cost-effective measure - or was in fact already being applied in practice - for eight Member States: Austria, Belgium, Denmark, Finland, Germany, Netherlands, Sweden, and the UK. (In Austria and Finland, the maximum sulphur content allowed at present is 0.1%. These two countries have a derogation allowing for this in their Accession Treaty with the EC, lasting over the transition period of four years, ending by 31 December 1998.) In all other Member States a further reduction of the sulphur content in gas oils below the current limit value of 0.2% sulphur is not cost-effective for the purpose solely to meet the interim acidification goals.

The combustion of heavy fuel oils is the dominating source of $SO_2$ emissions from the use of liquid fuels, their relative share of total EC emissions in 1990 being about 20%. In the absence of targeted measures, by 2010 it is estimated that this share would increase to nearly 40%. The emissions of $SO_2$ from heavy fuel oils come from a number of varying sources (see Table 4).

**Table 4: Emissions of $SO_2$ from heavy fuel oils (HFO) in 2010 according to the reference scenario, and after limiting the sulphur content to 1% (kilotonnes)**

| | Refineries and other conversion | Industry | Domestic | Transport | Power plants | SUM |
|---|---|---|---|---|---|---|
| Reference scenario | 404 | 574 | 158 | 81 | 901 | 2 119 |
| If 1% S in HFO | 207 | 329 | 75 | 27 | 350 | 988 |
| Difference | | | | | | 1 131 |

The analysis for the acidification strategy showed that for 12 Member States (the exceptions being Spain, Portugal and Greece) the use of low-sulphur heavy fuel oil in certain sectors e.g. transport and domestic use, was a cost-effective abatement option to meet the interim target. However, in other sectors such as power plants and industry the application of flue gas desulphurization was generally more cost effective and also more effective in removing emissions.

Given that the combustion of heavy fuel oils contributes significantly to emissions of $SO_2$, the Commission considers it appropriate as part of its strategy to combat acidification to reduce emissions of $SO_2$ from this source by placing limits on the sulphur content allowed in heavy fuel oil. In order to reflect the conclusions from the integrated assessment and to avoid non-cost-effective expenditure, the Commission recognizes that in some countries/regions where environmental conditions allow, and in some industries which already apply abatement technologies (such as flue gas desulphurization) which give equivalent or superior results in terms of reduced $SO_2$ emissions, it will be necessary to provide for derogations to any general limit on the sulphur content. In particular, any rules relating to heavy fuel oils should take account of and be consistent with the provisions of Directive 88/609/EEC on emissions from large combustion plants and the proposed amendment to that Directive (see section 4.4 below). With regard to the revision of Directive 88/609/EEC, it is currently foreseen that this will include provisions such as emission ceilings (similar to the concept included in this Directive) which afford large combustion plants a degree of flexibility with regard to the sulphur content of the heavy fuel oils they are using.

A proposal for a Council Directive relating to the sulphur content of gas oils and heavy fuel oils, and incorporating the principles set out in the paragraphs above, is attached to this Communication.

As regards the control of the sulphur content of marine bunker oils this is dealt with in section 4.5 below.

### 4.4 Action related to the LCP and IPPC Directives: controlling emissions from stationary sources

New emission limit values for $SO_2$ and NOx for all new large combustion plants are currently being prepared by the Commission in the process of revision of Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants (the LCP Directive). The new emission limit values will be based on so-called BATs (Best Available Techniques) for air pollution control. As part of the preparatory work for the revision of Directive 88/609/EEC, the Commission services are examining *inter alia* the potential value of establishing national emission ceilings for both new and existing plants. Such emission ceilings are motivated by the need to ensure both cost-effectiveness and attainment of environment quality targets. A study carried out for the purpose of the revision of the LCP Directive, as well as practical experience in several Member States, has shown that emissions from large combustion plants can be more cost-effectively dealt with through emission ceilings (possibly in combination with limit values), as compared to the use of emission standards only.

The conclusions from the analysis for the acidification strategy indicated that:

- For emissions of $SO_2$, the application of flue gas desulphurization, or emission limit values to the same effect, or emission ceilings leading to the same overall reductions, would be necessary for existing large combustion plants in all Member States, with the exception of Greece, Portugal, and partly also of Spain.

For emissions of NOx, the application of flue gas dentrification, or emission limit values to the same effect, or emission ceilings leading to the same overall reductions, would be necessary for existing large combustion plants in all member states, with the exception of Greece, Portugal, Spain, Italy, Finland, and Luxembourg.

The Commission's proposal for the revision of the LCP Directive will be consistent with the attainment by 2010 of the 50% gap closure interim target for acidification.

By the year 1999 for new installations, and the year 2007 for existing ones, the emission limit values as required by the IPPC-Directive (96/61/EEC), shall be based on integrated BATs, as defined in this Directive, taking into account:

- geographical location;
- local environmental circumstances;
- provisions on the minimization of long-distance or transboundary air pollution; and,
- the primary objective of the IPPC Directive, which is to prevent or, where that is not practicable, to reduce emissions in order to achieve a high level of protection for the environment taken as a whole.

The IPPC Directive is also the main tool for bringing reductions in emissions from industrial processes. According to the results from the analysis carried out in support of the acidification strategy, for the purpose of achieving the 50% gap closure target, it would be cost-effective to apply strict controls on $SO_2$ emissions from industrial processes in all member states of the Community with the exception of Greece and Portugal. Similarly, ten member states would need to control also NOx-emissions from these sources, the exceptions being Greece, Portugal, Spain, Italy, and Finland. Again, emission ceilings, or economic instruments, are conceivable that could lead to the same overall reductions in a more cost-effective way.

The conclusion from the analysis for the acidification strategy therefore is that, in order to meet the interim target, complementary measures of Community-wide or regional character are needed to reduce emissions from combustion plants and industrial processes. The legal instruments to use are the revision of the 88/609/EEC Directive on emissions from large combustion plants, and the IPPC Directive.

### 4.5 Action related to emissions from shipping

When including emissions from international shipping in the optimization for the interim target of 50% gap closure, it was demonstrated to be cost-effective to reduce the $SO_2$ emissions from ships in the Baltic Sea and the North Sea, and to reduce emissions of nitrogen oxides in the Baltic Sea, the North Sea and parts of the Atlantic Ocean. Due to lack of data, the emissions from ships in the Mediterranean were not included in the analysis. Reduction in $SO_2$ emissions can be achieved by lowering the sulphur content in the bunker fuel oils, and measures to reduce emissions of nitrogen oxides include the use of catalytic converters.

The sulphur content of marine bunker fuels is not subject to any international regulation. There are however proposals to control it under the International Maritime Organization's (IMO) Convention on Maritime Pollution (MARPOL Convention). This Convention is currently under revision, with the negotiations due for completion towards the end of 1997. In the preparatory discussions for the revision of the Convention, the countries bordering the Baltic Sea have proposed that this sea area be designated a sensitive zone with regard to emissions of $SO_2$. The countries bordering the North Sea are also working towards a similar designation for all, or part, of the North Sea/English Channel. In such sensitive zones it is proposed that ships should only be allowed to burn bunker fuels with a maximum sulphur content of 1.5%.

The designation of the Baltic Sea and all/parts of the North Sea/English Channel as sensitive zones for $SO_2$ emissions, and the associated restrictions on the sulphur content of marine bunker fuels used in these zones would, according to the Commission's analyses, be a highly cost-effective measure as part of an integrated strategy for combatting acidification in the EC. The Commission therefore considers that, in the context of the current revision of the MARPOL Convention, all member states should support the designation of the Baltic Sea and all/parts of the North Sea/English Channel as sensitive zones for $SO_2$ emissions. Following the revision of the MARPOL Convention, the Member States should move towards the implementation of the provisions regarding the sensitive zones as soon as practicable. The Commission will, if appropriate, make proposals to ensure a speedy implementation of those provisions by the Member States.

### 4.6 Action related to countries in Central and East Europe

Through its external relations, the EC and its member states could play an active role in promoting cost-effective measures outside its jurisdiction. For example, additional reductions in sulphur emissions, above those agreed under the 1994 Sulphur Protocol, appear to be cost-effective in some countries outside the EC in order to further reduce acidification inside the EC. Moreover, further control of emissions of NOx and $NH_3$, as planned for the forthcoming multi-pollutant protocol under the CLRTAP, would also help reduce the exceedance of critical loads for acidification. It is cost-effective, and in all likelihood necessary for meeting the critical loads for acidification, that additional emission reductions are achieved not only in the member states but also in countries in Central and East Europe (CEE), especially in those neighbouring EC countries.

The emission reductions identified in section 3.3 are based on the assumptions that emission reductions in countries outside the EC will be reduced in accordance with their present current legislation and as required under the various protocols of the UN ECE/CLRTAP. Such an assumption concerning the development of emissions in non-EC countries is prudent in as much as the EC has only limited influence over the acidification policy to be pursued by these countries. However, sensitivity analyses carried out by the Commission indicate very clearly that reductions in the acidifying emissions from certain countries, particularly some CEE countries, could allow the EC to pursue more ambitious goals in relation to acid deposition.

The scientific assessment carried out to support the Commission's strategy on acidification, has demonstrated that emissions from certain CEE countries such as Poland, the Czech Republic, Hungary, and Slovenia contribute significantly to the exceedance of critical loads for acidification in the EC (see Annex). However, the EC would tend to export more acidifying emissions to these countries than it receives. Nevertheless, it is in general true that emission reduction per unit investment is greater in the CEE countries than in the EC. For this reason and as long as decisions are made on a case by case basis, it would be possible to identify situations where the promotion of emission reductions in Central and East European countries would be mutually beneficial and cost-effective for all parties involved. The Community should seek to identify and exploit these "win" situations. There are several avenues which should be explored in order to realize this objective.

The EC has been developing contacts with ten countries from Central and East Europe (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) in order to encourage the approximation of their legislation to Community legislation and so to facilitate the adaptations that would be necessary when and if accession will occur. Environmental considerations and in particular the adoption of the *aquis communautaire* in the field of environmental regulation, constitute one of the priority areas for consideration in such a pre-accession strategy. Within the context of the ongoing dialogue with these countries, the Commission intends to identify acidification as one of the priority areas for discussion in the field of environmental protection. To this end the Commission will make use of the existing programme Phare and of facilities such as TAIEX (Technical Assistance and Information Exchange Office) and DISAE (Development of Implementation Strategies for Approximation in Environment) with a view to identifying opportunities for intensive collaboration on initiatives aimed at reducing acidifying emissions.

One of the most powerful mechanisms for bringing about a reduction in emissions in the economies of CEE countries is by influencing the pattern of investment, both governmental and private, especially in the energy supply sector. The Commission therefore intends to pursue discussions with governments, major industrial concerns, and financial institutions with a view to identifying investment strategies which will be optimal with regard to the reduction of emissions which contribute to acidification.

### 4.7 Action related to the Convention on long-range transboundary air pollution

The UN ECE/CLRTAP is the main forum by which the European Community and the member states can influence and promote emission reductions in countries not members of the EC. Further action in some of those countries has proven to be cost-effective for the attainment of the interim environmental quality target in the EC of a 50% gap closure. Moreover, it is necessary in order to achieve the ultimate target, that critical loads are not to be exceeded. The Commission and the member states should therefore play an active and promoting role in CLRTAP negotiations for a new multi-pollutant protocol, and for the urgent ratification and revision of the 1994 Sulphur Protocol (see section 4.2), to make these contribute to meet the environmental quality targets of the EC on acidification and related problems.

## 4.8 Possible action to reduce emissions of ammonia

Some environmental EC legislation, already existing or being developed, is expected to lead to reductions in ammonia emissions. Firstly, the establishment and application of Codes of Good Agricultural Practice through the implementation of the Nitrate Directive (91/676/EEC) is expected to not only reduce nitrate losses to surface and ground water but also has the potential to reduce ammonia emissions. Secondly, the IPPC Directive (96/61/EC) applies also to large installations for the rearing of poultry or pigs as well as to industrial installations that emit ammonia. Finally, the covering of manure storage is part of the Communication on a Strategy for Reducing Methane Emissions (COM(96) 557/2) and can achieve reductions of ammonia emissions.

The analysis carried out for this acidification strategy suggest that it is indeed cost-effective to further reduce ammonia emissions. The analysis suggests that in particular the following measures appear cost-effective:

- techniques that reduce ammonia emission during application of manure (dairy cows, cattle, pigs, laying hens, poultry, sheep), with the exception of a number of countries (i.e. Finland, Greece, Portugal, Spain);
- stable adaptations that reduce emissions from poultry, except in Finland, Greece, Portugal and Spain;
- reducing industrial ammonia emissions, except in Finland, Greece, Luxembourg, Portugal and Spain.

Uncertainties surrounding abatement efficiencies, actual and future emission levels and costs of reductions techniques for the livestock sector appear to be more pronounced than for other pollutants. Since abatement techniques for ammonia are not as well established as for other pollutants, a higher level of discretion for the member states seems appropriate in deciding upon the choice of measures to meet the proposed indicative national emission ceilings. When setting the national emission ceilings, the results of new research shall be taken into account.

## 4.9 Economic instruments

Broadening the range of instruments and where appropriate complement normative legislation with market based instruments is one of the five key priorities of the Fifth Environmental Action Programme. The use of national emission ceilings will create room for member states to implement economic instruments as additional tools in their national strategies. In addition, the proposals for source-based measures in the previous sections, are in as far as possible, designed so that they create flexibility for using economic instruments. The use of the national ceilings, however, constitutes the main operational objective and forms an anchoring point for member states for designing national economic instruments (or regulations) that go beyond common minimum environmental requirements. One can distinguish four main types of instruments: 1) charges/taxes; 2) subsidies; 3) tradeable emission permits, and 4) environmental agreements. Regarding the use of environmental levies the Commission has recently adopted a Communication (COM(97) 9 final) which spells out under which conditions member states can use environmental levies. The Communication explains the legal framework relating to the single market that member states wishing to introduce environmental taxes and charges must respect. The Commission has also adopted a Communication on environmental agreements (COM(96) 561 final), which clarifies the

criteria for the use of this instrument. The national ceilings and the communications will constitute the main incentive and framework for member states to expand the successful experiences with using economic instruments, where appropriate.

On top of the national use of economic instruments, several areas can be conceived where EC action in the form of economic instruments has value added for meeting the national ceilings or to induce further emission reductions through structural changes in energy use and agriculture, towards meeting the critical loads. These areas are: energy taxation, shipping dues, agriculture, and joint implementation of national ceilings.

### 4.9.1 Energy

In the energy sector, the use of economic instruments could result in fuel switching and improvements in energy efficiency. This would lower the costs of meeting the proposed national ceilings for both NOx and $SO_2$, while at the same time reducing $CO_2$ emissions. Differentiated fiscal measures for various energy products can be used for this purpose. The Commission does not find it appropriate to differentiate fiscal measures in separate Directives for each single environmental problem or product. Instead the integration of environmental concerns should be part of a more consistent Community excise duty system for energy products, following the request of the Council and the European Parliament.

For this reason, the Commission will take into account the need to steer markets towards a more efficient and cleaner use of fuels in its proposal for a Directive on the taxation of energy products, as requested by the ECOFIN council of 11 March 1996. This will accommodate more flexible policies at national levels within the Internal Market. The options being considered consist of a differentiation of the minimum levels of taxation applied to heavy fuel oils, related to the sulphur content, and the explicit possibility for member states to differentiate national tax rates on energy products on the basis of their environmental qualities. In addition, new energy products could fall under the scope of Community legislation, and future reviews of the Community levels of taxation would take into account environmental objectives. The proposal is expected to lead to small, but not negligible, reductions in emissions of NOx, $SO_2$ and $CO_2$.

### 4.9.2 Shipping

Section 4.5 reported on the current discussions within the International Maritime Organization (IMO) on setting limits on the sulphur content of bunker fuels. However, the approaches discussed in the context of the MARPOL are not exhaustive and additional mechanisms are available for reducing $SO_2$ emissions from shipping still further. In addition the current discussions in the context of MARPOL do not adequately address the issue of NOx emissions from shipping.

One possible further line of action is the use of environmentally differentiated shipping dues. The Swedish administration seeks to use a general due system, compatible with current shipping dues, for this purpose. Regarding NOx, the Swedish proposal discusses the option of rebating the operating costs and part of the capital investment of catalytic converters. Ships would be charged higher environmentally based dues if they do not install catalytic converters. As regards sulphur, Sweden is considering to increase the average level of the

present lighthouse dues and to allow rebates for ships using low (less than 0.5%) sulphur fuel. In this context, the Commission might further explore the possibility of differentiating shipping dues among a number of member states so as to promote further cost-effective reductions in acidifying emissions.

### 4.9.3 Agriculture

In the agricultural sector, it is not necessary to apply a large number of the available technical abatement measures in order to cost-effectively meet the intermediate target of a 50% gap closure. On top of the potential contribution from further technical measures to the reduction of ammonia emissions, a further evolution of the Common Agriculture Policy (CAP), developing the 1992 approach, might have positive side impacts on the level of ammonia emissions. Such a development could thus take into account the need of reducing ammonia emissions, bearing in mind that this is only one of the environmental problems challenging agriculture. Other problems, such as leakage or run-off of nitrates to surface and ground waters, and emissions of methane, are also relevant and could, together with acidification, preferably be addressed in a consistent framework. In the 1996 review of the Fifth Environmental Action Programme (COM(95) 647 final), integration of environment into other policy areas is one of the key priorities. Especially relevant for acidification are the following priorities mentioned in the 1996 review:

(a) to further develop links between agricultural market instruments and environmental requirements pursuant to the process of further evolution of the Common Agricultural Policy with reduced reliance on market price support as well as better integration of market policies, rural development and environmental policies;

(b) to promote extensive production, sustainable farming technologies and organic farming products in close cooperation with the actors concerned: the Regulation (EEC) No 2078/92 provides a good example of such a cooperation and has some potential to contribute to reducing ammonia emissions.

