

AVIATION LIBERALISATION AND THE
ENVIRONMENT IN EUROPE

For the World Wide Fund for Nature

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Acronyms

AEA	Association of European Airlines
ATM	Air Traffic Management
CAA	Civil Aviation Authority
CAB	Civil Aeronautics Board
CAEP	Committee on Aviation Environmental Protection
CO ₂	Carbon dioxide
COP	Conference of the Parties to the Convention
CRS	Computerised Reservation Systems
CTP	Common Transport Policy
ECAC	European Civil Aviation Conference
EATCHIP	European Air Traffic Control and Integration Programme
EU	European Union
FAA	Federal Aviation Authority
FFP	Frequent Flyer Programmes
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IEA	International Energy Agency
INC	Intergovernmental Negotiating Committee of the Convention
JAA	Joint Aviation Authorities
LTO	Landing and Take-Off
NO _x	Nitrogen oxides
RCEP	Royal Commission on Environmental Pollution
SARPS	International Standards and Recommended Practices
SEA	Strategic Environmental Assessment
TERN	Trans-European Transport Networks
UN	United Nations
UNEP	United Nations Environmental Programme
WMO	World Meteorological Organisation
WWF	World Wide Fund for Nature

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1. INTRODUCTION

This report describes some of the key features of European aviation and environment policies. It discusses the interactions between the two and makes recommendations for certain aspects of these policies. It reflects the results of a research programme recently undertaken by the authors on behalf of the World Wide Fund for Nature (WWF).

The main focus is the implications of the liberalisation of civil aviation in Europe for the emissions of pollutants to the atmosphere from aircraft engines. The atmospheric pollutants of interest here are implicated in environmental impacts at the regional and global scale, notably global warming and alteration of ozone concentrations. The pollutants include carbon dioxide (CO₂), nitrogen oxides (NO_x) and water. Local environmental impacts, such as noise or airport associated emissions, are not specifically considered. The study focuses on liberalisation within the European Union (EU) as constituted in 1994. However the increasing integration of a wider Europe (including the accession of new Member States) and the international nature of aviation means that the EU can not be analysed in isolation and so some attention is paid to these broader issues.

1.1 The general outlook for aviation and the environment

The purpose of this paper is not to discuss the science of aviation's impact on the environment, nor to cover the possible implications of policy elements other than liberalisation. Some documents covering other such aspects are hereafter mentioned in case the reader wishes to explore further. Detailed scientific and technical analyses covering various aspects of the environmental effects of aircraft emissions have been produced by the World Meteorological Organisation (WMO, 1995), the Intergovernmental Panel on Climate Change (IPCC, 1995), the National Aeronautics and Space Administration (NASA: 1992,1993) and the International Civil Aviation Organisation (ICAO, 1992). These research programmes generally continue. To date there are few publications by official and industry bodies indicating how aviation policy should comprehensively include environmental concerns. A general introduction to aviation and the environment and a discussion of policy is to be found in previous reports such as those by the World Wide Fund for Nature (WWF, 1991,1994), Vedanthan and Oppenheimer (1994), Bleijenberg (1993), Archer (1993) and Olivier (1992).

Aircraft presently release some 2 or 3% of the global emissions of carbon dioxide and 1 or 2% of nitrogen oxides from fossil fuels. This fraction will grow rapidly with unchanged policies. Aircraft also emit a mixture of other pollutants including soot, carbon monoxide and hydrocarbons. About half of these emissions is injected into the atmosphere at altitudes 8 to 12 km. At this height pollutants can have more serious and enduring effects than at ground level - even water may have adverse impacts. There are special concerns about the possible indirect and direct contributions of nitrogen oxides and water emission to global warming; and of these pollutants to stratospheric ozone depletion.

The global demand for air transport is forecast to grow at around 5% per year and so double in less than fifteen years. The long term growth potential outside of Europe is vast because of the low current per capita demand in poor but populous countries. But even in Europe demand is officially projected to grow strongly; this is partly because of the impacts of regulatory changes such as the Third Liberalisation Package described below.

1.2 Risks and benefits

As for other major industries (e.g. surface transport, electricity generation), the fuel use and pollution per unit of output of aviation has reduced substantially in the past because of technological advance, and there is still some scope for further improvement. As a result of further technical improvements, the scenarios produced by official and other bodies generally show that pollution emission will grow less rapidly than demand, but that emissions will nevertheless increase because the improvements are outweighed by demand growth. There is still considerable uncertainty about the environmental impacts of some aviation pollutants. However there is a firm consensus on the probable range of contribution of carbon dioxide to global warming, and that this has resulted in commitments by some governments for stabilising carbon dioxide emission in the short term.

As for any human activity, some balance between scientific uncertainty, potential environmental risk, and the social and economic costs and benefits must be made. To assume that pollutants other than carbon dioxide may be ignored in policy making until there is a perfect consensus on the environmental science may be taking a great risk, especially since such a consensus may never arrive. In practice political decisions about environmental policies are made before there is total scientific or economic certainty, as is manifested by the EU policy and associated Directives controlling road vehicle emissions or acid emission from large combustion plant. This general view is supported by the Royal Commission on Environmental Pollution (RCEP):

There is a powerful case on environmental grounds for regulatory action to avert what could be irreversible damage to the Earth's atmosphere from the growth of air transport, or at least serious damage of a long term nature. (RCEP, 1994, p 74)

The growth in carbon dioxide emission from aviation is inconsistent with the short and long term objective of controlling global warming through the limiting of emissions of those trace gases that cause global warming. Since half of aviation services is for the purposes of leisure, it may be argued that aviation should be subject to emission targets at least as stringent as other sectors.

Therefore a series of new or augmented policy measures is needed to moderate the emissions of pollutants such as carbon dioxide from aviation. There is some scope for extending technological improvement. This might include the extended use of slower more fuel efficient aircraft (such as turboprop engined aircraft), optimised for passenger transport. Operational changes such as increasing the load factor of aircraft, could reduce pollution substantially and rapidly. However, even if these two categories of measures are applied to a maximum, fuel use and pollution still eventually rise.

In consequence, if aviation is to stabilise or reduce its current emissions of greenhouse gases and other pollutants, demand management will be required. The preceding discussion is based on detailed analysis in a previous report by WWF (1994).

In a study such as this, it is necessary to bear in mind the nature of the dilemma posed by air transport (and indeed by many other human activities) in relation to the environment.

As explained above, civil aviation damages the environment; but the extent of this damage is uncertain. At the same time it contributes to human needs and the quality of some people's lives and to the global economy; yet only a small proportion of air transport is for purposes that are essential services such as manufacturing, or heating buildings. There is no low cost technological fix which can deliver a major advance in the environmental performance of aircraft without affecting air transport operations. Thus, unless one adopts the extreme positions either of eliminating environmental damage altogether, or of ignoring it completely, it is necessary to strike a balance between environmental protection and the provision of air services.

A number of methods are available which can help to assess what this balance might be. For example attempts can be made to attach monetary values to the environmental impacts of aviation (internalise externalities) and to determine the costs of different strategies to the industry and consumers so as to produce a quantified balance of financial costs and benefits. Such a cost benefit analysis is difficult to carry out even for cases which are limited in scope as compared to aviation (e.g. for acid rain in Europe), and even then the results are highly uncertain and debatable. To carry out such an analysis for a global industry like aviation would be a mammoth task which, if credible results are to be produced, is possibly beyond current capabilities. Furthermore there are complex ethical matters and international political issues which are not amenable to quantified analysis; for example about forty per cent of the environmental impact of aviation is brought about by some six per cent of the world's population living in north America. In this report we have not even tried to scope out these issues, let alone analyse them.

We also have made no attempt to analyse what the best mix of regulatory and fiscal instruments would be for achieving particular environmental goals; for example whether aircraft fuel efficiency standards or a fuel tax would be the most economically efficient way of meeting carbon dioxide emission targets.

This study of aviation in Europe is set within this general context.

1.3 Scope of study

It would be valuable to analyse the preceding issues, but it is outside of the scope of this report. To the authors' knowledge no analysis covering these issues in anything but a partial and piecemeal fashion has been conducted or published by any official or industry body. Because of these complexities and the lack of analysis the regulatory and fiscal framework for aviation emerges from complex political processes for which technical and economic analyses are amongst several inputs.

On a pragmatic basis, therefore, much of this report focuses on the environmental or resource efficiency of air transport provision - that is, on the means of minimising the fuel used and pollution emitted per passenger-kilometre of travel. In pursuing this approach certain key points must be borne in mind:

- Environmental efficiency is not synonymous with economic efficiency, especially when resources and pollution are undervalued or ignored within the conventional economic system. Therefore improved competitiveness or profitability do not necessarily lead to improved environmental performance - quite the contrary as undervalued commodities (such as the environment) will tend to be overexploited.
- This particular approach takes the level of passenger or freight demand as a given, and assesses efficiency on a *ceteris paribus* basis. More specifically, it does not attempt to distinguish between 'important' and 'trivial' uses of air services.

Emissions from aircraft are influenced in complex ways by the interactions between a number of factors, some of which are discussed in the reports mentioned above. The main factors and influences may be summarised as follows. Other things being equal, emissions from aircraft:

- i. increase as passenger and freight air transport demand grows;
- ii. decrease as load factor (the proportion of aircraft carrying capacity used) increases;
- iii. decrease with improvements in aircraft fuel efficiency and enhancements to emission control features (although there may be compromises between pollutants, such as between carbon dioxide and nitrogen oxides emission);
- iv. increase with congestion at airports and in airspaces.

Liberalising or deregulating commercial aviation can influence these factors and so alter the environmental performance of the industry. Accordingly, these factors will run as threads through this report. From an environmental perspective, liberalisation may have negative and positive effects. On the negative side, there may be more demand, more frequent flights, smaller aircraft, and on some routes lower load factors leading to more emission per service performed and more congestion at airports. On the positive side, liberalisation might lead to more investment in 'cleaner' equipment, although increased uncertainties following liberalisation might reduce long term investment: also load factors might increase on some routes.

A central objective of the EU is economic liberalisation and the notion of a single market. Subsumed under this wide objective, the EU has a programme for liberalising most forms of transport. As part of this programme important changes for aviation are due to be implemented over the next decade. Within the European context for aviation addressed in this paper, the term liberalisation¹ is used to mean a relaxation of controls imposed on the obviously commercial activities of the main players in the aviation industry. These controls include aspects such as free access to markets and

¹ In this report the terms liberalisation and deregulation are used synonymously.

airport facilities. However, this liberalisation will take place whilst other important regulatory controls will be maintained or tightened, such as measures relating to safety or NO_x emission standards for aeroengines. Such areas of regulation can have a substantial impact on commercial activities of the aviation industry such as the purchase and operation of aircraft.

Experience in the USA and Europe indicates that liberalisation may mean faster demand growth, and more frequent flights in smaller aircraft and so more congestion. The effect on load factors and investment in efficient aircraft is not so clear. Liberalisation may thus change the determinants of emission, i to iv outlined above, such that there is increased fuel use and pollution emission, so degrading both global and local environments.

So far there has been little study of the environmental consequences of liberalising aviation either in general, or with specific reference to a single country or region including the EU. The research in this report aims to initiate analysis of this issue. The research identifies the possible effects of liberalisation in Europe; and outlines how certain environmentally deleterious effects of liberalisation might be mitigated. As emphasised above, no attempt has been made to quantify these effects. The specific objectives of the work are:

- To assess the effect of liberalisation on the European air transport industry, and the consequences for the environment;
- To propose ways in which the compromise between environmental, economic and general political objectives might be improved.

The report is in three main parts. The first part describes aspects of liberalisation pertinent to this study, and assesses the effects of liberalisation historically in the USA. The second part gives some detail on the current position and future prospects for aviation in Europe given further liberalisation. The third part draws conclusions from the study with particular reference to the environmental implications of likely developments, and makes some recommendations.

The report's focus is on aviation within the European Union (EU). However the international dimension of aviation means that the EU can not be studied in isolation. Bodies of international law, standards and formal and informal agreements make for strong interaction between aviation in Europe and elsewhere, particularly the USA. The findings of the work may have wider significance. The EU framework may be used as a model for development in other parts of the world, or at least strongly influence developments. For example, the economic change occurring in the states of the former USSR and in China is changing the structure of aviation for a large part of Asia, and liberalisation will be a component of this change.

We hope this report will inform certain aspects of policy formulation concerning aviation and the environment. The historical evidence is explored, and salient questions raised. To carry out the research we have used a number of source documents and in addition have discussed the issues with numerous experts from industry, and from regulatory and other bodies. These efforts have unearthed no other

detailed research, published or otherwise, on the linkage between aviation regulation and the environment. However this report has extensively used a number of useful descriptions and analyses covering aviation generally and regulation in particular; especially those by the Civil Aviation Authority (CAA, 1993), Doganis (1991) and Shearman (1992). A draft of this report was sent out for comment by industry and other bodies.

The formulation of a comprehensive policy for aviation and the environment would require consideration of all available options including technological and operational improvement along with demand management. The means of implementing such options, for example taxation and regulation, need a detailed description and analysis. Previous reports attempt to broadly outline elements of such a policy at the global level (WWF; 1991, 1994), but to our knowledge this has not yet been done in any detail for Europe.

