# State Action Plan of Finland

## International Aviation $CO_2$ Emissions

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## International Aviation $CO_2$ Emissions

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# ACTION PLAN OF FINLAND

# INTRODUCTION

## Common Introductory Section

a) Finland 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) Finland, 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) Finland recognises the value of each State preparing and submitting to ICAO a State Action Plan on emissions reductions, as an important step towards the achievement of the global collective goals agreed at the 37$^{th}$ Session of the ICAO Assembly in 2010.

e) In that context, it is the intention that all ECAC States submit 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 Finland.

f) Finland 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 goals. This growth becomes possible through the purchase under an ETS of $CO_2$ 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, most of them led by the EU. They are reported in Section 1 of this Action Plan, where Finland's involvement in them is described, as well as that of stakeholders.

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[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

[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.

h) In Finland 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 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).

## CURRENT STATE OF AVIATION IN FINLAND

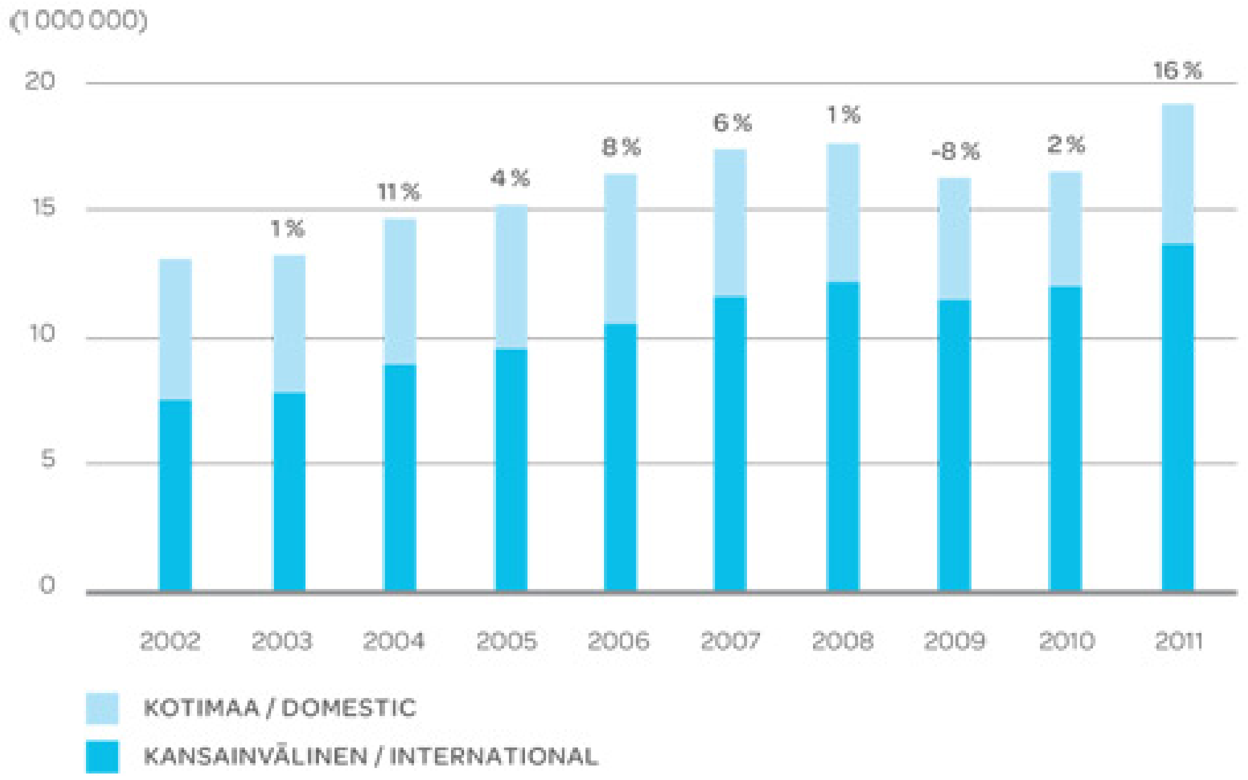
### 1. General

Air transport is an important part of an efficient and well-functioning transport system and a key factor for competitiveness of Finland. Economic growth in Finland is based on export, but our country is located far from the market areas for our products. Logistically, Finland is an island; without air transport, we would not be able to perform swift overnight carriages or move goods to the larger market areas of Europe. Flying to Central Europe takes a couple of hours, while the travel time with other forms of transport is several days. It is estimated that the aviation sector produces 3.2% of Finland's GDP, and employs a total of 100 000 persons directly or indirectly.

