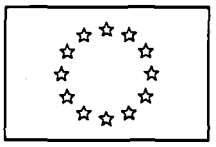

COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 1.12.1999
COM (1999) 640 final

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Air Transport and the Environment

Towards meeting the Challenges of Sustainable Development

EXECUTIVE SUMMARY

i) Air transport is a growth industry. This implies that this industry is important for the economies of the European Union. But the air transport industry is growing faster than we are currently producing and introducing technological and operational advances which reduce the environmental impact at source. The overall environmental impact is bound to increase since the gap between the rate of growth and the rate of environmental improvement appears to widen in important fields such as emissions of greenhouse gases. This trend is unsustainable and must be reversed because of its impact on climate and the quality of life and health of European citizens. The long-term goal, therefore, must be to achieve improvements to the environmental performance of air transport operations that outweigh the environmental impact of the growth of this sector.

ii) Meeting this challenge necessitates, in line with the provisions of the Amsterdam Treaty, significantly enhanced integration of environmental requirements into sectoral policies as part of the European Community's responsibilities for the promotion of sustainable development and of its responsibilities for securing an efficient functioning of the internal market.

iii) The present Communication analyses and identifies for the first time ways for coherent and integrated policy action for the European Union in the air transport field. To this end reliance on better, preferably internationally agreed standards and rules needs to be complemented by a more effective system of EU-wide national, regional and local measures aimed at accelerating the introduction of environmentally friendly technologies and operating techniques to reduce noise and gaseous emissions. It is also important that the European Union improves the promotion of its interests in the International Civil Aviation Organisation (ICAO).

iv) This Communication suggests the introduction of economic and regulatory incentives reinforcing the competitive edge of operators and users which choose to use state-of-art technologies and environmentally friendly operations. It is proposed to expose Europe's air transport system much more to a system of "Reward the best – Punish the worst" by drawing a clearer line between operations on the basis of their environmental quality. The air transport industry is invited to make, by means of establishing voluntary environmental agreements or otherwise, a pro-active contribution to reducing the environmental impact of its operations.

v) The Commission intends to continue its work on the creation of equitable conditions for competition within the overall transport system. This implies working towards integration of environmental costs into charging systems and significant improvement of the infrastructure at intermodal connecting points so that users and operators can actually orient their choice towards the environmental quality of transport services and avoidance of congestion. This will contribute to replacing shorter flights by truly competitive rail transport.

vi) Local rules for implementation at the level of airports are part of a policy aimed at integrating in a coherent way environmental requirements into sectoral policies. Therefore, the work programme outlined in this communication includes measures to be applied at the level of airports in order to reconcile the need for action on environmental grounds with the necessity to prevent distortive proliferation of local rules.

vii) In the longer run, it is important to ensure that the 5th and 6th Research and Development Framework Programmes aim at break-through achievements in the environmental performance of aircraft and their engines and the understanding and assessment of the atmospheric effect of aircraft exhaust gas emissions. In addition to improving the green credentials of the air transport business, innovation in this field will have the benefit of safeguarding the competitiveness of the EC's aeronautical industry.

viii) This Communication constitutes the point of reference for the Commission's workprogramme during the next five years and beyond. On the basis of the results in ICAO by the end of 2001 the Commission will present a re-assessment of the balance between global, Community and local measures with a view to ensuring fulfilment of the environmental goals laid down in the Amsterdam Treaty and the Kyoto-Protocol and update priorities, where required, by lack of progress at international level and/or new scientific evidence on environmental impacts of air transport.

CONTENTS

I INTRODUCTION: POLICY CHALLENGES, GOALS AND STRATEGIES

1. The air transport industry, as well as related industries such as the aeronautical industry and tourism, is growing at rates clearly above the average growth of the economy of the European Union. The International Panel on Climate Change (IPCC) special report on aviation and the global atmosphere[1] states that passenger traffic has grown since 1960 at nearly 9% per year, 2,4 times the average GDP rate. This development is, despite macroeconomic cycles, expected to continue due to underlying structural reasons for this above average growth, i.e. trade and air transport liberalisation, new leisure patterns, high income elasticity of demand and increasing value of goods to be transported.

2. At the same time, the air transport industry and Europe's citizens are increasingly facing the problems of success: Manifold environmental impacts of air transport are growing as well. Globally, it contributes to the greenhouse effect and to the depletion of the ozone layer, where high altitude emissions might be a specific problem. At a regional level aviation contributes to acidification, eutrophication and to the formation of tropospheric ozone by emissions of air pollutants. At local level, in the immediate vicinity of airports concerns focus on the potential health and environmental effects of noise and air pollution from emissions such as oxides of nitrogen (N0x), volatile organic compounds and particulates.

3. There are worrying signs that growth in air transport has started to outstrip environmental improvements resulting from continuous technology improvements and the industry's considerable own efforts: for example, during the first decade of the jet age (1960-1970) an annual technology induced fuel efficiency improvement of 6,5% was achieved. This rate has fallen down to 1,9% during the period 1980-2000.[2] Optimisation of operating techniques can only in part compensate for the increasing gap between technology improvement and overall growth. As a result carbon dioxide (CO_2) and other emissions increasing in absolute terms. The IPCC report on aviation and the global atmosphere estimates that carbon dioxide (CO_2) emission will grow at 3% annually over the period from 1990 to 2015.

4. Similar trends exist in the area of noise emissions. Transition from Chapter 2 to Chapter 3 classified aircraft[3] is largely completed in the European Community and will be definitely finalised in April 2002.[4] Results from random noise surveys carried out in 1986-1991 show that in particularly densely populated Member states about 15% of the population is affected by aircraft noise.[5] So far, there is no internationally agreed policy approach on how to carry forward measures aimed at decreasing noise around airports, both in the long- and in the short-term. Continuous fleet renewal will not be sufficient to reduce further annoyance by noise for people living under flight paths to and from airports. As a by-effect of this, most airport infrastructure projects face heavy opposition and delays in implementation which imply a trend towards further congestion and further waste of fuel.

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1 See IPCC report 'Aviation and the Global Atmosphere', Cambridge University Press, 1999, Summary for policy makers: www.ipcc.ch

2 See Statistical Annex

3 Noise certification standards according to Annex 16 of the Chicago Convention forming the basic law for international aviation

4 See statistical Annex

5 See LEN report no. 9420, 1994

5. A vicious circle endangering the air transport industry's economic success, the Globe's environment and the quality of life of citizens has become a real threat. The combination of existing environmental legislation, local improvements at airport level and the industry's own efforts obviously do not suffice for reconciling pressing environmental needs with the development of an industry which is of vital importance for the competitiveness of the economy and for job creation. Accordingly, action is required targeting beyond business-as-usual improvements. Current development trends indicating an increasing gap between the rate of growth and the rate of environmental improvement must be reversed by means of an integrated action programme encompassing policy and industry initiatives. The long-term policy target must be to achieve improvements to the environmental performance of air transport operations that outweigh the environmental impact of growth. This is a very ambitious benchmark, notably in the field of CO_2-emissions at least as long as breakthrough developments on engine technologies do not emerge. It requires new approaches looking beyond the traditional way of relying largely on improvements to technical environmental standards.

6. Achieving such ambitious goals necessitates integration of environmental concerns into sectoral policies. The entry into force of the Amsterdam Treaty – in which the principle of sustainable development is firmly enshrined – provides a policy obligation to do so. Air transport policy must be an important part of the Community strategy towards better integration of environmental goals which goes in line with both the Amsterdam Treaty and the Cardiff-process. The present communication outlines measures and strategies towards sustainable development in the air transport sector and, with a view to the 1999 Summit in Helsinki, already incorporates parts of the strategy presented in the Commission Communication "From Cardiff to Helsinki".[6]

7. The improvement of technical environmental standards on noise and gaseous emissions, strengthening of economic and regulatory market incentives, assisting airports in their environmental endeavours and advancing long-term technology improvements (R+D) are proposed as main pillars of a strategy integrating environmental concerns into sectoral policies. The industry is invited to register under the new Eco-Management and Audit Scheme (EMAS) and to consider establishment of voluntary agreements as a key element for meeting the aforementioned challenges. Decisions to be taken at international level (ICAO) will be of considerable importance for defining in the course of the implementation of this action programme the balance between the action parameters.

II IMPROVING TECHNICAL STANDARDS AND RELATED RULES

Noise

8. Certification standards and recommended practices for aircraft noise were first adopted by the ICAO-Council in 1971 pursuant to the provisions of Article 37 of the Chicago Convention. These standards and recommended practices, which were finally adopted as Annex 16 of the Chicago Convention, have been adapted to technological progress on a regular basis. However, the latest significant revision of the noise stringency rules within ICAO dates back to 1977, when the Chapter 3 noise

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[6] see COM(99) ....

standard was introduced. It simply no longer represents state of the art engine and aircraft design technology.

9. In the past, standards recommended at ICAO-level have also been used as benchmarks for Community legislation on the introduction of restrictions on the registration or operation of certain types of aircraft in the Community.[7].This approach has not been sufficient to relieve environmental pressure on the effective use of airport infrastructure or to stop a further proliferation of local operational restrictions with their problematic effects on the cost-effectiveness of operations and on the internal aviation market

10. It seems therefore questionable whether ICAO standards should in the future and under all circumstances continue to be used simultaneously for setting production standards for future types of aircraft, for derived versions of existing aircraft and for reaching regional environmental objectives, as has been the case in the past.[8]. More differentiated approaches will be required

11. Work on noise certification standards steering future aircraft design should, however, continue at ICAO level. Such standards are important for the undistorted and balanced development of both the aviation and aeronautical industries. In this context, the introduction of more stringent noise emission standards should be sufficiently ambitious to provide a framework for future aircraft design. At the same time, it will be essential for the European Community to insist on establishing, within the overall ICAO-framework, rules for transition that would facilitate to phase-out the noisiest categories of Chapter 3 aircraft within a reasonable time-frame in regions when this is required for environmental reasons

12. The current work programme of the Committee on Aviation Environmental Protection (CAEP), as endorsed by the 32nd Assembly of ICAO, has the potential to meet these ambitious targets. It includes an assessment of the prospects for further reduction of aircraft noise levels, including determination of the magnitude of short- and long-term aircraft noise reduction needs, as well as technically and economically practical solutions. It also covers an examination of the feasibility of introducing an aircraft noise certification scheme, which will be better adapted to modern aircraft and the operational procedures they use as well as the issue of transitional rules for phase-out of aircraft.

13. In the short-term, in order to alleviate the noise situation at the most noise-sensitive airports, economic and regulatory incentives should encourage operators to use state of the art aircraft noise technology and environmentally friendly techniques which exceeds the current ICAO Chapter 3 standard. These incentives are further discussed in Chapters III and IV of this Communication.

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7 Council Directive 80/51/EEC (O.J. L18 of 24-01-1980) as amended by Council Directive 83/206/EEC (O.J. L117 of 04-05-1983)
Council Directive 98/629/EEC (O.J. L363 of 13-12-1989)
Council Directive 98/14/EEC (O.J. L76 of 23-03-1992) as amended by Council Directive 98/20/EC (O.J. L107 of 07-04-1998)

8 As experience has shown this approach tends to suffer from trying to meet potentially conflicting objectives and from a lack of capacity to meet regional particularities.

Action:

a) The endorsement by the 32nd ICAO Assembly of the work programme on noise implies that the Commission, in close co-ordination with Member States, should participate actively in the CAEP work programme on the introduction of a new noise certification standard and transitional rules for phasing-out the noisiest of the current Chapter 3 aircraft. This standard should be significantly more stringent than the current Chapter 3 standard. In line with the position taken by the Community and its Member States at the 32nd ICAO Assembly, the target date for a decision is the 33rd Assembly in 2001.

b) In addition, the European Commission will prepare policy measures aimed at advancing, on the basis of objective and non-discriminatory conditions, the introduction of more stringent measures at regional level, with particular emphasis on noise-sensitive airports (see also Chapter IV).

c) Should ICAO fail to agree, in 2001, on more stringent noise certification standards and on transitional rules for phasing-out the noisiest categories of current Chapter 3 aircraft in line with Community requirements, the Commission may have to propose European requirements, in close co-operation with other industrialised regions. Any such proposal would have to consider the need for an economic hardship clause for developing countries and take account of the impact on competitiveness.

Gaseous Emissions

New Stringency Standards

14. Aircraft engine emissions have a negative impact on the local and regional level and on the global atmosphere. Currently, Volume II of Annex 16 to the Convention on International Civil Aviation lays down international certification standards targeting 4 categories of aircraft engine emissions: smoke, unburned hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NOx). In addition, ICAO has been mandated to pursue the reduction of the impact of the greenhouse effect from aircraft. Today, the reference conditions for certifying aircraft engines are those of the landing and take-off cycle (LTO). The debate on the reduction of greenhouse gas emissions has put into question the relevance of the LTO cycle for assessing the contribution of air transport to those global environmental problems, such as climate change and the depletion of the ozone layer which are caused by aircraft emissions.

