

# **State Action Plan of Finland**

## **International Aviation CO<sub>2</sub> Emissions**

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Finnish Transport Safety Agency  
Liikenteen turvallisuusvirasto Trafi  
Trafiksäkerhetsverket Trafi  
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## ALKUSANAT

Lentoliikenteen kansainvälistä ympäristötyötä tehdään YK:n alaisen kansainvälisen siviili-ilmailujärjestö ICAO:n johdolla. ICAO:n yleiskokouksen vuonna 2013 hyväksymä ilmastomuutosta koskeva päätöslauselma sisältää päästövähennystavoitteet ja yleiset suuntaviivat taloudellisille ohjaukskeinoille kansainvälisen lentoliikenteen CO<sub>2</sub>-päästöjen hillitsemiseksi. Lentoliikenteen päästöjen osalta pyritään hiilineutraaliin kasvuun vuodesta 2020 lähtien.

Liikenteen turvallisuusvirasto Trafi oli Suomen ilmailuviranomaisena mukana yleiskokouksessa 2013 sopimassa siitä, että lentoliikenteen energiatehokkuutta parannetaan vuosittain kahdella prosentilla vuoteen 2050 saakka. Valtioiden tulee raportoida kansainvälisen lentoliikenteen CO<sub>2</sub>-päästönsä ICAO:lle. Kunkin valtion on myös laadittava toimintasuunnitelma, joissa se linjaa toimensa ilmastomuutoksen hillitsemiseksi lentoliikenteen osalta.

### **Suomen kansallinen toimintasuunnitelma**

Suomen toimintasuunnitelma (State Action Plan) annettiin tänään sähköisesti ICAO:lle. Suomi laati suunnitelmansa EU / ECAC -valtioiden keskenään sopiman mallin mukaisesti, jossa mallissa on sekä ylikansallinen että kansallinen osuus. Ylikansallisen osuuden luonnosteli ACCAPEG-työryhmä (Aviation and Climate Change Action Plan Expert Group), jonka työhön Trafi osallistui. Kansallisia erityispiirteitä kuvaavan osuuden Trafi laati yhteistyössä suomalaisten lentoyhtiöiden, lentoaseman pitäjien ja lennonvarmistuspalveluiden tarjoajien sekä Nesteen kanssa. Suunnitelman kansallinen osuus käsittelee seuraavia aihealueita:

- Ilma-aluksiin liittyvä tekninen kehitys
- Kestävien vaihtoehtoisten polttoaineiden (biopolttoaineet) kehitys ja käyttöönotto
- Ilmatilanhallinnan ja infrastruktuurin optimointi ja parantaminen
- Tehokkaammat lento-operaatiot
- Markkinaperusteiset päästöjenvähennyskeinot
- Muut päästöjenvähennyskeinot

Suomen toimintasuunnitelmaa työstänyttä työryhmää on vetänyt erityisasiantuntija Joonas Laukia Trafista. Työryhmässä ovat olleet mukana liikenneneuvos Risto Saari liikenne- ja viestintäministeriöstä, johtava asiantuntija Kari Siekkinen Trafista, kestävän kehityksen johtaja Mikko Viinikainen ja ympäristöasiantuntija Johanna Kara Finaviasta, Vice president of safety, quality and environmental management Saija Stenbacka ja Manager Outi Merilä Finnairista, Head of operations support Ann-Sofie Snåre ja Operations engineering manager Jarno Ruotsalainen Nordic Regional Airlinesista, Head of compliance monitoring, safety & security Aki Tuominen ja Manager, support and engineering Janne Kulmala Blue1:sta sekä Sales Development Manager Roger Lindfors Nesteeltä.

