



Aviation in a sustainable world

Air Transport Emissions Trading Scheme Workshop

Thematic Area: Economics

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Department for Transport, London
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Omega is a one-stop-shop providing impartial world-class academic expertise on the environmental issues facing aviation to the wider aviation sector, Government, NGO's and society as a whole. Its aim is independent knowledge transfer work and innovative solutions for a greener aviation future. Omega's areas of expertise include climate change, local air quality, noise, aircraft systems, aircraft operations, alternative fuels, demand and mitigation policies.

Omega draws together world-class research from nine major UK universities. It is led by Manchester Metropolitan University with Cambridge and Cranfield. Other partners are Leeds, Loughborough, Oxford, Reading, Sheffield and Southampton.

Launched in 2007, Omega is funded by the Higher Education Funding Council for England (HEFCE).

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Our objective is to foresee strategies, policies and processes that are effective in mitigating human-induced climate change. We combine computer modelling with expert knowledge from economics, energy systems, engineering, applied mathematics and environmental science to understand how the transition to a low carbon economy can happen quickly, efficiently and equitably. www.4cmr.org

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Reviewed/checked by	

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Executive Summary

This report summarises a workshop held at the Department for Transport, London, on December 11 2008. The workshop was organised by the Omega partnership and the Cambridge Centre for Climate Change Mitigation Research (4CMR). It was convened to discuss the results of an Omega research project on the economic and environmental impacts of introducing aviation into the European Emissions Trading Scheme (EU ETS), carried out by the Universities of Cambridge (UK), Cranfield (UK) and Maine (USA).

There were 52 attendees at the workshop, including representatives of regulators, the airline industry, NGOs and academic research. In addition to the results of the Omega research, there were presentations on the practical details of introducing aviation into the EU ETS, its legality, the general impacts of aviation on climate change and the prospect of a global emissions trading scheme (GETS).

The Omega study *Air transport in the European Emissions Trading Scheme* employed an econometric model of the European economy known as E3ME, and studied the impact of introducing aviation into the EU ETS up to 2020. The results presented at the workshop can be summarised as follows:

- By 2020, CO₂ emissions from air transport are expected to grow less quickly as a result of the EU ETS. The expected reduction varies according to the allowance price, ranging from less than 1% to 7.4%, for prices between €5 and €40 per tonne of CO₂ respectively. These reductions are relative to the case with no emissions trading in aviation.
- Introducing aviation into the EU ETS is expected to have negligible effects on European GDP and a very small impact on demand for aviation.
- The air transport sector is expected to be a net purchaser of emissions allowances, buying largely from the power sector.
- CO₂ emissions from the wider European economy may increase slightly at lower allowance prices, due to auctioning revenues being recycled into the wider economy.
- A similar emissions reduction to that invoked by high allowance prices could be brought about by high oil prices, without emissions trading in aviation.

Discussions during the day centred on the following points:

- Is technology capable of delivering cuts in carbon emissions up to 7.4% as expected?
- Is it possible or desirable to earmark revenues from emissions allowances auctioned to the aviation industry, to help finance climate change mitigation technologies?
- Is it legal to impose the EU ETS on non-European airlines flying into Europe?

- Will carbon leakage be a problem? Leakage is when carbon emissions increase outside Europe as a result of European climate policy.

There was disagreement amongst delegates on the first three of these points. On the fourth point, panellists and delegates seemed to agree that while carbon leakage is very difficult to measure, it is likely to be small in response to introducing aviation into the EU ETS.

1.0 Introduction

The European Commission has now agreed to bring aviation into the European Union Emissions Trading Scheme (EU ETS) from 2012. Some practical details of how the scheme will work remain to be agreed, and detailed guidelines are due to be published by the European Commission in February 2009.

The EU ETS has been running since 2006. Its purpose is to cap carbon emissions from large industries such as the power industry, and to provide a clear financial incentive to reduce emissions. It requires industry to surrender emission allowances for the emissions of carbon dioxide they produce each year. Allowances are issued or auctioned, up to the cap on total carbon emissions. Companies that emit less than their allocation of emissions can sell their excess allowances on an open market, while those that emit more are able to purchase allowances.

