Department for Transport

UK STATE ACTION PLAN

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1. Contact and Background Information

Contact Information

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Introduction

a) The UK is a member of the European Union and of the European Civil Aviation Conference (ECAC). ECAC is an intergovernmental organisation covering the widest grouping of Member States[1] of any European organisation dealing with civil aviation. It is currently composed of 44 Member States, and was created in 1955.

b) ECAC States share the view that environmental concerns represent a potential constraint on the future development of the international aviation sector, and together they fully support ICAO's ongoing efforts to address the full range of these concerns, including the key strategic challenge posed by climate change, for the sustainable development of international air transport.

c) The UK, like all of ECAC's forty-four States, is fully committed to and involved in the fight against climate change, and works towards a resource-efficient, competitive and sustainable multimodal transport system.

d) The UK recognises the value of each State preparing and submitting to ICAO a State Action Plan on emissions reductions, as an important step towards the

1 Albania, Armenia, Austria, Azerbaijan, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, The former Yugoslav Republic of Macedonia, Turkey, Ukraine, and the United Kingdom

achievement of the global collective goals agreed at the 37th Session of the ICAO Assembly in 2010.

e) In that context, all ECAC States will be submitting to ICAO an Action Plan[2], regardless of whether or not the 1% de minimis threshold is met, thus going beyond the agreement of ICAO Assembly Resolution A/37-19. This is the Action Plan of the UK.

f) The UK shares the view of all ECAC States that a comprehensive approach to reducing aviation emissions is necessary, and that this should include:

   i. Emission reductions at source, including European support to CAEP work

   ii. Research and development on emission reductions technologies, including public-private partnerships

   iii. The development and deployment of low-carbon sustainable alternative fuels, including research and operational initiatives undertaken jointly with stakeholders

   iv. The optimisation and improvement of Air Traffic Management, and infrastructure use within Europe, in particular through the Single European Sky ATM Research (SESAR), and also beyond European borders, through the Atlantic Initiative for the Reduction of Emissions (AIRE) in cooperation with the US FAA.

   v. Market-based measures, such as open emission trading schemes (ETS), which allow the sector to continue to grow in a sustainable and efficient manner, recognising that the measures at (i) to (iv) above cannot, even in aggregate, deliver in time the emissions reductions necessary to meet the global goal. This growth becomes possible through the purchase under an ETS of CO2 allowances from other sectors of the economy, where abatement costs are lower than within the aviation sector.

g) In Europe, many of the actions which are undertaken within the framework of this comprehensive approach are in practice taken at a supra-national level. They are reported in Section 1 of this Action Plan, where UK involvement in them is described, as well as that of stakeholders.

h) In the UK a number of actions are undertaken at the national level, including by stakeholders, in addition to those of a supra-national nature. These national actions are reported in Section 2 of this Plan.

i) In relation to actions which are taken at a supranational level, it is important to note that:

   i. The extent of participation will vary from one State and another, reflecting the priorities and circumstances of each State (economic situation, size of its aviation market, historical and institutional context, such as EU/ non EU). The ECAC States are thus involved to different degrees and on different timelines in the delivery of these common actions. When an additional State joins a collective action, including at a later stage, this

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2 ICAO Assembly Resolution A37-19 also encourages States to submit an annual reporting on international aviation CO2 emissions. This is considered by Europe an important task, but one which is different in nature and purpose to the Action Plans, which are strategic in their nature. For that reason, the reporting to ICAO on international aviation CO2 emissions referred to at paragraph 9 of ICAO Resolution A37/19 is not part of this Action Plan, nor of those submitted by other Member States of ECAC. This information will be provided to ICAO separately.

broadens the effect of the measure, thus increasing the European contribution to meeting the global goals.

ii. Nonetheless, acting together, the ECAC States have undertaken to reduce the region's emissions through a comprehensive approach which uses each of the pillars of that approach. Some of the component measures, although implemented by some but not all of ECAC's 44 States, nonetheless yield emission reduction benefits across the whole of the region (thus for example research, ETS).

2. Current State of Aviation in the UK

Background on UK Policy on Aviation and Climate Change

As an island state the UK has historically been a leader in the aviation sector. The UK has been keen to drive international action on climate change across all sectors and there is a growing public expectation that sustainable growth is incorporated into all growth models, including aviation. The UK Government and its officials carry out analysis and research to the highest quality to inform its policy.

State of UK aviation

The aviation sector is invaluable as a mean of accessing the UK as shown in the table below.

Table 1: International Passenger Survey, 2010

2010	Foreign Residents: Visits to the United Kingdom	UK Residents: Visits abroad (in thousands)
Air	21,430	43,239
Sea	4,531	8,056
Tunnel	3,842	4,267
Total	**29,803**	**55,562**

In terms of travel, in 2010 overseas residents made around 30 million visits to the UK in 2010[3] and over 670,000 flights left the UK[4]. Air travel remains the preferred means of transport for the tourism industry and in 2010 72% of foreign residents visiting the UK travelled by air and 78% of UK residents travelled abroad[5]. Approximately 44% of the British public used air travel as a means of travel[6] .

The air transport sector's turnover is around £26 billion and the sector directly generates around £9 billion of economic output. It provides about 120,000 jobs in the and supports many more indirectly[7].

Goods worth £115 billion are shipped by air freight between the UK and non-EU countries representing 35 per cent of the UK's extra-EU trade by value[8].

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3 International Passenger Survey 2010, Office for National Statistics

4 Civil Aviation Authority airport statistics http://www.caa.co.uk/default.aspx?catid=80&pagetype=90

5 International Passenger Survey 2010, Office for National Statistics

6 National Travel Survey, 2010 http://www.dft.gov.uk/statistics/tables/nts0316/

7 Turnover, economic output (GVA) and employment figures are from Annual Business Survey, ONS, 2009, http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-249520, Section H: Transport and Storage, adding SIC 51 (air transport) and SIC 52.23 (service activities incidental to air transportation). 'Air transport' covers a wide range of activities including passenger scheduled, charter, taxi, helicopter, pleasure and sightseeing flights and freight transport. 'Service activities incidental to air transportation' includes airport, airfield and ground services and air traffic control activities. These estimates do not cover a variety of other sectors related to air transport including the manufacture, repair and maintenance of aircraft, the construction of airports and runways, cargo handling and warehousing. This is because data is not disaggregated to a level that it is usable when referring to air transportation. Secondly, these estimates do not include the activity of firms that constitute the air transport supply-chain where those activities are captured in other SIC codes (i.e. the indirect contribution of the aviation industry).

UK Airports

The top ten commercial airports in terms of passenger numbers are provided in the table below.

Table 2: Passenger numbers from CAA Airport Statistics, 2011[9]:

Top 10 UK airports in 2011 by terminal passengers only		Top 10 UK airports in 2011 by terminal + transit passengers	
Heathrow	69,390,591	Heathrow	69,433,230
Gatwick	33,643,989	Gatwick	33,674,264
Manchester	18,806,655	Manchester	18,892,756
Stansted	18,047,403	Stansted	18,052,843
Luton	9,509,915	Luton	9,513,704
Edinburgh	9,383,695	Edinburgh	9,385,245
Birmingham	8,608,192	Birmingham	8,616,296
Glasgow	6,858,268	Glasgow	6,880,217
Bristol	5,767,628	Bristol	5,780,746
Liverpool (John Lennon)	5,246,540	Liverpool (John Lennon)	5,251,161

Figure 1[10] (below) shows the percentage increase in terminal and transit passengers between 2010 and 2011.

8 CHIEF Non-EU data, HMRC, 2011(provisional data), https://www.uktradeinfo.com

9 http://www.caa.co.uk/default.aspx?catid=80&pagetype=90

UK Aviation Governance

Much of the UK aviation sector is not state owned: for example the UK en-route air navigation services provider, NATS, is a public-private partnership, regulated by the Civil Aviation Authority (CAA), the UK's specialist aviation regulator. The Department for Transport is the Government Department which sets policy and carries out international and European negotiations. There is more information on governance below.

CAA[11]

The CAA is a public corporation established by Parliament in 1972 as an independent specialist aviation regulator and (at the time) provider of air traffic services. Unlike many other countries, there is no direct Government funding of the CAA's work. The CAA has responsibility for economic, safety and consumer protection regulation, and airspace policy. In addition, it advises the Government on aviation issues, represents consumer interests, conducts economic and scientific research and produces statistical data.

