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**COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE
EUROPEAN PARLIAMENT**

**Thematic Strategy on air pollution
[ADVANCED UNOFFICIAL VERSION]**

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Thematic Strategy on air pollution

1. 1. INTRODUCTION

Air pollution damages human health and the environment. The need to deliver cleaner air has been recognised for several decades with action having been taken at national and EU level and also through active participation in international conventions¹. EU action has focused on establishing minimum quality standards for ambient air and tackling the problems of acid rain and ground level ozone. Polluting emissions from large combustion plant and mobile sources have been reduced; fuel quality improved and environmental protection requirements integrated into the transport and energy sectors.

Despite significant improvements, serious air pollution impacts persist. Against this backdrop, the Community's Sixth Environmental Action Programme (*6th EAP*) called for the development of a thematic strategy on air pollution with the objective to attain "*levels of air quality that do not give rise to significant negative impacts on, and risks to human health and the environment*"². Following its communication on the Clean Air For Europe programme (*CAFE*)³, the Commission has examined whether current legislation is sufficient to achieve the 6th EAP objectives by 2020. This analysis looked at future emissions and impacts on health and the environment and has used the best available scientific and health information. It showed that significant negative impacts will persist even with effective implementation of current legislation.

Accordingly, this thematic strategy on air pollution (the *Strategy*) establishes interim objectives for air pollution in the EU and proposes appropriate measures for achieving them. It recommends that current legislation be modernised, be better focused on the most serious pollutants and that more is done to integrate environmental concerns into other policies and programmes.

2. ASSESSMENT OF THE PRESENT SITUATION

Air pollution is both a local and a trans-boundary problem caused by the emission of certain pollutants which either alone, or through chemical reaction lead to negative environmental and health impacts.

In relation to health, ground level ozone and particulate matter ("fine dust") are the pollutants of most concern. Exposure can lead to impacts ranging from minor effects

¹ E.g. Convention on Long-range Transboundary Air Pollution (*CLRTAP*)

² Decision 1600/2002/EC OJ L242, 10.9.2002, p.1

³ COM (2001) 245 final

on the respiratory system to premature mortality (see Annex 2). Ozone is not emitted directly but is formed through the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. Particulate matter can be emitted directly to the air (so called primary particles) or be formed in the atmosphere as “secondary particles” from gases such as sulphur dioxide (SO₂), nitrogen oxides and ammonia (NH₃).

Ecosystems are also damaged by (1) the deposition of the acidifying substances – nitrogen oxides, sulphur dioxide and ammonia – which lead to loss of flora and fauna; (2) excess nutrient nitrogen in the form of ammonia and nitrogen oxides can disrupt plant communities, leach into freshwaters leading in each case to a loss of biodiversity (called “eutrophication”); and (3) ground level ozone that results in physical damage and reduced growth of agricultural crops, forests and plants. Air pollution also causes damage to materials leading to a deterioration of buildings and monuments.

Significant progress has already been made in reducing the main air pollutants. Figure 1 shows the reductions since 1990 in the emissions of nitrogen oxides, sulphur dioxide, volatile organic compounds and ammonia delivered by current policies.