Until now, no transport sector has been included in the EU ETS. Greenhouse gas emissions from the international transport modes of aviation and shipping have been excluded from the international climate change agreement known as the Kyoto Protocol.

Introducing aviation into the EU ETS is seen as a first step towards controlling greenhouse gas emissions from international transport, which are growing faster than emissions from any other sector.

The one-day workshop reported here was organised by the Omega partnership and the Cambridge Centre for Climate Change Mitigation Research (4CMR). It was convened to discuss the results of an Omega research project on the economic and environmental impacts of introducing aviation into the European Emissions Trading Scheme, carried out by the Universities of Cambridge (UK), Cranfield (UK) and Maine (USA).

The workshop brought together policymakers, representatives of the aviation industry, NGOs and academic researchers. There were 52 attendees.

This report summarises the presentations given at the workshop, and the discussions that followed. Since the workshop was held under the Chatham House Rule, none of the speakers are identified.

2.0 Rationale

The workshop served two purposes. Firstly, it was held to present the results of Omega research project 17-AIR ETS: *Air transport in the European Emissions Trading Scheme* to as wide a range of stakeholders as possible. It was timed to coincide with the completion of the research, so delegates had the benefit of early access to the results.

We invited government representatives, NGOs, airline industry representatives, lawyers, carbon investment groups and researchers working on the environmental impacts of aviation.

At present, airlines are engaged in the process of planning for the introduction of aviation into the EU ETS, while the details of the regulation are still being decided. A clear understanding of how effective the policy is and how it is likely to affect the aviation industry and the wider economy is very useful to both airlines and regulators at this time.

A second purpose of the workshop was to provide the opportunity for open conversation between the aviation industry, regulators, campaigners and researchers. Such exchange is crucial in the early days of any climate change policy. It is also helpful to those planning applied research, as it is likely to highlight gaps in knowledge.

The workshop programme was carefully designed to encourage airlines and NGOs to talk with researchers and regulators about the introduction of EU ETS - how the policy is perceived, how it could be improved or introduced more smoothly and where it is expected to be problematic.

To promote open and unhindered discussion, we held the workshop under the Chatham House Rule. This says that speakers will not be identified, although what they say can be reported.

3.0 Outline

The workshop comprised four sessions:

Session 1 - Aviation in the EU ETS – why, when and how?

This session covered the regulatory background and the practical and legal details of introducing aviation into the EU ETS, from national and international perspectives.

Session 2 Results of the Omega project

This session presented the results of the Omega research project.

Session 3 The global perspective

This session provided a broader global view, with presentations about the impacts of aviation emissions on climate change and about the prospect of a global emissions trading scheme.

Session 4 Panel discussion

The panel was made up of representatives from the UK Government, the European Commission, two airlines and an environmental NGO. Discussion was chaired by a representative from a carbon investment company.

4.0 Summary of discussion

4.1 Session one: introducing aviation into the EU-ETS

4.1.1 How aviation fits into European climate policy

The European Union (EU) has objectives to limit temperature change to 2°C and to reduce greenhouse gas (GHG) emissions by 20% by 2020. There is a four pillar approach to controlling aviation's impact on climate change:

- Imposing new standards
- Supporting research into new technologies
- Modernising air traffic management
- Market-based emissions control measures.

The 'Single European Sky' initiative, under the third pillar, is expected to lead to a 10% reduction in fuel use in aviation.



The ETS forms the fourth pillar. It is a way of reducing overall European emissions, whilst allowing the aviation sector to keep growing. All aircraft operators flying into Europe with aircraft > 5.7 tonnes will be included in the scheme. Aviation emissions will be capped at 97% of the 2004-2006 levels in 2012, then at 95% from 2012-2020. 85% of allowances will be free; the remaining 15% of the allocation for each operator will have to be bought in auctions, held in each of the 27 Member States (MSs). There will be a special reserve, equivalent to 3% of all allowances, put aside for new entrants or rapidly expanding carriers.