The CAA's work is focused on:

a) Enhancing aviation safety performance by pursuing targeted and continuous improvements in systems, culture, processes and capability.

b) Improving choice and value for aviation consumers now and in the future by promoting competitive markets, contributing to consumers' ability to make informed decisions and protecting them where appropriate.

c) Improving environmental performance through more efficient use of airspace and make an efficient contribution to reducing the aviation industry's environmental impacts.

d) Ensuring that the CAA is an efficient and effective organisation which meets Better Regulation principles

Department for Transport (DfT)[12]

The Aviation Directorate in the DfT sets aviation policy and is involved in international and EU negotiations. The Directorate is also the lead on international climate change policy and liaises directly with the European Commission, foreign governments and ICAO.

NATS[13]

National Air Traffic Services (NATS) is the UK's sole provider of en-route air traffic services and also provides aerodrome air traffic control at some airports. In March 2012 NATS published its Corporate Responsibility report which outlines its commitment to driving the sustainable aviation agenda in the UK[14].

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10 http://www.caa.co.uk/default.aspx?catid=80&pagetype=90

11 http://www.caa.co.uk/

12 www.dft.gov.uk

13 http://www.nats.co.uk/

14 http://www.nats.co.uk/wp-content/uploads/2012/03/NATSCorporateResponsibilityReport2012.pdf

Overseas Territories and Crown Dependencies[15]

The UK has a number of Overseas Territories and Crown Dependencies which are covered by the UK's ratification of the Chicago Convention. The DfT is responsible for ensuring that the UK's obligations under the Convention are implemented in these territories.

The territories are:

1) Anguilla
2) Bermuda
3) British Indian Ocean Territory
4) British Virgin Islands
5) Cayman Islands
6) Falkland Islands
7) Gibraltar
8) Bailiwick of Guernsey
9) Isle of Man
10) Bailiwick of Jersey
11) Montserrat
12) Pitcairn, Henderson, Ducie and Oeno Islands
13) South Georgia and South Sandwich Islands
14) St Helena, Ascension and Tristan da Cunha
15) Turks and Caicos Islands

The UK encourages the overseas territories to consider climate change impacts when making decisions on aviation policy and where appropriate to share best practice. However, for the purposes of reporting greenhouse gas emissions for the UK's carbon budgets the Crown Dependencies and Overseas Territories[16] are excluded - only emissions within the UK are reported. While under the European Union Emissions Trading System, the overseas territories (except Gibraltar) and Crown Dependencies are considered as non-EU states.

15 http://assets.dft.gov.uk/publications/topics/international-aviation/iasukot.pdf

16 http://www.decc.gov.uk/assets/decc/11/stats/climate-change/4282-statistical-release-2010-uk-greenhouse-gas-emissi.pdf

3. Supra-National actions

AIRCRAFT RELATED TECHNOLOGY DEVELOPMENT

Aircraft emissions standards

European states fully support the ongoing work in ICAO's Committee on Aviation Environmental Protection (CAEP) to develop an aircraft CO_2 standard. Assembly Resolution A37-19 requests the Council to develop a global CO_2 standard for aircraft aiming for 2013. It is recognised that this is an ambitious timeframe for the development of a completely new ICAO standard. Europe is contributing to this task notably through the European Aviation Safety Agency providing the co-rapporteurship of the CO_2 task group within CAEP's Working Group 3.

In the event that a standard, comprising certification requirement and regulatory level, is adopted in 2013, it is likely to have an applicability date set some years in the future. The contribution that such a standard will make towards the global aspirational goals will of course depend on the regulatory level that is set, but it seems unlikely that an aircraft CO_2 standard could have any significant effect on the fuel efficiency of the global in-service fleet until well after 2020.

Research and development

Clean Sky is an EU **Joint Technology Initiative** (JTI) that aims to develop and mature breakthrough "clean technologies" for air transport. By accelerating their deployment, the JTI will contribute to Europe's strategic environmental and social priorities, and simultaneously promote competitiveness and sustainable economic growth.

Joint Technology Initiatives are specific large scale EU research projects created by the European Commission within the 7th Framework Programme (FP7) in order to allow the achievement of ambitious and complex research goals. Set up as a Public Private Partnership between the European Commission and the European aeronautical industry, Clean Sky will pull together the research and technology resources of the European Union in a coherent, 7-year, €1.6bn programme, and contribute significantly to the 'greening' of aviation.

The Clean Sky goal is to identify, develop and validate the key technologies necessary to achieve major steps towards the Advisory Council for Aeronautics Research in Europe (ACARE) environmental goals for 2020 when compared to 2000 levels:

- Fuel consumption and carbon dioxide (CO_2) emissions reduced by 50%
- Nitrous oxides (NO_X) emissions reduced by 80%
- Perceived external noise reduction of 50%
- Improved environmental impact of the lifecycle of aircraft and related products.

Three complementary instruments are used by Clean Sky in meeting these goals:

Technologies

These are selected, developed and monitored in terms of maturity or "technology readiness level" (TRL). A detailed list of more than one hundred key technologies has been set. The technologies developed by Clean Sky will cover all major segments of commercial aircraft.

Concept Aircraft

These are design studies dedicated to integrating technologies into a viable conceptual configuration, and assessing their potential and relevance. They cover a broad range of aircraft: business jets, regional and large commercial aircraft, as well as rotorcraft. They have been grouped and categorised in order to represent the major future aircraft families. Clean Sky's environmental results will be measured and reported upon principally by Concept Aircraft.

Demonstration Programmes

Some technologies can be assessed during their development phase, but many key technologies need to be validated at an integrated vehicle or system level via dedicated demonstrators. These demonstrators pull together several technologies at a larger "system" or aircraft level. Airframe, Engine and Systems technologies are monitored through in-flight or large scale ground demonstrations. The aim is to validate the feasibility of these technologies in relevant (in-flight or operating) conditions. Their performance can then be predicted in areas such as mechanical or in-flight behaviour. This in turn will help determine the true potential of the technologies and enable a realistic environmental assessment. Demonstrations enable technologies to reach a higher level of maturity (or TRL: technology readiness level), which is the "raison d'être" of Clean Sky.

The environmental objectives of the programme are determined by evaluating the performance of concept aircraft in the global air transport system (when compared to 2000 level technology and to a "business as usual" evolution of technology). The ranges of environmental improvements result from the sum of technologies which are expected to reach TRL5-6 within the programme timeframe. While not all of these technologies will be developed directly through the Clean Sky programme, it is neither feasible nor relevant at this stage to isolate the benefits derived purely from Clean Sky technologies, as Clean Sky will achieve a significant synergy effect in European Aeronautics Research by maturing closely linked technologies to a materially higher TRL through demonstration and integration.

Clean Sky activities are performed within six "**Integrated Technology Demonstrators**" (ITDs) and a "**Technology Evaluator**".

The three vehicle-based ITDs will develop, deliver and integrate technologies into concrete aircraft configurations. The two "transversal" ITDs are focused on propulsion and systems, and will deliver technologies, which will be integrated in various aircraft configurations by the vehicle ITDs. A further ITD will focus specifically on the life cycle assessment and 'eco-design' philosophy.

Smart Fixed Wing Aircraft (SFWA) – co-led by Airbus and SAAB - will deliver innovative wing technologies together with new aircraft configurations, covering large aircraft and business jets. Key enabling technologies from the transversal ITDs, for instance Contra Rotating Open Rotor, will be integrated into the demonstration programmes and concept aircraft.

Green Regional Aircraft (GRA) – co-led by Alenia and EADS CASA - will develop new technologies for the reduction of noise and emissions, in particular advanced low-weight & high performance structures, incorporation of all-electric systems, bleed-less engine architecture, low noise/high efficiency aerodynamics, and finally environmentally optimised mission and trajectory management.

Green Rotorcraft (GRC) – co-led by AgustaWestland and Eurocopter - will deliver innovative rotor blade technologies for reduction in rotor noise and power consumption, technologies for lower airframe drag, environmentally friendly flight paths, the integration of diesel engine technology, and advanced electrical systems for elimination of hydraulic fluids and for improved fuel consumption.

Sustainable and Green Engines (SAGE) - co-led by Rolls-Royce and Safran - will design and build five engine demonstrators to integrate technologies for low fuel consumption, whilst reducing noise levels and nitrous oxides. The ‘Open Rotor’ is the target of two demonstrators. The others address geared turbofan technology, low pressure stages of a three-shaft engine and a new turboshaft engine for helicopters.