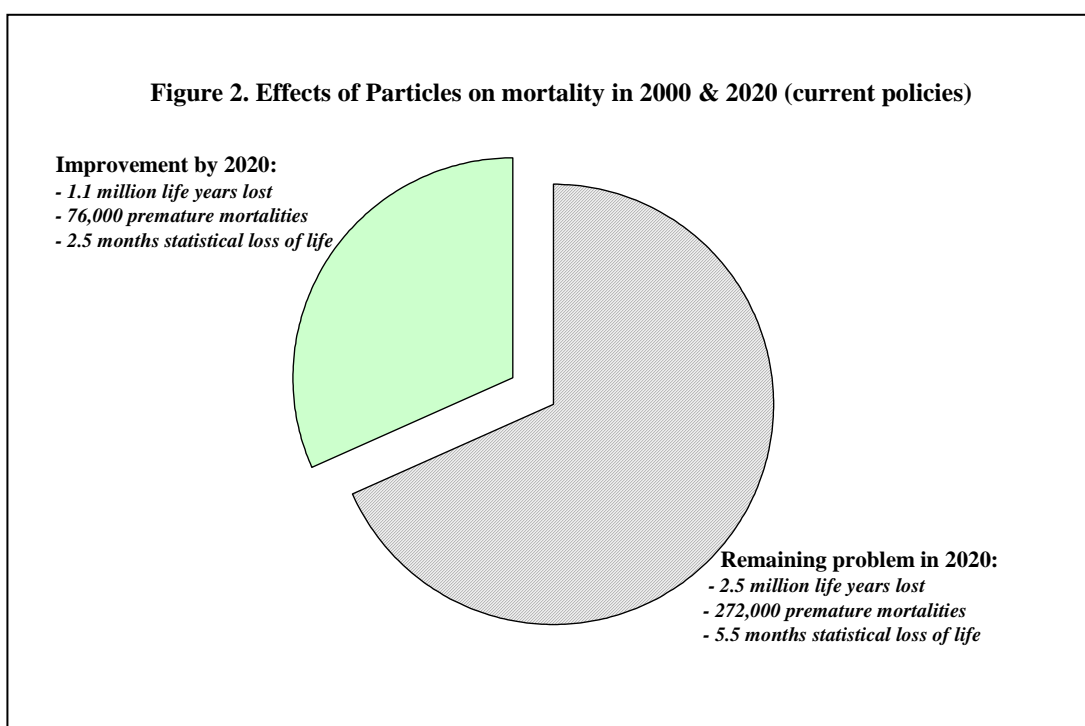
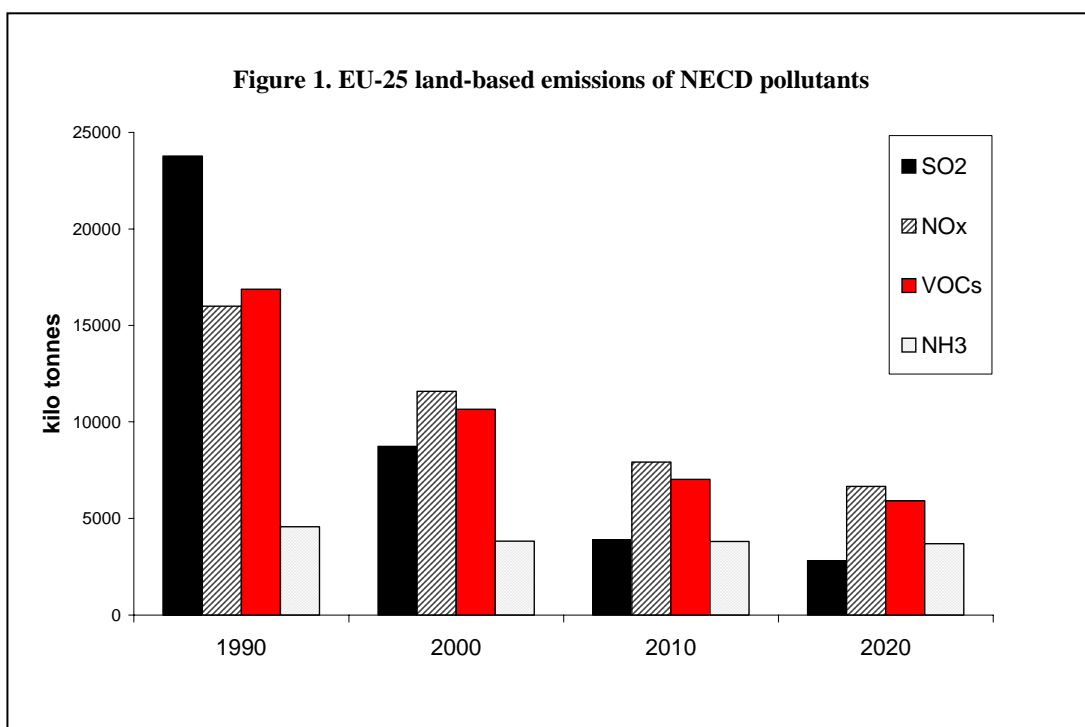
These reductions have had positive impacts, although two thirds of the lakes and streams surveyed in Scandinavia are still at risk from acid deposition and some 55% of all EU ecosystems suffer from eutrophication. Even with the full implementation of existing laws, environment and health problems will persist in 2020 if no further action is taken. While, compared to a baseline situation of 2000, there will be a reduction of around 44% in the area of ecosystems receiving excess acid deposition the current data suggests only a 14% reduction in areas affected by eutrophication due to only modest reductions in ammonia emissions. However, the projections were not able to include potential ammonia emission reductions following the reform of the Common Agricultural Policy⁴ and other recent measures. The area of forest affected by excessive levels of ozone will only fall by 14%.

Concerning health impacts, currently in the EU there is a loss in statistical life expectancy of over 8 months due to PM_{2.5} in air, equivalent to 3.6 million life years lost annually. Figure 2 shows that even with effective implementation of current policies this will reduce only to around 5.5 months (equivalent to 2.5 million life years lost or 272,000 premature deaths). For ozone there are estimated to be around 21,000 cases of hastened mortality in 2020. This has severe consequences for quality of life. Children, the elderly as well as citizens suffering asthma and cardiovascular diseases are particularly vulnerable. In monetary terms, the damage to human health alone is estimated at between €189 - 609 billion per annum in 2020. In view of these costs, taking no further action is not an option.