### 2. Development of air transport in Finland

International air transport has grown rapidly in recent years. In Finland, domestic traffic has been declining, but international services have increased. At present, about 80% of air traffic is international. The long-term trend in air traffic is still upward, although the current economic recession also affects the figures in aviation. To meet the challenges of globalisation, Finland must continue to ensure swift and efficient connections both within the country and abroad. Tourism will be a major factor in maintaining and developing domestic and international air transport in the future – according to an IATA study, 36% of foreign tourists arrive in Finland by plane. Some 95% of Finland's air freight traffic passes through Helsinki-Vantaa Airport. The total amount of air freight was 182 086 tonnes in 2011, out of which 96% was international traffic. The volume of air freight is expected to grow in the near future.

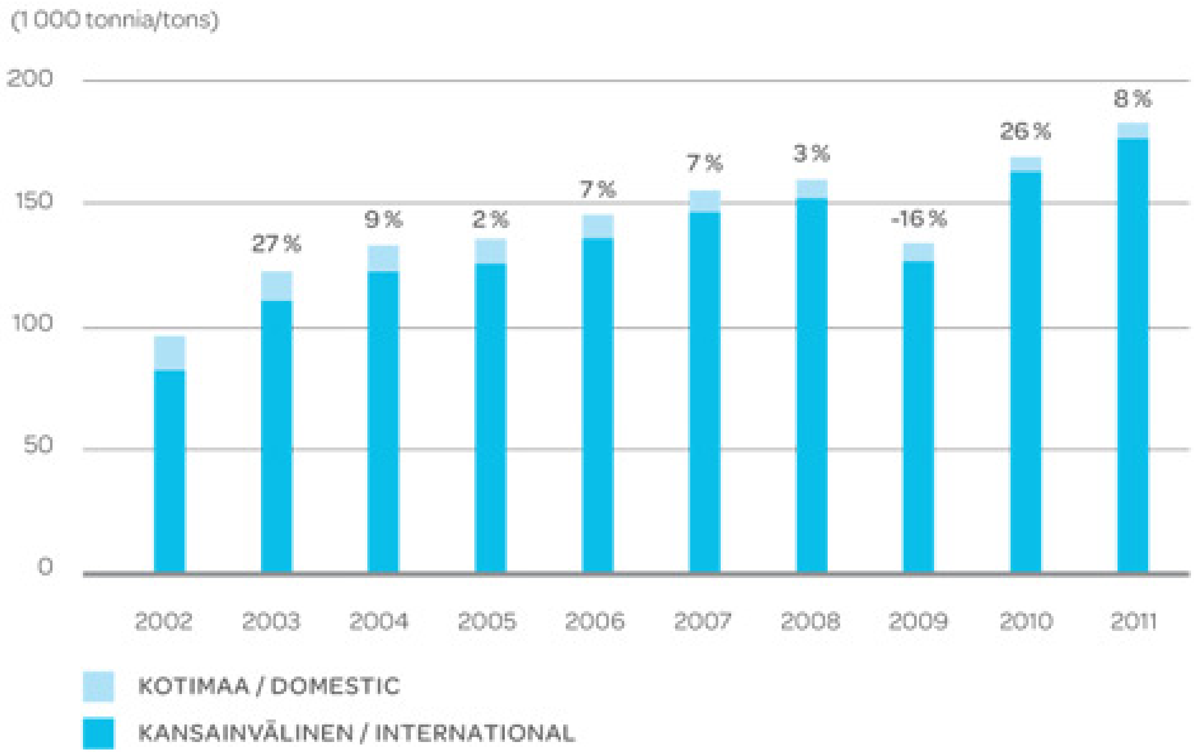
*Figure 1. Passenger traffic and growth rate 2002-2011*




Due to the gateway position of Helsinki-Vantaa Airport (14.9 million passengers in 2011), Finland is able to offer and maintain an exceptionally wide range of destinations with regard to the size of the country (5.4 million inhabitants). Finland aims to further strengthen its position as a gateway between Europe and Asia.