Systems for Green Operations (SGO) - co-led by Liebherr and Thales - will focus on all electrical aircraft equipment and system architectures, thermal management, capabilities for environmentally-friendly trajectories and missions, and improved ground operations to give any aircraft the capability to fully exploit the benefits of the “Single European Sky”.

Eco-Design - co-led by Dassault and Fraunhofer Gesellschaft - will support the ITDs with environmental impact analysis of the product life-cycle. Eco-Design will focus on environmentally-friendly design and production, withdrawal, and recycling of aircraft, by optimal use of raw materials and energies, thus improving the environmental impact of the entire aircraft life-cycle.

Complementing these six ITDs, the **Technology Evaluator (TE)** is a dedicated evaluation platform cross-positioned within the Clean Sky project structure. The TE is co-led by DLR and Thales, and includes the major European aeronautical research organisations. It will assess the environmental impact of the technologies developed by the ITDs and integrated into the Concept Aircraft. By doing this, the TE will enable Clean Sky to measure and report the level of success in achieving the environmental objectives, and in contributing towards the ACARE environmental goals. Besides a mission level analysis (aircraft level), the positive impact of the Clean Sky technologies will be shown at a relevant hub airport environment and across the global air transport system.

The first assessment by the Technology Evaluator on the way to meeting Clean Sky's environmental objectives is planned for the end of 2011. The ranges of potential performance improvement (reduction in CO_2, NO_X and Noise) will be narrowed or evolved during the life of the programme based on the results from the key technologies developed and validated through the demonstrations performed.

Clean Sky is a ‘living’ programme: each year, Annual Implementation Plans are produced and agreed, and research priorities are (re-)calibrated based on results achieved. The best approach to progressing the technologies is pursued. The Clean Sky JU uses regular Calls for Proposals to engage with the wider aeronautical industry, research organisations and universities in order to bring the best talent on board and enable broad collaborative participation. A very significant share of the

Clean Sky research programme is already being taken on by Europe's aerospace related SMEs, and by September 2011 nine Calls for Proposals will have been completed, demonstrating the JU's commitment to involving all competent organisations in the European aeronautics research arena. In June 2011, a major and exciting milestone was reached with the 400th partner joining the Clean Sky programme.

ALTERNATIVE FUELS

European Advanced Biofuels Flightpath

In February 2009, the European Commission's Directorate General for Energy and Transport initiated the SWAFEA (Sustainable Ways for Alternative Fuels and Energy for Aviation) study to investigate the feasibility and the impact of the use of alternative fuels in aviation. The goal was to provide the European Commission with information and decision elements to support its future air transport policy, in the framework of the European commitment to promote renewable energy for the mitigation of climate change, security of supply and also to contribute to Europe's competitiveness and economic growth.

The study team involved 20 European and international organisations, representing all players in alternative aviation fuels: aircraft and engine manufacturing, air transport, oil industry, research and consulting organisations covering a large spectrum of expertise in the fields of fuel, combustion, environment as well as agriculture.

The SWAFEA final report was published in July 2011[17]. It provides a comprehensive analysis on the prospects for alternative fuels in aviation, including an integrated analysis of technical feasibility, environmental sustainability (based on the sustainability criteria of the EU Directive on renewable energy[18]) and economic aspects. It includes a number of recommendations on the steps that should be taken to promote the take-up of sustainable biofuels for aviation in Europe.

In March 2011, the European Commission published a White Paper on transport[19]. In the context of an overall goal of achieving a reduction of at least 60% in greenhouse gas emissions from transport by 2050 with respect to 1990, the White Paper established a goal of low-carbon sustainable fuels in aviation reaching 40% by 2050.

As a first step towards delivering this goal, in June the European Commission, in close coordination with Airbus, leading European airlines (Lufthansa, Air France/KLM, & British Airways) and key European biofuel producers (Choren Industries, Neste Oil, Biomass Technology Group and UOP), launched the European Advanced Biofuels Flightpath. This industry-wide initiative aims to speed up the commercialisation of aviation biofuels in Europe, with the objective of achieving the commercialisation of sustainably produced paraffinic biofuels in the aviation sector by reaching a 2 million tons consumption by 2020.

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17 http://www.swafea.eu/LinkClick.aspx?fileticket=llISmYPFNxY%3D&tabid=38

18 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

19 Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM(2011) 144 final

This initiative is a shared and voluntary commitment by its members to support and promote the production, storage and distribution of sustainably produced drop-in biofuels for use in aviation. It also targets establishing appropriate financial mechanisms to support the construction of industrial "first of a kind" advanced biofuel production plants. The Biofuels Flight path is explained in a technical paper, which sets out in more detail the challenges and required actions[20].

More specifically, the initiative focuses on the following:

1. Facilitate the development of standards for drop-in biofuels and their certification for use in commercial aircraft;
2. Work together with the full supply chain to further develop worldwide accepted sustainability certification frameworks
3. Agree on biofuel take-off arrangements over a defined period of time and at a reasonable cost;
4. Promote appropriate public and private actions to ensure the market uptake of paraffinic biofuels by the aviation sector;
5. Establish financing structures to facilitate the realisation of 2G biofuel projects;
6. Accelerate targeted research and innovation for advanced biofuel technologies, and especially algae.

Take concrete actions to inform the European citizen of the benefits of replacing kerosene by certified sustainable biofuels.

20 http://ec.europa.eu/energy/technology/initiatives/doc/20110622_biofuels_flight_path_techn ical_paper.pdf

The following “Flight Path” provides an overview about the objectives, tasks, and milestones of the initiative.

Time horizons	Action	Aim/Result
Short-term (next 0-3 years)	Announcement of action at International Paris Air Show	To mobilise all stakeholders including Member States.
	High level workshop with financial institutions to address funding mechanisms.	To agree on a "Biofuel in Aviation Fund".
	> 1,000 tons of Fisher-Tropsch biofuel become available.	Verification of Fisher-Tropsch product quality. Significant volumes of synthetic biofuel become available for flight testing.
	Production of aviation class biofuels in the hydrotreated vegetable oil (HVO) plants from sustainable feedstock	Regular testing and eventually few regular flights with HVO biofuels from sustainable feedstock.
	Secure public and private financial and legislative mechanisms for industrial second generation biofuel plants.	To provide the financial means for investing in first of a kind plants and to permit use of aviation biofuel at economically acceptable conditions.
	Biofuel purchase agreement signed between aviation sector and biofuel producers.	To ensure a market for aviation biofuel production and facilitate investment in industrial 2G plants.
	Start construction of the first series of 2G plants.	Plants are operational by 2015-16.
	Identification of refineries &blenders which will take part in the first phase of the action.	Mobilise fuel suppliers and logistics along the supply chain.
Mid-term (4-7 years)	2000 tons of algal oils are becoming available.	First quantities of algal oils are used to produce aviation fuels.
	Supply of 1.0 M tons of hydrotreated sustainable oils and 0.2 tons of synthetic aviation biofuels in the aviation market.	1.2 M tons of biofuels are blended with kerosene.
	Start construction of the second series of 2G plants including algal biofuels and pyrolytic oils from residues.	Operational by 2020.
Long-term (up to 2020)	Supply of an additional 0.8 M tons of aviation biofuels based on synthetic biofuels, pyrolytic oils and algal biofuels.	2.0 M tons of biofuels are blended with kerosene.
	Further supply of biofuels for aviation, biofuels are used in most EU airports.	Commercialisation of aviation biofuels is achieved.

IMPROVED AIR TRAFFIC MANAGEMENT AND INFRASTRUCTURE USE

The EU's Single European Sky initiative and SESAR

The EU's Single European Sky initiative was originally launched by the European Commission in 1999. Its fundamental aim is to reform the architecture of European air traffic control to meet future capacity and safety needs. Its main principles are to reduce fragmentation in European air traffic management, between states, between civil and military, and between systems; to introduce new technology; and to establish a new regulatory framework built on closer synergy between the EU and Eurocontrol.

The first package of EU Single European Sky legislation was adopted by the Council and European Parliament in 2004. This was followed in 2009 by the Single European Sky II package of measures, which comprises five main pillars: performance, safety, technology, airport capacity and the human factor. The aim is to improve the performance of air navigation services by reducing the cost of flights, while improving the capacity and better preserving the environment, all having regard to the overriding safety objectives.