Each carrier will be administered by one MS. Non-European carriers will be allocated to the MS that receives the greatest emissions from that carrier, and this will remain fixed for the duration of the EU ETS.

The scheme is expected to lead to little or no competition distortion, according to results from the International Civil Aviation Organisation (ICAO)'s model, and a limited increase in ticket price of €40 per ticket on long haul flights by 2020, only €5 per ticket on short haul (this was calculated at an allowance price of €30/tonne CO₂, higher than the current price of €15).

The EC will publish an assessment of 'carbon leakage' caused by this scheme in June 2010. Leakage refers to emission increases outside European borders counteracting the benefits within Europe. In 2014, a review of the impacts of the EU ETS on aviation will be published.

There are concerns around the world that an EU-led trading scheme for aviation may not be the best approach. It has been described as an “aggressive programme of action” by the ICAO Environmental Committee. However, the EC would like aviation to be brought under the UNFCCC (United Nations Framework Convention on Climate Change) and believes that achieving broad international agreement at this stage is a major challenge. It is willing to develop specific bilateral agreements with any third countries that take their own measures to control aviation emissions, such as those being developed in Australia and New Zealand.

4.1.2 How it works in practice

The second speaker stressed that for many countries outside the EU that become involved in the EU ETS through international aviation, it will be their first experience of emissions trading. That is why it is imperative that the scheme is well organised and effective.

The Department for Energy and Climate Change has laid out a timetable of action for air transport operators, leading up to the EU ETS in 2012. The first deadline is June 2009, when operators have to submit a plan of how they will monitor revenue-tonne-kilometres (RTKs) from 2010. Since the allocation of allowances to each carrier is to be decided on the basis of RTKs in 2010, failure to monitor them in an agreed manner will mean airlines will not be allocated any allowances. Operators also have to begin monitoring emissions in 2010 and report them from 2012. Now is the time to start identifying verifiers for emissions monitoring.

In the UK, the scheme is to be administered by the Environment Agency. There is a clear penalty regime, in line with the rest of the EU ETS, for non-compliance.

In response to this presentation, a representative of a European airline expressed anxiety about the lack of information on how the scheme would work, particularly regarding emissions verifiers, and also about the international legality of the scheme. They were advised to speak to their likely national regulator.

There was a discussion about differences in the degree of engagement, and therefore the sanctions that might be imposed for non-compliance, between regulators in different MSs. Some regulators, for example in southern Europe, are not fully ‘on board’ yet, and there is significant outreach work to be done if the scheme is to be coherent across Europe.

4.1.3 Is it legal?

The next speaker highlighted two potential legal issues concerning the way aviation is introduced into the EU ETS.

Firstly, there is an issue about aeroplanes that are on short-term lease (known as wet-leasing). Is the lessee or the lessor responsible for emissions from such planes? This has not yet been clarified.

Secondly, the speaker suggested that non-EU airlines may be motivated to challenge the international legality of the EU ETS itself. He expressed the view that the scheme does not fall foul of the Chicago Convention on International Civil Aviation, because it does not discriminate between operators, it does not directly regulate aeroplane design or construction and it cannot be construed as a charge.

Following the presentation, there was more discussion about how the trading scheme applies to leased planes. This will be clearly defined in the guidelines issued by the EC to accompany the regulation. The lessee will probably be responsible. MSs will vote on the guidelines in February 2009.

One delegate argued that Americans are rightly annoyed if they will have to pay money to the EU for emissions they make flying over American air space.

Not just America, but also Australia, Russia and China think that imposing the EU ETS on non-EU airlines is unacceptable. It is naïve to imagine that America's position will change with a new administration.

The European Commission, however, is clear that introducing aviation into the EU ETS is compatible with international law. No detailed legal analysis has cast serious doubt over this. Third countries may complain about the scheme, but they will probably comply nonetheless.