Tough competition, rapid changes in jet fuel prices and the poor economic outlook significantly affect airline operations. Finnair is still by far the largest airline in Finland, whereas the market share of low-cost carriers has remained relatively small. New operators are, however, making continuous attempts to enter air traffic markets in Finland, and the market share of low-cost airlines is growing.

*Figure 2. Freight and mail at Finnish airports*




The airport network is dense in Finland: there are 27 airports, out of which three are in military use, and four are used for both military and civil operations. The Finnish airport network now operates rather cost-effectively, and the network approach has helped to ensure that the level of services can be maintained. In Finland, the air transport sector carries the cost of its own infrastructure, and also largely finances the work of the civil aviation authority. Fully state-owned Finavia Corporation maintains a network of 25 airports and the air navigation system covering the entire country.

Air transport is largely regulated at an international level. The International Civil Aviation Organization ICAO traditionally plays an important role in the international co-operation and harmonisation of the sector. The EU is a key actor both in the regulation of the air transport market, flight safety issues and airspace management. In international and EU-level co-operation and regulation, Finland aims to make sure that our specific needs are taken into account, while at the same time seeking to ensure a high level of flight safety and environmental protection.

## 3. Environmentally sound air transport and emissions from Finnish aviation

The environmental impact is one of the major challenges facing the aviation sector. The air transport sector must bear responsibility for the reduction of emissions as a part of the overall transport system. Currently the $CO_2$ emissions from the air transport sector compose approximately 6% of Finland’s total transport sector $CO_2$ emissions.

Finland supports aviation emissions trading as a tool to manage environmental impacts. The emissions trading scheme has strong support among stakeholders too. At EU level, aviation was included in the emissions trading scheme in year 2012. However, Finland still strives for a global solution to be agreed in the ICAO to ensure a level playing field for all airlines. Finland also promotes more efficient use of airspace and modernisation of air carrier fleet to reduce environmental impacts. Moreover, Finland aims to introduce new and cleaner technology as well as intelligent transport solutions.

Air traffic consumes roughly 5% of all energy used in traffic sector in Finland (in 2011). Also the $N_2O$ emissions from aviation are about 5% of total traffic sector emissions, and less for other greenhouse gases. The emissions from all flights departing from and arriving in Finland, excluding overflights, are roughly one per cent of the emissions of flights from the current EU-27. Altogether, the $CO_2$ emissions reported to Finland under the EU Emissions Trading System were a total of 2.9 million tons in 2011. It is expected that the emissions will grow in the future, although less than the volume of air traffic due to improving technology.

*Table 1. Emissions and energy consumption of Finnish air traffic.*

**Development of emissions and energy consumption of Finnish air traffic 2000-2011 [t]**[1]

| Year | CO | HC | NOx | PM | $CH_4$ | $N_2O$ | $SO_2$ | $CO_2$ | Liquid fuel |
|---|---|---|---|---|---|---|---|---|---|
| 2000 | 3 167 | 458 | 3 252 | 123 | 43 | 37 | 226 | 902 012 | 284 614 |
| 2001 | 3 008 | 414 | 3 121 | 120 | 39 | 36 | 220 | 876 967 | 276 711 |
| 2002 | 2 753 | 310 | 2 717 | 107 | 29 | 32 | 196 | 780 035 | 246 123 |
| 2003 | 3 020 | 314 | 2 801 | 108 | 30 | 32 | 199 | 791 893 | 249 863 |
| 2004 | 3 314 | 356 | 2 981 | 120 | 34 | 36 | 221 | 879 134 | 277 384 |
| 2005 | 3 068 | 311 | 2 855 | 114 | 30 | 34 | 210 | 833 953 | 263 130 |
| 2006 | 3 397 | 281 | 2 833 | 114 | 27 | 34 | 210 | 836 106 | 263 814 |
| 2007 | 3 431 | 277 | 2 928 | 118 | 26 | 35 | 217 | 861 749 | 271 905 |
| 2008 | 3 373 | 279 | 3 027 | 119 | 26 | 36 | 218 | 868 267 | 273 959 |
| 2009 | 3 621 | 283 | 3 073 | 120 | 27 | 36 | 221 | 878 509 | 277 189 |
| 2010 | 3 870 | 287 | 3 120 | 121 | 27 | 36 | 224 | 888 749 | 280 420 |
| 2011 | 4 119 | 292 | 3 166 | 123 | 28 | 37 | 226 | 898 996 | 283 650 |

[1] Includes int. flights in the Finnish flight information region, not overflights

## SECTION 1- Supra-national actions, including those led by the EU

### 1. 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 Agusta Westland 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.