⁴ The very preliminary estimated effect of the 2003 CAP reform, due to the expected reduction in livestock numbers only, is around a 5 to 6% reduction of ammonia emissions compared to the baseline in 2000. This estimation does not consider the positive impact of the expected reduced use of mineral nitrogen fertilisers.

3. OBJECTIVES OF ‘THE STRATEGY’

Achieving the 6th EAP objectives of “levels of air quality that do not give rise to significant negative impacts on, and risks to human health and the environment” means, for the natural environment, no exceedence of critical loads and levels. For human health, the situation is more complex as there is no known safe level of exposure for some pollutants such as particulate matter and ground level ozone. There is strong health evidence, however, that measures taken to reduce these pollutants will have beneficial effects for the EU population.



Various scenarios for meeting these strategic objectives have been analysed in the impact assessment⁵ ranging from taking no further action to the application of all technically feasible measures. Even if all such technical measures were applied irrespective of cost, it still would not be possible to meet the ambitious 6th EAP objectives. Therefore, a policy choice has to be made on the level of health and environmental protection that can be achieved by 2020, taking into account the associated benefits and costs. Extensive analysis was done to determine the costs and benefits of different levels of ambition with a view to finding the most cost-effective level consistent with the Community's Lisbon and sustainable development strategies. The analysis and the different scenarios are described in detail in the Impact Assessment accompanying this Communication.

The chosen strategy sets health and environmental objectives (Annex 3) and emission reduction targets for the main pollutants. These objectives will be delivered in stages. By setting objectives to be attained by 2020, EU citizens will be protected from exposure to particulate matter and ozone in air and European ecosystems will be better protected from acid rain, excess nutrient nitrogen and ozone. This implies that the concentration of PM_{2.5} would be reduced by 75% and ground level ozone by 60% from what is technically feasible by 2020. In addition, the threat to the natural environment from both acidification and eutrophication will be reduced by 55% from what is technically possible.

To achieve these objectives, SO₂ emissions will need to decrease by 82%, NO_x emissions by 60%, VOCs by 51%, ammonia by 27% and primary PM_{2.5} by 59% relative to emissions in 2000. A large part of these emissions reductions will be delivered by measures already adopted and implemented in the Member States. These reductions are estimated to save about 1.71 million life years from exposure to particulate matter and reduce acute mortalities from exposure to ozone by 2,200 relative to the position in 2000. They will also significantly reduce the environmental damage done to forests, lakes and streams and biodiversity by acid rain and better protect European ecosystems from atmospheric inputs of nutrient nitrogen.

Part of the strategy will be implemented through a revision of the current ambient air quality legislation comprising two main elements

- (a) streamlining of existing provisions and merging five legal instruments into a single directive
- (b) the introduction of new air quality standards for fine particulate matter (PM_{2.5}) in air.

The national emission ceilings directive (*NECD*)⁶ will also be revised to ensure reduced emissions of nitrogen oxides, sulphur dioxide, volatile organic compounds, ammonia and primary particulate matter consistent with the interim objectives proposed for 2020.

The level of ambition chosen for this Strategy has been estimated to deliver at least €42 billion per annum in health benefits. These benefits include fewer premature

⁵ SEC (2005) 1133

⁶ Directive 2001/81/EC OJ L 309, 27.11.2001, p. 22

deaths, less sickness, fewer hospital admissions, improved labour productivity etc. Although there is no agreed way to monetize ecosystem damage, the environmental benefits of reduced air pollution will also be significant in terms of reduced risks and reduced areas of ecosystems that may be damaged by acidification, eutrophication and ozone. Previously damaged ecosystems will also recover more quickly. In addition, damage to buildings and materials will also be reduced. Similarly, for agricultural crops the damage is reduced by around €0.3 billion per annum.

Attainment of these targets is estimated to cost approximately €7.1 billion per annum (representing about 0.05% of the EU-25 GDP in 2020). No net change in employment is expected. Production lost through ill health would be reduced and low income groups generally exposed to the highest levels of air pollution may benefit most.

Environmental standards can be a catalyst for business growth and innovation. The EU can gain competitive advantages and exploit opportunities by focusing research and development on resource-efficient and less polluting technologies that other countries will eventually need to adopt. Developed countries, like the USA and Japan, already have similar air pollution policies in place such as the new Clean Air Interstate Rule in the US. It is also clear that developing countries like China and Korea are also increasingly concerned about air pollution, are taking positive steps to limit emissions and are looking for policy and technical inspiration from Europe.