15. The current CAEP work programme on aircraft engine emissions is assessing technological advances in subsonic and supersonic aircraft which might influence emission levels and fuel consumption and is developing new recommendations for incorporation into Volume II of Annex 16. The development of new parameters for the assessment of an aircraft's emissions to replace the existing LTO parameters and to establish climb and cruise parameters is a high priority in the CAEP/5 work programme. This work programme was endorsed by the 32nd ICAO Assembly, which stressed the importance of taking the Kyoto Protocol on the Reduction of Greenhouse Gas Emissions fully into account in ICAO's work. The Assembly insisted on co-operation with the Secretariat of the United Nations Framework

Convention on Climate Change (UNFCCC) regarding the inclusion of greenhouse gas emissions from international aviation in national greenhouse gas inventories. It also requested immediate work in close co-operation with the UNFCCC Subsidiary Body for Scientific and Technical Advice (SBSTA) on the development of proposals for a suitable methodology for the allocation of greenhouse gas (notably CO_2) from international aviation.

In order to produce shorter term environmental improvements, economic and regulatory incentives should encourage aircraft operators to use clean aircraft engine technology and environmentally-friendly techniques (see chapter III below).

Action:

The Commission, will participate actively in the CAEP/5 work programme on gaseous emissions, with a view to reaching an agreement on new and complementary methodologies and standards by the year 2001. In this context, the Commission will attach priority to identifying the need of complementing the recent ICAO-decision on NOx with other measures targeting regional and local impacts of NOx and other gaseous emissions with a view to enhancing the environmental effectiveness of the recent ICAO NOx standard, which is only applicable to new engine design. and present its conclusions in 2001.

Enhancing the Efficiency of Air Traffic Management (ATM)

16. It has been estimated that 350,000 hours of flight by transport aircraft are wasted in Europe annually, due to airport and air traffic management (ATM) delays[9] and non-optimal routings. Accordingly a major saving in the amount of fuel burned could be made if ways can be found to improve the efficiency of ATM-systems. Indications are that the potential for such improvements is of the order of at least two year's growth in the volume of air transport and its emissions[10]. The recent IPCC-report on the global impact of aviation estimates that ATM improvement can reduce fuelburn by 6% to 12% within the next 20 years.[11]

16a. Air traffic delays and airspace congestion in Europe steadily deteriorated in 1998 and 1999. A Resolution of the Transport Council of 19 July 1999 stressed the need for actions to relieve such a situation which *"undermines the efficiency of Community air transport and also causes great inconvenience to the air travellers and an additional burden on the environment."* In the wake of this Resolution, the Commission is preparing a Communication on recent and ongoing measures aimed at reducing air traffic delays and congestion in Europe and identifying new initiatives to be taken.

17. A new CAEP working group has recently been entrusted with the task of quantifying the emissions reduction potential of a new Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) system. As a short term objective CAEP has been charged to ensure the development, the dissemination and, to the maximum practical extent, the actual use of best operating practices to achieve near-term reductions in aircraft emissions. Aircraft Ground and in-flight operations, ground service equipment and auxiliary power units (APU), are all being considered,

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9 ECAC "INSTAR" Study, 1995

10 EUROCONTROL-estimates

11 IPCC Special Report Aviation and the Global Atmosphere

together with possible actions for their broader adoption. The Commission services and Eurocontrol are actively involved in this CAEP work.

18. Through financial support for navigation systems, air traffic management and airport projects, via the Trans-European Transport Networks Programme and other Community sources (such as R&D), concrete contributions are being made to the implementation of such measures.

Action:

The European Commission will continue to strengthen its support, both at technical and organisational level, for the work of the ATM community, and in particular of EUROCONTROL in order to achieve significant improvements to the efficiency of ATM-systems, thus reducing aircraft emissions. A Communication on ongoing measures in this field has been adopted together with this Communication.

Operational Measures

19. Considerable effort is being put into reducing noise and emissions at source. However, these will not be sufficient to solve the problems and they have little impact on the global situation in the short term as they tend to be applicable only to new aircraft, or aircraft types. It is therefore also necessary to lookat operational measures that can be applied to in-service aircraft.

20. Current operational procedures require aircraft to follow fixed straight-line tracks, particularly on the approach, which concentrate aircraft and the resulting noise over a relatively narrow area but over a long distance. Modern aircraft fitted with sophisticated Flight Management Systems (FMS) increasingly have the ability to navigate accurately and to follow non-linear routes that avoid high population density areas and so minimise the noise impact. If this capability was used to the full and linked with ground-based noise monitoring systems and prediction models, which allow the routes to be regularly modified to take account of changing weather conditions, some noise problems could be avoided.

21. In the longer-term, the scope for operational measures to significantly reduce environmental impact is even higher. Given the appropriate approach aids and enhanced air traffic controller tools, aircraft will be able to follow different approach procedures (curved, stepped, segmented, steeper etc) not only to minimise noise footprints, but also to 'spread' the environmental burden more equitably. On the approach, about half of the aircraft noise is generated by the airframe, consequently further benefits could be obtained by operating procedures which keep the deployment of 'noise generators', flaps, undercarriage etc, as late as possible in the landing phase, consistent with the required level of safety.

Action:

The European Commission will, when implementing the transport related chapters of the 5th R&D Framework Programme, give priority to:

- **validating appropriate modelling and prediction tools to enable optimised noise abatement procedures to be introduced at airports, together with the required monitoring and enforcement systems;**

- developing and validating the longer term operational measures, associated aircraft and ground-based tools and safety nets that permit a further reduction in environmental impact.

III. STRENGTHENING MARKET INCENTIVES TO IMPROVE ENVIRONMENTAL PERFORMANCE

22. Current economic and regulatory incentives to enhance environmental performance mainly take the form of modulating the level of airport charges on the basis of environmental criteria[12] but may also include Member States' interventions on environmental grounds in the distribution of traffic rights, within an airport system and/or intervene in the exercise of traffic rights, in particular where other modes of transport can provide a satisfactory level of services. However, the role of market incentives for improving the environmental performance can still be strengthened significantly thus complementing effectively international standards. This would help to create a competitive edge for operators and users which choose to use state-of-the-art technologies and environmentally friendly operations ("Reward the best – Punish the worst"). In parallel, the potential role of voluntary agreements with the industry merits careful examination.

Economic Incentives

23. Minimum technical standards which bind operators and airports are important for the environmental performance of air transport activities. However, such minimum standards are of limited effectiveness if the aim is to promote market-oriented decisions to reduce noise and gaseous emissions. Such an approach gives operators the flexibility to choose the measures they will use to reduce emissions on the basis of a series of economic incentives which are linked to specific environmental problems. This allows them to establish cost-effective solutions. This is the rationale behind the principle of charging for the external environmental costs of transport[13] which should also apply in air transport.

24. Environmental goals, however, are not the only reason for seeking a more balanced treatment of air transport within the overall system of charges and taxes: as a consequence of decisions taken during the infancy of international civil aviation, international flights are exempted from taxes. This exemption raises fundamental questions from the point of view of equal treatment across sectors, of the internal market, general transport policy and in relation to the goal to internalise the external costs of air transport.

Kerosene Taxation

25. With a view to addressing the imbalances which result from the exemption of international aviation from excise duty, the European Commission issued a report n November 1996, recommending that excise duties on mineral oil should be extended to aviation kerosene. It stated that this should happen as soon as the international legal situation allows the Community to levy such a tax on all air carriers including

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12 The Commission's proposal on common principles for the establishment of airport charges includes the possibility for modulation on environmental grounds

13 see White Paper on: "Fair payment for Infrastructure Use", COM (1998)466 final

those from third countries.[14] The Council adopted the report in June 1997 and, in its Resolution of 9 June 1997, requested the Commission to provide further information on the effects of such taxation.[15] To this end the Commission has commissioned a study on the "Analysis of the taxation of aircraft fuel."[16]

26. The main results of this study show the impact of the imposition of the minimum rate of excise duty for kerosene as established for the territory of the European Community (245 EURO per 1000 litres). It covers a number of different scenarios for its application.[17] Among these scenarios, the results for an application on all routes departing from a Community airport (as proposed by the Commission – Option A) and for an application on all intra-EC air routes for Community carriers only (Option B) merit particular attention.

Summary table: **Summary of main impacts of taxation options for 2005 – EURO 245/1000 litres**

Indicator	Unit	EU2005	Taxation options (taxation level: EURO 245/1000 litres)	
			(1) All routes from EU Option A	(2) Intra-EU routes - EU carriers only Option B
Air transport and aircraft operation				
Intra EU routes				
Revenue Tonne km	10^{11} RTK pa	0.3	-7.0 %	-6.8 %
Routes to/from EU				
Revenue Tonne km	10^{11} RTK pa	1.7	-7.5 %	0.0 %
Effects on airlines				
EU carriers				
Operating result	10^{9} 1992 ECU	3.6	-14.7 %	-11.7 %
Employment	10^{5} Employees	7.2	-6.7 %	-2.7 %
Other carriers				
Operating result	10^{9} 1992 ECU	8.6	-4.0 %	2.1 %
Employment	10^{5} Employees	2.7	-1.2 %	0.1 %
Environmental effect				
Fuel consumption	10^{8} tonnes pa	2.0	-2.4 %	-0.5 %
Legal obstacles				
Required changes of Air Service Agreements		n.a.	Yes	No
Tax avoidance by tankering				
Reduction of revenues from taxation		n.a.	10-25%	5-10%
Reduction of environmental benefits		n.a.	35-70%	10-20%

Source: AERO modelling system
RTK = Revenue ton/kilometres

The table indicates, on the basis of a quantitative analysis for the year 2005, the effects of the imposition of the minimum excise duty level (EURO 245/1000 litres) on traffic volume (measured in revenue ton km RTK), operating resultsfor carriers, employment and environmental effects (tonnes of CO_2 emission reduction). In addition, the table contains a rough estimation of potential effects of tax avoidance by taking fuel in "tax-free" countries. The changes expressed in percentage rates refer to a business-as-usual development during the period from 1992 (base year for

14 see COM(96)549 final

15 European Environment Transport Council, Luxemburg 17-06-1997, item 9(f)

16 Resource Analysis, Delft, 1998

17 In parallel, calculations were also done on the basis of a tax rate of 185 EURO (as applied in Japan) and 10 EURO per 1000 litres (as applied in the U.S.)

AERO-model data) to 2005 assuming that the minimum excise duty would be introduced in 1998.

27. The results show clearly that the environmental effectiveness of imposing kerosene taxes is significantly higher where all routes departing from EU airports are taxed. Moreover, the ratio between environmental effectiveness, on the one hand, and economic and competitive impact on the European airline industry, on the other hand is, from a European view, significantly better where all air carriers are taxed, at least as long as circumvention practices by means of taking fuel in third countries is not widespread. Finally, in relation to cost-benefit considerations, it is at least questionable whether a reduction in all transport-related CO_2-emissions of just 0.26% (as calculated for an EU 2005 scenario with 1992 a base year on the basis of applying option B) and of NO_x-emissions by 0.12% would justify considerable pressure on the competitiveness of the European aviation industry which would have to compete head-on with third country air carriers enjoying intra-Community traffic rights, as a side-effect of the cumulative effects of so-called open-sky agreements concluded by Member States.

28. Consequently, any effective approach would necessitate a system that allows for taxing/charging all carriers operating out of Community airports (Option A). Such an approach, however, if applied in the field of kerosene taxation would require fundamental changes to existing policies at ICAO-level and, in particular, to existing bilateral Air Service Agreements (ASAs) that allow for the imposition of taxation only in case of a reciprocal agreement. These changes will be difficult to achieve without considerable concessions in other fields. For these reasons, the Commission considers that the approach suggested in its 1996 report should be maintained, for the time being, pending progress in international fora. The alternative (Option B), though legally feasible, is unacceptable in the Commission's view. It would not strike the delicate balance between environmental, economic and internal market requirements which is necessary for a coherent policy in this area. The conclusion reached as to the relative attractiveness of options A and B also applies to lower tax levels even though these may reduce the economic burden for Community air carriers.

Environmental Charges

29. Given the limited prospects for a fundamental change in the international framework on kerosene taxation at this stage, studies targeting alternative or complementary approaches have already been undertaken.[18] A priori, there are a number of options available.

30. Environmental charges could take the form of the following levies:

a) a levy added to the passenger ticket fare;

b) a levy based on the distance flown and aircraft engine characteristics to be collected via EUROCONTROL with en route charges differentiated on the basis of the environmental performance of the aircraft used;

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[18] See "A European Environmental Aviation Charge" by Centre for Energy Conservation and Environmental Technology, Delft, 1998 and report "Emission Charges and Taxes in Aviation, The Hague, 1998

c) a levy associated with airport LTO charges.

There are, in addition, several basic options for the revenues collected:

a) a revenue-neutral application (i.e. only modulation on the basis of environmental performance);

b) the funding of general public policies, of different environmental enhancements (R&D, investments in new technologies etc.) or of compensatory measures for environmental damage either directly related to the air transport sector, or not (forestation, house insulation);

c) a combination of a) and b) in the form of a base rate emission charge targeting the external environmental costs plus a modulation giving a premium in favour of "clean" and a sanction against "dirty" operations.