## 2. 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[3]. 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[4]) 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[5]. 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 2011 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.

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[6].

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.

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

[4] 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

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

[6] http://ec.europa.eu/energy/technology/initiatives/doc/20110622_biofuels_flight_path_technical_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**<br><br>**(next 0-3 years)** | Announcement of action at<br><br>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**<br><br>**(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** | Supply of an additional 0.8 M tons of aviation biofuels based on synthetic | 2.0 M tons of biofuels are blended with kerosene. |

| | | |
|---|---|---|
| **(up to 2020)** | biofuels, pyrolytic oils and algal biofuels. | |
| | Further supply of biofuels for aviation,<br><br>biofuels are used in most EU airports. | Commercialisation of aviation biofuels is achieved. |

## 3. 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.

## 4. 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.

## 5. 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, Optimisation and Carbon Neutrality), airport operators are required to demonstrate $CO_2$ 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 $CO_2$ data from participating airports over the past two years. This has allowed the absolute $CO_2$ 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’[7] for emissions under airports’ direct control (all airports) | 803,050 tonnes CO2 | 17 | 2,275,469 tonnes CO2 | 43 |

7 ‘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.

| | | | | |
|---|---|---|---|---|
| Carbon footprint per passenger | 2.6<br><br>kg CO2 | | 3.73<br><br>kgCO2 | |
| Aggregate reduction in emissions from sources under airports' direct control (Level 2 and above)[8] | 51,657<br><br>tonnes CO2 | 9 | 51,819<br><br>tonnes CO2 | 19 |
| Carbon footprint reduction per passenger | 0.351<br><br>kg CO2 | | 0.11<br><br>kg CO2 | |
| Total carbon footprint for 'year 0' for emissions sources which an airport may guide or influence (level 3 and above) | 2,397,622<br><br>tonnes CO2 | 6 | 6,643,266<br><br>tonnes CO2[9] | 13 |
| Aggregate reductions from emissions sources which an airport may guide or influence | 359,733<br><br>tonnes CO2 | | 675,124<br><br>tonnes CO2 | |
| Total emissions offset (Level 3+) | 13,129<br><br>tonnes CO2 | 4 | 85,602<br><br>tonnes CO2 | 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 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.

## SECTION 2- National Actions in Finland

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

## 1. Aircraft-related technology development

Maintaining a modern fleet is one of the most important measures an airline can do for the benefit of environment, as each new generation of aircraft reduces fuel consumption by approximately 20 per cent. According to IATA, the average age of the world’s commercial aircraft is about 11 years. The average age of Finnair’s fleet is about seven years. As Finnair continues to retire older aircraft and welcome to the fleet state-of-the-art, eco-efficient aircraft like the Airbus A350 (due 2015 onwards), the company plans to continue staying ahead of the curve.

The second-largest Finnish airline, Blue1, also develops its fleet continuously. In 2011 only, Blue1 phased out five Avro RJ jets, and in nine Boeing 717 aircraft.

## 2. Alternative fuels

The introduction of alternative fuels is an important way for airlines to reduce aviation’s impact on environment. Biofuels, for example, have the potential to reduce overall carbon emissions by between 50 to 80 per cent, depending on how they are produced and which feedstocks they come from. Biofuel refers to fuel made from renewable organic raw materials. The plants used in the production of biofuel absorb carbon dioxide, which is released back into the atmosphere when the biofuel combusts.

### *2.1 Governmental actions*

In early 2012, the Ministry of Transport and Communications established a working group to study future clean transport fuel solutions (alternatives to fossil fuels) in all transport modes, including aviation. The group will look into possible future alternative fuels for the entire Finnish transport sector as well as their availability. The group will also make suggestions for actions to be taken for the introduction of alternative fuels. The group will give its final report by the end of 2012.