4. ACTIONS AND MEANS

In order to attain these strategic objectives, current air quality legislation will be simplified and other legislation revised where appropriate. Further initiatives will be taken on new vehicles and, subject to careful impact assessment, new measures may be envisaged for small combustion plants, ships and aircraft emissions. Community structural funds, international cooperation, improved implementation and selection of appropriate instruments will all form part of the suggested policy mix.

4.1. Making environment legislation work better

This Strategy assumes that current legislation is implemented effectively. To this end, and with a view to making “Better Regulation” the Commission proposes to streamline current legislation on air quality to lighten the administrative burden and to enable Member States to overcome difficulties experienced in complying with the current rules. The Commission will also work towards improving the consistency of air quality assessments, disseminate best practice and build on its constructive dialogue with Member States.

4.1.1. Simplification of air quality legislation

A legislative proposal is attached to this Strategy which combines the Framework Directive⁷, the First⁸, Second⁹ and Third¹⁰ Daughter Directives and the Exchange of

⁷ Directive 96/62/EC, OJ L 296, 21.11.1996, p. 55

⁸ Directive 1999/30/EC OJ L 163, 29.6.1999, p.41

⁹ Directive 200/69/EC OJ L 313, 13.12.2000, p. 12

Information Decision¹¹. The recently adopted Fourth Daughter Directive¹² will be merged later through a simplified “codification” process. The proposal clarifies and simplifies, repeals obsolete provisions, modernises reporting requirements and introduces new provisions on fine particulates.

Strengthening implementation

Under the Framework Directive and daughter directives, air quality limit values apply throughout the territory of the Member States. Experience has shown that there are zones suffering from acute and exceptional problems. Therefore, as part of the new proposal and where Member States can demonstrate that they have taken all reasonable measures to implement this legislation, it is proposed to allow them to request an extension to the deadline for compliance in affected zones if strict criteria are met and plans are in place to move towards compliance.

Modernising monitoring and reporting

Member States monitor air quality at around 3,000 locations and routinely disseminate this information to the public and the Commission. The Commission, in cooperation with the European Environment Agency, proposes to move to a system of electronic reporting based on a shared information system using the INSPIRE framework for spatial data reporting¹³. This approach will cut red tape, reduce compliance reporting, streamline information flows and improve public access to information.

Control of human exposure to PM_{2.5} in ambient air

Evidence shows that fine particles (PM_{2.5}) are more hazardous than larger ones, although the coarse fraction (particles in the range of 2.5 to 10 µm in diameter) cannot be ignored. Thus, in addition to the existing controls on PM₁₀, there is a need to cap unduly high risks from exposure to PM_{2.5} and to reduce the general exposure of citizens everywhere. A cap of 25 µg/m³ is proposed which is unlikely to impose additional burdens except in the most polluted areas of the EU. The level chosen for the cap takes account of the inherent uncertainties in our current knowledge about the risks of PM_{2.5}. It is also proposed that Member States undertake more comprehensive monitoring of ambient levels of PM_{2.5} in urban areas as a first step in reducing average urban concentrations throughout their territory. A uniform interim reduction target of 20% is proposed for all Member States to be attained between 2010 and 2020. It is foreseen that this target will be reviewed when more air quality monitoring information is available. This review will address, in particular, the issues of introducing differentiated targets for the individual Member States according to their prevailing air pollution climate and whether these targets should become legally binding.

¹⁰ Directive 2002/3/EC OJ L 67, 9.3.2002, p.14

¹¹ Decision 97/101/EC O.J. L 35, 5.2.1997, p. 14

¹² Directive 2004/107/EC OJ L 23, 26.1.2005, p. 3

¹³ COM (2004) 516 final, 23.7.2004

4.1.2. *Revision of the NECD*

The Commission will review the national emissions ceilings directive in 2006 and propose revised emission ceilings that will be based upon the scenario set out in this Strategy. The proposal will be subject to a detailed impact assessment and will respect the need for an integrated approach to nitrogen management (see section 4.2.3). Also, simplified implementation and reporting provisions and targets for primary particulates will be considered. No further change is foreseen for combustion plants greater than 50 MW_{th} beyond the current directives on large combustion plants¹⁴ and integrated pollution prevention and control (*IPPC*)¹⁵. However, options to streamline existing legislation covering industrial emissions will be examined.

4.1.3. *Coherence with other environment policies*

The Strategy is consistent with climate change policies and will help meet commitments to halt the loss of biodiversity and support its longer-term recovery. Measures outlined in this Strategy will also deliver progress towards the objectives of the Community's mercury strategy¹⁶ by reducing combustion-related mercury emissions, the Water Framework Directive and the forthcoming thematic strategy on the marine environment.

