York Aviation

Analysis of the EC Proposal to Include Aviation Activities in the Emissions Trading Scheme

June 1st, 2007

This Study has been conducted at the request of:

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Association of European Airlines
www.aea.be

EBAA
European Business Aviation Association
www.ebaa.org

ECA
European Cargo Alliance
www.eca.web.com

ELFAA

European Low Fares Airline Association
www.elfaa.com

ERA
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Introduction

On 20th December 2006, the European Commission published a proposal for a Directive amending Directive 2003/87/EC to include aviation activities in the European Union's Emissions Trading Scheme (EU ETS).

The main associations representing European aircraft operators consider that the Impact Assessment conducted by the Commission to support its proposed Directive is inadequate. They have commissioned Ernst & Young and York Aviation to analyse some of the assumptions used by the Commission and examine the potential impacts of the proposed legislation, based on revised assumptions.

The Basic Assumptions used in the EC Impact Assessment do not reflect Market Realities

The inclusion of aviation in the EU ETS on the basis currently proposed by the European Commission will have serious implications for aircraft operators. The three basic assumptions made in the Commission's impact assessment, on cost pass-through, price elasticity and windfall profits, are challengeable, as shown by economic theory and research.

In the EC impact assessment, it is stated that the inclusion of aviation in the EU ETS would not adversely affect aircraft operators because:

Assumption 1*: Aircraft operators would be able to pass on a large part of or even the full allowance costs to their customers.*

We demonstrate that it is highly unlikely that aircraft operators could simply pass on their ETS costs to consumers. On the contrary, they will have to absorb a large proportion of these costs. The rates of the cost pass-through will vary according to the operator's business model, its exposure to competition and its position in the market (**Chapter 1.1 and related Appendix A**).

Assumption 2*: Demand would not be significantly reduced due to limited price elasticity.*

We review a range of research covering the elasticity of demand for air transport services and show that the assumptions used in the EC impact assessment do not reflect market realities as demand for air services is, in fact, highly price sensitive (**Chapter 1.4 and related Appendix B**).

Assumption 3*: As a majority of allowances would be granted free of charge, aircraft operators would benefit from windfall profits.*

We explain why, due to the combined effects of a liberalised market and high price elasticity of demand, windfall profits will not exist in the aviation sector. In particular, we demonstrate that the underlying comparison frequently made between the aviation and electricity sectors is misleading and flawed. The characteristics of the two industries are quite distinct. The electricity sector is a highly regulated industry with a very low price elasticity of demand. This creates the conditions in which it is possible to make windfall profits. In contrast, the aviation sector is largely liberalised with a high price elasticity of demand. In these circumstances, windfall profits are not possible (**Chapter 1.3 and related Appendix C**).

Impact on Aircraft Operators

At a commonly agreed price of allowances of €30/tCO_2, the costs of purchasing allowances needed for traffic growth will be over €45 bill. in the period to 2022. If auctioning is included, this would further increase the costs of allowances by 44%.

Airline profits would be reduced by over €40 bill. over the period to 2022, excluding the impact of auctioning. This estimate of lost profits takes into account the reduction in demand, due to price elasticity, the costs of both purchasing allowances and the costs of administering the scheme which are not able to be passed on to passengers. This reduction in profits needs to be seen in the context of the low profitability of the airlines industry over the last 10 to 15 years.

Costs of the Scheme

Cost of Purchasing Allowances Excluding Auctioning

In **Chapter 2**, we determine the amount of allowances aircraft operators would need to buy to cover their future emissions based on the projected growth of the aviation sector. Using commonly agreed price scenarios of allowances, we analyse the costs of purchasing allowances over the different trading periods.

With an annual traffic growth rate of 5%, corresponding to an annual emissions growth rate of 4%, and using the 2004-2006 average as a target, we estimate that aircraft operators would need to offset a cumulative quantity of 1,511 MtCO_2 from 2011 to 2022. As one allowance is required for one tonne of CO_2, this means that the quantity of allowances to be purchased by the aircraft operators would be equivalent to this figure.

After reviewing a number of studies (Appendix E: CO2 markets and aviation), we have selected the following price levels for the EU allowances:

- For 2011-2012: low price €15/tCO_2 high price €30/tCO_2
- For 2013-2022: low price €6/tCO_2 high price €30/tCO_2

Costs of Purchasing Allowances

Allowance Price	**€ 6/tCO_2**	**€ 15/tCO_2**	**€ 30/tCO_2**
Period			
2011		€ 222 mill.	€ 445 mill.
2012		€ 1,060 mill.	€ 2,120 mill.
2013 – 2018	€ 3,218 mill.		€ 16,088 mill.
2018 – 2022	€ 5,333 mill.		€ 26,667 mill.
Total - Low Price (€6 – 15/tCO_2) **2011 - 2022**	**€ 9,833 mill.**		
Total - High Price (€ 30/tCO_2) **2011 - 2022**			**€ 45,320 mill.**

If the allowance price were to increase to €60/tCO_2 (a 'what if' scenario with twice the generally accepted price of €30/t CO_2), the global cost of allowances to enable the aviation industry to meet growth in demand over the period between 2011 and 2022 would reach €90.64 bill., without the additional costs of auctioning.

Additional Costs of Purchasing Allowances through Auctioning

We also examine the impact of auctioning on the costs to be borne by the aircraft operators. The proposed directive would make auctioning mandatory for the aviation sector as from 2011. For the years 2011 and 2012, we have taken the figure of 3% for the proportion of auctioning. This represents the average percentage adopted by those Member States which have introduced auctioning for ground sources for the trading period of 2008-2012 (**Chapter 2.7**).

In the absence of a proposal for the proportion of auctioning for the aviation sector in subsequent trading periods (2013-2017 and 2018-2022), we have taken the figures considered by the Commission in its impact assessment of 20% and 40%.

Costs of Auctioned Allowances

Auctioning Price	**€ 6/tCO_2**	**€ 15/tCO_2**	**€ 30/tCO_2**
Auctioning %			
2011 (3%)		€ 23 mill.	€ 46 mill.
2012 (3%)		€ 93 mill.	€186 mill.
2013 - 2018 (20%)	€ 1,310 mill.		€ 6,548 mill.
2018 - 2022 (40%)	€ 2,619 mill.		€ 13,097 mill.
Total - Low Price (€ 6 – 15/tCO_2) 2011 - 2022	**€ 4,045 mill.**		
Total - High Price (€ 30/tCO_2) 2011 - 2022			**€ 19,877 mill.**

We estimate that, depending on the trading period, auctioning could increase the total allowance costs by more than 44%.

If the cost of acquiring allowances were to increase to €60/tCO_2 (a 'what if' scenario with twice the generally accepted price of €30/tCO_2), the global cost for aviation of auctioned allowances would reach €39.7 bill. between 2011 and 2022.

Combined Costs of Purchasing and Auctioning Allowances

Total Costs of Purchasing & Auctioning

Allowance Price	**€ 6/tCO_2**	**€ 15/tCO_2**	**€ 30/tCO_2**
Auctioning %			
2011 (3%)		€ 245 mill.	€ 491 mill.
2012 (3%)		€ 1,153 mill.	€ 2,306 mill.
2013 - 2018 (20%)	€ 4,528 mill.		€ 22,636 mill.
2018 - 2022 (40%)	€ 7,952 mill.		€ 39,764 mill.
Total - Low Price (€ 6 – 15/tCO_2) 2011 - 2022	**€ 13,878 mill.**		
Total - High Price (€ 30/tCO_2) 2011 - 2022			**€ 65,197 mill.**

If the cost of acquiring allowances were to increase to €60/tCO_2 (a 'what if' scenario with twice the generally accepted price of €30/tCO_2), the global cost for aviation of purchased and auctioned allowances would reach €130.4 bill. between 2011 and 2022.

ETS Administrative Costs

Additionally, the implementation of the EU ETS generates administrative costs for aircraft operators. Based on the experience of other sectors, we estimate that the cost of meeting EU requirements would range from an annual €187,000 for large companies to €116,000 for small companies when all the monitoring, verification and trading mechanisms will be in place. These calculations are dependent on the EC reporting, monitoring and verification guidelines that have not yet been published **(Chapter 2.8) (Table 2-5).**

These costs will be particularly significant for business aviation, where 85% of entities operate less than 5 aircraft. Per allowance, the cost will be 60 times higher for small aircraft operators than for large airlines.

The Concept of Cost Pass-Through

The proportion of additional costs that airlines will pass onto their customers will vary according to the airline business model and according to the level of competition on a given market. We estimate that on an average basis, the pass through of cost to consumers will not exceed one third of the cost of allowances.

The Commission's Impact Assessment assumes that airlines will pass on to a large extent or even in full to their customers the costs of buying CO_2 allowances. In reality, a 100% cost pass-through is only conceivable in a situation of perfect competition, which is defined as an environment where neither the consumer nor the producer can influence the market price by their behaviour. Perfect competition is purely a theoretical model and does not apply to the aviation sector.

Although this may seem counter-intuitive, economic theory demonstrates that the cost pass-through rate reduces as the number of competitors falls below that necessary to sustain a perfectly competitive market.

After an assessment of the competitive situation in various segments of the aviation market and taking into account the degree of competition existing on different types of route, such as those serving congested airports and those between regional points, we identify the following average cost pass-through rates across all routes in each market segment:

- In 2011/2012, network airlines would be able to pass on average on all routes around 35% of their allowance costs to passengers. Due to an increase in the number of congested airports and the resulting reduction in competition, the ability to pass on costs would decline over time to an average percentage of around 29% in 2022, taking into account that yields are already maximized at congested airports.

- Low fares airlines would be able to pass through on average around 30% of their allowances costs. This proportion would remain constant over time due to their business model which is to operate in general from secondary, uncongested airports.

- As with network airlines, cargo airlines would be able to pass around 35% of their allowances costs. Similarly, such a proportion would decline on average to 29% in 2022.

Although we have not considered regional and charter airlines individually, we consider that they would be able to achieve pass through rates within the range set out by network and low fares airlines.

The Concept of Price Elasticity

Demand will be reduced as a result of the changes in the price of air travel caused by airlines passing on a part of the costs of allowances into ticket prices.

Any change in price to consumers will lead to an increase or decrease in demand. The concept of price elasticity of demand describes this relationship between price and demand, and measures the degree of consumers' sensitivity to price fluctuations. The price elasticity is the ratio between the change in demand and the change in price.

Based on our review of existing research on the price elasticity of demand we have adopted the following assumptions for the price elasticity of demand which we believe better reflect market realities than the assumptions of the EC impact assessment:

For network airlines

- -0.8 for business passengers,
- -1.0 for long-haul leisure passengers
- -1.5 for short-haul leisure passengers

For low fares airlines:

- -1.5 for all passengers

For cargo airlines:

- -0.8 for express freight
- -1.6 for standard cargo

For example, if a low fares airline increases its price by 10%, then it will see its demand reduced by 15%. This means, that for this segment of the market, the price elasticity is the ratio between the change in demand and the change in price: -1.5.

Knowledge of price elasticity of demand and cost pass-through is essential to determine the change in demand corresponding to the increase or decrease in cost.

As a result, the loss of demand compared to business as usual would grow year by year until, by 2022, it would amount (and assuming that there is no auctioning of allowances) to between:

- 2.6 million passengers and 85,000 tonnes of cargo (Low allowance price scenario)

and

- 12.9 million passengers and 426,000 tonnes of cargo (High allowance price scenario).

If auctioning of allowance is introduced in the aviation sector, loss of demand will be even greater.

Impact on Profitability

The effect on the profitability of airlines needs to be seen in the context of the low aggregate profitability of the airline sector over the last decade. The criticality of the loss of profits will vary from airline to airline and could potentially result in an increase in airline failures.

Aircraft operators will be affected by a combination of two factors:

- Increased costs due to purchase of allowances and limited possibilities to pass costs on customers.
- Loss of revenue resulting from reduced demand.

Profit margins of most aircraft operators, be they network, regional or cargo carriers, represent at best 3% of their total turnover. Profits have generally been higher in the low fares segment but this is not necessarily the case with the newer low fares operators. Further details of a range of sensitivity tests, at different levels of profitability, are given in **Chapter 3**.

For the overall period between 2011 and 2022, carriers would face a cumulative reduction in profit margins. In the table below, we set out the absolute and percentage fall in profit margin for the key carrier groups:

Segment	Low CO_2 price (€ 6 – 15/tCO_2)	High CO_2 price (€ 30/tCO_2)
Network	down 0.3%	down 1.6%
	- € 5.2 bill.	**-€ 23.8 bill.**
Low Fares	down 0.9%	down 3.9%
	- € 1.3 bill.	**- € 5.1 bill.**
Cargo	down 0.9%	down 3.8%
	- € 3.0 bill.	**- € 11.6 bill.**

Over the last 10 years, the aggregate profit of the network carriers in Europe was only €2.1 bill. Clearly, profitability varies from airline to airline. However, it is clear from the table above that for some airlines, operating at lower profit margins, reductions in their margin at the levels indicated above could potentially lead to an increase in the rate of failures.

Impact on Consumers

The introduction of the EU ETS will result in a reduction in consumer choice in terms of the range and frequency of air services. We expect that regions and regional airports would be particularly affected.

The introduction of the EU ETS will also result in a loss of consumer surplus of between €55.9 mill. and €123.7 mill. in 2011 growing to between €426.2 mill. and €2,186.6 mill. in 2022.

The introduction of the EU ETS will affect the market in different ways, with some types of passenger disproportionately affected. Overall, we expect less choice for consumers in the form of limitations on types of service, number of frequencies and range of routes, as well as reduced development of regional airports. The effect on the overall quality of service in air transport is difficult to assess for the short and medium term, but long run effects could be far-reaching with substantial reductions in the supply of air transport services available.

As described in **Chapter 4**, depending on the allowance price, we estimate a loss of consumer surplus (that is the benefit consumers obtain when they would have been willing to pay a higher price than is actually charged) of between €55.9 mill. and €123.7 mill. in 2011 as a result of allowance costs being passed on, when the scheme is intended to operate on an intra-EU basis only. This impact is expected to grow with the inclusion of all services, leading to an annual loss of between €426.2 mill. and €2,187 mill. in 2022.

It is important to recognise that the impact on consumers will not be uniform and that there will be wider socio-economic impacts in terms of some passengers being priced out of being able to travel, particularly those on lower incomes.

Impact on the Economy and the Lisbon Agenda

There will be wider implications from the inclusion of the aviation sector in the EU ETS in its present form. Up to 42,000 fewer direct jobs will be created, even assuming no auctioning of allowances. Europe will be less well connected internally and with the rest of the world. Tourism in the EU will be damaged. These impacts are not consistent with the Lisbon agenda and will affect the competitiveness of the EU as well as competition between EU airlines and those in the rest of the world.

We consider the consequences of including aviation in the EU ETS on the wider economy. The role of aviation in facilitating economic development is well documented and has been the subject of extensive and valuable research (**Chapter 5**).

We estimate that, if the aviation sector is included within the EU ETS in its present form, in 2022 it will support between 8,000 and 42,000 fewer direct jobs and contribute between €772 mill. and €3,862 mill. less in terms of gross value added compared to a business as usual situation, dependent on the cost of allowances.

More importantly, curtailing the growth of aviation will result in fewer air service connections to support those economic sectors that are heavily dependent on air transport access to be globally competitive. The Lisbon Agenda set out an ambitious economic development target for the EU *"to be the most competitive and dynamic knowledge driven economy by 2010"*. In this context, it is essential that the EU remains an attractive place to invest and do business. Connectivity both within the EU and externally is central to achieving these objectives.

Furthermore, air transport plays a key social role by enabling and improving cohesion within the EU, allowing people to migrate effectively and supporting citizens' mobility. This is even more crucial for the less mature economies of the Eastern and Southern regions of the EU, as well as for new Member States. Air transport also provides essential social services, particularly in some peripheral regions, and this role could be damaged through the high cost of inclusion within the EU ETS.

The impact on tourism and regional development has to be considered with care. For economies that are economically heavily dependent on airborne tourism demand, such as a number of regions around the Mediterranean, there would be a serious potential risk of economic decline. This is particularly the case in regions where airlines have stimulated new, highly price sensitive markets through the availability of low fares as ETS has the potential to impact more heavily on highly elastic demand.

A further consideration is the effect of the inclusion of the aviation sector in the proposed EU ETS in its current form on the competitiveness of the air transport industry itself (**Chapter 5**). Whatever the geographical scope, by definition, the EU ETS will never involve all traffic across the world. Therefore, the aircraft operators based in Europe will be at a competitive disadvantage compared to carriers which do not operate to Europe, as they will have to bear the financial costs detailed above.

Application of the scheme to intra-EU flights only for the first year will impact the entire traffic of those EU carriers operating wholly or mainly within the EU. As their networks are not limited to intra-EU operations, the other carriers will have only a minority of their flights included in the ETS. This leads to distortion of competition between operators. It may be argued that the extension of the geographical scope in 2012 to cover all operators' flights to and from the EU may reduce this imbalance. However, a new type of distortion would then be introduced because 100% of European aircraft operators' traffic would be included whilst only a portion of non-EU carriers' traffic would be subject to the EU ETS.

One consequence of such distortion in competition is the high risk of traffic diversion away from the EU hub airports, with hubs close to the EU being in a particularly strong position to take advantage of this distortion in the market. It will be possible for airlines operating services from non-EU hubs to exploit the cost differential for passengers transferring on intercontinental routings from their position outside the EU resulting in further damage to the EU air transport sector. The wider competitive distortions need careful consideration in the design of the scheme.

INTRODUCTION

On December 20th 2006, the European Commission issued a proposal for a Directive amending Directive 2003/87/EC in order to include aviation activities in the European Union's Emissions Trading Scheme (EU ETS). The proposed amendment would introduce aviation in the EU ETS in 2011 for flights within the EU and, starting 2012, for all flights either departing from or arriving in the EU.

Europe's main aircraft operators' associations support the EU ETS as the most appropriate and cost effective market instrument to reduce CO_2 emissions. However, they have strong concerns about the design of the market. They challenge the Impact Assessment of the EU Directive proposal undertaken for the European Commission and have asked Ernst & Young and York Aviation to undertake an analysis of the validity of some of the assumptions and to make an independent assessment of the potential impacts of the proposed Directive on aircraft operators, users and the EU economy.

The document is structured as follows:

- in **Chapter 1**, we examine the economic rationales for modelling the impacts of the EU ETS in the airline industry, and the particularities of the sector to take into account;
- in **Chapter 2**, we present the likely range of allowance prices and analyse the costs related to the introduction of aviation into the EU ETS;
- in **Chapter 3**, we set out our assessment of the impact on aircraft operators finances;
- in **Chapter 4**, we analyse the implications for consumers within the EU;
- in **Chapter 5**, we discuss the potential impact on the wider EU economy of the introduction of the EU ETS.

1 REVISED ASSUMPTIONS FOR IMPACT ASSESSMENT

Key Points
• The ETS costs could not be entirely passed on to customers because of the nature of competition between airlines. The airline sector is characterized by a high degree of liberalisation, but with few competitors on routes due to high fixed costs. This situation differs significantly from a pure and perfect competition and the assessment that additional cost could be entirely passed through to customers is incorrect. • Any increase in price will lead to a decrease in demand. Price elasticity of demand describes the correlation between variation of price and change in demand, and several studies in the airline sector demonstrate that the price elasticity of air travellers is significant, with a difference between business and leisure travellers. • Windfall profits cannot arise in the aviation sector. With the generally high level of liberalisation in the market, profits are already maximized for the airline operators and any increase in cost will lead to a decrease in profits. This is not always the case in other sectors that are less liberalised and where windfall profits may occur.

In the EC impact assessment, it is stated that the inclusion of aviation in the EU ETS would not adversely affect aircraft operators because:

- Aircraft operators would be able to pass on to large extent, or even in full, the allowance costs to their customers,

- Demand would not be significantly reduced by the corresponding increase in the fare of air tickets due to limited price elasticity,

- As allowances would be granted free of charge, aircraft operators would benefit from windfall profits.

In this Chapter, we demonstrate that these different statements do not reflect the market reality of aircraft operators and we propose revised assumptions.

1.1 The concept of cost pass-through

The cost pass-through rate can be defined as the rate of cost increase (or decrease) that is passed on to consumers.

1.1.1 EC basic Assumption for Impact Assessment

The EC impact assessment states that aircraft operators would be able to pass on to large extent, or even in full, the allowance costs to their customers. We have analysed the situation of the ability of aircraft operators to pass-through additional costs and propose new assumptions as to the rate of cost-pass through.

1.1.2 Cost Pass-Through Rate Under Imperfect Competition

The optimal way to determine the rate of cost pass-through would be to establish an unequivocal relationship between the optimal price which companies can charge in the market and the costs they face.

However, on each route, the price is determined by a range of factors such as the features of demand, the cost of airline operations and the nature of competition[1]. In the aviation sector, competition is closer to an oligopoly (in some cases, to a monopoly), rather than pure and perfect competition. Several studies[2] related to airline competition are based on the fact that the competition is often close to a duopolistic situation. If we consider the European market and the routes with the heaviest traffic, we note that there are never more than eight competitors for any specific route[3]. Even with a high number of competitors, this is still insufficient to consider that competition is pure and perfect. The level of competition to be assumed is therefore a major issue for this impact assessment, and it should be considered carefully before reaching a conclusion on the rate of cost pass-through.

In order to determine the cost pass-through of the aviation sector, we take as our start point Ten Kate and Niels (**Note 23**) with the simple case of the monopoly. Ten Kate and Niels consider the standard case of a monopoly selling homogeneous goods with linear demand ($p = a - b.D(p)$) and constant marginal costs ($C(q) = c.q$). The monopoly will maximize its profits, with the profit being expressed as:

$$\Pi^b = (p - c).D(p) - F,$$

where p is the price of an air ticket, c the variable cost, D(p) the demand that depends on the price and F the fixed cost incurred by the airline, a and b are constant.

Solving this equation for maximum profits maximization leads to the following price:

$$p = \frac{1}{2}a + \frac{1}{2}c$$

In other words, in such a situation, exactly half of any cost change is passed on to price. This is due to the fact that the slope of the marginal revenue curve is twice the slope of the inverse demand curve so that the quantity increase δq triggered by a cost decrease δc is translated back into a price decrease half that size as illustrated in the **Figure 1-1**:

[1] The competition may exist on a specific route or between different routes. A passenger willing to travel from point to point may have several choices for the airport of departure and several choices for the airport of arrival. Different routes may then compete in order to deliver the transportation service for the passenger. For cargo, similar remark may be made.

[2] *Airline schedule competition* – Brueckner and Flores-Fillol – August 2006, for example.

[3] If we consider the most competitive routes that is to say the routes between North and South of Europe during holiday periods, there are rarely more than eight competing airlines that can be identified on a point to point trip.

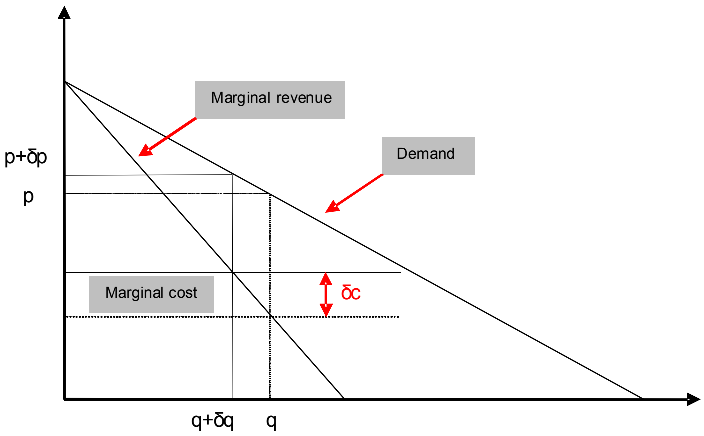

Figure 1-1: Cost Pass-Through Rate Under Imperfect Competition (According to Ten Kate and Niels)

The result by Ten Kate and Niels shows that the cost pass-through rate is independent of the demand and cost parameters and is always one half. This result may be counter-intuitive as the well-known Lerner equation would lead one to expect that a monopoly would have a cost pass-through rate even larger than one. However, this tends to show that the assumption of iso-elasticity is unrealistic. Eventually, even a small reduction of demand reduces profits considerably, and as Ten Kate and Niels write:

> *"A profit-maximizing monopolist passes on precisely half of his cost savings to price, independently of the parameters of demand and the initial cost level."*

This remark is also true for an increase in cost. After studying this simple case, Ten Kate and Niels extend their work to other types of cost functions, forms of demand and examine the general case of the oligopoly. Their conclusion is that the 'central cost pass-through rate'[4] in a market where *n* competitors are present is equal to:

$$\sigma = n/(n+1)$$

When the number of competitors is large, the cost pass-through rate increases so that it becomes close to one, which means that all the costs are passed through to the customer. This is the well-known result of the pure and perfect competition considered by the EC impact assessment.

1.1.3 Congested and un-congested airports

There are some situations where the normal course of business is limited by supply constraints. This is the case at congested airports, as outlined by Oxera in a recent study[5]. At such airports, the ability to increase supply in order to meet additional demand often does not exist since all available capacity is used.

[4] The actual cost pass-through rate depends on the form of the demand function and is higher if the demand is convex, or lower if the demand is concave. The actual form of the demand function being a matter of empirical experience, we use the '"central pass-through rate"' in this study.
[5] Assessment of the financial impact on airlines of integration into the EU greenhouse gas emission trading scheme – BAA External emissions trading steering group - Oxera – October 2003

In these circumstances, an increase in demand could not be satisfied by an increase in supply. Therefore, the price is not determined by reference to the cost but by taking into account the customers' ability to pay (the supply being fixed).

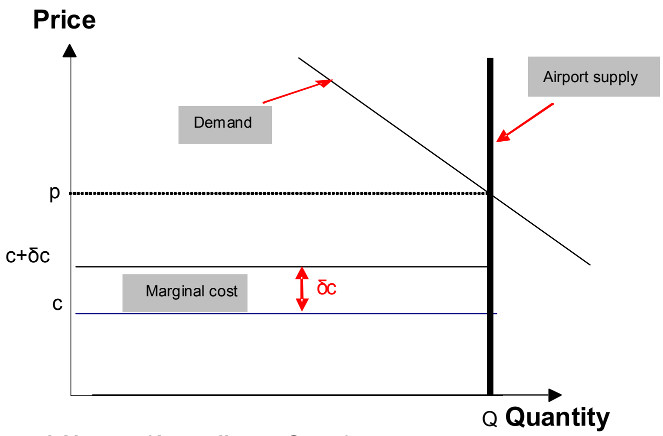

Figure 1-2: Demand at Congested Airports (According to Oxera)

The **Figure 1-2** shows that at congested airports, the supply is maximized which means that the potential demand is greater than the actual capacity of the airport. Demand is presented as a decreasing function of price, but the limited capacity of the airport makes the optimal price the crossing point between the demand curve and the airport supply curve. If the cost increases from c to c+δc, the number of passengers and the price will remain unchanged, because airlines already charge the maximum price they can, depending on passengers' willingness to pay. That is to say that no additional cost will be passed through to the passengers. The only difference for the airlines is that their costs will increase and consequently their financial performance will decrease.