4.2 Session two: first results from the Omega 'Air Transport in the European Emissions Trading Scheme' project

4.2.1 Methods and assumptions

A computer model of the European economy known as E3ME was used for the research. The model describes the economy as 42 industry sectors, one of which is air transport. It uses real historical data from 1970-2004 to estimate the interactions between different sectors of the economy – how they affect each other. Taking these interactions into account, it estimates the impacts of short and medium term greenhouse gas mitigation policies and predicts future economic changes to 2020.

The E3ME model treats emissions trading as a tax on fossil fuel use. It adds a cost to fuel, based on the carbon content of that fuel. The model has been run with and without aviation being included in the EU ETS, so the economic and environmental effects of including aviation can be analysed.



The study assumes that aviation is included in the EU ETS with 85% of allowances allocated free and 15% auctioned. It assumes that up to 15% of allowances for each airline can be bought from the Kyoto Clean Development Mechanism (CDM). Finally, it assumes that the allowances for aviation are capped at 97% of 2004-2006 levels in the first

year, 95% in the second year, and then diminish at around 2% per year until 2020, as proposed for Phase 3 (2013-2020) of the EU ETS.

For this study, E3ME was run with three allowance price scenarios – allowance prices of €5, €20 and €40 per tonne of CO₂.

4.2.2 Lower CO₂ emissions from air transport

The results showed that with emissions trading, the CO₂ emissions from air transport will be reduced compared to the reference scenario with no aviation emissions trading. However, the reductions will be small. Carbon emissions will be less than 1% lower with an allowance price of €5/tonne. At €20/tonne, CO₂ emissions will be reduced by 3.4% in 2020, and by around 7.4% at €40/tonne.

In 2015, emissions are reduced even further than this with intermediate and high allowance prices, but the model shows emissions rising again, as the economy adjusts to the new policy measures.

The model predicts a very small drop in demand for air travel, less than 1% reduction in 2020 even at the high allowance price.

The air transport sector is able to continue to grow in the model. It becomes a net purchaser of allowances, buying allowances largely from the power sector.

4.2.3 Small impacts on the wider economy

Introducing aviation into the EU ETS is expected to have negligible effects on European GDP.

However, CO₂ emissions from the wider European economy can be expected to increase slightly at lower allowance prices – by 0.2% at €20 per tonne, and 0.1% at €5 per tonne. This effect is a result of auctioning revenues being recycled into the general economy and increasing other economic activities. At the highest allowance price, emissions from the wider economy are reduced, although only by 0.2%.

If auctioning revenues were earmarked for spending on carbon reduction technologies, this effect may not happen.

Overall, the impacts of the EU ETS on the aviation industry are predicted to be small. This is because airlines can purchase allowances from the market, and the costs are passed directly to the consumer.

4.2.4 What about oil prices?

The Omega research used the same model to consider the effect of rising oil prices on CO₂ emissions and economic activity in the aviation sector and the wider economy. Can rising oil prices do the same job as emissions trading, without the effort?

The price of oil rose to record highs last summer (2008), then crashed precipitously when demand fell below supply. However, if new oil discoveries peak and start to fall in the next few years, which looks likely, the supply of oil will be dropping rather than rising in years to come, and the future is one of high oil prices.

Researchers ran the E3ME model with three oil price scenarios – high, medium and low – all of which included the recent price hike to an average of \$95/barrel in 2008. In the high oil price scenario, when the average price of oil remains close to \$100/barrel in 2009, and continues rising at 2.5% per year in line with inflation to 2020, the effect on CO₂ emissions from air transport is very similar to the effect of emissions trading, with a €40 allowance price. By 2020, CO₂ emissions are reduced by around 9% relative to a reference scenario with oil at the 2007 average price of \$60/barrel.

Medium oil prices, in which the price of oil remains more or less constant at today's level to 2020 (rising with inflation only), produce a similar effect to carbon trading at €5 per tonne. Low oil prices, in which the oil price effectively shrinks by rising more slowly than inflation, produce an increase in emissions from air transport of around 3% by 2020, relative to the reference scenario.