Monitoring of soil, water quality and biodiversity will feed into the evaluation of air pollution policies as all are affected by acidification and nutrient nitrogen. Similarly, air quality monitoring and reporting will support the Health & Environment Action Plan.

4.2. **Integrating air quality concerns into other policy areas**

Meeting the targets set out in this Strategy will require efforts and commitments by other sectors.

4.2.1. *Energy*

More efficient use of energy and better use of natural resources can all help to reduce harmful emissions. The EU has set itself the indicative target of producing 12% of energy and 21% of electricity from renewable energy sources by 2010. It has also adopted minimum targets for the share of biofuels and proposed safety measures in the field of nuclear energy. Several actions have been taken to curb energy demand including energy labelling, energy performance of buildings, a directive on cogeneration and a directive related to eco-design requirements for energy-using products. The Green Paper on energy efficiency also explores ways to make further progress in this area¹⁷.

¹⁴ Directive 2001/80/EC OJ L 309, 27.11.2001, p.1. A review pursuant to Article 4 (7) of this directive has been performed. See http://europa.eu.int/comm/environment/air/future_stationary.htm

¹⁵ Directive 96/61/EC OJ L 257, 10.10.1996, p. 26

¹⁶ COM (2005) 20 final

¹⁷ COM (2005) 265 final

4.2.1.1. Smaller combustion plants

This increasingly important emissions source is not regulated at Community level. The Commission will examine whether the IPPC directive should be expanded to cover sources below 50 MW_{th}. Harmonised technical standards will also be developed for domestic combustion appliances and their fuels. If feasible, smaller residential and commercial buildings could be included in an extended directive on energy efficiency.¹⁸

4.2.1.2. VOC emissions at fuel stations

Given the role of volatile organic compounds in the formation of ground level ozone, the Commission will examine the scope further to reduce VOC emissions at petrol filling stations.

4.2.2. *Transport*

In keeping with the commitments made in the White Paper on a common transport policy¹⁹, the Commission will further encourage shifts towards less polluting modes of transport, alternative fuels, reduced congestion and the internalisation of externalities into transport costs. With regard to infrastructure charging, the Commission has already made proposals regarding charges for the use of road infrastructure applicable to heavy vehicles (Eurovignette) and a common framework for all modes will be examined in due course. Other possible measures are presented below and these could be complemented by others when the White Paper is reviewed in 2005.

4.2.2.1. Land transport

Initiatives have been taken to revitalise and integrate European railway systems. This is supported by the guidelines for the Trans-European transport networks adopted in 2004 which will give priority to environmentally friendly modes including rail. Furthermore, intermodal freight transport will be promoted via the “Marco Polo” programme and transport efficiency improved by the European satellite radio navigation programme GALILEO.

A proposal to reduce emissions of new passenger cars and vans will be adopted in 2005 (EURO V). The Commission will also come forward with a proposal to tighten further the emissions from heavy duty vehicles. In the longer term, the Commission will also investigate the feasibility of improving the type approval process so that test-cycle emissions better reflect real world driving.

The Commission will also be considering other measures such as:

- practical guidelines for differentiated charging according to air pollution damage and impacts in environmentally sensitive areas

¹⁸ Directive 2002/91/EC OJ L 1, 4.1.2003, p. 65

¹⁹ COM(2001) 370 final, 12.9.2001

- obligations and recommendations on public authorities to implement minimum annual procurement quotas of new cleaner and energy efficient vehicles
- establishing a common framework for designating low-emission zones

Older road vehicles cause disproportionate levels of pollution. Therefore, Member States should consider targeted retrofitting and scrapping schemes when drawing up plans to meet air quality objectives.

In its thematic strategy on the urban environment, the Commission is exploring how best to help Member States and local authorities devise and implement sustainable urban transport plans which combine public transport improvements with transport demand management in order to ensure a fair contribution of transport activities to the achievement of air quality, noise and climate change objectives.

4.2.2.2. Aviation

Measures with potential synergies between climate change and air quality will be discussed in a forthcoming Communication on the use of economic instruments to reduce the climate change impact of aircraft.

4.2.2.3. Shipping

Air pollutant emissions of SO₂ and NO_x from ships are a serious concern, as they are expected to exceed those of all land-based sources in the EU by 2020. They are regulated by Annex VI of the IMO's Marine Pollution Convention and all Member States which have not yet ratified Annex VI should do so at the earliest opportunity.