Reducing fragmentation in European air traffic management is expected to result in significant efficiency and environmental improvements. A core starting point is the reduction of the current surplus length of flights in Europe, estimated on average to be almost 50 km. The defragmentation of European airspace with new possibilities for more direct routing, and efforts to define a true pan European network of routes and to implement flexible use of airspace are expected to result in emission reductions of 2% per year.

SESAR

SESAR (Single European Sky ATM Research) is the technological component of the Single European Sky (SES). It is a €2.1bn Joint Undertaking, funded equally by the EU, Eurocontrol and industry (€700m EU, €700m Eurocontrol, €700m industry). Fifteen companies are members of the SESAR JU: AENA, Airbus, Alenia Aeronautica, the DFS, the DSNA, ENAV, Frequentis, Honeywell, INDRA, NATMIG, NATS (En Route) Limited, NORACON, SEAC, SELEX Sistemi Integrati and Thales. The SESAR SJU includes an additional thirteen associate partners including non-European companies with different profiles and expertise.

SESAR aims to help create a "paradigm shift" by putting performance-based operations at the core of air traffic management's objectives, and will be supported by state-of-the-art and innovative technology capable of ensuring the safety, sustainability and fluidity of air transport worldwide over the next 30 years. It is composed of three phases:

- The Definition phase (2004-2008) delivered the ATM master plan defining the content, the development and deployment plans of the next generation of ATM systems. This definition phase was led by Eurocontrol, and co-funded by the European Commission under the Trans European Network-Transport programme and executed by a large consortium of all air transport stakeholders.
- The Development phase (2008-2013) will produce the required new generation of technological systems, components and operational procedures as defined in the SESAR ATM Master Plan and Work Programme.
- The Deployment phase (2014-2020) will see the large scale production and implementation of the new air traffic management infrastructure, composed of

fully harmonised and interoperable components guaranteeing high performance air transport activities in Europe.

Implementation of SESAR in general will facilitate the following:

- Moving from airspace to trajectory based operations, so that each aircraft achieves its agreed route and time of arrival and air and ground systems share a common system view.
- Collaborative planning so that all parties involved in flight management from departure gate to arrival gate can strategically and tactically plan their business activities based on the performance the system will deliver.
- An information rich ATM environment where partners share information through system wide information management.
- A globally agreed 4D trajectory definition and exchange format at the core of the ATM system where time is the 4th dimension providing a synchronised “time” reference for all partners.
- Airspace users and aircraft fully integrated as essential constituents and nodes of the ATM system.
- Dynamic airspace management and integrated co-ordination between civil and military authorities optimising the available airspace.
- Network planning focused on the arrival time as opposed to today’s departure based system with Airport airside and turn-around fully integrated into ATM.
- New Communication, Navigation & Surveillance (CNS) technologies providing for more accurate airborne navigation and spacing between aircraft to maximise airspace and airport efficiency, improve communication and surveillance.
- Central role for the human widely supported by automation and advanced tools ensuring safe working without undue pressure.

Within the SESAR programme most of the almost 300 projects include environmental aspects of aviation. They concern aircraft noise management and mitigation, aircraft fuel use and emissions management etc. throughout all of SESAR’s 16 work packages. The Joint Undertaking’s role is to establish environmental sustainability as an integral aspect of broader ATM development and operating processes.

SESAR aims at reducing the environmental impact per flight by 10% without compromising on safety but with clear capacity and cost efficiency targets in mind. More specifically, in addressing environmental issues, SESAR will:

1. Achieve emission improvements through the optimisation of air traffic management services. The SESAR target for 2020 is to enable 10% fuel savings per flight as a result of ATM improvements alone, leading to a 10% reduction of CO_2 emissions per flight;
2. Improve the management of noise emissions and their impacts through better flight paths, or optimised climb and descent solutions;
3. Improve the role of ATM in enforcing local environmental rules by ensuring that flight operations fully comply with aircraft type restrictions, night movement bans, noise routes, noise quotas, etc.;

4. Improve the role of ATM in developing environmental rules by assessing the ecological impact of ATM constraints, and, following this assessment, adopting the best alternative solutions from a European sustainability perspective.
5. Accompany the development of new procedures and targets with an effective regulatory framework in close cooperation with the European Commission;
6. Implement more effective two-way community relations and communications capabilities at local and regional levels including a commonly agreed environmental strategy and vision.

By 2012 SESAR is expected to deliver fuel burn reductions of approximately 2% (compared with a baseline 2010), to demonstrate environmental benefits on city pairs connecting 8 European airports, and to have airspace users signing up to the SESAR business case (including the environment case) for time-based operations.

Operational improvements: AIRE

The Atlantic Interoperability Initiative to Reduce Emissions (AIRE) is a programme designed to improve energy efficiency and lower engine emissions and aircraft noise in cooperation with the US FAA. The SESAR JU is responsible for its management from a European perspective.

Under this initiative ATM stakeholders work collaboratively to perform integrated flight trials and demonstrations validating solutions for the reduction of CO_2 emissions for surface, terminal and oceanic operations to substantially accelerate the pace of change.

AIRE has demonstrated in 2009, with 1,152 trials performed, that significant savings can be achieved using existing technology. CO_2 savings per flight ranged from 90kg to 1250kg and the accumulated savings during trials were equivalent to 400 tons of CO_2. Another positive aspect is the human dimension - the AIRE projects boost crew and controller motivation to pioneer new ways of working together focusing on environmental aspects, and enabled cooperative decision-making towards a common goal.

The strategy is to produce constant step-based improvements, to be implemented by each partner in order to contribute to reaching the common objective. In 2010 demand for projects has more than doubled and a high transition rate from R&D to day-to-day operations, estimated at 80%, from AIRE 2009 projects was observed (expected to further increase with time). Everyone sees the “AIRE way of working together” as an absolute win-win to implement change before the implementation of more technology intensive ATM advancements expected for the period 2013 onward. A concrete example of the progress achieved is that, due to AIRE, both FAA and NAV Portugal offer lateral optimisation over the transatlantic routes to any user upon request. In July 2010, the SESAR JU launched a new call for tender and had an excellent response - 18 projects were selected involving 40 airlines, airport, air navigation service providers and industry partners. More than 5,000 trials are expected to take place.

ECONOMIC / MARKET-BASED MEASURES

The EU Emissions Trading System

The EU Emissions Trading System (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively. Being the first and biggest international scheme for the trading of greenhouse gas emission allowances, the EU ETS currently covers some 11,000 power stations and industrial plants in 30 countries.

Launched in 2005, the EU ETS works on the "cap and trade" principle. This means there is a "cap", or limit, on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. Within this cap, companies receive emission allowances which they can sell to or buy from one another as needed. The limit on the total number of allowances available provides certainty that the environmental objective is achieved and ensures that the allowances have a market value.

At the end of each year each company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so. The number of allowances is reduced over time so that total emissions fall.

The EU ETS now operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway). It currently covers CO_2 emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Between them, the installations currently in the scheme account for almost half of the EU's CO_2 emissions and 40% of its total greenhouse gas emissions.

The EU ETS will be further expanded to the petrochemicals, ammonia and aluminium industries and to additional gases (PFCs and N_2O) in 2013, when the third trading period starts. At the same time a series of important changes to the way the EU ETS works will take effect in order to strengthen the system.

The legislation to include aviation in the EU ETS was adopted in November 2008, and entered into force as Directive 2008/101/EC of the European Parliament and of the Council on 2 February 2009. The proposal to include aviation in the EU ETS, made by the European Commission in December 2006, was accompanied by a detailed impact assessment.

Under the EU ETS, the emissions cap is increased to accommodate the inclusion of aviation. This addition to the cap establishes the total quantity of allowances to be allocated to aircraft operators. This quantity is defined as a percentage of historical aviation emissions, which is defined as the mean average of the annual emissions in the calendar years 2004, 2005 and 2006 from aircraft performing an aviation activity falling within the scope of the legislation. In July 2011, it was decided that the historical aviation emissions are set at 221,420,279 tonnes of CO_2.

The additional cap to be added to the EU ETS in 2012, the first year of operation for aviation, will be set at 97% of the historical aviation emissions. For the period from 2013 to 2020 inclusive the additional cap will be set at 95% of the historical aviation emissions.