31. Subject to further studies on this issue the Commission believes that the inclusion of environmental charges into the system of en route charges seems to be a promising technique. A combination of a base rate charge and a modulation of the rate of charges on the basis of the environmental performance of the equipment appears to be the most appropriate way to reconcile underlying environmental, economic and transport policy goals. In particular, such an approach would bring about stronger differentiation between more or less environmentally friendly operations, thus accelerating the use of better techniques and promoting equitable conditions for competition between rail and air transport.

32. The preparatory work for establishing a European Charge will be coordinated with the work taking place in the context of ICAO's CAEP/5 work programme, which is aiming to present conclusions to the 33rd Assembly in 2001, for a modernised policy framework for environmental levies including taxes and charges. The Commission is participating actively in this work. The goal is to reach decisions which meet the requirements of the European Community in 2001. The Commission, however, believes that policy action is urgent in any case and that the European Community may have to act in this field also in case ICAO fails to modernise existing rules.

Emission Trading

33. The trading of emission rights is a new concept that is largely untested in the aviation field. A priori, it could be implemented at three distinct levels:

- at State level as foreseen in the Kyoto-Protocol;
- at the level of companies, both internationally and within national borders, sector-wise or not;
- between air carriers operating at an individual airport imposing a quota on (noise) emissions.

34. Trading of emissions between, for example, States listed in Annex 1 of the Framework Convention on Climate Change (FCCC) clearly does not imply a sector-specific dimension. Developments in this field will take place in the context of implementing the Kyoto Protocol, therefore the fulfilment of emission reduction goals by means of trading emission rights will be a matter to be decided primarily at

State level. In practice this may mean that pressure on the aviation industry by individual countries to contribute to the fulfilment of their agreed and binding emission reduction goals may differ. This may give rise to concerns about distortions of competition in what is a globally organised market.

35. Future possibilities for trading of emission rights between companies on an international scale will depend on rules to be established when developing further flexibility provisions for the implementation of the Kyoto-Protocol. Since progress during the Conference of Parties (CoP) in Buenos Aires was somewhat slow, a lot will depend on the outcome of the next such meeting: CoP 6 in 2000 which will assess the outcome of the action programme agreed in Buenos Aires.

36. In theory, stronger use of emission trading as an instrument for furthering environmental improvements could also be established at regional (Community) or at national level. In that case it would be necessary to set a cap on emissions and to set rules for trading emissions under such a cap. This approach would imply that growth industries such as air transport may purchase emission rights from declining industries or from industries where new technologies already available pave the way forcost-effective reductions of emissions. This mechanism may contribute to both the acceleration of structural change and environmental improvement. However, it is worth noting that from the point-of-view of the aviation industry the effects of such a system would not necessarily be significantly different from the imposition of environmental levies. In both cases, environmental improvement would in essence be brought about by rendering more expensive emissions from air operations.

37. The trading of emission rights at an individual airport would imply the establishment of overall emission quotas for the airport concerned (preferably with the goal of lowering them over time) and of rules for the trading mechanisms which would have to be compatible with existing rules for the allocation of slots. The concept is attractive in terms of its underlying economic rationale. Therefore, the Commission firmly intends to undertake further studies to look at implementation and may prepare an initiative to be launched at a later stage.

Carbon Offsets

38. Another approach to improving the global environmental impact of air transport could be to look for a system which will allow the air transport industry to offset the environmental impact of industry growth by investments in carbon sinks (forestation etc.). Unfortunately, there is at this stage a considerable scientific uncertainty in relation to the impact of forestation activities on absorption of CO_2.[19] Therefore, in the short-term, the priority must be to analyse carefully the research findings in this field prior to preparing possible policy conclusions.

Action:

1. The European Commission will, in close co-ordination with the ongoing work on this issue at ICAO-level, continue and accelerate its preparatory work with a view to possibly introducing proposals to establish a

[19] see articles in New Scientist of 24-10-1998. Such uncertainties also reduce, at this stage, possibilities to determine the appropriate level of environmental levies on the basis of an accurate knowledge of prevention costs.

European Environmental Aviation Charge to be presented in 2001. This work will in particular aim at:

- defining the approach on the level of the charge and its modulation;
- identifying a collection method, in cooperation with EUROCONTROL;
- proposing rules for decisions on the use of proceeds;
- ensuring its compatibility with the international legal framework.
- considering options for emission related charges at the level of airports.

2. Prior to policy conclusions on this work the Commission will maintain its proposal COM(96)549 on the imposition of kerosene taxation.

3. The Commission will continue its study work on innovative concepts for economic instruments such as emission trading and carbon offsets with a view to better identifying their capacity to contribute to solutions to environmental problems in the aviation field whilst respecting legal requirements.

Encouraging Industry Initiatives

Environmental Management Schemes

39. The introduction of an environmental management system enables a company, such as an airline or an airport, to develop an effective and co-ordinated response to all the environmental issues that are part of its day-to-day business. It is an effective means of demonstrating, environmental concern and responsibility as well as a willingness to tackle the negative impacts of air transport activities in a structured and transparent way. By setting objectives and targets for reducing their impacts and by implementing the appropriate system capable of delivering real environmental performance improvements.

40. In the Community, Council Regulation 1836/93/EEC has created a framework for voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme (EMAS). ISO 14001, the international standard for environmental management systems, represents an essential step towards improved environmental management. EMAS, however, is a more ambitious system requiring that the company reports to the public about its environmental performance. Both the implementation of the system and the report are subject to external scrutiny which provides for credibility concerning the environmental achievements of the company. Organisations having already implemented ISO 14001 can built on it without duplicating their system by adding the missing elements of EMAS to their ISO 14001 certification.

41. A number of airports in the Community were involved in a pilot project on the introduction of EMAS. This project aimed at testing the feasibility to introduce EMAS in the air transport sector. The result was undoubtedly positive. The revision of the EMAS Regulation will make it accessible to the air transport sector in the very

near future whilst currently ISO 14001 certification was the only available standard and was therefore used already by some airports.

Action:

The Commission will facilitate the exchange of experience and the promotion of the upcoming revised Eco-Management and Audit Scheme (EMAS) in the air transport sector.

Environmental Agreements

42. The objectives and practicalities of environmental agreements are laid down in a Communication[20], which was presented in November 1996 by the Commission to the Council and the European Parliament. Some aviation stakeholders, in particular the Association of European Airlines (AEA), have expressed their interest in exploring with the European Commission the feasibility and scope of a voluntary self-binding commitment on CO_2 emissions. Possible inclusion of other emissions impacting on the global atmosphere may have to be explored.

42a. Entering into a more formal approach on the possibility of establishing a voluntary agreement with the air transport industry would necessitate the establishment of environmental targets ensuring a significant contribution to fulfilling the reduction targets as laid down in the Kyoto-Protocol which apply, however, to economies as a whole and not to individual industries. According to estimates of the Association of European Airlines (AEA) fuel efficiency of the fleet of member airlines will increase in a business-as-usual scenario by 9,7% during the period 1998-2012 which would, in view of most growth forecasts imply further increases of CO_2 emissions in absolute terms. This would imply a decrease of progress if compared with the recent 10 years where an annual improvement in the order of more than 2% was achieved. The Commission considers doubling the rate of progress if compared with the recent decade as an appropriate goal to be achieved by the end of an initial period of 10 to 15 years where no technology breakthrough is in sight. Putting together the various possibilities to increase fuel-efficiency in all parts of the aviation system, an environmental agreement should aim at reaching an improvement of 4% to 5% p.a. by the end of the period. With the availability of new technologies as from 2015 even more ambitious goals could be envisaged.

43. In order to be fully effective and to fit within the structure of the aviation industry, an agreement may have to include or cover under separate agreements the different parties concerned: air carriers, aircraft engine and airframe manufacturers, fuel suppliers, air traffic management providers and airports. The agreement should contain quantified objectives, in absolute or relative terms, going beyond achievements already brought about by ongoing technology development and fleet renewal ("business as usual"). With a view to providing a tool for assessing the effectiveness of the agreement, intermediate objectives ("milestones") as well as an indicative timetable for their achievement should be part of the agreement. The monitoring mechanisms should give sufficient guarantees regarding the reliability and accuracy of the agreement and foresee enforcement provisions in case of non-fulfilment of agreed goals which should include legislative measures to be taken

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20 COM(96)561final of 27.11.1996

swiftly such as increase of environmental charges. Openness about the initial commitments and the achievement of environmental objectives is crucial to ensuring their effectiveness.

44. Given the international nature of air transport and the aeronautical industry an important question is whether voluntary agreements on limiting CO_2- and other emissions from aviation activities should include Third country operators and manufacturers. This aspect is especially important for the manufacturing industry which has a strong homebase in North America. This will have to be examined as well as the more general issue of avoiding "free riders" who exploit the benefits of such agreements without making a contribution to achieving agreed goals. In this context, the role ICAO might play in establishing a world-wide agreement merits careful attention.

Action: The Commission will further investigate the appropriateness and possible benefits of reaching voluntary agreements on CO_2 and other emissions based on clearly defined targets, whilst ensuring that such agreements go well beyond what would be achieved in a business-as-usual-scenario. In the light of the outcome of this work the Commission will decide on a framework for entering into formal negotiations on a voluntary agreement on the basis of clearly established targets including time-table

IV. ASSISTING AIRPORTS

The citizens living in the vicinity of airports are very directly exposed to the environmental impact of air transport. However, it is also true that the variety of situations at Community airports in terms of traffic volume and number of aircraft movements, nightflights, proximity to residential areas, land-use rules in place and environmental sensitivity of the population concerned make it difficult to target environmental problems predominantly with uniform rules applying across the board. Obviously, there is a need to strike a consistent balance between uniform "bottom line" rules and possibilities to take action at local level within an agreed framework safeguarding the internal market.

A Common Noise Classification Scheme

45. Noise-related charges are levied at several European airports as an incentive to use quieter aircraft and to finance noise insulation programs. The noise charges can take the form of an extra landing charge or a specific noise charge or tax. The noise charges are presently based on aircraft noise classifications fixed according to principles which vary from one country to another. Classification of aircraft is also used as a basis for operational restrictions based on different local noise schemes, such as night bans.

46. Most existing classifications are based on the noise certification values. With the completion of the Chapter 2 aircraft phase-out, existing aircraft noise classifications will have to be updated. That will be an appropriate time to adopt a common scheme for noise classification of aircraft within Chapter 3 in order to prevent further proliferation of different local schemes. Such a classification scheme is also necessary for several aspects of the general EU noise policy as well as for any local noise reduction measures and charging schemes which prove necessary. A common noise classification scheme would also make it simpler for air carriers to plan

operations, since it will establish a fair and transparent system applicable throughout Europe.

47. The basic idea behind the classification is that it should reflect the contribution to the noise exposure of people living near airports . The classification could be based on one of two different principles:

- certification values;
- input data for the computation of noise exposure due to air traffic;

48. Certification values are used in many countries as a basis for charging and for operational rules. They are established values based on a carefully described procedure recommended by ICAO. The purpose of the certification procedure is to establish a method for comparing the noise emission of different aircraft with the regulations. Unfortunately, the procedures are not always representative for normal flights.

49. Computed operational noise data is more closely related to real noise disturbance on the ground than certification data. Different conditions, such as the actual power and flap setting, as well as local conditions in the airport vicinity, can be included. At present, however, there is no common European methodology or procedure used for aircraft noise computation and the basic data used for the computation has not been subject to the same control as the certification data.

50. Noise monitoring is performed at a number of European airports, mainly as an instrument to control the noise situation, but there are also some examples of noise databases consisting of measured data. As with the computed noise data there is, however, so far no common European methodology or procedure for monitoring. It is important that the classification reflects the degree of impact on the area surrounding the airport. On the other hand, the classification has to be founded on accepted standardised methods and a prescribed technical procedure.

51. The establishment of modelling guidance for airports is the subject of much international discussion. When a common method for calculating noise around airports has been achieved, together with a common database to support it, then this will probably be the best basis for noise classification. Today only the certification values can be used.

Action:

The Commission will propose in the year 2000 a Community framework on noise classification of aircraft with a view to establishing an objective common basis for the computation of noise exposure for local and national decisions on airport charges, operational restrictions and, subject to the outcome of further study work for the introduction of environmental performance criteria, rules to the allocation of slots.

A Framework for Noise Measurement and Land-use Rules

52. In its White Paper on the future development of the Common transport Policy[21], the Commission stressed the need to ensure that areas surrounding airports are adequately protected against an increase in noise volume due to the growth in air transport and that no new noise-sensitive activities are allowed near airports. To that effect measures were announced with a view to

- introducing a standard noise exposure index;
- establishing a standard method of calculation of noise exposure levels;
- implementing noise monitoring, noise zoning and land–use rules around airports.