The Commission has developed an EU strategy on ship emissions and a directive on sulphur in marine fuel²⁰ has been agreed. However, more must be done and the Commission intends to:

- Submit to the Council a recommendation for a decision authorising the Commission to negotiate within the framework of the IMO to strengthen current air emission standards; the Commission intends to consider a proposal for tighter NO_x standards by the end of 2006 if the IMO has not made any proposals for tighter standards by that date
- promote shore-side electricity for ships in port (preferably from renewable energy sources) by developing guidelines and considering energy tax exemptions
- ensure that low-emission operation is effectively applied as a criterion for EU funding programmes, including Marco Polo and Motorways of the Sea.

4.2.3. Agriculture

Cattle farming, the pig and poultry sectors and the use of mineral fertilisers account for the vast majority of ammonia emissions. Recent reform of the Common Agricultural Policy should bring about a reduction in ammonia emissions from

²⁰ COM (2002) 595

agricultural sources following: (1) the removal of the link between financial support and the obligation to retain specific animal numbers; (2) the removal of incentives towards intensification which will result in a reduction of mineral fertiliser use; and (3) the introduction of obligatory cross compliance with environmental directives as a condition for the full granting of direct payments. Further improvements are also expected to result from an effective implementation of certain environmental Directives, such as the Nitrates Directive, the IPPC Directive, the Environmental Impact Assessment Directive and the Water Framework Directive.

However, these improvements could be insufficient to meet the objectives of the Strategy. Given that nitrogen plays a role in several environmental problems, the Commission will pursue a coherent and integrated approach to nitrogen management²¹. Priority will be attached to measures and policies to reduce “excessive” nitrogen use in agriculture and which simultaneously address nitrates in water, and ammonia and nitrous oxide emissions to air. Such policies could address (1) the nitrogen content of animal feedstuffs; (2) excessive use of nitrogen fertilisers; and (3) the promotion of further research into the nitrogen cycle and its environmental implications.

In order to comply with existing and new emissions ceilings for ammonia when the NECD is revised, the Member States will have to prepare plans and programmes to demonstrate how they will meet these new ceilings. The achievement of reduction objectives may require the development of national actions plans, including obligations applicable at farm level, allowing emissions reductions to be phased in over a ten year period or so following the adoption of a revised NECD.

The current Rural Development Regulation and the Commission proposals for rural development for 2007-2013 provide several possibilities to tackle ammonia emissions from agricultural sources. These include measures related to farm modernisation, meeting standards and agri-environment. The Commission urges the Member States to make full use of these measures. In particular, Member States can design agri-environment schemes which go beyond environmental legislative obligations and minimum requirements for fertiliser use identified in rural development programmes. These could also help towards a more effective compliance with the CLRTAP code of good farming practice.²²

4.2.4. *Structural Funds*

Structural Funds are co-financing many measures in the Member States and regions that contribute to improved air quality. The Commission’s proposal for the reform of cohesion policy for 2007-2013²³ includes proposals that will help meet the objectives of this Strategy. For example, support for sustainable transport systems, sustainable and cleaner energy supplies, and the rehabilitation and reuse of derelict land. Environment protection is included in the three proposed Objectives of Convergence, Competitiveness and Employment and Territorial Co-operation. Under the first, which is addressed to less favoured regions and countries, air quality is mentioned in

²¹ Consistent with the Declaration of the 3rd International nitrogen conference, October 2004, Nanjing China.

²² Required by Annex IX of the CLRTAP Gothenburg Protocol

²³ COM (2004) 492 final

the proposal for a Regulation on the European Regional Development Fund (ERDF)²⁴. Ensuring full exploitation of eco-innovations and technologies and the introduction of environmental management systems in SMEs is also a priority for future cohesion policy.

4.2.5. *International dimension*

As the regional and global background contribution to European air pollution is growing, the Community must work on building an international consensus around the importance of hemispheric pollution. The Commission, in cooperation with the Member States, will lead a new task force on hemispheric air pollution within the CLRTAP jointly with the USA. The Commission is also stepping up its cooperation with China on air pollution. The EU will also continue to support the Convention's scientific and monitoring activities.

5. NEXT STEPS

5.1. Evaluation, review & research

This Strategy will be reviewed in 2010 and this will feed into the final evaluation of the 6th EAP. Ongoing assessment of policies will continue using existing indicators and reported information. Assessment work will be increased in readiness for the review.

The analysis underpinning this Strategy builds upon Community research on air pollution, including the health impacts of particles, performed under the various RTD Framework Programmes²⁵. The Strategy also builds on economic-environmental models and tools developed using Community RTD funds²⁶.

In the coming years more research will be required on emission sources, atmospheric chemistry and pollutant dispersion and on the effects of air pollution on health and the environment including long term European epidemiological studies. We will also need to improve the monetary evaluation of ecosystem impacts and the analysis of costs and effectiveness of measures actually implemented. This will require EU RTD funding, work by the Joint Research Centre of the European Commission, and the support of the Member States.