1.1.4 Fixed cost and variable costs

The question of cost pass-through is closely related to the question of marginal costs. This question is not so simple in the airline industry since the marginal cost for one additional passenger on a specific flight may be viewed as nearly equal to zero, as most of the costs are related to the operation of the flight as a whole. The fact that one more passenger joins the flight will not really increase the cost of operation. In order to evaluate fixed costs and variable costs, it is necessary to consider the dimension of time. In the short-term, for time periods of say one season, the cost of operating a flight can be viewed as virtually fully fixed.

Over such a short period, it is difficult for an airline to adjust the supply in response to a change in demand for example by changing the size of an aircraft on a specific route. In the medium and long term, the 'room for manoeuvre' is greater and a smaller part of the cost can be considered as fixed on a particular route. The ability to respond also depends on the business model of the airline. For example, with their largely standardized aircraft, low fares airlines may be less able to adjust the size of their aircraft as easily in response to a change in demand compared to the network airlines, which have a wider range of aircraft at their disposal. As a consequence, it is necessary to take into account the fact that part of the cost of a flight arising from ETS cannot be considered as a variable cost but should be seen as an increase in the fixed cost that cannot be passed through to customers.

1.1.5 New assumptions regarding cost pass-through

We have considered three typical forms of competition on routes (i) the monopoly, (ii) the small oligopoly (with three airlines) and (iii) the large oligopoly (with nine airlines). We have considered two types of airlines to demonstrate the range of impacts: network airlines and low fares airlines[6]. Network airlines and low fares airlines face different types of competition. The assumptions that we used are presented in the following tables and discussed below:

Table 1-1: Type of Competition for Network Airlines

Assumptions for network airlines[7]	2005	2025	Note
Percentage of congested airports	30%	50%	(a)
Percentage of un-congested airports	70%	50%	(a)
% of monopolistic routes	15%	15%	(b)
% of small oligopolistic routes	75%	75%	(b)
% of large oligopolistic routes	10%	10%	(b)

Table 1-2: Type of Competition for Low Fares Airlines

Assumptions for Low Fares airlines	2005	2025	Note
Percentage of congested airports	-	-	(a)
Percentage of un-congested airports	100%	100%	(a)
% of monopolistic routes	60%	60%	(c)
% of small oligopolistic routes	40%	40%	(c)
% of large oligopolistic routes	-	-	(c)

(a) We have taken, as a basic assumption that only network airlines operate from congested airports. This is not always the case, for example EasyJet that operates from Paris-Orly, but in general low fares airlines use secondary, un-congested airports. In order to assess the percentage of congested airports overall, we used the study by Mott MacDonald, according to which 30% of passengers would be handled by heavily congested airports in 2005, but this figure would rise to 50% by 2025.

We have assumed that these figures represent the percentage of demand at heavily congested airports where there would be limited ability to pass through additional costs. This may actually be an underestimate of the overall financial impact since the average revenue from a passenger at a heavily congested airport is higher than for an average passenger at a less heavily congested airport. Heavily congested airports are hubs for the network airlines from which long-haul flights, whose ticket prices are higher than short-haul flights, depart. The situation is different at un-congested airports, since the absence of supply limits allows for a more traditional form of competition between airlines.

[6] We assume that cargo airlines will face the same type of competition as network airlines.
[7] These assumptions are similar for network airlines and cargo airlines.

(b) The percentage of point-to-point markets on which the network airlines face the different types of competition is derived from the study of the percentage of flights facing different levels of competition for European network airlines. We have considered that routes between European countries on one hand and their present or past overseas territories on the other hand were monopolistic routes, due to the specific relationship between these territories. Short-haul flights were considered as ‘large’ oligopolistic routes, since competition arises with other network airlines but also other types of carriers like regional airlines leading to a high number of potential competitors. Other long-haul flights were considered as ‘small’ oligopoly routes since we assumed that the competition would occur mainly between network airlines.

(c) We have estimated that low fares airlines were more often in a position close to monopoly, either because they operate on specific airport pair routes or because they serve a specific market they have helped to create and which could not easily be served by their competitors. We also considered the case of ‘small’ oligopolistic competition for low fare airlines, but did not address the case of ‘large’ oligopolistic routes, since we considered that low fares airlines tend to avoid competition with a high number of other competitors.

In order to determine the level of cost pass-through for these different types of sub-markets, we have applied the formula of Ten Kate and Niels and have referred to the considerations by Oxera on congested airports. The results are presented in the following table.

Table 1-3: Cost Pass-Through Rates by Type of Competition

Competition	Cost pass-through rate
Congested airports	0%
Monopoly	50%
Small oligopoly	75%
Large oligopoly	90%

Table 1-4: Financial Assumptions for Airlines

	Network airlines	Low fares airlines	Note
Fixed costs (%)	60%	70%	(a)
ETS fixed costs (%)	25%	50%	(b)
Profit margin (%)	4%	15%	(c)

(a) For the purpose of this modelling, the percentage of fixed costs over a period of one year is assumed to represent more than half the costs incurred by airlines. Furthermore, the proportion of fixed costs for low fares airlines are assumed to be higher than for network carriers. A sensitivity analysis of this assumption has been conducted (See Appendix F: Results of sensitivity testing).

(b) The ETS fixed costs are assumed to be lower than the general fixed costs since they are related to fuel consumption, which is more variable than other airline cost items. We also assume that these costs are higher for low fares airlines than for network carriers. A sensitivity analysis has also been conducted for that assumption (See Appendix F: Results of sensitivity testing).

(c) The profit margin rate for network airlines is assumed to be close to 4% but we have undertaken sensitivity analyses for profit margins of 1% and 7%. For low fares airlines, only Ryanair has experienced sustained high profit levels in recent years and we considered an assumption mirroring such profits, with a sensitivity analysis for 10% and 20% of profit margin (See Appendix F: Results of sensitivity testing).

1.2 The Concept of Price Elasticity

Any increase in price will lead to a decrease in demand. The relationship between that increase in price and the subsequent decrease in demand is evaluated by a price elasticity of demand that describes the relationship between changes in quantity demanded of a good or a service and changes in the price for that good or that service. If the price increases by 1% and the quantity demanded decreases by 2%, the price elasticity of demand would be 2% ÷ 1%, or 2. Any number above 1 indicates relatively elastic demand, whereas numbers between 0 and 1 indicate relatively inelastic demand. Once we have established cost pass-through rates and the price elasticity of demand, it is possible to determine the change in demand corresponding to the increase in cost.

1.2.1 EC Basic Assumption for Impact Assessment

The EC impact assessment states that elasticity of demand in the aviation sector is limited. This is not borne out by research work undertaken in this area and we propose new assumptions regarding elasticity of demand based on this work.

1.2.2 New Assumptions Regarding Elasticity of Demand

We have assumed the following elasticity of demand for our defined market segments for passenger airlines:

	Business	**Leisure**	**Note**
Network airlines (short haul)	-0.8	-1.5	(a)
Network airlines (long haul)	-0.8	-1.0	(a)
Low fares airlines	-1.5	-1.5	(a)
	Express	**Standard**	**Note**
Cargo airlines	-0.8	-1.6	(b)

(a) Our assumptions in relation to the behaviour of consumers are based on the existing research summarized below: **Table 1-5**

Table 1-5: Existing Research on Elasticity of Demand for Passenger Airlines

Study	Elasticity of demand
OXERA	-0.8 (business) and -1.5 (leisure)
CE DELFT	-0.2 to -1.0
TRUCOST	-1.0 to -1.5
Dresdner Kleinwort Wasserstein	-0.5 to -1.4
Government of Canada	-0.7 to -1.5

We believe that the estimates set out in the OXERA Study provide sensible mid-point assumption[8], particularly as the Study provides a distinction between business and leisure travellers. In considering the impact of ETS on demand, we feel that this distinction is an important consideration, particularly considering the recent rapid growth and consequent increasing market share of price sensitive low fares services. We have, however, used a lower estimate for long-haul leisure passengers as this market is generally perceived to be less elastic and was not specifically considered by the OXERA study.

(b) In relation to cargo airlines and their services, information on the price elasticity of demand is scarcer. However, some research has been undertaken by the World Bank in this area, summarising results from a range of studies[9]. This research suggests a range for elasticity of demand for cargo services of between -0.8 and -1.6. For the purposes of this impact assessment, we have assumed that express freight services have an elasticity of demand in line with the bottom end of this range, and that standard air cargo services are at the top end of the range.

1.3 The Concept of Windfall Profits

The introduction of the EU ETS in 2005 had a windfall effect for many electricity producers who incorporated CO_2 costs into electricity prices when allowances where freely allocated.

1.3.1 EC Basic Assumption for Impact Assessment

A central tenet of the Commission's impact assessment in relation to windfall profits was that airlines would increase the price of the tickets and that demand would not react significantly, meaning that little financial impact on airlines would occur. According to these assumptions, any allowance grandfathered to the airlines would represent a windfall profit as airlines would increase prices on all services.

These conclusions are close to what was observed in the electricity sector, and we assume that the EC impact assessment for aviation was prepared on the basis that the same results would arise in the aviation sector. However, the underlying comparison between the electricity sector and the aviation sector is questionable. We assess this below with a simple model of the monopoly and address the slightly more technical case of the oligopoly in Appendix C: Additional considerations on windfall profits.

1.3.2 Examination of Windfall Profits for a Monopoly

At the outset, we assume a monopolistic company whose profit Π^b before the introduction of the ETS may be written as follows:

$$\Pi^b = (p - c).D(p) - F$$

Where p is the price of an air ticket, c the variable cost, $D(p)$ the demand that depends on the price and F the fixed cost incurred by the airline. The airline determines the price of the tickets in order to maximize its profits. The profit maximizing price, prior to the introduction of the ETS, is written as p^{b^*}.

[8] It should also be noted that the OXERA work draws on 37 other studies to identify its estimates of the Price Elasticity of Demand.

[9] *A Survey of Recent Estimates of Price Elasticities of Demand for Transport* – Infrastructure and Urban Development Department, World Bank (1990).

After the introduction of ETS, the variable cost increases by *δc* and the fixed cost by *δF*, so the price rises by *δp* and the demand will decrease by *δD*. If we note that *δp = σ.δc,* where *σ* is the cost pass-through rate and *ε* the price elasticity of demand, the new profit Π^a can then be expressed as:

$$\Pi^a = \Pi^b - \delta c.(1 - \sigma).D - (p - c).\varepsilon.D.\delta p/p - \delta F$$

This expression shows the different effects on the monopoly's profitability. The profit after ETS is equal to the profit before ETS less three different terms:

1. the first term is the increase in the variable cost that is not passed through to customers which reduces the gross margin for the airlines: *the variable cost not passed through*;
2. the second term is the loss of gross margin due to the reduction of demand (implied by the price increase): *the decrease in demand due to price increase*;
3. the third term is equal to the fixed costs of ETS that cannot be passed through to customers and thus reduces the profit margin of the airline: *the additional fixed costs*.

Not only will the monopoly experience losses due to the increase in costs, but the new maximizing price after ETS will differ from the maximizing price before ETS so that the profit Π^b in the previous expression will in any event be lower than that without ETS, as illustrated in the following graph.

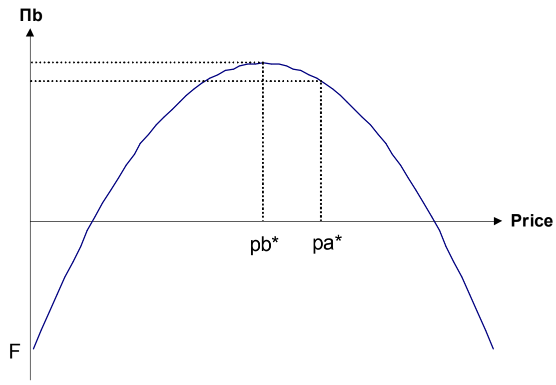

Figure 1-3: Profit Curve of a Monopoly

This generalized curve form reflects the fact that the airline will incur losses if the fare is free since it will bear the fixed costs with no revenue. Conversely, if the price is very high, there will be no demand and no revenue whereas the fixed cost will still be incurred. Between these two extreme prices, there is the price that maximizes airline profit before the introduction of ETS (p^{b*}). After the introduction of ETS, the airline will increase its price (p^{a*}) which will lead in any event to a loss of profit. Eventually, assuming that the gross margin rate is equal at equilibrium to the inverse of the price elasticity of demand, the previous equation may be re-written as:

$$\Pi^a = \Pi^b - \delta c.D - \delta F$$

This equation shows that the loss of profit will be exactly equal to the full additional cost, in our case the cost of ETS. This simple model shows that the general assumptions of the EC impact assessment under which the airline will in any event, even in the case of the monopoly, bear no cost is incorrect since the first euro of additional cost will represent a loss of margin for the airline. The situation in the electricity sector was quite different as explained below.

How could windfall profits occur?

The main difference between the airline industry and the electricity sector is their degree of liberalisation. The airline sector is highly liberalised, suggesting that prices are already fixed at a level that maximizes profits for the airlines. For this reason, any additional cost will lead to a decrease in profits. However, in the electricity sector, the situation is different since the prices of electricity are not fully liberalised in Europe.

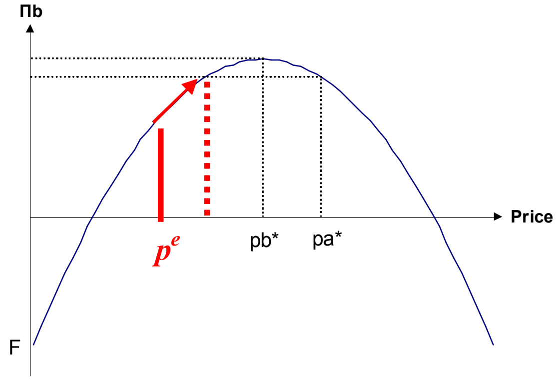

Figure 1-4: Effects on Profits of an Increase in Price for a Regulated Monopoly

The above graph gives support to the argument that windfall profits may exist in a sector where prices are regulated. If the price of a commodity is fixed at the level p^e,as a result of government interference in the market, the introduction of the ETS may be an opportunity for the suppliers of that commodity to persuade the regulators to allow them to increase their prices. The increase in price is not only driven by the cost of ETS but also by opportunistic considerations: the commodity is structurally under-priced from the profit-maximizing perspective of its suppliers and any increase in price will then lead to an increase in profits. If the price elasticity of demand for the commodity is lower than in the airline sector, then operators could increase their price significantly.

This simple model suggests that windfall profits in the electricity sector may be explained by the specificities of this sector. The principal determinant regarding the ability to achieve windfall profits is the extent of liberalisation within the sector and the consequent 'room for manoeuvre' offered to increase the price over and above the increase in cost due to ETS.
The additional costs due to ETS, therefore, represent an opportunity to increase the price with the consent of the regulators.

1.3.3 Conclusion on Windfall Profits

There is no situation in which airlines can get windfall profits from the introduction of the ETS. Comparisons that have been drawn with the experience of the electricity sector are not relevant in assessing the possibility of windfall profits since the airline and the electricity sectors within Europe are not similar in terms of the extent of liberalization. Electricity prices tend to be capped for political reasons. The introduction of ETS therefore represented an opportunity for a price increase that would allow an increase of profit for electricity suppliers. The main driver of the windfall profits in the electricity sector is not, therefore, linked to any grandfathered allowances but due to an increase of the regulated price following the implementation of the ETS.

In the aviation sector, the situation is completely different as prices are already at a level that maximizes airline profits. Any additional cost will, therefore, necessarily lead to a decrease in airline profits. Windfall profits are therefore not possible in the aviation sector due to its degree of liberalisation, and introduction of ETS will necessarily lead to loss of profit margin for airlines.

1.4 Conclusion

The inclusion of aviation activities in the EU ETS will lead to a loss of profit margins for airlines. The extent of the loss will depend on two main factors that are related on one hand to the supply (and more particularly to the level of competition), and on the other hand to the demand (with the price elasticity). In **Chapter 3**, we examine the financial impacts of the ETS on airlines under the set of realistic assumptions we have determined.

2 COSTS OF ETS FOR AIRCRAFT OPERATORS

Key Points

- Between 2011 and 2022, the aviation sector may need to buy 1,511 mill. tCO_2 (approximately 126 mill. tCO_2 per year).
- The possibilities for aircraft operators to reduce emissions are limited and abatement costs are very high compared to other sectors. Air traffic growth, combined with a target of stabilisation of emissions at the average level of 2004-2006, will make the aviation sector a net buyer on the market (although some aircraft operators may be net sellers).
- For 2011-2012, our assumption is that allowance price could range from €15/tCO_2 to €30/tCO_2.
- For 2013-2022 our assumption is that allowance price could range from €6/tCO_2 to €30/tCO_2 (with a high degree of uncertainty due to the lack of robust information on prices in that period).
- Depending on the price of allowances, and if the maximum price is not higher than €30/tCO_2, the costs of purchasing allowances in order to cover the aviation sector's growth would range from €9,833 mill. to €45,319 mill.
- Assuming that the percentage of auctioning would be 3% for 2011-2012, 20% for 2013-2017 and 40% for 2018-2022, the additional cost of auctioning only would range from €4,045 mill. to €19,877 mill.
- The combined cost to cover growth and auctioning would range from €13,878 mill. to €65,197 mill.
- Administrative costs would be significant, particularly for small aircraft operators.

2.1 Introduction

In this chapter, we determine the overall amount of allowances which the aircraft operators would need to cover their future emissions based on the projected growth of the aviation sector. We consider the abatement possibilities and the emissions target assigned to aviation. We study the different drivers of the price of allowances and propose a range of prices, in accordance with the main studies which have been conducted so far on this subject. We examine the different type of costs generated by the inclusion of aviation in the EU ETS, and have organised the discussion under the following main headings:

- Number of allowances to be purchased;
- Aviation Abatement costs;
- Allowance prices for 2011-2012 and for 2013-2022;
- Auctioning costs;
- Administrative costs;
- Estimation of the total ETS costs for aviation.

2.2 Number of Allowances to be Purchased

The European Commission proposes that aircraft operators will enter the EU ETS in 2011 for intra-EU flights. The annual impact of emissions abatement is assumed to be a 1% efficiency gain. With an annual economic growth of 5%, the annual emissions growth rate would then be 4%. On this basis, we forecast that aircraft operators will emit 69.2 mill. tCO_2 for intra-EU flights in 2011. The Commission has proposed an emission reduction goal for the aviation sector which requires it to stabilise its emissions at the average of the years 2004, 2005 and 2006.

On the basis of historical yearly emissions being 54.4 mill. tCO_2 per year on average, aircraft operators would have to achieve a net reduction, or purchase allowances equivalent to, of 14.8 mill. tCO_2 in 2011 based on projected market growth.

From 2012 onwards, the European Commission proposes to extend the coverage to both intra-EU flights and flights to and from Europe. Those flights are expected to produce 288.9 mill. tCO_2 of emissions in 2012. Taking 218.3 mill. tCO_2 as the average historical yearly emissions for this wider scope, together with an annual emission's growth rate of 4%, the amount to be covered by purchased allowances would then be 70.7 mill. tCO_2 in 2012, rising to 209.4 mill. tCO_2 in 2022.

Figure 2-1 below shows the gap between emissions and allocation between 2011 and 2022.

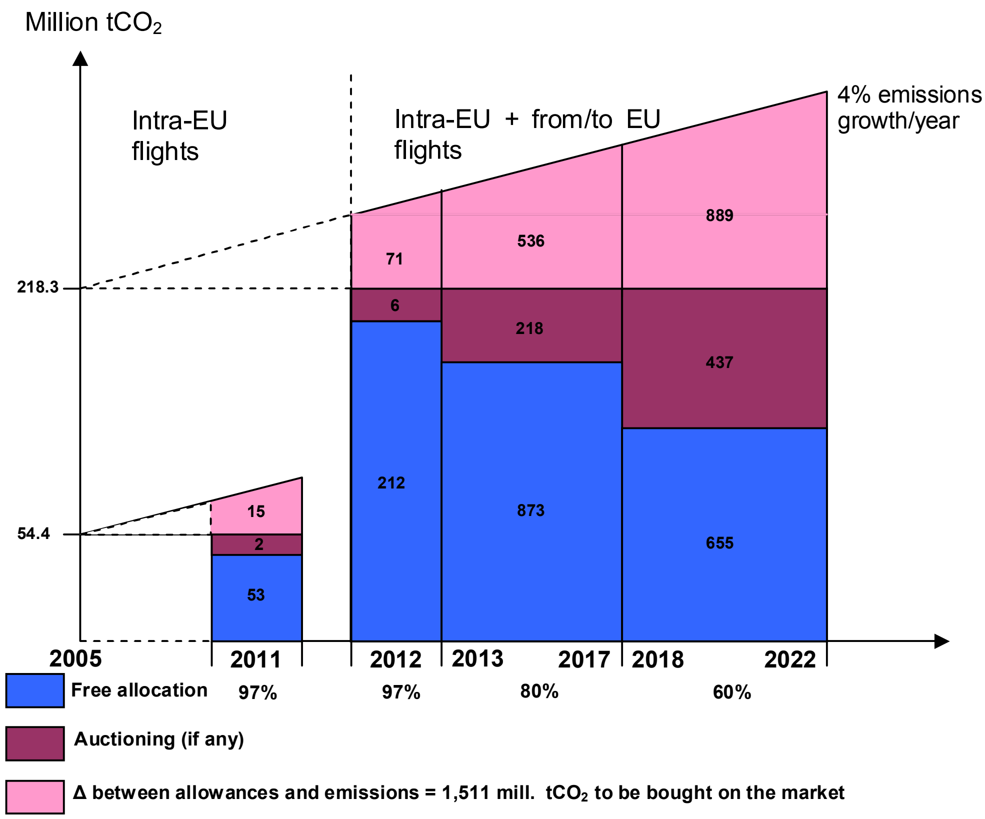

Figure 2-1: Total aviation emissions by type of allocation method – in mill. tCO2
Source: Ernst & Young

As one allowance is required for one ton of CO_2, this means that the quantity of allowances to be purchased by the aircraft operators would be equivalent to these figures.

2.3 Aviation Abatement Costs

To achieve the targets set under the EU ETS, aircraft operators will either have to reduce their own emissions or buy tonnes of CO_2 on the ETS market to the levels set out above.

There are three ways in which the aviation sector can reduce its CO_2 emissions per RTK: improve capacity utilization, improve aircraft efficiency (or other technological improvements), or improve the efficiency of air traffic management (this is not under the control of aircraft operators).

In reality, experts suggest that the cost driver presented by high fuel prices has already generated most of the achievable efficiencies in fuel burn. According to HSBC (**Note 1**), improvements in capacity utilization have already been achieved to maximize revenue. Additional savings from this source are expected to be marginal. Technological improvements could provide a source of reduction, but none that would result in significant emission reductions before 2022. Improvements in air traffic management could achieve a 6 to 12% efficiency of fuel burn over the next 20 years according to the 1999 IPCC report (**Note 10**), but this would require the co-operation of 41 different national air traffic control agencies, Eurocontrol and the aviation sector. This is a key objective for the SESAR project but the scale of improvement and the timescale for implementation has yet to be validated.

The Commission's impact assessment of the proposed directive (**Note 2**) estimated the price of EUAs in a closed market (i.e. unrelated to the other sectors' market) at between €114/tCO_2 and €326/tCO_2. This gives an order of magnitude for the abatement cost in the aviation sector. According to Oxera (**Note 3**) and Hendricks *et al.* (**Note 4**), aviation has the highest abatement cost, as no substitute fuels exist. Oxera and CE Delft estimated that, with an allowance price at €20/tCO_2, the aviation sector could abate 12 mill. tCO_2, whereas the energy sector could abate 250 mill. tCO_2 and other industrial sectors 500 mill. tCO_2 based on the cost effectiveness of abatement measures available. McKinsey (**Note 5**) also estimated that the lowest abatement costs (under €40/tCO_2) were in industries and sectors other than the aviation sector. It is also notable that some sectors have currently excluded research and development projects with potential abatement cost of more than €60/tCO_2, setting this price as a maximum that is not expected to be reached. In the longer term, another approach for mitigating global climate change is to capture and store CO_2 (CCS). Significant deployment of this approach starts at €22/tCO_2 (**Note 9**).

In light of the aviation sector's abatement costs, the most economic option for aircraft operators to comply with future emission caps will be to become net buyers of at least 14.8 mill. tCO_2/year in 2011, 70.7 mill. tCO_2 in 2012 and 209.4 mill. tCO_2 in 2022 on the ETS market.

2.4 Allowance Prices for 2011-2012

Several factors can influence the price of European Unit Allowances (EUAs). The total quantity of allowances, climate conditions, the price of energy, the policy implementation timeline, and the introduction of disruptive technologies are among the main factors.

A number of studies (**Note 1**), (**Note 6**) have analysed the impact of including the aviation sector in the EU ETS on the price of EUAs. Most of them are based on the assumption that no disruptive technologies or solutions reducing CO_2 emissions can be expected before 2012 and even 2022, and that abatement costs will be too high in the sector to reduce CO_2 emissions per RTK. These studies generally estimate the allowance price at between €5/tCO_2 and €30/tCO_2.

As an example, ICF Consulting (**Note 6**) provides allowance price estimates that are mainly based on the interaction between EUAs (European Union Allowances), CERs (Certified Emissions Reduction) and ERUs (Emissions Reduction Units), and the price of natural gas. The results are summarized in **Table 2-1**.

Table 2-1: Forecast EUA Prices in the EU ETS in 2012
Source: ICF Consulting

	Scenario 1 (low demand, high supply)	Scenario 2 (base)	Scenario 3 (high demand, low supply)
Gas price	Low (fuel switching)	Base	High case
German nuclear closure	Delayed	As planned	As planned
Abatement activity	All sectors active	All sectors active	All sectors active
'Track1' ERUs	30% - 100% enter	0% - 30% enter	0% enter
Expected CERs	120 mill. tCO_2	90 mill. tCO_2	60 mill. tCO_2
EUA Price	**€5/tCO_2**	**€11/tCO_2**	**€21/tCO_2**

Whatever the price of EUAs (Note 8), aircraft operators would buy less than 1% of EU ETS allowances in 2012. Therefore, the aviation sector would not impact the EU ETS allowance price in any significant way during the 20011-2012 trading period. In the following periods however, due to its growth the aviation sector might become a major driver for EUAs price.