It was further highlighted that such measures would need to give due consideration to the characteristics of individual airports.

53. Various noise measuring, noise monitoring and land-use measures already exist at a large number of Community airports. Indices and methodologies for determining noise exposure due to aircraft operations however are different in individual Member States[22]. The Commission sees great merit in the establishment of a common noise exposure index as well as a standard methodology for calculation of noise exposure around airports. Such common standards would make it possible to carry out a valid comparison between existing noise exposure levels and limits. They would also provide a general reference framework for assessing the compatibility of airport capacity provisions with environmental objectives. Unambiguous methods also facilitate the establishment of transparent and comparable common targets. In the longer term, a coherent framework covering all (transport) sources would be envisaged[23] as suggested in the recent green paper on a future noise policy As a follow-up to the Green Paper on future noise policy the Commission is preparing measures on the harmonisation of noise indices, computation and measurement methods for all the traffic noises.

54. Any aircraft noise abatement policy should include aircraft noise monitoring to provide information to the public on the actual noise situation around an airport and to assess complaints about aircraft noise. When combined with flight data from the airport surveillance radar, the noise monitoring system allows compliance with prescribed standard flight procedures and tracks to be checked. Such an integrated flight track and aircraft noise monitoring system makes it possible to detect immediately violations of standard procedures and to trace offenders against established noise limits.

55. In addition, the lack of proper land-use planning around airports has caused an increasingly problematic situation in relation to balancing the valid interests of different stakeholders. Although the present location of residential areas in the vicinity of airports cannot be reversed, it is important to improve the situation for the future construction and extension of airports. Compatible land use planning is essential to ensure that the gains achieved by the reduction of noise at source are not offset by further residential and other non-compatible developments around airports.

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21 COM(92)494 final of 2 December 1992.

22 A study into existing methodologies for the calculation of noise exposure levels in and around airports, National Aerospace laboratory, the Netherlands, 1992

23 COM(96)540 final of 4 November 1996 on Future Noise Policy

The European Spatial Development Perspective (ESDP) provides a framework for making progress in this field.[24]

56. However, the establishment and enforcement of land-use planning control is and will remain the responsibility of the local and national government. In recognition of the subsidiarity principle, the Commission does not intend to propose a change to the existing allocation of responsibilities. However, the Commission considers that guidelines for such controls, based on best practice techniques, could be an appropriate approach to improving the situation. Also, the use of the same indicators and assessment methods in these procedures will help the transfer of knowledge and experience. Furthermore, leverage through the Community's financial instruments for airport infrastructure development could be used for stimulating progress in this important field.

Action:

The Commission will propose a common noise measurement index, a methodology for noise calculation and minimum requirements for noise monitoring.

The Commission will, in close cooperation with Member States, consider the possibility of establishing recommended practices on land-use decisions in the vicinity of airports.

The Commission will propose that proper land-use rules should be considered as an eligibility criterion for financial support to airport construction and extension projects under the Community's various financial instruments.

A Community Framework on Operating Rules

57. In the present legal framework the imposition or modification of operating restrictions to reduce the impact of aircraft noise at Community airports is the prime responsibility of the relevant national, regional and local authorities. Community involvement in this field is strictly limited to ensuring that such decisions comply with Community law and in particular with the rules of Regulation 2408/92 and general Treaty principles such as non-discrimination and proportionality and with the Community's competition rules. The diversity of situations at individual airports in terms of traffic volume, noise performance of the aircraft used and, in particular, their closeness to residential areas, have tended to imply that Community harmonisation initiatives, for example on nightflights, would be inconsistent with the subsidiarity principle

58. A fair balance of interests is difficult to reach by attempting to set down uniform and binding rules on operating restrictions for all Community airports. Decisions must continue to be taken at local level if the best-balanced solution is to be found for each individual situation. However, the appropriateness of a Community Framework for decision-making procedures is a distinct matter. For example, there is no convincing argument on environmental grounds for objecting to industry's interest in establishing common points of reference for measuring the noise performance of the operations which are to be restricted. Similarly, significant changes to existing rules

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[24] ESDP, prepared by the Committee on Spatial Development, Potsdam, 1999

should incorporate sufficient time for operators to adapt their operations. It may also be important to consider establishing the enforceable right of airport neighbours to request consultations and negotiations on the imposition of new operating rules and guarantees that noise is actually reduced and not just shifted to other areas. Finally, the establishment of a body with a balanced representation of stakeholders to discuss best practices in this field at Community level could contribute towards avoiding weaker, "lowest common denominator" standards and in favour of a reasonable degree of harmonisation without recourse to legislation. Such "best practice guidance" might over time, develop towards a Code of Conduct on operating rules.

Action:

The Commission will examine, in close co-operation with stakeholders concerned and Member States, options for establishing a Community framework for decision-making procedures in the field of environmental operating restrictions at Community airports, including a forum for disseminating best practice.

Introducing More Stringent Rules on Noise at Individual Airports

59. The present international framework for advancing the introduction of new stringency standards on noise is based on ICAO Resolution A28-3 on the chapter 2 phase out of 1990. This established an international understanding on a target date for a non-operation rule. In the past, this date has also served as benchmarks for Community legislation governing intra-Community and international flights. Therefore, any Membrer state decisions to advance the introduction of more stringent noise requirements rules are currently not in conformity with Community legislation.[25]

60. It is foreseeable that discussions and negotiations on future certification standards for noise ("Chapter 4")will again be heavily influenced by the closely-related question of appropriate phase-in dates for non-addition and non-operation rules for Chapter 3 aircraft. The European request that certification standards as such and regional rules for their implementation should be strictly separated reflects objective policy requirements in Europe but has attracted, so far, little support in international fora (see also chapter II). Therefore, the establishment of a Community system of identifying particularly noise-sensitive airports, i.e. airports creating a large number of sleep disturbed and annoyed citizens, could pave the way for a more balanced and, in an international context, more acceptable solution to problems at individual Community airports reducing the number of annoyed people.

61. Such a system would consist of establishing objective and controllable Community rules under which, at the request of the Member State concerned, an individual airport might, on the basis of a decision of the Commission and after examination of the case assisted by an advisory committee, introduce more stringent noise rules prior to their general introduction in the Community market place.

62. With a view to safeguarding internal market requirements and undistorted competition, it is important, however, that entitlement for introduction of more stringent rules must be based on fulfilment of clear and objective criteria constituting

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[25] see Commission decision of 22 July 1998 on access to Karlstad airport. O.J. L233 of 20-08-1998

an exceptional situation and on use of common benchmarks for the determination of the noise impact on the environment of the airport. Such benchmarking will be greatly facilitated by the introduction of common indicators and assessment mehods as discussed above. Granting a permit to advance the introduction of more stringent rules could be justified in particular to avoid new operational restrictions or to pave the way for public approval of airport extensions.

62a. An alternative track towards better recognition of the situation at particularly noise sensitive airports could be to introduce environmental criteria into the rules on the allocation of slots at congested airports. The basic idea would be to give some preference to operations with more silent aircraft when defining priority criteria for re-allocation from the pool and to make sure, in any case, that air carriers cannot substitute less acceptable aircraft for existing equipment.

62b. The potential attractiveness of introducing criteria on the environmental performance of aircraft into the system of re-allocating slots not only stems from the prospects for environmental improvement: If combined with a system of overall noise quotas at individual airports, the incentive to use more silent aircraft in order to obtain slots would also improve the overall capacity of airports instead of accepting the current tendency to "solve" environmental problems by means of capping the overall number of movements.

62c. However, some of the implications of such a modification of the existing regulatory systems require further examination in order not to disturb the balance between the interests of incumbent air carriers and those of new entrant operators. Such a step necessitates definition of common reference criteria (a common noise classification scheme) in order to be compatible with essential internal market requirements.

Action:

The Commission will examine the feasibility and possible scope for a Community system for identifying particularly noise sensitive airports with a view to addressing the need for the introduction of more stringent rules at these specific airports. Its proposals in this respect will take into account the outcome of the CAEP/5 work on future noise stringency measures.

The Role of other Modes

63. From an environmental perspective, other modes are relevant for air transport in two ways. First, for many short to medium distance flights rail, in particular high-speed rail, can offer a realistic alternative. Second, air transport generates other traffic to and from airports, which highlights the role of airports as intermodal terminals.

64. The interconnection of different modes of transport is being pursued in the context of the trans-European transport networks (TEN-T). The Commission is currently working towards a revision of the TEN-T Guidelines, in which the linkage of airports to other modes of transport – notably rail – will receive particular attention in order to create the conditions for efficient connections.

65. Provided that infrastructural preconditions do exist there is a significant potential for enhancing rail/air intermodality, thus easing pressure on ATM-systems and facilitating the situation at congested airports. This would free air transport

infrastructure capacity for (longer) flights where competitive alternative transport modes do not exist.

66. Most air trips are automatically multimodal because of the necessity to travel to and from the airport. The local and regional traffic thus generated is in itself a major source of air pollution, noise and congestion. But efficient public transport between airports and city centres is not only a requirement on environmental grounds, it also lowers the risk of delay through congestion and reduces parking requirements. This constitutes an obvious "win-win" situation. In its Communication on the Citizen's network[26], the Commission highlighted the necessity of linking the TEN-T to local networks, and in particular connecting airports to rail infrastructure. In this context it must be ensured that rules on public procurement do not hinder local and regional authorities from using above-standard equipment, e.g. clean buses, for such connections. The Commission is working to disseminate best practice in local transport solutions[27]

Action:

The Commission will press for more effective air/rail connections in the future development of the TEN-T and continue to accelerate its efforts to make rail transport more competitive and better integrated facilitating replacement of shorter flights by rail transport. In order to enable transport authorities to develop environmentally advanced public transport systems around airports, the Commission will work towards public procurement rules that allow and encourage procurement officers to purchase environmentally advanced equipment. Existing activities to disseminate best practice in local transport solutions will be strengthened.

V. ADVANCING TECHNOLOGICAL IMPROVEMENTS (R&D)

67. The need for a long-term Research and Development (R&D) strategy is underlined by the fact that the aeroplanes produced today are in general based on established technologies, the development of which started some 10 or 15 years before. Improvements in environmental performance such as emissions and noise are an integral part of the systems development for new aircraft which demonstrates the need for an integrated R&D approach.[28] The European Community has developed its aeronautical research programme in close consultation with industry, research organisations and regulatory authorities taking into account related Community policies.

68. The Community will continue to support research on the atmospheric effects of aircraft emissions (see part 2 of the Annex to this communication). This will be part of the Key Action on Global Change, Climate and Biodiversity under Thematic

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26 COM(98) 431 final of 10 July 1998

27 For example by means of databases on the World Wide Web such as ELTIS (http://www.eltis.org) and its planned extensions.

28 European efforts on the atmospheric impact of aircraft emissions have predominantly been supported by the Environment and Climate Research Programme (E&C) as well as by the national programmes of the EC Member States. Complementary R&D activities on both aircraft and engine technologies for reducing exhaust gas emissions and noise have been supported by the Industrial and Materials Technologies Research Programme (Area 3A: Aeronautics). Community funded research on emissions have been part of the 2nd, 3rd and 4th Framework Programmes while major research on external noise from aircraft started more recently in the 4th Framework Programme.

Programme 4 on Energy, Environment and Sustainable Development. The overall objective of the Key Action is to develop the scientific, technological and socio-economic basis and tools necessary for the study and understanding of changes in the environment such as climate change, stratospheric ozone depletion, etc. In particular, the quantification and the relative importance of aircraft emissions to other anthropogenic and natural emissions and their impacts on the ozone layer and climate will be studied.

69. R&D on both aircraft and engine aspects related to exhaust gas and noise emissions will be part of the Key Action 4 on New Perspectives in Aeronautics of the Competitive and Sustainable Growth (GROWTH) programme under FP5.The Key Action Aeronautics distinguishes two strands of work. The development of critical technologies with a medium and long term perspective (10 to 15 years) will lead research to improve the enabling technology base. Technology platforms with a shorter term perspective (5 to 10 years) are designed to integrate and validate technology developments. The overall objectives of both strands are:

- to increase fuel economy of both the airframe itself and the propulsion system by 20% in 10 years, consequently reducing emissions of the greenhouse gases CO2 and H2O;

- to develop and validate ultra low emission combustor concepts to achieve significant reductions of pollutant emissions such as nitrogen oxides (NOx) and particulates in the LTO cycle compared to the current ICAO 96 standard, and in climb/cruise phase to a NOx emission index of less than 8 g per kg fuel burned;

- to reduce external noise by 10 dB in 10 years in relation to present best available technology.

70. R&D under critical technologies will include, in the field of reducing emissions from air transport:

- the development of technologies for improved aerodynamics, research on structures and materials to reduce weight, development of new and improved engine designs with improved efficiency and in addition research on advanced on-board systems and equipment contributing to improve the ATM system;

- to develop new combustor concepts for achieving substantial reductions in NOx and improve the knowledge of the nature and effects of emissions. This will include technologies for efficient and stable combustion systems, on-board measurement techniques, modelling of the composition of engine exhaust gas emissions and development of a new emission parameter for aircraft/engine certification as recommended by ICAO/CAEP4;

- the reduction of external noise through reduction of noise at source generated by engines, propellers and the airframe itself. This will include the development of active noise and vibration control technologies and the development of prediction models for airframe and engine for field noise radiation including work on improved noise certification parameters and procedures.