5.2. Consultative arrangements

There were over one hundred stakeholder meetings during the CAFE programme and a two-month web-based public consultation on the Strategy. Of the 11,578 responses received over 10,000 were from private individuals. Respondents indicated a clear need for better public information, a greater desire for protection from air pollution and a willingness to pay for reduced risks on a par with those for drinking water.

²⁴ COM (2004) 495 final, Article 4

²⁵ CLEAR cluster (<http://www.nilu.no/clear/>); INTEGAIRE thematic network (<http://www.integaire.org/>)

²⁶ Health valuation from ExternE and NewExt projects; macroeconomic analysis used the general equilibrium model GEM-E3.

The CAFE Steering Group will continue to be the main forum for future stakeholder consultation but the current structure of the consultative groups on air pollution will need to be modified over time. In addition, a working group was established in May 2005 to assist in the technical work associated with the revision of the NECD. Greater use is also likely to be made of the Regulatory Committee on air pollution regarding implementation issues, and in particular monitoring and reporting.

6. CONCLUSION

Air pollution continues to diminish the health and quality of life of EU citizens as well as the natural environment. The magnitude of these effects is too large to ignore and doing nothing more beyond implementing existing legislation is not a sensible option. This Strategy sets out a long term perspective for cleaner air in Europe.

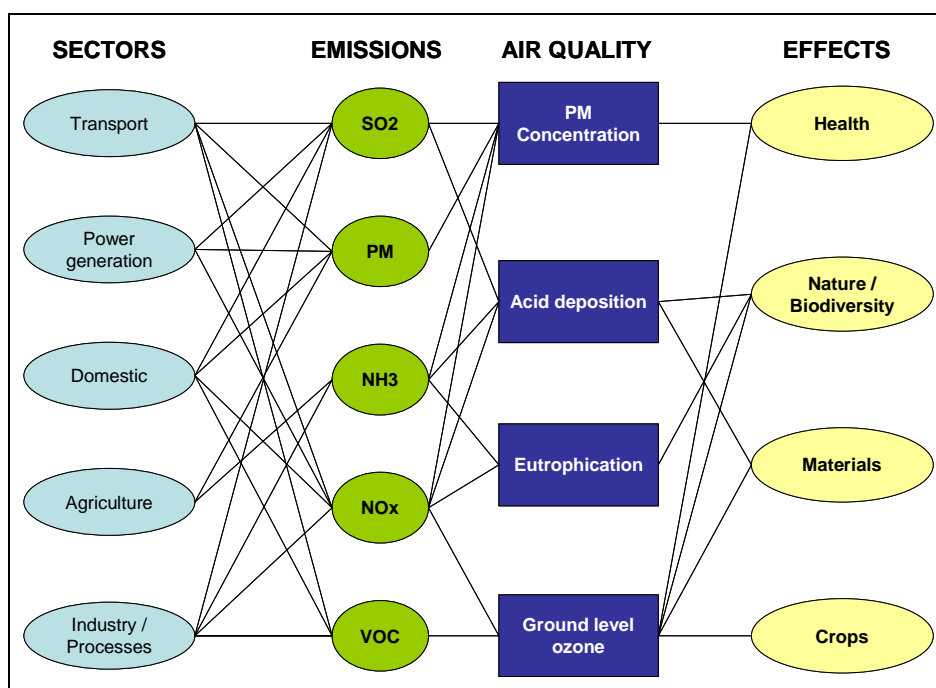
ANNEX 1

GLOSSARY	
<i>Acidification</i>	Excess acidity from the deposition of ammonia, nitrogen oxides and sulphur dioxide can lead to the damage of freshwater and terrestrial ecosystems. Nitrification of ammonia in soils also contributes to acidification although it is not an acid gas.
<i>Aerosol</i>	A dispersion of solid particulate matter or droplets in air.
<i>Air quality limit value</i>	A legally binding pollutant concentration in air which may be exceeded on a prescribed number of occasions per calendar year (c.f. <i>target value</i> which is a non- legally binding air quality objective).
<i>Ammonia (NH₃)</i>	A gas which is emitted mainly from animal wastes and following the application of fertilisers.
<i>CAFE baseline</i>	The expected evolution in EU-25 pollutant emissions up to 2020 based upon forecasts of energy use (including climate policies) and macroeconomic parameters.
<i>Critical level</i>	A pollutant concentration level in air below which significant adverse impacts on vegetation is not expected.
<i>Critical load</i>	A level of deposition below which significant adverse impacts on ecosystems are not expected
<i>Eutrophication</i>	Excess nutrient nitrogen (mainly in the form of ammonia or nitrogen oxides) can lead to changes in the composition of ecosystem communities and a loss of biodiversity.
<i>Ground level ozone (O₃)</i>	Ozone formed in the lowermost part of the atmosphere from the reaction of nitrogen oxides and volatile organic compounds in the presence of sunlight. Ozone is a strongly oxidising gas.
<i>National emission ceiling</i>	The maximum amount of a substance expressed in kilotonnes that may be emitted by a Member State in a particular calendar year.
<i>Nitrogen oxides (NO_x)</i>	The gases nitric oxide (NO) and nitrogen dioxide (NO ₂). NO is predominantly formed in high temperature combustion processes and can subsequently be converted to NO ₂ in the atmosphere.
<i>PM₁₀, PM_{2.5}</i>	Particulate matter in ambient air with a diameter less than 10 or 2.5 millionths of a metre respectively.
<i>Secondary pollutant</i>	Secondary pollutants are not emitted directly but are formed by subsequent chemical processes in the atmosphere. Examples include ground level ozone and nitrate and sulphate aerosols.
<i>Sulphur dioxide (SO₂)</i>	Gas formed from the combustion of fuels which contain sulphur.