Aircraft operators flying to and from airports in 30 European states from 2012 will be required to surrender allowances in respect of their CO_2 emissions on an annual basis. The large majority of allowances will be allocated to individual aircraft operators free of charge, based on their respective aviation output (rather than emissions) in 2010, thus rewarding operators that have already invested in cleaner aircraft. In 2012, 85% of the total quantity of the additional allowances (or “cap”) will be allocated free of charge according to this benchmarking methodology, while in the 2013-2020 trading period 82% of the additional allowances will be allocated free of charge in this way. In the 2013-2020 trading period, an additional 3% of the total additional allowances for aviation will be set aside for allocation free of charge via the special reserve, to new entrants and fast-growing airlines. The remaining 15% of allowances will be allocated each year by auction.

Aircraft operators that choose to emit more than their free allocation of allowances will be able to source allowances from other participants in the ETS (including those outside the aviation sector), from intermediaries who trade allowances, from Member States via auctions, or they can use specific quantities of international credits from emissions reduction projects in third countries (e.g. CDM credits and ERUs).

The system also includes a de minimis provision under which commercial aircraft operators with a low level of aviation activity in Europe are excluded from its scope. This is likely to mean that many aircraft operators from developing countries will be unaffected by the scheme and, indeed, over 90 ICAO states have no commercial aircraft operators included in the scope of the EU ETS.

The EU legislation foresees that, where a third country takes measures of its own to reduce the climate change impact of flights departing from its airports, the EU will consider options available in order to provide for optimal interaction between the EU scheme and that country's measures. In such a case, flights arriving from the third country could be excluded from the scope of the EU scheme. The EU therefore encourages other countries to adopt measures of their own and is ready to engage in bilateral discussions with any country that has done so.

The legislation also makes it clear that if there is agreement on global measures, the EU shall consider whether amendments to this Directive as it applies to aircraft operators are necessary.

Anticipated change in fuel consumption and/or CO_2 emissions

The environmental outcome of an emissions trading system is pre-determined through the setting of an emissions cap. In the case of the EU ETS, an addition to the overall cap is established for aviation emissions. However, aircraft operators are also able to use allowances allocated to other sectors to cover their emissions. It is therefore possible (indeed highly likely given traffic growth forecasts) that the absolute level of CO_2 emissions from aviation will exceed the number of allowances allocated to aviation. However, any aviation emissions will necessarily be offset by CO_2 emissions reductions elsewhere, either in other sectors within the EU that are subject to the EU ETS, or through emissions reduction projects in third countries. The "net" aviation emissions will however be the same as the number of allowances allocated to aviation under the EU ETS.

In terms of contribution towards the ICAO global goals, the states implementing the EU ETS will together deliver, in "net" terms, a 3% reduction below the 2005 level of aviation CO_2 emissions in 2012, and a 5% reduction below the 2005 level of aviation CO_2 emissions in the period 2013-2020.

Other emissions reduction measures taken, either at supra-national level in Europe or, by any of the 30 individual states implementing the EU ETS, will of course make their own contribution towards the ICAO global goals. Such measures are likely to moderate the anticipated growth in aviation emissions in Europe and therefore reduce the extent to which the absolute level of CO_2 emissions from aviation will exceed the number of allowances allocated to aviation. However, assuming that absolute aviation emissions will nonetheless in future exceed the additional aviation cap, the aggregate contribution towards the global goals is likely to remain that which is determined by the EU ETS cap.

Expected co-benefits

The EU ETS covers both international and domestic aviation and does not distinguish between them. It is not therefore possible to identify how the "net" emissions reductions it delivers are apportioned between international and domestic aviation.

SUPPORT TO VOLUNTARY ACTIONS: ACI AIRPORT CARBON ACCREDITATION

Airport Carbon Accreditation is a certification programme for carbon management at airports, based on carbon mapping and management standard specifically designed for the airport industry. It was launched in 2009 by ACI EUROPE, the trade association for European airports.

This industry-driven initiative was officially endorsed by Eurocontrol and the European Civil Aviation Conference (ECAC). It is also officially supported by the United Nations Environmental Programme (UNEP). The programme is overseen by an independent Advisory Board. ACI EUROPE is looking at expanding the geographical scope of the programme through the other ACI regions. Discussions are currently under way with ACI Asia Pacific for a possible extension of the programme to the Asia Pacific region.

Airport Carbon Accreditation is a four-step programme, from carbon mapping to carbon neutrality. The four steps of certification are: Level 1 "Mapping", Level 2 "Reduction", Level 3 "Optimisation", and Level 3+ "Carbon Neutrality". One of its essential requirements is the verification by external and independent auditors of the data provided by airports. Aggregated data are included in the *Airport Carbon Accreditation* Annual Report thus ensuring transparent and accurate carbon reporting. At level 2 of the programme and above (Reduction, Optimization and Carbon Neutrality), airport operators are required to demonstrate CO2 reduction associated with the activities they control.

In June 2011, 2 years after the launch of the programme, 43 airports were accredited, representing 43% of European passenger traffic. ACI/Europe's objective for the end of the 3rd year of the programme's operation is to cover airports representing 50% of European passenger traffic. Programme's implementation is twofold: on top of recruiting new participants, individual airports should progress along the 4 levels of the programme.

Anticipated benefits:

The Administrator of the programme has been collecting CO2 data from participating airports over the past two years. This has allowed the absolute CO2 reduction from the participation in the programme to be quantified.

	2009-2010	2010-2011
Total aggregate scope 1 & 2 reduction (tCO2)	51,657	54,565
Total aggregate scope 3 reduction (tCO2)	359,733	675,124

Variable	Year 1		Year 2	
	Emissions	Number of airports	Emissions	Number of airports
Aggregate carbon footprint for 'year 0'[21] for emissions under airports' direct control (all airports)	803,050 tonnes CO_2	17	2,275,469 tonnes CO_2	43
Carbon footprint per passenger	2.6 kg CO_2		3.73 kgCO_2	
Aggregate reduction in emissions from sources under airports' direct control (Level 2 and above)[22]	51,657 tonnes CO_2	9	51,819 tonnes CO_2	19
Carbon footprint reduction per passenger	0.351 kg CO_2		0.11 kg CO_2	
Total carbon footprint for 'year 0' for emissions sources which an airport may guide or influence (level 3 and above)	2,397,622 tonnes CO_2	6	6,643,266 tonnes CO_2[23]	13
Aggregate reductions from emissions sources which an airport may guide or influence	359,733 tonnes CO_2		675,124 tonnes CO_2	
Total emissions offset (Level 3+)	13,129 tonnesCO_2	4	85,602 tonnes CO_2	8

Its main immediate environmental co-benefit is the improvement of local air quality.

Costs for design, development and implementation of *Airport Carbon Accreditation* have been borne by ACI EUROPE. *Airport Carbon Accreditation* is a non-for-profit initiative, with participation fees set at a level aimed at allowing for the recovery of the aforementioned costs.

The scope of *Airport Carbon Accreditation,* i.e. emissions that an airport operator can control, guide and influence, implies that aircraft emissions in the LTO cycle are also covered. Thus, airlines can benefit from the gains made by more efficient airport operations to see a decrease in their emissions during the LTO cycle. This is

21 'Year 0' refers to the 12 month period for which an individual airport's carbon footprint refers to, which according to the Airport Carbon Accreditation requirements must have been within 12 months of the application date.

22This figure includes increases in emissions at airports that have used a relative emissions benchmark in order to demonstrate a reduction.

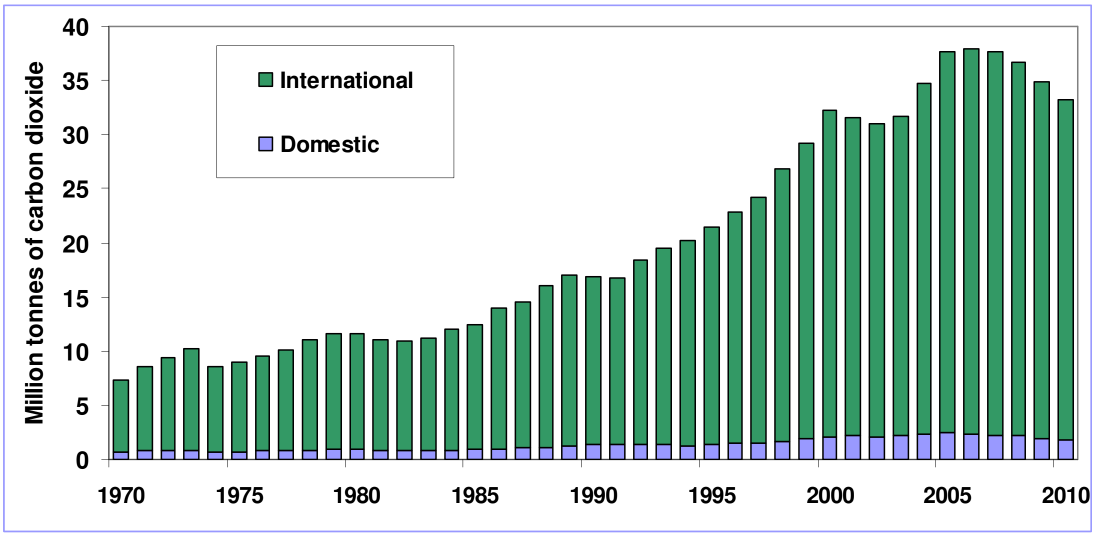
coherent with the objectives pursued with the inclusion of aviation in the EU ETS as of 1 January 2012 (Directive 2008/101/EC) and can support the efforts of airlines to reduce these emissions.