71. The overall goal of the technology platform on the more efficient and environmentally friendly aero-engine is to improve the competitiveness of the

European aero-engine manufacturing industry and at the same time actively contribute to curbing man-made climate change related to aviation. The activity includes tests of the best available component technologies in a conventional performance cycle engine and validation of an advanced engine performance cycle using an inter-cooled and recuperated engine core.

72. The technology platform on low external noise aircraft is developed on the background that research in the last two decades has focused on the aero-engine as the dominant noise source, resulting in substantial decrease of noise levels. However further progress can only be achieved by the combination of developments of several different elements: engine source noise, nacelle technology, airframe-generated noise and installation effects as well as low noise flight operational procedures. The objective of this activity is better integration of these different elements to achieve and to demonstrate a substantial reduction of perceived noise.

Action:

In executing the 5th R&D Framework Programme, the European Commission, in line with established procedure rules, is attaching priority to :

- **explore the scientific, technological and socio-economic basis and to develop tools for quantifying any change in the atmospheric environment which may be caused by air transport**
- **assist the aeronautical industry to develop major improvements to the environmental performance of aero-engines and aircraft.**

The Commission services intend to establish a common European position within the ICAO/CAEP process and enhance international co-operation in environmental research.

CONCLUDING REMARKS AND FUTURE MONITORING

The action programme as outlined in this Communication represents the position of the European Commission in relation to strategies to achieve sustainable development as required by the Amsterdam Treaty by means of integrating environmental concerns into sectoral policies in the air transport field. The European Commission is looking forward to early reaction in support and advice on priorities from the other EU-institutions when implementing this programme. With a view to the importance of decisions to be taken at the level of the International Civil Aviation Organisation (ICAO) by the end of 2001 for safeguarding EU-goals the Commission believes that ways for more effective representation of EU-interests will have to be identified. In any case the European Commission intends to re-assess the implications of such decisions for the balance between the main areas for action. A report serving this goal will be presented early 2002.

A review on the implementation of this action programme may also be required by new scientific evidence and by the availability of further developed environmental indicators. The impact of air transport on the environment will be monitored regularly on the basis of the Transport and Environment Reporting Mechanism (TERM).[29] TERM is a set of indicators which has been developed in pursuit of a Transport Council Conclusion to measure the integration process in the transport sector as well as to monitor deficits and achievements in the implementation of sustainability of transport. The Commission will co-operate with

[29] Transport and Environment Reporting Mechanism (TERM); TERM-Zero Report to be published in the beginning of 2000

Member States in order to encourage the collection of missing data to improve the TERM as a monitoring system for measuring environmental impacts of air transport. The Commission will also continue its work on improving the meaningfulness of cross-modal comparisons of environmental impacts.

ACTION PLAN – SUMMARY

AREA	*OBJECTIVES/TARGETS/ACTIONS*	*TARGET DATES*
I. IMPROVING TECHNICAL STANDARDS AND RELATED RULES		
1. Noise	More stringent international standards and rules for transition	By 2001 (33rd ICAO Assembly)
2. Gaseous Emissions		
NOX	More stringent international rules	By 2001 (33rd ICAO Assembly)
CO2 and other greenhouse gases	Reductions according to the targets of the Kyoto protocol.	2001 for review and update (33rd ICAO Assembly)
LTO emissions	Provide proposal for an equivalent charge	By 2001 (33rd ICAO Assembly)
Emission methodologies	To be improved, in co-operation with SBSSTA and CAEP	By 2001 (33rd ICAO Assembly)
3. Operational Measures		
Air Traffic Management	Improve ATM efficiency	Communication end 1999
II. STRENGTHENING MARKET INCENTIVES		
1. Economic Incentives		
Aviation charges	Proposal for an aviation charge	By early 2001 (after CAEP 5)
Emission trading	Explore benefits/risks	By 2001
Carbon offsets	Explore benefits/risks	By 2001
2. Encouraging Industry Initiatives		
EMAS	Encourage airports/airlines to register under the new EMAS regulation (upcoming)	New EMAS regulation (mid 2000)
Voluntary agreements	Suggest voluntary agreements on emission reductions.	Early 2000 launch of substantive discussions

III. ASSISTING AIRPORTS		
1. A Common Noise Classification Scheme	Proposal for a Community framework on noise classification	By 2000
2. A Framework for Noise Measurement	Proposal for a common noise measurement index, a methodology for noise calculation and minimum requirements for noise monitoring	By 2001
A Framework for Land-use Rules	Guidance on best practices for land-use decisions	By 2001 (Report)
3. A Community Framework for Operating Rules	Framework fo procedural rules , best practices dissemination	By 2001 (Report)
4. Introducing More Stringent Noise Rules at Individual Airports	Analyse appropriateness of a Community system for identifying noise-sensitive airports	By 2001 (Report)
5. The role of other modes	Working towards for more effective air/rail intermodality	Ongoing
R&D	**IV- ADVANCING TECHNOLOGICAL IMPROVEMENT (R&D)**	Ongoing (5^{th} and 6^{th} R&D framework programme)
Monitoring	Develop inventories of statistics and indicators through the Transport and Environment Review Mechanism (TERM) process.	TERM-Zero report to be published in early 2000, review by 2002

ANNEX 1

EU Passenger Transport Performance
Main Modes of Transport

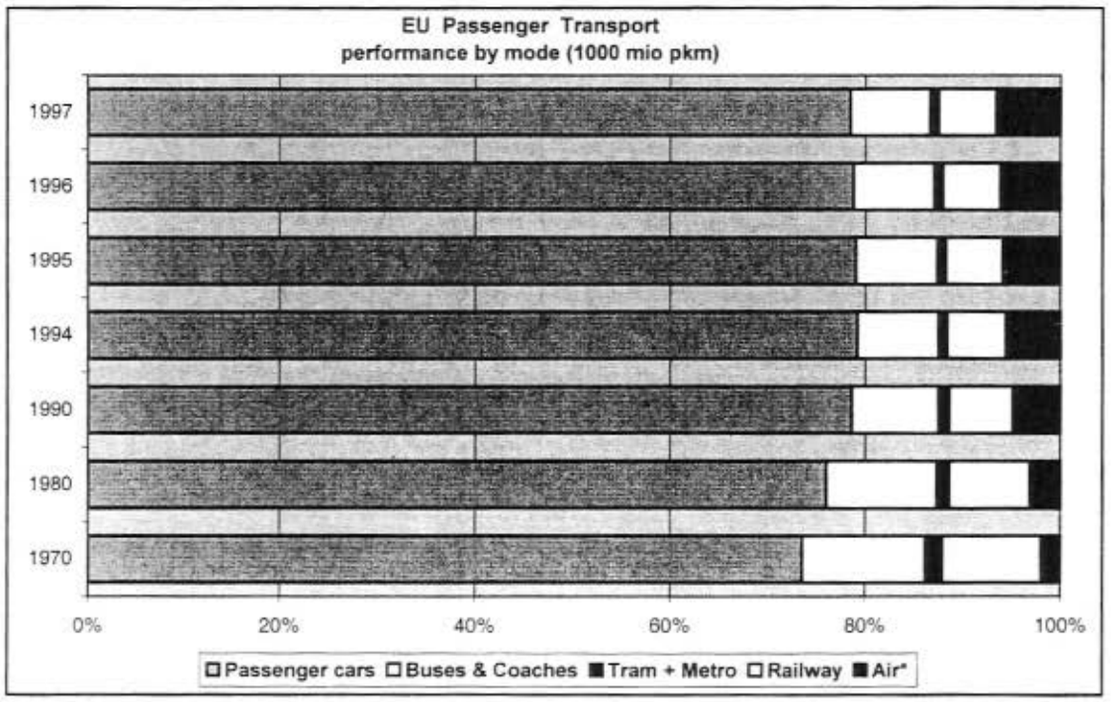
Figure 1: Performance by mode
1000 mio pkm

	Passenger cars	Buses & Coaches	Tram + Metro	Railway	Air*	Total
1970	1 583	270	38	217	*43*	2 151
1980	2 333	347	40	253	*96*	3 069
1990	3 302	369	48	274	*204*	4 197
1994	3 584	374	41	270	*254*	4 523
1995	3 656	384	41	270	*274*	4 624
1996	3 710	386	41	279	*290*	4 707
1997	3 787	393	41	282	*322*	4 826
1990-97	+ 15 %	+ 6 %	- 13 %	+ 3 %	+ 58 %	+ 15 %

Source : ECMT, UIC, UITP, national statistics and estimates

Notes : * European traffic, Source : AEA, IATA and estimates

Worldwide traffic of EU carriers was 550 bio pkm in 1995



Source: EU TRANSPORT IN FIGURES. STATISTICAL POCKETBOOK. DG TRANS. EUROSTAT

MARKET DEVELOPMENT – SUPPLY

Figure 2: Growth and Forecast in Scheduled Air Traffic Capacity

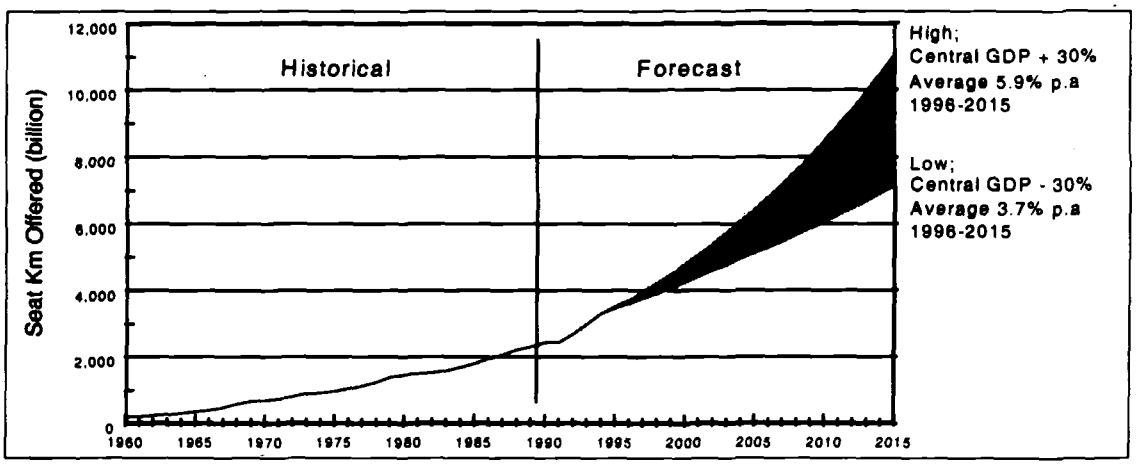
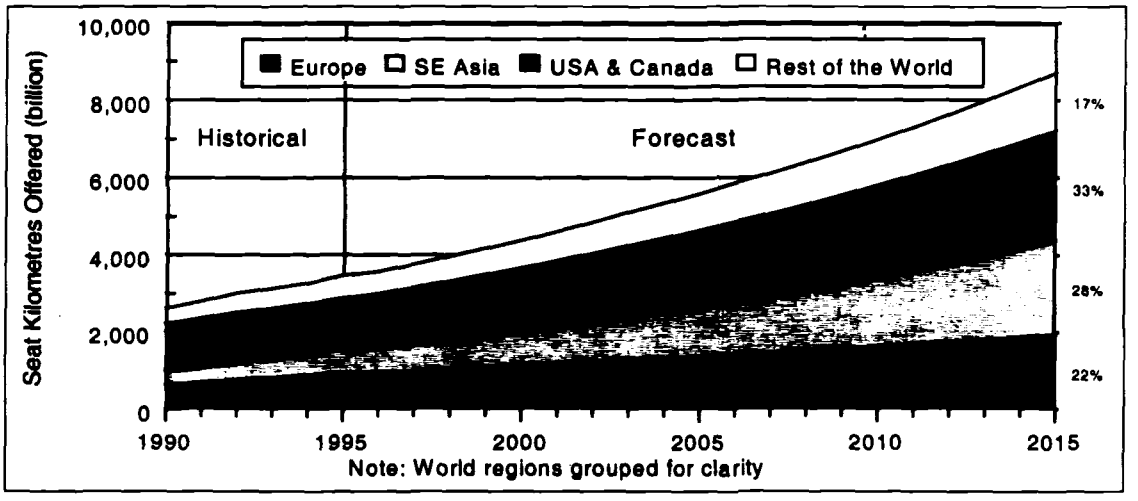
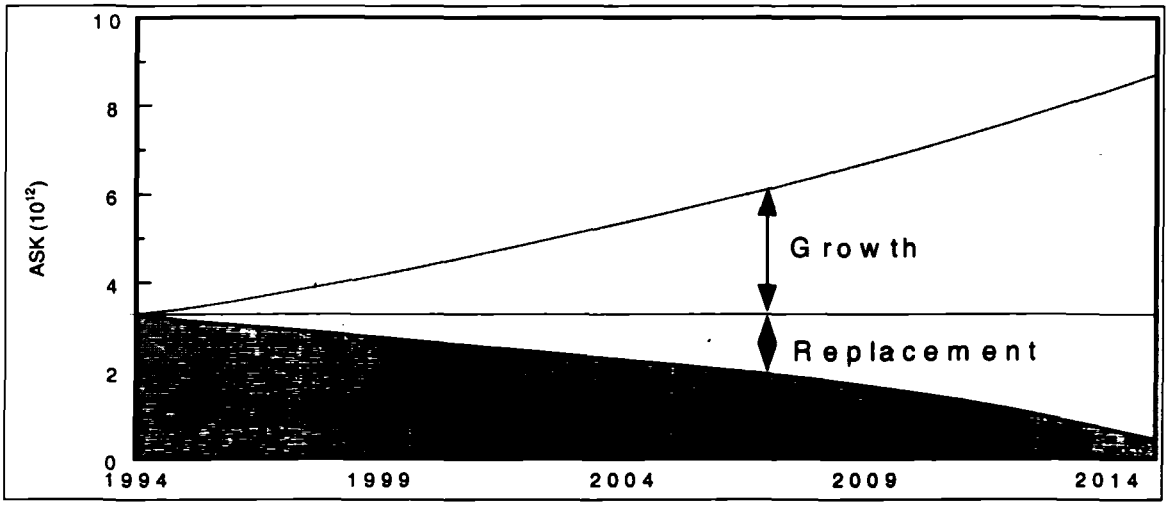