Finally, economic instruments (e.g. fertilizer taxes, which have been applied in some countries) could be explored to induce further emission reductions towards meeting the critical loads.

### 4.9.4 Joint implementation of national ceilings

Joint implementation implies that two or more actors cooperate to fulfil specific commitments or obligations. In the context of the acidification strategy this means the joint implementation of agreed national emission ceilings. Joint implementation is discussed since it offers more flexibility to meet agreed ceilings at lower costs. The 1994 Sulphur Protocol states that the Parties to the Protocol may, under specific rules and conditions to be elaborated, jointly implement the obligations (the national emission ceilings). Some studies show that the potential cost savings of joint implementation are significant. It is less straightforward how these cost savings could be realized while at the same time meeting environmental quality targets. The Commission will examine the potential contribution of joint implementation in the context of its future proposal for a Directive on national emission ceilings.

### 4.10 Possible further action related to emissions from transport

The control of emissions from road transport are regulated by an extensive set of existing Community legislation. Proposals for new, tightened, emissions and fuel standards, to be introduced by the year 2000, were recently adopted by the Commission (COM(96) 248 final). By the end of 1998, the Commission will come forward with proposals for further vehicle and fuel quality standards to come into effect as from 2005.

A Commission proposal (COM(95) 350 final) for Community-wide legislation to reduce the emissions from non-road mobile sources is well advanced, and expected to be adopted by Council and Parliament in the near future. The Commission will investigate the opportunities of further strengthening these emission standards, as well as of expanding them to cover a wider category of vehicles.

### 4.11 Actions to promote energy efficiency and energy conservation

As described elsewhere in the text (section 3.4 and the Annex) changes in energy consumption and the pattern of energy production may have a significant impact upon the amount of acidifying emissions released to the atmosphere. As a consequence initiatives aimed at the development of alternative and renewable energy sources as well energy conservation can lead to reductions in acidifying emissions.

At the level of the Community, The JOULE programme is providing insights into the more rational use of energy and energy conservation. The FAIR programme is *inter alia* examining the use of renewable raw materials and the production of "clean" energy. Demonstration programmes such as ALTENER and SAVE will facilitate the development of alternative energy sources and energy saving technologies. Results from these research programmes and demonstration programmes will influence energy consumption and the balance of energy production from different sources and will as a result lead to a reduction in acidifying emissions.

Finally, in Communication (COM(95) 509 final) "Cohesion Policy and the Environment" it is underlined that the structural funds are providing incentives for the promotion of environmentally friendly production, among others, to promote renewable energy and use of energy saving technologies.

### 4.12 Review process

As mentioned above, the ultimate target could not be attained by 2010, even when assuming application of technically feasible abatement measures within the EC. Therefore, the Commission will have to come back and address this issue again, at a later stage. The Commission would then review the acidification strategy and evaluate the results attained so far as well as the prospects of member states meeting the emission ceilings required to meet the interim target by the 2010 deadline. Based on that evaluation, and on possible new scientific evidence on the matter, for example as regards critical loads for acidification, and taking into account measures already taken to reduce emissions, the Commission should identify and propose which additional measures are needed to complement the existing acidification strategy, in order to reach the goal of no exceedance of critical loads.

It is proposed that the Commission, before the end of 2004, should come forward with a report to the Council, presenting the progress made in reducing emissions of acidifying air pollutants, as well as an evaluation of the prospects of member states meeting their emissions ceilings by 2010. Based on this report, and on possible new scientific evidence relating to acidification, the Commission should present to the Council, before the end of 2004, a revised acidification strategy.

## 5. PRELIMINARY ASSESSMENT OF THE ENVIRONMENTAL BENEFITS AND THE COSTS OF THE COMMISSION'S STRATEGY

The Commission's strategy will result in the achievement of the 50% gap closure interim target across the European Community. Translated into terms of the ecosystem area in each country in which critical loads will be exceeded the Commission's strategy will result in a significant improvement as compared to the situation in 1990 (see Table 5).

**Table 5: Ecosystems where critical loads for acidification are exceeded. The situation in 1990, in 2010 according to the reference scenario (REF), and after implementation of the acidification strategy (STRAT) (thousand hectares)**

| Country | 1990 | 2010 (REF) | 2010 (STRAT) |
|---|---|---|---|
| Austria | 2 896 (59%) | 943 (19%) | 642 (13.2%) |
| Belgium | 477 (77%) | 117 (19%) | 9 ( 1.4%) |
| Denmark | 174 (18%) | 38 (3.9%) | 21 ( 2.2%) |
| Finland | 5 016 (16%) | 1 211 (3.8%) | 1 144 ( 3.6%) |
| France | 618 (4.3%) | 82 (0.6%) | 40 ( 0.3%) |
| Germany | 6 972 (80%) | 2 541 (29%) | 978 (11.3%) |
| Greece | 0 ( 0%) | 0 ( 0%) | 0 ( 0%) |
| Ireland | 23 (4.8%) | 4 (0.7%) | 1 ( 0.1%) |
| Italy | 1 160 (18%) | 285 (4.3%) | 103 ( 1.6%) |
| Luxembourg | 15 (17%) | 7 (7.5%) | 2 ( 2.2%) |
| Netherlands | 282 (88%) | 121 (38%) | 23 ( 7.3%) |
| Portugal | 1 ( 0%) | 0 ( 0%) | 0 ( 0%) |
| Spain | 74 (0.9%) | 24 (0.3%) | 10 ( 0.1%) |
| Sweden | 10 108 (23%) | 1 235 (2.8%) | 699 ( 1.6%) |
| UK | 4 741 (60%) | 2 112 (27%) | 809 (10.3%) |
| EC15 | 32 557 (24%) | 8 719 ( 6.5%) | 4 481 ( 3.3%) |

In this context it should be recalled that further reductions than those envisaged for the interim target of a 50% gap closure are necessary to meet the ultimate target of no exceedance of critical loads. Moreover, that acidification is only one of several environmental aspects motivating the need for reduced emissions of sulphur dioxide, nitrogen oxides, and ammonia. Therefore, when considering the possible need and options for measures to abate emissions, also these related aspects should be taken into account (see section 2.2).

The additional abatement costs, that is the annual cost of additional measures as compared to the reference scenario, for the whole of EC from attaining the interim target has been estimated to ECU 7 billion by 2010 (see Table 6). This estimate is based on the assumptions that the reductions are being obtained by the use of technical measures only. It should be noted that the abatement options analysed do not take into account non-technical abatement measures, such as structural changes (including fuel switching) in the various sectors. Furthermore, the Community's international commitments in relation to climate change and the associated reductions in the emissions of "green-house" gases, particularly carbon dioxide, will also imply significant reductions in the emissions of acidifying pollutants and consequently in the estimated costs of the acidification strategy (see section 3.4). In conclusion, it is therefore likely that the costs for achieving the necessary emission reductions have been overestimated. A more detailed presentation of the costs associated with the achievement of the 50% gap closure target is given in the Annex.

**Table 6: Additional emission control costs of meeting the interim target (million ECU/year in 2010)**

| | $SO_2$ | NOx | $NH_3$ | Total |
|---|---|---|---|---|
| EC15 | 2 940 | 1 795 | 2 305 | 7 040 |

## 6. POSITIVE SIDE-EFFECTS/DOUBLE BENEFITS

Although the focus of this strategy is on acidification (as acid deposition), it is important to note that airborne emissions of the acidifying pollutants have other detrimental effects on the environment. Reducing emissions of acidifying air pollutants will thus deliver "secondary" benefits, because it helps reducing other environmental problems caused by the same pollutants, such as eutrophication, ground-level ozone, corrosion of buildings and materials, and damage to human health. Furthermore, emission reductions in the EC will result in deposition reductions in countries outside the EC. Some of these side-effects have been more thoroughly analysed, namely the impacts on eutrophication and on ozone, as well as the benefits for countries outside of the EC. Side-effects on air quality have not been analysed in detail, but some conclusions can still be made. The results are summarized below.

### 6.1 Eutrophication

The analysis has shown that in 1990, critical loads for eutrophication were exceeded over 34% of the ecosystem area of the EC. This represents an area of about 38 million hectares. As a result of emission reductions foreseen by 2010 in the reference scenario, this will be reduced to 19%, or 21 million hectares. Reductions needed for the interim target of a 50% gap closure, would result in exceedance over 13%, or 15 million hectares, of the ecosystem area. This would mean an improvement that is more than half of the way from the situation in the reference case towards what was estimated to be maximum technically feasible to attain with measures within the EC.

As a sensitivity analysis, the result of using combined environmental quality targets, based on the critical loads for both acidification and eutrophication, as explicit deposition objectives for the optimization, was evaluated. The outcome showed some move of emission reductions,

from sulphur dioxide to nitrogen oxides and ammonia. This was especially the case for countries in the south and central parts of the EC, such as Spain, Italy, France, and Germany. The level of ecosystem protection for eutrophication increased - resulting in less than 10 million hectares exceeded - as did that for acidification. Also the costs increased: The total additional costs for this scenario amounted to ECU 9.4 billion, as compared to ECU 7 billion for the main scenario.

## 6.2 Ozone

The impacts on ground-level ozone was analysed using the EMEP model, based on emissions of NOx as given in the acidification analysis. Projected emissions of volatile organic compounds (VOCs) for 2010 were taken from the current reduction plans (CRP) of the UN ECE/CLRTAP, which are based primarily on nationally submitted data. For reasons of consistency and realism, additional emission reductions expected from the auto-oil package of proposals, were included for the EC Member States.

The analysis showed a significant improvement in most member states. In the reference scenario, by 2010 the exceedance of the critical threshold level for forests, crops and natural vegetation of 40 ppb (parts per billion) as well as of the indicative critical threshold level for health of 60 ppb were reduced over almost the entire EC area, as compared to 1990. The largest improvements were found in the exceedance of the 60 ppb level, a level used by the CLRTAP as a substitute to indicate possible effects on human health. The additional emission reductions in the main scenario will lead to further declining ozone levels over most of the affected areas. In some smaller areas, however, ozone levels would increase slightly. It is expected that further requirements to reduce VOC emissions will eliminate or significantly reduce this negative side-impact.

## 6.3 Air quality

As a result of reduced emissions of $SO_2$ and NOx, ambient concentrations of these pollutants, as well as of their secondary products (e.g. particulates and ozone), will be reduced. This would bring subsequent benefits for human health as well as for buildings and materials, and the historic and cultural heritage. Some of these benefits were included in a study of economic valuation (see section 6.5).

## 6.4 Improvements outside the EC

Emission reductions in the EC will, because of the transboundary nature of these pollutants, result in reduced deposition and consequently reduced exceedance of critical loads for acidification in countries outside the EC. For example, the calculations indicate that the level of ecosystem protection in these countries would by 2010 improve from 97 to 98%, as a result of reductions in the main scenario, as compared to the reference scenario. Expressed differently, the ecosystem area on which critical loads are exceeded in countries outside of the EC will be reduced from 11 to 9 million hectares. The biggest improvements, in terms of reduction in the area exceeded, were to be found in Norway, the Czech Republic, Poland, Russia and Switzerland. By 2010, the exceedance of the critical threshold levels for ozone (see section 6.2) were reduced in all non-EC countries.

As regards eutrophication, in 1990 critical loads were exceeded over 10% of the ecosystem area, that is over 39 million hectares, in the non-EC countries. The reference scenario would by 2010 reduce this to about 27 million hectares. Emission reductions in the EC as in the main alternative, would reduce the exceedance further, to about 6%, or 25 million hectares. The improvements could be found in many of the non-EC countries, but in terms of absolute area protected, they were biggest in the Czech Republic, Norway (where exceedance is brought down to zero), Switzerland, Poland and Hungary.

### 6.5 Economic evaluation of certain benefits

Further reductions in acidifying emissions will lead to a number of benefits for human health, materials and buildings, crops, forests, and for terrestrial and aquatic ecosystems. The economic valuation of these benefits have been the subject of work by DGXII under the so-called ExternE project. The method developed under that project was applied to estimate some of the benefits of the emission reductions required for attaining the interim target of the acidification strategy. More specifically, additional monetary benefits resulting from the avoided environmental effects, were calculated. The consultant evaluated impacts on public health in the form of mortality and morbidity; on crops; and, damage to modern building materials. A number of major benefits were not assessed in the study, such as the reduced (risk of) forest damage; improvement of forest functioning (e.g. soil stabilization, carbon retention, and biodiversity); improvements in other terrestrial or aquatic ecosystems; and, the impacts on the historic and cultural heritage.

The dominating economic benefits were, according to the study, to be found in reduced damage to human health, primarily as a result of reduced levels of the secondary pollutants sulphate and nitrate aerosols, and ozone. It was concluded that for EC as a whole, the benefits outweigh the costs. The largest benefits were to be found in Germany, France, the UK, Italy, Spain, the Netherlands, Belgium and Denmark. Only for one country, Ireland, it was found that the additional costs for pollution control outweighed the estimated incremental monetary benefits. However, if effects of long-term (chronic) exposure to air pollution on mortality were also to be considered, the benefits outweighed by far the costs for all member states. The inclusion of benefits to ecological and cultural resources, which currently can not as easily be quantified in monetary terms, would further increase the benefits of emission reductions.

In summary, the incremental annual benefits of the additional emission reductions (i.e. those needed on top of the reference scenario to attain the interim target) were estimated to amount to nearly ECU 20 billion in 2010 for the Member States. Moreover, benefits arising in non-EC countries were estimated to about ECU 4 billion. In both these figures, the so-called chronic effects on mortality were excluded.

**Annex to**

**Communication to the Council and the European Parliament Parliament on a Community strategy to combat acidification**

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# 1. THE ENVIRONMENTAL QUALITY OBJECTIVE: CRITICAL LOADS

The critical load indicates the sensitivity of a particular environment by defining how much exposure to pollution it can tolerate before long-lasting or other significant damage occurs. The concept of critical loads is science-based. Consequently, the data used reflects current best knowledge and includes a certain level of uncertainty. Critical loads have significance for sustainable development, since depositions above the critical loads are not sustainable in the long term.

The data on critical loads for acidification that are being used when elaborating the strategy have been developed under the Convention on Long-Range Transboundary Air Pollution (CLRTAP), and were revised and updated in 1996. The data have been supplied by the CLRTAP's mapping centre for critical loads, the Coordination Center of Effects (CCE) in the Netherlands. Of the EC member states, ten countries have produced and submitted national data to CCE; These are Austria, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom. Outside the EC, six countries have also done so. For the remaining five Member States, as well as for other countries in Europe that have not submitted national data, the CCE has estimated critical loads based on information in its European background data base. In all countries critical loads have been calculated for forest ecosystems, and in several countries also for freshwater ecosystems. Some countries have calculated critical loads also for peatlands, heathlands and grasslands. The ecosystem area is the area for which critical loads have been estimated.

When establishing critical loads for acidification, the combined acidifying effect of both sulphur and nitrogen compounds is taken into account. Their relative share in contributing to acidification will depend on the characteristics of the ecosystems considered as well as on the amount of deposition of sulphur and nitrogen compounds, respectively. By comparing the critical loads with actual and forecasted deposition levels, the levels of emission reductions - in various combinations - needed to avoid exceedance of critical loads can be quantified.

As there is no single critical load value for each of the three pollutants (sulphur, oxidized and reduced nitrogen) involved, the exceedance of critical loads can not be expressed as the difference between the critical load and the deposition of a single pollutant. Therefore, exceedance is now expressed in terms of the proportion of the ecosystems in each EMEP[2] grid cell which is not protected from acidification at a given combination of sulphur and nitrogen deposition in that grid. (An EMEP grid cell is 150 times 150 kilometres, which is the resolution used by the CLRTAP when mapping critical loads on a European scale, and also when monitoring emissions and depositions of air pollutants). The term *ecosystem protection* is used to indicate the percentage of ecosystems in a grid cell, country, or other area, where the critical loads are *not* exceeded.

The ultimate target of the Fifth Environmental Action Programme, echoed in the Council conclusions from 18 December 1995, is that critical loads should not be exceeded. This means that for each ecosystem in the EC acid deposition should be lower than the critical load. As both deposition and critical loads data are mapped in accordance with EMEP

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[2] EMEP stands for the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe, and is subsidiary to the CLRTAP.

grid cell resolution, it was decided to use 100% ecosystem protection in each such grid cell within the EC as a target. By applying the target for each grid cell, it is also ensured that improvements will take place in all geographical areas where exceedance of critical loads occurs, i.e. that the benefits of emission reductions are widely distributed, rather than concentrated to a few areas only. In practice, the resulting exceedance of critical loads can be shown both as percentage ecosystem protection country-by-country, and as the specific area remaining as unprotected.

## 2. INTERIM TARGETS: THE GAP-CLOSURE APPROACH

The ultimate target of no exceedance of critical loads for acidification might, for practical and/or political reasons, not be achievable by 2010. The modelling of future emissions for the purpose of this strategy indicated that even when applying so-called maximum technically feasible reductions in the whole of Europe, it would not be possible to reach the ultimate target for the whole of the EC by 2010.

The Council conclusions of December 1995 recognized the difficulty of meeting the objective of no exceedance of critical loads in the immediate future. It therefore invited the Commission not only to prepare a more coherent acidification strategy to reach the goal of no exceedance of critical loads, but also to identify interim targets on the path to reaching that goal.