According to the different caps in the National Allocation Plans (NAPs) validated or submitted to the European Commission for the EU ETS 2008-2012, no more than 14.5% of CERs and ERUs are expected to enter the European market **(Appendix A: CO2 markets and aviation, Table 9-3).**

An examination of the futures market suggests that the price of EUAs range from €15/tCO_2 to €32/tCO_2 (**Figure 10-2**).

Based on this analysis, we estimate that the price of EUAs will range between €15/tCO_2 and €30/tCO_2 at the end of the second trading period (2008-2012) when the aviation sector enters the EU ETS.

2.5 Allowance Prices for 2013-2022

To date, no specific proposals have been defined for the EU ETS post-2012 and very few economic models forecast CO_2 prices up to 2022 on a worldwide basis.

Estimates based on a future worldwide carbon market are available from Russ and Criqui (**Note 7**). These results were compared to a number of other modelled estimates. The average price for CO_2 allowances is expected to be around €13/tCO_2 in 2012 and could rise to €30/tCO_2.

Table 2-2: Carbon Emissions Permit Prices for the Soft Landing Scenario Derived by Different World Energy Models
Source: Russ and Criqui

€/tCO_2	2010	2020	2030	2040	2050
POLES	4,5	21,5	35,3		
NEWAGE	8,8	5,9	21,9		
MESSAGE	38,8	14,6	10,9	11,4	11,1
DNE21	0	27,3	36,9	46,4	60,8
GMM	12,3	16,1	9,7	19,2	20,5
AIM	11,1	17,0	29,0	38,9	32,0

The assumptions used in these models are consistent with the Washington Legislators forum statement, made in February 2007 in Washington, D.C. during the G8+5, to cap and trade CO_2 emissions on domestic markets. These interrelated domestic markets, including the USA, Europe, Russia and most of the major emitters, could be in place between 2012 and 2020.

Above a certain price for EUAs (depending on both coal and gas prices), it can be expected that major power generation companies will decide to switch from coal-fired plants to gas-fired plants. This would reduce the demand for EUAs and as a consequence decrease the EUA price (Appendix E: CO2 markets and aviation).

On this basis, we estimate that the price of one ton of CO_2 should range from €6 and €30 after 2012. However, there is a high degree of uncertainty in these estimates as no global policy has yet been established.

For our calculation, the minimum cost is €15/tCO2 in 2011 and 2012 and then €6/tCO2 in 2013-2022. This gap comes from the quality of information available for these different periods. 2011 and 2012 figures are based on a currently existing market of futures when 2013-2022 figures are based on assumptions regarding a market which rules are currently not set.

2.6 Cost of purchasing allowances

Based on the assumptions described above regarding allowances costs and activity growth, the costs of purchasing allowances are described in the **Table 2-3**:

Table 2-3 : Costs of Purchasing Allowances

Allowance Price	€ 6/tCO_2	€ 15/tCO_2	€ 30/tCO_2
Period			
2011		€ 222 mill.	€ 445 mill.
2012		€ 1,060 mill.	€ 2,120 mill.
2013 -2018	€ 3,218 mill.		€ 16,088 mill.
2018 - 2022	€ 5,333 mill.		€ 26,667 mill.
Total - Low Price (€ 6 – 15/tCO_2) 2011 - 2022	**€ 9,833 mill.**		
Total - High Price (€ 30/tCO_2) 2011 - 2022			**€ 45,320 mill**.

Figure 2-2 below presents the global minimum cost for the aviation sector of buying allowances in order to comply with the proposed directive, based on the main assumptions of a low market price of carbon (€15/tCO_2 in 2011 and 2012, then €6/tCO_2 from 2013 to 2022 for either EUAs, CERs or ERUs).

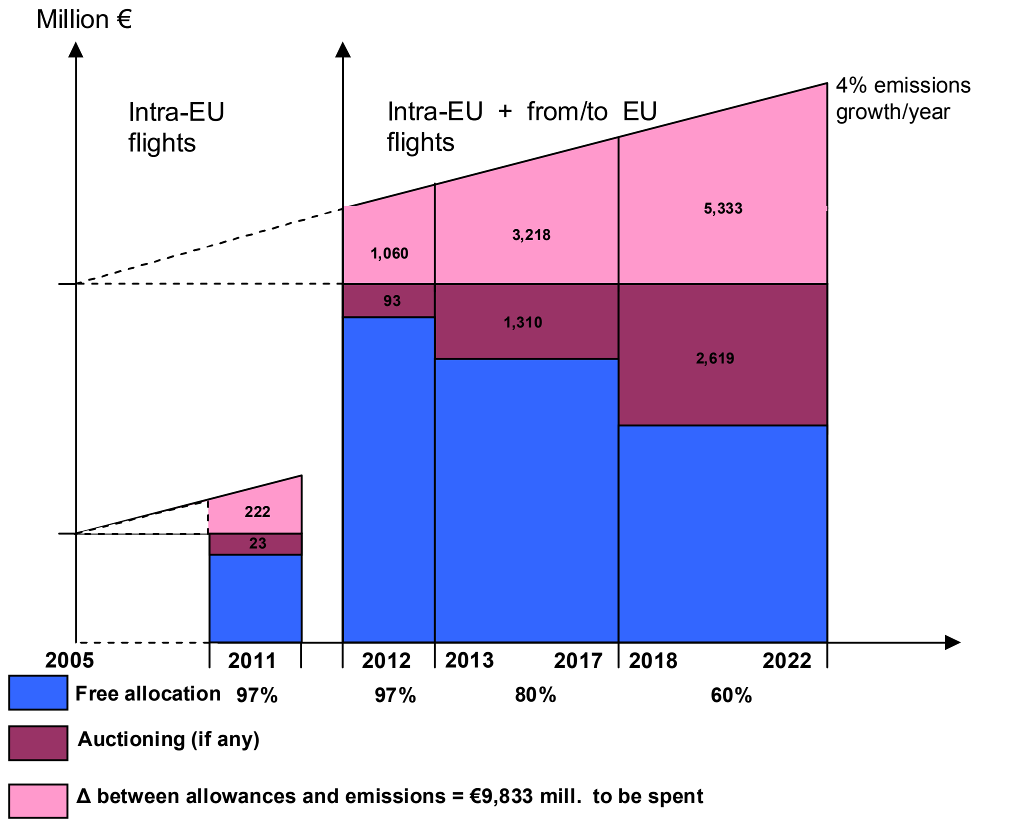

Figure 2-2: Total Aviation Emissions Costs by Type of Allocation Method – in € mill. Low Price Scenario
Source: Ernst & Young

Figure 2-3 below presents the global maximum cost for the aviation sector of buying allowances in order to comply with the proposed directive, based on the main assumptions of a high market price of carbon (€30/tCO_2 from 2011 to 2022 for either EUAs, CERs or ERUs).

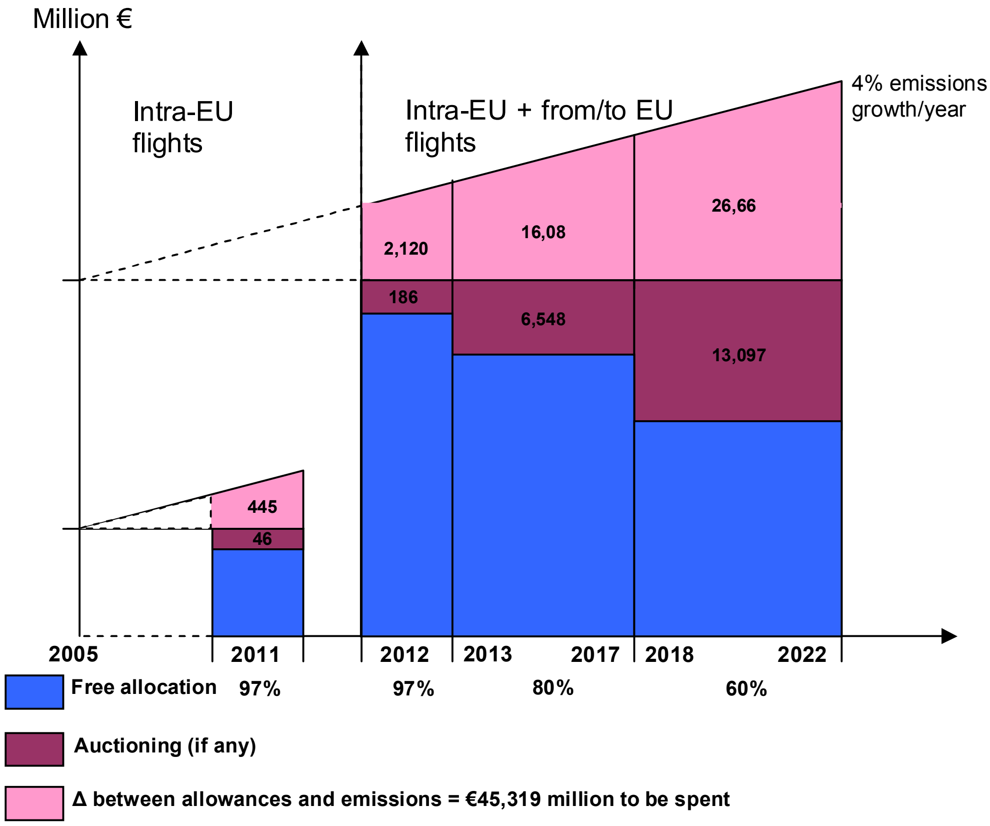

Figure 2-3: Total Aviation Emissions Costs by Type of Allocation Method – in € mill. High Price Scenario
Source: Ernst & Young

The prices of CERs and ERUs are expected to be in the range of the EUAs price forecasts for the period 2008-2012. Consequently, we have not considered the specific impact of these Kyoto credits in our estimates.

2.7 Cost of purchasing auctioned allowances

The European Directive 2003/87/EC allows Member States to auction a maximum of 5% of the total allocation in the first trading period (2005 to 2007) and 10% in the second trading period (2008 to 2012). During the first period, only Ireland, Denmark, Lithuania and Hungary chose to auction a percentage of their allocation, which represented 0.13% of the total allowances assigned for the first trading period (**Table 10-1**). The auctioned EUAs were sold at a price close to spot market prices, and the €30 mill. profit made by the Member States through these auctions was to be used in part to finance the administrative costs of the EU ETS.

For aviation, a proportion of allowances will be auctioned. For the 2008-2012 period, the proposed directive states that the percentage of auctioning applied to the aviation sector will be the average percentage of auctioning proposed by the Member States in their national allocation plans (NAP). Based on the NAPs II accepted so far by the EC in April 2007, no more than 2.84% of the total allowances assigned for the second trading period might be auctioned (**Table 10-2**). For the aviation sector, this represents 7.74 mill. tCO_2 for 2011-2012. If auction prices are directly correlated to the ETS price forecasts (between €15/tCO_2 and €30/tCO_2 in 2011-2012), the total amount of EUAs for auction could cost between €116.1 mill. and €232.3 mill. for 2011-2012.

Beyond 2012, the Commission's impact assessment of the proposed directive (**Note 2**) suggests that 20% and 40% of the allocation could be bought by aircraft operators through auctioning in 2013 and 2018 respectively.

We estimate that the total amount of EUAs to be auctioned would represent

- 218.3 mill. tCO_2 (43.7 mill. tCO_2/year) for the 2013-2017 period and
- 436.6 mill. tCO_2 for the 2018- 2022 period (87.3 mill. tCO_2/year).

Based on this analysis we estimate that, depending on the trading period and on the price of EUAs, auctioning could range between €4,045 mill. and €19,877 mill. over the 2011 – 2022 period. This represents 44% of the total cost for the aviation sector to enter the EU ETS.

Table 2-4 : Costs of Auctioned Allowances

Auctioning Price	**€ 6/tCO_2**	**€ 15/tCO_2**	**€ 30/tCO_2**
Auctioning %			
2011 (3%)		€ 23 mill.	€ 46 mill.
2012 (3%)		€ 93 mill.	€186 mill.
2013 -2018 (20%)	€ 1,310 mill.		€ 6,548 mill.
2018 – 2022 (40%)	€ 2,619 mill.		€ 13,097 mill.
Total - Low Price (€ 6 – 15/tCO_2) 2011 - 2022	**€ 4,045 mill.**		
Total - High Price (€ 30/tCO_2) 2011 - 2022			**€ 19,877 mill.**

2.8 ETS administrative costs

Implementation of the EU ETS also generates administrative costs for the operators covered by the scheme. These costs can be classified as follows (**Table 2-5**):

- Internal costs, i.e. costs borne by operators through the working hours of their personnel for calculating historical yearly emissions and annual emissions, submitting requests to competent authorities, following up on annual verification and legal support.

- External verification costs, i.e. the costs of verification performed by the accredited verifier appointed by the aircraft operator.

- Costs related to registration fees and allowances trading.

We have calculated the costs for three different types of aircraft operators:

- 'Large companies': companies operating a high number of destinations, already reporting their CO_2 emissions, with trading resources inside the company and all aircraft equipped with Digital Flight Data Recorders (DFDR);

- 'Medium-size companies': companies operating several destinations, but with no detailed report of fuel consumption, without internal resources for trading or for monitoring and reporting the CO_2 emissions;

- 'Small-size companies': companies not already reporting fuel consumption by destination, with no internal resources for trading or for monitoring and reporting CO_2 emissions.

Table 2-5: Minimum Administrative Costs Related to the Entry in the EU ETS
Source: Ernst & Young

Type of cost (k€)	Large companies	Medium-size companies	Small-size companies
Internal costs	79	64	49
External verification	75	56	43
Registration	33	30	25
Total	**187**	**149**	**116**

We estimate that administrative costs will range from k€116 to k€187 per annum when all the monitoring, verification and trading mechanisms will be in place. Based on the assumption that the allowances distributed to a company may range from 50,000 tCO_2 to 5 mill. tCO_2 per year, the administrative costs borne will range from €0.04 per allowance for large companies to €2.33 per allowance for the smallest aircraft operators. The relative cost can thus be 60 times higher for small aircraft operators than for large companies. Sectors like business aviation, where 85% of the companies have less than five aircraft will be penalized.

Moreover, these costs are dependent on the EC reporting, monitoring and verification guidelines that have not yet been published.

For some aircraft operators, these costs could easily be multiplied by a factor of two or three during the first year when companies will have to adapt their reporting tools and become familiar with the trading system.

2.9 Cumulative costs of purchasing and auctioning

Table 2-6 : Total Costs of Purchasing & Auctioning

Allowance Price	€ 6/tCO_2	€ 15/tCO_2	€ 30/tCO_2
Auctioning %			
2011 (3%)		€ 245 mill.	€ 491 mill.
2012 (3%)		€ 1,153 mill.	€ 2,306 mill.
2013 -2018 (20%)	€ 4,528 mill.		€ 22,636 mill.
2018 – 2022 (40%)	€ 7,952 mill.		€ 39,764 mill.
Total - Low Price (€ 6 – 15/tCO_2) 2011 - 2022	**€ 13,878 mill.**		
Total - High Price (€ 30/tCO_2) 2011 - 2022			**€ 65,197 mill.**

2.10 Conclusion

In this chapter, we have examined the different costs related to the inclusion of the aviation sector in the EU ETS. We have estimated the total amount of allowances needed by aircraft operators, taking into account traffic growth, abatement possibilities and the aviation sector's emissions target. We have studied the different drivers of the price of allowances and proposed a range of prices in accordance with the main research work on this subject:

- Aircraft operators may have to buy a total amount of 1,511 mill. tCO2 on the market by 2022;
- The global costs of purchasing allowances for 2011-2022 would be between €9,833 mill. and €45,319 mill.;
- The global costs of auctioning for 2011-2022 would range from €4,045 mill. to €19,877 mill.;
- In order to assess the sensitivity of the costs, if the allowance price were to rise as high as twice the generally accepted price of €30/tCO2 between 2011 and 2022, the global cost for aviation would reach €130.4 bill. for the difference between allowances and emissions, and €39.7 bill. for auctioning.

The different costs are presented in **Table 2-6**, in total between 2011 and 2022, and on average.

Table 2-7: Costs of the Inclusion of the Aviation Sector in the EU ETS
Source: Ernst & Young

	Low price scenario	High price scenario
Auctioning	€4,045 mill. (€337 mill. per year)	€19,877 mill. (€1,656 mill. per year)
Difference between allowances and emissions	€9,833 mill. (€819 mill. per year)	€45,319 mill. (€3,776 mill. per year)
Total	**€13,878 mill. (€1,156 mill. per year)**	**€65,196 mill. (€5,433 mill. per year)**

3 IMPACTS OF ETS ON AIRCRAFT OPERATORS' PROFITABILITY

Key Points

- We estimate that passenger demand in 2022 will be between 2.6 mill. and 12.9 mill. less than the business as usual scenario without the implementation of the ETS, depending on the allowance price. On the same basis, we estimate that demand for cargo services could be reduced by between 85,000 and 426,000 tonnes.

Between 2011 and 2022 we estimate that the cumulative loss of margin would be:

- between €5.2 billion and €23.8 billion for network airlines, taking into account grandfathered allowances. This could lead to a fall in the profit margin rate of nearly a third by 2022.
- between €1.3 billion and €5.1 billion for low fares airlines. Again we anticipate a decrease in the profit margin rate of around one third by 2022 for relatively profitable operators, which is likely to result in the cutting of less profitable routes.
- between €3.0 billion and €11.6 billion for cargo operators. The profit margin rate could decrease significantly with the high-allowance cost and be almost equal to zero on average, which indicates that the sector could be heavily affected, leading to dramatic changes in the structure of air transportation for cargo.
- Aircraft operators would be significantly affected by the ETS. As a consequence free allowances grandfathered to them based on the situation in the airline market in 2005 could not lead to any windfall profits, but would only permit aircraft operators to limit the extent of the loss of margin they will incur.

3.1 Introduction

The aviation sector is a diverse sector, comprising aircraft operators with a wide variety of business models and companies, including:

- network or 'legacy' carriers, such as British Airways, Air France-KLM, Lufthansa;
- regional airlines, such as Air Nostrum, Eastern Airways, Cimber Air;
- leisure airlines, formerly known as charter airlines, such as Thomas Cook, TUI or Futura;
- low fares airlines, such as Ryanair, EasyJet or Air Berlin;
- cargo operators, such as Cargolux, DHL, TNT and freight subsidiaries of the major carriers;
- Business aviation, which includes a wide range of operators providing specialist transport services for passengers and goods.

In Appendix D: Defining the market segments, we provide more information about these various market segments and discuss some considerations for each sector in relation to the impact of ETS. In this Study, we have focused on providing quantitative estimates of the impact of ETS on aircraft operators based on a simplified division of the market between network, low fares and cargo airlines. We believe this division provides a sound basis for making an overall assessment of the impact of ETS and that the impacts on the other sectors of the market, such as regional airlines, will be within the range of impacts assessed.

Our primary measure estimates the difference in profit margin for the aircraft operators before and after the introduction of the EU ETS. This involves estimating the additional cost for aircraft operators, the extent to which they pass through these costs to customers and the consequent effect on demand. The profit margin of the airlines is modelled under these two scenarios with and without ETS. The difference in margin represents the impact for the airlines.

3.2 Impact on prices and demand

In analysing the effect of the ETS on demand, we have modelled the impact of the cost of allowances passed through to customers on average air fares or cargo tariffs to establish a percentage rise in these prices upon which to apply the elasticity of demand described above. The change in demand has then been applied to the growth in demand since 2005. We have assumed that there is no auctioning of allowances and that aircraft operators only need to surrender allowances to cover the growth.

These average fares and tariffs and the corresponding impact of increased costs have been identified by reference to a series of 'typical routes'. For each market segment, we have identified the typical characteristics of a domestic, short haul and long haul route, including:

- a typical aircraft type;
- sector length;
- cabin configuration (where relevant);
- number of seats;
- average load factor;
- average yield per RPK or RTK;
- fuel consumption and corresponding CO_2 emissions.

The resulting impact on demand on these typical routes has then been compared to demand under a 'business as usual' (BAU) scenario, without the inclusion of the aviation sector into the EU ETS. The data used in these calculations has been drawn from a variety of published sources, most notably AEA's STAR 2006 report, the CORINAIR/EMEP report and Airline Performance Indicators 2006 produced by TRL. In defining our typical routes we have adopted relatively conservative assumptions, using commonly operated, relatively modern aircraft and using published information regarding key variables. With this in mind, the estimates that follow should similarly be considered as conservative. The details of these assumptions and the process by which the impact on fares and tariffs is calculated can be found in Appendix B: Calculating the effect on demand.

The extent to which demand is affected is reduced by the fact that aircraft operators are not able to pass through the costs of ETS to consumers. However, the impact on demand is still potentially significant. We estimate that in 2022 demand will be between 2.6 mill. and 12.9 mill. less than the business as usual scenario with the implementation of the ETS, depending on the allowance price. On the same basis, we estimate that demand for cargo services could be reduced by between 85,000 and 426,000 tonnes.

In terms of passenger demand, it is also worth noting the differential effect on the low fares sector compared to the network airlines. With their lower ticket prices and higher than average growth since the baseline year, this segment suffers a disproportionately high loss of demand due to the proportionately greater costs to be passed through. In terms of passenger numbers, around half of the passengers expected to be lost in 2022 are forecasted to come from low fares airlines.

As we have described above, we have not modelled the impact on the demand for business aviation explicitly. Considering the relatively high cost of these services and the relatively fuel efficient aircraft used for these services, we would not anticipate any more than a marginal impact on demand. The primary cost for this business segment is likely to come from the need to implement administration, monitoring and verification systems.

3.3 Impact on Aircraft Operator's profitability per segment

3.3.1 Results for Network Airlines

The impact of the introduction of the EU ETS on network airlines for the two allowance cost scenarios outlined in **Chapters 3.4 and 3.5** is shown in the following table. We present the business as usual profit margin of 4% for illustrating the impact of ETS:

Table 3-1: Estimated Loss of Margin of Network Airlines

Year	Business as usual Profit Margin (€mill.)	Low Allowance Cost (€ 6-15/tCO_2) (€mill.)	High Allowance Cost (€ 30/tCO_2) (€mill.)
2011	5,749	- 88	- 174
2012	5,948	- 520	- 1,033
2013	6,184	- 248	- 1,225
2014	6,430	- 288	- 1,426
2015	6,687	- 331	- 1,637
2016	6,954	- 375	- 1,858
2017	7,234	- 422	- 2,089
2018	7,525	- 471	- 2,332
2019	7,830	- 522	- 2,586
2020	8,147	- 576	- 2,852
2021	8,478	- 632	- 3,132
2022	8,824	- 691	- 3,425
Total	**85,890**	**- 5,164**	**- 23,769**

The EU ETS costs incurred by network airlines will significantly increase over the two periods, and, within a few years, will reach a level that will lead to significant loss of margin where net margins are already traditionally low. We estimate that the net margin rate will be reduced from our assumption of 4.0% to 3.7% during the period 2011 to 2022 under the low allowance cost scenario and from 4.0% to 2.4% under the high allowance cost scenario. Sensitivity analysis to the main assumptions is presented in Appendix F: Results of sensitivity testing. This shows that the loss of margin is not significantly affected by other parameters than the price of the allowances.

We have concluded that, for this segment, supply would not be dramatically affected due to network considerations of airlines. However, it still seems likely that some particular routes would be closed and especially those where airlines compete with other modes of transport. Domestic flights would then be the first affected, especially where aviation competes with other transport modes not subject to ETS. For other short-haul and long-haul flights, there is no evidence that there could be a reduction in supply by network airlines due to their hub and spoke model, and complex cross-subsidies between routes. However it can be expected that the frequency of flights would decrease compared with the business as usual scenario.

It could also be argued that the loss of margins could limit or delay airlines' capacity to invest in new, environmentally friendly, technologies in the long-run. The impact of the introduction of the EU ETS could therefore have an unwanted negative impact on emissions, if it makes it more difficult for airlines to take advantage of new environmental technologies in the future due to the lowering of their margins.

If the allowance price were to rise as high as €60/tCO_2, the loss of margin for the airlines would be €47.0 bill. and the percentage of profit margin would decrease from 4.0% to 0.9%.

3.3.2 Results for Low Fares Airlines

The impact of the introduction of the EU ETS on low fares airlines in the different scenarios outlined in **Chapters 2.4 and 2.5** is shown in the following table:

Table 3-2: Estimated Loss of Margin of Low Fares Airlines

Year	Business as usual Profit Margin (€mill.)	Low Allowance Cost (€ 6-15/tCO_2) (€mill.)	High Allowance Cost (€ 30/tCO_2) (€mill.)
2011	1,398	- 109	- 216
2012	1,511	- 133	- 263
2013	1,587	- 60	- 294
2014	1,667	- 66	- 327
2015	1,750	- 73	- 362
2016	1,838	- 90	- 398
2017	1,930	- 89	- 436
2018	2,026	- 107	- 476
2019	2,128	- 117	- 518
2020	2,234	- 127	- 563
2021	2,346	- 137	- 609
2022	2,463	- 148	- 658
Total	**22,878**	**- 1,256**	**- 5,120**

The impact on the low fares airlines is particularly high when compared to network airlines. The net margin rate is expected to decrease from 15.0% to 14.1% in the low allowance cost scenario and from 15.0% to 11.1% in the high allowance cost scenario. Sensitivity analysis to the main assumptions is presented in the Appendix F: Results of sensitivity testing, and shows that the loss of margin is not significantly affected by other parameters than the price of the allowances.

Differences between network airlines and low fares airlines explain these results. Firstly, the price elasticity of demand faced by low fares airlines is higher as, to a large extent, these airlines have more price sensitive customers and in many cases a greater focus on the leisure market. Secondly, short-haul flights are characterised by relatively higher fuel consumption than long-haul flights so that low fares airlines are more affected by the ETS. The combination of these two factors triggers a decrease in demand that will severely impact on the profit margin of these carriers.

At present only a few low fares airlines are believed to have positive margins and, consequently, the introduction of the EU ETS could lead to rationalisation within this sector, with some carriers exiting the market. At a less extreme end of the spectrum, it seems likely that the low fares airlines will start to rationalise their route networks by cutting more marginal routes and by becoming more risk averse in the development of new services, thereby curtailing the rapid growth in connectivity that these carriers have brought to many parts of Europe in recent years. The consequences of this in terms of tourism and regional development in Europe may also be significant, as is discussed further in **Chapter 5**.

If the allowance price were to rise as high as €60/tCO_2, the loss of margin for the airlines would be €10.8 bill. and the percentage of profit margin would decrease from 15.0% to 6.3%.