2. AVIATION LIBERALISATION: AN OVERVIEW

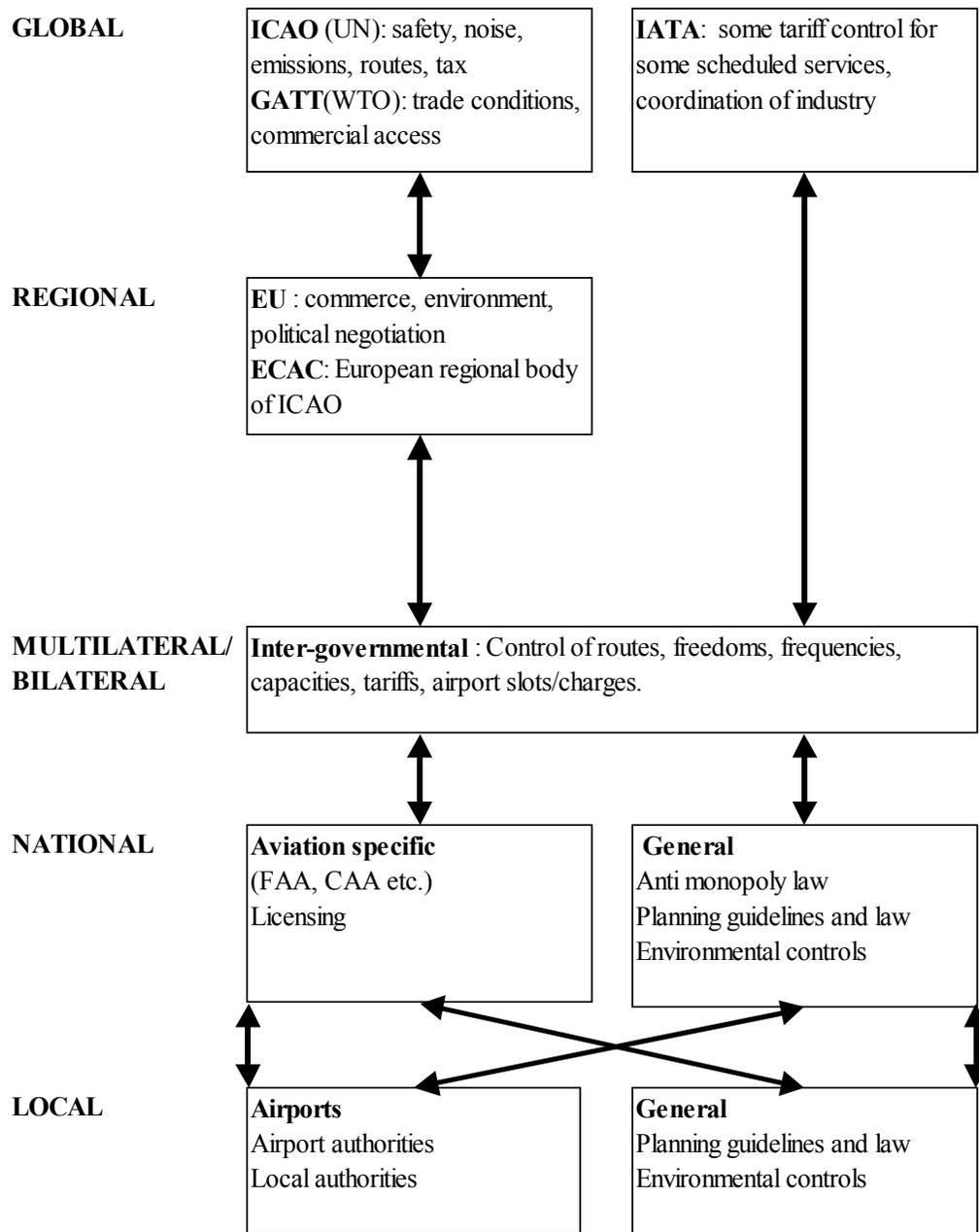
Liberalisation entails the relaxation of an existing regulatory regime. Accordingly, pertinent aspects of the existing regulatory framework are summarised before going on to discuss liberalisation itself.

The regulatory framework may be viewed as a network of interrelationships operating at different levels ranging from the global through regional and national to the local level. This is shown schematically in Figure 1. Regulatory forces and constraints can operate upwards, downwards and sideways through this network, although predominantly they operate downwards. At the international level the regulatory framework is largely a set of agreements and practices rather than laws which are enforceable; the framework is expressed as laws predominantly at the national level and lower. Regulation at a particular level is generally constrained by regulation at higher levels, rather than vice versa. For example, the allowable emissions of pollutants from technologies implemented locally are usually largely determined by national or international standards, although there are often local variations on laws. However, the setting up of regulation at any level is often heavily influenced by pre-existing regulation and practice at the level below. For example, the setting of regional or global standards for the emission of pollutants from technologies such as aircraft or power stations is often determined by multilateral international negotiations based on the capacities of national industries and economies to meet standards without excessive economic or other cost. Not all of the below are considered in detail in this study.

Presently governments dominate the regulation of the commercial activities of airlines through their control of the servicing of international and domestic routes. The influence of governments is greatest through the bilateral or multilateral negotiated agreements concerning the servicing of international routes or domestic routes by foreign operators. The International Air Transport Association (IATA) has an

important but declining influence on tariffs, and is also attempting to coordinate responses by the aviation industry to environmental concerns. The International Civil Aviation Organisation (ICAO) is the most important regulator of safety and environmental standards for aircraft.

Figure 1 : Regulatory network



2.1 Historical background

For the first fifty years of development, civil aviation was viewed as a strategic sector of particular national interest, partly no doubt because of the military implications of

aviation. However, the rapid growth in international civil aviation led to requirements for coordination and reciprocity which could only be achieved through international agreements. Initially these were mainly ad hoc and made bilaterally between individual countries. It became obvious that a broader multilateral system was required to cover other aspects such as environmental standards and international air traffic control.

Accordingly, during the early post war period an international regulatory framework was developed covering most aspects of civil aviation. The Chicago convention (1944) covered commercial rights into and across national airspaces; air navigation; and certain legal aspects of international air transport. Some areas of aviation are not covered including parts of military, customs and police operations. Eighteen Annexes to the Chicago Convention, known as International Standards and Recommended Practices (SARPS), were developed. These cover most aspects of civil aviation including Rules of the Air (Annex 2), Airworthiness (8), Facilitation (9), and Environmental Protection (16). Now there is a large body of international conventions, standards and agreements built on this foundation which restrict the policy options available in Europe.

However bilateral agreements between governments are still of prime importance, especially with respect to traffic rights between countries for scheduled services.

The International Civil Aviation Organisation (ICAO), an organ of the United Nations (UN), was formed in 1947. Under Article 44 of the Convention, ICAO pursues the objectives of developing the principles and techniques of international air navigation, and fostering the planning and development of international air transport. In doing so it seeks to foster international cooperation, for example in the fields of agreed safety standards, and the expansion of navigational facilities.

ICAO now plays a central role in the administration and development of the international regulatory framework controlling aviation. It has departments, committees and working groups dealing with specific areas, many of which influence, more or less directly, the environmental impact of aviation. Some of the committees, such as the Committee on Aviation Environmental Protection (CAEP) have representatives from interested and expert parties including aircraft and aeroengine manufacturers and airport authorities.

To a large degree, in order to be workable, the regulations formed by ICAO arise from formal and informal negotiations between national governments and bodies such as the Federal Aviation Administration (FAA) and the CAA; and regional bodies such as the EU, European Civil Aviation Conference (ECAC) and the aviation industry (airlines and manufacturers).

This regulation bears on technical safety and environmental issues, and on factors directly affecting commercial operation including taxes, costs and prices. In the main, charter services are not subject to the same commercial regulation as scheduled services, although other regulation pertaining to safety and environment does apply. This is important since charter operations provide a large proportion of air services in Europe.

2.2 Liberalisation and Regulation

2.2.1 The shift from protection to liberalisation

As noted above, aviation was initially seen, in many countries, to be in the national interest. Many aviation enterprises (airlines, manufacturers, airports) were initially developed as nationally owned industries. Even where privately owned, the aviation industry was, and still is, regarded as strategically important for economic and defence reasons. Furthermore, as a prominent international industry, it is often seen as a matter of national prestige. Accordingly one main objective of regulation has been the preservation of the market shares of national carriers, particularly in domestic operations.

In today's world, most economic sectors of the majority of countries are subject to regulation although this is not always sector specific as Staniland (1995) observes². Regulation applies to many facets of the economy including market monopolisation, consumer rights, and product performance including safety and environmental impact. Those sectors which have outright or near monopolies are more regulated: either through the public administration of publicly owned industries (e.g. the French nuclear power industry); or through the public regulation of private industries (e.g. US electricity supply utilities). Even where a sector has many competing suppliers, competition typically occurs within a framework of regulation. Two important points can be made: first, regulation applies to many facets of industrial activity, not just those which relate to obviously commercial matters such as market access; second, it is not a matter of mutually exclusive regulation or freedom, usually there is some freedom of manoeuvre within a regulatory framework.

The preponderant view used to be that quite extensive regulation had economic and consumer service benefits. Commercial air transport was often viewed almost as a public utility. This brought to the operators the advantages of restricted competition, but also the accompanying responsibilities of a public service. It was also surmised that deregulation would lead to an oligopoly which in turn would cause wasteful competition. Concerns were expressed about the effect of more competition on the financial stability of the industry.

The past fifty years has seen commercial aviation develop into global transport system now carrying more than a billion passenger journeys a year (but note that many people make more than one journey by air per year, and so the vast majority of the world's population do not travel by air in any particular year). In the last two decades, this growth, coupled with the increasing dominance of free market thinking in many countries, gave rise to the idea that aviation should be liberalised. The argument was, and is, that liberalisation will bring greater competition through the fragmentation of monopolies. This in turn will increase economic efficiency and benefit consumers through lower fares and a diversification of services offered. Lowered fares would also have the benefit of making air travel affordable by more people. This benefit to

²There are important sectors, such as the military, that are less subject to regulation.

consumers also has the implication of more travel and thereby more atmospheric pollution, but such potential environmental disbenefits have largely been ignored in setting liberalisation policy.

2.2.2 Some features of liberalisation

Liberalisation may be characterised by the measures or changes which the process can involve. These changes generally involve less control of access to domestic or international markets by operators; and a reduction in, or abolition of, price regulation. For the USA and Europe the measures are as summarised in Table 1.

Table 1 : Liberalisation measures

Industry sector	Measure
General	No preference to domestic companies over foreign
	No price controls except to prevent predation or discrimination
	Less differentiation and integration of domestic and international services
	Control of market monopolies
	Flexible development of cargo services
Airlines	Relaxation of charter rules
	Less restriction on capacity, frequency and route access and operation
	No anti-competitive use of booking systems
	Restriction of customer loyalty rewards such as Frequent Flyer Programmes
Airports	Charges related to cost irrespective of nationality
	Fair access of airlines to slots/bays etc.
	Competition for airport services such as baggage handling
Travel agents	No exclusive relationships with airlines, through commission or agreement

Note: Largely based on text from Doganis (1993) and Shearman (1992)

2.2.3 Service coordination: interlining, pooling and code-sharing

The demand for air transport between a particular origin and destination can be met incurring the least pollution by getting the best balance of high load factors on the best available aircraft and achieving the lowest possible total flight distance. A single carrier has a limited number of routes and aircraft available. However, in theory, given a stock of aircraft at any time, the environmental impacts and costs of air transport services can be minimised by operators coordinating their services as if they were part of a single enterprise. For example a passenger from London might want to

visit Paris and Berlin and then return direct to London. The environmentally best arrangement might be to use different airlines for each of the three flights, whereas being constrained to one airline could worsen one or more of the factors determining pollution emission.

Where such coordination does not exist, environmental and economic inefficiency can result. Competing services may result in lower load factors, greater frequency of flights by smaller aircraft, and the bunching of flights around peak demand periods. These effects result in increased pollution because of the direct implications for individual aircraft, and also because of aggravated congestion in airspaces and at airports. In some cases, being restricted to one airline can mean a passenger flying a needlessly circuitous route because one airline may not offer direct services between the passenger's origins and destinations, whereas another may. In this case the distance travelled by the passenger can be substantially greater than necessary, and more distance generally means more pollution, other things being equal.

Partly in recognition of the limitations of single operator services, some airlines already coordinate their services on certain routes such that a traveller with only one ticket may travel on aircraft operated by different airlines: this is called interlining. Interlining is principally arranged through three mechanisms: interline agreements, pooling and code-sharing. An interline agreement is where one airline operates a flight or route which uses aircraft from that airline and another, with aircraft keeping the codes of their own airlines. Code-sharing is like an interline agreement except that a single code is used. This means that only one code appears on the Computerised Reservation System (CRS) which delivers advantages in marketing services. Pooling is where two or more airlines agree to share the provision of services, and sometimes the revenues and costs on one or more routes.

Of course if airlines act 'as if they were part of a single enterprise', there is a risk that this would diminish competition. Conversely, certain forms of interlining can enhance competition by, for example, allowing small airlines to provide services on certain stages at certain times when they could not service a whole route. Furthermore coordinating or sharing services potentially offers cost reductions to the consumer because capital and other resources are used more efficiently, but only to the extent that competition is not reduced so as to allow monopolistic pricing. It is clear that service coordination can work to increase or decrease competition and economic efficiency and so it presents a difficult problem to regulators. Both the European Commission and the US Department of Transport are currently studying code-sharing.

Pooling is viewed as especially inimical to competition and is illegal in the USA, and was even before deregulation there. Conversely interlining can enhance competition by allowing smaller airlines to enter the market compete on certain routes - the European Commission has on occasion required major airlines to compete with smaller ones. Goldman (1995) discusses several aspects of code-sharing with a focus on the US context. He argues that code-sharing should be deregulated and any threats to competition controlled by more general legislation such as that relating to anti-trust (monopoly) activities.

As remarked at the outset of this section, the environmental efficiency of air transport services, measured for example in pollution engendered by transporting a passenger over a given route, can be affected by the degree of air service coordination. This balance between coordination and competition is very significant environmentally, and could be strongly affected by liberalisation.

2.3 Liberalisation in Europe

As explained above, the overall regulatory framework of post-war civil aviation was established under the Chicago Convention of 1944. However, the detailed arrangements for the provision of air services remained in the hands of individual states. In the European Economic Community as elsewhere, the air transport market was heavily regulated through bilateral agreements between Member States. These often included fixing of fares on routes, and preferential treatment or exclusive access to national carriers.