Using a so-called gap-closure approach, the Commission therefore has analysed various possible interim targets. A similar approach was used in the negotiations for the 1994 Sulphur Protocol under the CLRTAP. However, due to the more complex critical loads now used - with both sulphur and nitrogen compounds involved - the gap closure is based on grid-by-grid ecosystem protection data. The concept applied aims at closing the gap, that is the difference, between the level of ecosystem protection in 1990 and the ultimate target of 100% ecosystem protection, by a certain minimum percentage in each EMEP grid cell in the EC by the year 2010. Based on the ecosystem protection resulting from full application of technically feasible reduction options, the maximum attainable percentage gap closure towards the ultimate goal was determined, and cost-optimized scenarios were consequently constrained to gap closure targets below that figure.

After thorough analysis of several options, it was found that the most appropriate interim target was a 50% gap closure. In practice that means that in each EMEP grid cell within the EC, the area of sensitive ecosystems in which critical loads where exceeded in 1990, should be at least halved, i.e. reduced by at least 50%. The main motive for selecting this interim environmental quality target was that it provided the highest level of ecosystem protection at the least cost, given that additional measures are restricted to within the Community. The reason for applying the gap closure target for each EMEP grid cell was to ensure that improvements should take place everywhere where the critical loads were exceeded, i.e. all affected areas should receive benefits.

Examples: In one grid cell the ecosystem protection level in 1990 was 40% (i.e. critical loads where exceeded over 60% of the ecosystems). The 50% gap closure means that the area where critical loads are exceeded - here 60 % - should be at least halved. In this case the percentage ecosystem protection therefore should increase by a minimum of 30 percentage points (half of 60%). The end result would be a level of ecosystem protection of at least 70% (40+30=70). In another grid cell, the ecosystem protection level in 1990 was 80%, i.e. critical

loads were exceeded over 20%. Following the same line of reasoning as above, for this cell, the 50% gap closure would result in a minimum protection level of 90% (80+10=90).

Alternative effects-based approaches to the gap closure approach were considered. One such alternative could be to minimize the area - or set an interim target for a maximum area - of exceedance within the EC, irrespective of geographical location. The advantage of this approach is that it would result in a higher level of ecosystem protection at less cost, as compared to the gap closure approach. The main disadvantage, however, is that the benefits would be concentrated to a few geographical areas, i.e. to a limited number of countries. Another alternative could be to minimize, or set an interim target for, the absolute exceedance (in terms of e.g. deposition of acid equivalents). A main problem with this approach is that it implies a linear relationship between the level of exceedance and environmental effects, i.e. the higher the exceedance, the higher the damage.

## 3. INTEGRATED ASSESSMENT MODELLING: COST-EFFECTIVENESS

The strategy shall reach the objective, and possible interim objectives, in a cost-effective manner. In order to identify the range of technical measures available and their cost-effectiveness for the purpose of reducing acidification, the Commission has chosen to work with integrated assessment modelling. That method has been used successfully for several years under the LRTAP Convention, and as all member states, as well as the European Community, are parties to that Convention, the method is well known and generally approved by the member states. Moreover, the choice of this method ensures compatibility with ongoing and future work under the UN ECE/CLRTAP in their development of new international agreements to reduce air pollution. The consultant chosen by the Commission for the purpose of both the acidification and ozone strategies is the International Institute for Applied Systems Analysis (IIASA), that has developed the principal model for integrated assessment, the RAINS model.

The RAINS model can be operated either in the scenario analysis mode or the optimization mode. The first alternative can be used for the evaluation of emissions, costs, depositions, and environmental impacts resulting from specified emission control strategies, such as current legislation or application of best available techniques. The optimization mode can be used for minimizing emission control costs for a certain region, subject to the constraint that specified environmental targets, in this case grid-specific acid deposition targets, are attained. Such an optimization can also be done in combination with given constraints on emission reductions.

For the purpose of the analysis for the strategy, the optimization mode was used primarily, but not exclusively, to minimize total costs of reducing $SO_2$, NOx, and $NH_3$ in the Member States of the EC, subject to the conditions that:

- acid deposition is equal or lower than the desired acid deposition target (the 50% gap closure) in each of the grid cells in the EC;

- emissions from each country are always equal or lower than what would result from current legislation or current reduction plans (the reference scenario);

- emissions in countries outside the EC remain equal to what would result from current legislation or current reduction plans (the reference scenario).

In the model, the cost estimates for various abatement options are combined with the projected pattern of energy use and agricultural activity for the year 2010. Starting from these unabated national emission levels, national cost curves are produced, in which all the technical abatement options are ranked according to their marginal costs. Non-technical abatement options, such as structural changes, fuel switching, and energy conservation are not included, unless they are assumed in the underlying energy scenario. This also implies that the model overestimates the abatement costs.

The (static) optimization procedure employs the national cost functions to determine the least-cost allocation for meeting a set of environmental targets at one point in time. For this purpose investment outlays are recalculated as annual capital costs (annuities), using a discount factor and the technical lifetime assumed. Annual capital costs are then combined with other costs to determine the total annual costs for each technology. Annual costs of all technologies are then combined in the national cost functions. The optimization gives the level of the annual costs in one specific year - in the case of the acidification strategy for the year 2010. The model does not provide information on the Net Present Value of the costs for a specific time horizon. Annual costs can be lower or higher than calculated for a specific point in time, depending on the level of energy use and agricultural activity.

The result of the optimization procedure provides a set of national emission ceilings for each acidifying pollutant (see Table 1), determined on the basis of maximum cost-effectiveness for the region analysed. It also provides information country-by-country on the least-cost technical measures to attain those emission ceilings. A preliminary assessment of the additional emission control costs associated with the achievement of the 50% gap closure target is presented in Table 2.

**Table 1:** **The emission levels in 2010 which according to the preliminary scientific analysis would be necessary to achieve the 50% gap closure target shown together with projected emissions without the acidification strategy (REF).**

| Country | $SO_2$ (ktonnes) | | NOx (ktonnes) | | $NH_3$ (ktonnes) | |
|---|---|---|---|---|---|---|
| | **REF** | **LEVEL** | **REF** | **LEVEL** | **REF** | **LEVEL** |
| Austria | 57 | 57 | 116 | 116 | 93 | 93 |
| Belgium | 215 | 52 | 196 | 129 | 106 | 74 |
| Denmark | 71 | 31 | 119 | 88 | 103 | 82 |
| Finland | 116 | 116 | 163 | 163 | 30 | 30 |
| France | 691 | 235 | 895 | 766 | 669 | 630 |
| Germany | 740 | 414 | 1 279 | 1 079 | 539 | 318 |
| Greece | 361 | 361 | 282 | 282 | 76 | 76 |
| Ireland | 155 | 41 | 73 | 42 | 126 | 126 |
| Italy | 847 | 204 | 1 160 | 1 160 | 391 | 305 |
| Luxembourg | 4 | 4 | 10 | 10 | 6 | 6 |
| Netherlands | 56 | 38 | 140 | 140 | 81 | 81 |
| Portugal | 194 | 194 | 206 | 206 | 84 | 84 |
| Spain | 1 035 | 618 | 851 | 826 | 373 | 373 |
| Sweden | 97 | 66 | 207 | 207 | 53 | 49 |
| UK | 980 | 279 | 1,244 | 753 | 270 | 224 |
| Sum EC15 | 5 619 | 2 710 | 6 921 | 5 967 | 3 000 | 2 551 |

**Table 2: Additional emission control costs of meeting the interim target (million ECU/year in 2010)**

| Country | $SO_2$ | NOx | $NH_3$ | Total |
|---|---|---|---|---|
| Austria | 0 | 0 | 0 | 0 |
| Belgium | 364 | 118 | 193 | 675 |
| Denmark | 59 | 42 | 80 | 181 |
| Finland | 0 | 0 | 0 | 0 |
| France | 294 | 153 | 36 | 483 |
| Germany | 624 | 586 | 1 435 | 2 645 |
| Greece | 0 | 0 | 0 | 0 |
| Ireland | 75 | 26 | 0 | 101 |
| Italy | 433 | 0 | 400 | 833 |
| Luxembourg | 0 | 0 | 0 | 0 |
| Netherlands | 76 | 0 | 0 | 76 |
| Portugal | 0 | 0 | 0 | 0 |
| Spain | 159 | 5 | 0 | 164 |
| Sweden | 145 | 0 | 18 | 163 |
| UK | 711 | 865 | 143 | 1 719 |
| EC15 | 2 940 | 1 795 | 2 305 | 7 040 |

## 4. ASSUMPTIONS AND STARTING POINT FOR THE SCENARIO ANALYSIS

For the purpose of this document, scenario means a series of assumptions on combinations on abatement measures, emissions, costs, and environmental objectives. A detailed description of the modelling work and its results is given in the first and second interim reports by IIASA on Cost-Effective Control of Acidification and Ground-Level Ozone (contract No B4-3040\96\000086\MAR\B1), available upon request from the Commission. For each scenario, data on emissions, the abatement measures assumed to be applied country-by-country as well as their costs, and the resulting exceedance of critical loads for acidification (expressed both as% and hectares of ecosystems unprotected), have been produced.

### 4.1 The baseline

The base year chosen was 1990, as this was the most recent year for which there were extensive sets of verified emission data available. The same base year is expected to be used by the CLRTAP when negotiating the new multi-pollutant protocol. Due to the increasing

uncertainty the longer the time horizon being applied when making scenarios, for example as regards energy use, and the fact that any legal obligations entered into by member states must be introduced and implemented in a reasonable time span, scenarios for the acidification strategy were restricted up to the year 2010.

### 4.2 Assumptions on energy use

For the EC member states, the analysis was based on energy projections provided by DG XVII, extracted from the so-called Conventional Wisdom Scenario, and updated with new official data submitted by one member state. In the Conventional Wisdom Scenario, a 20% increase in energy consumption and a 10% increase in the emissions of $CO_2$ between 1990 and 2010, is envisaged. For non-EC countries, energy projections were based on national data officially submitted to the UN/ECE, and published in the UN/ECE Energy Data Base.

In order to reflect the need to reduce $CO_2$ emissions, and also for the purpose of investigating how an alternative energy scenario would impact upon the emissions of acidifying pollutants as well as on the costs for their abatement, a sensitivity analysis was made with a so-called low-$CO_2$ energy scenario, which would result in a reduction in $CO_2$ emissions from the EC of 10%, between 1990 and 2010.

### 4.3 Reference scenario (REF)

In order to evaluate the need for additional measures, and their respective costs and effectiveness, a reference scenario (REF) was determined. In order to accommodate the different approaches adopted by countries, two scenarios were constructed:

- The first one is the current legislation scenario (CLE): Based on projections on future energy use, the emission levels resulting from current national, EC, and international legislation were estimated. For this purpose a detailed inventory of relevant legislation in individual countries, EC Directives, and mandatory technical requirements in protocols of the CLRTAP, was used. As regards EC-Directives, the scenario includes the Directive on large combustion plants (88/609/EEC), the Directive on sulphur in liquid fuels (93/12/EEC), the IPPC Directive (96/61/EEC), and Directives related to emissions from road vehicles as well as non-road vehicles. Moreover, proposals adopted by the Commission, such as those of the auto-oil programme (COM(96) 248 final, 96/0163(COD), 96/0164(COD)), were also included.

- The second is the current reduction plans scenario (CRP): In case countries have officially adopted or internationally submitted (to the UN ECE/CLRTAP) national emission ceilings, or have entered into international agreements on emission reductions (for example by signing protocols under the CLRTAP), the resulting obligations were covered in this scenario.

In order to properly reflect both these types of constraints, when determining the reference scenario the one of these two scenarios (CLE and CRP) that resulted in the lowest emissions by 2010, was then used for the reference scenario. The specific abatement measures assumed to be applied in the member states for this scenario are presented in full detail in the country-by-country cost-Tables contained in the interim reports by IIASA.

The reference scenario (REF) shows that if current, and well-advanced planned, legislation is fully implemented in all European countries, emissions of $SO_2$, NOx and $NH_3$ would be reduced by 58, 36, and 16%, respectively, between the base year 1990 and 2010.

The ecosystem area in the EC where critical loads for acidification are exceeded would be reduced from 33 million hectares in 1990 to 9 million hectares. Expressed in%, the ecosystem protection would increase from 76% to 93%. The lowest levels of gap closure achieved are less than 10% (in northern Germany/Netherlands, and in northern Finland).

### 4.4 Maximum technically feasible reductions scenarios (MFR)

In the RAINS-model, the maximum possible abatement of air pollutants is limited by the technical abatement measures available. For some types of measures, the implementation takes place gradually over time, as is the case for example as regards the effect of introducing new emission standards for new motor vehicles. The turnover time of the vehicle fleet, which varies between countries, will determine how long it takes until all new vehicles will live up to the new standards. For that reason two MFR-scenarios have been developed: the first, called $MFR_{real}$, shows the maximum technically feasible reductions that can be implemented by the year 2010, assuming a standard turnover rate of motor vehicles and installations. The second, called $MFR_{ultimate}$, shows the result after full implementation of the same measures. And, in addition to $MFR_{real}$, the vehicle emission standards indicated in the auto-oil programme for the year 2005 were introduced in the latter scenario. An unrealistically rapid turnover rate is thus assumed, while still assuming energy use as forecasted for the year 2010. It should be noted that the abatement scenarios presented do not take into account non-technical abatement measures, such as structural changes (including fuel switch) in the various sectors of society. Thus, the MFR-scenarios tend to underestimate the potential for emission reductions, and to overestimate the costs for achieving the reductions indicated.

According to $MFR_{real}$, emissions in the EC of $SO_2$, NOx, and $NH_3$ would be reduced by 91, 69, and 44%, respectively, between 1990 and 2010. The additional annual costs, as compared to REF, would be ECU 30 billion for the EC. Ecosystem protection in the EC would reach 99%, leaving 1.1 million hectares unprotected. $MFR_{ultimate}$ would reduce emissions by 92% for $SO_2$, 84% for NOx, and 44% for $NH_3$. Ecosystem protection in the EC would reach over 99%, leaving 0.8 million hectares unprotected.

In order to find out the maximum attainable ecosystem protection levels for the EC by 2010 when limiting further emission reductions to the EC, a third MFR-scenario was investigated, called $EU_{max}$. Here emissions as in $MFR_{real}$ for the EC and as in REF for the rest of Europe were assumed. The resulting ecosystem protection level for the EC by 2010 was 98%, leaving about 3 million hectares unprotected.

## 5. RESULTS FROM THE SCENARIO ANALYSIS

Between the extremes of the REF scenario and the MFR scenarios, that is doing nothing more than is expected from current legislation *or* applying all technically feasible reduction measures, a number of least cost scenarios were elaborated and analysed.

## 5.1 Identifying the interim target

Initially, three different gap closure targets were investigated, of 45, 50, and 55%, respectively. For these, deposition targets were restricted to grid cells within the EC only. Optimization of emission reductions were also confined to the EC, while emissions as in REF were assumed for the rest of Europe, except for the 55% gap closure, where also emissions from ships in the Baltic Sea were included in the optimization.

A given policy constraint for the acidification strategy is that measures to reduce emissions must primarily take place within the EC, since the EC can not impose legally binding commitments/measures outside of its territory. Therefore, the 50% gap closure was the most relevant to consider, as it is attainable with measures within the EC, and since it results in deposition levels closer to the ultimate target. Moreover, scenarios with more significant reductions in acid deposition resulted in a sharp increase in marginal costs relative to the additional ecosystem protection obtained (see Figure 1).

## 5.2 Sensitivity analyses

In order to explore alternative options as well as to check the consistency of data input and robustness of the modelling results, a series of scenarios, based on various assumptions and introducing different constraints, were performed. The results could be compared with those of the main scenario, i.e. the one aiming for a 50% gap closure, based on optimized emission reductions within the EC. All of these scenarios achieve the interim target of at least a 50% gap closure of the ecosystem protection in each EMEP grid cell within the EC.

Acidifying air pollutants are transported by winds over long distances, and the potential and costs for emission reductions vary between countries. Thus, in order to find the least-cost option to meet environmental targets, it was thought worthwhile to investigate if reductions outside the EC could provide a cheaper option than further reductions within the EC. The following four scenarios explored this issue, and the results are also summarized in Table A1:

Scenario 1: Optimization with ships

When including emissions from international shipping in the optimization, it was shown to be cost-effective to reduce emissions of $SO_2$ in the Baltic Sea and the North Sea, and those of NOx in the North Sea and the Atlantic Ocean. Such reductions would relieve some of the member states from taking more expensive abatement measures on land-based emission sources. For the EC as a whole, the additional cost of meeting the interim target could be reduced by more than ECU 2 billion per year. The additional annual costs for measures to reduce emissions from ships was estimated to amount to about ECU 300 million.

Scenario 2: Optimization with whole of Europe, excluding ships

This scenario explored the cost effectiveness of including non-EC countries in the optimization for taking further action to reduce emissions, while keeping the environmental quality target restricted to the member states. Under such conditions it was found to be cost effective to further reduce $SO_2$ emissions in Poland, Hungary, the Czech Republic, and Slovenia. Emission reductions in those countries would replace some measures taken by EC member states, thus reducing the costs for those member states. For the EC as a whole, the

additional annual costs, as compared to the main scenario, could be reduced by nearly ECU 1 billion, a cost-saving of about 14%, while the extra costs for measures taken in those four non-EC countries would amount to about ECU 400 million. The resulting potential cost-saving thus amounted to about ECU 600 million. The level of ecosystem protection for the EC would be nearly 97%, with critical loads exceeded over 4.5 million ha.