3.3.3 Results for Cargo Airlines

The impact of the introduction of the EU ETS on cargo airlines in the different scenarios outlined in **Chapters 2.4 and 2.5** are shown in the following table:

Table 3-3: Estimated Loss of Margin of Cargo Airlines

Year	Business as usual Profit Margin (€mill.)	Low Allowance Cost (€ 6-15/tCO_2) (€mill.)	High Allowance Cost (€ 30/tCO_2) (€mill.)
2011	911	- 84	- 167
2012	967	- 288	- 473
2013	1,031	- 138	- 566
2014	1,099	- 162	- 664
2015	1,171	- 187	- 769
2016	1,248	- 213	- 882
2017	1,330	- 204	- 1,001
2018	1,417	- 271	- 1,129
2019	1,510	- 303	- 1,265
2020	1,609	- 337	- 1,411
2021	1,715	- 373	- 1,566
2022	1,828	- 411	- 1,731
Total	**15,836**	**- 2,971**	**- 11,624**

The profit margin rate will decrease from 4.0% to 3.1% in the low allowance cost scenario and from 4.0% to 0.2% with the high allowance cost scenario. The impact in the high allowance cost scenario is dramatic for cargo airlines in our model, since the margin is reduced almost to zero despite using a start point of 4% under the BAU scenario, which is quite high compared with the recent history of margins in the cargo sector. This not only threatens the introduction of new environmentally friendly technologies, but could also result in dramatic changes in supply, with the severe cut backs in the routes that are not highly profitable.

This could have perverse environmental effects. As most cargo transport in Europe is truck-based, reduced air cargo activity is likely to lead to increased use of road transport to move goods and this has its own environmental implications. Sensitivity analysis to the main assumptions is presented in the Appendix F: Results of sensitivity testing, and shows that the loss of margin is not significantly affected by other parameters than the price of the allowances.

If the allowance price were to rise as high as €60/tCO2, the loss of margin for the airlines would be €26.6 bill. and the percentage of profit margin would decrease from 4.0% to -4.8%. The future of cargo airlines would be highly questionable in such a case.

3.3.4 Impact on Business Aviation

According to EBAA, European Business Aviation is shared between about 850 operators of taxi aircraft and 600 operators of corporate aircraft jointly operating a total of 2,850 aircraft. The business model of air taxi operators is close to the model of other carriers (and the ETS will impact on their margins), but corporate business aviation is different. Owners of corporate aircraft value the possibility to fly to the largest possible number of destinations, the possibility to adjust schedules at short notice and to reduce delays to the maximum possible extent.

It should also be noted also that, according to Eurocontrol, about 85% of the business aviation sector is essentially made up of small firms operating less than 5 aircraft, which could make the administration of the ETS excessively expensive for these operators.

Actually, many of the administrative costs related to the inclusion of the aviation sector in the EU ETS are fixed costs, independent of the aircraft operators' size. For example, the baseline calculation, the management of the allocation process, registration trading and legal competencies are among the tasks all aircraft operators will have to deal with in a similar way, whatever their size. In relation to its emissions, business aviation will bear much higher costs than the rest of the sector.

3.4 Conclusion

Quantification of the financial impacts on aircraft operators, demonstrated through the expected decrease in the profit margins of airlines, shows that even in the low allowance cost scenario, these impacts are potentially significant for low fares and cargo airlines and become even more significant under the high allowance cost scenario. Under the high allowance cost scenario, network airlines are also significantly affected. Net margins are expected to decline by around 4% for low fares and cargo, and around 2% for network airlines. Cargo may be dramatically affected by the ETS and significant rationalisation may occur on the supply side and other modes of transport may be preferred for goods transportation. This could lead to adverse effects from an environmental point of view, since trucks, which are the most important competitors in the goods transportation market, would increase their market share.

It could be argued that future productivity gains in the industry could allow aircraft operators to maintain their margins at the present level despite the ETS. However, this argument seems weak if we consider the effects of fuel price rises. During the past few years, higher fuel prices have provided a strong incentive to examine closely the opportunities for rationalising airline cost bases and it seems likely that, in most cases, the opportunities for productivity savings have largely been exhausted. Furthermore, it seems reasonable to suggest that fuel prices may rise still further in the future and offset the financial impact of any productivity gains.

In this situation, the impact of ETS has to be considered on a stand-alone basis, bearing in mind the costs that will have to be borne over and above any other potential increases in the airline cost base.

It is significant that, over the last 10 years, the aggregate profit of the network carriers in Europe was only €2.1 billion. Clearly, profitability varies from airline to airline. However, it is clear from our analysis above that for some airlines, operating at lower profit margins, reductions in their margin at the levels indicated above could potentially lead to an increase in the rate of failures.

4 IMPACT ON CONSUMERS

Key Points
• The inclusion of the aviation sector in the EU ETS will have a significant impact on consumers. In 2012, we estimate that consumers would experience an annual loss of consumer surplus of between €398 mill. and €876 mill. in the low and high allowance cost scenarios. By 2022, the annual impact is expected to grow between €426 mill. and €2,186 mill. respectively.
• If allowance prices were to rise as high as €60/tCO_2, then this impact would be considerably increased. In this case, in 2012, the annual loss of consumer surplus could be estimated at around €1,569 mill., growing to an annual loss of €4,196 mill. in 2022.
• In addition to this quantifiable impact, the introduction of the EU ETS is likely to lead to a reduction in choice for consumers, as the scheme would impact differentially on individual segments within the market. This is likely to come in the form of limitations of the choice of service types, range of routes and in reduced development of regional airports.

4.1 Introduction

In this chapter, we discuss the impact on consumers of the implementation of the ETS. Our primary quantitative measure is the estimated impact on consumer surplus in terms of air fares. However, we also consider the implications for passengers in terms of choice and the impact on other elements of consumer surplus that cannot be quantified through this approach, such as journey times.

4.2 Quantifiable Impact of Consumers surplus

This chapter will focus on changes to air fares and cargo shipping costs and their impact on consumers' demand. In reality, the price of an air ticket or the cost of shipping air freight is only one part of the consumer's demand decision. This price is only one element of a generalised cost function, which includes considerations such as journey time or convenience. Within the scope of this exercise, we have not sought to identify the value of these other costs but use the impact of air fare-related changes in welfare as an indicator of this broader impact. In this sense these estimates should be considered conservative.

It is also important at the outset to understand the concept of consumer surplus and its relationship to the changes in the market brought about by the introduction of ETS. Consumer surplus can be defined as the difference between the amount that consumers actually pay and the amount that they would have been willing to pay for goods or service. If someone would have been willing to pay more than the actual price, their benefit from a transaction is how much they have saved when they did not pay that price.

As prices increase, the consumer surplus decreases as some consumers will no longer afford an air ticket and will then consume goods or services with a reduced value to them, whereas other ones will still buy air tickets but at a higher price and will then have less money available for other spending. The reduction in consumer surplus may be seen as the loss of satisfaction of the consumers, expressed in monetary terms. For instance, if an airline passenger pays €100 for a one-way fare between London and Paris but would have been prepared to pay €150, then that passenger's consumer surplus would be equal to €50.

This concept is represented diagrammatically in **Figure 4-1** by the blue area bounded by the equilibrium price (P) and the demand curve. This diagram also introduces the concept of producer surplus, which can be defined as the amount that producers benefit by selling at a market price that is higher than that they would be willing to sell for. In this case, this is the benefit to aircraft operators.

Understanding the balance between these two concepts is important in considering the impact on consumers of the inclusion of the aviation sector in the EU ETS and understanding the flow of welfare benefits stemming from the additional costs associated with ETS.

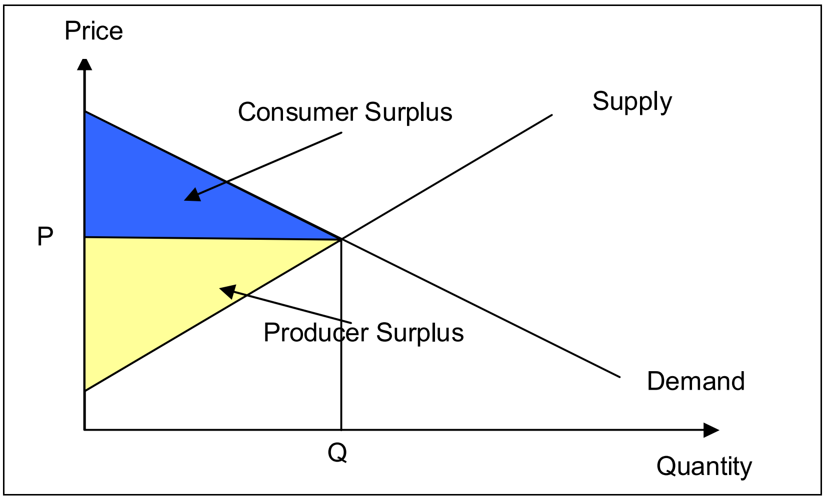

Figure 4-1: Consumer and Producer Surplus

Figure 4-2 shows a simplified illustration of the effect on consumers of including the aviation sector in the EU ETS. The additional cost leads to an upward shift in the supply curve. This raises the market price and reduces demand. The area that represents the loss of consumer surplus resulting from this change is marked on the diagram. However, it is important to note that in this case benefit is not transferred to the aircraft operators. This benefit is in fact transferred to a third group, the financial institutions that trade in carbon allowances, other sectors with surplus allowances or other sources of carbon allowances from which the additional allowances required by the aircraft operators must be purchased.

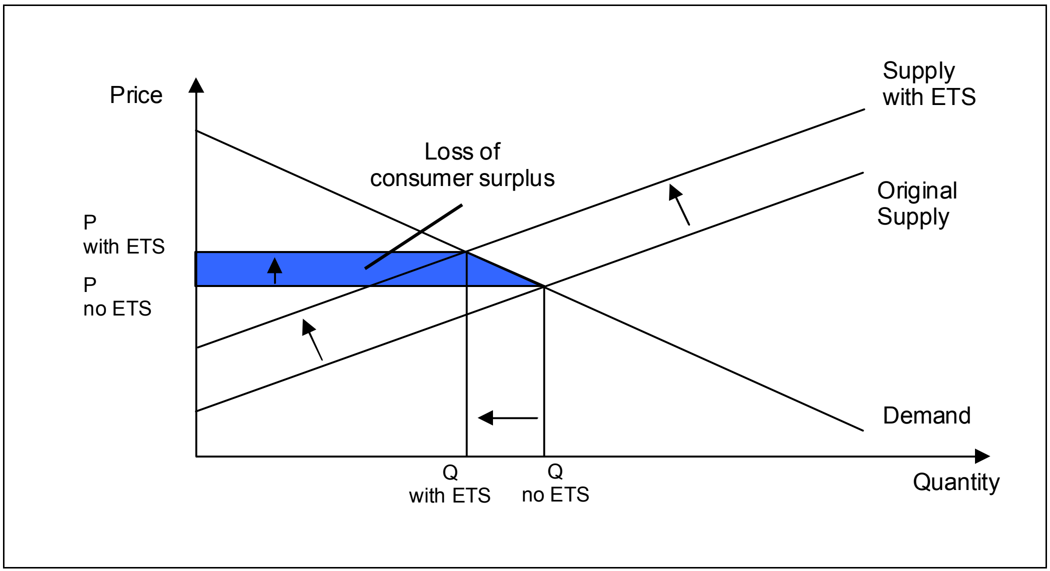

Figure 4-2: The Impact of the Inclusion of the Aviation Sector in the EU ETS on Consumer Surplus

Based on this framework, we have calculated the impact of ETS on consumers using the changes in fares and cargo tariffs identified in our demand estimates and the consequent change in demand[10]. The impact of the introduction of the EU ETS on consumers for our two main allowance price scenarios and for our extreme scenario is shown in **Table 4-1**.

[10] The assumptions relating to our calculations of the impact of ETS on air fares and cargo tariffs are set out in Appendix B: Calculating the effect on demand. This Appendix explains how we have used example routes to examine the impact of the ETS on air fares and cargo tariffs and also sets out in full the impact on demand of the different allowance cost scenarios. The loss of consumer surplus is calculated by multiplying the growth in demand since 2005 after the introduction of ETS in any given year by the change in price for that market segment (this reflects the additional cost to consumers who are still travelling) plus the difference between the baseline demand and the demand after the introduction of ETS multiplied by the change in price divided by two (as outlined by the commonly used rule of a half). This latter term reflects the loss of consumer surplus for those who are no longer willing or able to travel or use air cargo services.

Table 4-1: Estimated Loss of Air Fare Based Consumer Surplus in €mill.
Source: York Aviation.

Year	Low Allowance Cost (€ 6-15/tCO_2) (€mill.)	High Allowance Cost (€ 30/tCO_2) (€mill.)	Extreme scenario (€ 60/tCO_2) (€mill.)
2011	55.9	123.7	220.1
2012	398.3	875.9	1,569.1
2013	184.5	997.2	1,812.0
2014	209.6	1,120.6	2,059.3
2015	235.1	1,246.2	2,311.0
2016	261.1	1,374.0	2,567.2
2017	287.6	1,504.0	2,827.7
2018	314.4	1,636.2	3,092.7
2019	341.7	1,770.5	3,362.1
2020	369.5	1,907.1	3,635.8
2021	397.6	2,045.8	3,913.9
2022	426.2	2,186.6	4,196.3

This analysis indicates that the imposition of the EU ETS on the aviation sector is likely to have a significant negative effect on consumers. Some consumers still travelling or shipping goods will have to pay higher prices and some others who are either no longer able to or prepared to travel by air or use air cargo services will lose the benefit that travel would have brought.

In its first year of operation, 2011, when the scheme is intended to operate on an intra-EU basis only, we estimate an annual loss of consumer surplus of between €56 mill. and €124 mill. in the Low and High Allowance cost scenarios. When the full scope of the proposed Directive comes into force in 2012, we estimate the annual impact on consumer surplus will be between €398 mill. and €876 mill.. This impact is expected to grow to an annual loss of between €426 mill. and €2,187 mill. in 2022.

If the allowance price were to rise as high as €60/tCO_2, then these impacts would be considerably increased. We estimate that in 2012 the impact on consumer surplus would be around €1,569 mill., growing to an annual impact of around €4,196 mill. by 2022.

4.3 Other Impacts on Consumers

In addition to this quantitative assessment of the impact on consumer surplus, a number of further qualitative issues should be considered. Primarily, these issues relate to choices within the market place, as the EU ETS changes competitive dynamics and affects the various market segments in different ways.

Below, we briefly describe these impacts in relation to three key issues:

1. choice of service types;
2. range of destinations;
3. development of regional airports.

4.3.1 Choice of Service Types

The European air transport market is characterised by variety of business models which offer a wide range of choices for consumers. For passenger services, these range from business jets at perhaps the top end of the market, offering highly specialised services to time sensitive people, to the ultra low fares ethos of airlines that use low fares as a method of effectively 'stimulating' markets.

The inclusion of the sector in the EU ETS will impact these segments differently, changing the competitive dynamics in the market place, hindering growth in some sectors more than others and, consequently, affecting the range of choices available to consumers. Perhaps the most obvious example of this issue is the potentially disproportionate effect the EU ETS may have on the low fares airlines' sector, which also happens to be the fastest expanding sector in the EU market. With its lower fares, a higher overall price elasticity of demand and a tendency towards the development of 'thinner' routes, it is likely that this sector's growth will suffer more than some of the more traditional airline segments. This will affect the low fares options available to EU consumers and reduce the role of these airlines as a competitive constraint and driver of efficiency in the wider market.

4.3.2 Range of Destinations

By necessity, assessments of this type tend to generalise in terms of market demand. However, the economics of individual routes can be quite different from the overall pattern in the market place. In this context, it is unlikely that the EU ETS will simply apportion its impact across all the routes covered by the scheme. In reality, relatively small changes in costs may make some routes marginal in terms of their viability, while others would hardly be affected. These routes may be withdrawn, bringing about a rationalisation within the route network and limiting choice for consumers.

Similarly, this issue needs to be considered in terms of future route development. As the viability of existing routes may be affected by the introduction of the EU ETS, decisions to develop new routes could be either delayed or shelved. This will again impact on the choice of destinations available to EU consumers.

4.3.3 Development of Regional Airports

One of the features of the development of the air transport market within the EU in recent years, driven particularly by the growth of low fares airlines, has been the rapid expansion of regional airports. This has been an important trend in widening access to air travel for consumers in the EU.

As we have described, the potentially disproportionate effect on the low fares sector is a particularly important factor when considering this issue. Routes into regional airports tend to be 'thinner' than those serving major hub or national airports and, consequently, the economics of these routes are more fragile. Low fares airlines have been particularly effective in developing these markets and have accounted for a large proportion of the growth in intra-EU traffic in recent years. With this segment's growth curtailed, it seems reasonable to assume that the development of services from regional airports would also be impaired, thereby influencing the range of choice available to consumers in the catchment areas of these airports. These consumers will either have the option of not travelling at all or having to travel to alternative, less accessible, airports.

4.4 Conclusion

In this chapter, we have demonstrated that the aviation's entry into the EU ETS will have a significant impact on consumers. The rise in prices for both passengers and cargo services and the accompanying loss of demand would lead to an annual loss of consumer surplus (based solely on air fares) of between €426 mill. and €2,187 mill. in 2022 for our low and high allowance price scenarios respectively. If the allowance price were to rise as high as €60/tCO_2, this annual impact would rise to around €4,196 mill. in 2022.

In addition, choice for consumers within the EU market also needs to be considered. As we have described, the EU ETS is likely to impact disproportionately on some market segments, most notably low fares carriers. This could lead to a reduction in the growth of these carriers, a lessening of the competitive constraint they represent for the rest of the market and a slowing in the development of regional airports. More generally, as discussed in **Chapter 1**, the imposition of additional costs on aircraft operators will slow route development and therefore inhibit the choice available to consumers.

5 IMPACT ON THE EUROPEAN UNION ECONOMY

Key Points

- If the aviation sector is included in the EU ETS, we estimate that in 2022 the sector would lose between 8,000 and 42,000 jobs compared to a business as usual situation in our low and high allowance cost scenarios respectively, even taking no account of the possible additional impact of auctioning.
- If allowance prices were to reach €60/tCO_2, this impact could be as high as 84,000 jobs in 2022.
- The ETS, as proposed in the draft Directive, could lead to a distortion of competition between EU and non-EU hubs through a substantial diversion of traffic way from EU hub airports. This would have implications for the EU airlines based at these hubs and also for the wider economy, in terms of economic growth.
- Business aviation is becoming an increasingly important tool for business travel. The costs of the EU ETS could constrain the sector's development and in consequence impact on the high value businesses that are its main users.
- Tourism, as an important economic sector within the EU, is heavily reliant on air service connectivity, particularly in the Southern States around the Mediterranean. The impact of ETS on this sector needs to be considered particularly in relation to local and regional economies where minor changes in air service networks could have a significant negative impact.
- There will also be potential adverse implications in peripheral regions where there is a greater social dependence on air service connections.
- The Lisbon Agenda sets out an ambitious economic development target for the EU *"to be the most competitive and dynamic knowledge driven economy by 2010"*. In this context, it is essential that the EU remains an attractive place to invest and do business. Connectivity both within the EU and externally is central to this. Impairing growth in this area damages these aspirations.

5.1 Introduction

In this chapter, we consider the impact of the aviation sector's admission into the EU ETS on the wider economy. The role aviation plays in facilitating economic development is well documented and has been the subject of extensive research. The sector has been identified as:

- a substantial employer and generator of prosperity through its direct, indirect and induced impact on the European economy;
- an important facilitator and driver of wider economic activity through the connections it provides both within the EU and to the rest of the global economy.

In this assessment, we have not sought to examine the general arguments on the importance of air transport in supporting economies but have tried to examine how the aviation sector's entry into the EU ETS would change the sector's economic impact.

5.2 Impact on Employment and Gross Value Added

In **Table 5-1** we set out our estimates of the economic impact of the air transport industry within the EU, with and without the inclusion of the aviation sector in the EU ETS. These estimates have been based on two well-recognised research works:

- work undertaken by York Aviation for ACI EUROPE in 2003/2004 examining the economic and social impact of airports in Europe. This research identified three key elements:

1 an average employment density for European airports of 950 employees per mill. passengers per annum in 2001;

2 an average productivity growth rate in the industry of between 2 and 3% per annum;

3 a combined indirect and induced multiplier at a national level of 2.1.

- recent research undertaken by Oxford Economic Forecasting into the contribution of air transport to the UK economy[12]. This report provides further supporting evidence in relation to the indirect and induced multipliers applying to air transport. OEF identify a combined indirect and induced multiplier of 1.81, of which the indirect impact is estimated to be around 0.9.

We have provided estimates for the representative years 2005, 2012, 2017 and 2022. It should be noted that these estimates include the activity supported by both passenger and cargo airlines but exclude the impact on economic activity in wider sectors (the catalytic impact) which we analyse in qualitative terms below.

Table 5-1: Employment Supported by Air Transport in 000s
Source: York Aviation.

	2005	2012	2017	2022
Business as usual				
Direct	944	1,112	1,250	1,409
Indirect & Induced	1,846	2,174	2,444	2,754
of which indirect	850	1,001	1,125	1,268
Total	2,790	3,286	3,695	4,163
Low Allowance Cost (Variance to Baseline)[13] (€6 – 15/tCO_2)				
Direct	0	-3	-2	-3
Indirect & Induced	0	-6	-4	-6
of which indirect	0	-3	-2	-3
Total	0	-9	-6	-8
High Allowance Cost (Variance to Baseline) (€30/tCO_2)				
Direct	0	-6	-10	-14
Indirect & Induced	0	-13	-20	-28
of which indirect	0	-6	-9	-13
Total	**0**	**-19**	**-31**	**-42**
Extreme scenario (Variance to Baseline) (€60/tCO_2)				
Direct	0	-13	-21	-28
Indirect & Induced	0	-25	-41	-56
of which indirect	0	-12	-19	-26
Total	**0**	**-38**	**-62**	**-84**

[12] *The Contribution of Air Transport to the UK Economy* - Oxford Economic Forecasting (2006).
[13] The high level of impact in the early period of this scenario is a function of the higher allowance cost assumed for 2011 and 2012, €15/tCO2, compared to the later period.

This demonstrates that the aviation's entry into the EU ETS will have a significant impact on the aviation sector's ability to support employment within the EU. We estimate that in the first year of full operation, 2012, the aviation sector could lose between 9,000 and 19,000 jobs. In 2022, the sector is forecast to lose between 8,000 and 42,000 jobs compared to the business as usual scenario. If allowance prices were to rise as high as €60/tCO_2, this impact could be as high as 84,000 jobs in 2022. There would be further impacts as a result of auctioning, dependent on the percentage rate adopted.

In **Table 5-2**, we set out our corresponding estimates of the impact on Gross Value Added in the EU. As with employment, this demonstrates that the introduction of the EU ETS will impact significantly on GVA within the EU. In 2012, in the low and high allowance price scenarios, the air transport sector will generate between €714 mill. and €1,428 mill. less in GVA than under a business as usual scenario, rising to a loss of between €772 mill. and €3,862 mill. in 2022. If allowance prices were to rise as high as €60/tCO_2, this impact could be as high as €7,724 mill. in 2022. Again, these impacts will be greater when the effects of auctioning are taken into account.

In the context of this discussion, it is also worth noting that the Commission has consistently underestimated the importance of the sector in terms of Gross Value Added and employment: Eurostat figures fail to take into account some key elements of the industry, for instance tour operators and their associated airlines. This failure to recognise the importance of the sector in terms of its supply chain and its role in facilitating other economic activity, leads to an underestimation of the economic importance of the sector.

Table 5-2: GVA Supported by Air Transport in €mill.
Source: York Aviation.

All amounts in €mill.	2005	2012	2017	2022
Business as usual				
Direct	61,942	83,814	104,034	129,427
Indirect & Induced	121,097	163,857	203,386	253,030
of which indirect	55,748	75,433	93,630	116,484
Total	**183,039**	**247,671**	**307,420**	**382,457**
Low Allowance Cost (Variance to Baseline)[14] (€6 – 15/tCO_2)				
Direct	0	-242	-174	-261
Indirect & Induced	0	-472	-339	-511
of which indirect	0	-217	-156	-235
Total	**0**	**-714**	**-513**	**-772**
High Allowance Cost (Variance to Baseline) (€30/tCO_2)				
Direct	0	-483	-868	-1,307
Indirect & Induced	0	-945	-1,696	-2,555
of which indirect	0	-435	-781	-1,176
Total	**0**	**-1,428**	**-2,564**	**-3,862**
Extreme scenario (Variance to Baseline) (€60/tCO_2)				
Direct	0	-966	-1,735	-2,614
Indirect & Induced	0	-1,889	-3,393	-5,110
of which indirect	0	-870	-1,562	-2,353
Total	**0**	**-2,855**	**-5,128**	**-7,724**

[14] The high level of impact in the early period of this scenario is a function of the higher allowance cost assumed for 2011 and 2012, €15/tCO2, compared to the later period.

5.3 Impact on Competition and Development

One of the risks inherent in the design of the ETS, as proposed in the Draft Directive is the potential for a distortion of competition between EU and non-EU carriers and between different airlines dependent upon the extent to which their route networks are internal to the EU. Whatever the geographical scope, by definition, the EU ETS will never involve all traffic across the world. Therefore, the aircraft operators based in Europe will be at a competitive disadvantage vis-à-vis carriers which do not operate to Europe, as they will have to bear the financial costs detailed above.

Application of the scheme to intra-EU flights only for the first year will impact the entire traffic of those EU carriers operating wholly or mainly within the EU. As their networks are not limited to intra-EU operations, the other carriers will have only a minority of their flights included in the ETS. This leads to distortion of competition between operators. It may be argued that the extension of the geographical scope in 2012 to cover all operators' flights to and from the EU may reduce this imbalance. However, a new type of distortion would then be introduced because 100% of European aircraft operators' traffic would be included whilst only a portion of non-EU carriers' traffic would be subject to the EU ETS.

One consequence of such distortion in competition is the high risk of traffic diversion away from the EU hub airports, with hubs close to the EU being in a particularly strong position to take advantage of this distortion in the market. It will be possible for airlines operating services from non-EU hubs to exploit the cost differential for passengers transferring on intercontinental routings from their position outside the EU resulting in further damage to the EU air transport sector. Even with the extension of the ETS to cover all flights arriving at and departing from EU airports in 2012, there will still be an inherent distortion as 100% of EU-based airlines operations will be subject to the additional costs associated with the Scheme, while non-EU competitors would be only partially affected. This has the potential to place EU-based airlines that operate from these hubs at a competitive disadvantage. This issue is perhaps best illustrated by examples.

The EU hubs, such as London Heathrow, Paris Charles de Gaulle, Frankfurt and Amsterdam Schiphol, are at the heart of the global air transport network, providing ideal connecting points for passengers between markets in North America, Africa, Asia and Australasia.