This shows that changes in oil price could be as effective as emissions trading at reducing emissions from aviation.

4.2.5 What do airlines think?

Early results from an initial survey of airline attitudes to emissions trading show that they are very concerned about distortion between EU and non-EU operators as a result of the scheme. They are already spending money on environmental improvements, and they think that the best opportunities for environmental improvements lie in engine and airframe manufacture and air traffic management. The survey is also revealing little understanding of the

banking and borrowing of emissions allowances that are possible under the EU ETS.

4.2.6 Discussion

The discussion following this presentation generally welcomed the Omega research and its findings.

4.2.6.1 Is the technology available?

A question was raised about the feasibility of higher than 7% cuts in carbon emissions from air transport by 2020. What technologies will these come from?

Airlines have already been under intense pressure to reduce fuel use, due to rising fuel prices and competition for low ticket prices. It is the European air transport infrastructure, and aircraft and fuel suppliers, which can deliver such cuts. But if the allowance costs are passed directly to consumers, it is not clear that the EU ETS will reach these parts of the industry.

One member of the audience questioned this view, saying that the airlines buy airframes and fuel, so why shouldn't they influence the manufacturers? The answer was that there are hundreds of airlines, but just two aircraft manufacturers, so there is a serious imbalance of power.

It is clear that oil prices already send a strong carbon price signal to airlines. At the moment, there is a huge surge in orders for new, more fuel efficient aircraft. But the signal is not yet strong enough to invoke companies like Airbus, Boeing or Shell to manufacture aviation biofuels, or planes that run on them.

Some abatement options incur very low costs even at low oil prices, but there are lots of options where the oil price is critical to whether they make economic sense or not. It could therefore be very important to supplement the effect of oil price with an additional carbon price through the EU ETS.

4.2.6.2 Airline business models

A representative of low cost airlines pointed out that different air transport markets have different degrees of regulation, and differing abilities to pass on the cost of allowances to consumers.

Another delegate wondered how sensitive the model would be to the proportion of costs passed on.

A member of the panel replied that this model is not the best way to dissect impacts on different sectors within the air transport industry.

4.2.6.3 Use of revenues

An aviation industry representative said it is very interesting to see the effects of emissions trading on the wider economy, and to note that the use of auctioning revenues can undermine the objective of the EU ETS by causing overall CO₂ emissions to rise. The Treasury argues that it cannot 'hypothecate' revenues (i.e. earmark them for a particular source), but can this position be challenged?

4.2.6.4 Leakage

Members of the audience pointed out that the Middle East is the most likely area for carbon leakage due to airlines avoiding the EU ETS. In particular The United Arab Emirates is developing an air transport hub at Abu Dhabi. It is difficult to find hard evidence that leakage is going to be a problem, but it might become more common to fly from New York to Asia via Dubai instead of Europe.

4.3 Session three: a global perspective

4.3.1 The case for global emissions trading

Here the speaker argued that transport policies are ripe for reform, but the European Emissions Trading Scheme may not be the best approach. The EU ETS is provoking conflict, particularly because American airlines object to the scheme.

The speaker advocated a Global Emissions Trading Scheme (GETS), involving international aviation and shipping. This would require global agreement and reform of both the IMO (International Maritime Organization) and the ICAO. Neither international aviation nor shipping is currently covered by the Kyoto Protocol.

One reason for including shipping in emissions trading is that the more potential technologies included in the scheme, the more cost effective the emission reductions are likely to be.

If there is a global, medium term depression, as some are now predicting, the price of allowances in any emissions trading scheme may collapse to near zero and the scheme will become ineffective.

Ministers should consider emergency legislation to tighten the emission reduction targets if the carbon price falls below €10. The announcement of such a plan would probably be enough to raise the carbon price.

After this presentation, a member of the audience asked why just aviation and shipping should be included, when the opportunities for reducing emissions are limited and expensive in both these sectors.

The speaker said he would expect most of the reductions under a GETS to take place in shipping, where there could be some very cheap carbon reductions.