In 1974, the European Court ruled that the general rules of the Treaty of Rome should apply to the aviation sector, thus establishing a basis for EC civil aviation policy in the promotion of free and open competition for services. Some minor practical developments followed (notably a Directive on interregional services in 1983), but it was not until 1987 that the First Liberalisation Package signalled a major step forward.

This Package included two Regulations (3975/87 and 3976/87) which implemented the Community's competition rules in the air transport sector. These were accompanied by a Directive on scheduled air fares and a Council Decision on capacity sharing and route access for carriers. These measures began the process which was progressively to replace bilateral agreements between Member States with truly EU-wide arrangements; and in the same year the Council adopted a political commitment to complete the Single Aviation Market.

The so-called Second Package of liberalisation measures was adopted in 1990, but some Member States were reluctant to proceed as quickly as the Commission had proposed. In 1992, however, the aims of the CTP acquired more tangible form with the completion of the Single European Market. Almost by definition this in turn required further liberalisation of transport systems and the removal of trade barriers, for example through common standards and open borders, in order to enable the free movement of goods and people throughout the Community.

For the air transport sector, these changes came in the form of the Third Liberalisation Package, which is expected to bring about a further extension of 'Open Skies' policies. The earlier measures had established many of the principles required for a liberal policy and gradually opened up the EU's air transport market; but the Third Package is generally regarded as the culmination of the 'Open Skies' approach, effectively designed to replace the former bilateral agreements with a multilateral regime for services within the Community.

Key elements in the package involve the establishment of common operator licensing rules for the whole Community, and the abolition of regulatory distinctions between

scheduled and charter operations. So-called 'fifth freedom' and 'cabotage' rights are also made virtually universal (although cabotage rights do not come fully into effect until 1997). These rights allow a carrier from one country to operate international services between two other EU Member States, and domestic services within another Member State, respectively.

It should be noted, however, that the Third Package came into effect at a time when the rapid air traffic expansion of the late 1980s had been thrown into reverse by the Gulf Crisis and economic recession. As a result, most carriers were more concerned with consolidation than expansion, and the take-up of the new measures has to date been limited. Furthermore, Member States are reluctant to cede negotiating rights with third countries to the Commission. It is therefore still rather early to assess the practical impact of the measures adopted; but as explained below, this is a potentially important determinant of the environmental impact of European policy.

2.4 General effects of liberalisation

This section looks at the effects of liberalisation, as defined by the sorts of measures outlined above, which arise because of the responses of the aviation industry and consumers to the altered regime. One can learn of these effects by studying historical experience, or by undertaking some theoretical analysis. These two approaches are complementary. The analysis focuses on effects which are environmentally important.

In this report the historical approach is principally employed. A number of difficulties arise in this historical analysis as is explicated in the following points.

- **Isolating the effects of liberalisation - what would have happened anyway?** It is not easy to isolate the effects of changes in regulation from the effects of other factors. For example: an increase in air transport demand could be due to some combination of lower fares, greater wealth, cheaper holidays, economic internationalisation, the degradation of alternative modes or something else. Furthermore, deregulation has never been implemented rapidly and widely - it has been introduced gradually, sometimes piecemeal, over a period of years. This makes the effects particularly difficult to isolate.
- **Effects on different market segments.** The impacts of liberalisation may vary across market segments, to the degree that the consequences may even be contrary in different segments. For example the proportional change in fares may not be the same for business as for leisure travellers. The implications for routes may vary especially between domestic and international services. This is even so for domestic routes: Belobaba and Van Acker (1994) show how the degree of concentration³ on different hub and spoke routes in the USA is markedly different.
- **Dynamic response.** The dynamic response of the industry and consumers to deregulation means the effects may vary over different time scales. This is in part

³ Concentration is a measure of the dominance of a few airlines.

because the system contains inertia to change due to factors such as the slow turnover of aircraft stock, lead times for the development of airport and other facilities, and the time taken for operators to find new strategies in the altered context. For example: it seems that immediately after deregulation one can expect many new entrants into the market with all the consequences which such competition implies; but that in the longer term the large players drive the small entrants out of business or possibly absorb them with the result of an oligopoly and reduced competition (see Belobaba and Van Acker; 1994). This is not always the case however - new entrants can compete successfully especially in restricted niches.

- **Different socioeconomic and geographic context.** The context for liberalisation changes with time and place. The USA is different from Europe, and Europe in the 90s is different from Europe in the 80s. Some notable differences are summarised later in Table 4.
- **Different liberalisation (deregulation).** The combination, extent and rate of implementation of liberalising measures of the past in the USA and Europe are not those of the future in Europe. Also, as noted elsewhere, extensive liberalisation has already occurred in certain segments of the European market.

For these reasons, as is always the case with historical analysis, it is not possible to draw very firm conclusions as to the effects of the specific factor of liberalisation. In the next section the US experience is assessed, but it is emphasised that conclusions from this experience can all not be directly and obviously applied to Europe.

2.5 The US experience

The main experience of liberalisation or deregulation on a large scale has been in the USA over the past twenty years. This experience is most important because the USA is such a large aviation country, currently constituting some 42% of world aviation, and exercises such a powerful influence on global aviation developments.

Prior to 1978 aviation in the USA was strongly regulated by the Civil Aeronautics Board (CAB). The most significant powers of the CAB were perhaps route allocation and price control. In 1978 the Airline Deregulation Act was passed. Under this Act most of the controls were phased out over the seven year period to 1985. The impacts of this deregulation on those factors affecting environmental performance are summarised below.

2.5.1 Routes

Liberalisation led to substantial alterations to the route network. For the smaller volume routes single plane services were generally uneconomic, and so these routes were integrated into a hub and spoke system. This means small aircraft flying infrequently along spokes from small market centres into major hubs. Passengers generally have to change planes at the hub before flying out on another route. The hub and spoke system increases the need for airport slots at the hubs and therefore generally increases congestion there.

The hub and spoke system can increase competition on the high volume traffic routes between hubs. Small volume routes and airports tend to be dominated by single airlines because the market is not large enough to sustain many competitors. The CAA comments that:

Even when consolidated, the demand on the thinner spokes requires aircraft smaller than those operated by the hubbing airline. To exploit the advantages of intralining, the large airlines have reached agreements with commuter carriers to serve these routes on their behalf on a code-sharing basis. (CAA, 1993; p143).

For pairs of nodes with substantial actual or potential traffic, more airports were connected directly in domestic city to city services, and in city to foreign city services, as a result of these changes.

The needs of the smaller communities encouraged the development of the commuter airlines, the small airlines using aircraft with less than 50 seats and linking the smaller towns and cities with a nearby larger city served by a bigger carrier. (Shearman, 1992)

Such restructuring of the route and services network has a number of potential implications for fuel consumption and pollution. Unfortunately it is not possible to quantify the implications in this report, even to the extent of concluding whether the network changes lead to a net increase or decrease in pollution.

2.5.2 Congestion

The number of aircraft movements results from a combination of passengers moved, load factors and aircraft size in seats and the pattern of services. Shearman (1992) observes that traffic increased as a result of deregulation in the USA, and that therefore *“The inevitable congestion, particularly at peak times, forms a significant effect of de-regulation.”*

2.5.3 Frequent Flyer Programmes (FFP) and Computerised Reservation Systems (CRS)

FFPs give free air miles or reduced air fares to passengers using a particular airline regularly. The principal objective of FFPs is to encourage loyalty to particular airlines. A secondary effect is to make the marginal cost of some future flights low or zero and thereby stimulate demand. Part of any increase in demand may be at a low environmental penalty if it is mainly taken up by increases in load factor.

The booking and thence loading of aircraft is organised through CRS. There is a temptation for the owner(s) of CRS to highlight the services of any airlines in which they have an interest, to the disadvantage of other (usually small) airlines. In practice this is prevented by government regulation in the USA and the EU, although Staniland (1995) suggests that US CRS still discriminate against EU carriers.

One potential consequence of FFPs and CRS is reduced competition because there are difficulties or disadvantages to the customer in changing airline: the degree to which

this occurs depends on the stringency of regulation in practice. This can bring about environmental disadvantages because the customer may then be less likely to choose the optimal environmental route and aircraft. An additional disadvantage of FFPs is that they stimulate demand and thereby increase emissions.

2.5.4 Airlines

Following deregulation many new airlines were formed. They attempted to secure viable market shares by aggressive marketing and fare setting. Generally their efforts were not very successful in the longer term.

Over the period 1979-1992 168 new entrants were launched, of which 56 were still flying in 1992. (CAA, 1993; p144).

Early in this period these potential new entrants had a great impact on the established operators in dragging down their profits on domestic and international routes. However the world economy was not strong during the same period therefore causality is not established with complete certainty.

The above data indicates that, while the industry has grown more concentrated, markets have on average become less so. (CAA, 1993; p145).

What this means is that while there are fewer large companies effectively competing in aviation as a whole, there is more competition between particular city pairs.

2.5.5 Air fares

Although there was some attempt to lure customers through enhanced quality of service, much competition centred on ticket pricing. After regulation a wider spectrum of fares was offered with far more passengers buying discounted tickets.

The industry was faced with the advent of new airlines with low overhead costs or with non-unionised labour or with new innovations to produce high traffic volumes. The result not surprisingly was that air fares fell. Compared with 1974 the average air fare in real terms in the mid 1980s had fallen by 25%. Shearman (1992)

Competition has definitely produced lower and more readily available air fares. Shearman (1992)

It seems clear that there was considerable downward pressure on prices, and so deregulation encourages demand growth. This pressure may have weakened in the longer term in some route groups as new entrants have failed and some consolidation and monopolisation has taken place.

2.5.6 Demand

In the ten years following deregulation (1978 to 1988) domestic air traffic in the USA grew by some 54%. It is notable that world domestic and international traffic grew by

about the same amount during this period, and that much of this traffic growth took place in regulated markets. This suggests that deregulation did not have a very large effect, but it must be remembered that the USA was growing from a much higher base demand in per capita terms than any other large country.

2.5.7 Load factors

The load factor of a passenger aircraft on a particular flight is defined as the proportion of seats filled. Note that what is of interest is the number of people carried by an aircraft, which is determined by the load factor and the density (or spacing) of seats. Chartered aircraft services tend to have higher seating densities and load factors, and thereby, *ceteris paribus*, emit less pollution per passenger kilometre. The load factor of aircraft in the USA is less than the weighted average of Europe. Airlines will in any case generally try to maximise their load factors to improve the revenue cost ratio, but low fares increase the rewards of so doing.

... what is certain is that the larger number of lower fare passengers per flight has necessitated higher seat factors. (Shearman, 1992)

Deregulation blurs the difference between scheduled and charter services where the latter generally have higher load factors. *By mixing normal traffic and charter traffic, the scheduled carriers are able to improve load factors by filling up seats which would otherwise be empty* (Doganis, 1993)

New entrants can lead to an overcapacity of aircraft, and until this is 'shaken out' the load factor will be suppressed as airlines compete for market share.

To summarise: to reduce fares and compete more effectively, airlines try to increase load factors. (However one way they do this is to increase discretionary travel which increases demand.) Overcapacity depresses load factors, as can the hub and spoke system on some routes. These forces may be in approximate balance. The CAA suggests that the effect on load factor may not have been large.

In the US there does not seem to have been a radical improvement in two other key cost-efficiency parameters, seat factors and aircraft utilisation, nor have low costs been a guarantee of success. (CAA, 1993; p111)

2.5.8 International dimension

There was extensive renegotiation of the bilateral agreements especially on the north Atlantic and Pacific routes. An immediate effect of this was an increase in the number of airlines and their aggregate scheduled capacity. But then, in the longer term, the collapse of several North Atlantic services ensued. Demand jumped by 23.4% in 1978, but grew only by 1.5 % the following year. The load factor leaped upwards from 60.7% in 1977 to 66.6 % in 1978 thereafter stabilising at between 65% and 70%

2.5.9 Summary of US experience

It should be clear that deregulation has altered factors which affect the environmental impacts of aviation in the USA. The directions of the individual effects are summarised in Table 2. Unfortunately it is not clear what the overall net environmental impact has been, since the effects of liberalisation vary with market segment and time.

US air transport as an industry is now as concentrated as it had been under CAB regulation and perhaps the most notable feature of deregulation has been the failure rate of new entrants. The barriers to entry in air transport have proved much higher than has been suspected by those who believed the industry to be contestable. (CAA, 1993; p162).

For this reason, and those adumbrated previously, the long term impact of deregulation in the USA has probably not been very large in its alteration of environmental performance. A few comparisons with contemporaneous trends in the rest of the world support this view.

Table 2 : Effects of US Deregulation

Driver	Effect	Fuel use and emission
Lower fares	More demand	+
Overcapacity	Lower load factor	+
Hub and spoke network	More plane changes, landings and take-offs	+
	Longer flying distance	+
	More airport congestion	+
	Smaller aircraft on spokes	+
	Efficient turboprop aircraft with higher load factors on spokes	-
	Larger aircraft between hubs	-
	Higher load factors	-
Direct routes	Shorter flying distance	-
Poor profitability	Less investment in new aircraft	+

Note: '+' increase, '-' decrease

3. THE CIVIL AVIATION INDUSTRY IN EUROPE

In Europe, as elsewhere, the early development of civil aviation was heavily dependent upon state subsidy, and dominated by national carriers, which emerged as the natural consequence of each state's sovereignty over its own airspace. These state airlines were a source of national pride and symbolic of technological progress, sometimes to the exclusion of economic rationality. This system did however lay the foundations of civil aviation as it exists today, and air services in many states remain dominated by airlines closely bound to their national government, both financially and politically. To one extent or another this remains the case within the EU; but now government intervention and national carrier domination are viewed primarily as a serious obstacle to the 'Open Skies' policies being pursued by the EU collectively.

The latter part of the 1980s witnessed rapid growth in air transport services, and the EU was no exception to this. For example, the number of seats offered on intra-Community services increased by 50 per cent between 1987 and 1991, and 100 new routes were added. This was partly in response to falling fuel costs, and was partly engendered by the process of liberalisation of air transport services.