Scenario 3: Optimization with whole of Europe, EC interim target for whole of Europe

This scenario explores the Europe-wide perspective, that is assuming the 50% gap closure target and performing cost-optimization for the whole of Europe, including ships. To attain that target, the emissions in the EC would need to be reduced more than in the main scenario, thus increasing the costs for the EC. Emissions from international shipping were reduced in all three sea areas. Moreover, emissions in countries outside the EC would need to be substantially reduced. The additional annual costs as compared to REF were ECU 8 billion for the EC (nearly on billion more than in the main scenario), 0.5 billion for measures to reduce emissions from ships, and 3.4 billion for measures taken in countries outside the EC, adding up to a total additional cost of nearly ECU 12 billion. In the EC, the level of ecosystem protection attained was 98%, leaving 2.9 million ha unprotected. For Europe as a whole, ecosystem protection reached 99%, leaving 6.1 million ha unprotected.

Scenario 4: Optimization with EC, setting sulphur in bunker fuel oil to 1.5%

In the revision of the MARPOL Convention (see section 4.5 in the Communication) it has been suggested to designate the North Sea and the Baltic Sea as sensitive areas, and thus to limit the sulphur content of bunker fuels used by ships there to maximum 1.5%. In this scenario it was assumed that such a limit was applied. It was found that such a measure could reduce the cost for the EC to attain the interim target of a 50% gap closure by more than ECU 1.1 billion. The additional costs for reducing the sulphur content in bunker fuels was estimated to less than ECU 100 million. The resulting level of ecosystem protection was slightly lower than for the main scenario: 96.4, as compared to 96.7% - leaving 4.7 million ha unprotected, as compared to 4.5 million ha in the main scenario.

On top of these four scenarios, a number of other issues related to the main assumptions made, were investigated through scenario analysis. The main results are presented below, and for scenarios 5 and 6, also in Table A2:

Scenario 5: Optimization with EC, using alternative (low-$CO_2$) energy scenario

For reasons described in section 4.2 above, the impacts of assuming an alternative (low-$CO_2$) energy scenario was analysed. In this scenario, the increase in final energy demand was restricted, energy efficiency improved, and the share of renewable sources of energy increased. As a result, $CO_2$ emissions were reduced by 10% between 1990 and 2010, and moreover, the emissions of $SO_2$ and NOx were also reduced. For these reasons, less abatement measures were needed to meet the interim target for acidification. Consequently, the additional annual cost for this scenario was estimated to ECU 2.9 billion, a reduction of more than ECU 4 billion, or nearly 60%, as compared to the main scenario. It should be noted that costs associated with the shift in energy systems have not been estimated, and could therefore not be taken into account. The level of ecosystem protection attained was 96.5%, with 4.7 million ha unprotected.

Scenario 6: Optimization with EC, including eutrophication

A scenario using combined environmental quality targets, based on the critical loads for both acidification and eutrophication, as explicit deposition objectives for the optimization, was evaluated. Obviously, the outcome of such a combined scenario depends on the environmental quality targets assumed. In this case, the target for acidification was kept the same (50% gap closure), and a similar target was used also for eutrophication. (To use exactly the same target for eutrophication was found to be infeasible. Therefore some adjustments were made, and also some infeasible grid cells - on the border of Belgium/France and Netherlands/Germany - had to be disregarded when performing the optimization.) The result was that some emission reductions "moved" from $SO_2$ to NOx and $NH_3$. The area unprotected for eutrophication was reduced from 21 million ha in REF (14.6 million ha in the main scenario), down to 9.4 million ha. There was also some improvement as regards acidification, the area unprotected being reduced to 4.2 million ha. Total additional costs increased by 40%, to ECU 9.4 billion.

Scenario 7: Optimization with EC, using different UK critical loads

During the time of preparation of the acidification strategy, it was found that the critical loads data for the UK, specifically, was too low, and that new, correct data could not be submitted in time to be considered in the modelling activities. By request from the UK, it was therefore agreed to, as a sensitivity analysis, run the model with an alternative set of data, submitted by the UK, where the critical loads for the UK where too high. This was done, and it was found that such a change did not have any impact on emission reduction requirements for any country. The only change in the results was that the level of ecosystem protection in the UK increased.

Scenario 8: Optimization with EC, using 95 percentile cut-off point

For technical as well as practical reasons, the modelling for the acidification strategy used a so-called cut-off point at the 98-percentile level, i.e. the critical loads data for the two% of the most sensitive ecosystems were excluded as targets for the optimization. The 1994 Sulphur Protocol is based on the so-called 5-percentile critical loads, i.e. here the critical loads data for the five% most sensitive ecosystems were excluded. To investigate the possible impact of the choice of cut-off point, a sensitivity analysis was made using a 95-percentile. The results showed some relatively small changes to the effect that Spain could increase the emissions of $SO_2$ from 618 ktonnes in the main scenario to 730 ktonnes, while - most probably as an effect of that - the UK would decrease the emissions of $SO_2$, from 279 ktonnes to 272 ktonnes. The overall costs and the ecosystem protection level for the EC as a whole remained about the same,

## 5.3 Binding grid cells

Inevitably, when running cost-optimized gap closure scenarios, some EMEP grid cells will be "binding" This implies that in these grid cells the deposition target is met exactly, while in all other grid cells deposition is lower than the target. It could be said that these binding grid cells will "drive" emission reduction demands for one or more countries that contribute to deposition over these grid cells. As a result of the large geographical area involved, for each scenario a number (usually 3-6) of such binding grid cells, well spread out in the north,

south, east, west, and central parts of the EC, will occur. The primary reason being that some grid cells, because of the ecosystems they contain, have lower critical loads than the surrounding grid cells in the region. In the optimizations performed, the binding grid cells were usually the same in the different scenarios (except for scenario 3, with the target applied for the whole of Europe) appearing in northern Germany/Netherlands, southeastern Sweden (the island of Gotland in the Baltic Sea), eastern Germany, and northern Italy. Although removing or relaxing the deposition target for such binding grid cells would decrease total abatement costs, it does not necessarily relieve the countries contributing to deposition over those grid cells from action to reduce emissions. The reason being that other, usually neighbouring, grid cells, will become binding instead.

In some circumstances the deposition/gap closure target set might not be attainable in certain grid cells, which then become "unfeasible". For example, it was found that three grid cells located on the border between northern Finland and Russia were unfeasible when the optimization of measures was restricted to the EC only. The main problem of the exceedance in this area was related to sulphur deposition primarily emanating from sources in neighbouring areas of Russia. In all scenarios, except those including the whole of Europe in the optimization, these three grid squares were deleted from the gap closure targets when performing the optimization.

Again, for the purpose of sensitivity analysis, two additional optimizations were done: One excluding the binding grid on the island of Gotland in the Baltic Sea, and another excluding the binding grid in northern Italy.

The first case resulted in higher $SO_2$ emissions in Sweden, with the side-impact that the UK would need to lower $SO_2$ emissions somewhat more. NOx-emissions in Germany increased, while those in Belgium decreased. The overall costs for the EC remained about the same, but the level of ecosystem protection was reduced, leaving 4.6 million ha unprotected.

The second case, excluding the binding grid in northern Italy, the main result was that emissions of all three pollutants from Italy remained at the same level as in the REF-scenario, with resulting cost-savings for that country. A side-effect of that was that emissions of $SO_2$ in the UK and Denmark were somewhat lowered, with resulting increases in costs. The net result was reduced costs by about ECU 700 million. As regards ecosystem protection, for the EC as a whole an area of 4.7 million ha remained unprotected. Specifically for Italy, the unprotected area increased from 103 000 ha in the main scenario, to 246 000 ha. Some impact could also been noted in surrounding countries, such as Austria, where the unprotected area increased as compared to the main scenario.

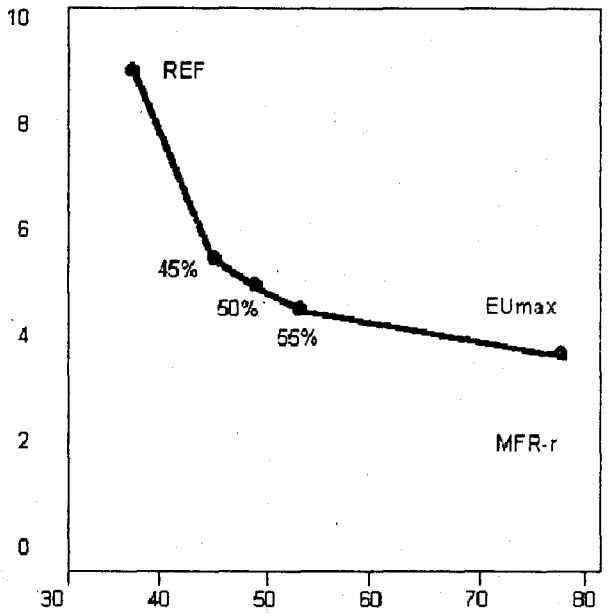
**Table A1: Overview of results from REF, the main scenario, and scenarios 2-4.**

| Scenario | REF | 50% gap closure | MFR real | Scen. 2 non-EC | Scen. 3 whole Europe | Scen. 4 Ships 1.5% S |
|---|---|---|---|---|---|---|
| Emission change in EU (from 1990): | | | | | | |
| $SO_2$ | -66% | -84% | -91% | -83% | -85% | -83% |
| NOx | -48% | -55% | -69% | -55% | -56% | -54% |
| $NH_3$ | -15% | -27% | -44% | -26% | -28% | -26% |
| Additional costs for EC, compared to REF (bill. ECU/yr) | - | 7.0 | 30.0 | 6.1 | 8.0 | 5.9 |
| Ecosystem area unprotected in EC (million ha) | 8.7 | 4.5 | 1.1 | 4.5 | 2.9 | 4.7 |

**Table A2: Overview of results from, REF, the main scenario, and scenarios 5 and 6.**

| Scenario | REF | 50% gap closure | Scen. 5 low-$CO_2$ | Scen. 6 Eutro |
|---|---|---|---|---|
| Emission change in EU (from 1990): | | | | |
| $SO_2$ | -66% | -84% | -85% | -82% |
| NOx | -48% | -55% | -57% | -59% |
| $NH_3$ | -15% | -27% | -24% | -37% |
| Additional costs for EC, compared to REF (bill. ECU/yr) | - | 7.0 | 2.9 | 9.4 |
| Ecosystem area unprotected in EC (million ha) | 8.7 | 4.5 | 4.7 | 4.2 |

**Figure 1. Cost-effectiveness of scenarios.**



**Explanatory Memorandum to the**
**Proposal for a**
**COUNCIL DIRECTIVE**
**relating to a reduction of the sulphur content of certain liquid fuels and amending Directive 93/12/EEC**

## 1. Introduction

Sulphur is naturally present both in coal and liquid petroleum products, the sulphur being derived from the proteins present in the tissues of the plants and other organisms from which coal and oil are formed. When coal and liquid petroleum products are combusted (burnt) in power stations, Industry, domestic heating appliances, internal combustion engines etc., the sulphur is oxidized to sulphur dioxide and, in the absence of suitable abatement measures, released to the atmosphere (see Table 1 for the relative contribution of different fuel types to total $SO_2$ emissions). Sulphur dioxide is one of the principal pollutants (the others being oxides of nitrogen and ammonia) which cause acidification (acid rain). Sulphur dioxide is directly toxic to humans and plants. In addition, sulphur dioxide can also contribute to the formation of small, suspended, atmospheric particles which are now recognized to have a significant impact upon human health.

The objective of this Directive is to reduce emissions of $SO_2$ across the European Community by placing restrictions on the sulphur content of certain liquid fuel products. The proposed Directive is only one part of an integrated package of measures designed to combat acidification as well as problems of air pollution caused by sulphur dioxide and particulate matter.

## 2. Environmental and human health impact of sulphur dioxide emissions

### 2.1. Acidification

The present proposal is put forward together with the Commission's Communication for a Community strategy to combat acidification[3]. As set out in that Communication and on the basis of an extensive analysis, the Commission considers that the control of the sulphur content of certain liquid fuels constitutes an integral part of a cost-effective strategy. The environmental challenge presented by acidification as well as a description of the rationale underlying the Commission's proposed strategy is to be found in the Communication and will not be repeated here. However, a number of issues are of critical importance in shaping future policy and need, therefore, to be underlined.

First of all, the nature of the acidification problem constitutes a significant challenge to the policy maker in that the sensitivity of ecosystems to acid deposition varies widely across the Community. In general, countries in the northern part of the Community have the most sensitive ecosystems. However, because atmospheric emissions of gases such as sulphur

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[3] Ref. ...

dioxide can be carried hundreds even thousands of kilometres before they are deposited, in order to reduce acidification in one country it will be necessary to reduce emissions in many of the countries across the Community even in those countries where acidification does not constitute a major environmental problem. The Commission proposal for a strategy to combat acidification takes into account the different environmental sensitivities across the Community as well as the patterns of emissions and acid deposition. In order for the strategy to remain cost-effective, it is essential that the individual measures which are put forward, even those dealing with products, are responsive to these regional patterns in ecosystem sensitivity, emissions and acid deposition.

**Table 1**
**Total emissions of $SO_2$ in 1993 from different fuels**

| FUEL | 1993 Emissions of $SO_2$ | |
|---|---|---|
| | Millions Tonnes/Year | Percentage |
| | EC15 | EC15 |
| Gasoline | 0.09 | 0.6 |
| Kerosene | 0.03 | 0.2 |
| Gasoil/Diesel | 1.08 | 7.0 |
| Bunkers | 0.3 | 2.0 |
| Heavy Fuel Oil | 2.82 | 18.4 |
| Coal | 9.66 | 62.9 |
| Refinery Fuels | 0.99 | 6.5 |
| Other | 0.38 | 2.5 |
| TOTAL | 15.35 | 100 |

The Commission's strategy for the control of acidification is designed to make significant progress towards the achievement of the objective set down in the Fifth Environmental Action Programme and endorsed once again by the Council in December 1995, namely that the critical loads for acidification shall not be exceeded. The Commission's strategy is considered as representing the least cost package of measures necessary to achieve significant progress towards meeting the environmental objective.

## 2.2. Effects on human health

Sulphur dioxide is directly toxic to humans. It acts upon the mucous membranes of the mouth, nose and lungs and its main impact is on respiratory function. The sectors of the population most at risk from the effects of sulphur dioxide pollution are the young, the old and the sick, particularly those suffering from chronic respiratory conditions such as asthma, bronchitis and chronic obstructive pulmonary disease. Sulphur dioxide can, through its impact upon respiratory function, also aggravate cardiovascular conditions.

In addition to the direct effects of sulphur dioxide, there is also evidence of indirect effects due to the formation of small acidic particles resulting from the interaction of oxides of sulphur and small water droplets. These small particles are believed to provoke further respiratory and cardiovascular problems among vulnerable sectors of the population.

The Community has, since 1980, had legislation establishing air quality standards for sulphur dioxide and particulate matter (Directive 80/779/EEC on air quality limits values for sulphur dioxide and suspended particulates[4]). While a report produced by the Commission[5] indicated a clear downward trend in ambient concentrations of sulphur dioxide and general compliance with the air quality objectives set down in Directive 80/779/EEC, recent studies (APHEA[6]) indicate that sulphur dioxide continues to cause health problems throughout the Community, contributing to mortality, morbidity and reduced quality of life. A significant proportion of the inhabitants of towns and cities in the Community are exposed to concentrations of sulphur dioxide exceeding the latest WHO guidelines for long term exposure ($50\mu g/m^3$)[7].

In the light of the recent epidemiological evidence on the continuing health effects and costs of sulphur dioxide pollution the Commission is currently in the process of preparing a proposal to revise the air quality objectives for sulphur dioxide established under Directive 80/779/EEC using as a basis for its proposal the most recent recommendations from the WHO.

## 2.3. Damage to vegetation from atmospheric sulphur dioxide

In addition to contributing to acid deposition, atmospheric sulphur dioxide directly affects vegetation by uptake through parts of the plants that are above the ground. Potential effects include degradation of chlorophyll, reduced photosynthesis, raised respiration rates, and changes in protein metabolism. The sensitivity of different types of plants varies considerably, with lichens the most susceptible. The WHO has adopted a series of guidelines for annual and winter concentrations of sulphur dioxide which would provide protection to different types of vegetation. The Commission is taking these guidelines as a starting point in preparing its proposals for revised air quality objectives for sulphur dioxide in pursuance of the objective set down in the Fifth Environmental Action Programme and endorsed once again by the Council in December 1995, that "permitted concentration levels of air pollutants should take into account the protection of the environment".

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4 OJ No L 229, 30.8.1980, p. 30.

5 COM(95) 372 final: Report from the Commission on the state of implementation of ambient air quality directives.

6 Katsouyanni K., Zmirou D., Spix C., Sunyer J., Schouten JP., Ponka A., Anderson HR., Le Moullec Y., Wojtyniak B., Vigotti MA., Bacharova L. (1994). - Short-term Effects of Air Pollution on Health: A European Approach Using Epidemiological Time Series Data. - Eur Resir J 1995; 8: 1030-1038.

7 Draft position paper on $SO_2$ prepared in the framework of the Commission's future proposals for revised air quality standards. Available from DG XI.

## 2.4. Damage to buildings and materials

In addition to the damage to ecosystems and human health, sulphur dioxide pollution contributes to the weathering and corrosion of buildings and building materials. Stone work, cement, concrete and plaster are all subject to corrosion by acidifying emissions. In particular, old buildings which form part of Europe's rich architectural heritage are especially susceptible to attack.