Figure 3: Capacity Forecast by Geographical Region



Source: ECAC/ANCAT (Expert group on Abatement of Noise Caused by Air Transportation)

Figure 4: Capacity Trend

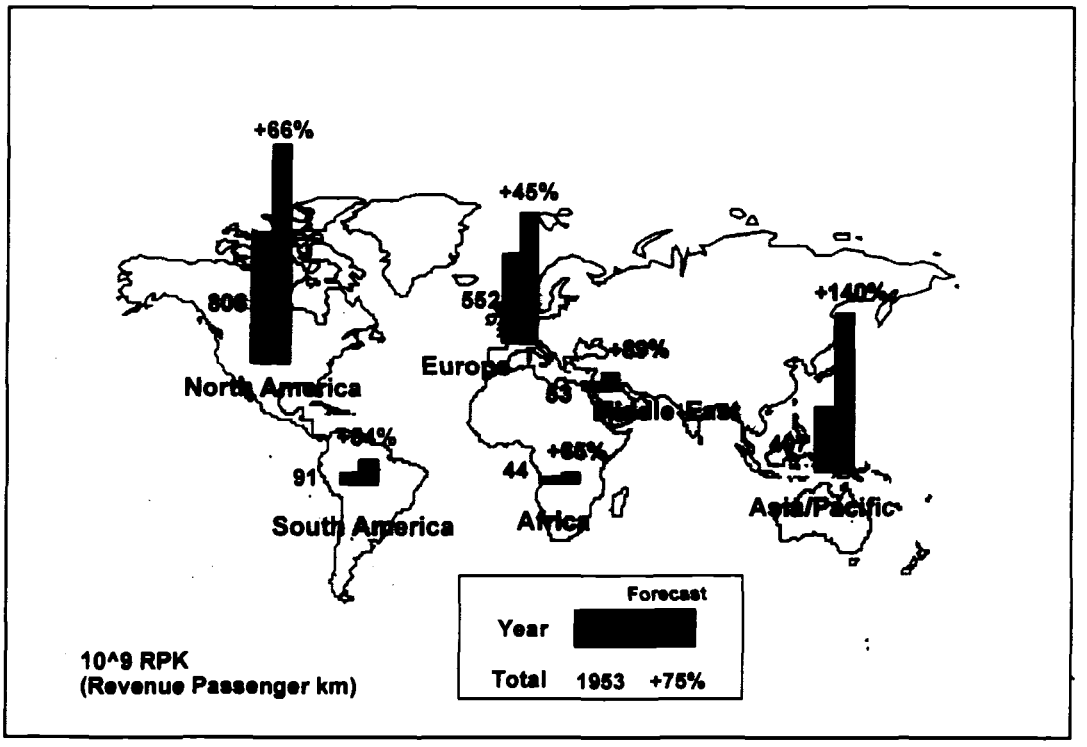


ASK: Available Seat Kilometres

Source: ECAC/ANCAT (Expert group on Abatement of Noise Caused by Air Transportation)

MARKET DEVELOPMENT - DEMAND

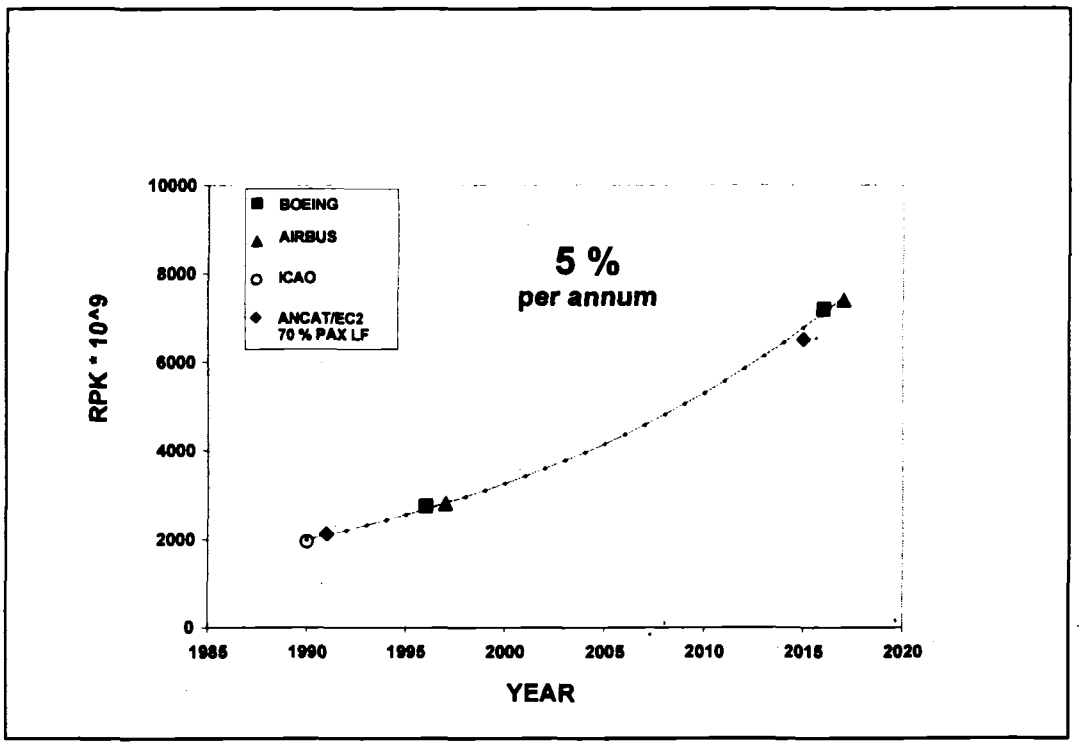
Figure 5: Growth Situation of Aviation



Source: DLR (Deutsches Zentrum fur Luft- und Raumfahrt)

Figure 6: Forecast of Passenger Demand in Aviation

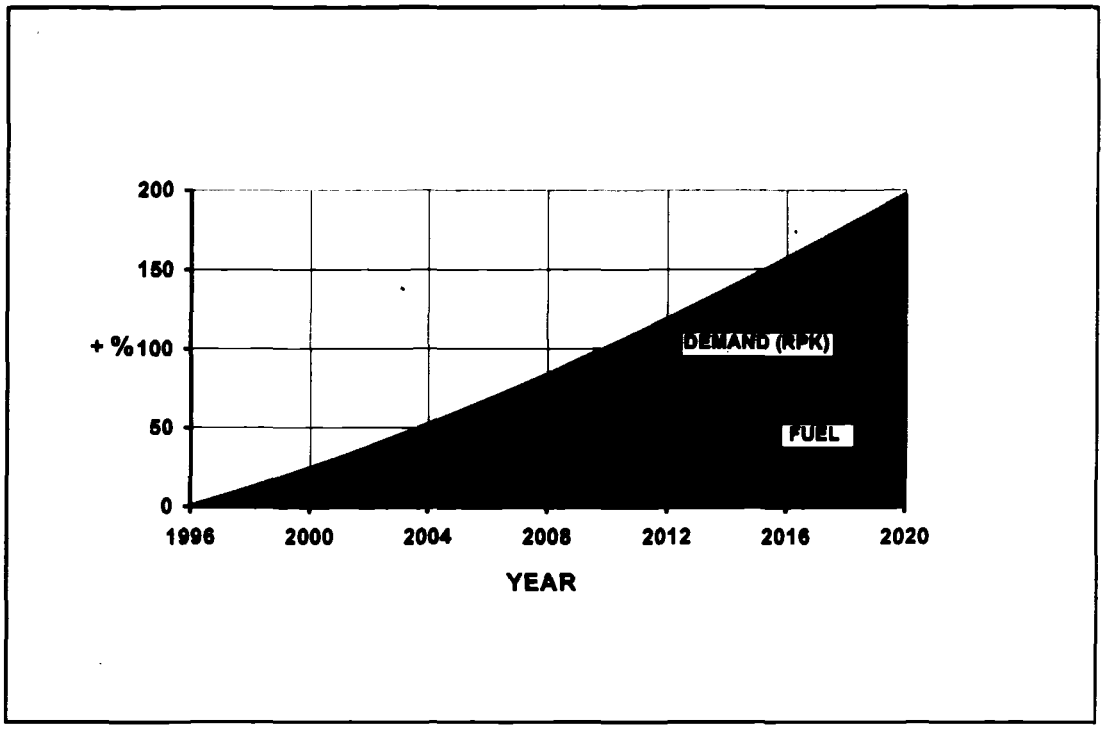
(10^9 Revenue Passenger Kilometre)



Source DLR (Deutsches Zentrum fur Luft- und Raumfahrt)

FUEL CONSUMPTION AND CONSUMPTION EFFICIENCY

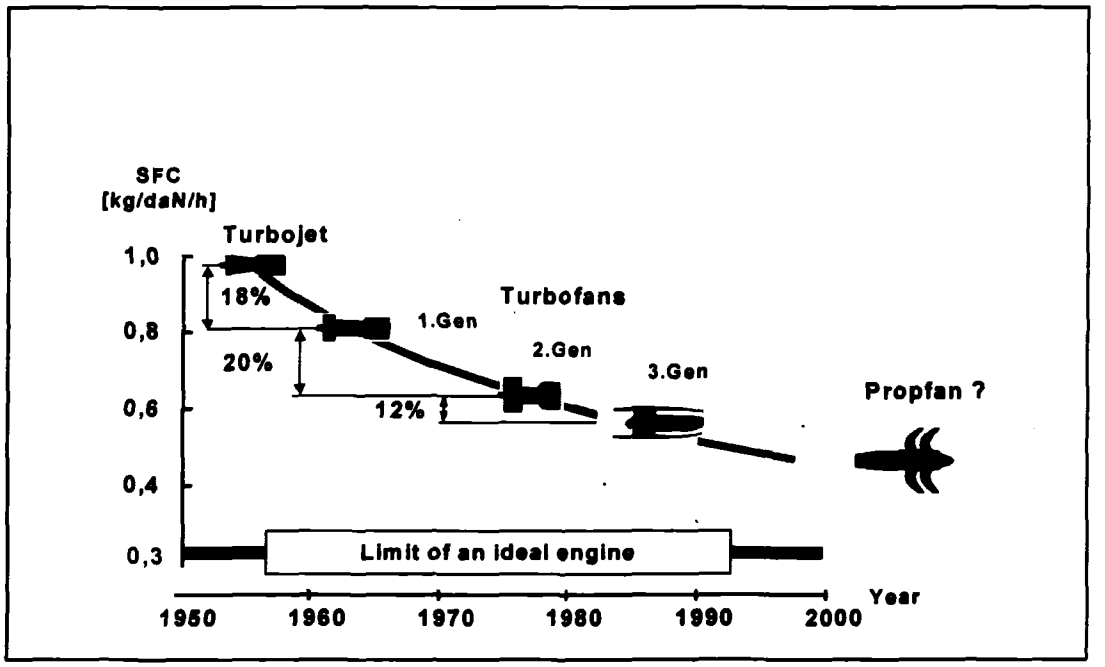
Figure 7: Growth of Air Traffic and Fuel Consumption