The Association of European Airlines (AEA, 1994) stresses that a great deal of capacity was added by European airlines in the 1980s, partly to strengthen their competitive position in anticipation of future market liberalisation. This process contributed to chronic overcapacity in the industry, which became acute when the delivery of new aircraft ordered in the mid to late 1980s coincided with the Gulf War and a global recession.

It is thus a central paradox that the European civil aviation sector is an industry characterised by huge growth accompanied by at best marginal profitability. Some independent operators have maintained at least modest profit margins throughout the period, but many have been forced into bankruptcy. The largest losses have been sustained mainly by the national carriers (IATA, 1993). This has raised questions about the efficiency of national carriers, and their ability to compete effectively with US carriers on the North Atlantic routes (CAA, 1993). Objections have also been raised as to the extent of state subsidy to some national carriers since these are obviously a barrier to free competition.

In June 1994, the International Air Transport Association announced that it expected world airlines to return to profit in 1994, after worse than expected losses totalling US\$4.1 billion in 1993. The latter loss came in spite of traffic growth of 7.7 per cent year on year, with IATA arguing that the increase in passengers had been 'bought' through widespread fare discounting. It considered lower fares to be the result primarily of continuing overcapacity, and noted that capacity continued to increase in 1993, albeit less rapidly than the number of passenger journeys.

This has led to recent moves to reassess the industry and to bring about further changes, as described below. Owing to the pressing financial problems faced by many airlines, attention has focused on the economic aspects of airline operations. Environmental consequences have often been overlooked as a result, or been addressed in an extremely partial fashion. This report, however, will attempt to assess

the environmental implications of future changes in the European civil aviation industry, should these occur.

3.1 The present structure of aviation in Europe

Airlines who are member of AEA constitute the major suppliers of air services in Europe. Table 3 gives a breakdown of the services provided by AEA airlines in 1993. Of note is that nearly half of supply is on routes between Europe and other regions at least in terms of passenger distance. Domestic and intra-EU services are rather more important in terms of the total number of flights or passenger journeys. Nonetheless, this underlines the importance of the impact of EU liberalisation on the EU's external arrangements.

Table 3 : Passenger service supply in Europe: 1993

Route class	Passenger distance (Gp.km)	% 1993 total	% Growth 1992-3
Domestic	102	29%	
International flights in Europe	80	23%	7.0
North Atlantic route	102	29%	6.5
Far East/Australasia	68	19%	8.4
Total scheduled	352	100%	6.6

Source: AEA (1994)

The demand for all services has grown in the years to 1993, with the highest level being in the long haul for the Far East. About 90% of passenger service (in terms of p.km) is scheduled, the remainder being charter. Charter operations provide more than half of international services (in p.km) between EU countries: this is important since liberalisation will have most effect on scheduled (i.e. non-charter) services.

Fuel consumption is a good general indicator of pollution emission: it is very accurate for carbon and water emission, but nitrogen oxides emission is also dependent on engine design and loading. Figure 2 shows use of jet fuel for the EU and for a wider Europe. This uses International Energy Agency (IEA, 1992) data which relate to the country in which fuel is loaded, and so is not directly related to the consumption of airlines or passengers of particular nationalities. The Figure shows the dominance of a few countries. Britain, Germany and France account for about 60% of fuel use, and thus a similar proportion of pollution, in the EU. This is important since liberalisation is already relatively extensive in Britain in that there is no nationally owned airline, and certain bilateral and multilateral arrangements between Britain and other countries, such as the Netherlands, were already quite liberal before the EC Third Package. This means that the impact of liberalisation on Britain, a large air service provider, will be less than many other countries. The addition of Eastern European countries will not alter greatly this dominance unless the Russian Federation is included.

The historical growth of aviation fuel use in Europe is depicted in Figure 3. This shows two decades of growth in EU countries for all bar four years. Over this period, despite a significant fall in fuel use per passenger kilometre, the growth in total fuel use and its associated pollution has been substantial in the EU, and in wider Europe. The demand projections made by the industry and regulating bodies imply a continuation of these trends: that is further increases in pollution emission and environmental impact.

Figure 2 : Jet fuel use (1991)

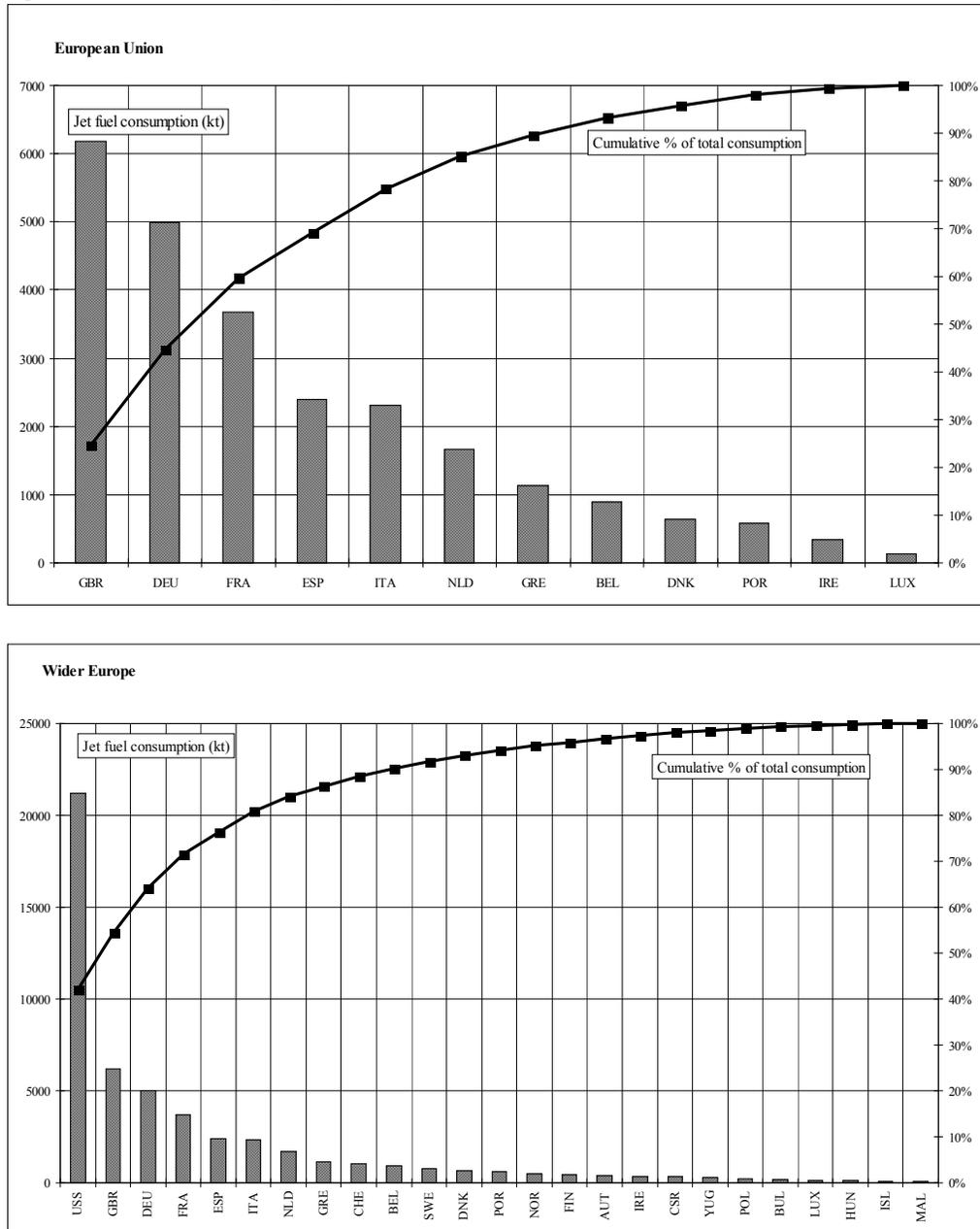
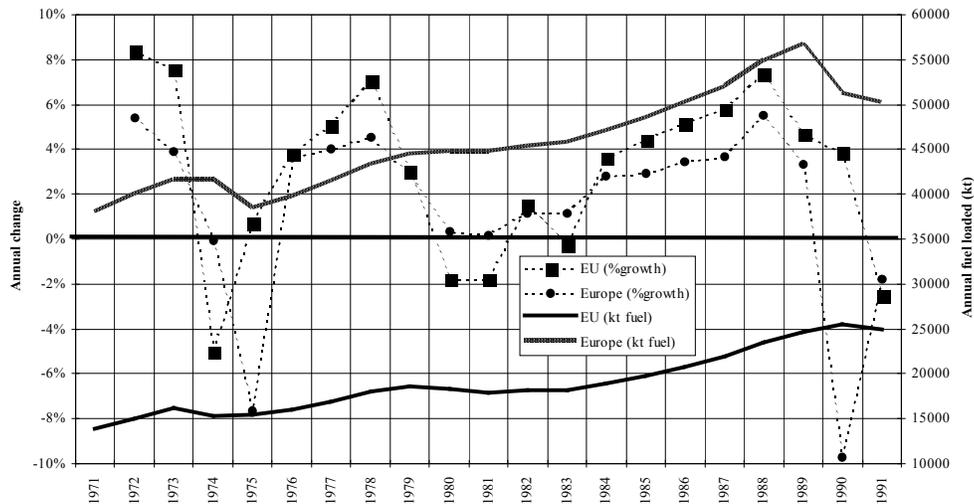


Figure 3 : Jet fuel use trends



3.2 EU Policy towards aviation

The Common Transport Policy (CTP) was seen to be at the heart of the European Economic Community from its inception, as its *raison d'être* is the promotion of trade, and hence movement of goods. It should be added that the free movement of people is also regarded as an aspect of an open market (especially an open labour market), but this has had less obvious effects on the development of the CTP as a whole. However, aviation and shipping have been dealt with by the Community separately from land-based modes of transport.

For the civil aviation sector, the promotion of free competition between operators in different Member States has been a more important determinant of policy than has the requirement for free movement. As noted above, air transport in Europe has evolved through a system of national carriers, most of which remain in the public sector. These have traditionally been heavily subsidised during difficult economic times in the interests of national prestige rather than sound economic or industrial policy. Alongside this, their access to domestic markets has been protected, amongst other means through preferential allocation of takeoff and landing slots at national airports, and bilateral agreements with external carriers.

This has resulted in higher air fares and poorer productivity in the EU civil aviation sector than in the US, for example (although valid comparisons are difficult to make, as CAA (1993) notes). Thus reform of this sector has become a priority of EU industrial policy, not only to improve the efficiency and competitiveness of the European industry, but also to offer lower costs to air transport users. These policies are described in greater detail below.

The EU's Civil Aviation policy began to take tangible form from 1974, when the European Court ruled that the general rules of the Treaty of Rome should apply to the aviation sector. Some minor developments followed; but it was in 1987 that the first

major step towards liberalisation was taken through the so-called ‘December package’ of measures.

The Second Package of liberalisation measures was adopted in 1990. Then in 1992 the completion of the Single European Market aimed at the removal of trade barriers and measures to enable the free movement of goods and people throughout the Community. For the air transport sector, these changes came in the form of the Third Liberalisation Package.

The recent White Paper on the Common Transport Policy (discussed below) outlines the main areas of action required from the Commission under the Third Liberalisation Programme. These are:

- to adjudicate on licensing of carriers;
- to decide whether Member States' allocation of slots at airports is fair and justified (although the regulation dealing with slot allocation was not itself part of the Third package);
- to respond to complaints on excessive or unrealistically low fares

In general, the Community's institutions must also ensure that its legislation is properly implemented via national laws, regulations and administrative procedures, and that airport facilities are being used effectively and without discrimination in the interests of the single market. The White Paper also makes it clear that the Community's powers to interfere in the aircraft field go beyond those available in other transport modes, as oversight of licensing, routes and fares was thought to be necessary to deliver an open air transport market.

Increasingly, moreover, it is envisaged that the EU will take over negotiation of relations and agreements with states outside the EU, which to date have been handled bilaterally by each Member State.

3.3 Aviation and EU environment policy

While a Common Transport Policy was provided for under the Treaty of Rome in 1957, the Community did not acquire explicit Treaty responsibilities for environmental protection until the Single European Act took effect in 1987: responsibilities and powers which have now been extended under the Maastricht Treaty. The White Paper on Sustainable Mobility is intended to reflect these changes in Treaty obligations, and the EU's commitment to sustainable development. However, serious tensions remain between these two policy areas, as discussed below.

Alongside the White Paper, the Fifth Action Programme on the Environment made explicit the importance of trade and transport within the context of EU environmental policy, and justified a more radical approach to the latter. Specifically it stated (in ¶1(ii)) that:

The present approach and existing measures are not geared to deal with the expected growth in international competition and the upward trends in Community

activity and development which will impose even greater burdens on natural resources and environment and, ultimately, the quality of life.

The Action Programme also reflected the developing requirement to integrate environmental protection into other policy areas - a trend which has been stressed increasingly since the publication of the third Action Programme in 1983, and became a Treaty obligation under the Single European Act in 1987.

The Programme drew attention to the problems of noise and emissions from both road and air traffic, and commented that:

Present trends in road and air transport are all leading towards even greater inefficiency, congestion, pollution, wastage of time and value, damage to health, danger to life and general economic loss. Physical constraints - mainly environmental constraints - are such that it will not be possible in the future as it was in the past, to base transport policy on the demand side of the equation.

This of course is a rather radical statement; but as described below, it is difficult to see how it has been translated into specific policy action in the air transport sector in particular.

More recently, the final chapter of the White Paper on *Growth, Competitiveness and Employment* (COM (93) 700 final) has expanded on the theme of environmental taxation with particular reference to the transport sector, and in some respects goes beyond the statements in the Transport White Paper.