## 2.5. The costs of sulphur dioxide pollution

A number of studies[8] [9] have been carried out on the costs of sulphur dioxide and other acidifying emissions. Studies of this type do necessarily contain a certain level of uncertainty. Taking that into account, in general, these studies have tended to provide relatively good estimates in relation to the economic cost of the impact on human health and buildings/building materials. However, the damage to the structure and functioning of ecosystems and in particular biodiversity have not been quantified. While the impact of $SO_2$ emissions varies from region to region in relation to the population which is exposed and the sensitivity of the environment, it is estimated that, on average, the economic cost of the damage resulting from 1 tonne of $SO_2$ emissions in the Community is approximately 4000 ECU: the majority (80+ %) of these costs being attributed to damage to human health.

## 3. Directive 93/12/EEC

Directive 93/12/EEC[10] relating to the sulphur content of certain liquid fuels lays down concentration limits for sulphur in gas oils (0.2% by weight as from 1 October 1994) and diesel fuels (0.2% by weight as from 1 October 1994 going down to 0.05% by weight as from 1 October 1996). In Article 2 of Directive 93/12/EEC, the Commission was requested to bring forward, before 1st January 1994, a report indicating the progress which had been made in controlling emissions of $SO_2$ and in addition a proposal introducing yet tighter standards for the sulphur content of gas oil and diesel fuels plus new limit values for the sulphur content of aviation kerosene.

The Commission was reluctant to bring forward proposals introducing further restrictions on the sulphur content of liquid fuels until such time as these measures could be justified in the context of a global, cost-effective and integrated strategy for combatting acidification. Furthermore the analysis undertaken to support the Commission's proposed acidification strategy indicates that tightening the controls on the sulphur content of gas oils and diesel fuels may not be the most effective way to reduce $SO_2$-emissions arising from the combustion of liquid fuels and that other products, in particular heavy fuel oils, are a far more important source of pollution.

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8 Case Study 2: Benefits of an Acidification Strategy for the European Union. ExternE Project, 1996. European Commission, DG XII, JOULE programme.

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

10 OJ No L 74, 27.3.1993, p. 81.

With regard to diesel fuels, the Commission has recently brought forward a proposal for a Directive relating to the quality of petrol and diesel fuels[11]. In this proposal the sulphur content of diesel fuels is to be reduced to 0.035% by weight as compared to the value of 0.05% as set down in Directive 93/12/EEC. However, this reduction in sulphur content was motivated more by the need to reduce particulate emissions rather than the need to reduce $SO_2$.

With regard to aviation kerosene, the Commission considers that emissions of $SO_2$ arising from this source make a very small contribution to the problems of acidification and atmospheric pollution. Therefore, the Commission does not, at this stage, consider it necessary to legislate to impose mandatory limits on the sulphur content of aviation kerosene.

As part of its strategy to combat acidification and to reduce $SO_2$ pollution in cities, the Commission considers that it is cost-effective to introduce/maintain controls on the sulphur content of certain liquid fuels namely heavy fuel oils and gas oils. A description of the proposed measures and their relationship to the current market situation is given below.

## 4. Products to be regulated in the this proposal

### 4.1. Heavy fuel oil

Heavy fuel oil is the most important source of $SO_2$ emissions arising from the combustion of liquid fuels (see Table 1). Heavy fuel oil is used in refineries, power stations and industry with smaller quantities used for domestic purposes and transport.

The consumption and the average sulphur content of heavy fuel oil used in each of the Community countries is shown in Table 2. There are clearly significant differences between the Member States, with Italy, Spain, France, Greece and Ireland and to a lesser extent UK, Germany and Belgium showing a significant dependence on heavy fuel oil as a source of heat and power. Furthermore, the estimated average sulphur content of the heavy fuel oil used across the Community also show considerable variations with many Member States having average figures of 1% sulphur or less whereas in others some categories of heavy fuel oil have average sulphur concentrations as high as 3.5%.

The Commission has decided to put forward a general limit value for the sulphur content of heavy fuel oil across the Community of 1% by weight. As can be seen from Table 7 this will have a significant benefit in terms of reducing sulphur dioxide emissions.

The Commission is however sensitive to need for measures to be cost-effective. It is apparent that in some regions of the Community where air quality objectives with regard to sulphur dioxide are respected and where emissions of $SO_2$ do not contribute to any significant degree to problems of acidification, that it may not be necessary to impose a strict 1% limit on the sulphur content of heavy fuel oil. In such regions a higher sulphur limit could be allowed without compromising the environmental objectives. In such regions the Commission is proposing that the use of heavy fuel oil with a sulphur content up to a limit of 2.5% should

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[11] COM(96) 248 final: Proposal for a European Parliament and Council Directive relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC.

be permitted. The reason for imposing an upper limit on the sulphur content of the heavy fuel oils is to avoid the "dumping" of heavy fuel oil with a very high sulphur content in regions which currently benefit from good environmental quality: the Commission's proposal should not result in the deterioration of the environmental quality in these regions.

**Table 2**
**Statistics on the use and average sulphur content of heavy fuel oil in the Member States**

| | Total annual consumption(*) in 1995 (kilotonnes) Includes heavy fuel oil used in refineries | | Average sulphur content (percent) |
|---|---|---|---|
| Belgium | 1 975 | (1 925) (**) | ~1.0 |
| Denmark | 811 | (811) | 1.0 |
| Germany | 7 012 | (3 160) | 1.2 |
| Greece | 2 677 | (102) | 2.7 |
| Spain | 8 222 | (720) | 1-3.5(***) |
| France | 7 275 | (1 215) | 2.1 |
| Ireland | 1284 | (60) | ~2.0 |
| Italy | 30 586 | (19 406) | 1.53 |
| Luxembourg | 98 | (98) | - |
| Netherlands | 1 176 | (170) | 2.2 |
| Austria | 930 | (475) | 0.96 |
| Portugal | 3 335 | (339) | - |
| Finland | 1 678 | (1 220) | 1.1 |
| Sweden | 1 930 | (1 930) | 0.3 |
| United Kingdom | 9 028 | ( ? ) | 2.18 |

(*) Information provided by Member States in Nov./Dec. 1996.
(**) Figures in brackets give the estimated consumption of heavy fuel oil with a sulphur content of less than 1%; figures provided by Member States to DG XI in Nov./Dec. 1996 or provided to DG XVII as part of the annual submission of statistics.
(***) Dependent upon the specific type of heavy fuel oil.

The analysis carried out to support the proposed strategy to combat acidification also demonstrated that for power stations and certain industries it would be more cost-effective to remove the $SO_2$ from their emissions using technologies such as flue gas desulphurisation rather than to use low sulphur heavy fuel oils. The Commission is also conscious of the need to avoid any unnecessary overlap between the current Directive and the provisions of Directive 88/609/EEC[12] on large combustion plants. It clearly would not make sense to require such plants to use 1% sulphur heavy fuel oil while at the same time requiring the use of sophisticated technologies to remove $SO_2$ from their emissions.

In the light of the above considerations, the Commission considers that all new (as defined in Article 2.9 of Directive 88/609/EEC) combustion plants above a rated thermal input of 50 Megawatt which comply with the requirements of Directive 88/609/EEC should be exempt from the requirement to use heavy fuel oil with a sulphur content of 1% by weight or less. With regard to all other combustion plants, the Commission considers that these plants should either be required to use heavy fuel oil with a sulphur content of 1% or less OR respect an emission standard of 1700 mg $SO_2/m^3$ which is approximately the equivalent, in terms of emissions, of burning heavy fuel oil with a 1% sulphur content.

With regard to the relationship between this Directive and Directive 88/609/EEC, it should be remembered that the Commission has already announced its intention to bring forward by the end of 1997, proposals to modify Directive 88/609/EEC. The provisions of this Directive as they relate to large combustion plants will need to be reviewed in the light of the future revision to Directive 88/609/EEC.

### 4.2. Gas oils

A limit of 0.2% sulphur by weight was laid down for gas oils in Directive 93/12/EEC. The current consumption and the average sulphur content of gas oils used in the different Member States is shown in Table 3.

The analysis carried out to support the Commission's proposed strategy to combat acidification indicated that for six Member States - Belgium, Denmark, Germany, Netherlands, Sweden and the UK - a further reduction in the sulphur content in gas oil would be a cost-effective measure. However, in France, Greece, Ireland, Italy, Luxembourg, Portugal and Spain such a measure would not be cost-effective. With regard to Austria and Finland both of these countries had a limit value of 0.1% prior to their accession to the Union and under the terms of the Accession Treaties with these countries they are permitted to maintain their lower limit values during a transition period of four years ending on 31 December 1998. During the period from 1 January 1995 to the end of the transition period and under the terms of the accession treaties the provisions of Directive 93/12/EEC as they apply to gas oils are to be reviewed in accordance with EC procedures.

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12 OJ No L 336, 7.12.1988, p. 1.

**Table 3**

**Statistics(*) on the use and average sulphur content of gas oils in the Member States**

| | Total annual consumption in 1995 (kilotonnes) | Average sulphur content (percent) |
|---|---|---|
| Belgium | 5 623 | 0.20 |
| Denmark | 1 643 | 0.20 |
| Germany | 34 382 | 0.16 |
| Greece | 2 259 | 0.27 |
| Spain | 1 650 | 0.30 |
| France | 14 050 | 0.15 |
| Ireland | 1 214 | 0.16 |
| Italy | 3 578 | 0.20 |
| Luxembourg | - | - |
| Netherlands | 1 594 | 0.19 |
| Austria | 2 460 | < 0.2 |
| Portugal | 900 | information not provided |
| Finland | 2 334 | 0.05 |
| Sweden | 2 700 | 0.076 |
| United Kingdom | 3 815 | 0.14 |

(*) Information provided by Member States in Nov./Dec. 1996.

In the light of the above considerations, the Commission does not consider it appropriate to impose a sulphur limit of 0.1% sulphur for gas oil across the Community. On the other hand, neither is it considered appropriate to oblige Member States that wish to go further than the current 0.2% limit and in particular Austria and Finland, to refrain from doing so. For reasons which are explained in more detail further in the text, the Commission considers that as the primary motivation for the present measures is an environmental one, it is more appropriate for the current Directive to be based upon Article 130s of the Treaty. The Commission therefore intends to maintain the current standard of 0.2% sulphur in gas oil but as a minimum standard. Member States will not be prevented from maintaining or introducing more stringent measures on condition that such measures are compatible with the Treaty and are notified to the Commission. Where a Member State wishes to introduce more stringent measures they will be required to notify the Commission in accordance with the provisions of Directive 83/189/EEC. In the case of Austria and Finland these countries will be able to maintain their current provisions from the time of entry into force of this Directive in accordance with the provisions of Article 130t of the Treaty.

While the majority of gas oils are used for purposes of domestic heating a certain proportion is used for power and heat generation in shipping. For Greece throughout its territory and for Spain with regard to the Canary Islands, a limit value of 0.2% sulphur in gas oils used for marine purposes may have significant economic consequences. Furthermore, emissions of sulphur dioxide from shipping around mainland Greece and the many Greek Islands as well as shipping in the vicinity of the Canary Islands has a minimal effect upon human health and the environment. For the reasons given above the Commission considers it appropriate to allow Greece for the entirety of its territory and Spain in the case of the Canary Islands to have a derogation with regard to the implementation of the 0.2% sulphur limit for gas oils used for marine purposes.

### 4.3. Other types of liquid fuel including bunker fuels

As indicated in section 3, this Directive will not cover diesel fuels used in road transport or aviation kerosene. Another category of liquid fuel which will, for the present, be excluded from the scope of the Directive is bunker fuel. Bunker fuel is used in ships and has been shown in the analysis underlying the Commission's acidification strategy to be a significant source of acidifying emissions particularly in the Baltic Sea and certain parts of the North Sea. Controlling emissions of $SO_2$ arising from the combustion of bunker fuels would also be an extremely cost-effective measure. However, although the sulphur content of bunker fuels is currently not subject to any international regulation, proposals to that effect are being discussed in the context of the International Maritime Organisation's (IMO) Convention on Marine Pollution (MARPOL). The MARPOL Convention is currently in the process of revision and it is expected that the new Convention will be completed by autumn 1997. As part of the revised Convention it is foreseen that certain areas can be designated as SOx sensitive areas. In such areas ships will be required to use bunker fuel with a sulphur content of 1.5% or less as compared to the general limit value of 4.5% which, it is proposed, will apply elsewhere. Rather than introduce unilateral EC wide measures to limit the concentration of sulphur in bunker fuels, the Commission considers that it would be more effective for the Community countries to pursue a common position in the current negotiations for the revision of the MARPOL Convention whereby the Baltic Sea and parts or all of the North Sea/English Channel would be designated as SOx sensitive areas under the Convention. Following the conclusion of the revision to the MARPOL Convention the Commission will review its position as to the need to include provisions for bunker oils in this Directive.

## 5. The European refining industry

The European Community (15) has 106 refineries with a total distillation capacity of 13 212 833 barrels per day. In the past, refineries have been categorized in three types: simple, catalytic cracking and full upgrading.

However, these categories no longer represent the range of refineries operational in Europe. Over the last three to five years, some refiners have upgraded their installations in response to tighter product specifications such as the reduction of lead in petrol and the lowering of the sulphur content in gas oil and diesel fuel.

The currently existing refinery types are best categorized as follows:

- Simple - including thermal operations & some vacuum distillation
- Fluid Catalytic Cracking (FCC)
  - with or without feed pretreatment
  - with or without C6-Isomerisation
- Hydrocracking
- Fluid Catalytic Cracking (FCC) and hydrocracking
- Others (e.g. lube oil production, etc.)

The refinery type most common in Europe is the fluid catalytic cracking (FCC) type (with or without pretreatment and with or without C6-Isomerisation but not including the combination FCC plus Hydrocracker) accounting for around 61% of total atmospheric distillation capacity in the European Community.

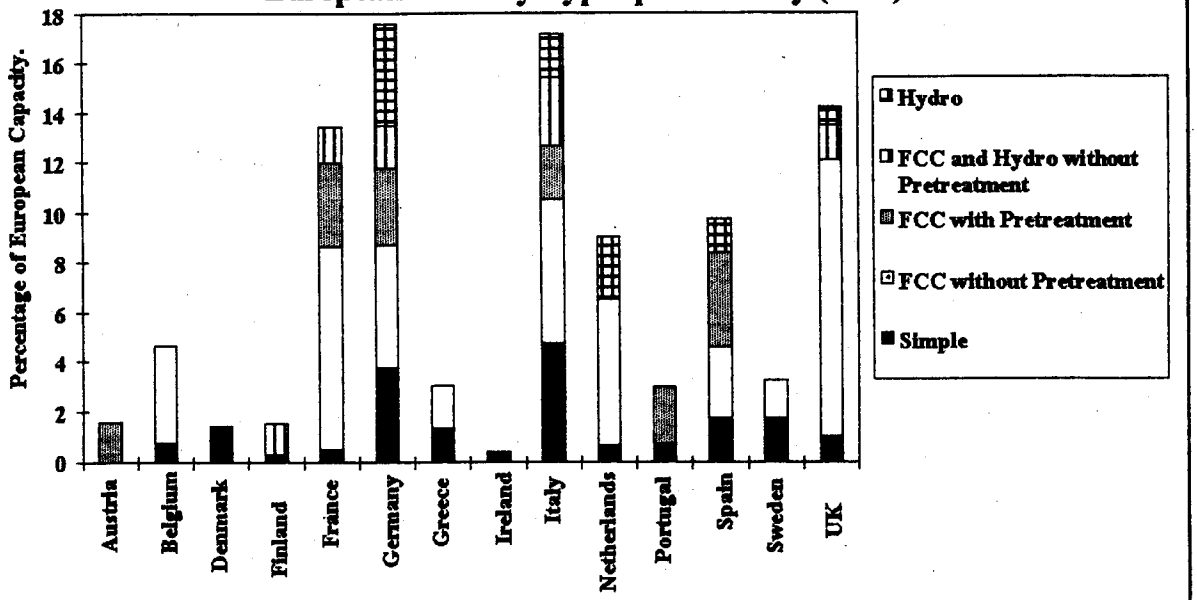
Table 4 provides an overview of European refinery types and their percentage share of total European distillation capacity. Figure 1 shows the types of refinery existing in each country and their total distillation capacity.

**Table 4**
**European refinery types and their share of European distillation capacity (1994)**

| Refinery Type | Number of Refineries | Total Atmospheric Distillation Capacity (b/cd) | % of European Capacity in Each |
|---|---|---|---|
| Simple without thermal or C6 Isomerization | 18 | 969 030 | 7.3% |
| Simple without thermal but with C6 Isomerization | 3 | 244 000 | 1.8% |
| Simple with thermal but without C6 Isomerization | 10 | 737 118 | 5.6% |
| Simple with thermal and C6 Isomerization | 9 | 696 700 | 5.3% |
| Hydrocracker without C6 Isomerisation | 7 | 881 160 | 6.7% |
| Hydrocracker with C6 Isomerization | 3 | 494 000 | 3.7% |
| FCC without Pretreatment or C6 Isomerization | 19 | 3 218 500 | 24.4% |
| FCC without Pretreatment but with C6 Isomerisation | 17 | 2 793 000 | 21.1% |
| FCC with Pretreatment but without C6 Isomerisation | 8 | 1 454 025 | 11.0% |
| FCC with Pretreatment and C6 Isomerization | 3 | 598 300 | 4.5% |
| FCC and Hydrocracker without pretreatment or C6 Isomerization | 4 | 737 000 | 5.6% |
| FCC and Hydrocracker without Pretreatment but with C6 Isomerization | 2 | 390 000 | 3.0% |
| Other | 3 | 0 | 0% |
| **Total in Europe** | **106** | **13 212 833** | |

*Figure 1*

**European Refinery Types per Country (1994)**




It can be seen from Figure 1 that in Austria, Belgium, France, Italy, the Netherlands, the UK and Spain the various types of FCC refineries predominate. Greece's distillation capacity is divided between simple and FCC refineries however, one of the FCC refineries also has some hydrocracking capacity which increases its flexibility with regard to the fuel quality changes required. German refineries have the biggest hydrocracking capacity of all Member States. Finland has a simple and a FCC/hydrocracking refinery. Denmark and Ireland only operate simple refineries. Sweden's distillation capacity is nearly equally divided between the simple and the FCC refinery type. One of the latter however has some hydrocracking capacity.