RPK= Revenue Passenger Kilometres

Source: Assessment using Boeing Market Outlook

Figure 8: Engine Technology Steps and Gain of SFC

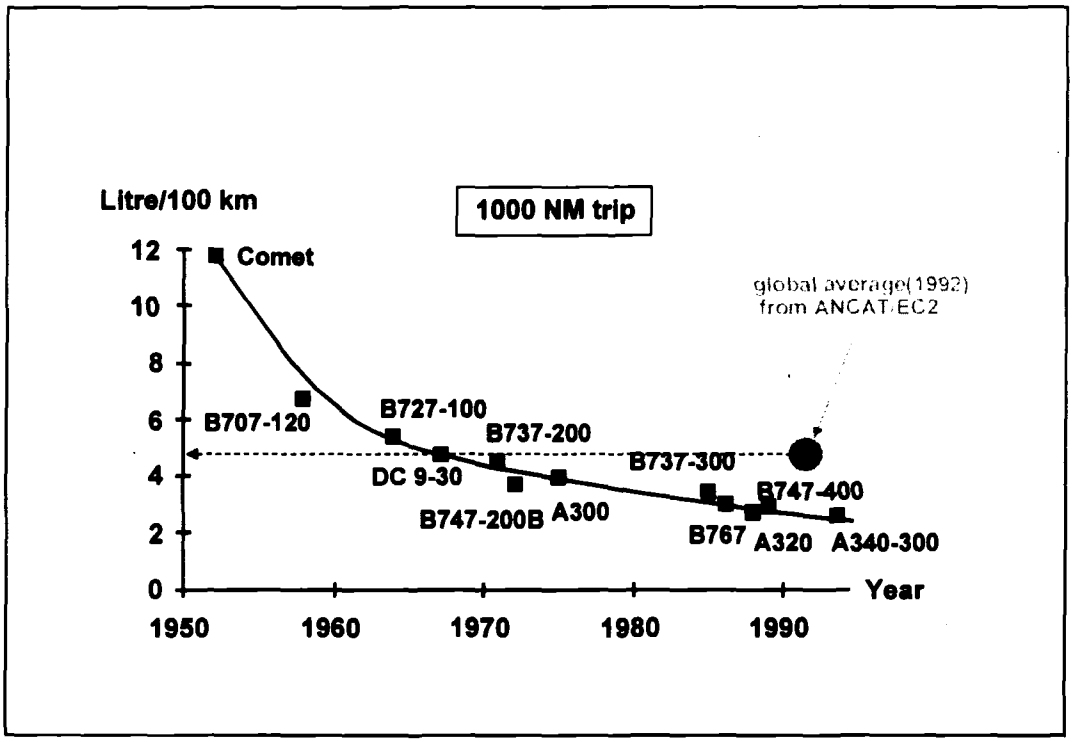


(Specific Fuel Consumption) at cruise conditions

Source: MTU/DLR

Note: Specific Fuel Consumption means the amount of fuel weight flow to an engine's combustor in kg per hour (kg/h) divided by the amount of thrust produced by the engine in dekanewton (daN=10 N)

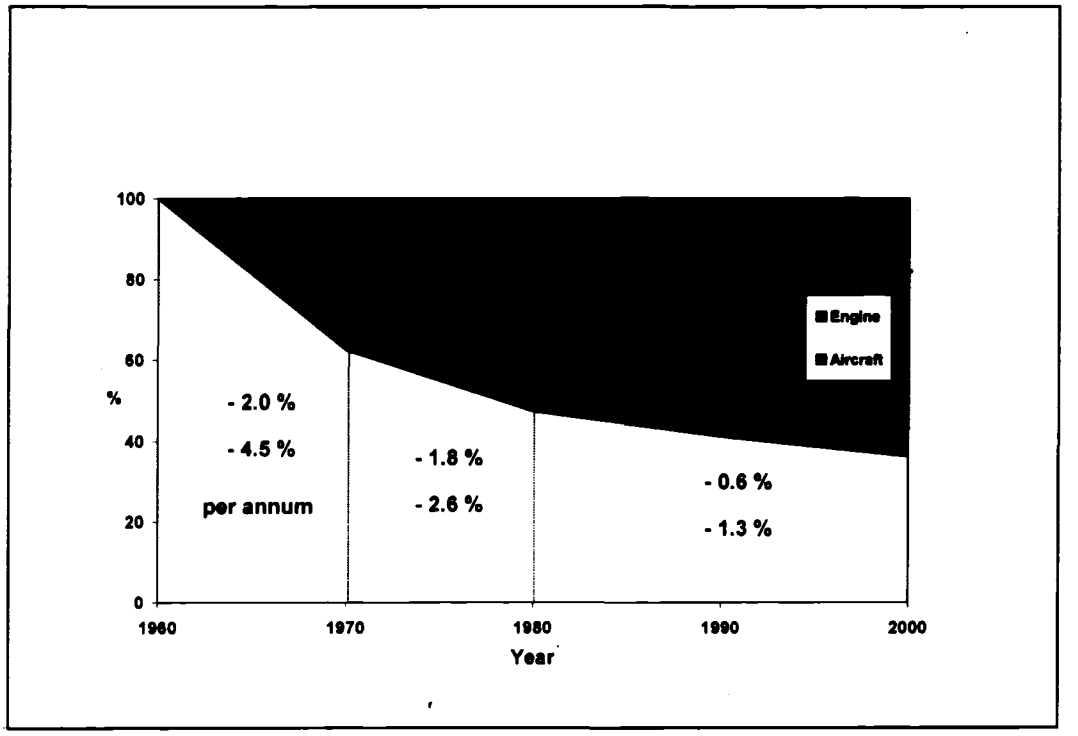
Figure 9: Development of Aircraft Fuel Consumption per 100 Available Seat Kilometres (ASK)



Source: DLR (Deutsches Zentrum fur Luft- und Raumfahrt)

Figure 10: Aircraft and Engine Fuel Efficiency Improvement

(Long range transport)



Source: DLR

Base: B707

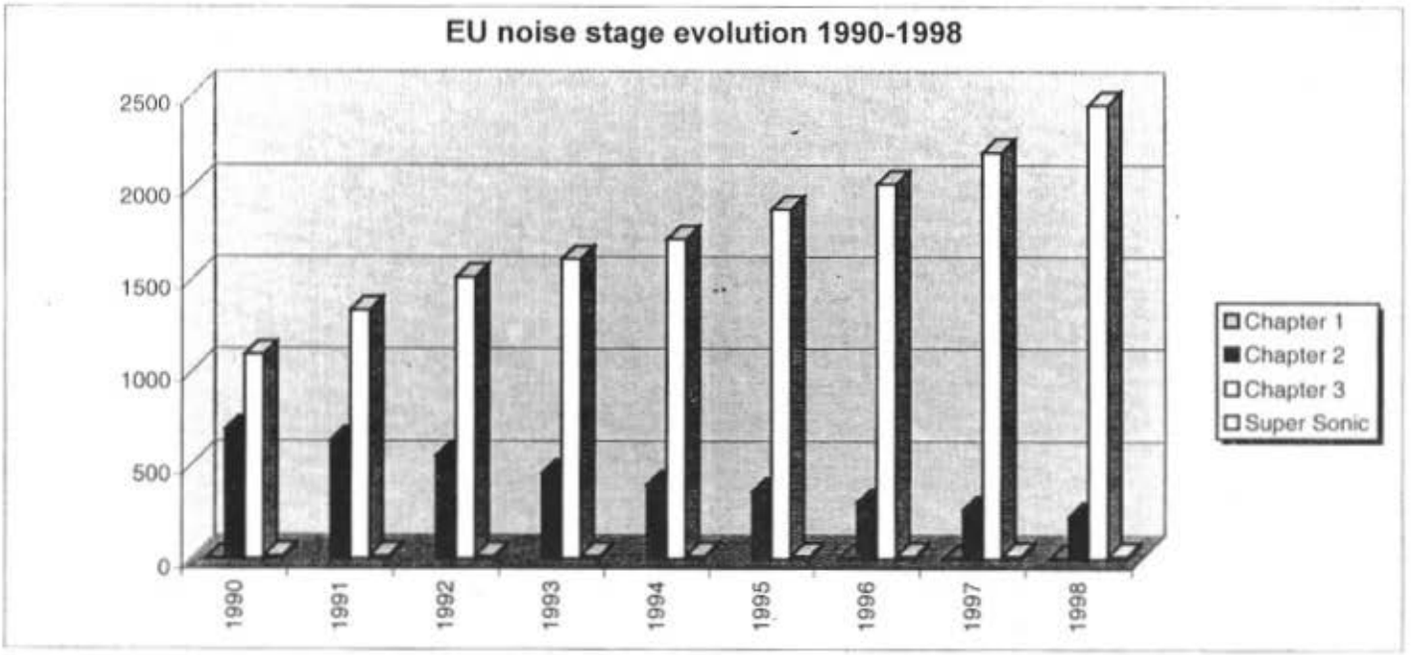
Figure 11 : Number of commercial aircraft by Noise certification operated in EU

ICAO noise classifications:

Chapter 1: aircraft types certified before 1970 (e.g. Boeing 707)
Chapter 2: aircraft types certified between 1970 and 1978 (e.g. Boeing 747-200)
Chapter 3: aircraft types certified after 1978 (e.g. Airbus A310)
SS - Super Sonic (Concorde)

Stage	1990	1991	1992	1993	1994	1995	1996	1997	1998
Chapter 1	1						2	2	2
Chapter 2	690	632	551	457	397	358	299	260	224
Chapter 3	1093	1336	1515	1613	1723	1883	2022	2195	2448
Super Sonic	14	14	14	14	14	13	13	13	13
Total	1798	1982	2080	2084	2134	2254	2336	2470	2687

(source: Aircams)



Fuel burned, Nox and CO_2 forecast 1991/2 and 2015

	EU 1992	EU2015	USA 1992	USA 2015	World 1992	World 2015
Fuel (Tg)	15,5	29,5	29,9	51,4	107,4	226,5
Nox* (as Gg NO_2)	177	331,5	327,3	557,7	1317,8	2678,8
CO_2 (Tg)	49,3	94,3	95,5	164	342,9	723,4

Source : ANCAT / ECAC

Tg (teragram) = 10^{12} grams
Gg (gigagram) = 10^9 grams
* as Gg NO_2
Notes:

Notes:
The data excludes the following:
1. Dedicated freight traffic
2. Business jet traffic
3. Military traffic
4. General aviation and helicopters
5. Carriers from the former Soviet Union and Eastern European states

Figure 12: Fuel and NOx forecast for 1992 and 2015

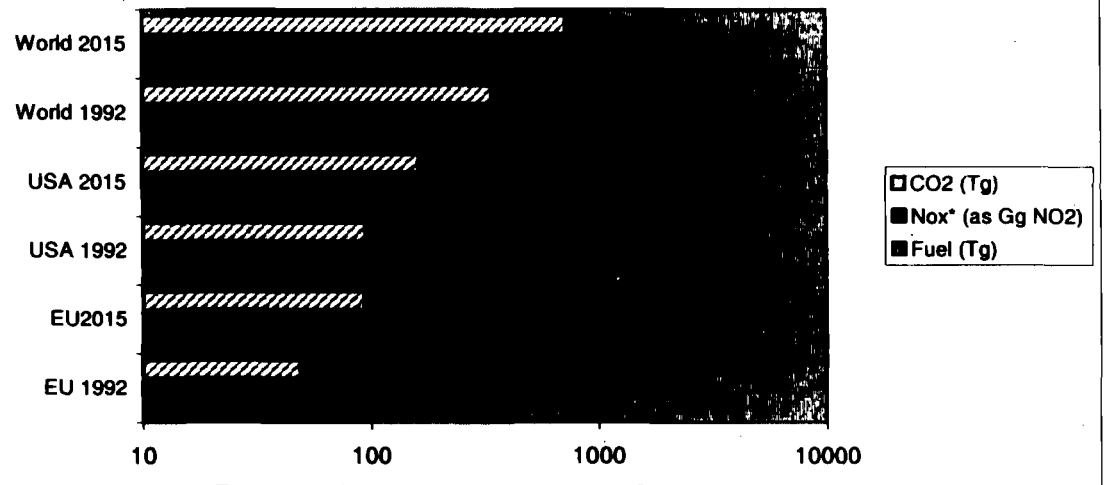


Figure 13: Annual emissions of NO_x (Gg NO_2) from civil aviation and percentage of global totals 1991/92