As a result of these developments, the internalisation of external costs is seen to some extent as the philosopher's stone which will transform the relevant policy areas (economic growth; single market; social policy and environment) into a coherent strategy for sustainable mobility. However, there remain numerous obstacles to achieving this end; and the problems of imposing taxes on a market such as air transport are especially intractable, as discussed below.

In the sections which follow, particular aspects of environment policy as it affects air transport are reviewed.

3.4 The regulatory framework of civil aviation in Europe

It should be noted that, since the coming into force of the European Economic Area agreement, the EU civil aviation regime has covered Norway, Sweden, Austria, Iceland and Finland as well as the Member States themselves. In that respect, the coming enlargement of the Community to include Austria, Sweden and Finland will have relatively little impact.

Prior to that the Community had negotiated agreements with Norway and Sweden in 1992. Beyond this, however, external aviation relations of the Community remain largely governed by pre-existing bilateral agreements, and little progress has been made in substituting Community-wide arrangements. The European Parliament is also wary of such an extension of the Commission's powers because of the implications for Member State sovereignty.

Priority in the aviation sector is now expected to be placed on developing Community-level arrangements with the states of Central and East Europe which have recently entered trading agreements with the EU. It should be noted that the European Civil Aviation Conference (ECAC), which has a broad and expanding membership amongst European states, is actively involved in the wider harmonisation of civil aviation.

European Union Member States are parties to the 1944 Chicago Convention on International Civil Aviation. Member States are also members of the International Civil Aviation Authority (ICAO). The Convention and ICAO are introduced above, their relevance to EU liberalisation is expanded upon below.

3.4.1 Noise and nitrogen oxides emissions

ICAO regulates a very wide range of operational aspects of global civil aviation - setting standards for safety and environmental performance, for example. Of particular relevance in the context of this paper are the ICAO standards on noise and nitrogen oxides (NO_x) emissions (although carbon monoxide, hydrocarbons and smoke emissions are regulated along with NO_x).

Noise standards are defined in Volume 1, Part 2 of Annex 16 to the Chicago Convention. Subsonic aircraft (jets and large propeller-driven types) complying with the latest standard (i.e. certificated after 6 October 1977) are listed in Chapter 3, and earlier, noisier types in Chapter 2.

Standards for nitrogen oxides emissions are also defined in Annex 16, which in 1981 was given the new title of *Environmental Protection* in 1981, to reflect its broadening coverage. A 20 per cent reduction from the 1981 NO_x limits was agreed in 1993, to cover all new types of engine introduced after 31 December 1995. It should be remarked that for technical reasons a compromise has to be made between reducing NO_x emission and reducing fuel consumption (and thereby fuel related pollution such as carbon dioxide) of engines. For example, as the Royal Commission for Environmental Pollution (RCEP) reports:

Post-1982 jet engines in the USA, for example, were found to produce 70-85% less carbon monoxide and unburnt hydrocarbons than earlier engines, but at least 12% more nitrogen oxides. (RCEP, 1994, p 73).

These emissions standards are a function of the power of the engine being tested, so aircraft with larger engines or a larger number of engines have a higher allowable level of emissions. The standards do not directly relate to what might be more useful measures such as emission per seat kilometre.

The current standards also relate only to the landing and take-off (LTO) cycle, so they do not provide an accurate guide, for all engines, to emissions when climbing or cruising at altitude. This is important since, as the RCEP (1994, p74) notes "the great bulk of nitrogen oxides is emitted during the climb and cruise phases". There are of course enormous difficulties in measuring actual emissions at altitude, and emissions depend upon characteristics of the airframe and its operation, as well as the engine

itself. ICAO is considering some means of certifying aircraft emissions to reflect these points, but a reliable method is likely to be some way off.

Furthermore, as ICAO must seek to achieve consensus amongst its members, the standards which it sets are those which most if not all new aircraft can already meet, so they do not have the effect of forcing improvements in the environmental performance of aircraft. That is, they reflect progress in aircraft engine technology, and exclude technology which would be a retrograde step, but have not to date contributed greatly to meeting any particular environmental standards or targets. The RCEP (1994, p74) argues that this should change, and that ICAO "should not confine itself to technology-based standards, but should adopt a technology-forcing role". Although the ICAO standards in this field are advisory rather than mandatory, they are in practice regarded by manufacturers as an industry standard.

To date the European Community has followed the standards set by ICAO, but has given them mandatory force and has had the effect of ensuring their introduction across the EU. That is, a Directive of 1989 forbade carriers in EU Member States from adding the noisier Chapter 2 aircraft to their fleets from 1990; while a Directive of 1992 forbids the operation of the oldest of these aircraft from 1995. This Directive reflects the terms of an ICAO Resolution and a recommendation from the European Civil Aviation Conference. Chapter 2 aircraft under 25 years old are to be phased out by 1 April 2002, with some exemptions. The latter Directive applies not only to EU-based carriers, but also to aircraft of non-EU carriers which fly into EU airports.

There is however mounting concern (especially in Europe) that the growth in air traffic is outstripping the environmental gains which will be achieved through the measures taken so far. ICAO's Committee on Aviation Environmental Protection (CAEP) is currently considering the adequacy of the standard agreed for 1995, but the need for consensus, concerns over the overall cost of tighter standards, conflicting priorities and the degree of scientific uncertainty over environmental effects all add to the difficulty of tightening the standards any further.

The possibility now exists, therefore, that the EU could 'go it alone' on NO_x and/or noise standards if ICAO does not agree to more stringent standards soon. At the time of writing, the Commission is considering a draft proposal for tougher noise and emission standards to be applied at EU level. This is described and discussed in greater detail below.

3.4.2 Carbon dioxide emissions

The carbon dioxide emissions of aircraft are determined by their fossil fuel consumption. Standards are not set for fuel use or carbon emission; but because fuel use accounts for a significant share of airline operating costs, operators (and therefore manufacturers) have an incentive to reduce fuel consumption and thereby carbon dioxide emission.

Although individual aircraft emissions are not regulated, the total emissions of the civil aviation sector will attract increasing scrutiny because of their contribution to global climate change. While not large by comparison to those of some other sectors,

the anticipated rate of growth of aircraft carbon dioxide emissions is clearly a cause for concern, as are the potential effects of other emissions from aircraft at high altitude (see for example WWF, 1994).

Under the terms of Article 4(1)(a) of the Framework Convention on Climate Change, parties to the Convention must compile an inventory of their greenhouse gas emissions, including those of carbon dioxide. Article 4(2) further commits developed countries to draw up policies to mitigate these emissions. Owing to the international nature of air travel, however, the bulk of emissions from aviation bunker fuels are not currently included in national inventories, even though the air transport contribution to the national total could be significant in some cases. It follows from this that they will also be excluded from national emissions control plans. As yet no guidance has been provided as to how this omission will be tackled, but it is currently under consideration in the Convention process.

The eleventh session of the Intergovernmental Negotiating Committee of the Convention (INC 11) made recommendations on this and other methodological issues to the first Conference of the Parties to the Convention (COP 1) in Berlin in 1995. It was proposed that the relevant technical bodies would report on their work on allocation and control of emissions to the second Conference,

... taking fully into account ongoing work in Governments and international organizations, including the International Maritime Organization and the International Civil Aviation Organization

Relevant international organisations and other bodies were also invited to contribute to these deliberations.

It now seems quite likely that in future CO₂ emissions from bunker fuels (i.e. aviation and maritime transport) will be recorded separately in national inventories, as recommended by the Intergovernmental Panel on Climate Change. However, there are serious difficulties in determining how these emissions could fairly be attributed to nation states, or any commitments made as to curbing the growth in emissions. This problem is likely to hamper progress significantly.

Instead, it is possible that ICAO may become involved in attempts to control aviation CO₂ emissions globally. However, ICAO is not a sovereign state or a signatory to the Framework Convention on Climate Change, and has no mandatory powers in this area over either airlines or its own member states. As such, it is difficult to see how effective international controls, as part of an overall strategy on global warming, can be achieved through this route.

Also of relevance to the control of carbon dioxide emissions from aircraft is the taxation of aviation fuels. This subject is dealt with below.

3.4.3 Provision of air services

Amongst other things, the signatories to the Chicago convention acknowledge that every state has exclusive sovereignty over the airspace above its territory. Based on this and other provisions, and on the Annexes to the Convention (which are updated

periodically by ICAO), national governments exchange traffic rights in numerous bilateral air transport agreements which form the basis of current civil aviation services. These agreements incorporate rules which are binding to the parties concerned, in addition to the rules agreed in the Convention.

The Convention is a general framework, based on largely political considerations, and embodying general legal principles, such as nation state; sovereignty; nationality of aircraft; equal opportunities and equal treatment for all countries; mandatory provision of air navigation facilities; etc.

However it is the bilateral agreements which deal with the detailed requirements for the provision of air services between country pairs, as the Convention does not set a detailed framework for the sharing of air space. Bilateral agreements contain principles and rules not found in the Convention, and often more restrictive than the Convention itself: for instance, clauses that require substantial ownership and effective control of designated carriers to be in the hands of the designating state or of nationals of that state (the so-called 'nationality clause'); the predetermination and apportionment of capacities to be provided on the agreed services, etc.

In the context of EU policy, it should be stressed that the Convention does not preclude multilateral arrangements for the exchange of rights or the setting up of multinational operating agencies. Indeed, Chapter XVI of the Convention contains provisions to facilitate joint operating organisations and pooled services. The main obstacles to the creation of 'Open Skies' in Europe arise from existing bilateral agreements, which are considered to reflect the increasingly protectionist and anti-competitive policies pursued by many governments, as outlined above.

These agreements contain provisions which are incompatible with the EU Single Aviation Market as it is now defined such as the nationality clause for designation of airlines and the mandatory commercial arrangements between designated carriers. As Member States are obliged, according to Article 234 of the Treaty of Rome, to take all appropriate steps to eliminate these incompatibilities, bilateral agreements will now have to be renegotiated when necessary.

It is possible for the EU Member States to enter into liberal arrangements under the umbrella of the Chicago Convention, and either to revise their bilateral agreements or simply to render them irrelevant among themselves in a defined geographical area - as the EU partners have done in their preparations for 1992. This process is complex, however, and a transition to multilateralism, even within the EU, will not happen overnight.

Aircraft certification remains the responsibility of individual states, for example, and standards therefore differ from country to country. Within the EU, the Joint Aviation Authorities (JAA) are working to coordinate specifications but have no powers to enforce their recommendations upon governments of Member States.

The European Civil Aviation Conference (ECAC) also pursues issues of technical harmonisation and the strengthening of air traffic control across a wider Europe. It makes recommendations across a wide range of subjects including noise and emissions standards, but these are not mandatory to its members. There is however

considerable overlap between the functions of ECAC and the Commission, and they often pursue similar proposals in parallel.

4. RECENT EU AVIATION POLICY

The overall context of EU policy towards air transport and the environment, in the context of the Fifth Environmental Action Programme, has been set out in Section 3.3. In particular, the requirement to integrate environmental policy concerns into other sectoral policies has been identified as a central feature of EU policy.

In the sections which follow, a range of relevant policy areas at EU level is described, and the extent to which these reflect the environmental considerations set out in this report is critically assessed.

4.1 The Mineral Oils Directive

Directive 92/81/EEC concerns the harmonisation of structures of excise duties on mineral oils. This Directive is noteworthy in that it sets a precedent for EU involvement in fiscal measures, by setting minimum levels for duty on certain classes of mineral oils (i.e. in effect, petroleum based fuels). Although interventions of this sort are as yet rare in the field of Community transport policy, it should be borne in mind that this is consistent with Article 99 of the Maastricht Treaty, which requires that:

The Council shall ... adopt provisions for the harmonisation of legislation concerning turnover taxes, excise duties and other forms of direct taxation to the extent that such harmonisation is necessary to ensure the establishment and functioning of the single market ...

However, Article 8, para 1(b) of the Directive specifically provides for exemption of commercial air fuels, and indeed it apparently *prevents* Member States from levying duty. This is however in conformity with an ICAO resolution under the Chicago Convention (ICAO, 1966), whereby fuel and other consumables are to be exempted from taxation. This provision for air transport can be contrasted with paragraph 2 of this Article, which merely allows Member States to exempt passenger transport, rail, water and other non-road modes from such duties.

It should be noted that the Council must review this exemption by 31 December 1997, 'taking account of the external costs entailed in such means of transport and the implications for the environment ...'. Any decision requires a unanimous vote by the Council, however, on the basis of a Commission report and recommendations.

Thus there remains a clear dilemma in the field of aviation fuel taxation. A decision to impose taxes would be wholly consistent with EU policy on transport and environment, as explained above. Furthermore, action at Community level would be

amply justified both by the nature of the air transport industry and by the requirements of the single market.

On the other hand, such a policy would be in opposition to the terms of the Chicago Convention, and would encounter strong resistance from a wide range of vested interests, as the arguments set out in the Wise Men's report (see below) suggest.

Moreover, unanimity in the Council of Finance Ministers would be required for any such decision, as taxation remains amongst the most jealously-guarded areas of national sovereignty within the Community. The fate of the Commission's proposals for a carbon/energy tax should serve as a reminder of the enormous obstacles which face attempts to impose eco-taxes at the European level, and it seems unlikely that there will be early or rapid developments in this direction.

4.2 The White Paper on the Common Transport Policy

The White Paper on the future of the Common Transport Policy was published at the end of 1992, and is subtitled *a global approach to the construction of a Community framework for sustainable mobility*. Arguably this circumlocution reflects an awareness that the White Paper will not be the last word on transport and sustainable development in Europe. Nonetheless it is the EU's principal attempt to reconcile the requirements of its transport and environment policies.

Paragraph 19 of the paper sets out the transport context in Europe, and places particular emphasis on the rapid growth in air travel. It also highlights the growing pressure on infrastructure capacity in the road, rail and air sectors. Much of the document is concerned with surface transport; but paragraph 166 gives a clear statement of the importance of high altitude emissions from aircraft, as follows:

... the problem of emissions from civil aviation will need to be addressed more fully. Although civil aviation is responsible for a relatively small percentage of gaseous emissions from all forms of transport, it is the only mode where these emissions are directly injected at critical altitudes.