The first distortion appears where passengers are travelling between two points outside of the EU, with the option to travel on an EU-based airline, connecting at an EU hub, or on a non-EU carrier via a non-EU hub. An example of such a journey could be travelling between Hong Kong and New York. Currently, a British Airways flight via London Heathrow is competing on the same terms as an Emirates flight connecting in Dubai. However, with the aviation sector's inclusion in the EU ETS, the British Airways option connecting at London Heathrow will require the surrender of the necessary allowances to cover both the flight from Hong Kong to London and the flight from London to New York. Operating these two flights will incur an additional allowance cost of around €41 per passenger[15] at an allowance price of €30/tCO_2. In contrast, the Emirates flight bypasses any involvement in the EU ETS and consequently incurs no costs of this nature. This results in a clear competitive disadvantage for carriers operating from EU hubs in this situation, which could lead to the diversion of traffic from EU hubs to non-EU competitors.

[15] This assumes the flights are operated by a Boeing 777 with 340 seats and an 80% load factor.

There is also a potential distortion where flights operating directly to EU airports are competing with indirect flights operating via non-EU hubs. An example of this type of journey could be a direct service from Hong Kong to Frankfurt competing with an indirect service to Frankfurt via Dubai. Under the EU ETS, the direct flight will be liable for carbon allowances to cover the whole flight distance, approximately €24 per passenger[16] at an allowance price of €30/tCO_2. However, the indirect service operating via Dubai will only be liable for carbon allowances for the Dubai to Frankfurt sector, approximately €13 per passenger at an allowance price of €30/tCO_2. Again this clearly demonstrates that the EU ETS has the potential to introduce distortions into the market that will impact negatively on EU-based airlines and could lead to the diversion of traffic to routings via hubs outside of the EU.

The scope of this impact assessment does not include a detailed examination of this issue. However, recent work undertaken by MVA Consultancy on the "Consequences for the Dutch Aviation Sector of Inclusion in the European Emissions Trading Scheme" examined this issue in some detail. This research identified that across all flights in an ETS scheme covering departing flights only[17], the number of passengers travelling via EU hubs would fall by around 2.3%, while passengers travelling via non-EU hubs would only fall by around 0.1%. This demonstrates the clear competitive disadvantage suffered by EU hubs and the European airlines with bases at these hubs.

In terms of the impact on the wider economy, this disparity and the risk of impaired development at the EU's main airports will impact on European airlines' long term development and the economic activity they support. It also has the potential to adversely impact on the connectivity that these major airports provide, which will in turn affect the EU's relative position as a place to do business and to visit.

5.4 The Importance of Business Aviation

In terms of its economic impact, business aviation is essentially a highly specialised form of passenger airline. The sector essentially services very specific point-to-point demand and increasingly, particularly post-9/11, business aviation has become an important tool for global businesses. As such, it can be an important factor in company location decisions, international trade and productivity, just as more conventional air services have an influence in these areas. However, below, we outline briefly some more specific arguments in relation to business aviation.

A common characteristic of business aviation is the ability to fly at short notice, to a bespoke schedule and itinerary, and to airports that may not be served by scheduled commercial flights. This flexibility is a key feature of Business aviation and makes it less a luxury than a high value business tool. By definition, businesses most willing to pay a premium for the use of private business aircraft will be most adversely affected if they cannot fly at the time they need and from the most convenient airport. Therefore, if the inclusion of air transport in the ETS limits choice and growth in the industry, these high value users will be affected, possibly influencing their choices in relation to location and investment and their ability to operate effectively and productively within the EU.

[16] This assumes the flights are operated by a Boeing 777 with 340 seats and an 80% load factor.
[17] This research was completed prior to the publication of the Draft Directive and consequently did not examine the departing and arriving flights scope.

Companies are now increasingly able to make a clear business case for the use of business aviation, by evaluating the increased productive use of time and resources against the cost of the flight. Operators report that, increasingly, groups of middle managers as well as senior executives can justify the use of a business jet to fulfil a complex itinerary, very often at an overall cost saving. The huge growth in the market generally, and especially in the market for fractional ownership, is testament to this. Adding cost to the use of this sector or limiting its growth through the imposition of the EU ETS, has the potential to constrain this increasingly used and valuable business tool, with adverse implications for business productivity.

5.5 Impact on Tourism

Tourism is a major economic sector within the EU. According to Eurostat it directly accounts for around 4% of the EU's GDP and, if its influence on other sectors is included, it generates around 11% of EU GDP and creates around 24.3 mill. jobs. Its influence is expected to grow substantially in the future. The impact of ETS on air services and the consequent impact on tourism is an issue that needs to be considered with a care. The issue is perhaps not primarily the overall demand for tourism, although this will obviously be affected, particularly where alternative destinations outside the EU (such as Morocco or Tunisia) can provide a similar product, but more about the distribution of demand for tourism within the EU. The issue needs to be considered at a more local and route level.

Eurostat figures suggest that around 25% of tourism trips within the EU involve air travel. However, where data is available, Eurostat also suggests that trips involving air travel account for around 33% of expenditure. This demonstrates the importance of air services in terms of developing higher value tourism and shows that trips involving air travel have a potentially disproportionate impact in terms of expenditure. At a local level, the potential risk of economic decline is greater than previously thought for economies with a strong dependency on airborne tourism demand. Economies that are particularly at risk include the Southern states (Spain, Portugal, Greece and Italy), which have regional economies that are focused strongly on tourism and for which air access is the primary mode of transport[18], and the peripheral and ultra peripheral areas, such as the Canary Islands, which are, to all intents and purposes reliant on air service connectivity to service their tourism economies.

This issue also needs to be viewed in the context of the growth of low fares airlines in recent years. Through their ability to stimulate the market, these carriers have literally 'created' tourism destinations overnight. The local economies at these destinations are now often heavily reliant on the expenditure brought in by visitors. ETS has the potential to impact more heavily on low fares carriers because of their cost structure and the elastic nature of their demand base. Therefore, rises in costs could impact severely on more marginal routes, either reducing frequency or leading to complete withdrawal. This could have severe economic implications for destinations which rely on these services to bring in tourism revenue.

5.6 Impact on EU Cohesion

In 2005, over 460 million people used air services to travel within the EU, and cargo airlines moved around 2.2 million tonnes of freight. This clearly demonstrates the important role played by air transport in connecting the different points within the European Union.

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[18] Information from Iberia suggests that, in 2004, 72% of international visitors arrived by air.

Air transport has a key social role to play in enabling and improving cohesion within the EU, allowing people to migrate effectively and establishing a true common market for goods, services, labour and capital. Raising the price of air services or effectively limiting the growth of connectivity will limit the extent to which air services can play their part in developing this cohesion. This constraint is again likely to have a differential effect across the European States.

Those states that are either already isolated by their geographic position or that have joined the EU more recently and are still integrating, are at a greater risk from this loss of connectivity than others. Countries such as Sweden, Finland, Cyprus or Greece are at the peripheries of the EU and the ability to interact with the countries at its heart is vital for overall cohesion. For recent accession states, such as Bulgaria and Romania, it is similarly important to have access to the economic heart of the EU.

Air services also play a vital social role, particularly in peripheral areas in providing links to essential services and in ensuring social cohesion. To the extent that the costs of air travel rise as a result of ETS, this will have wider social implications.

5.7 Impact on the Attractiveness of the EU as a Business Location

In 2000, the Lisbon Agenda set out a commitment to make the EU *"the most competitive and dynamic knowledge-driven economy by 2010"*. Central to this goal is the need to attract investment, to trade and interact in global markets and to create jobs in growth sectors. The role of air service connectivity in facilitating trade and attracting foreign direct investment is well established and consequently the role of the aviation sector in supporting the vision set out in the Lisbon Agenda is clear. However, to date, it is generally recognised that only limited progress has been made in achieving this goal. The inclusion of the aviation sector in the EU ETS has the potential to further damage the prospects of achievement. The potential lessening of connectivity, damage to the future prospects of European hubs and higher air fares and cargo tariffs will make the EU a less attractive business location, limiting the flows of investment, both into the EU and between EU states, affecting trading links and putting the EU at a disadvantage compared to other potential locations.

5.8 Conclusion

Air transport is an important economic sector both as an employer and generator of prosperity, but also as a facilitator of growth in wider economic sectors. The inclusion of the aviation sector into the EU ETS could potentially have a number of adverse impacts on the EU economy.

In terms of the sector's ability to support economic activity through its operations, we estimate that in 2022 it will create between 8,000 and 42,000 fewer jobs following its entry into the EU ETS and generate between €772 mill. and €3,862 mill. less of GVA in our low and high allowance price scenarios respectively. If allowance prices were to reach €60/tCO_2, this impact could increase to around 84,000 jobs and €7,724 mill. in 2022. The impacts could increase still further once the effect of auctioning of allowances is taken into account.

In terms of wider issues, the inclusion of the aviation sector in the EU ETS has the potential to substantially distort competition between EU and non-EU airlines and even between EU airlines, dependent on the balance between intra-EU and external flights in the first phase of implementation. As an example of this, there will be distortion of competition between EU and non-EU hubs, which will have a detrimental effect on EU carriers based at these airports.

The diversion of transfer traffic away from these hub airports will also impact on these airports as nodes for air service connectivity, impairing their ability to deliver wider benefits, such as improved trade and inward investment performance, which are central to the success of the Lisbon Agenda.

Tourism is a major economic sector within the EU and air services are a key facilitator of this activity, particularly in the Southern States and the peripheral and ultra peripheral areas of the EU. Many regional economies in these areas are heavily focussed on tourism and the curtailment of growth in services to these areas has the potential to do significant harm. This is particularly the case where low fares carriers have effectively 'created' markets in recent years, with local tourism economies becoming almost entirely dependent on these services.

With the continued expansion of the EU and the challenges inherent in achieving the integration of the accession countries into the wider European economy, it is perhaps particularly important to consider the potential impact of the EU ETS in curtailing growth in carrier networks and on more marginal routes. As we have shown, the scheme has particularly strong implications for the low fares carriers, the market segment that has been central to developing connectivity in these markets.

6 APPENDIX A: ADDITIONAL CONSIDERATIONS ON COST PASS-THROUGH

The aim of this chapter is to examine in further detail the drivers of cost pass-through and the arguments in the literature supporting pure and perfect competition in the airline industry.

Introduction

6.1.1 Examination of the EC impact assessment

The EC impact assessment states that the additional cost due to ETS will be entirely passed on customers. Two situations are considered for that purpose: (i) a high level of competition exists on most of the routes so airlines that price at marginal cost can pass-through the whole additional cost of ETS and (ii) some routes do have less competition, but the monopolistic position of the airline will make it possible to pass through the whole cost. We explain here why those assumptions are not realistic.

The impact assessment states that, one of the reasons why the additional cost will be passed through on to customers, is the ability of airlines to use yield management techniques in order to increase the fares of passengers that are the more willing to pay proportionally more. However, airlines already use yield management in order to maximize their profit by adapting their fares to passengers' ability to pay. For example, if it were possible for the airlines to charge more for their tickets to business passengers wanting flexibility, they would do so even in the absence of ETS in order to increase their profits.

The use of this assumption within the EC impact assessment has two implications. First, if the cost passed-through is higher than the increase in marginal cost for certain categories of passengers, this means that the increase in price is not so related to the cost, and in that case, price was not maximized for the business travelers before the ETS, which seems unrealistic. Second, if the increase is more significant for business fares than for restricted economy fares, this contradicts the main assumption of pure and perfect competition that pricing is at marginal cost. Furthermore, the distinctions between the types of passengers will not be constant for all flights. In particular, some flights may have few business travelers with a high ability to pay. Firstly, business travellers are more likely to travel to certain destinations and during peak periods when capacity is quite constrained, and they are less willing to travel during other periods. Secondly, some companies do not offer specific business products, so the numbers of time-sensitive business passengers using the services will decline. The dependence on discretionary leisure travel, with lower willingness to pay, and higher prices will particularly impact on leisure and low fares airlines.

Other underlying assumptions are made in the EC impact assessment in support of the idea that the cost will be entirely passed on consumers. We discuss each of these in turn.

No elasticity of demand. The above mentioned assumption related to the yield management techniques of airlines is accompanied by an assumption that global elasticity of demand is negligible. However, this is not true particularly for low fares airlines, which cannot afford significant increases in price without a major impact on demand.

A study performed by Trucost[19] suggests that low fares airlines would face significant problems in passing on increased costs to passengers since they do not have a business class product. Furthermore, their business model is to maximize load factors not to maximize individual yields. As mentioned in the body of the report, other studies indicate that the price elasticity is quite high even for network airlines. Consideration of the price elasticity of demand is necessary to understand the impact of ETS, and the mechanisms described in the EC impact assessment are not realistic as they take no account of the present situation of the market, ignoring the fact that passengers may decide on a macro-economic basis not to use air transportation if the price increases above their utility.

Costs of ETS are only variable. The EC impact assessment is also based on the assumption that the costs implied by ETS will only be variable costs passed on to consumers through marginal cost pricing in a perfectly competitive market. The underlying model to which the EC impact assessment actually refers distinguishes between fixed costs and variable costs. While variable costs may be passed-through in a perfectly competitive environment, this is no longer theoretically the case for fixed costs, which are assumed to be financed through the gross margin of airlines but are not directly taken into account in the pricing. Even in the simplified environment assumed by the EC impact assessment, fixed costs could not be passed-through to passengers, and such fixed costs are significant in the airline industry. Additional fixed costs incurred by the EU ETS should be financed through the gross margin and will then reduce the net profitability of airlines.

All Airlines are similar. The impact assessment does not distinguish between the different types of airlines. However, whilst the impact assessment concludes that the overall impact of the ETS scheme will be marginal, it does recognize that some differences may exist at a company level but that the losses incurred by some companies will lead to gains for others, as 'new room for manoeuvre' is left by the departure of some airlines from the market. Such a macro-economic approach seems unsuited to the realities of the airline industry since all airlines do not have the same business model, and the weakening of a business model does not necessarily lead to the strengthening of another one, but may instead reduce consumer surplus. The issue of differences between the companies is an aspect that has to be examined carefully by assessing trends within the industry.

6.1.2 Proposed Approach to Assess the Cost Pass-Through

The approach set out in the EC impact assessment describes a macro-economic situation that does not really fit the complexity of the airline market. Of course, no modeling can fully articulate every aspect of a real-world problem, but some significant improvements can be made to the rather simplistic approach adopted in the EC impact assessment. The assumptions used appear very one dimensional and do not take into account the complexities of the market, for example the cost pass-through rate, where it is assumed that cost will be entirely charged to consumers in all situations. We have, therefore, adopted more realistic approach that considers several issues that were neglected in the EC impact assessment.

[19] Emissions trading and European aviation – Trucost – March 2004

What are the Constraints on Supply

Assuming that the common form of competition between airlines throughout Europe is pure and perfect is an over-simplified assumption that neglects several key facts: (i) the supply by airlines is limited by the existence of available capacity at some airports and (ii) the existence of fixed cost does not allow for pure and perfect competition but mainly tends to towards oligopoly.

6.1.3 Congested Airports

As explained in the main body of the report, there are some situations where perfect competition cannot be considered as the normal course of business due to limitations on supply. Some airports are congested.

In its Worldwide Scheduling Guidelines, IATA[20] classifies airports in two categories: (i) schedule-facilitated airports, where airlines have to explain in advance their requirements to land and take off and (ii) coordinated airports where airlines cannot arrive or depart until they have been allocated specific slots by a coordinator appointed for the airport. According to study carried out by a Mott MacDonald (**Note 26**) study for the European Commission[21], airports could be classified in three categories based on their level of congestion: (i) un-congested, (ii) partially congested and (iii) heavily congested. This study was based on 35 airports selected from the 73 coordinated airports and 55 schedule-facilitated airports in the Community. These airports include all the heavily congested airports, a large proportion of all the reasonably congested airports, a small proportion of the larger number of lightly congested airports and a small number of schedule-facilitated airports. Classification was based predominantly on the ratio of slots made available by airports and the number of slots allocated during the summer 2005 IATA Slot allocation meetings. Slots made available by airports are the slots that may be bid on by airlines. Other criteria were developed in the Mott MacDonald study in order to qualify the level of congestion of an airport, and the results for 2005 are presented in the **Table 6-1**.

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[21] Study on the impact of the introduction of secondary trading at Community airports – European commission - Mott MacDonald – November 2006

Table 6-1: Slot Availability During Summer 2005

Summer 2005	Town	Airport	Allocated slots / available slots
Partially congested	Amsterdam	Amsterdam	111%
Heavily congested	London	Gatwick	102%
Heavily congested	Milan	Linate	101%
Heavily congested	Paris	Orly	100%
Heavily congested	London	Heathrow	99%
Partially congested	Paris	Charles de Gaulle	88%
Partially congested	London	Stansted	83%
Un-congested	Brussels	Brussels	79%
Partially congested	Zurich	Zurich	78%
Partially congested	Rome	Fiumicino	75%
Un-congested	Lisbon	Lisbon	70%
Un-congested	Milan	Malpensa	67%
Partially congested	Copenhagen	Copenhagen	64%
Un-congested	Geneva	Geneva	59%
Un-congested	Stockholm	Arlanda	53%
Un-congested	Milan	Bergamo	52%
Un-congested	Budapest	Budapest	47%
Un-congested	Oslo	Oslo	41%
Un-congested	Stockholm	Bromma	37%
Un-congested	Rome	Ciampino	34%

Data was not available or not requested for seven airports, three of which have been considered as heavily congested airports. Eight airports are considered to be heavily congested by this study, including Paris Charles de Gaulle Airport which will be considered a heavily congested airport well before 2025.

According to Mott MacDonald, 30% of passengers were handled by heavily congested airports in 2005, but this figure will rise to 50% by 2025. We have assumed that these figures prepared for the European Commission represent the percentage of demand at heavily congested airports. This is actually an underestimate since it is reasonable to assume that the average revenue from a passenger at a heavily congested airport is higher than for an average passenger at a less heavily congested airport. Heavily congested airports are hubs for the network airlines, handing long-haul flights with higher prices than short-haul flights. We propose the following percentages:

Table 6-2: Percentage of Congested Airports

	Percentage of congested airports
2005	30%
2025	50%

6.1.4 Unlimited Supply and Competition

The situation is different at un-congested airports since the absence of supply limits allows for a more traditional form of competition between airlines.

However, such competition cannot be considered systematically perfect, and its actual nature depends on point-to-point markets. On some point-to-point markets, competition is closer to an oligopoly, and in some cases even a monopoly. We will first examine these different cases by assuming that no changes occur on the supply side.

Pricing under perfect oligopolies
The cost pass-through approach in an oligopoly is another issue, which has also been considered in a paper by Ten Kate and Niels[22]. They examine the case of cost savings in a monopoly and in an oligopoly, and the way such savings are passed on to consumers. They theoretically consider the different situations for a monopoly and an oligopoly according to the nature of cost and demand. They conclude that cost pass-through in the case of an oligopoly does not only depend on the elasticity of demand, but on the number of assumed equal-size competitors and on the convexity or concavity of the demand function at the equilibrium point. This result may be surprising, since a well-known result in the case of a monopoly is the Lerner equation:

$$(p-mc)/p=1/e$$

where *p* is the single price of the goods or services provided by the monopoly, *mc* the marginal cost and *e* the elasticity of demand. By assuming that the demand is iso-elastic, such an equation is often solved by giving the following result:

$$P = e.c/(e-1)$$

This result means that the cost pass-through is higher than 100%, or in other words, that the monopoly may decrease or increase its price much more significantly than the decrease or increase in costs it faces. However, as outlined by Ten Kate and Niels, the use of an iso-elastic demand result is nothing more than the choice of a particular form of demand, which is fairly unrealistic. They then propose to determine the cost pass-through rate by assuming no particular form of the demand function and discuss how such a cost pass-through rate depends on the actual form of the demand function and not only on the elasticity at the equilibrium point. The example case is one of linear demand for which the cost pass-through rate is determined only by reference to the number of competitors:

$$\sigma = n / (n+1)$$

If the demand is actually convex (resp. concave) at the equilibrium point, the cost pass-through rate will be higher (resp. lower) than the reference pass-through rate. On a route level, deciding if the demand is convex or concave is a matter of empirical experience, and it is not possible within the scope of this study to consider the full range of routes throughout Europe.

[22] *To what extent are Cost Savings passed on to Consumers? An oligopoly approach*. – European journal of law and economics - A. Ten Kate and G. Niels - 2005

This analysis of the cost pass-through rate can also be applied to perfect competition, which leads to cost pass-through results of 100% if the number of competitors is infinite, which corresponds to the assumption made in the EC impact assessment. However even a situation where nine airlines compete, leads to a cost pass-through rate lower than 100% and equal to 90%.

Elasticity of Supply

According to Brueckner and Flores-Fillol[23], any increase in the fixed costs of an airline cannot be passed through to customers and the only way for an airline to maintain its profitability is to reduce the number of flights. The impact of an increase in the variable costs is more difficult to assess and depends on the nature of competition.

According to Jagersma and M. van Gorp[24], *Network companies* because of their 'hub-and-spoke system' need a critical mass of passengers to operate intercontinental flights, and consequently to turn their business into a success. The network airlines ensure not only try to maximize their profit on every route on which they operate but also to assure the fact that the number of passengers on long-haul flights will be maximized. They think 'network wide'. In this case, and notably in order to support their long-haul routes, they may decide to maintain the supply as it is, despite the loss of profits on certain routes due to the increase in costs stemming from ETS. For the purpose of this study, we will hence assume that network companies will not change their supply.

Low fares airlines. An assumption of inelasticity of supply may be unrealistic in some cases, especially for low fares airlines. Low fares airlines do not have any reason to maintain unprofitable routes because their customers are not concerned with such features. Low fares airlines have stimulated new markets and are therefore addressing a specific demand, which is mainly concerned with prices rather than frequency of service.

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[23] *Airline Schedule Competition* - J.K. Brueckner, R. Flores-Fillol – University of California and Universitat autònoma de Barcelona – August 2006
[24] *Competition in the airline industry* – Dr Jagersma and M. van Gorp – Universiteit Nyenrode - 2002

7 APPENDIX B: CALCULATING THE EFFECT ON DEMAND

In this Appendix, we set out the methodology and assumptions that have been used to calculate the impact on demand of the extension of the EU ETS to the aviation sector. This Appendix should be considered in conjunction with Appendix C: Additional considerations on windfall profits**,** which discuss the issue of cost pass-through in the airline sector, and **Chapter 1** which includes information on the price elasticity of demand used. We do not revisit these issues here.

We have organised this discussion under the following main headings:

- Establishing Business as Usual Demand (BAU)

- Calculating the Impact on Demand

It should be noted at the outset that, in quantitative terms, our approach focuses on the impact on passenger airlines, divided into the two principal business models; network and low fares airlines, and on cargo carriers. We consider that the impact on charter or regional airlines will fall within the spectrum of the impacts of the principal carrier types considered. We have not sought to develop estimates for business aviation as the lack of information available for that sector makes this impractical. It should also be noted that we have assumed that there is no auctioning as part of the EU ETS scheme. Therefore, it is only the growth above the baseline level (assumed to be 2005) that is affected.

Establishing Business as Usual Demand

Within the scope of this study we have not sought to undertake detailed modelling of the future demand for air transport. We have, instead, drawn upon existing work undertaken by a number of organisations to develop a business as usual demand position. The sources used for this analysis were:

- Eurostat which provided a base for 2005 for both passenger and cargo demand;

- IATA forecasts for 2006 to 2010;

- Boeing Current Market Outlook 2006 and World Air Cargo Forecast 2006-07;

- Airbus Market Outlook 2006 to 2025;

- AEA and ELFAA information on the market share of low fares airlines.

Based on an assessment of the growth rates identified in these publications for different market segments, we have identified a business as usual (BAU) demand scenario that reflects forecast growth without the extension of the EU ETS to cover the aviation sector. The results of this analysis separated into business model and sector length are set out in **Table 7-1**.

It should be noted that we have also made two further assumptions that impact on the later calculation of the impact of ETS on traffic:

- in terms of journey purpose, there is little definitive information on the purpose of travel at an EU level and consequently we have used as a basis the percentage of premium class and economy class seat sales on AEA airlines as a crude indicator of non-price sensitive passengers on network airline flights;

Table 7-1: Business as usual Demand Scenario

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passengers (mill.)																		
Network Airlines																		
Domestic	126	130	133	136	140	143	146	149	154	159	164	169	175	181	186	192	199	205
Intra EU	233	239	245	251	258	264	269	275	284	293	303	312	322	333	344	355	366	378
Extra EU	245	257	268	281	294	308	322	337	353	369	386	404	423	442	463	484	507	530
Total	604	625	647	669	691	714	737	761	791	821	853	886	920	956	993	1,032	1,072	1,114
Low Fares Airlines																		
Domestic	36	39	42	46	50	54	59	64	68	71	75	80	84	89	94	99	105	110
Intra EU	66	71	78	84	92	100	108	118	124	131	139	147	155	164	173	183	193	204
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**101**	**110**	**120**	**130**	**142**	**154**	**167**	**182**	**192**	**203**	**214**	**226**	**239**	**252**	**267**	**281**	**297**	**314**
Cargo (mill. tonnes)																		
Domestic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Intra EU	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
Extra EU	9	9	10	10	11	12	12	13	14	14	15	16	17	18	19	20	21	23
Total	11	12	12	13	14	14	15	16	17	18	19	20	21	22	23	25	26	28
Revenue Passenger Kilometres (billion)																		
Network Airlines																		
Domestic	138	140	143	146	149	151	154	156	160	164	169	173	178	182	187	192	197	202
Intra EU	254	259	264	269	274	279	283	288	295	303	311	319	328	336	345	354	364	373
Extra EU	902	947	993	1,042	1,094	1,148	1,204	1,264	1,326	1,392	1,461	1,534	1,610	1,689	1,773	1,861	1,953	2,050
Total	**1,293**	**1,346**	**1,401**	**1,457**	**1,516**	**1,578**	**1,641**	**1,707**	**1,782**	**1,859**	**1,941**	**2,026**	**2,115**	**2,208**	**2,305**	**2,407**	**2,514**	**2,626**
Low Fares Airlines																		
Domestic	39	42	45	49	53	57	62	67	70	74	77	81	85	90	94	99	104	109
Intra EU	72	77	84	90	98	106	114	123	129	136	143	150	157	165	174	182	191	201
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**110**	**119**	**129**	**139**	**151**	**163**	**176**	**190**	**200**	**210**	**220**	**231**	**243**	**255**	**268**	**281**	**295**	**310**
Revenue Tonne Kilometres (Cargo Operators)																		
Domestic	3	3	4	4	4	4	4	5	5	5	6	6	6	7	7	7	8	8
Intra EU	7	7	8	8	9	9	10	10	11	12	12	13	14	15	16	17	18	19
Extra EU	41	43	46	49	52	55	59	63	67	72	77	82	88	94	100	107	114	122
Total	**51**	**54**	**57**	**61**	**65**	**69**	**73**	**78**	**83**	**89**	**95**	**101**	**108**	**115**	**123**	**131**	**140**	**150**

- we have divided the cargo traffic between express freight and standard air cargo. Again there is no definitive data available on this split but for the purposes of this assessment we have assumed that around 15% of cargo traffic is express freight based on information provided by the European Cargo Association.