The refinery configuration has a major influence on the oil industry's ability to meet product specifications and is the key indicator as to the technical capacity of an individual refinery to cope with tighter specifications as a consequence of European environmental legislation.

In general FCC refineries are the least favoured configuration for generating low sulphur products. It is therefore clear that the proposed legislation will constitute a significant challenge to the refining industries in France, Belgium, Portugal, UK and Spain.

## 6. Effects on trade

In order to produce a range of fuels and satisfy local demand it is often necessary for a refiner to trade a portion of their refinery products. This enables refiners to balance refinery configuration and design against fuel demand and the nature of the crude oil supply. Presently this trade is both between Member States and, to a lesser extent, externally to third parties. Indicative figures for the scale of this trade are given in Table 5 below.

**Table 5: External trade in heavy fuel oil EC15 1995 (Source: COMEXT2 data base)**

| N.C. Code | Sulphur Content | Import (millions of tonnes) | Export (millions of tonnes) |
|---|---|---|---|
| 2710 00 74 | < 1 % | 11.662 | 3.041 |
| 2710 00 76 | 1 - 2 % | 1.125 | 0.582 |
| 2710 00 77 | 2 - 2.8 % | 2.749 | 1.028 |
| 2710 00 78 | > 2.8 % | 1.332 | 14.151 |
| | **TOTAL** | **16.868** | **18.802** |
| | **Net trade balance : 1.934 million tonnes** | | |

Trade between refining operations, product reprocessing and reclassification means that a certain amount of double counting and masking can distort trade statistics. Nevertheless, the Table indicates that net trade in these liquid fuels is small compared to production and consumption levels.

Much of the substantial trade flows, both between regions of the Community and externally with third countries, is a result of seasonal factors and quality fluctuations. Whilst high sulphur fuel oils are in general exported from the EC and low sulphur grades imported, there are also substantial movements of residual products for further processing.

The proposal is likely, at least in the medium term, to lead to an increase in the overall level of trade in liquid fuels and a proportion of this increase will be external trade with third countries especially in low sulphur heavy fuel oil. At the same time, however, the proposal is not expected to alter in any significant manner the net external trade balance in liquid fuels as a whole. Indeed in the longer term refiners may find that increases in the import of low sulphur heavy fuel oil will lead to an increased price differential between high and low sulphur heavy fuel oils, making investment in fuel oil upgrading capacity and flue gas desulphurisation equipment more attractive.

There is wide variation in the sulphur content of crudes imported into the Community. The average sulphur content in the first quarter of 1995 was approximately 1.0%, and indicative figures for the sulphur content of various crudes from different producer regions are given in Table 6.

**Table 6: Indicative sulphur content in crude oils from different producer regions**

| Crude oil | Community Imports(*) | | Price(**) | Range of percentage content of Sulphur(**) |
|---|---|---|---|---|
| | Volume (1 000 Barrels) | % of EU Imports | (US$/Brl) | |
| **Saudi Arabia** | | | | |
| Light | 97 010 | 11.4 | 18.3 | 1.33 - 1.9 |
| Medium | 11 243 | 1.3 | 17.7 | 2.4 - 2.41 |
| Heavy | 10 881 | 1.3 | 17.45 | 2.55 - 2.8 |
| Berri | 21 564 | 2.5 | 18.61 | 1.2 - 1.33 |
| Other | 9 024 | 1.1 | - | 1.1 |
| **Libya** | | | | |
| Light | 36 690 | 4.3 | 18.76 | 0.1 - 0.43 |
| Medium | 42 785 | 5.0 | 18.68 | 0.18 - 0.39 |
| Heavy | 3 889 | 0.5 | 18.04 | 1.8 - 1.85 |
| **Russia** | | | | |
| Urals | 49 501 | 5.8 | 18.40 | 0.88 - 1.6 |
| Other | 46 610 | 5.5 | 17.81 | 0.3 - 3.7 |
| **Mexico** | | | | |
| Maya | 13 065 | 1.5 | 16.54 | 2.32 - 3.31 |
| Isthmus | 296 | 0.0 | 19.23 | n.k. |
| **Norway** | | | | |
| Statfjord | 54 725 | 6.5 | 18.68 | 0.2 - 0.3 |
| Gullfaks | 15 067 | 1.8 | 19.08 | 0.25 - 0.45 |
| Oseberg | 23 252 | 2.7 | 18.89 | 0.3 - 0.31 |
| Ekofisk | 29 925 | 3.5 | 19.11 | 0.17 - 0.2 |
| Other | 30 589 | 3.6 | 18.75 | 0.02 - 0.26 |

(*) First Quarter 1995, data supplied by DG XVII.
(**) Figures taken from April 1995, data supplied by DG XVII.

The trade in refined liquid fuels will to some extent lessen the impact of the Directive on the trade in crude oils. Nevertheless, since reserves of low sulphur crude oil are limited, it is reasonable to expect the price differential to widen between low sulphur "sweet" crudes and higher sulphur "sour" crudes. It is also reasonable to expect imports into the Community of the highest sulphur crudes to decline. Table 6 indicates, however, that all the producer regions which presently supply the highest sulphur crudes also supply lighter crudes nearer or at the current average sulphur content of 1.0%.

## 7. The Costs and the emission reduction benefits of the Commission's proposal

The estimated benefits expressed in terms of reduced $SO_2$ emissions resulting from the imposition across the Community of 1% limit on the sulphur content of heavy fuel oil are shown in Table 7. The figures shown in Table 7 do not differentiate between emission reductions which are directly associated with the burning of 1% sulphur heavy fuel oil as opposed to those reductions which result from users either switching fuels or installing flue gas desulphurization as alternative, possibly cheaper, means to reduce their emissions. The figures shown in Table 7 also do not take into account the derogations which are foreseen for certain regions and as a consequence the emission reduction benefits for countries such as Greece, and Portugal are undoubtedly overestimated. Notwithstanding these qualifications the introduction of the 1% sulphur limit for heavy fuel oil will reduce $SO_2$ emissions in 2010 by approximately 1 million tonnes as compared to what would be the case in the absence of the Commission's proposal.

**Table 7: Estimated emissions of $SO_2$ in 2010 resulting from the burning of heavy fuel oil (thousands tonnes)**

| | Reference/Business As Usual | With 1% Sulphur | Difference |
|---|---|---|---|
| Belgium | 104.1 | 54.4 | 49.7 |
| Denmark | 12.0 | 10.6 | 1.4 |
| Germany | 125.2 | 76.2 | 49.0 |
| Greece | 79.0 | 27.4 | 51.6 |
| Spain | 400.1 | 151.9 | 248.2 |
| France | 177.1 | 63.6 | 113.5 |
| Ireland | 94.6 | 33.7 | 60.9 |
| Italy | 500.2 | 240.7 | 259.5 |
| Luxembourg | 0.2 | 0.1 | 0.1 |
| Netherlands | 18.2 | 17.7 | 0.5 |
| Austria | 22.9 | 21.9 | 1.0 |
| Portugal | 74.7 | 32.4 | 42.3 |
| Finland | 36.0 | 35.9 | 0.1 |
| Sweden | 23.6 | 23.6 | -- |
| United Kingdom | 451.2 | 197.5 | 253.5 |
| **TOTAL** | **2 119.0** | **987.6** | **1 131.4** |

The estimated costs of the Commission's proposal in each country and for each sector are presented in Table 2 in the attached Impact Assessment Form. Taking account of the costs and the benefits, it is the Commission's view that the right balance has been found.

## 8. Opinions of affected parties

The impact on business as well as the opinions of affected parties can be found in the attached Impact Assessment Form.

## 9. Legal base

Emissions of sulphur dioxide contribute to problems of acidification as well as having both direct and indirect impacts upon human health (see section 2). The motivation for reducing such emissions is therefore primarily an environmental one. Reducing the sulphur content of certain liquid fuels is an integral part of a cost effective package of measures designed to reduce emissions of $SO_2$ to levels compatible with the attainment of ambitious environmental objectives with regard to both acid deposition and air quality targets for $SO_2$ and particulate matter.

In developing cost-effective strategies to combat acidification and atmospheric pollution, it is also necessary to take account of the nature of the environmental problem under consideration. With regard to acidification, there are marked differences in the sensitivities of the ecosystems throughout the Community. This means that the deposition of the same amount of acidifying substances may have severe consequences for example in the soils and lakes of Sweden whereas it may have a negligible impact on the well buffered soils of Spain or Portugal. Acidifying emissions are also carried hundreds/thousands of kilometres by prevailing winds to cause damage far away from their point of origin. A cost effective strategy must take these considerations into account. The analysis carried out to support the Commission's strategy to combat acidification and which takes into account inter alia differences in ecosystem sensitivity, regional patterns in emissions and deposition as well as cost effectiveness, has demonstrated that controls on the sulphur content of liquid fuels will be cost effective in some countries/regions but not in others. If considerations of cost effectiveness, which have been an integral part of building the strategy, are to be retained it is essential that the legislative measures which are put forward to implement the strategy are flexible and responsive to the spatial complexity of the environmental phenomena which are being addressed.

The above considerations which put the emphasis on the environmental objectives and the need for flexibility would clearly argue in favour of using Article 130s of the Treaty as the legal base. However, consideration must also be given to the rules of the internal market: the possibility allowed by Article 130t, that Member States adopt more stringent protective measures, does not exonerate those measures from the obligation of being compatible with the Treaty, that is to say, *inter alia*, justified and proportional. The proposal indeed foresees that where a Member State wishes to introduce more stringent measures they will be required to notify the Commission in accordance with the provisions of Directive 83/189/EEC. Moreover, the Commission notes incidentally that the nature (type of product, monetary value, method of trading, etc.) of the product is such that the flexibility permitted cannot result in severe disruption in the market with significant economic dis-benefits. In the case of heavy fuel oil and gas oil there is no evidence that the existence of a restricted number of different national standards would have negative economic consequences. Indeed, the opposite is probably true, in that variations in the market place will allow the refining Industry the opportunity to blend and mix their products such that the high sulphur fuels can be sold in regions or to industries which benefit from the various derogations allowed under the

Directive whereas the low sulphur products will be sold to those regions and industries which due to their location contribute significantly to environmental problems. Finally, the establishment of national programmes for the sampling and analysis of the fuel products covered by the Directive and as foreseen in Article 6, will ensure that control of compliance will be carried out on the fuels as they are used rather than at the border, thereby minimizing any disruptive effects on trade.

Finally, it should be borne in mind that an act based on Article 130s allows Austria and Finland to continue with the limit value of 0.1% which was in place before their accession and which they are currently allowed to maintain during a four-year transition period ending in December 1998.

In conclusion, given that:

(a) the primary motivation for the measure is environmental;

(b) the nature of the environmental problems to be addressed demands a flexible and spatially differentiated response;

(c) there is no evidence that the existence of different sulphur limit values for gas oil and heavy fuel oil in different countries and regions in the Community would cause significant market disruption or economic dis-benefits;

the Commission has decided that the most appropriate legal base for this Directive is Article 130s of the Treaty.

## 10. Need for action at the level of the Community subsidiarity

### 10.1. What are the objectives of the action envisaged in relation to the Community's obligations?

The proposed measure is an integral part of a cost-effective strategy designed to combat acidification as well as reducing atmospheric pollution by sulphur dioxide and particulate matter.

Acidification is a major environmental challenge. It is transboundary in nature and requires a Community-wide strategy in order to bring about improvement. Actions taken by individual Member States acting alone will, in the absence of complementary actions taken in other Member States, have, at most, a minimal impact.

In the Fifth Environmental Action Programme, the objective in relation to acidification was "no exceeding ever of critical loads and levels". This objective was endorsed once again by the Environment Council meeting in December 1995. At this Council meeting the Commission was requested to come forward, by the beginning of 1997, with a Community strategy to combat acidification and aimed ultimately at no exceeding of the critical loads and levels.

The Commission has now put forward its strategy to combat acidification. This proposal is part of that strategy.

With regard to air quality, the Community already has air quality standards for sulphur dioxide and particulate matter: these standards are currently in the process of revision. Atmospheric pollution by sulphur dioxide and particulate matter contribute to respiratory and cardiovascular diseases among sensitive sectors of the population. Sulphur dioxide concentrations also have direct effects on the environment. Significant reductions in the emissions of sulphur dioxide will be necessary to achieve satisfactory air quality with respect to sulphur dioxide and particulate matter (sulphur dioxide contributes to the formation of sulphates which in turn contribute to the formation of secondary particulate matter in the atmosphere). The reduction of $SO_2$ emissions arising from the combustion of liquid fuels and which result from the introduction of the present proposal will make a significant contribution towards the attainment of satisfactory air quality objectives.

Combatting acidification and improving air quality are part of the Community's environmental policy, as set out in Article 130r of the Treaty. In addition, Article 129 of the Treaty foresees that health protection shall form a constituent part of the Community's other policies. Furthermore, Article 3(o) of the treaty also foresees that activities of the Community should include a contribution to the attainment of a high level of health protection.

**10.2. Is the action envisaged an exclusive competence of the Community or a shared competence with the Member States?**

The Community has a general competence to adopt measures in order to achieve the environmental objectives referred to in Article 130r.

The proposal for a Community strategy for combatting acidification which was recently adopted by the Commission quantifies the emission reductions which must be achieved by each Member State in order to achieve the environmental objective. The emission reductions are to be achieved in a cost-effective manner and this will require an integrated package of interlocking and mutually reinforcing measures. Some of these measures should be taken at the level of the Community such as the present proposal and the forthcoming revision to Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants. Other measures such as the negotiation of emission ceilings with industry sectors or sub-sectors will be done at the national level. In addition further measures will need to be taken in international fora such as the International Maritime Organisation's Convention on Marine Pollution and the UN ECE Convention on Long-Range Transboundary Air Pollution.

With regard to the attainment of air quality objectives this will also require concerted action. Measures such as the present proposal will be taken at the level of the Community whereas others such as local fuel standards, fiscal incentives for low sulphur fuels and local emission management plans will be taken at the national, regional or local level.

Taken together, the concerted actions taken at different levels, will achieve the emission reductions necessary to reduce acidification and to achieve satisfactory air quality while at the same time fully respecting the principles of cost-effectiveness and subsidiarity.

### 10.3. What is the Community dimension to the problem? What solution has been in force until now?

Acidification is a transboundary problem which can best be tackled by concerted action at the level of the Community. Similarly, atmospheric pollution is an environmental challenge which demands concerted action.

In the absence of a Community strategy with regard to acidification, measures have, until now, tended to be introduced in a rather ad-hoc fashion. Community legislation does exist for the control of emissions from combustion plants (Directive 88/609/EEC) and limiting the sulphur content of certain liquid fuels (Directive 93/12/EEC). The Commission's proposal for a Community strategy to combat acidification provides a clear framework for the development of future policy instruments.

### 10.4. What is the most effective solution, comparing the means of the Member States and the Community?

The analysis carried out by the Commission to support the development of a Community strategy to combat acidification, clearly identified control of the sulphur content of certain liquid fuels as an integral part of a cost-effective strategy to reduce acidifying emissions.

### 10.5. What is the added value brought about by the action envisaged to the Community and what would be the cost of inaction?

The economic consequences of acidification and air pollution are significant (see section 2). Unilateral action taken by one Member State acting alone will not be successful in the absence of complementary action being taken in other Member States: indeed in the absence of a clear strategy and concerted action Member States risk to take mutually antagonistic actions. The implementation of an integrated Community strategy is a means to ensure that the environmental objectives will be secured in an effective manner. A clear strategy based upon principles of cost-effectiveness and burden sharing and with a clear definition of the roles of the Community and the Member States is an advantage to Industry in that it allows long-term investment and planning on the basis of a rationale and transparent approach to environmental policy development.

The costs of the proposal are estimated at ECU 0.8 billion/year. This achieves a reduction of 1 113 ktonnes $SO_2$ compared to no further action beyond business as usual at an average cost of around ECU 700 per tonne of $SO_2$. Studies suggest that the benefits might, in as far as they have been monetarized, be as high as ECU 4 000/ton $SO_2$.

### 10.6. What actions are available to the Community?

The purpose of the action is to reduce the emissions of sulphur dioxide resulting from the combustion of certain liquid fuels. The means which has been identified to achieve this objective is the establishment of limit values for the sulphur content of certain liquid fuels. The establishment of limit values is best achieved by Regulation or Directive.

### 10.7. Is uniform regulation necessary or is a Directive setting out the general principles leaving the detailed execution to the Member States enough?

The imposition across the Community of general limits on the concentration of sulphur in certain liquid fuels is a cost-effective measure for reducing emissions of sulphur dioxide arising from the combustion of such fuels. The cost-effectiveness of the measure is considerably improved particularly in the case of heavy fuel oil (see section 4.1 ) by building in flexibility to allow for the diversity of environmental conditions across the Community and the fact that installations may chose to use alternative technologies to reduce sulphur dioxide emissions.