The Commission's programme on airports and environment is set out briefly in paragraph 382. Much of this concerns the monitoring of aircraft noise, but there is also a clear commitment to tighter NO_x standards.

In terms of the operation of civil aviation, however, congestion, rather than the sheer scale of demand, is singled out as a central element of the environmental problem. Furthermore, the environmental dimension of liberalisation *per se* is played down. This is clearly seen in paragraph 80, which states that:

Competitive pressures leading airlines to opt for higher frequencies with smaller aircraft ... are likely to exacerbate the problem.

'The problem', however is that of congestion, and is to be tackled primarily through increasing capacity. The environmental consequences of this policy are not considered here; and this approach seems to be largely at variance with what was set out in the Fifth Action Programme as explained above. At the same time this

paragraph gives implicit recognition to the potentially negative environmental consequences of air transport liberalisation policy *per se*.

On the positive side, paragraph 81 of the Paper stresses the benefits of better use of air-rail links. However, these are regarded as a short term palliative, to overcome the long lead times in establishing additional airport infrastructure. Policies towards the latter are discussed in the next section of this report.

The Transport Council responded to the White Paper, formally publishing its conclusions at its meeting in June 1993. These generally welcomed the integrated approach adopted and endorsed various specific aspects of the White Paper, while restating the need

... taking account of the requirements for freedom of choice regarding mode of transport, to strike a balance between the overall development benefits of transport and the protection of the environment.

The Council response makes no specific mention of air transport.

The European Parliament had published its own Resolution on the White Paper in May (B3-0782/93, 27 May 1993). This was rather more detailed and specific than the Council response, but followed largely similar lines. Of particular relevance to air transport were a call for the Commission to accelerate its activities in air transport policy (as for other modes), and a call for the most stringent possible standards for aircraft engines *inter alia*.

4.3 The Trans-European networks

4.3.1 The development of the networks

On 29 October 1993, the Council adopted its Decision on the creation of the main Trans-European Transport Networks, including the roads network, or TERN (OJ L305, 10.12.93). These followed on from the high speed rail network plan, which was proposed by the Commission, at the request of the Council, in 1990. At the time of writing, draft proposals for other networks including conventional rail, combined transport and airports have been published, but no final decision has been adopted. The latest proposals are described below.

All of the trans-European networks are the subject of a specific Title (Title XII) under the Maastricht Treaty, which lays down three elements for Community policy, as follows:

- the establishment of guidelines for objectives, priorities and broad outlines of measures envisaged, identifying projects of common interest;
- the implementation of measures to ensure the inter-operability of networks, particularly technical standardisation, and;
- financial support for projects of common interest.

Article 129b of the Treaty further requires the Community to '*contribute to the establishment and development of trans-European networks in the areas of transport, telecommunications and energy infrastructures*'. Community action is to '*aim at promoting the interconnection and inter-operability of national networks as well as access to such networks*' and shall take account of '*the need to link island, landlocked and peripheral regions with the central regions of the Community*'.

There is a rationale for the establishment of networks (especially land-based ones), as set out in 1992 in a Commission Communication (COM(92)231). That is, that communications links have historically developed to cater for largely national trade and travel. As such, cross-border links are often less strong, and trans-European routes may be fragmented or lacking. These weaknesses can themselves be seen as impediments to the free movement of people and goods between Member States. It should be noted, however, that this rationale applies far less strongly to air transport than to other modes whose routes are predetermined by fixed infrastructure (i.e. road, rail or inland waterway).

4.3.2 The Commission proposal on an airport network

The proposals for an air transport network were first published in April 1994 (COM(94)106 final, 1994). This document incorporates outline network plans and priority projects for road; rail (both conventional and high speed); air; and water (ports, sea routes and inland waterways). Combined transport links to facilitate transshipment of freight from road to other modes were also listed.

This document purported to reflect a '*multimodal approach*' as a step towards integrated network of trans-European transport systems. In truth the publication of all the network plans in a single document can only be a first step in this process, however. Apart from anything else, the network plans inevitably reflect the degree of integration (or the lack of it) in Member States' own networks or network plans.

The airports designated in the appropriate draft plan are by definition deemed to be of common interest to the Community as a whole. This would place Member States under an obligation to facilitate and accelerate any new projects designated within the plan (Article 7), and would be likely to attract European funding for such projects.

Annex II sets out criteria for a three-tier structure of airports on the network, in the titles '*community connecting point*'; '*regional connecting point*' and '*accessibility point*' respectively, in descending order of size. These different tiers are defined primarily by the volume and nature of the traffic which they handle. Any airport open to civil aviation may qualify in the third category if it serves an island or remote area, however.

Designated projects and selection criteria are listed in Annex II of the proposal, while Article 17 states that:

*These specifications shall enable the airport network to **meet demand growth between now and the year 2005.** [emphasis added]*

Again this appears to be consistent with the approach set out in the White Paper, but not with the philosophy on demand management set out in the Fifth Action Programme. Particularly in the absence of any means to internalise the external costs of aviation, it is also questionable whether such an approach is consistent with the requirement to internalise environmental considerations into other policy areas.

At the time of writing, an amended proposal is subject to the co-decision procedure, with the latest version published as COM(95)298 final. Interventions by the European Parliament in particular have succeeded in increasing the emphasis on environmental protection in the network proposals. For example, the first indent of Article 2(2) refers particularly to the requirement for environmental protection and to Article 2 of the Treaty, while a new Article 7 is devoted exclusively to environmental requirements.

Specifically, Article 7(a) requires the development of a methodology for strategic environmental impact assessment, and for trans-European corridor analyses '*where appropriate*'. Article 7(b) requires environmental impact assessment and further safeguards at national level. The proposed Article 17 referred to above has been deleted in this version.

These are clearly positive developments in the multimodal transport networks proposals, although many MEPs remain unhappy about the way the co-decision procedure is being handled. At the time of writing the final outcome remains unclear. It should also be emphasised that the increased emphasis on a multimodal network will add further methodological difficulties in developing requirements for a strategic environmental assessment of the proposals.

Improved and integrated air traffic control is also proposed as being an area of common interest in the network document, and reflects a range of initiatives to improve and harmonise European air traffic control.

4.4 EU competition policy and the environment

A recent Commission report sets out its view on the interrelationship between competition and environment policy (*23rd Competition Report*, COM(94)161). This argues that free competition is not inimical to environmental protection and must take account of the latter. It goes on to argue that:

The effect of environmental considerations on competition policy is not a one-way street. Competition policy when put into its proper framework has a very important role to play in achieving environmental objectives.

This 'proper framework' is argued in essence to lie in the polluter pays principle, through which environmental considerations can be internalised into the market. Thus, the argument runs, free competition ensures proper market operation, and thereby enhances environmental protection through the operation of externality costs.

4.4.1 Internalising external costs

In this context the imposition of environmental costs is seen as being central to the incorporation of environmental considerations into industrial policy (itself a requirement of the Maastricht Treaty). It is therefore of particular significance for the aviation sector that these requirements have been ignored by the Wise Men in their assessment of the industry's future, as discussed below. At the same time, the difficulties involved in imposing taxes on air transport fuels, for example, are discussed elsewhere in this report, and raise serious doubts as to the adequacy of this approach for the transport sector.

The Report goes on to discuss a number of cases in which interventions in the market designed to improve environmental protection have been either upheld or rejected by the Commission. It concludes that:

... the Commission will examine carefully all agreements between companies to see if they are indispensable to attain the environmental objectives. It will be particularly vigilant to ensure that such agreements do not foreclose market entry to outsiders and that where membership of the system is necessary for market access because there is no viable alternative, then this membership will be given on non-discriminatory terms.

These requirements would be of central importance to any policy change designed to improve the level of environmental protection in the EU civil aviation sector.

4.4.2 The Report of the Comité des Sages

In early 1993, the Commission appointed an expert group to inquire into the problems facing the European civil aviation sector - notably the poor profitability of recent years as outlined in the Introduction. This Committee, known as the *Comité des Sages* (or Committee of Wise Men), took evidence during the second half of 1993 and reported in January 1994.

It should be noted that the terms of reference of the Committee were primarily economic, that its composition was dominated by expertise from within the aviation and aerospace industries, and that environmental interests were not represented. The Committee took evidence principally from similar sources, and from EU Commissioners Matutes and van Miert in charge of industrial and competition policy respectively.

4.4.3 Contents of the Wise Men's report

The aviation industry

The first part of the report presents an economic analysis of the global and European civil aviation interests. This amply demonstrates both the relatively high costs of European carriers compared to their US counterparts, and their poor profitability. The report identifies a number of reasons for the apparent lack of productivity in the European industry. These include: high labour costs and relatively low productivity; higher landing and overflying charges; and high fuel costs. The report attributes poor

productivity to the overcapacity and protection of domestic carriers which predated the Third Package of liberalisation measures, and therefore strongly advocates further liberalisation, the removal of state subsidies, and potentially industrial restructuring, to improve underlying productivity.

In general the Wise Men supported the need to control collaboration between airlines as a means of promoting competition and countering the development of cartels. They do however recognise some of the drawbacks of this approach, for example in planning and restructuring capacity on given routes. The consumer benefits of interlining are also recognised; but no recommendations are made on this practice. This point is returned to towards the end of the current study, however.

Slot allocation and airport capacity

As well as levels of airport charges, the report lays great stress on the importance of slot allocation as a means of ensuring competition. This is partly a question of ensuring fair access for all carriers; but it is of course difficult to ensure access to a range of carriers when the number of landing slots is capacity constrained, as it is in many places throughout Europe. Thus they state that:

It is a fact that congestion at some key airports has reduced the possibility for new entrants to take advantage of new business opportunities offered by the Third Package.

The report also draws attention to the inadequacy of air traffic control arrangements over Europe, plus the large areas of military air space from which civil aircraft movements are excluded.

As a consequence they urge immediate action by the EU to increase capacity, recommending a European Airport Capacity Enhancement Plan and other measures to extend the airport infrastructure. It should be noted that they also advocate moves to inform the public of the 'economic, social and environmental benefits of air transport'. They do not however define the environmental benefits to which they refer, and it is not clear what these might be.

When these requirements are coupled with the adverse trends in load factor and aircraft size as outlined in the White Paper, it can clearly be seen that air transport liberalisation is itself a major driving force behind the pressure for increased airport capacity.

Harmonisation, taxes and charges

The report is generally in favour of harmonisation measures where these increase the efficiency of the single market. However, it argues that harmonisation measures should be undertaken (including those for environmental protection) *only* where they improve cost-efficiency. Although it advocates cost-benefit analysis of such proposals, the report goes on to recommend that:

Whenever these measures would increase the average cost burden of European air carriers, they should not be implemented.

This sweeping suggestion does not appear to leave a great deal of room for reflecting the external benefits (such as environmental protection) which might result from any proposed harmonisation measures.

Furthermore, in advocating exemption of aviation from carbon taxes, the following line of argument is offered:

Its [carbon tax's] basic idea, i.e. to promote the use of alternative forms of energy, is not valid in relation to air transport where no alternative to the use of kerosene is ... in sight.

This is of course to misrepresent the purpose of a carbon tax, which is actually to reduce carbon emissions. Fuel switching is only one of the means available to achieve this in response to higher taxation - others being improved efficiency; modal shift; and reduced use of energy services. The latter options are in principle available in the aviation sector as elsewhere; and even if they were not, this would not be a sufficient reason for tax exemptions either in economic theory or under the polluter pays principle.

Aviation and environmental policy

The report praises the high environmental standards of the European aviation sector in comparison to global standards - noting in particular that 69 per cent of European aircraft are certified to Chapter 3 standards, as against 61 per cent in the United States.

It goes on to argue that any further improvements must not adversely affect the competitive position of the European industry, and that some European airports will have to accept aircraft from other countries '*which do not and will not meet the highest environmental standards*'. This point is reiterated with particular regard to noise standards in a later section, and is adduced as an argument against tighter regulations.

Yet it is not clear why this should be the case. Indeed, the report appears to ignore the precedent set by Directive 92/14 which banned the operation of Chapter 2 aircraft from 1995 at EC airports. The latter incorporated a range of exceptions to the overall ban, including provisions to avoid exceptional financial hardship to any given operator. An annex also gave a detailed list of aircraft from developing countries which would be allowed to continue flying within the EU area until the year 2002. Thus, a model already exists to create a balance between environmental standards and excessive costs or hardship to individual airlines, which should be capable of meeting the concerns raised by the Wise Men.

The report's coverage of emissions and global warming is brief, putting commercial air transport's contribution to total carbon dioxide emissions at 1.3 per cent, and citing the Energy Research Centre of the Netherlands in support of an estimate of 0.2 per cent contribution to total warming from aircraft NO_x. There is thus no mention of the potential effects of water vapour; of damage to the ozone layer; of the extent of scientific uncertainty in this area or of the advisability of applying the precautionary principle.

Assessment of the Comité's report

In sum, this report gives a useful insight into the position of the European civil aviation industry. While it contains the necessary rhetoric about a balance of interests taking into account environmental considerations, however, many of its recommendations do not appear to take account of environmental concerns.

That is, not only does it apparently fail to take any account of a number of the environmental impacts of air transport; but also, through its absolute rejection of any measures which would increase costs to the industry, it effectively rejects any moves either to tighten regulations or to reflect external costs, such as those of environmental damage, through taxation. As explained above, the latter is seen as central to the integration of environmental policy into the European Single Market; so the report's recommendations inevitably fly in the face of established Community policy.

In his introduction to the report, the Committee's Chairman remarked that:

... the main lesson that I have drawn from this exercise is that old habits obviously die hard. Mentality changes are lagging behind technological, economic and regulatory changes.

Failure to integrate environmental considerations was presumably not amongst the 'old habits' which he had in mind. If it had been, it might have been a fitting judgement on the Committee's own mental processes.