4. UK National Plan

Historic Emissions and Baselines

Figure 2 shows UK aviation emissions since 1970. It demonstrates that, in keeping with the global growth in demand for air travel previously discussed, CO_2 emissions have tended to grow strongly. Some deviations from the trend are evident, and these are explained by demand variations, such as those resulting from the oil price shocks in the 1970s, recessions, terrorism threats or fears of global pandemics. The unprecedented reduction in aviation CO_2 emissions following the recent financial crisis and associated recession is clearly visible. Figure 2 also shows that international travel from the UK, as opposed to domestic flights, has been the main source of emissions growth, consistently accounting for over 90% of aviation emissions.

Figure 2: Aviation CO_2 emissions, $MtCO_2$, 1970-2010



Source: DECC emissions statistics, www.decc.gov.uk

Table 3: UK greenhouse gas emissions ($MtCO_2e$) in 2010[24]

	Millions of tonnes of carbon dioxide equivalents	% of total UK green house gas emissions*
Total UK emissions excluding international shipping and aviation	587.8	-
Total UK emissions including international shipping and aviation	628.4	-
Total Transport	162.5	25.9

24 UK Greenhouse Gas Emissions, Department for Energy & Climate Change, 2012

Of which		
- Road	112.0	17.8
- Rail	2.2	0.4
- Shipping	11.2	1.8
- Aviation	33.6	5.3
- domestic	*1.8*	*0.3*
- international	*31.8*	*5.1*

UK Aviation Forecasts

The UK Department for Transport (DfT) produces forecasts of air passengers using UK airports, and of CO_2 emissions from UK aviation, to inform and monitor long term strategic aviation policy, and wider Government policy on tackling climate change. The forecasts represent the UK Government's assessment of how activity at UK airports and the associated CO_2 emissions are likely to change into the future, given existing policy commitments.

The UK air passenger demand forecasts use time series econometric models of past UK air travel demand and combine these with projections of key variables and assumptions about how the relationship between UK air travel and its key drivers change in the future. The DfT also combine economic determinants with assumptions on improvements in aircraft efficiency and fleet evolution to forecast the range of aviation CO_2 emissions[25].

There is currently no internationally agreed way of allocating international emissions to individual countries. The DfT forecasts CO_2 emissions produced by all flights departing UK airports to 2050, adjusted to match the Department of Energy and Climate Change's (DECC) published estimate of outturn aviation CO_2 emissions (using the UNFCCC reporting method) in the base year[26]. The forecasts therefore include CO_2 emitted from all domestic and international flights departing UK airports, irrespective of the nationality of passengers or carriers and include all freighter traffic.

Figure 3 below presents the UK aviation CO_2 forecasts published in August 2011. Following the drop in emissions associated with the impact of the recent financial crisis and global economic slowdown on aviation activity, UK aviation CO_2 emissions are forecast to grow steadily without further government intervention over the next twenty years. They increase from 34 $MtCO_2$ in 2010 to 48 $MtCO_2$ in 2030 in the central forecasts. Post 2030, the effects of market maturity and airport capacity constraints cause the growth of activity at UK airports to slow. Improvements in aircraft fuel efficiency are expected to continue beyond 2030 and, in the central and high forecasts, biofuels are expected to penetrate the aircraft fleet as kerosene and EU ETS allowance prices increase. By 2040, the balance of these two effects causes emissions to stabilise, before starting to fall by 2050.

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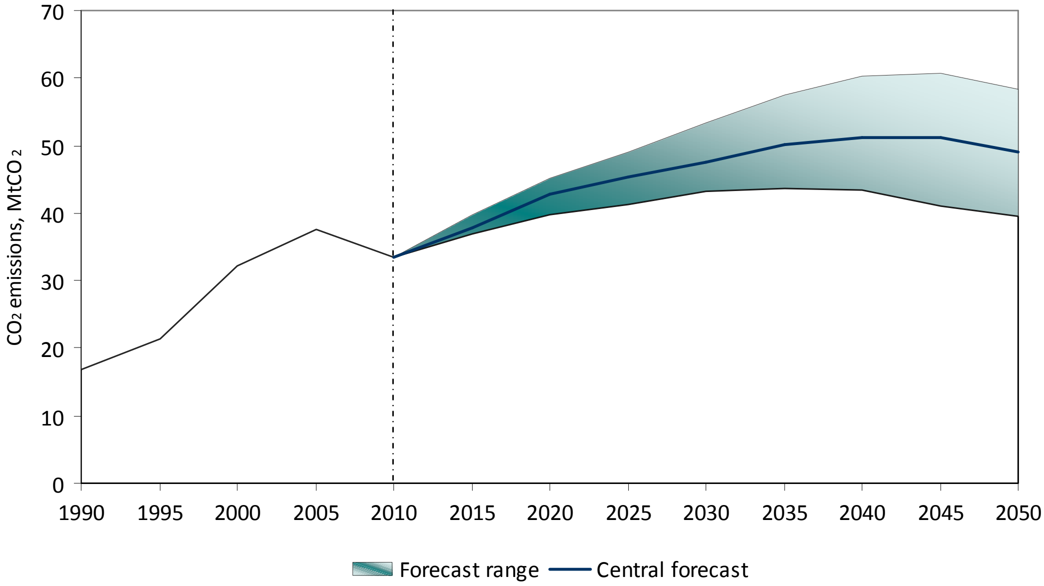
25 More detail on the forecasts and methodology can be found in the UK Aviation Forecasts report (August 2011) - http://www.dft.gov.uk/publications/uk-aviation-forecasts-2011/

26 This covers the 31 largest airports in the UK. Emissions from the other minor airports are unlikely to be significant as they offer only short range services. DECC's estimates of outturn CO2 emissions from aviation are based on the amount of aviation fuel uplifted from bunkers at all UK airports. Our 'forecast' for 2008 is about 0.5 MtCO2 (1%) below the latest revised DECC estimate for that year

Figure 3: UK Aviation CO2 forecasts to 2050



A detailed copy of the forecast, *UK Aviation Forecasts 2011*[27], is available online and presents the results of a series of tests to illustrate the sensitivity of the forecasts to changes in key drivers within reasonable bounds.

All aspects of the forecasting methods used to produce the updated forecasts have been subject to independent peer review. A series of peer review reports written by the independent peer reviewer, and a covering letter summarising the conclusions of the review, have been published alongside the 2011 forecasts on the DfT website[28]

The forecasts of UK aviation CO_2 emissions should be interpreted within the context of broader UK and EU climate change policy. Aviation's entry into the EU ETS from 2012 will mean that CO_2 emissions in the aviation sector will be capped. Airlines operating flights into, within and out of the EU will be required to surrender carbon allowances to cover their annual CO_2 emissions. Therefore, although CO_2 emissions from aviation are forecast to continue to grow in the UK and other EU countries, this growth will not result in any overall increase in the total CO_2 emissions from sectors included in the ETS, because the aviation sector will pay for reductions to be made elsewhere. The overall result will be that the net contribution of the aviation sector to CO_2 emissions will not exceed the level of the cap.

27 http://www.dft.gov.uk/publications/uk-aviation-forecasts-2011/

28 http://www.dft.gov.uk/publications/uk-aviation-forecasts-2011

5. UK Mitigation

Why is it important to address aviation's climate change emissions?

While aviation is currently a relatively small contributor to total greenhouse gas emissions (both at the UK and global levels), its projected continuing growth in emissions alongside reductions in other sectors means that aviation's contribution will increase significantly in the coming decades.