Calculating the Impact on Demand

In order to examine the impact on demand of the extension of the EU ETS to cover the aviation sector, we have identified a series of sample routes that can be used to illustrate of the impact of ETS on fares or cargo tariffs for different business models and markets.

Below, we set out three tables containing the assumptions used in developing these sample routes (**Table 7-2** Network Airlines, **Table 7-3** Low fares Airlines, **Table 7-4** Cargo Operators).

Table 7-2: Assumptions for 'Typical' Routes: Network Airlines

Assumption	Source	Domestic	Short Haul/Intra-EU	Long Haul/Extra EU
Aircraft	YALLP Assumption	Airbus A320	Airbus A320	Boeing 777
Total Seats	Aircraft Manufacturer Website	150	150	340
Business Seats	Aircraft Manufacturer Website	12	12	40
Leisure Seats	Aircraft Manufacturer Website	138	138	300
Sector Length (km)	AEA STAR06	476	895	6,436
Average Passenger Load Factor	AEA - STAR06	66.2%	67.7%	80.1%
Average Passenger Yield per RPK (€)	AEA - STAR06	0.16	0.12	0.06
Implied Bus Pax Yield per RPK (€)	AEA STAR06 adjusted for Network Airlines on basis of UK CAA Passenger Survey Data	0.29	0.33	0.23
Implied Leisure Pax Yield per RPK (€)	AEA STAR06 adjusted for Network Airlines on basis of UK CAA Passenger Survey Data	0.15	0.11	0.05
Flight RPK		47,267	90,887	1,752,780
Business RPK		3,781	7,271	206,209
Leisure RPK		43,485	83,616	1,546,571
Business Revenue (€)		1,115	2,413	47,972
One Way Business Yield per pax (€)		140	297	1,497
Leisure Yield (€)		6,308	9,335	75,990
One Way Leisure Yield per pax (€)		69	100	316
LTO Cycle Fuel Usage	EMEP/CORINAIR Database	802.3	802.3	2562.8
Fuel Usage per KM in Cruise	EMEP/CORINAIR Database	3.1	3.1	7.4
Fuel Usage in Kg per sector		2,278	3577	50,189
CO2 Emissions in Kg	Based on fuel usage and carbon factor of 3.15	7,175	11,267	158,096

It was assumed that the additional cost due to ETS was based on the average fuel consumption and the load factor set out in the table above.

Table 7-3: Assumptions for 'Typical' Routes: Low Fares Airlines

Assumption	Source	Domestic	Short Haul/Intra-EU	Long Haul/Extra EU
Aircraft	YALLP Assumption	Airbus A320	Airbus A320	n/a
Total Seats	Aircraft Manufacturer Website	150	150	n/a
Sector Length (km)	AEA STAR06	476	895	n/a
Average Passenger Load Factor	ELFAA Key Statistics	83.0%	83.0%	n/a
Average Passenger Yield per RPK (€)	TRL Airline Performance Indicators	0.05	0.05	n/a
Flight RPK		59,262	111,428	n/a
Revenue (€)		3,141	5,906	n/a
One Way Yield per pax (€)		25	47	n/a
LTO Cycle Fuel Usage	EMEP/CORINAIR Database	802.3	802.3	n/a
Fuel Usage per KM in Cruise	EMEP/CORINAIR Database	3.1	3.1	n/a
Fuel Usage in Kg per sector		2,278	3,577	n/a
CO2 Emissions in Kg	Based on fuel usage and carbon factor of 3.15	7,175	11,267	n/a

Table 7-4: Assumptions for 'Typical' Routes: Cargo Operators

Assumption	Source	Domestic	Short Haul/Intra-EU	Long Haul/Extra EU
Aircraft	YALLP Assumption	Boeing 737 Freighter	Boeing 737 Freighter	Boeing 747 Freighter
Total Capacity	Aircraft Manufacturer Website	18	18	114
Sector Length	AEA STAR06	476	895	6,417
Average Freight Load	AEA STAR06	41.3%	57.4%	67.4%
Average Yield per Freight Tonne Kilometre (€)	AEA STAR06	0.96	0.57	0.22
Flight Tonne Kilometres		3,539	9,247	493,057
Yield (€)		3,397	5,271	108,472
One Way Yield per Kilogramme (€)		0.46	0.51	1.41
LTO Cycle Fuel Usage	EMEP/CORINAIR Database	825.4	825.4	3402
Fuel Usage per KM in Cruise	EMEP/CORINAIR Database	3.1	3.1	10.0
Fuel Usage in Kg per sector		2,301	3,600	67,572
CO2 Emissions in Kg	Based on fuel usage and carbon factor of 3.15	7,248	11,340	212,852

The information in the tables above is then used to examine the impact of ETS on air fares and cargo tariffs, which can in turn be used to make an assessment of the impact on overall demand. This process needs three further inputs discussed in other chapters in this report:

- the assumed allowance price;
- the average rate of cost pass-through for the market segment;
- the price elasticity of demand for the market.

In **Table 7-5** below, we have illustrated this process for a low fares, short haul/intra EU route where the allowance price is assumed to be €30/tCO_2 in 2022. For the purposes of this illustration, we have examined the impact on passenger demand.

Table 7-5: Impact of ETS on Demand: Low Fares Airline, Short Haul/Intra EU Route

Allowance Price of €30/tCO_2	
Average One-Way Fare (€)	47.44
CO_2 emitted by flight	11,267 kg
Cost of Allowances at €30/tCO_2 (€)	338.01
Cost per Passenger Flown (Number of Seats x Load Factor) (€)	2.71
Average Cost Pass-through Rate[25]	30%
Cost Passed to Passenger (€)	0.81
New Average One-Way Fare (€)	48.25
% Rise in Fare	1.7%
Price Elasticity for the Market Segment	-1.5
Resulting Change in Demand	-2.6%
Baseline Passengers in 2022	203,573,035
Growth since 2005	137,881,695
Fall in Passenger Demand	3,551,218
Passenger Demand in 2022 with ETS at €30/tCO_2	200,021,817

Our assessments of the impact on demand are an extension of this process. The impact is assessed for each year, for each carrier type, for each sector length and for each allowance price scenario. Where appropriate, different price elasticities are applied for business and leisure passengers and for express freight and standard air cargo users. This percentage impact is then applied to the different measures of demand shown in **Table 7-1**.

For ease of reference, we have set out in **Table 7-2** to **Table 7-4** the impact on fares and tariffs for the various market segments and sector lengths based on the process and assumptions shown above, including the cost pass-through assumptions set out in Appendix A: Additional considerations on cost pass-through and the elasticity of demand set out in **Chapters 1.1 and 1.2**. These assumptions are re-summarised in **Table 7-9** and **Table 7-10**. It should be noted that we have presented here the average cost-pass through rates for the different market segments. In reality, the rate of cost pass-through is determined by the level of competition on each route but, for the purposes of modelling the impact on demand, it is necessary to apply an average rate.

[25] The average cost pass through rate is calculated on the basis of the discussions in Chapter 4 and Appendix D.

Table 7-6: Changes in One Way Air Fares and Tariffs Resulting from the Introduction of the EU ETS: Domestic Routes

	Network Business		Leisure	Low Fares			Cargo		
Average Fare/ Tariff per Kg	€140		€69	€25			€0.46		
Allowance Cost Price Increase €	**Low**	**High**	**Extreme**	**Low**	**High**	**Extreme**	**Low**	**High**	**Extreme**
2011	0.05	0.10	0.20	0.10	0.20	0.41	0.001	0.003	0.005
2012	0.06	0.11	0.23	0.11	0.23	0.46	0.001	0.003	0.006
2013	0.03	0.13	0.27	0.05	0.25	0.49	0.001	0.003	0.006
2014	0.03	0.15	0.30	0.05	0.26	0.52	0.001	0.003	0.007
2015	0.03	0.16	0.33	0.05	0.27	0.55	0.001	0.004	0.007
2016	0.04	0.18	0.36	0.06	0.29	0.57	0.001	0.004	0.008
2017	0.04	0.19	0.38	0.06	0.30	0.60	0.001	0.004	0.009
2018	0.04	0.20	0.41	0.06	0.31	0.62	0.001	0.004	0.009
2019	0.04	0.21	0.43	0.06	0.32	0.64	0.001	0.004	0.009
2020	0.04	0.22	0.45	0.07	0.33	0.66	0.001	0.005	0.009
2021	0.05	0.23	0.47	0.07	0.34	0.68	0.001	0.005	0.009
2022	0.05	0.24	0.48	0.07	0.35	0.70	0.001	0.005	0.010

Table 7-7: Changes in One Way Air Fares and Tariffs Resulting from the Introduction of the EU ETS: Short-Haul Routes

	Network Business		Leisure	Low Fares			Cargo		
Average Fare/ Tariff per Kg	€297		€100	€47			€0.51		
Allowance Cost Price Increase €	**Low**	**High**	**Extreme**	**Low**	**High**	**Extreme**	**Low**	**High**	**Extreme**
2011	0.08	0.16	0.31	0.16	0.32	0.65	0.001	0.003	0.006
2012	0.09	0.18	0.35	0.18	0.36	0.73	0.002	0.003	0.007
2013	0.04	0.20	0.40	0.08	0.38	0.77	0.001	0.004	0.007
2014	0.05	0.23	0.46	0.08	0.41	0.82	0.001	0.004	0.008
2015	0.05	0.25	0.50	0.09	0.43	0.86	0.001	0.004	0.008
2016	0.05	0.27	0.55	0.09	0.45	0.90	0.001	0.004	0.008
2017	0.06	0.29	0.59	0.09	0.47	0.94	0.001	0.005	0.010
2018	0.06	0.31	0.62	0.10	0.49	0.98	0.001	0.005	0.011
2019	0.07	0.33	0.65	0.10	0.50	1.02	0.001	0.005	0.012
2020	0.07	0.34	0.69	0.10	0.52	1.05	0.001	0.005	0.013
2021	0.07	0.36	0.71	0.11	0.54	1.08	0.001	0.005	0.014
2022	0.07	0.37	0.74	0.11	0.55	1.11	0.001	0.005	0.015

These results are based on the assumption that no auctioning would be in force at any date of the future.

Table 7-8: Changes in One Way Air Fares and Tariffs Resulting from the Introduction of the EU ETS: Long-Haul Routes

	Network Business	Leisure		Low Fares			Cargo		
Average Fare/ Tariff per Kg	€1,497	€316		n/a			€1.41		
Allowance Cost Price Increase €	**Low**	**High**	**Extreme**	**Low**	**High**	**Extreme**	**Low**	**High**	**Extreme**
2011	0.00	0.00	0.00	n/a	n/a	n/a	0.000	0.000	0.000
2012	0.81	1.63	3.26	n/a	n/a	n/a	0.005	0.009	0.018
2013	0.36	1.79	3.59	n/a	n/a	n/a	0.002	0.010	0.020
2014	0.39	1.94	3.88	n/a	n/a	n/a	0.002	0.011	0.021
2015	0.42	2.08	4.16	n/a	n/a	n/a	0.002	0.012	0.023
2016	0.44	2.20	4.40	n/a	n/a	n/a	0.002	0.012	0.025
2017	0.46	2.31	4.63	n/a	n/a	n/a	0.003	0.013	0.026
2018	0.48	2.41	4.82	n/a	n/a	n/a	0.003	0.013	0.027
2019	0.50	2.50	5.00	n/a	n/a	n/a	0.003	0.014	0.028
2020	0.52	2.58	5.16	n/a	n/a	n/a	0.003	0.014	0.028
2021	0.53	2.65	5.30	n/a	n/a	n/a	0.003	0.014	0.029
2022	0.54	2.71	5.41	n/a	n/a	n/a	0.003	0.015	0.029

Table 7-9: Price Elasticity of Demand Assumptions

	Business		**Leisure**
Network Airlines	-0.8		-1.5 (short haul)/ -1.0 (Long Haul)
Low Fares		-1.5	
	Express Freight		Standard
Cargo	-0.8		-1.6

Table 7-10: Average Cost Pass-through Rate (% Costs Passed to Consumer)

	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Network Airlines	34.9%	34.4%	33.8%	33.3%	32.7%	32.2%	31.6%	31.1%	30.6%	30.0%	29.5%	28.9%
Low Fares Airlines	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Cargo	34.9%	34.4%	33.8%	33.3%	32.7%	32.2%	31.6%	31.1%	30.6%	30.0%	29.5%	28.9%

The results of this process are set out in **Table 7-11** for the low allowance price scenario, in **Table 7-12** for the high allowance price scenario and **Table 7-13** for the extreme scenario.

Table 7-11: Low Allowance Price Demand Scenario (€ 6-15t/CO_2)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passengers (mill.)																		
Network Airlines																		
Domestic	126	130	133	136	140	143	146	149	154	159	164	169	175	180	186	192	198	205
Intra EU	233	239	245	251	258	264	269	275	284	293	302	312	322	333	343	354	366	378
Extra EU	245	257	268	281	294	308	322	336	352	369	386	404	422	442	462	484	506	530
Total	**604**	**625**	**647**	**669**	**691**	**714**	**737**	**760**	**790**	**820**	**852**	**885**	**919**	**955**	**992**	**1,030**	**1,070**	**1,112**
Low Fares Airlines																		
Domestic	36	39	42	46	50	54	58	64	67	71	75	79	84	88	93	99	104	110
Intra EU	66	71	78	84	92	100	108	117	124	131	138	146	154	163	172	182	192	203
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**101**	**110**	**120**	**130**	**142**	**154**	**166**	**181**	**192**	**202**	**214**	**226**	**238**	**252**	**266**	**280**	**296**	**313**
Cargo (mill. tonnes)																		
Domestic	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5
Intra EU	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.1	3.3	3.5
Extra EU	8.8	9.3	9.8	10.3	10.9	11.6	12.2	12.9	13.6	14.4	15.3	16.1	17.0	18.0	19.0	20.1	21.3	22.5
Total	**11.0**	**11.6**	**12.2**	**12.9**	**13.6**	**14.4**	**15.2**	**15.9**	**16.9**	**17.8**	**18.8**	**19.9**	**21.0**	**22.1**	**23.4**	**24.7**	**26.1**	**27.5**
Revenue Passenger Kilometres (billion)																		
Network Airlines																		
Domestic	138	140	143	146	149	151	154	156	160	164	169	173	178	182	187	192	197	202
Intra EU	254	259	264	269	274	279	283	287	295	303	311	319	327	336	345	354	363	373
Extra EU	902	947	993	1,042	1,094	1,148	1,204	1,261	1,325	1,391	1,459	1,532	1,607	1,687	1,770	1,858	1,950	2,047
Total	**1,293**	**1,346**	**1,401**	**1,457**	**1,516**	**1,578**	**1,641**	**1,704**	**1,780**	**1,858**	**1,939**	**2,024**	**2,112**	**2,205**	**2,302**	**2,404**	**2,510**	**2,622**
Low Fares Airlines																		
Domestic	39	42	45	49	53	57	61	66	70	74	77	81	85	89	94	98	103	109
Intra EU	72	77	84	90	98	106	113	123	129	136	142	149	157	165	173	182	191	200
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**110**	**119**	**129**	**139**	**151**	**163**	**175**	**189**	**199**	**209**	**220**	**230**	**242**	**254**	**267**	**280**	**294**	**309**
Revenue Tonne Kilometres (Cargo Operators)																		
Domestic	3	3	4	4	4	4	4	5	5	5	6	6	6	7	7	7	8	8
Intra EU	7	7	8	8	9	9	10	10	11	12	12	13	14	15	16	17	18	19
Extra EU	41	43	46	49	52	55	59	63	67	72	77	82	87	93	100	107	114	122
Total	**51**	**54**	**57**	**61**	**65**	**69**	**73**	**77**	**83**	**88**	**94**	**101**	**108**	**115**	**123**	**131**	**140**	**149**

Table 7-12: High Allowance Price Demand Scenario (€ 30t/CO_2)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passengers (mill.)																		
Network Airlines																		
Domestic	126	130	133	136	140	143	146	149	154	159	164	169	174	180	186	192	198	204
Intra EU	233	239	245	251	258	264	269	274	283	292	302	311	321	331	342	353	364	376
Extra EU	245	257	268	281	294	308	322	335	351	367	384	401	420	439	460	481	503	526
Total	**604**	**625**	**647**	**669**	**691**	**714**	**737**	**759**	**788**	**818**	**849**	**881**	**915**	**951**	**987**	**1,025**	**1,065**	**1,107**
Low Fares Airlines																		
Domestic	36	39	42	46	50	54	58	63	67	70	74	78	83	87	92	97	102	108
Intra EU	66	71	78	84	92	100	107	117	123	130	137	145	153	161	170	179	189	200
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**101**	**110**	**120**	**130**	**142**	**154**	**165**	**180**	**190**	**200**	**211**	**223**	**235**	**248**	**262**	**277**	**292**	**308**
Cargo (mill. tonnes)																		
Domestic	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5
Intra EU	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	3.0	3.1	3.3	3.4
Extra EU	8.8	9.3	9.8	10.3	10.9	11.6	12.2	12.8	13.5	14.3	15.1	16.0	16.9	17.8	18.8	19.9	21.0	22.2
Total	**11.0**	**11.6**	**12.2**	**12.9**	**13.6**	**14.4**	**15.1**	**15.9**	**16.7**	**17.7**	**18.6**	**19.7**	**20.7**	**21.9**	**23.1**	**24.4**	**25.7**	**27.2**
Revenue Passenger Kilometres (billion)																		
Network Airlines																		
Domestic	138	140	143	146	149	151	153	156	160	164	168	173	177	182	187	191	196	202
Intra EU	254	259	264	269	274	279	283	287	295	302	310	318	327	335	344	353	362	372
Extra EU	902	947	993	1,042	1,094	1,148	1,204	1,258	1,319	1,384	1,452	1,523	1,598	1,677	1,760	1,846	1,938	2,033
Total	**1,293**	**1,346**	**1,401**	**1,457**	**1,516**	**1,578**	**1,641**	**1,700**	**1,774**	**1,850**	**1,930**	**2,014**	**2,102**	**2,194**	**2,290**	**2,391**	**2,496**	**2,606**
Low Fares Airlines																		
Domestic	39	42	45	49	53	57	61	66	69	73	76	80	84	88	92	97	102	107
Intra EU	72	77	84	90	98	106	113	122	128	134	141	148	155	163	171	179	188	198
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**110**	**119**	**129**	**139**	**151**	**163**	**174**	**188**	**197**	**207**	**217**	**228**	**239**	**251**	**263**	**276**	**290**	**304**
Revenue Tonne Kilometres (Cargo Operators)																		
Domestic	3	3	4	4	4	4	4	5	5	5	5	6	6	7	7	7	8	8
Intra EU	7	7	8	8	9	9	10	10	11	12	12	13	14	15	16	16	17	19
Extra EU	41	43	46	49	52	55	59	62	66	71	76	81	86	92	99	105	113	120
Total	51	54	57	61	65	69	73	77	82	88	93	100	106	113	121	129	138	147

Table 7-13: Extreme Allowance Price Demand (€ 60t/CO2)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passengers (mill.)																		
Network Airlines																		
Domestic	126	130	133	136	140	143	146	149	153	158	163	168	174	179	185	191	197	203
Intra EU	233	239	245	251	258	264	268	274	282	291	301	310	320	330	341	351	363	374
Extra EU	245	257	268	281	294	308	322	334	349	365	381	399	417	436	456	477	499	522
Total	**604**	**625**	**647**	**669**	**691**	**714**	**736**	**756**	**785**	**814**	**845**	**877**	**911**	**945**	**982**	**1,019**	**1,059**	**1,099**
Low Fares Airlines																		
Domestic	36	39	42	46	50	54	57	62	66	69	73	77	81	85	90	95	100	106
Intra EU	66	71	78	84	92	100	106	115	121	128	135	143	150	159	167	176	186	196
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**101**	**110**	**120**	**130**	**142**	**154**	**164**	**177**	**187**	**197**	**208**	**219**	**231**	**244**	**257**	**272**	**286**	**302**
Cargo (mill. tonnes)																		
Domestic	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5
Intra EU	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2	3.4
Extra EU	8.8	9.3	9.8	10.3	10.9	11.6	12.2	12.7	13.4	14.1	14.9	15.7	16.6	17.6	18.6	19.6	20.7	21.9
Total	**11.0**	**11.6**	**12.2**	**12.9**	**13.6**	**14.4**	**15.1**	**15.7**	**16.6**	**17.5**	**18.4**	**19.4**	**20.5**	**21.6**	**22.8**	**24.0**	**25.4**	**26.8**
Revenue Passenger Kilometers (billion)																		
Network Airlines																		
Domestic	138	140	143	146	149	151	153	155	159	164	168	172	177	181	186	191	196	201
Intra EU	254	259	264	269	274	279	282	287	294	301	309	317	325	334	343	351	361	370
Extra EU	902	947	993	1,042	1,094	1,148	1,204	1,251	1,312	1,376	1,443	1,513	1,587	1,665	1,746	1,832	1,922	2,017
Total	**1,293**	**1,346**	**1,401**	**1,457**	**1,516**	**1,578**	**1,640**	**1,693**	**1,765**	**1,841**	**1,920**	**2,002**	**2,089**	**2,180**	**2,275**	**2,374**	**2,478**	**2,587**
Low Fares Airlines																		
Domestic	39	42	45	49	53	57	60	65	68	72	75	79	82	86	91	95	100	105
Intra EU	72	77	84	90	98	106	112	121	126	133	139	146	153	160	168	176	185	194
Extra EU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**110**	**119**	**129**	**139**	**151**	**163**	**172**	**186**	**195**	**204**	**214**	**224**	**235**	**247**	**259**	**272**	**285**	**299**
Revenue Tonne Kilometers (Cargo Operators)																		
Domestic	3	3	4	4	4	4	4	5	5	5	5	6	6	6	7	7	8	8
Intra EU	7	7	8	8	9	9	10	10	11	11	12	13	14	14	15	16	17	18
Extra EU	41	43	46	49	52	55	59	62	66	70	75	80	85	91	97	104	111	118
Total	**51**	**54**	**57**	**61**	**65**	**69**	**73**	**76**	**81**	**86**	**92**	**98**	**105**	**112**	**119**	**127**	**135**	**144**

8 APPENDIX C: ADDITIONAL CONSIDERATIONS ON WINDFALL PROFITS

Some elements regarding the possible occurrence of windfall profits in the airline industry, in a situation where allowances are grandfathered to airlines were presented in the body of the report. The aim of this chapter is to examine such a possibility further.

Examination of windfall profits for the monopoly

As mentioned in the corresponding chapter of the report, we assume a monopolistic company whose profit before the introduction of the ETS may be written as follows:

$$\Pi^b = (p - c).D(p) - F$$

Where *p* is the price of an air ticket, *c* the variable cost, *D(p)* the demand that depends on the price and *F* the fixed cost incurred by the airline. The profit may be seen as the difference between the two terms, the first being the gross margin of the airline, and the second being the fixed costs. The airline will determine the price of the tickets in order to maximize its profits. The profit maximizing price prior to the introduction of the ETS is written as p^{b*}.

After the introduction of the ETS, the variable cost increases by *δc* and the fixed cost by *δF*, hence the price rises by *δp* and the demand will decrease by *δD*, so that the new profit for the airline just after ETS can be defined as:

$$\Pi^a = ((p + \delta p) - (c + \delta c)).(D(p) - \delta D) - (F + \delta F)$$
$$\Pi^a = ((p - c) + (\delta p - \delta c)).(D(p) - \delta D) - (F + \delta F)$$
$$\Pi^a = (p - c).D(p) - F + (\delta p - \delta c).D - (p - c).\delta D - \delta F$$
$$\Pi^a = \Pi^b + (\delta p - \delta c).D - (p - c).\delta D - \delta F$$

We note that $\delta p = \sigma.\delta c$ where σ is the cost pass-through rate and ε the price elasticity of demand. We then have:

$$\Pi^a = \Pi^b - \delta c.(1 - \sigma).D - (p - c).\varepsilon.D.\delta p/p - \delta F$$

This expression shows the different effects that will impact the profitability of the airlines, as mentioned in the body of the report. Analysis of this formula and consideration of the degree of liberalisation of the industry suggests that windfall profits in a particular commodity sector may be explained by individual circumstances within this sector. The principal determinant with regard to the ability to achieve windfall profits is the extent of liberalisation within the sector and the consequent ‘room for manoeuvre’ to increase the price over and above the increase in cost due to ETS. Therefore, the additional costs of ETS represent an opportunity to increase the price with the consent of the regulators. On the contrary, in the case of a liberalised sector the monopoly will incur losses.

Examination of windfall profits for the duopoly

A duopoly situation is similar to a monopoly situation, although some differences do exist. In examining the duopoly situation, we use the Cournot model. We assume that the price function for both airlines will be $p(q_1,q_2)$, where q_1 and q_2 are the supply of services provided by operators 1 and 2. The profit of operator 1 before the introduction of the ETS can be rewritten as follows:

$$\Pi_1^a(q_1,q_2) = [p(q_1,q_2) - c]q_1 - F$$

After the introduction of the ETS and with the additional cost, profit may be written as:

$$\Pi_1^a(q_1,q_2) = [p(q_1,q_2) - (c+\delta c)]q_1 - (F+\delta F)$$

This equation can be rewritten as follows:

$$\Pi_1^a(q_1,q_2) = \Pi_1^b(q_1,q_2) - [\delta F + \delta c\ q_1]$$

This equation shows that the profit after ETS is equal to the profit before ETS less the cost of allowances. This equation is similar to the profit maximization formula for a monopoly, with the exception that it is necessary to take into account the change in supply of operator 2 relating to the introduction of the ETS, which may have an effect on the profit of operator 1. In order to examine the impact on the profitability of operator 1, we identify q^{b1*} and q^{a1*}, quantities which maximize the profit of the company before and after the introduction of the ETS respectively. The same notation is used for company 2.