4.4.4 The Commission's response

In June 1994, the Commission published its response to the Committee of Wise Men's report, entitled *The way Forward for Civil Aviation in Europe*. In this report, the Commission concurs with a great deal of the Committee's analysis in relation to liberalisation, harmonisation of standards and the need to improve profitability.

On the question of balancing competing objectives, the Commission points out that the terms of reference of the Committee naturally lead it to place emphasis on the industry's perspective. The Commission however reserves the right to intervene in support of other policy objectives including the environment. Similarly, the Commission asserts that present financial difficulties 'should not be used as an excuse' to avoid the permanent task of balancing these objectives.

The Commission shares the Committee's view that '*cost-saving forms of airline cooperation*' may remain an important element in restructuring, provided that they are not anti-competitive in effect. It also notes the exemption of IATA consultations from rules forbidding tariff consultations, emphasising that this provision is designed to facilitate interlining, '*which is essential for maintaining the high degree of flexibility of Europe's air transport systems*'.

The Commission supports the Committee's views on the need to improve and unify European air traffic control. The paper argues that Air Traffic Management (ATM) systems should be regarded as an element of the Trans-European Networks, which would provide a framework for Community action. The Commission intends to

provide 'significant funding' from a range of sources for the European Air Traffic Control and Integration Programme (EATCHIP). These will include measures aimed at the states of Central and East Europe, in order to integrate them into a pan-European control network.

On the question of EU noise and NO_x standards, the Commission argues that:

it appears questionable to introduce more stringent operational measures during economically very difficult times if such measures are likely to have a clear negative financial impact.

This view is not on close inspection as negative towards the proposal as it may at first appear. First, it does not rule out a measure once economic recovery sets in - which appears already to be happening. Second, it remains to be demonstrated whether the measures would have a 'clear' effect on costs, given that most future engines can already meet the requirements of the proposed Directive (discussed below). Third, it is in any case questionable whether a future tightening of standards for new aircraft would count as an 'operational measure' anyway.

Furthermore, the paragraph which follows sets out a clear rationale for special measures to be taken in industrial countries, over and above the agreements of the ICAO. This is as follows:

A further question, however, is whether international organisations (ICAO) can effectively respond to developments in industrialised regions. Given the fundamentally different interests of developing nations in this area, it is doubtful whether leaving the issue entirely to world-wide organisations would best serve the long-term interests of Europe's aviation industry and related businesses, or of airport users, of the population living in the vicinity of airports and finally, of the general interest in protecting the environment.

This question is arguably at the heart of the environmental regulation of the air transport industry in Europe. The proposed Directive, and its rationale, are therefore discussed in greater detail below.

4.4.5 The Council decision on the Wise Men's Report

On 24 October 1994, the Council adopted a Resolution in response to the Wise Men's report. Their response was generally to welcome the proposals and recommendations, and to identify a number of priorities for action. These included improved air traffic control arrangements; uniform safety provisions within the single market; elimination of distorting state aids to airlines; and more open ground handling arrangements.

The Council also expressed concern over the possibility of flags of convenience becoming a major feature of the European aviation sector, and requested a report and recommendations from the Commission. Such developments could be of particular relevance in the event of the EU pursuing more stringent environmental controls.

4.5 The council of environment ministers

At the 1817th Council Meeting on 15 and 16 December 1994, environment ministers from the Member States noted their concerns at the environmental consequences of the completion of the Single Market and developments in the wider Europe.

They went on to table their views on a broad range of transport issues, many of which are not directly relevant to this report. They did however emphasise the need to improve the modal share of transport fulfilled by less damaging transport modes (primarily rail and shipping), and for the Trans-European Networks to contribute to this objective. In a separate section on civil aviation, they specifically advocated a shift from air to rail transport wherever possible.

The Council also endorsed concerns over the implications of growing air transport demand, stating that:

In view of the sharp increase in air traffic, the Council stresses the desirability of further substantial reductions in environmental pollution from exhaust gases, in particular of reducing NO_x engine emissions at cruise altitudes as well as CO₂ emissions from air traffic, and noise of aircraft and airports. The development of low pollution and fuel-efficient aircraft engines should in parallel be promoted in the European Union.

They went on to call on the Commission to suggest appropriate initiatives, notably towards the ICAO.

An additional paragraph asserts that the exemption of air traffic from indirect taxation "cannot be justified on environmental grounds", and calls on the Commission to take this into account when reviewing the issue in the context of the Mineral Oils Directive, as discussed above.

The possibility of imposing taxes on aviation fuel have been discussed in greater detail in subsequent meetings, but no specific conclusion has yet emerged, and the Commission has not made any formal proposals.

4.6 The Commission proposal on noise and NO_x standards

The Commission's Directorate General for the Environment (DGXI) has recently proposed a new Directive which would restrict EU carriers to buying new aircraft of types which emitted significantly less NO_x than specified by the 1993 ICAO standard. The latest version represents a 16.25 per cent cut from the earlier level discussed above or 33 per cent below the 1981 standard; but as with the earlier standard it is largely a reflection of technical progress to date. Even if introduced, the emission reductions brought about by the new NO_x standard would be soon be overwhelmed by the traffic growth forecast by the industry, and NO_x emissions in the medium and long term would continue to rise (see WWF projections; 1994).

There are indications that the proposal will be adopted by the Commission soon; but its future progress will depend on a range of other factors. In particular, a great deal hangs on the response of ICAO, which is itself in the process of considering a range of

possible standards which go beyond its 1993 level. ICAO has not previously pursued very stringent standards, for the reasons outlined above; but for the EU to 'go it alone' would be a departure from its regulatory policy to date, which would be unwelcome to the ICAO.

Few would deny that concerted action on standards by ICAO would be preferable to unilateral action by a single trading block - even one as large as the EU. The latter would be argued to place EU airlines at a competitive disadvantage, and there would be a possibility of some 'flagging out' to non-EU partners to evade restrictions. On the other hand, the EU market is very substantial in its own right. Internal competition would be relatively little affected by any change in standards, and other carriers wishing to fly into EU airports could also be required to meet new standards as they have in the past. It is thus open to question whether barriers to competition, or the competitive disadvantage of higher standards, would be as great as they are sometimes claimed to be.

The threat of unilateral action may on the other hand help to persuade ICAO to take a tougher line in its own standard setting, which would promote more widespread adoption of new standards. At the time of writing, a compromise between the EU and ICAO remains a possibility.

Further EU proposals on noise are also likely to emerge shortly, and these would almost by definition go beyond the Chapter 3 standards laid down by ICAO. While progressively tighter noise standards are already a feature of EU policy, as set out above, it should be recalled that to date these have been directed towards hastening and making mandatory compliance with the ICAO standards. In this sense further noise legislation would also be a departure in the absence of further moves from ICAO; and again it can be anticipated that the prospect of EU action will be a factor in the development of new ICAO standards.

5. POLICY ASSESSMENT FOR EUROPE

5.1 The environmental impact of Open Skies

In this section, the overall environmental impact of air transport liberalisation in Europe is assessed. Concerns that current policies may themselves accelerate environmental damage were raised by WWF (1994), and are outlined in the introductory sections above. In essence these arise from two principal sources:

- The negative effects of liberalisation in the US, which resulted in more flights, and the use of smaller and sometimes older and more polluting aircraft; however these are to a degree balanced by positive effects such as increased load factors on some routes;
- The expectation of lower air fares in Europe, which, other things being equal, should lead to accelerated growth in the demand for air travel.

Preceding sections have summarised the historical experience of liberalisation in the USA, and the outlook for regulatory and other changes in Europe. We now try to synthesise these elements in order to assess the effect of liberalisation in Europe.

There are some critical differences between the current position in Europe and that of the US in the 1980s which makes the latter an unreliable guide to future developments in Europe. Table 4 compares certain features of Europe and the USA. A key difference is the air travel per capita: it is more than three times greater in the USA than in the EU. This may mainly be due to the differences in population density and distribution of the two regions, and the difference in wealth.

Our research included a review of relevant literature and discussions with official and independent experts. There is some consensus between European experts as to economic effects of liberalisation, but few views as to the environmental impacts. Despite this, we may now make some observations, albeit tentatively.

A common view, with which we agree, is that the impact of liberalisation in Europe will be less marked than that of deregulation in the USA. This is principally because:

- A number of other differences listed in Table 4 (political tradition, alternative transport modes and geography) will tend to reduce the effects.
- The structures of the industries are different; especially important is the higher proportion of charter services in Europe.
- European liberalisation may entail less extensive and rapid deregulation than that which occurred in the USA, partly because the industry in Europe is now generally more deregulated than aviation in the USA was in 1978.
- Airport capacity is currently a heavier constraint in Europe than in the USA. Limited airport capacity will suppress the move towards greater flight frequency and smaller aircraft. However the rapid expansion of regional airports is conceivable, and there are indications that this will occur. This would allow network developments similar to those in the USA.

Certainly liberalisation in Europe to date has not brought about the dramatic fall in fares which some had promised, or the growth in demand which would probably follow. Similarly, the early proliferation of new entrants on a number of the key routes has been followed by a process of consolidation, so that the pressure on airport capacity may not be as great as it might have been.

However despite these moderating factors, it does seem likely that greater competition will lead to more frequent flights and to smaller aircraft size on average. At the same time, lower fares (where these occur) can be expected to stimulate demand over and above the rapid growth which would be likely to occur anyway. All of these trends can be expected to increase the pollution burden from European air traffic, and to decrease its efficiency in terms of emissions per passenger-kilometre.

Ironically, however, if the effects are less marked than has been argued above, this could more properly be seen as a reflection of certain *failures* of liberalisation rather than its successes.

Table 4 : Comparison of Europe and USA

		EU	USA
General	Political tradition	Strong government involvement with transport	Less government involvement with transport
	Population (million)	346	255
	Area (million km ²)	2.26	9.36
	Population density (p/km)	153	27
	Geographical distribution	Population and economic centres dispersed through Europe, but with a heavily concentrated central corridor.	Population and economic centres concentrated along distant east and west littorals.
	Leisure travel	Diverse climate, scenery and culture	Diverse climate and scenery.
	Labour	Working populations with different languages and restricted access to foreign labour markets.	Mobile working population with single language and free access to single labour market.
	Income (\$/a/cap)	19400	23119
Transport	Transport systems	Developing long distance rail system extensively publicly owned or subsidised. Other modes: road and water good.	Poor rail system. Other modes: road good, water restricted mainly to coastal.
Aviation	Passenger services provided (km/a/cap)	940	2900
	Charter services	50%	3%
	Airline ownership	Public/private	Private
	Airports	Congested, expansion difficult	Fewer capacity constraints

5.2 Open Skies and airport facilities

The focus of this report has been on pollutants emitted during flight, but liberalisation will almost certainly result in increased pressure on airport capacity. This in turn will make the environmental impacts of airports larger than they otherwise would be. There are a number of reasons for suggesting that this will be the case:

- Recourse to smaller aircraft and more frequent services will in itself lead to additional movements at airports.
- Commercial services at some regional and/or peripheral airfields will increase.
- Financial uncertainty could, as outlined above, lead to older aircraft being retained longer in service in the EU. In the absence of legislation to prevent this, it could lead to a higher proportion of movements by aircraft with poor environmental characteristics.
- As several of the documents surveyed above make clear, the availability of sufficient slots to allow a number of carriers to serve a given route is a prerequisite for meaningful competition. However, the continuation of grandfather rights for established carriers results in only a small number of existing slots becoming available to new entrants. There is thus pressure to make additional slots available in order to deliver free market objectives, and this itself contributes in many cases to plans for airport expansion.
- Insofar as liberalisation reduces fares and stimulates demand, more people will travel to airports and so the impact of the required surface transport will increase.

Increasing airport capacity, especially the capacity for aircraft movements (i.e. landing and take-offs), presents a two edged sword to the environment.

Increasing airport capacity:

- reduces congestion provided demand does not increase and thereby fuel use and emissions as planes wait on the ground for take-off, or stack in the sky waiting for landing.
- allows greater increases in demand which increases pollution.
- contributes to other changes in services (e.g. smaller aircraft, lower load factors) which generally increase aircraft movements and thence pollution.

Constraining capacity:

- brings pressure on the industry to move a given number of passengers with the least aircraft movements. This is accomplished by increasing load factor and aircraft size, which will reduce fuel use and emissions per passenger during the cruise phase of the flight which typically engenders the major part of the pollution. Another way of increasing factor and size would be to increase charges for aircraft movements at airports. This would reduce the disadvantage of congestion.
- suppresses demand growth.

In the longer term it is probable that the environmental disadvantages of increased capacity will outstrip the initial benefits of reduced congestion - principally because it allows indefinitely increasing demand. While the overall effect of liberalisation on emissions is uncertain, the effects on airport and traffic control capacity are clearer.

This liberalisation policy will in itself will place increasing pressure on both air traffic control and on airports' handling facilities - many of which are, of course, often overloaded. Without concerted action this in turn will increase congestion both on the ground and in the air, and thereby add to the pollution which results.

These trends will add further impetus to the major programme of airport expansion which is already under way in Europe. The EU's institutions are adding their weight to this and considering additional funding sources, as outlined above. The potential effects of widespread efforts to extend airports and access facilities on the local environments around some airports seem certain to be adverse.

Effectively incumbent airlines have extensive control over the use of airports through their ownership of airport slots. A small proportion of these are sold or leased each year, and these will tend to be the least attractive commercially. This has made it difficult for new entrants. If a more competitive market in slots were to be opened up, then this could increase the value of those slots. This in turn would change the cost structure of air transport in such a way as to increase the number of passengers carried per aircraft movement. This is accomplished by combination of higher load factor and larger aircraft which generally leads to greater environmental efficiency.

5.3 The prospects for tighter emissions controls

Under current policies, further and rapid expansion of demand for air travel can be expected. The liberalisation process in Europe is only one element of this - and not necessarily the most important factor in demand growth. According to most projections it seems clear that this will lead to an overall increase in emissions of NO_x, water vapour, carbon dioxide etc - with potentially serious environmental consequences, as outlined in earlier reports (WWF, 1991 and 1994).