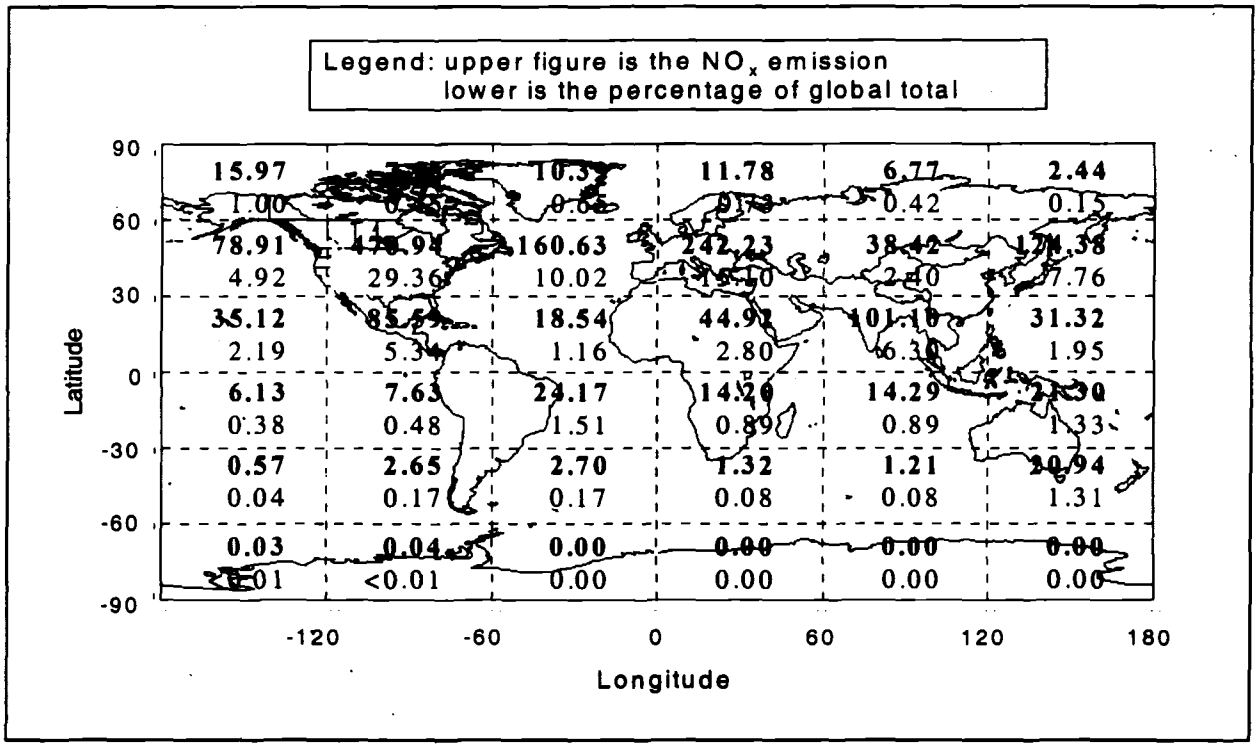
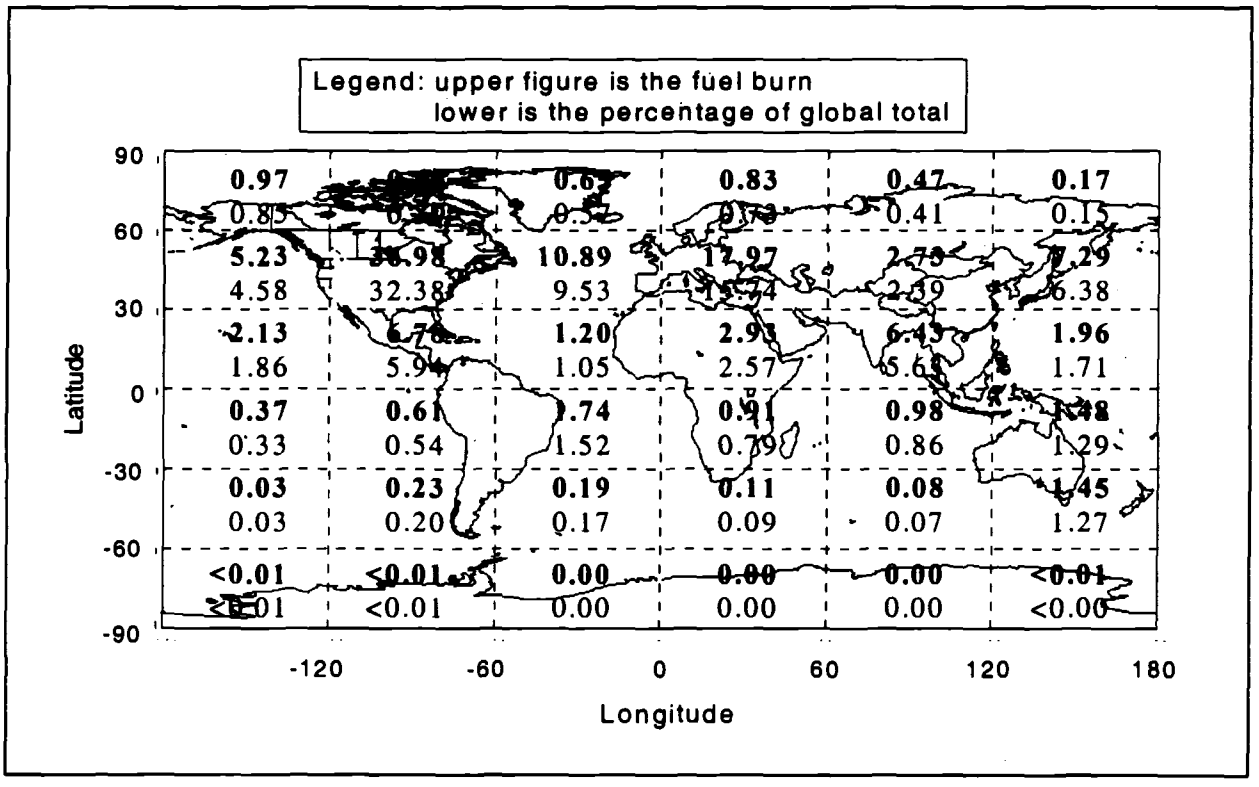


Figure 14: Annual consumption of fuel (Tg) from civil aviation and percentage of global totals, 1991/92



source : ANCAT/ECAC

Annex 2

2. Air Transport and Climate Change

- The problem

  Air transport contributes through the emission of gases and particles from aircraft engines to changes in air quality at the Earth's surface, in climate, and in the stratospheric ozone loss, thus affecting the UV-B radiation at the surface. The question of how significant emissions and their effects are, is, naturally of particular importance for future policy priorities.

  The present fleet of subsonic aircraft consumes about 130 to 160 Tg (i.e. millions of tons) of fuel per year and emits carbon dioxide (CO_2), water vapour (H_2O), nitrogen oxides (NO_X), particles (mainly soot), sulphur oxides, carbon monoxide, various hydrocarbons (HC), and radicals such as OH. Though the absolute amounts of the emissions are small compared to other anthropogenic global emissions (2-3% for CO_2 and NO_X), these emissions occur in the critical altitude region below and above the tropopause, between 9 km and 14 km altitude, and are concentrated mainly in the latitude regions between 40°N and 60°N. Furthermore, global air traffic is increasing rapidly, at rates outperforming the impact of technology improvements reducing engine emissions.

- European research (current activities)

  Research related to the atmospheric effects of aircraft emissions and their mitigation through aircraft/engine technological and operational measures is of increasing importance within the Framework Research Programmes of the European Commission. From a few singular activities at the beginning of this decade this has developed into a specific target area.

  The European R&TD efforts concerning the atmospheric impacts of aircraft emissions are predominantly supported by the Environment and Climate Research Programme (E&C) of the European Community (EC) as well as by national programmes of the Member States of the European Union e.g. Germany, France, the Netherlands, UK, etc. The complementary R&TD activities on both aircraft and engine technologies for reducing the exhaust gas emissions are supported by the EC Industrial and Material Technologies Research Programmes (Area 3: Aeronautics).

  The European efforts have been concentrated since 1990 on the effects of subsonic transport. For the first time, an integrated study aiming towards a better understanding of the atmospheric effects of emission of subsonic aircraft, the AERONOX project, was supported under the Environment Research Programme. After the initiation of AERONOX, further research activities have been supported by the European Community such as the POLINAT, STREAM, MOZAIC, AEROCHEM and AEROCONTRAIL projects.

- The European Assessment[30]

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[30] Published in Atmospheric Environment, Vol. 32, n° 13, July 1998

This report concluded that aircraft emissions are small in comparison to all other man-made emissions, but could be significantly affecting atmospheric ozone and cloud coverage with possible implications for climate change in the future having regard to the predicted growth of air traffic. More specifically:

a) The 20-50% increase in the NO_x abundance caused by aircraft traffic in the vicinity of their cruising altitude (10-12 km) has produced a 4-8% increase in the ozone concentration of the upper troposphere (maximum value during summertime) where ozone is a strong greenhouse gas. The warming effect associated with this ozone increase is comparable to the warming effect of CO_2 emitted by aircraft (about 2-3% of all anthropogenic CO_2 emissions).

b) Climate pertubations could also result from the formation of persistent contrails and high-level cirrus clouds produced in the busiest flight corridors. Additional effects on the radiative balance of the atmosphere could have been generated by the soot and sulphur particles released by aircraft engines. The warming effect of the changes in cloudiness is more difficult to assess but appears to be also of the same magnitude as the warming effect of CO_2 emitted by aircraft.

c) The total climate impact caused by the present fleet of commercial aircraft (about 0.1 Wm^{-2}) is a small contribution to the total forcing (2.4 Wm^{-2}) associated with industrial development. However, with air traffic in the next 20 years expected to grow faster than the global economy, the relative contribution of aviation to environmental changes (pollution, stratospheric ozone, climate) will become more significant, unless new, less-polluting engines and significantly more fuel-efficient aircraft technologies are introduced.

European research also identified a number of areas where improved knowledge could advance understanding of how aircraft perturb the atmosphere. It stresses that the impact of emissions at cruising altitudes, straddling the tropospheric and stratospheric boundary at around 12km, is not yet sufficiently understood. A better understanding of the background ('natural') state of this region is required prior to being able to identify the impact arising from aircraft emissions with accuracy. For instance, the natural production of NO_x from lightning needs to be better quantified before the impact of aircraft-induced NO_x can be determined with confidence. In addition, the effect of aircraft emissions on the abundance of particles that provide the surface for complex heterogeneous reactions, needs to be carefully studied. The considerable large uncertainty and the large potential for climatic impact due to possible changes in cloudiness induced by aircraft emissions, requires more R&TD emphasis on this topic in future. Finally, the relative importance of aircraft emissions may evolve in the course of future changes e.g. in tropospheric and stratospheric temperature, in water vapour concentration and in the residence time of other greenhouse gases like methane.

IPCC special report "Aviation and the Global Atmosphere"

Because of the potential policy importance and the need of the industry for better information on medium- and long-term implications and the underlying complexity of the global atmospheric phenomena involved, it was considered appropriate that an international understanding of the status of both scientific understanding and technological/economic options associated with these issues should be reached.

A coordinated assessment involving the Intergovernmental Panel on Climate Change (IPCC) as leading body, the Ozone Science Panel of the Montreal Protocol under the auspices of the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), and the International Civil Aviation Organization (ICAO) was launched and finalised early 1999.

The report considers the current (*year 1992*) and possible future (*year 2050 on the basis of different scenarios*) effects of aircraft engine emissions on the atmosphere. CO2, which represents 2% of total emissions in 1992, could represent 3%in 2050. In absolute terms for the range of scenarios, the range of increase in emissions would be 1.6 to 10 times the value of 1992 in 2050. NOx increased O3 (ozone) by 6% in 1992 and could increase it by 13% in 2050. Even though NOx is expected to decrease the concentration of CH4 (methane), the net regional radiative effects of O3 and CH4 do not cancel, because the geographical distribution of the radiative forcing (*a measure of the importance of the potential climate change mechanism*) is different: changes in O3 are mainly located near the flight routes in the Northern Hemisphere, while those of CH4 are globally mixed. This implies that NOx emissions from aircraft continue to be a problem in the upper troposphere. The effect of water vapour, a greenhouse gas, from aviation is smaller than those of other aircraft emissions such as CO2 and Nox. Aircraft contrails, which contribute to the warming of the Earth are expected to increase by a factor of 5 between 1992 and 2050. Over the period 1992 to 2050 the overall radiative forcing by aircraft can be a factor 2 to 4 larger than the forcing by aircraft CO2 alone.

The report further explores the potential options for emissions mitigation through changes in technology, the air transport system and in regulatory and economic frameworks. The report assumes a 20% "natural" improvement in fuel efficiency by 2015 and a 40 to 50% improvement by 2050 compared to today's technology. Improvements in ATM could reduce fuel burn by 6 to 12% in the next 20 years. Other operational measures could bring about a further 2 to 6% reduction. The assumption that there would be no shortage of airport capacity in the time-horizon of the report was seriously questioned. The report also recognises that although the improvements in aircraft and engine technology and in the efficiency of the air traffic system will bring environmental benefits, these will not fully offset the effects of increased growth of air transport. Regulatory and market based options are identified as other mitigation measures.

The key areas of scientific uncertainty, which are identified in the report, include i.a. the role of NOx in changing O3 and CH4 concentrations, the climate response to regional forcing.

Although the IPCC special report on "Aviation and the Global Atmosphere", in line with established IPCC practice, does not make policy recommendations or suggest policy preferences, it has become a key reference point for future policy decisions aimed at reducing gaseous emissions from aviation that can affect the chemical properties of the atmosphere