### *2.2 Airlines*

On July 20, 2011 Finnair flew its first biofuel flight, from Amsterdam to Helsinki, which was the longest biofuel flight to that date. In the near future, Finnair plans to fly its first long-haul flight between Asia and Europe with biofuel. The economics of biofuels do not yet make their everyday use financially viable, but Finnair’s early embrace of the technology – without the benefit of government subsidies – is helping to stimulate the developments needed in the overall biofuel supply chain and will probably pay off in the long run.

Finnair was one of the first airlines to provide verified emissions information to authorities in 2010, and has been prepared for the EU emissions trading scheme which came into force on January 1, 2012. Finnair continues to work for the speedy establishment of a much fairer – and more ecologically sound – global emissions trading scheme through international aviation bodies.

### 2.3 Alternative fuel producers

Neste Oil is a refining and marketing company, with a production focus on premium-quality, lower-emission traffic fuels. The company produces a comprehensive range of major petroleum products and is the world's leading supplier of renewable diesel. The company had net sales of EUR 15.4 billion in 2011 and employs around 5,000 people. Neste Oil's share is listed on the NASDAQ OMX Helsinki.

Neste Oil produces both conventional and renewable aviation fuel at its Porvoo refinery in Finland. The company is a global pioneer in aviation biofuels and currently one of the only companies in the world capable of producing renewable aviation fuel in industrial quantities. In addition to its refinery in Finland, also its refineries in Rotterdam and Singapore could be harnessed to produce NExBTL renewable aviation fuel in the future.

Neste Oil's NExBTL renewable aviation fuel is a pure hydrocarbon and therefore very similar to fossil-based aviation fuel. NExBTL renewable aviation fuel fully complies with ASTM D7566-11a standard. It is a drop-in fuel, and its use does not require any modifications to the aircraft, for example its engines. Quality is particularly important in the aviation sector, as aircraft fuel must have a high energy content and be capable of being used in cold conditions. Conventional biodiesel and ethanol cannot meet these requirements. NExBTL renewable aviation fuel is fully able to meet these very stringent quality standards. Its suitability for aviation use and high-level performance have been verified in a commercial test program consisting of over 1,000 commercial flights (with Lufthansa, see more details below).

Neste Oil has committed itself to the European Aviation Biofuels Flightpath. The joint goal of the signatories is to promote the efficient adoption of biofuels by the aviation sector, as well as to ensure that aviation biofuels are produced sustainably and are suitable for use by aircraft flying on commercial routes. Neste Oil is also a member of AIREG, the Aviation Initiative for Renewable Energy in Germany, which advances the development and deployment of renewable liquid fuels in aviation and aims to contribute to achieving aviation's ambitious $CO_2$ reduction goals. Neste Oil has been an active member in developing ASTM standard specifications for renewable aviation fuel.

Neste Oil's renewable aviation fuel is based on the company's NExBTL technology, which can make very flexible use of a wide range of vegetable oils and waste- or residue-based raw materials, such as waste animal fat from the food industry. Neste Oil's procurement processes and systems are fine-tuned to ensure that all its renewable inputs are produced sustainably. Neste Oil prefers certified feedstocks, and already 49% of the raw materials that Neste Oil used in 2011 to produce its renewable fuel was certified. Material classified as waste, residues, or by-products accounted for 41% of the renewable raw materials used by Neste Oil in 2011. The company's long-term goal is to increase its use of these raw materials – which include e.g. waste animal fat from the food industry, stearin, and PFAD (palm fatty acid distillate) – to 50% of renewable inputs.

NExBTL renewable aviation fuel can significantly reduce an aircraft's greenhouse gas (GHG) emissions compared to fossil jet fuel. Depending on the feedstock and logistics, the reduction in GHG emissions is significantly smaller compared to conventional jet fuel. For instance, in the 6 months test program carried out with Deutsche Lufthansa, the greenhouse-gas savings potential of NExBTL renewable aviation fuel was

60%, resulting in a reduction of 1500 tons in $CO_2$ emissions during the program. In addition to a smaller carbon footprint, the fuel also offers lower emissions of other pollutants. NExBTL renewable aviation fuel is less toxic than conventional jet because it does not contain any aromatics. The sulphur content is also close to zero.