The idea of a global trading scheme was broadly welcomed by airline representatives, although there was some doubt over whether developing countries could be persuaded to take part.

According to one delegate, introducing aviation into the EU ETS was really a response to the US withdrawing from the Kyoto Protocol. Without this international political context, it may have been better to aim for a truly international scheme from the outset.

4.3.2 Non-CO₂ climate impacts of aviation

This speaker explained the latest research on the climate impacts of other greenhouse gases from aviation, particularly oxides of nitrogen (NO_x).



NO_x is the most likely candidate to be included in the EU ETS along with CO₂ in the future. Its effects are more complex. Emissions of NO_x do not have a linear relationship to fuel use, as CO₂ emissions do.

The climate effects of NO_x are indirect, and include both cooling and warming. NO_x emissions from aircraft cause an increase in low level ozone, which causes warming, and a decrease in the amount of methane through two different processes, which have a cooling effect. The balance between these processes is crucial, and differs with cruise altitude.

At higher altitudes, the lifetime of emitted NO_x is longer and it is more efficient at producing ozone, therefore it tends to have a net warming effect.

This understanding raises the question: could the climate impact of aviation be mitigated by changing the cruise altitude? The question is a complex one. Whilst the magnitude of the cooling and warming effects appear to cancel each other out at an altitude of 8.5 km (normal cruise altitude is around 10km), the timescales of the effects are different so it is not as simple as that. A paper on the optimal cruise altitude is expected early next year.

The amount of sunlight also affects the atmospheric chemistry, so the balance of effects is different at different latitudes. The climate impact of increasing

aviation traffic over India and China is much greater than it would be over the US and Europe.

Including NO_x and other climate effects from aviation (contrails, for example) in the EU ETS is difficult, because there is not one metric that accounts for all of them.

The speaker was asked whether he had considered the tradeoff between fuel use and NO_x emissions, since flying at lower altitude increases fuel use. He replied that even if you include CO₂ effects, the current cruise altitude has maximum environmental impact. His research showed that a reduction of cruise altitude would be advisable.

4.4 Session Four: general panel discussion

The panel included representatives from two airlines (one low cost), the European Commission, the UK government and an environmental NGO.

4.4.1 Allocation and auctioning

Both airlines represented on the panel said they were strongly in favour of the EU ETS for aviation, and had advocated that position internationally. However, there was strong disagreement about what the level of auctioning should be.

The environmental NGO representative made a case for full auctioning, where airlines have to purchase 100% of their allowances. The current scheme is favourable to aviation, with a generous cap relative to 2005 levels instead of 1990 levels like other sectors, and low auctioning levels. Yet many governments think aviation should have to pay in full for its external costs.

Airlines, on the other hand, argued there is no environmental justification for high auctioning levels and that the proposed 15% is too high. The Omega study shows that auctioning revenues could prevent the EU ETS from meeting its objective of reducing overall emissions.

In addition, auctioning increases the cost of the ETS scheme to airlines, thus reducing their capacity to invest in mitigation technologies.

Another economist's perspective says that industries should have 100% auctioning by 2020. If you give the allowances free, this is equivalent to a windfall, especially if the companies pass extra costs on to consumers anyway.

The largely free-of-charge allocation for aviation has been done for political reasons, so that aviation's introduction to emissions trading is gentle. However, 100% auctioning is only acceptable if imposed globally. This is why the level has been set at 15% and is likely to stay at that level until 2020 at least.

Even if the 2014 review provides evidence that auctioning costs are not high enough, or too high, changes to the level of auctioning would probably not be implemented until 2020.

4.4.2 Earmarking auctioning revenues

The European Commission originally proposed that auctioning revenues be earmarked for climate change mitigation – to be spent, for example, on projects in developing countries or invested in aeronautical research. However, this proposal was rejected by the European Council as contrary to the constitution. The agreed legislation states that revenues *should be* used for climate change mitigation, where it previously said *shall be...*

Is there any political commitment to earmarking? The UK Government (Treasury) position is against hypothecation, favouring the view that the most efficient way to allocate public funds is to keep them all in one pot.