If environmental protection is truly to be a factor in European air transport policy, then there is an obvious case for tighter emission controls. Whether this will be effectively pursued by ICAO, or will fall to the lot of the EU itself, remains to be seen. Certainly in developed countries, however, it appears essential that significant progress be made if the civil aviation industry is to continue to enjoy public acceptance in the longer term.

5.4 Air travel and sustainable development

As outlined in the introduction, recent history and future projections both highlight the dramatic growth rates of air travel, in Europe as elsewhere. These rates of increase eclipse even those of road transport.

For air as for road transport, the trends beg much the same question - is this growth consistent with the principles of sustainable development? Definitions of the latter are complex, various, and often vague, making it difficult to give a definitive response to this question. However, common sense dictates that, at some stage at least, the answer must be 'no'. As the RCEP remarks:

An unquestioning attitude towards future growth in air travel, and an acceptance that the projected demand for additional facilities and services must be met, are incompatible with the aim of sustainable development. (RCEP, 1994, p75)

To date, policy in the EU as elsewhere has been concerned primarily with catering for growing demand, and in some respects is fostering that demand. On the basis of our current research, it seems fair to conclude that environmental protection has not yet been fully integrated into air transport policy. Emphasis is being given to the problems of NO_x and noise; but the outcome of this is as yet uncertain, and other environmental problems posed by demand growth have yet to be tackled comprehensively.

In the future one can speculate that the civil aviation industry will have to adapt itself to the environmental and capacity constraints which are increasingly making themselves felt in road transport, for example. As yet, European policy does not appear to reflect such constraints; but the final section of this report explores some mechanisms whereby a balance more favourable to environmental protection and sustainable development might be achieved.

6. CONCLUSIONS

The preceding analysis has not provided conclusive answers as to the environmental consequences of air transport liberalisation, but it has clearly shown that there are potential conflicts between liberalisation and environment policies. Liberalisation policy is well established within the EU's institutions and supported by the policies of a wide range of other actors.

6.1 Air transport and environmental policy

Environmental policy, by contrast, has been brought to bear in this area relatively recently, and so has been 'bolted on' to existing policy priorities. Significant areas of uncertainty on the environmental significance of air transport have also acted as obstacles to decisive intervention. As a result, measures in this field have been adopted in only a sporadic and piecemeal fashion, and there remain numerous obstacles to the implementation of a comprehensive policy for environmental protection. This, we argue, falls short of the requirements of the Maastricht Treaty for the integration of environmental concerns into other policy areas.

As in other areas, it seems that as yet, it has not been possible to establish a true balance between the momentum towards a free European market, and certain aspects

of environmental protection. If however it transpires that the liberalisation policies are indeed contributing to environmental damage, and that there are no easy technical fixes to ameliorate this, then clearly a better balance between these conflicting policy goals will need to be established. The problems arising in the pursuit of this balance can be seen as the natural consequence of a field of activity which spans policy making at many different levels (from local to global), and which cuts across a wide range of policy areas (notably competition, industrial policy, external relations, transport, environment, regional and cohesion policies).

In such circumstances, inconsistencies and conflicts of policy objectives within the EU are probably inevitable. The requirements of environmental policy integration, and the mechanisms set up to achieve such integration, are in principle intended to overcome these problems. However, the evidence reviewed here suggests that the historical and institutional development of policy, along with the difficulties set out above, have been sufficient to render these mechanisms ineffective. It seems that additional work is needed in this area in order to better identify problems and suggest solutions or improvements.

We should mention that liberalisation may have general implications for environmental planning and policy implementation. With liberalisation, the activities of the industry as a whole will become more unpredictable. In particular the likelihood of the industry meeting environmental targets becomes more difficult to determine because of increased uncertainty, particularly financial. This uncertainty is coupled with a loss of government controls over the industry which in turn means that, if required, remedial action is more problematic. This unpredictability and loss of control undermines environmental planning, and makes it more difficult for governments to make commitments to targets. This disadvantage may in some cases be somewhat tempered by the fact that private industries may adapt more successfully to new conditions, and sometimes Governments find it easier to regulate private industries than national ones.

In the following sections we summarise some of the effects of liberalisation, and then suggest some measures which might mitigate these effects.

6.2 Environmental consequences of liberalisation

In section 1.1 we set out four factors as foci for studying the effects of liberalisation: demand, load factor, aircraft environmental efficiency and congestion. It is difficult to establish cause and effect for many aspects of deregulation. Perhaps the only firm conclusion is that deregulation destabilises the industry in the short term as operators and manufacturers adjust to a new business environment. This reduced stability probably persists in the longer term, albeit with reduced force, simply because a liberal market is more unpredictable than a highly regulated market with extensive monopolisation.

The historical experience, and certain theoretical considerations, indicate that the likely effects of liberalisation (relative to what would happen with no change in regulation) on the main determinants of environmental impact will be as follows:

- i. **Demand growth will be faster.** Fares will decrease markedly in the short term. In the longer term, fares will probably be lower than without liberalisation, but perhaps not so significantly.
- ii. **Average aircraft size will be smaller.** If this smaller size is not accompanied by increases in load factors or fuel efficiency then it will lead to more emissions.
- iii. **Aircraft ‘environmental efficiency’ may suffer.** The decreased profitability of some airlines coupled with the heightened uncertainty following liberalisation may make some operators less able or inclined to invest in the best new aircraft.
- iv. **Congestion will be worse.**
- v. **Load factors may increase or decrease.** There will be countervailing pressures on load factors. Because of competition more sophisticated methods for increasing factors may be deployed. Conversely competition especially with many new entrants may make factors deteriorate. The balance between these pressures is difficult to quantify - but it may be that overall load factors do not change significantly.
- vi. **Pressure on airport capacity will increase.**

Five of these six effects will increase the environmental impact of aviation. If the load factor does not change significantly then the net effect will be a deterioration in environmental performance.

The actual, possible and potential effects of liberalisation in particular regions have been described throughout this report and summarised, for the USA in Table 2, and generally for Europe. It is concluded that in Europe increases in demand, flight frequency and congestion coupled with the use of smaller, and possibly older, aircraft will increase the emission of most pollutants. As in the USA, the load factor may increase on some routes, and decrease on others. The net quantitative effect of these factors on emissions is not known with any certainty. Nonetheless, we may conclude that liberalisation will certainly affect the environmental impact of European aviation, and that, on balance, the evidence indicates that liberalisation as presently structured may increase this impact.

6.3 Recommendations

The limited scope of this study and the complexity of the issue have not allowed us to draw very firm conclusions, and thence to make unequivocal recommendations. Despite the lack of a strategic environmental assessment (SEA), it is clear that liberalisation may have significant environmental consequences, that many aspects need careful analysis, and that there are certain measures which offer, at least *prima facie*, the potential to alleviate some of the negative consequences of liberalisation.

6.3.1 Assessment and research

It is clear from the foregoing discussion that many of the issues surrounding air transport and the environment remain unresolved. Further assessment and research is needed before firm policy recommendations can be made. The RCEP (1994, p75) recommends that “*further measures to promote competition in air services in Europe be accompanied by a full assessment of the environmental implications.*”

We suggest the following:

- i. **A thorough analysis** is needed of the impact of increased air traffic demand, and of the specific impacts of liberalisation, on aircraft noise and atmospheric emissions in the Community. Particular attention should be paid to the interaction between the growing demand for air travel, the changing structure of air services, and the development of aircraft technology. The results of this research should in turn inform a strategic environmental assessment of the various aspects of air transport policy.
- ii. **A proper strategic environmental assessment** should be undertaken, not only of airport operations, but of the overall effects of aviation policy. The effects of liberalisation and the Trans-European Network should be included in this assessment. An SEA in principle offers one of the principal tools for integration of environmental protection into policies, plans and programmes. There are inevitably difficulties in reflecting feedback effects and the complexities of the likely results of future changes in such an assessment. However, it is particularly important that such an approach be taken in the aviation sector because other integrative mechanisms appear to be lacking.
- iii. **A detailed analysis of long haul transport** options in Europe is needed. Air transport has particular environmental problems, but it is difficult to switch to other modes for long distances even if environmentally superior. The analysis should take account of both costs and environmental impacts, and should evaluate the potential for enhanced rail or water based services as an alternative to air travel.
- iv. **The constraints that international agreements** impose upon EU and national air transport policies should be detailed. As well as outlining an appropriate course of action to protect the EU's own environment, policy developments should consider how best the EU and its Member States could contribute to a greater element of environment protection in air transport services globally.

All of these assessment and analyses should be executed by the EC.

In the next sections, some policy options are considered.

6.3.2 General policy

Given the special difficulties of integrating environmental concerns into the aviation sector (and especially the problems of internalising external costs), there is clearly a balance which needs to be struck between the interests of a free and efficient market, and of adequate environmental protection. Indeed, in the absence of adequate measures to avoid a degradation of the environment around airports, and in view of the need for a precautionary approach to the threat of damage to the upper atmosphere, additional safeguards appear essential.

However, past experience from transport and other related policy areas demonstrates that prior policy commitments (e.g. to economic growth, social cohesion or economic liberalisation) can easily override environmental considerations. Institutional inertia is one of the many elements which contributes to this outcome, and so improved institutional arrangements may be needed in order to improve the consistency of EU policies towards air transport, and to secure proper integration of environmental considerations in particular into other policy areas.

Very long time scales are involved in both developing and introducing new aircraft technologies, and in planning and developing airport facilities. Policies to manage the long term consequences of air travel therefore need to be approached with particular urgency. Awaiting resolution of the scientific uncertainties over the effect of high altitude emissions is thus a high risk strategy, and a large measure of precaution is advisable. This is also a matter of common prudence, in that measures introduced gradually over a planned timescale are generally cheaper in the long run than emergency measures taken at a later date.

As noted earlier, the special nature of air travel is already accepted as sufficient to justify special powers of market supervision and intervention for the Commission. By the same token, it can be argued that the special nature of aviation (in both environmental and political terms) is sufficient to justify stronger intervention in order to secure environmental protection.

6.3.3 Specific actions and measures

In this section we describe some specific measures which offer the prospect of controlling the harmful consequences to liberalisation. Measures which are not greatly dependent on liberalisation, such as improved air traffic control, are not discussed here. It must be stressed from the outset that some of the measures set out below would probably compromise objectives in other EU policy areas. In particular, measures such as route franchising or interlining could potentially limit the scope of competition, or at the very least place some restrictions on the commercial freedom of airline operators. The latter however is not in itself automatically at odds with free market principles, provided first that any restrictions are sufficiently justified by environmental or other objectives; and second, that measures are applied fairly and equally to all competing carriers.

We suggest the following:

- i. **Aviation environmental control frameworks** should be integrated into other pollution control frameworks. At present a proportion of aviation fuel consumption and emission is generally excluded from national inventories. Consideration should be given to the development of separate bubble limits for high altitude pollutants to allow for any special effects at altitude.
- ii. **A tax on aviation fuel** should be imposed in order to harmonise aviation with most surface transport sectors. The tax would stimulate many responses which would act to reduce the emission of carbon and certain other pollutants. These responses would probably not dramatically reduce emissions, but then nor would any other single policy element. An aviation fuel tax would require changes in the current set of conventions covering international transport.
- iii. **Long term business planning** can enhance investment in large 'clean' aircraft and improve load factors. One means of increasing the planning horizon of airlines might be to auction routes and airport slots for fairly long periods - but the longer the period the less the competition. An adequate framework would be needed to ensure that such arrangements did not, for example, encourage the retention of older 'environmentally inferior' aircraft.
- iv. **An increase in the load factor** could be encouraged by measures including increased airport charges relating to aircraft movements. On the passenger side a cost of transferring to another, usually later, flight could improve load factors. If this were coupled with an extra cost for not showing up for a flight, airlines would have a more accurate idea of how many passengers would turn up for a flight, and hence the operating margin could be reduced and so the load factor increased.
- v. **Enhanced coordination between airlines** can lead to many environmental benefits through higher load factors and the use of better aircraft. This can be accomplished by a number of means including pooling, code sharing, transferable tickets and short term aircraft leasing. It is particularly difficult to enhance coordination without reducing competition.
- vi. **Intermodal coordination** could help to maximise the welfare benefit (in terms of travel) at the least possible environmental cost. Current EU policy activities are placing emphasis on enhancing the interchange capacity between different modes of transport (e.g. through rail links to airports), but do not amount to a coordinated strategy to optimise services whilst minimising environmental impact.

These measures, we consider, require active consideration within the context of air transport liberalisation policy in Europe. Other measures not specifically connected to liberalisation should be assessed as options within an overall framework. These should include technical measures.

However it should be recognised that against the background of current demand projections, feasible packages of measures can only slow the rate of increase in environmental damage due to aviation. In this context, it seems that the problem of

indefinite and rapid growth in air travel will need to be addressed, and the need to find ways of managing that demand.

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Appendix A. Airport operations

The Airfields Environment Federation (AEF) recently undertook a study of environmental standards and controls at airports and airfields (Johnson, 1993). Survey forms were sent to a wide range of national governments and other institutions, and responses achieved a good geographical coverage, albeit mainly OECD and other developing markets.

Survey responses confirmed that some controls on noise nuisance were almost universal amongst those responding. These were mainly in the form of operational restrictions, for example on length of runway in use; on preferential and rotational use of runways; on operating hours; or on types of aircraft permitted to land.

Financial penalties for infringement of restrictions are also found, as are noise related charges in some cases. However, it appears that not all airport authorities even have the necessary powers to impose charges based on environmental criteria.

While some form of local control on noise is quite usual, restrictions or charges based on other environmental criteria appear to be far less common. Furthermore, it is unlikely that airport-based restrictions would be an effective means of tackling regional or global pollutants (such as NO_x or CO₂). They are not therefore considered in great detail in this report, important as they are for local environmental protection.

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