Neste Oil's aim is to increase commercial production of NExBTL renewable aviation fuel and generate growth as a supplier of this new fuel. Currently renewable aviation fuel is produced in batch production at the Porvoo refinery in Finland. In the upcoming years, the demand of this new fuel is expected to increase. Continuous industrial-scale production of both renewable diesel and aviation fuel at Neste Oil's refineries in Rotterdam and Singapore does, however, require additional investments.

In order to support the commercialization of renewable aviation fuel globally, cooperation is required among all stakeholders. As a fuel producer, Neste Oil supports FlightPath targets by actively participating in the work in different organizations and various workgroups, and by developing common roadmaps with airlines, OEMs, and authorities.

## 3. Improved air traffic management and infrastructure use

World's air traffic management system is a complicated patchwork of nation-based air traffic control systems. In Europe particularly, which is burdened with about 40 different flight control zones, the shortest distance between two points is not always a straight line. Planes must often zigzag around different airspace requirements, which can be extremely wasteful of both time and fuel. The Single European Sky, a pending initiative of the EU, would eventually do away with these different zones of control and would potentially save around 10 per cent in aircraft emissions almost immediately, as flight plans through Europe are rationalised, less fuel is consumed and more of passengers' valuable time is saved.

The infrastructure that determines the way airplanes land and the courses that they are allowed to plot are crucial factors in fuel efficiency, and addressing them requires close cooperation with air traffic authorities in multiple countries.

Airport infrastructure is developed with a long-term approach. Finland aims to reduce aircraft noise and also invest in reducing other environmental nuisance at airports. Infrastructure for air traffic is relatively light in comparison with other transport sectors, leading to smaller infrastructural effects on environment.

### *3.1 International state level co-operation in air navigation service (ANS) to improve environmental efficiency and reduce emissions*

Regulation (EC) No 1070/2009 of the European Parliament and of the Council requires EU Member States to set up functional airspace blocks. Under the regulation, Member States shall by 4 December 2012 take all necessary measures in order to ensure the implementation of functional airspace blocks (FAB) with a view to achieving the required capacity and efficiency of the air traffic management network within the Single European Sky and maintaining a high level of safety and contributing to the overall performance of the air transport system and a reduced environmental impact.

Negotiations on the North European Functional Airspace Block (NEFAB) between Finland, Norway, Estonia and Latvia are at their final stages.

The Benefits of the NEFAB area can be divided into two parts: Airspace Development and ATS (Air Traffic Services) provision that will give benefits to customers as well as business opportunities.

Two major NEFAB projects -Airspace 2015 and ATS Provision 2015- were kicked off in April 2012. The two projects are the first concrete joint projects where NEFAB ANSPs (Air Navigation Service Providers) and states will deliver real benefits for the customers. The projects are expected to deliver benefits in terms of new airspace structures with free route airspace, shorter routings and more efficient service provision, which again will reduce emissions and costs. Resulting from a more efficient airspace structure and more direct routes, the establishment of NEFAB is estimated to have positive impacts on the environment. It is estimated that the formation of the functional airspace block will reduce total flying time at the NEFAB area by about 6 200 hours annually by year 2015, and by 8 400 hours by 2020, in comparison with 2011. Respectively, fuel consumption will be 13 800 tons (2015) and 18 800 tons (2020) lower compared to 2011, leading to $CO_2$ reductions of 46 000 tons (2015) and 62 500 tons (2020).

### *3.2 Nordic cooperation between air navigation service providers for environmental benefits*

The Air Navigation Service Providers of NEFAB members (for Finland: Finavia Corporation, the Finnish Air Navigation Service Provider that maintains a network of 25 airports in Finland and the air navigation system covering the entire country), along with the ANSPs of Iceland, Sweden and Denmark, have signed a Memorandum of Understanding in December 2011. The MoU is intended for common airspace development and service provision among the parties, aiming to benefit customers and airspace users in terms of more efficient airspace structure and service provision.

### *3.3 International co-operation between air navigation service providers*

Finavia Corporation has been active in establishing a wide alliance between ANSPs in Northern Europe. ANSPs from Finland, Latvia, Estonia, Norway, Sweden, Denmark, United Kingdom, Ireland and Iceland will sign an agreement on an alliance called **Borealis** in June 2012. The objective is to facilitate cooperation between the Members under commercially recognized business partnering principles that will make a contribution to the operational and financial performance of the Members’ air traffic services. By 2015, the alliance should also contribute to the achievement of Single European Sky and ICAO performance targets.