The difference in profit for operator 1 before and after the introduction of the ETS may be noted as:

$$\Pi_1^a(q_1^a*,q_2^a*) - \Pi_1^b(q_1^b*,q_2^b*) = [\Pi_1^b(q_1^a*,q_2^a*) - \Pi_1^b(q_1^b*,q_2^b*)] - [\delta F + \delta c\ q_1^a*]$$

We first resolve the first term. First order Taylor development leads to the following equation:

$$\Pi_1^b(q_1^a*,q_2^a*) - \Pi_1^b(q_1^b*,q_2^b*) = \frac{\partial \Pi_1^b}{\partial q_1}(q_1^b*,q_2^b*)\ (q_1^a* - q_1^b*) + \frac{\partial \Pi_1^b}{\partial q_2}(q_1^b*,q_2^b*)\ (q_2^a* - q_2^b*)$$

The first term of this equation will be close to zero since the operator maximized his profit before the ETS so that the first order condition is driven only by the second term.[26]

$$\frac{\partial \Pi_1^b}{\partial q_2}(q_1^b*,q_2^b*) = \frac{dp}{dq}(q_1^b* + q_2^b*)\ q_1^b*$$

At this stage, we consider that *dp* could be considered as a small change in price and we consider that *dp* may be interchanged with *δp* whereas *dq* may be interchanged with *δq*.

[26] Note that a second development would lead to a negative term which means that the decrease in profit will be more significant if the impact of the ETS is not marginal.

We also assume that the market share of operators 1 and 2 will remain unchanged after the introduction of the ETS and if we define $q^{b1*} = \alpha_1.Q^b$ then $q^{a1*} = \alpha_1.Q^a$, where α_1 is the market share of operator 1.

$$\Pi_1^b(q_1^a*, q_2^a*) - \Pi_1^b(q_1^b*, q_2^b*) = \delta p \cdot q_1^b * \cdot (1-\alpha_1),$$

The impact of the introduction of the ETS on profits can be rewritten as the sum of the two terms rearranged:

$$\Pi_1^a(q_1^a*, q_2^a*) - \Pi_1^b(q_1^b*, q_2^b*) = \alpha_2\ \delta p\ q_1^b * - (\delta F + \delta c\ q_1^a*)$$

At the first order, the following expression can be determined:

$$\Pi_1^a(q_1^a*, q_2^a*) - \Pi_1^b(q_1^b*, q_2^b*) = -(\delta F + (1-(1-\alpha_1)\sigma)\cdot \delta c\ q_1^a*),$$

where σ is the variable cost pass-through rate. This expression means that there is, in any case, a financial loss for the duopoly even if this loss is lower than for a monopoly, as the increase in costs leads to a decrease in the quantities supplied by both operators, thus a decrease in competition and as a consequence a relatively higher increase in fares.

The preceding equation shows that the decrease in profits for the airlines depends, at the first order and assuming that the duopoly is of Cournot-type, on (i) the cost pass-through rate (the higher the cost pass-through rate the lower the financial impact on the airline since the cost is passed through to customers), and (ii) the market share of the airline (the lower the market share the lower, the financial impact since the operator benefits from the reduction in supply of its competitor).

The main conclusions of this analysis are as follows:

- in the case of a monopoly (α_1 = 1), we find the same result as described in the preceding chapter, that is to say the financial loss is at least equal to the additional costs, just as if there were no cost pass-through;

- in the case of pure and perfect competition (α_1 = 0, σ = 1), the financial impact on airlines would be reduced to the fixed part of the additional cost of the ETS that cannot be passed-through to customers;

- If the cost-pass-through rate is equal to 0 (e.g. at congested airports where price are set at a level that equals the demand and the capacity of the airport), the financial impact is equal to the whole additional cost with no regard to the market share.

Two issues have to be taken into account when interpreting these results:

1 the financial impact is lower for airlines with a low market share than for others. However, this is no longer true if we talk about relative financial impact. Small airlines will be less affected by variable costs than larger ones, but their financial position may be dramatically affected by the increase in fixed costs that in certain cases could not be offset by their relatively low gross margin. For larger airlines, the additional fixed costs may be absorbed more easily due to the volume effect;

2 the impact that we have determined is a first order impact and we have not sought to examine second order impacts that would have shown that the negative financial impact on airlines is higher, since all second order terms are negative and thus would lead to a further reduction in the profits of airlines.

9 APPENDIX D: DEFINING THE MARKET SEGMENTS

Introduction

In this Appendix, we provide a brief description of the main market segments in the aviation sector that are discussed within this Impact Assessment. It should be noted at the outset that the aviation sector and the aircraft operators within it are an enormously diverse group. Consequently, what is presented below is an overview of the main business models in the sector and some commentary on the particular characteristics of these different models that are relevant in a consideration of the impact of the EU ETS.

We organise this discussion under the following main headings:

- Passenger Airlines;
- Cargo Airlines;
- Business aviation.

Passenger Airlines

Passenger airlines are the largest of the market segments examined in this impact assessment. In 2005, passenger airlines carried around 705 million passengers[27], a rise of 8.5% on the previous year. Based on information in the Boeing Market Outlook for 2006[28], we estimate that this activity equated to around 1,400 bill. Revenue Passenger Kilometres (RPK). **Figure 9-1** shows the breakdown of this traffic in terms of national/domestic, intra-EU and extra-EU passengers.

The largest group, 42% of passenger demand in 2005, was passengers travelling on services within the EU, demonstrating the important role air services play in connecting the different countries within the EU. The next largest group was those travelling to destinations outside the EU (35%). Those travelling on domestic services made up around 23% of demand.

[27] Eurostat. It should be noted, that whilst we feel that Eurostat provides the most comprehensive single source for passenger data, it is developed on the basis of submissions from member states. Consequently, there may be some inconsistencies within this dataset. It should also be noted that, in a wider context, Eurostat does not fully capture the Gross Value Added of the airline industry as tour operators (and airlines belonging to them) are not taken into account.

[28] It should be noted that a precise baseline for RPK for the EU as opposed to Europe is not available. We have, therefore, assumed that around 90% of RPK for Europe are flown from within the EU.

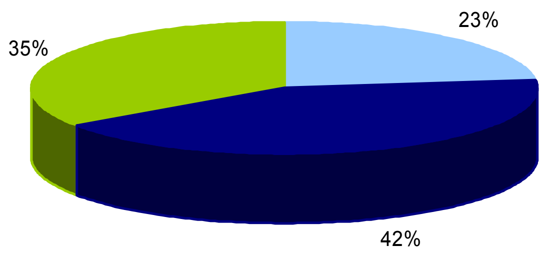

Figure 9-1: EU Airline Passengers by Geographic Area for 2005
Source: Eurostat.

The passenger airline industry is a diverse sector, containing a wide variety of business models and companies, including:

- network or 'legacy' carriers, such as British Airways, Air France-KLM, Lufthansa;
- regional airlines, such as Air Nostrum, Eastern Airways, Cimber Air;
- leisure airlines, formerly known as charter airlines, such as Thomas Cook, TUI or Futura;
- low fares airlines, such as Ryanair, EasyJet or Air Berlin.

Below, we have used this broad categorisation as a basis for describing the main characteristics of these core business models and the interaction and competition between them. It should be recognised that there is a growing trend within the industry whereby the traditional differences between the different business models are becoming more blurred. However, they all have one thing in common. They can all be subjected to rapid changes in demand which can have a significant impact upon their businesses very quickly.

Product differentiation and price are important. Within the current market, at present, it could be argued that price is a more important criterion than product, depending on the type of passenger (for instance a business passenger is generally less driven by price than a leisure passenger). In terms of the cost structure, the passenger airline business is characterised by high fixed operating and overhead costs. However, product price evolution and the structure of costs can vary considerably across business models.

Network or 'Legacy' Airlines

Network or 'legacy' airlines are typically the former national 'flag' carriers. These airlines mainly operate scheduled passenger services, with 'bellyhold' freight capability. A limited number of freighter or charter services may also be operated. Most of these airlines continue to offer a multi-class product, with business and economy classes differentiated by service and price. However, some airlines have adopted a single class model for intra-European services, partly to compete with low fares airlines.

The network or 'legacy' carriers typically operate so-called 'hub and spoke' models, which focus their operations on key hub airports. This network approach allows the airlines to concentrate passenger demand at these airports and improve the economics of their route networks. This is particularly the case for long-haul services, which are a core driver of profitability in this market segment. However, at the same time, many network carriers retain substantial regional networks in competition or cooperation with regional airlines.

There are a number of characteristics of network carriers that need to be considered in the context of the inclusion of the aviation sector in the ETS:

- as we have described, network airlines focus their activities on their hub airports. These airports are often among the largest and most congested in Europe, such as London Heathrow, Paris Charles de Gaulle and Frankfurt. These capacity constraints have implications for the extent to which these carriers can pass-through the costs of ETS to consumers. At these airports, the network airlines may have considerable market power and consequently it is reasonable to assume that they seek to charge fares that are at the maximum the market will bear. In these circumstances, the scope for passing on the costs associated with ETS will be limited by the price elasticity of demand in the market;

- network carriers operate complex yield management models aimed at maximizing revenue on each flight. Hence, for time sensitive business travellers, this again suggests that fares may already be close to the maximum which the market will bear, which will limit the scope for passing through the costs associated with ETS. However, this is less so for price sensitive leisure passengers, where the ability to pass through these additional costs will be limited by the price elasticity of demand and the nature of competition within the market;

- competition both between the network carriers and with other business models, is an important consideration in understanding the potential impact of the EU ETS on this business model. The network carriers, both EU and non-EU based, compete with eachother for long haul travellers with fares via competing hubs, particularly for leisure travellers, often undercutting direct point to point fares. This competitive dynamic may limit the extent to which the costs associated with ETS can be passed on to consumers, particularly in the shorter term;

- network airlines also compete with low fares airlines. Low fares airlines operating the same routes either to the same airports or secondary airports nearby, can constrain the prices that can be charged by a network carrier in certain market segments, particularly for price sensitive passengers. Hence, to understand the extent to which the network carriers can pass on the costs of ETS, the nature of the competition with low fares airlines needs to be taken into account.

The issue of cost pass-through is examined in more depth in Appendix A: Additional considerations on cost pass-through. However, this basic analysis demonstrates that the issue is far from simple and that previous research on the impact of ETS on the aviation sector, including the Commission's Impact Assessment, has failed to adequately consider the characteristics and competitive dynamics in the market place when assuming that costs will simply be passed wholly to consumers. In reality, there are considerable barriers for network airlines in seeking to pass on these costs.

Low Fares Airlines

The defining characteristic of the low fares airline sector is the stripping out of all non-essential costs, thereby allowing them to offer consumers the lowest possible fares. These airlines seek to maximize revenue using complex yield management systems based on attaining a target load factor against a booking profile up to the date of flight departure. Fares will be adjusted upwards if bookings are ahead of target or downwards if bookings are below target as the airline seeks to extract the maximum revenue from the flight. These carriers also have a strong focus on the sale of ancillary services to passengers. Such revenues are an important element in the profitability of this segment.

The markets served by low fares airlines tend to be far more price sensitive than those served by network carriers, particularly for services to secondary airports or those not attached to pre-existing high density markets. In recent years, these carriers have effectively created new markets through offering prices which would previously not have been possible. In this context, the ability to pass through the additional costs associated with ETS will depend on the price elasticity of demand in the market, and it is far from clear whether these costs can be passed on to consumers without constraining the growth in demand these carriers depend on.

To the extent that costs cannot be passed on, or where the effect of costs being passed on results in a loss of passengers, it is likely that more marginal services will be withdrawn. These supply side effects will compound the impact of ETS and may be felt more strongly in the less mature markets of the new member states. It should also be noted that low fares airlines are perhaps quicker to react to such changes in the market. Without the wider network or alliance considerations of some of the other carriers, decisions regarding route viability are clearer cut and consequently unprofitable services survive for less time. Hence, these supply side effects may appear more rapidly.

Regional Airlines

Regional airlines offer a variety of different services including point to point, hub feed, charter and public service obligation routes and cargo/mail services.

Regional airlines typically operate smaller aircraft than those network carriers or low fares airlines, typically of less than 100 seats (average across the fleet is 68 seats). Regional airlines also fly shorter sector lengths, 550 km on average. These may be shorter than those operated by network carriers but less distinct from the sector lengths operated mainly by the low fares airlines, which focus on short haul markets.

Although the distinctions are becoming blurred, what tends to distinguish regional airlines from low fares airlines is greater emphasis on meeting inter-regional business travel needs and high frequencies of service with smaller aircraft, as distinct from low frequencies of service and higher capacity aircraft more suited to leisure markets, like those commonly operated by low fares airlines. 50% of regional airline passengers travel for business purposes, which is a significantly higher proportion than would be found on low fares airlines.

Regional airlines themselves can operate either full service models, similar to those of the network carriers, or models closer to the low fare model. To that extent, the impact of ETS will vary depend on the price elasticity of demand in the market being served and the nature of competition. A further factor, particularly for the regional airline sector, is competition with rail where short haul air services are operated in competition with rail transport. Users trade off price and time in making modal choices. This additional competitive constraint may make it more difficult for regional airlines to pass through the costs of ETS where the primary competition is with surface modes.

Some regional air services are covered by public service obligations (PSOs). In these cases, airlines are generally remunerated for costs incurred against a guaranteed fare and service level to consumers. PSO routes are awarded to airlines after a competitive tendering process. As governments generally accept the lowest bid, airlines that can meet the PSO within their existing ETS allowance would be at a competitive advantage in wining the tender.

Charter Airlines

Leisure airlines, to the extent that they remain a distinct market segment for intra-EU travel, operate to meet the requirements of tour operators or charters, who sell the seats as part of a broader travel package, often including accommodation.

Leisure air services are characterised by the charterer or the tour operator paying the the full operating costs, plus a profit margin, for the whole aircraft for the journey concerned. This will influence the extent to which the costs of ETS can be passed on to charterers, particularly considering the increasing interaction within the market place with low fares airlines and the growth of ‘seat only’ sales by leisure airlines.

Increasingly, the distinction between scheduled and charter services is becoming blurred within the EU, with many former charter services selling seats direct to the public or offering services on a low fares scheduled basis. There is intense competition between charter services and low fares scheduled services on many traditional high density leisure routes between northern and southern Europe. This competition will be a factor in the extent to which leisure airlines are able to pass through the costs associated with ETS.

Analysing the Impact of ETS on Passenger Airlines

Clearly, the distinctions between the different segments of the passenger airline market are blurred. To that extent, it is dangerous to generalise in terms of the impact of the ETS on each segment in isolation or across the market as a whole. However, at the same time it is impractical to seek to examine each segment individually.

Therefore, in order to consider the impact of ETS on the passenger airline industry overall, we have concentrated on the impact on the passenger airline segment by reference to the two more extreme market models, the network or 'legacy' carriers and the point-to-point low fares carriers, in order to present a range of impacts.

Making this division is largely a matter of judgement as there are no precise definitions. However, based on information in the AEA Yearbook 2006 and on the ELFAA website, we have estimated that in 2005 low fares carriers accounted for around 22% of passenger traffic within Europe[29]. The recent rapid growth of the low fare sector and experience from the United States would suggest that this share of the market will continue to grow strongly in the coming years. We have assumed that low fares carriers will account for around 35% of intra-EU passengers in 2022.

Cargo Airlines

Air cargo is one of the fastest growing segments of the air transport market. In 2005, around 11 million tonnes of air freight was handled within the EU, the large majority (around 80%) being shipped to destinations outside the EU. This breakdown by geographic area is shown in **Figure 9-2**. Based on information in the Airbus Market Outlook for 2006, we estimate that this equates to around 51 bill. RTKs[30].

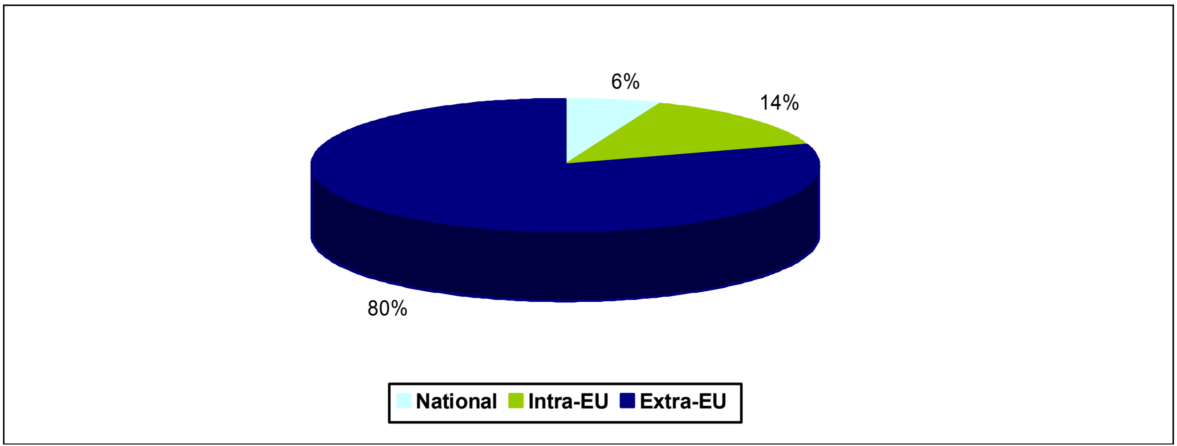

Figure 9-2: EU Air Freight by Geographic Area for 2005
Source: Eurostat.

As with passenger demand, throughput has grown substantially in recent years, fuelled by the increasingly global nature of the world economy. This has engendered a growth in the key drivers of air cargo demand, such as the increasing use of just-in-time production techniques, greater reliance on complex logistics services and the increasing to transport high-value/time sensitive products.

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[29] We recognise that Low Fare Airlines do operate to a small number of destinations outside of the EU. However, we believe that at the broad level of this assessment this impact is likely to be 'de-minimis'.
[30] There is no precise baseline information available for EU RTK. We have therefore estimated this figure based on Airbus's analysis of the Top 20 Freight Markets.

As with passenger airlines, it should be recognised that there is considerable segmentation between cargo airlines within this market:

- a substantial amount of air freight is in fact carried as 'belly-hold' cargo in passenger aircraft;
- dedicated freighter aircraft operate on a point-to-point basis as both scheduled and charter services;
- the express freight industry makes extensive use of air services for time critical deliveries around the world, with the major integrators operating their own large airlines with their own hub and spoke networks.

The impact of ETS will vary across these different segments of the cargo air transport market. For 'bellyhold' cargo, the impact will be absorbed largely within the impact for passenger network or 'legacy' carriers. Dedicated air freighter operations are likely to exhibit characteristics similar to those applying to leisure based non-time sensitive air passengers[31] in terms of the price sensitivity of demand and the extent to which the costs of ETS can be passed through. Express freight operations are more akin to business passenger demand, being particularly time sensitive.

Within the scope of this work, we have not sought to distinguish between these different operating models in making our quantitative assessment of impacts. We do, however, draw a broad brush distinction between express freight activity and more general air freight activity in terms of the impact of ETS.

Business Aviation

The business aviation segment is a specialised area of the air transport market in Europe and one that, again, has been growing rapidly in recent years. Defining the segment is a complex issue and data is limited. For the purposes of this assessment, we have used the definition set out by the European Business Aviation Association:

"Business aviation is that sector of aviation which concerns the operation or use of aircraft by companies for the carriage of passengers and goods as an aid to the conduct of their business, flown for purposes generally considered not for public hire and piloted by individuals having at the minimum a valid commercial pilot licence with an instrument rating."

In 2005, 6.9% of all instrument flight rules (IFR) flights in Europe were made by business aviation. Since 2001, this segment has grown twice as fast as other, with business jet flights demonstrating particularly strong growth (around 8.9% in 2005).

The drivers behind this growth are linked to continued globalisation and trends in the wider air transport industry. Since 9/11, there has been a general perception of greater delays at airports, mostly because of security constraints; growing prosperity has brought this sort of travel within the reach of more companies and individuals; and changing European social perspectives have recognised the value of business aviation.

[31] Accepting that air freight is chosen over surface freight transport in the main due to journey time advantages.

For many multi-sector or time sensitive business trips, particularly those involving more than one person, business aviation may well be a cheaper alternative than conventional business air travel on a scheduled service. As such, to some extent demand may be subject to the same sensitivities to price increases as other business air travel.

A recent study undertaken by Eurocontrol has provided some useful information on the current size of the sector in terms of the number of air transport movements and the growth of the sector in recent years. This trend is shown in **Figure 9-3**.

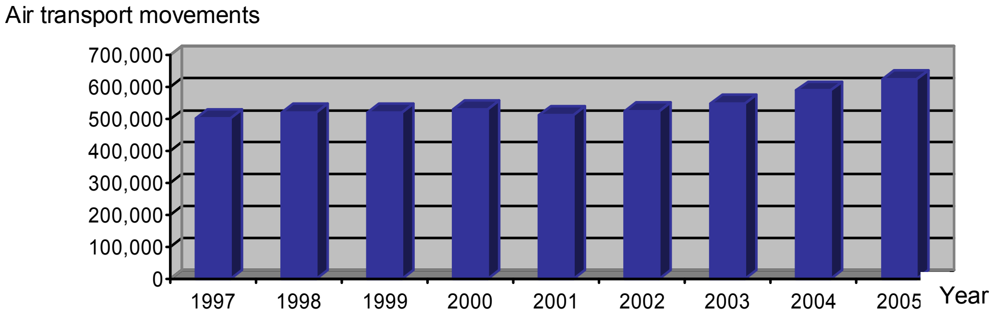

Figure 9-3: Business Aviation Air Transport Movements
Source: Eurocontrol.

We are not aware of any passenger demand or movement forecasts for the business aviation sector, although relevant stakeholders believe that these prospects are strong. Eurocontrol did estimate the potential growth of the business aviation fleet by comparing data from seven published forecasts. It estimated that the European fleet of business aircraft will grow by 4% (±2%) per annum over the next ten years, adding around 1,000 aircraft to the existing 2,000, with the jet fleet increasing at 6.5% (±2.5%) per annum. Based on this growth in the business aviation fleet, we estimate that annual movements will grow from around 630,000 in 2005 to 820,000 in 2012 and on to around 1.2 million by 2022. In general, data coverage of the sector is poor, especially with regard to data on financial performance and demand characteristics; therefore we intend to discuss impacts on this sector on a qualitative basis.

Within this segment, we have also included a further specialist sub-set helicopter operations. Again, there is little hard data available on the operations of this group and consequently we intend to consider the impact on this group through qualitative analysis. However, we are able to provide some basic details on the volume of operations that would be affected by the introduction of the ETS. Based on information received from the European Helicopter Association and Eurocopter, we estimate that there are around 200 helicopters operating within Europe that would be included within the ETS on the basis of their maximum take-off weight. Assuming that the average flight hours per year for these aircraft is around 800 and the average fuel consumption is 500 kg per hour[32], the total fuel consumption amounts to 80,000 tonnes per year. Therefore, the contribution of this sector to emissions is very small.

[32] Data provided by the European Helicopter Association.

Conclusion

In this chapter, we have set out the scope of this assessment in terms of the business segments to be analysed. We have provided a brief profile of each segment and examined some of the competitive issues facing aircraft operators in each case, focussing on particularly the extent to which different business models will be likely to be able to pass through the costs of ETS to consumers. This is an area we discuss in detail in Appendix A: Additional considerations on cost pass-through. However, we have already established that it will not be possible for aircraft operators to simply pass on the costs associated with ETS as has been assumed by many of the previous impact assessments undertaken, including the impact assessment produced by the European Commission.

10 APPENDIX E: CO_2 MARKETS AND AVIATION

CO_2 Spot Market and Futures Market

10.1.1 EU ETS spot market

Figure 10-1 below shows the historical prices of EUAs on the ECX spot market, where 90% of the CO_2 European Union Allowances (EUAs) trading takes place.

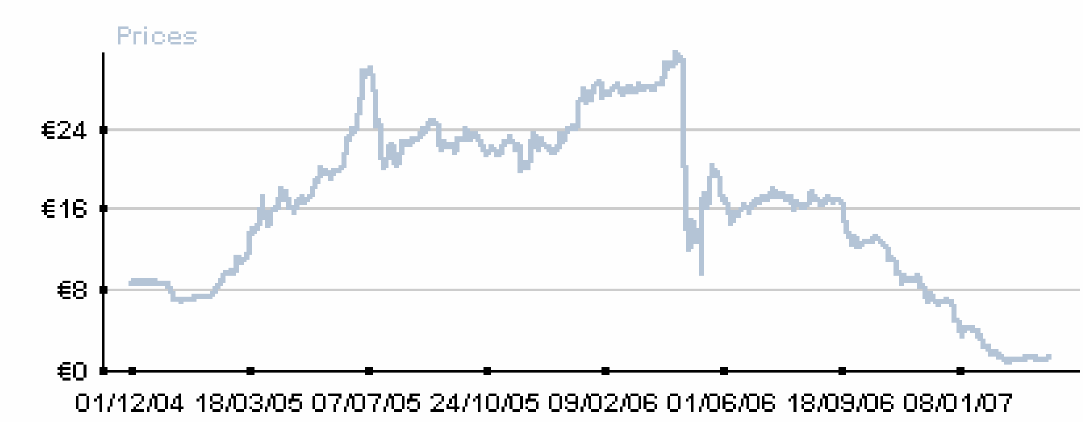

Figure 10-1: EUAs Prices on the ECX Spot Market

10.1.2 EU ETS Futures Market

European CO_2 derivatives markets (for example, ECX and Nord Pool), can provide a first approximation of the CO_2 allowance price available between 2008 and 2012.

Figure 10-2 shows a future CO_2 allowance price on March 29, 2007 of €17.58 /tCO_2 available in 2008 and beyond on the ECX market. The lower price was around €15/tCO_2.

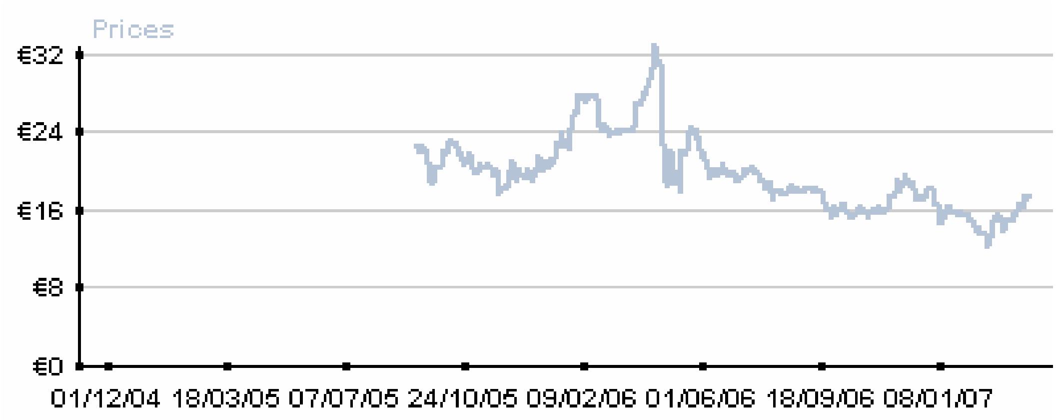

Figure 10-2: EUAs Futures Prices on the ECX Market

Auctioning

Only four countries auctioned a part of their allowances during the trading period 2005-2007.