Available evidence indicates that the aviation sector is responsible for approximately one to two per cent of global greenhouse gas emissions[29]. At UK level, domestic aviation accounts for 0.3% of UK greenhouse gas emissions. If internal shipping and aviation emissions are added to the total in 2010, UK aviation (domestic and international) accounted for 5.3% of UK GHG emissions and total transport accounted for 25.9%[30] .

Aviation is, however, likely to make up an increasing proportion of the UK's total GHG emissions as other sectors decarbonise more quickly over time. The Government's objective is to ensure that the aviation sector plays a full part in reducing the UK's contribution to climate change.

Climate Change Strategy

The Climate Change Act established a legally binding target to reduce the UK's greenhouse gas emissions by at least 80% below base year levels by 2050[31]. The Act introduced a system of carbon budgets which provide legally binding limits on the amount of emissions that may be produced in successive five-year periods, beginning in 2008. The first four carbon budgets have been set in law, covering the time period to 2027.

Domestic aviation and shipping are already included in UK carbon budgets and so will need to contribute to meeting the 2050 target. International aviation and shipping are not currently included within the 2050 carbon target or carbon budgets; a decision whether to include them is due by the end of 2012.

UK policy on aviation and climate change

Aviation is an international sector, crossing national boundaries, and so differs from other transport modes, such as road and rail, which are more domestic issues. Flights departing from UK airports to international destinations account for about 95% of UK aviation emissions[32], and GHG emissions emitted anywhere in the world contribute to a global problem which we believe requires a global solution.

Our emphasis is therefore on action at a global level as the best means of securing our objective, with action at an EU level a second best option and a potential step

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29 Reducing Transport Greenhouse Gas Emissions: Trends and Data, International Transport Forum, 2010

http://www.internationaltransportforum.org/Pub/pdf/10GHGTrends.pdf/

Pew Centre on Global Climate Change (2009) Aviation and Marine Transportation: GHG Mitigation Potential and Challenges

http://www.pewclimate.org/docUploads/aviation-and-marine-report-2009.pdf.

30 http://www.decc.gov.uk/assets/decc/11/stats/climate-change/4282-statistical-release-2010-uk-greenhouse-gas-emissi.pdf

31 http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx

32 Measured on a bunker fuel sales basis. Transport Statistics Great Britain, DfT, 2011,

http://www.dft.gov.uk/statistics/releases/transport-statistics-great-britain-2011.

towards wider international agreement. We will take action at a national level where appropriate and cost-effective.

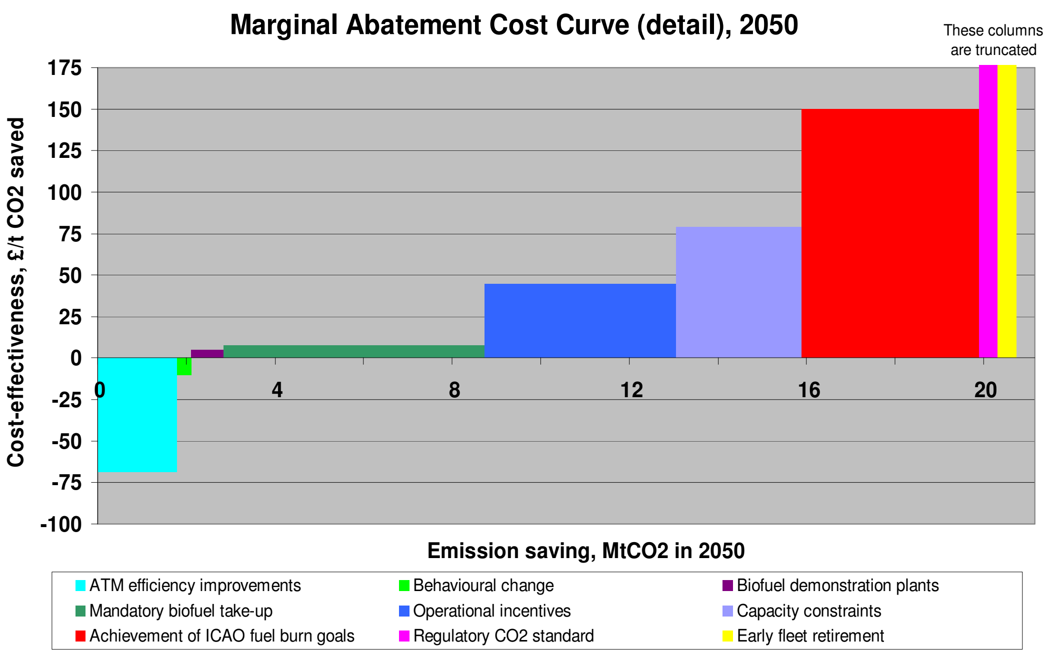
The UK has played a leading role in securing progress internationally, both within the International Civil Aviation Organization (ICAO), and within the European Union (EU). The global nature of the climate change challenge and the international character of the aviation industry make a strong case for a global deal on emissions that is comprehensive, non-discriminatory and avoids carbon leakage. The greatest contribution that any single State can make to reducing aviation emissions is to actively support steps towards such a global deal. The UK will, therefore, continue to push for an international agreement for global action.

Development of an Aviation Policy Framework

The UK is currently producing an Aviation Policy Framework. In 2011 the UK Government consulted on a scoping document. Following on from this, the Government will publish a draft Aviation Policy Framework for consultation in summer 2012 with a view to the framework being adopted by spring 2013. The final framework will aim to support economic growth and address aviation's environmental impacts; as part of this, it will detail the UK's intentions on how to address aviation emissions domestically. In light of its relevance the UK will include the Aviation Policy Framework, once it is published, on the ICAO website alongside its State Action Plan

As part of the development of this policy, in 2010 the UK commissioned a piece of work to create a Marginal Abatement Cost (MAC) curve. A MAC curve is an analytical tool to present and compare estimates of the emissions savings from different (policy) measures ("abatement potential"), and the net cost of the measures (costs minus benefits) per tonne of emissions saved (the "cost-effectiveness").

The MAC curve for 2050 that was generated for the central scenario is presented below. Each policy option is represented by a block, with the width of the block representing the estimate of emissions savings from that measure in 2050, and the height of the block representing the total net cost (cost minus benefits) of the measure per tonne of CO_2 emissions that it saves over the assumed lifetime of the policy.



The results suggest that if all policies assessed were successfully implemented, and each of them achieved the central estimate of emissions savings, UK aviation emissions could be reduced by about 20 million tonnes of CO_2 ($MtCO_2$) in 2050. This would reduce the estimate of total UK aviation emissions in 2050 (in the absence of further government intervention) under our central baseline forecast to about 30 $MtCO_2$ in 2050.

The estimated net cost of the policy measures varies from a saving of about £69 per tonne of CO_2 saved (ATM efficiency improvements), to a cost of over £1,600 per tonne of CO_2 saved (early fleet retirement). This represents the estimated cost-effectiveness of measures given that the EU ETS is included in the baseline; that is, the estimate of cost-effectiveness includes the reduction in cost associated with having to purchase fewer EU ETS allowances as a consequence of producing fewer emissions.

It should be noted that these estimates of cost-effectiveness are based on the estimated level of emissions savings achieved from flights departing from the UK only. They do not take account of changes in the level of emissions from non-UK aviation that might also result. For example, the regulatory CO_2 standard is assumed to be implemented at an international level in order to be effective. However, the estimate of cost-effectiveness only takes account of the emission reductions in the UK as a result of implementing the international lever.

Contextualising MAC Curve Analysis

Importantly, the MAC curves included in this Action Plan should not be read as intent to implement the policy measures analysed but rather as an analysis of their potential cost and environmental impact.

Whilst a MAC curve is a key piece of evidence that needs to be considered when taking decisions about the most appropriate policy measures to adopt to reduce emissions, it should be noted that it does not capture other important factors that may also need to be considered, including impacts on the UK's growth agenda, air quality, noise, non-CO_2 emissions and consumer choice.

Furthermore, a MAC curve does not provide an answer to the question of how to deliver these measures; nor does it assess practical issues involved. Thus before any decision were taken on whether any of the options assessed in the MAC curve work should be taken forward, the feasibility and deliverability of each one would need to be considered.