ANSPs have seen that they need to collaborate to drive better performance. The Alliance rationale includes e.g. the following issues:

- Optimization of flight profiles on a repeatable basis between key Borealis airports (fuel savings and delay reductions for customers)

- Environmental Initiative to seek sustainability and improved score in environmental efficiency (fuel efficiency and $CO_2$ emissions)

### *3.4 Finavia Corporation's air navigation services provide an efficient airspace in Finland*

According to a study carried out in May and October 2010, average horizontal en-route flight efficiency between city pairs in Finland was extremely good. The en-route part of the flights was on average 2.2% and 2.0% longer than the optimum trajectory, while at the same time the European reference level for en-route extensions is 5.4% on an average.

The Free Route Airspace Concept will be implemented progressively during years 2014-2015 together with other NEFAB states.

### *3.5 Continuous descent operations*

By using the Continuous Descent Operations (CDO) technique, fuel burn, emissions and aircraft noise can be reduced. Finavia Corporation offers Continuous Descent Operations at all its 25 airports. Since 2008 Finavia Corporation has had a project to develop methods to improve knowledge about and performance of CDO with three major Finnish airlines (Finnair, Blue1 and FinnComm/Flybe Nordic).

At Helsinki Airport, the percentage of CDOs during 2011 was 55% of all approaches. Even during parallel-runway operations, 29% of the aircraft approaching the runway for which the procedure allows altitude to be adjusted according to the CDO technique were able to perform CDO. During night time (00 – 07) the proportion of CDO was 59%. At other Finavia airports the percentage of CDO is higher because of uncongested airspace.

With good co-operation between Air Traffic Control and airlines, CDO can be performed to all three runways at Helsinki Airport at all times except for the afternoon rush hour, when independent parallel operations are in use. Approximately 100 kg of fuel (which means 320 kg of $CO_2$) can be saved by performing CDO with a narrow body aircraft. The amount of $CO_2$ emissions savings by CDO is roughly 13 000 tonnes per year at Helsinki Airport.

Finavia Corporation is constantly developing arrival routes and procedures to allow more planes to perform CDOs. A code of conduct for Continuous Descent Operations has been produced to be handed out as a guideline for all the airlines. Finavia Corporation is striving to achieve better results by 2015.

For example, good cooperation with Air Traffic Control allows about 60 per cent of Finnair's landings to use a Continuous Descent Approach, which requires significantly less fuel than the standard "stepped" approach. In traditional stepped landings, pilots must repeatedly increase engine thrust to level off as they descend, which greatly increases emissions and noise around the airport. However, greener, quieter CDA landings are only possible with the well-developed, relatively uncongested infrastructure of airports such as Helsinki's.

Blue1 takes full advantage of CDA as well, and has included green landings in its fuel savings programme.

## 4. More efficient operations

Technological improvements are not the only means to reduce emissions. Better planning of operations is also a key factor when trying to find a way towards cleaner aviation.

Airlines act proactively by thoroughly reviewing their operations with the goal of reducing fuel consumption. “Weight watcher” programs for all aircraft, for example, can mean lighter seats and catering trolleys made of lighter, tougher, more modern materials. The lower the aircraft weight, the less fuel it needs to burn.

Sophisticated Cost Index components of aircraft avionics, meanwhile, perform real-time calculations based on weather and flight plan data to suggest changes in speed or altitude that optimise fuel economy. On the ground, single-engine taxiing and using airports’ main electrical power instead of aircrafts’ fuel-hogging auxiliary power units can also have a significant impact on fuel economy and on reducing noise at airports.

In 2011 Finnair launched a programme which aims at approximately 2 per cent annual savings in jet fuel consumption. This equates to saving approximately 14 million kilograms of jet fuel annually. With respect to fuel-related economy projects, Finnair completed its programme aiming to reduce the use of APU (auxiliary power unit). A reduction of slightly over 20 per cent in using APU in the Airbus 320 fleet brought about savings of 1.1 million kilograms of fuel, which is nearly 48,000 GJ and thus reduces 3.5 million kg of $CO_2$. APU is an on-board auxiliary power unit which provides electricity, compressed air and hydraulic power for the aircraft’s systems.