Table 10-1: Average of Auctions in the NAPs I
Source: Ernst&Young

Country	Total EUAs mill. tCO_2/year	% auctioned	EUAs auctioned (mill. tCO_2/year)
Denmark	33,5	5%	1,7
Hungary	31,6	2,50%	0,8
Ireland	22,3	0,75%	0,2
Lithuania	12,3	1,50%	0,2
Total	**99,7**		**2,8**
Weighted average			2,82%
EU25 Total	**2 151**		**2,8**
EU25 weighted average			0,13%

The table below presents the respective percentage of auctioning in the various NAPs II submitted and validated by the EC on April 1, 2007. Thus, the average of 2.8% represents the limit of auctioning for the aviation sector in 2011 and 2012.

Table 10-2: Average of Auctions in Validated NAPs II
Source: Ernst&Young

Country	Total EUAs mill. tCO_2/year	% auctioned	EUAs auctioned (mill. tCO_2/year)
France	132.8	3.0	3.4
U.K.	246.2	8.0	19.7
Germany	453.1	2.6	12
Austria	32.8	1.2	0.4
Spain	152.3	0	0
Poland	279.6	2.6	0.9
Denmark	24.5	0	0
Total	**1288.5**		**36.4**
Weighted average			2.84 %

Kyoto credits

In addition to the cap and trade system, the Kyoto Protocol proposed two mechanisms: Clean Development Mechanisms (CDM) and Joint Implementation (JI).

The CDM defined in Article 12 of the Kyoto Protocol provides for Annex I Parties (the European Union, Japan, Canada, Russia, etc.) to implement project activities that reduce emissions in non-Annex I Parties, in return for certified emission reductions (CERs). The CERs generated by such project activities can be used by Annex I Parties to help meet their emissions targets under the Kyoto Protocol.

The Protocol provides for Annex I Countries to implement policies and measures jointly with other Parties. In order to build experience and 'learn by doing', COP 1 (Berlin, March/April, 1995) launched a pilot phase of jointly implemented activities under which Annex I Parties may implement projects in other countries that reduce emissions of greenhouse gases or enhance their removal through sinks.

The sponsoring governments will receive Emissions Reduction Units (ERUs) that may be applied to their emissions targets; the recipient nations will gain foreign investment and advanced technology (but not credits toward meeting their own emissions caps).

There are several ways to obtain project-based credits:

- develop a CDM or JI project on one's own;
- contract with a trader or a company specialized in finding CDM or JI projects;
- participate in a carbon fund.

Aircraft operators may have more difficulties to develop CDM/JI projects than other actors already included in EU ETS for the following reasons:

- Emissions abatement opportunities are low in the aviation sector. Activities commonly used for CDM and JI projects development are less linked to the aviation sector than to other sectors where the implementation of such projects is far less expensive. Aircraft operators will not have access to project in their core business when many other actors do.

- Subsidiaries of aircraft operators in an Annex II countries will not have the required size and skills to develop CDM/JI themselves when this in more in line with regular activities of other sectors (cement, energy).

Therefore, if the price of CERs/ERUs is lower than the EUAs price, aircraft operators will be net buyers of those credits once they are validated and issued.

The number of CERs or ERUs that an aircraft operator will be allowed to use to meet its emissions cap is calculated as the product of its emissions cap multiplied by the average percentage of CERs/ERUs allowed in the different National Allocation Plans (NAPs).

According to the different NAPs validated or submitted to the European Commission for the EU ETS 2008-2012, no more than 15% of CDM and JI credits (respectively CERs and ERUs) are expected to enter the European market.

Table 10-3: Level of Kyoto Credits Use in the EU ETS Market for the Second Period 2008-2012
Source: European Commission

Member State	2008-2012 annual allowances (mill. tCO_2)	maximum % of Kyoto credits use	maximum Kyoto credits use (mill. tCO_2)
Germany	453.1	12%	54.4
U.K.	246.2	8%	19.7
Poland	208.5	25%	52.1
Spain	152.3	20%	30.5
France	132.8	14%	17.9
Czech Republic	86.8	33%	28.6
The Netherlands	85.8	10%	8.6
Greece	69.1	9%	6.2
Belgium	58.5	4%-24%	8.2
Slovakia	30.9	7%	2.2
Sweden	22.8	10%	2.3
Ireland	21.2	22%	4.6
Lithuania	8.8	13%	1.1
Latvia	3.3	10%	0.3
Luxembourg	2.7	10%	0.3
Malta	2.1	0%	0.0
Slovenia	8.3	18%	1.5
Italia*	209.0	9%	18.8
Romania*	97.6	10%	9.8
Finland*	39.6	12%-35.4%	9.4
Austria*	30.7	20%	6.6
Portugal*	37.9	10%	3.8
Hungary*	30.8	10%	3.1
Estonia*	24.5	0%	0.0
Denmark*	24.5	19%	4.7
Bulgaria*	56.2	20%	11.2
Cyprus*	7.7	0%	0.0
Total	**2,151.7**		
Weighted average			14.21%
Total Kyoto credits that can be used in the EU ETS annually (mill. tCO_2)			**305.8**

* National Allocation Plans not validated at the beginning of April 2007

According to the UNFCCC, at March 30, 2007, 212 CDM projects had been validated, representing a total of 40.3 mill. CERs issued (1 CER is equivalent to 1 tCO_2).

More than 1,600 CDM projects were being prepared or assessed, representing more than 1,900 mill. tCO_2, 104 were in the process of registering (120 mill. tCO_2) and 573 were registered (790 mill. tCO_2).

Together with the expected ERUs from JI projects, the total amount of Kyoto credits until year-end 2012 would reach 2 000 mill. tCO_2, if all of the projects followed through to completion, which is a very optimistic assumption. Considering other assessments, between 150 mill. tCO_2/year and 300 mill. tCO_2/year could be originated from CDM/JI project development.

The estimated expected demand for CERs and ERUs in 2012 is 900 mill. tCO_2/year, of which:

- European Union: 400 mill. tCO_2/year;
- Japan: 270 mill. tCO_2/year;
- Canada: 200 mill. tCO_2/year.

As supply is inferior to demand, it can be expected that the price of CERs/ERUs will rise to a level that depends on the approach of the countries to 'hot air'.

'Hot air' refers to the gap between reduction targets and actual emissions in former USSR countries. As the target is being calculated on the basis of 1990 emissions and given the economic recession that has taken place since then, these countries will reach their targets without any effort and will be able to trade their residual credits with other countries. The amount of hot air is estimated to be 1,000 mill. tCO_2/year.

Table 10-4 below shows the variation of Kyoto credits supply depending on the levels of hot air and CERs/ERUs produced. The second part presents the difference between supply and demand in the EU ETS with the same assumptions.

Table 10-4: Supply and Demand of CERs/ERUs in Different Cases (Scenarios)
Source: Ernst & Young.

Projected supply of Kyoto credits (mill. tCO_2/year)	**Low level of CERs/ERUs: 150 mill. tCO_2/year**	**Intermediate level of CERs/ERUs: 225 mill. tCO_2/year**	**High level of CERs/ERUs: 300 mill. tCO_2/year**
0% of hot air entering the market	150	225	300
50% of hot air entering the market	650	725	800
100% of hot air entering the market	1,150	1,225	1,300

Kyoto credits missing (mill. tCO_2/year)	**Low level of CERs/ERUs: 150 mill. tCO_2/year**	**Intermediate level of CERs/ERUs: 225 mill. tCO_2/year**	**High level of CERs/ERUs: 300 mill. tCO_2/year**
0% of hot air entering the market	750	675	600
50% of hot air entering the market	250	175	100
100% of hot air entering the market	-250	-325	-400

According to our experience in developing and financing CDM projects, the current price of CERs is between €8/tCO_2 and €12/tCO_2, depending on the probability of issuance. Most of the countries have declared their intention not to use 'hot air' to reach their reduction targets. If this is respected, the price of CERs/ERUs may rise.

The future of CDM and JI mechanisms after 2012 is uncertain, as no decision has been taken regarding the continuation of the Kyoto Protocol.

Fuel switching

During the first trading period (2005-2007), 56% of allocations in Europe were distributed to the energy sector. In Germany three companies in the electricity sector received 46% of the allowances (229 mill. tCO_2/year). In Italy, Spain, France and the UK, 16 companies in the electricity sector totalled 65.6 mill. tCO_2/year of allowances. One of the approaches for reaching the emissions targets of these major contributors is to switch a part of their activities from coal to fuel and gas burning.

This opportunity is measured by the difference between the Clean Dark Spread (CDS) and the Clean Spark Spread (CSS). The Dark spread (€/MWh) is the difference between the selling price of the electricity at peak hours and the price of the coal used to produce that electricity. CDS also takes into account the price of CO_2 emitted to generate the electricity. The CSS represents the same information for gas. Comparing CDS and CSS shows which type of production is more profitable.

The Figure 10-3 below shows the evolution of the difference between CDS and CSS in the UK in 2005 and 2006.

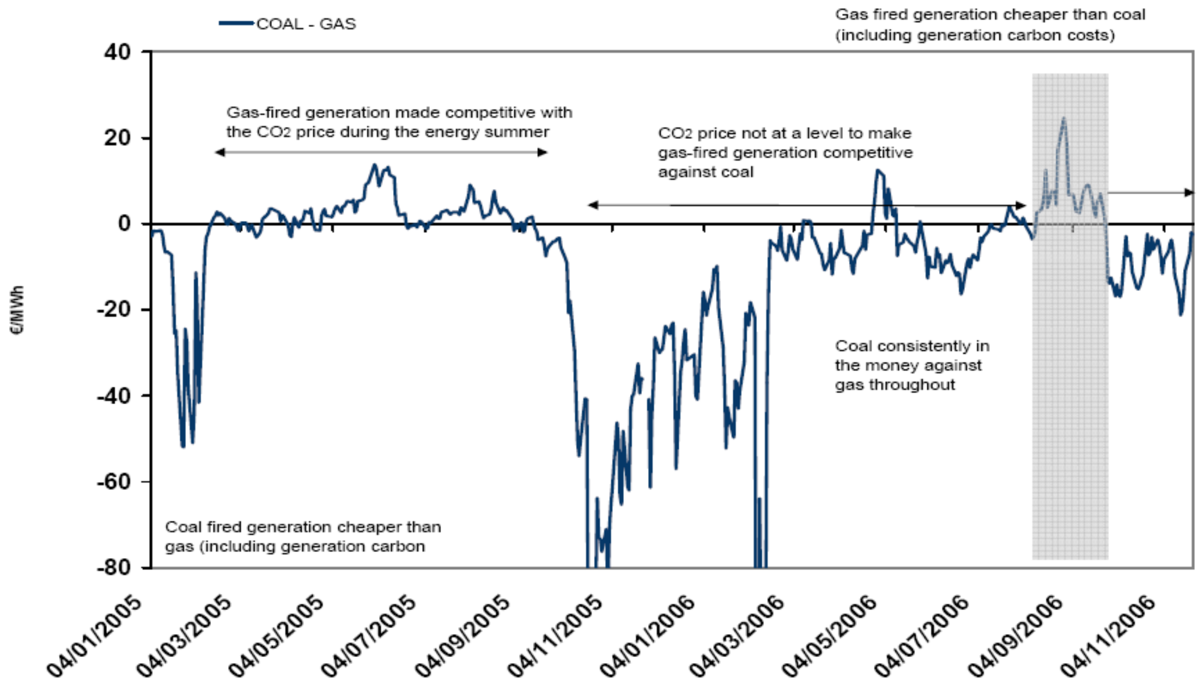

Figure 10-3: Switching Potential in the UK, 2005-2006
Source: PointCarbon

For example, in July 2005, it was more profitable for power generation companies to use their gas-fired plants than their coal fired ones.

This indicator is monitored on a day-to day basis in order to manage the production of electricity. But it can also influence decisions on investments in future plants. In reality, as the emission factor for gas is approximately half that of coal, a high EUAs price can make gas-fired plants more profitable than coal-fired ones.

That price (combined with the difference in prices between coal and gas) will be the higher acceptable limit for power generation companies to go on the market. Above this limit, they would switch their energy mix, at the same time decreasing the demand for EUAs. However, in many cases, important investment may be needed to allow this switch.

11 APPENDIX F: RESULTS OF SENSITIVITY TESTING

In this Appendix, we present the results of two key sensitivity tests that have been undertaken in relation to the Impact Assessment. The purpose of these tests was to examine the impact of varying certain core assumptions made as part of this assessment and to examine whether these could significantly alter the conclusions drawn.

The two tests undertaken focussed on:

- the Price Elasticity of Demand Assumptions – while the literature relating to the price elasticity of demand is extensive, we tested the sensitivity of the models developed to our assumptions by reducing each of the assumed elasticities by 0.1;
- the Rate of Cost Pass-through – a key message from this impact assessment is that it will simply not be possible for airlines to simply pass on all the costs of ETS to consumers and we have identified a series of theoretical models that demonstrate the likely extent of cost pass-through by segment. However, again we felt it would be prudent to assess the overall sensitivity of the models to our assumptions. To do this, we have increased the fixed cost of ETS by 10% in each case, reducing the rate of cost pass-through.

Below, we have set out the results of these tests for the period 2011 to 2022:

- passenger and cargo demand;
- the financial impact on airlines;
- the impact on consumer surplus;
- the impact on employment and GVA.

Our assessment of the results is that, while these assumptions obviously do alter the results of the impact assessment to a small degree, the core assumptions presented within the main body of the report represent the most appropriate basis for assessing the impact of the extension of the EU ETS, particularly in the longer term.

The impact of the price elasticity sensitivity test illustrates that the assumption that has the greater impact is the allowance price. Of course, the other assumptions may be discussed and adjusted, but we have illustrated that this would not lead to dramatic changes in the assessment of the financial impact for airlines. This test reduces the impact on demand marginally but there seems to be no reason to suggest that these assumptions provide a more accurate picture of the impact of ETS or that this substantially alters the overall result. The impacts on consumer surplus, employment and GVA reflect this impact on demand. With demand reduced marginally less, the loss of consumer surplus is marginally higher, as more passengers remain to pay higher prices, and the financial impact for airlines is still higher since a large part of the cost is not passed on customers

Table 11-1: Passenger and Cargo Demand Sensitivity Results

Passengers (mill.)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Business as Usual	**905**	**943**	**983**	**1,024**	**1,067**	**1,112**	**1,159**	**1,208**	**1,260**	**1,313**	**1,369**	**1,428**
Low Allowance Cost	903	941	981	1,023	1,066	1,111	1,157	1,206	1,257	1,311	1,367	1,425
Elasticity Sensitivity	903	941	982	1,023	1,066	1,111	1,158	1,206	1,258	1,311	1,367	1,425
Cost Pass Through Sensitivity	904	941	982	1,023	1,066	1,111	1,158	1,207	1,258	1,311	1,367	1,425
High Allowance Cost	902	938	977	1,018	1,060	1,104	1,151	1,199	1,249	1,302	1,357	1,415
Elasticity Sensitivity	902	939	977	1,018	1,061	1,105	1,151	1,200	1,250	1,303	1,358	1,416
Cost Pass Through Sensitivity	903	939	978	1,019	1,061	1,106	1,152	1,200	1,251	1,304	1,359	1,417
Extreme	899	933	972	1,011	1,053	1,096	1,142	1,189	1,239	1,291	1,345	1,402
Elasticity Sensitivity	900	934	972	1,012	1,054	1,098	1,143	1,191	1,241	1,293	1,347	1,404
Cost Pass Through Sensitivity	900	935	973	1,013	1,055	1,099	1,145	1,192	1,242	1,295	1,349	1,406

Cargo Tonnes (mill.)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Business as Usual	**15.17**	**16.02**	**16.92**	**17.86**	**18.86**	**19.92**	**21.03**	**22.21**	**23.45**	**24.76**	**26.15**	**27.61**
Low Allowance Cost	15.16	15.95	16.88	17.82	18.82	19.87	20.97	22.14	23.38	24.69	26.07	27.52
Elasticity Sensitivity	15.16	15.95	16.89	17.83	18.82	19.87	20.98	22.15	23.39	24.69	26.07	27.53
Cost Pass Through Sensitivity	15.16	15.96	16.89	17.83	18.82	19.87	20.98	22.15	23.39	24.70	26.08	27.53
High Allowance Cost	15.15	15.87	16.74	17.66	18.63	19.66	20.75	21.90	23.11	24.39	25.75	27.18
Elasticity Sensitivity	15.15	15.88	16.75	17.67	18.65	19.68	20.77	21.92	23.13	24.42	25.78	27.21
Cost Pass Through Sensitivity	15.15	15.89	16.76	17.69	18.66	19.70	20.79	21.94	23.16	24.44	25.80	27.24
Extreme	15.12	15.71	16.56	17.46	18.40	19.41	20.47	21.59	22.77	24.03	25.35	26.76
Elasticity Sensitivity	15.13	15.74	16.59	17.48	18.44	19.44	20.50	21.63	22.82	24.08	25.41	26.81
Cost Pass Through Sensitivity	15.13	15.76	16.61	17.51	18.47	19.47	20.54	21.67	22.86	24.12	25.46	26.87

In the following tables, we present the sensitivity analysis to various assumptions. The figures in the following tables represent the change in cumulative loss of margin of the airlines over the period 2011-2022.

Table 11-2: Loss of Profit Margin Sensitive Results with a Low Price of Allowance (€ 6-15t/CO_2)

Network airlines	Central assumption		Lower assumptions		Higher assumptions	
In mill. of €	Assumption	Loss of margin	Assumption	Loss of margin	Assumption	Loss of margin
Profit margin (%)	4%	23,769	1%	23,662	7%	23,876
Fixed cost rate	60%	23,769	50%	22,911	70%	24,627
ETS fixed cost rate	25%	23,769	15%	23,370	35%	24,173
Oligopoly (3) routes	standard	23,769	+10%	23,666	-10%	23,873
Price elasticity	standard	23,769	-0.1	23,281	+0.1	24,257
Allowance cost	€ 30	23,769	€ 15	5,164	€ 60	46,969

Cargo airlines	Central assumption		Lower assumptions		Higher assumptions	
In mill. of €	Assumption	Loss of margin	Assumption	Loss of margin	Assumption	Loss of margin
Profit margin (%)	4%	11,624	1%	11,557	7%	11,691
Fixed cost rate	60%	11,624	50%	11,086	70%	12,162
ETS fixed cost rate	25%	11,624	15%	11,564	35%	11,688
Oligopoly (3) routes	standard	11,624	+10%	11,619	-10%	11,629
Price elasticity	standard	11,624	-0.1	11,407	+0.1	11,841
Allowance cost	€ 30	11,624	€ 15	2,971	€ 60	22,775

Low Fares airlines	Central assumption		Lower assumptions		Higher assumptions	
In mill. of €	Assumption	Loss of margin	Assumption	Loss of margin	Assumption	Loss of margin
Profit margin (%)	4%	5,120	1%	5,086	7%	5,154
Fixed cost rate	60%	5,120	50%	4,927	70%	5,313
ETS fixed cost rate	25%	5,120	15%	5,146	35%	5,097
Oligopoly (3) routes	standard	5,120	+10%	5,136	-10%	5,104
Price elasticity	standard	5,120	-0.1	5,014	+0.1	5,226
Allowance cost	€ 30	5,120	€ 15	1,256	€ 60	10,045

The sensitivity analysis show that the most sensitive assumption is the price of the allowance. Other assumptions do not lead to dramatic impacts on the loss of profits of airlines.

Table 11-3: Impact on Consumer Surplus

€mill.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Low Allowance Cost (€)	56	398	184	210	235	261	288	314	342	369	398	426
Elasticity Sensitivity (€)	56	398	185	210	235	261	288	314	342	370	398	426
Cost Pass Through Sensitivity (€)	47	344	159	181	203	225	248	271	295	319	343	367
High Allowance Cost (€)	124	876	997	1,121	1,246	1,374	1,504	1,636	1,771	1,907	2,046	2,187
Elasticity Sensitivity (€)	124	877	998	1,121	1,247	1,375	1,505	1,637	1,772	1,909	2,047	2,188
Cost Pass Through Sensitivity (€)	104	756	861	968	1,076	1,186	1,299	1,413	1,529	1,646	1,766	1,887
Extreme (€)	220	1,569	1,812	2,059	2,311	2,567	2,828	3,093	3,362	3,636	3,914	4,196
Elasticity Sensitivity (€)	220	1,572	1,815	2,063	2,315	2,571	2,832	3,098	3,367	3,641	3,920	4,203
Cost Pass Through Sensitivity (€)	185	1,356	1,566	1,780	1,998	2,219	2,444	2,673	2,906	3,142	3,382	3,626

Table 11-4: Impact on Employment

Employment (000s)		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Business as Usual	Direct	1,086	1,112	1,138	1,165	1,193	1,221	1,250	1,280	1,311	1,343	1,375	1,409
	Total	3,210	3,286	3,364	3,443	3,525	3,608	3,695	3,783	3,874	3,968	4,064	4,163
Low Allowance Cost	Direct	1,085	1,109	1,137	1,164	1,191	1,219	1,248	1,278	1,309	1,340	1,373	1,406
	Total	3,205	3,277	3,359	3,438	3,519	3,603	3,689	3,777	3,867	3,960	4,056	4,155
Elasticity Sensitivity	Direct	1,085	1,109	1,137	1,164	1,191	1,219	1,248	1,278	1,309	1,340	1,373	1,406
	Total	3,206	3,278	3,360	3,439	3,520	3,603	3,689	3,777	3,868	3,961	4,057	4,155
Cost Pass Through Sensitivity	Direct	1,085	1,109	1,137	1,164	1,191	1,220	1,249	1,278	1,309	1,341	1,373	1,406
	Total	3,206	3,278	3,360	3,439	3,520	3,604	3,689	3,778	3,868	3,962	4,058	4,156
High Allowance Cost	Direct	1,083	1,106	1,131	1,157	1,184	1,212	1,240	1,269	1,299	1,330	1,362	1,395
	Total	3,201	3,267	3,342	3,419	3,498	3,580	3,664	3,750	3,839	3,930	4,024	4,121
Elasticity Sensitivity	Direct	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083	1,083
	Total	3,202	3,269	3,344	3,421	3,500	3,582	3,666	3,753	3,842	3,933	4,027	4,124
Cost Pass Through Sensitivity	Direct	1,084	1,107	1,132	1,158	1,185	1,213	1,242	1,271	1,301	1,332	1,364	1,397
	Total	3,203	3,270	3,346	3,423	3,503	3,584	3,669	3,755	3,844	3,936	4,031	4,128
Extreme	Direct	1,080	1,099	1,124	1,149	1,175	1,202	1,229	1,258	1,287	1,317	1,348	1,380
	Total	3,192	3,249	3,321	3,396	3,472	3,552	3,633	3,717	3,804	3,893	3,985	4,079
Elasticity Sensitivity	Direct	1,081	1,100	1,125	1,150	1,176	1,203	1,231	1,260	1,289	1,319	1,350	1,383
	Total	3,193	3,251	3,324	3,399	3,476	3,556	3,638	3,722	3,809	3,898	3,991	4,085
Cost Pass Through Sensitivity	Direct	1,081	1,101	1,126	1,152	1,178	1,205	1,233	1,261	1,291	1,321	1,353	1,385
	Total	3,195	3,254	3,328	3,403	3,480	3,560	3,643	3,727	3,815	3,904	3,997	4,092

Table 11-5: Impact on Gross Value Added

GVA (€bill.)		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Business as Usual (€)	Direct	80.3	83.8	87.5	91.4	95.4	99.6	104.0	108.7	113.5	118.6	123.9	129.4
	Total	237.2	247.7	258.6	270.0	281.9	294.4	307.4	321.1	335.4	350.4	366.0	382.5
Low Allowance Cost (€)	Direct	80.1	83.6	87.4	91.2	95.3	99.5	103.9	108.5	113.3	118.3	123.6	129.2
	Total	236.8	247.0	258.2	269.6	281.5	293.9	306.9	320.5	334.8	349.7	365.3	381.7
Elasticity Sensitivity (€)	Direct	80.2	83.6	87.4	91.2	95.3	99.5	103.9	108.5	113.3	118.4	123.6	129.2
	Total	236.9	247.0	258.3	269.6	281.5	293.9	306.9	320.6	334.8	349.8	365.4	381.7
Cost Pass Through Sensitivity (€)	Direct	80.2	83.6	87.4	91.3	95.3	99.5	103.9	108.5	113.3	118.4	123.7	129.2
	Total	236.9	247.1	258.3	269.6	281.5	294.0	307.0	320.6	334.9	349.8	365.4	381.8
High Allowance Cost (€)	Direct	80.0	83.3	86.9	90.7	94.7	98.8	103.2	107.7	112.5	117.4	122.7	128.1
	Total	236.5	246.2	256.9	268.1	279.8	292.0	304.9	318.3	332.3	347.0	362.5	378.6
Elasticity Sensitivity (€)	Direct	80.0	83.4	87.0	90.8	94.7	98.9	103.2	107.8	112.5	117.5	122.7	128.2
	Total	236.5	246.4	257.0	268.2	279.9	292.2	305.0	318.5	332.6	347.3	362.7	378.9
Cost Pass Through Sensitivity (€)	Direct	80.1	83.4	87.0	90.8	94.8	99.0	103.3	107.9	112.6	117.6	122.8	128.3
	Total	236.6	246.5	257.2	268.4	280.1	292.4	305.3	318.7	332.8	347.6	363.0	379.2
Extreme (€)	Direct	79.8	82.8	86.4	90.1	94.0	98.0	102.3	106.8	111.4	116.3	121.4	126.8
	Total	235.8	244.8	255.3	266.2	277.7	289.7	302.3	315.5	329.3	343.7	358.9	374.7
Elasticity Sensitivity (€)	Direct	79.8	82.9	86.5	90.2	94.1	98.2	102.4	106.9	111.6	116.5	121.6	127.0
	Total	235.9	245.0	255.5	266.5	278.0	290.1	302.7	315.9	329.7	344.2	359.4	375.3
Cost Pass Through Sensitivity (€)	Direct	79.9	83.0	86.6	90.3	94.2	98.3	102.6	107.1	111.7	116.7	121.8	127.2
	Total	236.1	245.3	255.8	266.8	278.4	290.4	303.1	316.3	330.2	344.8	360.0	375.9

12 NOTES

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13 GLOSSARY

AAU	Assigned Amount Unit
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CO_2 e	Carbon dioxide equivalent
COP	Conference of the Parties
EC	European Commission
ERU	Emission Reduction Unit
ETS	Emissions Trading System
EU ETS	European Union Emissions Trading Scheme
EUA	European Union Allowance
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
JI	Joint Implementation
Mt	Million tonne
NAP	National Allocation Plan
RPK	Revenue Passenger Kilometer
RTK	Revenue Tonne Kilometer
UNFCCC	United Nations Framework Convention on Climate Change
Profit margin	Net profit or loss expressed in percentage of revenue