Earmarking revenues from the EU ETS could be interpreted as sector subsidy which would be politically problematic.

4.4.3 Mitigation technology

How big are the barriers to rolling out new technology in aviation? It would clearly be very expensive, if not impossible, to develop zero emissions aircraft. This, said one panel member, is why we need emissions trading, so that mitigation can be paid for in sectors where it is cheaper.

According to one scientist, engineers will tell you it is possible to get a 60% reduction in the quantity of CO₂ emissions per passenger with current technologies. Technologies such as open rotor engines have been around for more than 20 years, but there is a cost to developing these technologies commercially.

Perhaps the way forward is to look for a niche market in high cost, long distance, low carbon transport, amongst consumers who place a high priority on carbon emissions.

An EC forecast found that achieving a 20% reduction in greenhouse gas emissions would require an allowance price of €39 per tonne. Since everyone wants a higher than 20% reduction by 2020, the level of the allowance price becomes a priority.

One opinion from within the British Government is that using auctioning revenues to support research into implementing the technologies should be a priority.

But this was countered by an alternative view, also from within the British Government, that the purpose of the ETS is to let the market find the most cost effective abatement, *not* to fund expensive technologies.

Summing up, the panel agreed that introducing aviation into the EU ETS was a good first step, but that it should be seen as a move towards a broader global scheme for international transport, including as many sectors as possible.

However, a couple of panellists felt that the political will was still lacking for this kind of progress, and that the outcomes from the forthcoming UNFCCC negotiations were likely to be weak.

5.0 Conclusion

The workshop was considered to be successful in conveying the results of the Omega study and exposing issues that would affect future ETS policy and implementation. The feedback we received was entirely positive. Discussions on the day were lively, both during sessions and in the breaks. We felt that the combination of people brought together by this event was unique and the day was extremely valuable to all concerned.

Following the workshop, speaker presentations have been made available on-line, and the Omega report will be published on-line.

More details of the workshop, including downloads of the presentations, are available at:

<http://www.omega.mmu.ac.uk/air-transport-emissions-trading-scheme-workshop.htm>

Appendix 1: Workshop Programme

- 09:00 Coffee and registration
- 09:30 **SESSION 1 Aviation in the EU ETS – why, when and how?**
Welcome and introduction Roger Gardner, Omega, UK
Chair: Dr Jonathan Köhler, Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, Germany
- 09:40 Keynote speech: **Extending the EU Emissions Trading Scheme to aviation**
David Batchelor, Directorate General Energy and Transport, European Commission
- 10:10 **Emissions trading – a Member State view**
Dr Philip Andrews, Department for Energy and Climate Change, UK
- 10:40 **Legal aspects of including aviation in the EU ETS**
Andrew Waite, Berwin Leighton Paisner, UK
- 11:10 Tea
- SESSION 2 Results of the Omega project**
Chair: Jeff Gazzard, Aviation Environment Federation, UK
- 11:30 **Economic and environmental impacts of including air transport in the EU ETS**
Annela Anger, 4CMR, University of Cambridge, UK; Professor Peter Allen, University of Cranfield, UK
- Discussant: Dr Brian Pearce, International Air Transport Association (IATA)
- 13:00 Lunch
- SESSION 3 The global perspective**
Chair: Dr Andreas Schäfer, Institute for Aviation and the Environment, University of Cambridge, UK
- 14:30 **Including aviation in the EU ETS versus a global trading scheme for international transport**
Dr Terry Barker, 4CMR, University of Cambridge, UK
- 15:00 **Global climate impacts from air transport**
Dr Marcus Koehler, King's College London, UK
- 15:30 **Tea**
- 16:00 **SESSION 4 Panel discussion**
Chair: Alexander Sarac, EcoSecurities, UK
- Andy Kershaw, British Airways
Danny Jowers, Department for Transport
Chris Essex, easyJet
Tim Johnson, Aviation Environment Federation
- 17:20 **Concluding remarks**
Dr Jonathan Köhler, Fraunhofer Institute for System and Innovation Research, Germany
- 17:30 Drinks reception