For the year 2012, other energy saving measures in flight operations are yet to be determined. Projects which have already been started aim to save fuel by reducing aircraft empty weight, optimising flight techniques and speed as well as improving taxi, take-off and approach procedures. All these initiatives are expected to bring about savings already during 2012.

Another way of improving aircraft fuel economy is training the pilots. Finnair Flight Academy’s new training solutions emphasise the benefits of economical flying. Their aim is to reduce operative costs, improve training models and reduce emissions. International Air Transport Association (IATA) has estimated that inefficient operational models increase operational costs by as much as 2–8 per cent. The Reverse Green™ type training programme covers all areas of flying that have an effect on overall economy in relation to skills and attitude. The Fit to Fly™ recurrent training programme offers the same elements in annual training sessions. Multifly™, organised in collaboration with Patria Pilot Training, provides newly qualified pilots extensive skills in economical flying, also in the challenging Northern conditions.

Finnair Flight Academy also markets its training solutions to other airlines. These measures are expected to bring about up to 2 per cent savings in fuel consumption and operative costs for Finnair.

Also Blue1 has adopted a fuel saving programme, which includes flight crew training in environmental flying, operational procedures with reference to the environment, new flight planning system to be introduced during Q1 2012, as well as maintenance and washing of aircraft engines to reduce emissions.

## 5. Other measures

### *5.1 Airport collaborative decision making, A-CDM*

Finavia Corporation has run Airport Collaborative Decision Making (CDM) at Helsinki Airport since March 2011. Helsinki is the country’s main airport with some 14 Mpax and 190000 annual movements. A-CDM is a concept which aims at improving air traffic flow management at airports by reducing delays, improving the predictability of events and optimizing the utilization of resources. The concept is based on the Eurocontrol Airport CDM Implementation Manual.

A-CDM aims at increased efficiency in the use of airport capacity. A-CDM includes the timely use of runways, stands and services supporting the turn-around of aircraft. During wintertime, efficiently coordinated de-icing services are vital for smooth operation of an airport. E.g. better estimated in-block times will be provided to the airport partners using more accurate landing times, actual landing runway information and estimated taxi-in time calculation.

One of the major targets of A-CDM is to reduce taxi-out time by managing the off-block times of departing aircraft. Minimizing holding on taxiways significantly reduces fuel burn and emissions at the airport. Airlines are responsible for ensuring that they inform the Air Traffic Control (ATC) on the target off block time properly and according to the CDM rules. This enables accurate operative decisions by the ATC.

### *5.2 Energy efficiency at airports*

Finavia Corporation has an Energy and Climate Programme which requires monitoring and controlling energy efficiency at airports (electricity, heating, airside vehicles etc.). With various measures under the programme, the emissions from airport activities have been reduced. The use of biofuels in the heating of airport buildings has resulted in emission reductions. The total $CO_2$ emissions from all Finavia's 25 airports have decreased by around 5 000 tonnes during the last five years, and totals 32 000 tonnes in 2011.

Finavia Corporation joined **ACI's Airport Carbon Accreditation** programme in 2011. The Lapland Airports group, consisting of 6 airports (Kittilä, Enontekiö, Rovaniemi, Kuusamo, Ivalo and Kemi-Tornio), was accredited to ACA level 2 (Reduction) of the 4-step programme. Helsinki Airport will be accredited to the Reduction level in June 2012.

## CONCLUSION

It is clear that air traffic continues be an essential part of Finland's transport network also in the future. Geographical challenges make sure that air connections are needed, although different modes of ground transport improve and offer alternatives to travellers. In addition, aviation brings significant economic benefits to the Finnish economy and its citizens. We must bear in mind that reducing emissions is a task which calls for a comprehensive approach in the society.

The Action Plan shows that a lot has already been done at multinational and national level to reduce aviation carbon footprint. Reduction of aviation carbon emissions is a joint effort for various actors. Airlines, airports, air engine and aircraft manufacturers, multinational and national transport authorities, international organisations and renewable aviation fuel providers all need to work together towards the common goal of cleaner aviation. Though there remains work to be done, aircraft engines, air traffic management and flight operations can only be improved to a limited extent. To achieve better results we need to look for alternatives for fossil fuel. A big challenge ahead is the commercialisation of sustainable alternative fuels for aviation.