An assessment of the environmental conditions which prevail in different regions of the Community and the permitting of industrial installations can be carried out most effectively by the authorities in the different Member States in cooperation ,where appropriate, with the regional and local authorities. In addition, the monitoring and control of the quality of fuels used in the Community can also be carried out effectively by the national authorities.

For the reasons given above the Commission considers that a Directive, rather than a Regulation is the most appropriate choice of legal instrument. In particular, the extensive involvement of the national authorities and the considerable discretion allowed to those authorities will ensure the most cost-effective implementation of the foreseen measures.

## 11. Description of the legislative situation in the Member States

### 11.1. Gas oil

With regard to gas oil all Member States with the exception of Austria and Finland are required to comply with the limit value of 0.2% laid down in Directive 93/12/EEC. In Austria and Finland a limit value of 0.1% sulphur in gas oil is currently in force.

### 11.2. Heavy fuel oil

With regard to heavy fuel oil the current situation in the Member States is as follows:

Austria

A general limit of 1% sulphur in heavy fuel oil is in force. However, more severe restrictions (0.2%, 0.3% and 0.6% sulphur content) exist in relation to combustion plants dependent upon their age and capacity.

Belgium

There are three different types of heavy fuel oil recognized under Belgian legislation. Different sulphur limits of 1%, 2% and 3% are applied to the three types of fuel. In 1995, it is estimated that approximately 1 925 kilotonnes of heavy fuel oil with a sulphur content of less than or equal to 1% were used as compared to only 51 kilotonnes of fuel with a sulphur content greater than 1%. Tax incentives are also offered to encourage the use of low sulphur fuels.

Denmark

A limit of 1% is imposed on the sulphur content of heavy fuel oils. In addition a charge of DKK 10 per kilogram is applied to $SO_2$ emissions in order to encourage the use of low sulphur fuels.

Finland

The sulphur content of heavy fuel oils is limited to 1%.

France

Three different types of heavy fuel oil are recognized under French legislation. Three different sulphur limits are applied to each type - 1%, 2% and 4%. In 1995 it is estimated that 1 215 kilotonnes of the 1% sulphur fuel were used as compared to 1 162 and 2 608 kilotonnes of the 2% and 4% sulphur fuels respectively. A further 2 290 kilotonnes of heavy fuel oil of undefined sulphur content were used in refineries.

Germany

For combustion plants with a capacity of greater than 1 Megawatt, either the sulphur content of the heavy fuel oil used must be limited to 1% or the $SO_2$ emissions must be less than 1700 mg per cubic metre of flue gas.

Greece

The sulphur content of heavy fuel oils is generally limited to 3.2%. However in the Athens (Attica) area a limit of 0.7% applies.

Ireland

There are no legal limits in force with regard to the sulphur content of heavy fuel oils. However, certain industries must comply with $SO_2$ emission limits which are equivalent to using heavy fuel oil with a 1% sulphur limit.

Italy

Within the industrial sector, combustion plants with an output of 3 Megawatts or less must use fuel with a sulphur content of 0.3% or less. Plants with a capacity of 50 Megawatts or greater and refineries can use fuel with a sulphur content up to 3% on condition that they respect defined emission limits.

Luxembourg

There are no limit values applied to the sulphur content of heavy fuel oil.

Netherlands

Combustion plants in the industrial sector (excluding refineries) must either use heavy fuel oil with a sulphur limit of 1% or respect an emission standard for $SO_2$ of 1 700 mg per cubic metre of flue gas.The refining industry has a general emission limit of 1 500 mg $SO_2$ per cubic metre of flue gas taken across the whole Industry. No limit values with regard to the sulphur content of heavy fuel oils are imposed on the refining Industry.

Portugal

Four different types of heavy fuel oil are recognized under Portuguese legislation. Different sulphur limits - 1%, 2%, 3% and 3.5% are applied to the different types of fuel.

Spain

There are two different types of heavy fuel oil with sulphur limits of 2.7% and 3.5%.

Sweden

For the majority of Swedish territory emission standards are imposed such that the sulphur emissions arising from the combustion of different fuel types must not exceed:

(i) 50mgS/MJ (yearly average) if the total emissions of sulphur exceed 400 tonnes per annum;

(ii) 100mgS/MJ (yearly average) if the total sulphur emissions are less than 400 tonnes.

These limit values are valid for all boilers together within one district heating system or industrial site. These emission standards compare to a sulphur limit value in heavy fuel oil of 0.2% and 0.4% respectively. In certain regions of Sweden, a sulphur limit of 0.8% or the equivalent in sulphur emissions applies.

In addition to the use of emission standards, Sweden also imposes a sulphur tax of SEK 27 per cubic metre of fuel per 0.1% sulphur content.

United Kingdom

There are currently no limits imposed on the sulphur content of heavy fuel oil.

## 12. Explanation of the detailed provisions of the proposal

### 12.1. The purpose and scope of the Directive (Article 1)

The purpose of the proposal is to reduce emissions of $SO_2$ arising from the combustion of certain liquid fuels. This objective is to be achieved by controlling the sulphur content of certain liquid fuels.

The proposal does not apply to fuel contained in the fuel tanks of vessels crossing a frontier between a third country and a Member State. The proposal does not cover fuels intended for processing in the refining Industry.

### 12.2. Definitions (Article 2)

The definitions of the various fuels are compatible with definitions given in other pieces of Community legislation.

### 12.3. Maximum content of sulphur in heavy fuel oil (Article 3)

A general limit of 1% for the sulphur content of heavy fuel oil is proposed. Derogations are provided for countries or regions where $SO_2$ emissions do not contribute to human health or environmental problems. Derogations are also provided for new combustion plants which are covered by Directive 88/609/EEC and for other combustion plants which respect an $SO_2$ emission standard which is equivalent to using heavy fuel oil with a 1% sulphur concentration.

### 12.4. Maximum content of sulphur in gas oil (Article 4)

The current limit value of 0.2% sulphur as laid down in Directive 93/12/EEC is maintained. Derogations are provided for Greece and for the Canary Islands with regard to gas oils used for marine purposes.

### 12.5. Changes in the supply of crude oil (Article 5)

In order to avoid problems caused by a sudden change in the supply of crude oil or petroleum products, the Commission can authorize a higher limit value for the sulphur content of the different fuel types for a period not exceeding six months.

### 12.6. Sampling and analysis (Article 6)

Procedures for sampling and analysis are outlined.

### 12.7. Reporting and review (Article 7)

Member States will be required each year to submit to the Commission a short report on the sulphur content of liquid fuels marketed in their territory. On the basis of these reports and the observed trends in air quality and acidification, the Commission will by the end of 2003 submit a report to Council. This report will if appropriate be accompanied by proposals to revise the provisions of the Directive.

### 12.8. Repeal of the existing Directive (Article 8)

All relevant provisions of Directive 93/12/EEC as they relate to gas oils will be taken over by the present proposal. The provisions of Directive 93/12/EEC must therefore be repealed.

### 12.9. Transposition/sanctions/entry into force (Articles 9, 10 and 11)

These Articles contain standard provisions.

97/0105 (SYN)

Proposal for a

COUNCIL DIRECTIVE

relating to a reduction of the sulphur content of certain liquid fuels and amending Directive 93/12/EC

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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[13],

Having regard to the Opinion of the Economic and Social Committee[14],

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

(1) Whereas the objectives and principles of the Community's environmental policy as set out in the action programmes on the environment and in particular the fifth Environmental Action Programme[15] on the basis of principles enshrined in Article 130r of the Treaty, aim in particular to ensure the effective protection of all people from the recognized risks from sulphur dioxide emissions and to protect the environment by preventing sulphur deposition exceeding critical loads and levels;

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

(3) Whereas emissions of sulphur dioxide contribute significantly to the problem of acidification in the Community; whereas sulphur dioxide also has a direct effect on human health and on the environment;

(4) Whereas acidification and atmospheric sulphur dioxide damage sensitive ecosystems, reduce biodiversity and reduce amenity value as well as detrimentally affecting crop production and the growth of forests; whereas acid rain falling in cities may cause significant damage to buildings and the architectural heritage; whereas sulphur dioxide pollution may also have a significant effect upon human health, particularly among those sectors of the population suffering from respiratory diseases;

(5) Whereas acidification is a transboundary phenomenon requiring Community as well as national or local solutions;

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13 OJ No C

14 OJ No C

15 OJ No C 138, 17.5.1993, p. 5.

(6) Whereas emissions of sulphur dioxide contribute to the formation of particulate matter in the atmosphere;

(7) Whereas the Community and the individual Member States are contracting parties to the UN ECE Convention on Long-Range Transboundary Air Pollution; whereas under the protocol on further reduction of sulphur emissions established under that convention, contracting parties should make significant reductions in emissions of sulphur dioxide;

(8) Whereas sulphur which is naturally present in small quantities in oil and coal has for decades been recognized as the dominant source of sulphur dioxide emissions which are one of the main causes of "acid rain" and one of the major causes of the air pollution experienced in many urban and industrial areas;

(9) Whereas the Commission has recently published a Communication[16] on a cost-effective strategy to combat acidification in the Community; whereas the control of sulphur dioxide emissions originating from the combustion of certain liquid fuels was identified as being an integral component of this cost-effective strategy;

(10) Whereas, in conformity with the principle of subsidiarity and the principle of proportionality referred to in Article 3b of the Treaty, the objective of reducing the emissions of sulphur dioxide arising from the combustion of certain types of liquid fuels cannot be achieved effectively by Member States acting individually and whereas unconcerted action offers no guarantee of achieving the desired objective, is potentially counterproductive and will result in considerable uncertainty in the market for the fuel products affected and whereas, in view of the need to reduce sulphur dioxide emissions across the Community, it is more effective to take action at the level of the Community; whereas this Directive limits itself to the minimum requirements necessary to achieve the desired objective;

(11) Whereas, it should only be possible to use gas oils and heavy fuel oils within the territory of the Community on condition that their sulphur content does not exceed certain limits set out in this Directive;

(12) Whereas, in accordance with Article 130t of the Treaty, this Directive should not prevent any Member State from maintaining or introducing more stringent protective measures and whereas such measures must be compatible with the Treaty and should be notified to the Commission;

(13) Whereas a Member State, before introducing new, more stringent protective measures, should notify the draft measures to the Commission in accordance with Council Directive 83/189/EEC of 28 March 1983[17], as last amended by Directive 96/139/EC[18], laying down a procedure for the provision of information in the field of technical standards and regulations;

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16 OJ No C

17 OJ No L 109, 26.4.1983, p. 8.

18 OJ No L 32, 10.2.1996, p. 31.

(14) Whereas, with regard to the limit on the sulphur content of heavy fuel oil, it is appropriate to provide for derogations in Member States and regions where the environmental conditions allow;

(15) Whereas, with regard to the limit on the sulphur content of heavy fuel oil, it is also appropriate to provide for derogations for their use in combustion plants which comply with the emission limit values laid down in Council Directive 88/609/EEC of 24 November 1988[19] on the limitation of emissions of certain pollutants into the air from large combustion plants, as last amended by Directive 94/66/EC[20]; whereas in the light of the forthcoming revision of Directive 88/609/EEC, it will be necessary to review and, if appropriate, to revise certain provisions of this Directive;

(16) Whereas a limit value of 0.2% for the sulphur content of gas oils has already been established under Council Directive 93/12/EEC of 23 March 1993 relating to the sulphur content of certain liquid fuels[21], as amended by the Act of Accession of Austria, Finland and Sweden; whereas that limit value should continue to be generally applicable;

(17) Whereas, in accordance with the Act of Accession of Austria, Finland and Sweden, Austria and Finland have a derogation for a period of four years from the date of accession regarding the provisions in Directive 93/12/EEC concerning the sulphur content of gas oil;

(18) Whereas the limit value of 0.2% for the sulphur content of gas oils intended for marine use in sea-going ships may present technical and economic problems for Greece throughout its territory and for Spain with regard to the Canary Islands; whereas a derogation for Greece and the Canary Islands should not have a negative effect upon the market in gas oil intended for marine use and given that exports of gas oil for marine use from Greece and the Canary Islands to other Member States should satisfy the requirements in force in the importing Member State; whereas Greece and the Canary Islands should be afforded a derogation from the limit value of 0.2% sulphur by weight for gas oil used for marine purposes;

(19) Whereas in the case of a disruption in the supply of crude oil or petroleum products, the Commission may authorize application of a higher limit within a Member State's territory;

(20) Whereas Member States should establish the appropriate mechanisms for monitoring compliance with the provisions of this Directive; whereas regular reports on the sulphur content of liquid fuels should be submitted to the Commission;

(21) Whereas, for reasons of clarity, it will be necessary to amend Directive 93/12/EEC;

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19 OJ No L 336, 7.12.1988, p. 1.

20 OJ No L 337, 24.12.1994, p. 83.

21 OJ No L 74, 27.3.1993, p. 81.

HAS ADOPTED THIS DIRECTIVE:

Article 1
Purpose and scope

1. The purpose of this Directive is to reduce the emissions of sulphur dioxide resulting from the combustion of certain types of liquid fuels and thereby to reduce the harmful effects of such emissions on man and the environment.

2. Reductions in the emissions of sulphur dioxide resulting from the combustion of certain petroleum-derived liquid fuels shall be achieved by imposing limits on the sulphur content of such fuels as a condition for their use within the territory of the Community.

   The limitations on the sulphur content of certain petroleum-derived liquid fuels as laid down in this Directive shall not, however, apply to fuels:

   (a) contained in the fuel tanks of vessels crossing a frontier between a third country and a Member State;

   (b) intended for processing prior to final combustion;

   (c) used for processing in the refining industry.

Article 2
Definitions

For the purpose of this Directive:

1. "Heavy fuel oil" means any petroleum-derived liquid fuel falling under CN code 2710 00 71 to 2710 00 78 or any petroleum-derived liquid fuel (other than gas oil as defined in point 2) which, by reason of its distillation limits, falls within the category of heavy oils intended for use as fuel and of which less than 65% by volume (including losses) distils at 250° C by the ASTM D86 method. If the distillation cannot be determined by the ASTM D86 method, the petroleum product is likewise categorized as a heavy fuel oil.

2. "Gas oil" means any petroleum-derived liquid fuel falling under CN code 2710 00 69 or any petroleum-derived liquid fuel which, by reason of its distillation limits, falls within the category of middle distillates intended for use as fuel and of which at least 85% by volume (including losses), distils at 350° C by the ASTM D86 method. Diesel fuels as defined in Article 2(2) of European Parliament and Council Directive .....[22] [relating to the quality of petrol and diesel fuels] are excluded from this definition.

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22 OJ No L

3. The term "ASTM method" means the methods laid down by the American Society for Testing and Materials in the 1976 edition of standard definitions and specifications for petroleum and lubricating products.

## Article 3
### Maximum sulphur content of heavy fuel oil

1. Member States shall take all necessary steps to ensure that as from 1 January 2000 within their territory heavy fuel oils cannot be used if their sulphur content exceeds 1.0% by weight.

2. Provided that the air quality standards for sulphur dioxide laid down in Council Directive 80/779/EEC[23] and other relevant Community provisions are respected and the contribution to transboundary pollution is negligible, a Member State may authorize heavy fuel oils with a sulphur content between 1.0 and 2.5% by weight to be used in part or the whole of its territory.

3. Paragraphs 1 and 2 shall not apply to heavy fuel oils used in combustion plants with a rated thermal input equal to or greater than 50 MW which are considered new plants in accordance with the definition given in Article 2.9 of Directive 88/609/EEC and which comply with the sulphur dioxide emission limits for such plants set out in Article 4 of and Annex IV to that Directive.

   Paragraphs 1 and 2 shall not apply to heavy fuel oils used in combustion plants and industrial cement plants other than those mentioned above, if the emissions of sulphur dioxide from the plant are less than or equal to 1700 mg $SO_2/Nm^3$.

   Member States shall take the necessary measures to ensure that any combustion plant using heavy fuel oil with a sulphur concentration greater than that referred to in paragraph 1 shall not be operated without a permit issued by a competent authority which specifies the emission limits.

4. The provisions of paragraph 3 shall be reviewed and, if appropriate, revised in the light of any future revision of Directive 88/609/EEC.

5. If a Member State avails itself of the possibilities referred to in paragraphs 2 or 3, it shall, at least 12 months beforehand, inform the Commission and the public. The Commission shall be given sufficient information to assess whether the criteria mentioned in paragraphs 2 or 3 respectively are met. The Commission shall inform the other Member States. Within six months of the date on which it receives the information from the Member State, the Commission shall examine the measures envisaged to ensure that they comply with this Directive and with other provisions of Community law and shall communicate its decision to the Member States.

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23 OJ No L 229, 30.8.1980, p. 30.

Article 4
Maximum sulphur content in gas oil

1. Member States shall take all necessary steps to ensure that as from 1 January 1999 within their territory and waters, gas oils, including gas oils for marine use, cannot be used if their sulphur content exceeds 0.2 % by weight.

2. By way of derogation from paragraph 1, Spain, for the Canary Islands, and Greece, for the whole or part of its territory, may authorize the use of gas oils for marine use with a sulphur content in excess of 0.2 % by weight.

Article 5
Change in the supply of crude oil

If, as a result of a sudden change in the supply of crude oil or petroleum products, it becomes difficult for a Member State to apply the limits on the maximum sulphur content referred to in Articles 3 and 4, that Member State shall inform the Commission thereof. The Commission may authorize a higher limit to be applicable within the territory of that Member State for a period not exceeding six months and shall notify its decision to the Council and the Member States. Any Member State may refer that decision to the Council within one month. The Council, acting by a qualified majority, may adopt a different decision within two months.