<i>Transboundary air pollution</i>	Pollutants emitted in one country are transported in the atmosphere and may contribute to adverse health and environmental impacts in other countries.
<i>Volatile Organic Compounds (VOCs)</i>	VOCs are volatile carbon-based chemical compounds (such as solvents or components of paints and varnishes) which are emitted to the atmosphere from natural sources or as a result of human activities.

ANNEX 2

Interaction between pollutants and impacts

The complex interaction between pollutants, impacts and pollution receptors is illustrated below. The figure shows that several pollutants contribute to the same environmental impact and that a broad range of economic sectors are responsible for the emissions of atmospheric pollutants, except for ammonia where agricultural activities are the predominant source.



Acidification: excess acidity from the deposition of NH₃, NO_x and SO₂ can damage freshwater and terrestrial ecosystems and so cause loss of biodiversity. Ammonia contributes to acidification by undergoing nitrification in soils which releases acidity.

Eutrophication: excess nutrient nitrogen (mainly in the form of NH₃ or NO_x) can change ecosystem balance and cause loss of biodiversity.

Ozone formation: tropospheric ozone is harmful to health and vegetation (including forests and crops) and is formed at ground level from the reaction of NO_x and VOCs in the presence of sunlight (c.f. “good” stratospheric ozone in the upper atmosphere which shields us from ultraviolet radiation).

Particulate matter: Consists of primary particles emitted directly to the atmosphere and secondary particles which are formed chemically from NO_x, SO₂, NH₃, and VOCs in the atmosphere. According to the World Health Organization it is not possible to differentiate between primary or secondary particles in terms of their impacts on health.

ANNEX 3
Benefits and Costs of the Strategy

The benefits, costs and health and environmental objectives of the Strategy are summarised in the tables and figure below.

<i>Benefits and costs of the Strategy in 2020</i>									
Ambit- ion level	Benefits								Costs per annum (€bn)
	Human health			Natural environment					
	Life Years Lost (million) fine parti- culate matter only	<i>Premature deaths</i> (000s) particulate matter and ozone	Range in monetised health benefits per annum (€bn)	Ecosystem area exceeded acidification (000 km ²)			Ecosystem area exceeded eutro- phication (000 km ²)	Forest area exceeded ozone (000 km ²)	
			Forests	Semi- natural	Fresh- water				
2000	3.62	370	-	243	24	31	733	827	-
Baseline 2020	2.47	293	-	119	8	22	590	764	-
Strategy	1.91	230	42 – 135	63	3	19	416	699	7.1
MTFR	1.72	208	56 – 181	36	1	11	193	381	39.7

Note: Ecosystem benefits have not been monetised but are expected to be significant. MTFR is the Maximum Feasible Technical Reduction and includes the application of all possible technical abatement measures irrespective of cost. Only costs and benefits of moving beyond the baseline are presented. Lower value is based on the median of the value of a life year lost (VOLY) & higher value is based on mean value of a statistical life (VSL). Costs and benefits are annual amounts. Ecosystem benefits for the Strategy scenario have been interpolated from existing analyses but these estimates will be revised shortly following further calculations and are likely to rise slightly.

<i>Objectives of the Strategy expressed as % improvements relative to the position in 2000</i>					
Life Years Lost (million) from particulate matter	Acute mortality from ozone	Ecosystem forest area exceeded acidification	Ecosystem freshwaters area exceeded acidification	Ecosystem area exceeded eutrophication	Forest area exceeded ozone
47%	10%	74%	39%	43%	15%

**Improvement of health & environment indicators following the Strategy
(improvement relative to 2000)**