Aviation and biofuels

The Government believes that sustainable biofuels have a role to play in reducing carbon emissions from transport, particularly in sectors where there are limited alternatives to fossil fuel such as aviation. However, to realise this benefit it is crucial that sustainability is assured. In particular it is important that the issue of Indirect Land Use Change (ILUC), where biofuel production on agricultural land leads to displacement of production onto previously uncultivated land, is addressed.

We will continue to work with industry and the international community to explore how to bring about an increase in the use of sustainable biofuels in aviation. A number of studies conducted in the UK including the Carbon Plan[33] and Committee on Climate Change Bioenergy Review[34], have indicated there is a potential role for biofuels in aviation as a sector that cannot otherwise easily decarbonise. The Committee on Climate Change has also carried out studies on biofuels as a means of reducing emissions. Their latest estimate is that biofuels could supply 10% of global jet fuel demand by 2050.

Non-CO2 emissions

While this Action Plan focuses specifically on CO2 emissions, the UK recognises that aviation's total climate change impacts are greater than its CO2 emissions alone. These other emissions such as Nitrogen oxides (NOx), sulphur oxides (SOx) and water vapour can have both cooling and warming effects on the climate, with an overall warming impact on the atmosphere. Despite advances over the past decade, considerable scientific uncertainty remains about the scale of the effect on climate change of non-CO2 emissions and there is no consensus on how to mitigate them.

The UK supports efforts to improve the understanding of the non-CO2 impacts of aviation and we participate in and help to fund a number of projects into non-CO2 impacts such as the impacts of contrails and NOx on atmospheric warming.

UK Government Funded Research

Between 2004 and 2010 UK Government invested over £230m in collaborative research, matched by business, to develop lighter, more efficient, environmentally friendly aircraft – for example:

- advanced composite wing structures,
- more environmentally friendly engines, and
- more electric systems to replace engine air bleed systems

The UK Government has also invested heavily in bringing to market new aircraft which will deliver significant environmental benefits:

- £340m to Airbus for the development of the Airbus A350XWB
- £60m to GKN for composite wing components; and
- £114m to Bombardier Aerospace (Shorts) for the development of composite wings for the Bombardier C Series programme.

UK aviation industry

UK industry continues to investigate innovative ways of addressing aviation's climate change emissions through the use of new technologies, biofuels and offsetting. Sustainable Aviation, a coalition bringing together the main players from UK airlines, airports, manufacturers and air navigation service providers, has agreed a long term, collective approach to ensuring a sustainable future for the UK aviation industry. Sustainable Aviation has agreed a CO_2 roadmap and has produced a number of progress reports, all of which can be found at their website[35].

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33 http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx

34 http://www.theccc.org.uk/reports/bioenergy-review

35 http://www.sustainableaviation.co.uk/

Civil society

The UK has an active NGO sector, which engages on aviation and climate change issues. DfT works closely with organisations like the Aviation Environment Federation, WWF, Friends of the Earth and local environmental groups on a wide range of topics including noise, air quality and natural resources, amongst others.

CAA action on climate change

The UK Civil Aviation Authority (CAA) has a sustainability objective as part of its five-year Strategic Plan[36] to 'improve environmental performance through more efficient use of airspace and make an efficient contribution to reducing the aviation industry's environmental impacts.'

Its specific current aims are to:

- Support a reduction in aviation emissions through more efficient use of UK airspace.
- Enable consumers to make decisions that take account of the environmental impact of their air travel arrangements and inform the wider public on aviation's environmental performance.
- Engage with Government, providing expert advice to help develop environmental policy, to help implement the EU ETS and to establish the CAA's environmental remit.
- Engage with stakeholders to identify and support initiatives that may yield environmental performance improvements, where the CAA can play a useful, value-adding role, and do so efficiently.

The CAA has recently consulted on its approach. It will develop and publish a finalised programme for delivering its environmental strategy by summer 2012.

The Civil Aviation Bill is currently going through Parliament. The Bill includes an information and publication duty for the CAA, which would give the CAA a role in promoting better public information about the environmental impact of aviation. This will improve consumer's ability to make an informed choice.

The Bill has been designed to require the CAA to publish or arrange for the aviation industry to publish, information and advice that it considers appropriate relating to:

(a) The environmental effects of civil aviation in the UK;

(b) How human health and safety is, or may be affected by such effects; and

(c) Measures taken, or proposed, for reducing, controlling or mitigating the adverse environmental effects of civil aviation in the UK.

NATS action on climate change

NATS became the first air traffic service provider in the world to have challenging targets on operational CO_2 emissions, and the first to benchmark the airspace system under their control. NATS is targeting a 10% CO_2 reduction on average per

36 http://www.caa.co.uk/docs/1743/CAA%20Strategic%20Plan%202011-16%20v2.pdf

aircraft in UK airspace by 2020 (against a 2006 baseline); this target was not set as a result of any regulatory requirement, but because NATS believes it has a key part to play in helping to deliver a sustainable future for the aviation industry.

Leading on from this target setting process, and through close consultation with its regulator and airline customers, in January 2012, NATS will become the first ATC organisation in the world to be financially incentivised on its environmental performance as part of its regulatory agreements. Underpinning this environmental performance monitoring and target setting was the establishment of an award winning environmental research centre of excellence within NATS.

To help deliver improved day to day environmental performance NATS have built an extensive environmental awareness programme for their air traffic control teams, engineers, airspace designers and managers. The result of this enhanced awareness across the organisation has triggered numerous near term ideas for environmental improvements, all captured in the NATS Airspace Efficiency Database, now holding more than 170 potential improvements suggested by airline and airport customers and NATS staff. More than 50 of these fuel and CO_2 savings ideas have been delivered into operation by NATS over the past 2 years.

Most of the changes take the form of flight plannable direct routes and/or changes to procedures, for example:

- A new shorter route between Belfast City and Newcastle airports providing savings of 460 tonnes of fuel (1,450 tonnes of CO_2) per annum.
- Removal of a restriction allowing aircraft to stay higher for longer operating inbound to Edinburgh saved 1,250 tonnes of fuel (4,000 tonnes CO_2) per annum. This change affects over 4000 flights a year, each saving approximately 350 kg of fuel and nearly 1 tonne of CO_2.
- A joint initiative with the Irish Aviation Authority (IAA) through the collaborative UK Irish 'functional airspace block, has enabled a change to the procedures of aircraft between Irish and UK airspace saving 1,250 tonnes of fuel (4,000 tonnes of CO_2) per annum.

The delivery of short term improvements enabled savings of 8,000 tonnes of fuel (25,000 tonnes of CO_2) and 16,000 tonnes of fuel (50,000 tonnes of CO_2) in 2009 and 2010. For 2011, NATS has challenging targets to deliver in excess of 23,000 tonnes of fuel savings enabled (more than 70,000 tonnes of CO_2)

The 'Continuous Descent Approach' (CDA) was pioneered by NATS and UK airlines in the 1970s and the delivery CDA now forms a fundamental objective for current and future operations in the UK. In the London area, current airspace constraints mean that CDA can generally only commence for Heathrow, Gatwick and Stansted at 6000ft, but even here a CDA can save up to 0.3 tonnes of fuel (nearly 1 tonne of CO_2) and reduce noise levels by up to 5dB (decibels). At these airports, CDA performance averages 80 to 90%. NATS are continually looking to enable CDA from higher levels and further out when considering airspace redesign. In particular current NATS large scale airspace change plans for the South East and North of the UK are considering the possibility of CDA as far as possible. And as part of these same programmes, Continuous Climb Departures" (CCD) have dramatic fuel burn and CO_2 saving possibilities. NATS analysis shows CCD at Heathrow has potential to deliver a 10 to 20% fuel efficiency improvement on a standard profile in use today; that equates to up to 1.5 tonnes of fuel (4.5 tonnes of CO_2) per aircraft.

In July 2010 NATS, in collaboration with British Airways and airport operator BAA, conducted the UK's first 'perfect flight' between Heathrow and Edinburgh. The flight was calibrated to achieve minimal emissions and delay starting at the pushback from the stand and taxi, through to a continuous descent approach. NATS tested techniques which they are seeking to employ on a regular basis in the future. The flight used around 350kg less fuel generating around one tonne less CO_2 (about 11%) on the normal performance for the route.

6. **Conclusion:**

This Action Plan provides an overview of the actions undertaken in the UK to address CO_2 emissions from aviation and to contribute to the development of a resource-efficient, competitive and sustainable multimodal transport system.

The national actions of this Action Plan were completed upon 13 June 2012, and shall be considered as subject to update after that date.