Appendix 2: Delegates List

Title	Name	Surname	Organisation
Professor	Peter	Allen	Cranfield University
Dr	Philip	Andrews	Department for Energy and Climate Change
Ms	Annela	Anger-Kraavi	4CMR, University of Cambridge
Dr	Terry	Barker	4CMR, University of Cambridge
Mr	David	Batchelor	European Commission
Mr	Illimar	Bilas	BMVBS
Ms	Debbie	Bryce	Aviation Environment Federation
Mr	David	Coulborn	Environment Agency
Mr	John	Collins	Department for Transport
Mr	Ben	Combes	Committee on Climate Change Secretariat
Ms	Mairead	Curran	4CMR, University of Cambridge
Dr	Olivier	Dessens	University of Cambridge
Dr	Lynnette	Dray	University of Cambridge
Dr	Lynn	Dicks	4CMR, University of Cambridge
Mr	Chris	Essex	easyJet
Ms	Theresa	Francis	DHL Aviation (UK) Ltd
Mr	Roger	Gardner	Omega
Mr	Jeff	Gazzard	Aviation Environment Federation
Mrs	Cathy	Goss	4CMR, University of Cambridge
Mr	Matthew	Griffin	Department for Transport
Mr	Jerome	Hilaire	CATE, MMU
Ms	Kati	Ihamaki	Finnair Plc
Mr	Tim	Johnson	Aviation Environment Federation
Mr	Danny	Jowers	Department for Transport
Mr	Andy	Kershaw	British Airways
Dr	Ferdinand	Koch	Cargo-Partner GmbH
Dr	Marcus	Koehler	Kings College, London
Dr	Jonathan	Köhler	Franhofer Institute for Systems and Innovation Research (ISI)
Ms	Marilyn	Larden	Sustainable Travel International
Mrs	Anna	Mahoney	Strategic Aviation Special Interest Group
Mr	Michael	Mann	Mann Economic Consulting Limited
Dr	Frankie	O'Connell	Cranfield University
Dr	Brian	Pearce	International Air Transport Association
Miss	Holly	Preston	Centre for Air Transport and the Environment
Professor	Dave	Raper	CATE / Omega
Mr	Tadeusz	Rewlewski	Polish Civil Aviation Office
Mr	Alexander	Sarac	EcoSecurities
Dr	Andreas	Schäfer	University of Cambridge
Dr	Serban	Scrieci	4CMR, University of Cambridge
Mr	Philip	Shearmar	City University
Ms	Diane	Simiu	ICF International
Mr	Ben	Smith	Department for Transport

Title	Name	Surname	Organisation
Mrs	Heidi	Smith	Department for Transport
Mr	Robert	Stevens	JP Morgan ClimateCare
Mr	Peter	Swann	Rolls-Royce plc
Mr	Tom	van Lier	Free University of Brussels (VUB)
Mr	Andrew	Waite	Berwin Leighton Paisner
Miss	Fiona	Wilford	Department for Transport
Ms	Emily	Woods	4CMR, University of Cambridge

Appendix 3: Feedback Form

To help us in planning future events, we would be grateful if you could fill in this form, and either hand it in at the registration desk or post it to:

Dr Lynn Dicks
4CMR, Department of Land Economy
19 Silver Street, Cambridge. CB3 9EP.

Your name _____

How did you find out about this workshop? _____

Please score as follows:

- 1 = excellent
- 2 = good
- 3 = fair
- 4 = poor

	Score
1 - Organisation	
Information provided beforehand	
Arrival at the venue	
2 - Facilities	
Conference room	
Food	
Other facilities (toilets, accessibility)	

3 - Did you find the content of the workshop interesting? YES / NO

4 - In your view, were the important issues adequately covered? YES / NO

5 - Were you given enough opportunity to contribute your own views? YES / NO

Any other comments?