Article 6
Sampling and analysis

1. Member States shall take all necessary measures to check by sampling that the sulphur content of fuels used comply with Articles 3 and 4. The sampling shall commence within six months of the date on which the relevant limit for maximum sulphur content in the fuel comes into force. It shall be carried out with sufficient frequency and in such a way that the samples are representative of the fuel examined.

2. The reference method adopted for determining the sulphur content shall be that defined by:

   (a) ISO method 8754 (1992) for heavy fuel oil and marine diesel oil;
   (b) ISO method 4260 (1987) for gas oil.

   The statistical interpretation of the verification of the sulphur content of the gas oils used shall be carried out in accordance with ISO standard 4259 (1992).

Article 7
Reporting and review

1. On the basis of the results of the sampling and analysis carried out in accordance with Article 6, Member States shall by 30 June of each year supply the Commission with a short report on the sulphur content of the liquid fuels falling within the scope of this Directive and used within their territory during the proceeding calendar year.

2. On the basis *inter alia* of the annual reports submitted in accordance with paragraph 1 and the observed trends in air quality and acidification, the Commission shall, by 31 December 2003, submit a report to the Council. The Commission may submit with its report proposals aimed at revising this Directive and in particular the limit values laid down for each fuel category and the exceptions and derogations provided for in Article 3(2), Article 3(3) and Article 4(2).

Article 8
Amendments to Directive 93/12/EEC

Directive 93/12/EEC is amended as follows:

(1) In Article 1, paragraph 1(a) and paragraph 2 are deleted;

(2) In Article 2, the first subparagraph of paragraph 2 and paragraph 3 are deleted;

(3) Articles 3 and 4 are deleted.

The first paragraph shall apply as from 1 January 1999.

Article 9
Transposition

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive before 1 June 1998. They shall immediately inform the Commission thereof.

   Member States shall apply these provisions from 1 January 1999.

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

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

Article 10
Sanctions

Member States shall lay down the system of penalties for breaching the national provisions adopted pursuant to this Directive and shall take all the measures necessary to ensure that those penalties are applied. The penalties thus provided for shall be effective, proportionate and dissuasive. Member States shall notify the relevant provisions to the Commission before 1 June 1998 and shall notify any subsequent changes as soon as possible.

Article 11
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 12
Addressees

This Directive is addressed to the Member States.

Done at Brussels,

For the Council
The President

# IMPACT ASSESSMENT FORM

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

**TITLE OF THE PROPOSAL**

Proposal for a Council Directive relating to a reduction of the sulphur content of certain liquid fuels and amending Directive 93/12/EC

Reference Number (Repertoire):

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

The Commission has recently brought forward, following the request of the Council, a proposal for a Community strategy to combat acidification[24]. This strategy has identified the need for concerted and cost-effective actions to reduce emissions of acidifying pollutants such as sulphur dioxide, oxides of nitrogen and ammonia. The strategy identified a number of measures to be taken at the level of the Community, at national and local level and in international fora. Controls of the sulphur content of certain liquid fuels are an integral part of the strategy.

In addition to the need for reducing emissions of sulphur dioxide in order to combat acidification, sulphur dioxide also has significant effects on human health and upon the corrosion of buildings and building materials. The Community has established air quality objectives in relation to sulphur dioxide (Directive 80/779/EEC) and the Commission is currently in the process of preparing proposals to make these air quality objectives more severe. Reducing emissions of sulphur dioxide through the control of the sulphur content of certain liquid fuels, will be an important contribution towards the attainment of the new air quality guidelines and will produce significant benefits for the environment and human health.

The proposal does not cover all categories of liquid fuel. The existing sulphur limits for gas oils established under Directive 93/12/EEC are maintained. The most significant new element in the proposal concerns the introduction of a general sulphur limit of 1% (with extensive exemptions) for heavy fuel oils.

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## 2. WHO WILL BE AFFECTED BY THE PROPOSAL?

- **Which sectors of industry?**

The major sector of industry to be affected will be the refining industry which will be required to produce heavy fuel oil with a lower sulphur content. Oil traders will also be affected.

The major users of heavy fuel oil are power stations, refineries and industry with smaller quantities being used for domestic and transport purposes. It is clear that the price of heavy fuel oil with a low sulphur content will increase although the extensive derogations allowed for in the proposal will mitigate these costs in many areas.

- **Which sizes of business?**

Oil refining companies are large often multi-national concerns. Oil trading companies may be small/medium sized enterprises. Power generation companies are also large concerns. The users of heavy fuel oil in industry and transport will be a mixture of large, medium and small enterprises.

- **Are there particular geographical areas of the Community where these businesses are found?**

The businesses which produce and use heavy fuel oils are distributed throughout the Community. However, in many Member States the sulphur content of heavy fuel oil is already at or around the limit of 1% proposed by the Commission (see Table 1). Where the economic impact of the proposal will be felt most keenly is in those Member States where the sulphur content of heavy fuel oil is currently quite high and where consumption of this type of fuel is also high for example in France, Greece, Ireland, Italy, Portugal, Spain and the United Kingdom. However, many of these countries will be able to benefit from the derogation which allows Member States to permit the use of heavy fuel oil with a higher sulphur content in those parts of their territory which do not suffer from problems of air quality and which do not contribute significantly to problems of acidification.

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

Some refineries will have to change their refinery processes, install new process units and/or undertake blending operations in order to achieve he changes in sulphur content. The technology used to reduce the sulphur content of heavy fuel oils are all currently available and proven technologies.

Refineries will also be able to go some way to reducing the sulphur content of their products by changing their crude oil supply towards crudes with a lower sulphur content. In general North Sea crudes tend to be lower in sulphur content than crudes originating in the middle east.

With regard to the users of heavy fuel oils they will be required to ensure that the fuel oil used by them conforms to the sulphur limit of 1%.

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

- **On employment and investment and the creation of new businesses**

In those countries where the sulphur content of heavy fuel oil is already around the 1% limit proposed by the Commission the economic consequences will be minimal. However, in those countries where a significant drop in the sulphur content of heavy fuel oil will be necessary (see Table 1) the economic consequences for the refining industry will be more severe. The degree of investment which will be required will be heavily dependent upon the current configuration of the refining industry in each country. In particular, in France, UK, Spain and Portugal where the majority of the refinery capacity is based on Fluid Catalytic Cracking (a technology which is poorly adapted to dealing with demands for a low sulphur product) considerable investment will be necessary. Given the current over-capacity in the European refining industry and the very low operating margins it is not excluded that the proposals will precipitate some restructuring in the Industry with consequent job losses. However, the Commission's proposals will not on their own lead to such changes only when taken together with other pressures on the industry.

The investment in the new plant required for refineries to produce the low sulphur product will produce increased revenue for companies which manufacture and install such plant. This will undoubtedly give rise to increased employment opportunities in these industries.

The increased production costs for refineries will probably be passed on to the users of heavy fuel oil. In Table 2 the estimated additional costs for each industrial sector in each country are given. It is clear that there will be significant differences in the addtional costs faced by industrial sectors in different parts of the Community if they continue to use heavy fuel oil for heat and power. However, a very strong trend over previous years has been the shift away from solid and liquid fuels to gas. The present proposal will reinforce that trend.

- **On the competitiveness of business**

As explained above, the impact on the refining industry will vary considerably from country to country. While the competitiveness of some refineries may be negatively affected others which are already equipped with the appropriate technology, will have a competitive advantage. Taken as a whole it is considered that their will be a minor negative impact on the competitiveness of the European refining industry.

With regard to the users of heavy fuel oil it is not considered that their competitivity will be affected significantly by the proposal.

## 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 major impact of the proposals will be on the refining industry and given that the impact upon the users of heavy fuel oil will not be significant, it was not considered necessary to introduce special provisions for SMEs.

## 6. CONSULTATION

During the course of 1996 and 1997 the Commission held three meetings (29 May, 31 October, and 16 January) with the Member States, Industry and NGOs to discuss the proposed strategy for combatting acidification and the associated legislative proposals. Bilateral discussions have also been held with UNICE, EUROPIA and EURELECTRIC. The following is a summary of the positions of the Industry organisations as expressed at the last meeting held on 16 January 1997 and in correspondence exchanged subsequent to that meeting.

UNICE (the employers organisation representing European industry) representatives expressed the view that given the uncertainty associated with the model predictions concerning acidification and the considerable progress which had already been made to reduce acidifying emissions, it was premature to pursue further emission reductions, including the present proposal, before having a clearer appreciation of the environmental improvements which would be achieved by already agreed measures.

The Commission considers that the views expressed by UNICE are incompatible with the request made by the Council to come forward with a Community strategy to combat acidification by the beginning of 1997. Furthermore, while recognizing that there will be a degree of uncertainty associated with all model predictions the Commission is confident that the RAINS model which has been used to underpin its acidification strategy and associated proposals is a solid basis upon which to base policy. Finally, the Commission considers that in the case of environmental phenomena such as acidification which are well documented and understood that the precautionary principle contained in the Treaty precludes the " wait and see" approach which is seemingly favoured by UNICE.

EURELECTRIC, (the organisation representing European electricity suppliers) expressed concerns with regard to the balance of the emission reductions which would be required as a consequence of the Commission's proposed strategy to combat acidification. In particular, this organisation felt that the emission reductions for sulphur dioxide were too ambitious. Such a conclusion obviously places a question mark against the present proposal which is aimed at reducing sulphur dioxide emissions. In correspondence EURELECTRIC have also expressed the view that the present proposal should be incorporated into the future revision of Directive 88/609/EEC on the emissions from Large Combustion Plants.

The Commission considers that the assessment from EURELECTRIC is flawed. Indeed the Dutch studies which are cited by this organisation as evidence that the emission reductions for sulphur dioxide are too high was directed at resolving a

situation in the Netherlands rather than a Community wide transboundary problem. With regard to the relationship between the present proposal and Directive 88/609/EEC and future revisions to that Directive, the Commission considers that the derogations and cross-references included in the present proposal will ensure the necessary level of coherence.

EUROPIA (the organization representing the European petroleum industry) representatives expressed reservations with regard to the reliability of the models upon which the Commission had based its proposed strategy to combat acidification. This organization also cautioned against a piecemeal approach to the problem of acidification which ignored the related problems of eutrophication and tropospheric ozone.

With regard to the present proposal, EUROPIA considers that heavy fuel oil used in refineries should be excluded from the scope of the Directive. Secondly this organization considers that Member States should be given more freedom with regard to the application of the derogations foreseen under Article 3.2 and 3.3. In particular, EUROPIA argued against the imposition of a ceiling on the sulphur content of heavy fuel oil in areas benefitting from the derogation foreseen under Article 3.2.

The Commission's position with regard to the reliability of the models used to support its policy has already been given in relation the observations made by UNICE (above). The Commission policy on acidification also takes account of tropospheric ozone and eutrophication. The present proposal does provide for a derogation for fuels destined for processing in refineries. However, fuels burnt by refineries as a source of heat and power in their production processes generate polluting emissions in the same way as any production process and there is no reason why the refining Industry should receive special treatment as compared to other industrial sectors. The issue of the sulphur ceiling imposed under Article 3.2 of the proposal is dealt with in section 4.1 of the explanatory memorandum.

The European Cement Organization were concerned to ensure that the derogation foreseen under Article 3.3 of the proposal with respect to heavy fuel oil would also apply to plant in cement factories.

The proposal from the Commission provides the safeguards requested by the cement manufacturers.

**Table 1**

**Statistics(*) on the use and average sulphur content of heavy fuel oil in the Member States**

| | Total annual consumption in 1995 (kilotonnes) | Average sulphur content (percent) |
|---|---|---|
| Belgium | 1 976 | ~1.0 |
| Denmark | 811 | ~1.0 |
| Germany | 7 012 | 1.2 |
| Greece | 2 677 | 2.7 |
| Spain | 8 222 | 1-3.5(**) |
| France | 7 275 | 2.1 |
| Ireland | 1 284 | ~2.0 |
| Italy | 30 586 | 1.53 |
| Luxembourg | - | - |
| Netherlands | 1 176 | 2.2 |
| Austria | 930 | 0.96 |
| Portugal | - | - |
| Finland | 1 678 | 1.1 |
| Sweden | 1 930 | 0.3 |
| United Kingdom | 9 028 | 2.18 |

(*) Information provided by Member States in Nov./Dec. 1996.
(**) Dependent upon the specific type of heavy fuel oil.

Table 2

**The incremental costs by country and by industrial sector associated with the introduction of a 1% sulphur limit for heavy fuel oil** (million ECU/year)

| Country/Sector | Refineries & oth. conv. | Other industry | Domestic | Transport | Power Plant | Total |
|---|---|---|---|---|---|---|
| Belgium | 19.1 | 0.0 | 7.1 | 9.1 | 2.1 | 37.4 |
| Denmark | 0.5 | 0.0 | 0.4 | 0.0 | 0.4 | 1.2 |
| Germany | 17.5 | 25.4 | 0.1 | 0.0 | 0.2 | 43.3 |
| Greece | 5.1 | 2.3 | 0.6 | 16.2 | 11.0 | 35.1 |
| Spain | 44.0 | 74.0 | 18.4 | 20.7 | 21.0 | 178.1 |
| France | 37.1 | 27.4 | 6.4 | 0.0 | 1.9 | 72.7 |
| Ireland | 0.5 | 16.5 | 3.3 | 0.0 | 19.5 | 39.9 |
| Italy | 11.3 | 20.1 | 0.1 | 0.0 | 68.0 | 99.6 |
| Luxembourg | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 |
| Netherlands | 0.0 | 0.2 | 0.0 | 0.0 | 0.2 | 0.4 |
| Austria | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.5 |
| Portugal | 4.6 | 21.3 | 3.0 | 0.3 | 4.3 | 33.6 |
| Finland | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sweden | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| United Kingdom | 9.2 | 8.4 | 35.3 | 2.5 | 162.2 | 217.5 |
| **Sum** | **148.9** | **195.8** | **74.8** | **48.8** | **291.1** | **759.4** |

The estimated costs are based on the assumption that power plants and large boilers in industry and in refineries will, whenever it is cheaper, use flue gas desulphurization rather than low sulphur fuel oil. The figures do not take account of the fact that the Directive also allows for derogations in those regions where air quality standards for $SO_2$ are respected and where emissions do not contribute significantly to acidification.

**Explanatory Memorandum to the**
**Proposal for a**
**COUNCIL DECISION**
**on the conclusion by the European Community of the Protocol to the 1979 Convention on long-range transboundary air pollution on further reductions of sulphur emissions**

On the basis of the Council Decision of 9 June 1994, the Community signed on 14 June 1994 in Oslo the Protocol to the 1979 Convention on long-range transboundary air pollution on further reduction of sulphur emissions.

The Community has been a Party to the Convention since 1982. On 28 September 1984 the Community signed and on 17 July 1986 approved the Protocol on long-term financing of the cooperative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe (EMEP). The Community acceded to the Protocol concerning the control of emissions of nitrogen oxides or their transboundary fluxes on 17 December 1993 and signed the Protocol concerning the control of emissions of volatile organic compounds or their transboundary fluxes on 2 April 1992. A proposal for a Council Decision concerning the approval of the latter Protocol is submitted separately.

The aim of the Protocol on further reduction of sulphur emissions is to reduce the annual sulphur emissions of the Parties, to establish emission limit values and to ensure that depositions of oxidized sulphur compounds in the long term do not exceed critical loads. The Fifth Environmental Action Programme of the Community stipulates a similar long-term target.

The aim of the Protocol therefore coincides with the objectives of Community policy in the field of environment as provided in Article 130r of the Treaty. The approval of the Protocol will contribute to the achievement of these objectives.

In the field of Community legislation, several Directives specifically address the question of sulphur emissions. Among the most recent legislation, Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control is also applicable to sulphur emissions from major stationary combustion sources. The recently adopted acidification strategy of the Commission foresees a particularly broad range of measures which seeks to cut back sulphur emissions from various sources.

The measures foreseen in the Protocol represent environmental policy instruments. The proposal for a Council Decision is therefore based on Article 130r(4) in conjunction with the first sentence of Article 228(2) and the first subparagraph of Article 228(3) of the Treaty.

97/0107 (CNS)

Proposal for a

COUNCIL DECISION

on the conclusion by the European Community of the Protocol to the 1979 Convention on long-range transboundary air pollution on further reductions of sulphur emissions

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THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 130r(4) in conjunction with the first sentence of Article 228(2) and the first subparagraph of Article 223(3) thereof,

Having regard to the poposal from the Commission[25],

Having regard to the Opinion of the European Parliament[26],

Whereas the Community signed in Olso on 14 June 1994 the Protocol to the 1979 Convention on long-range transboundary air pollution on further reductions of sulphur emissions (hereinafter "the Protocol");

Whereas the Protocol seeks to establish ceilings for sulphur emissions for all contracting parties to the Convention;

Whereas the measures envisaged in the Protocol contribute to achieving objectives of the Community policy on the environment;

Whereas the Community and the Member States cooperate, in the framework of their respective competences, with third countries and the competent international organizations;

Whereas, in consequence, the Community should approve the said Protocol,

HAS ADOPTED THIS DECISION:

Article 1

The Protocol to the 1979 Convention on long-range transboundary air pollution on further reductions of sulphur emissions, signed on 14 June 1994, is hereby approved on behalf of the Community.

The text of the Protocol is attached to this Decision.

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25 OJ No C

26 OJ No C

Article 2

The President of the Council is hereby authorized to designate the person entitled to deposit the instruments of approval with the Secretary General of the United Nations, in accordance with Article 14 of the Protocol.

Article 3

This Decision will be published in the *Official Journal of the European Communities.*

Done at Brussels,

For the Council
The President

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