Helsingissä 30.6.2015

Pekka Henttu

ilmailujohtaja

# Sisällysluettelo

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# 1 Common preamble for European States' Action Plans for emissions reductions

- 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<sup>1</sup> 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 on-going 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 an updated State Action Plan for emissions reductions, as an important step towards the achievement of the global collective goals agreed at the 38th Session of the ICAO Assembly in 2013.
- e) In that context, it is the intention that all ECAC States submit to ICAO an Action Plan<sup>2</sup>. 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, recognizing 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<sub>2</sub> 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 European Union. 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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<sup>1</sup> 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

<sup>2</sup> ICAO Assembly Resolution A38-18 also encourages States to submit an annual reporting on international aviation CO<sub>2</sub> emissions, which is a task different in nature and purpose to that of Action Plans, strategic in their nature. For that reason, the reporting to ICAO on international aviation CO<sub>2</sub> emissions referred to in paragraph 11 of ICAO Resolution A38/18 is not part of this Action Plan. This information will be provided to ICAO separately, as this is already part of the existing routine provision of data by ECAC States.

- h) In Finland, a number of actions are undertaken at the national level, including those 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).

## 1.1 Current state of aviation in Finland

### 1.1.1 General

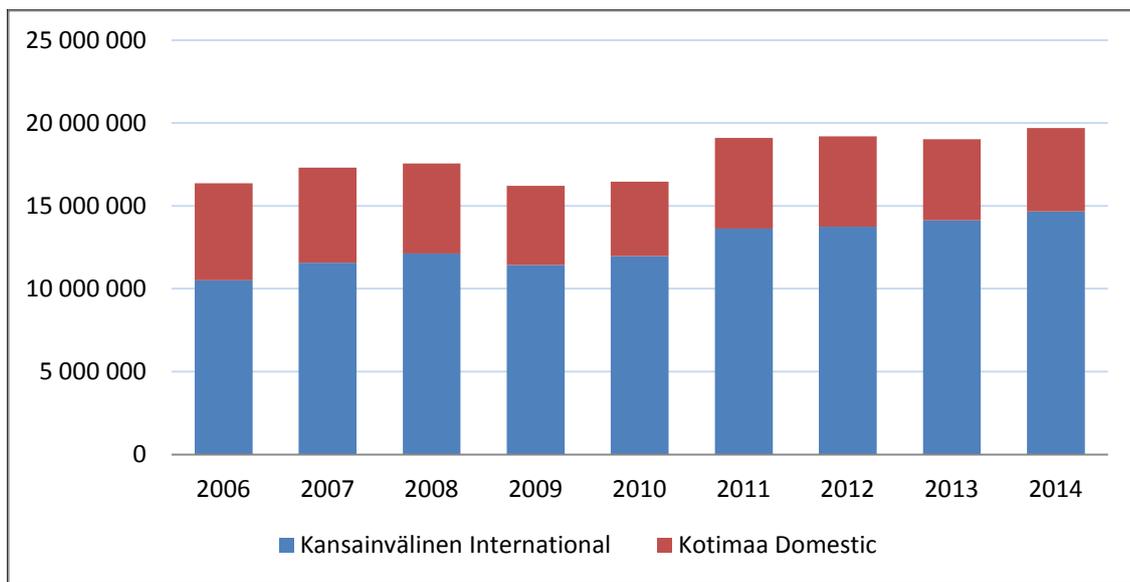
Air transport is an important part of an efficient and well-functioning transport system and a key factor for competitiveness of Finland. Economic growth in Finland is based on export, but the country is located far from the market areas for our products. Logistically, Finland is an island; without air transport, it 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. A study conducted by Oxford Economics estimated that the aviation sector, together with closely connected industry sectors, produce 3.2% of Finland’s GDP, and employ a total of 100 000 persons directly or indirectly.

### 1.1.2 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 connectivity with 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. More than 80 % of Finland´s air passenger traffic and about 95% of air freight traffic passes through Helsinki Airport. A total of 19.7 million passengers and 194 475 tonnes of air freight went through Finnish airports in 2014. Even though only about 1 % of the total volume of imports and exports are carried by air freight, about 10 % of total value of foreign trade is carried by air. The volume of air freight is expected to grow in the near future.

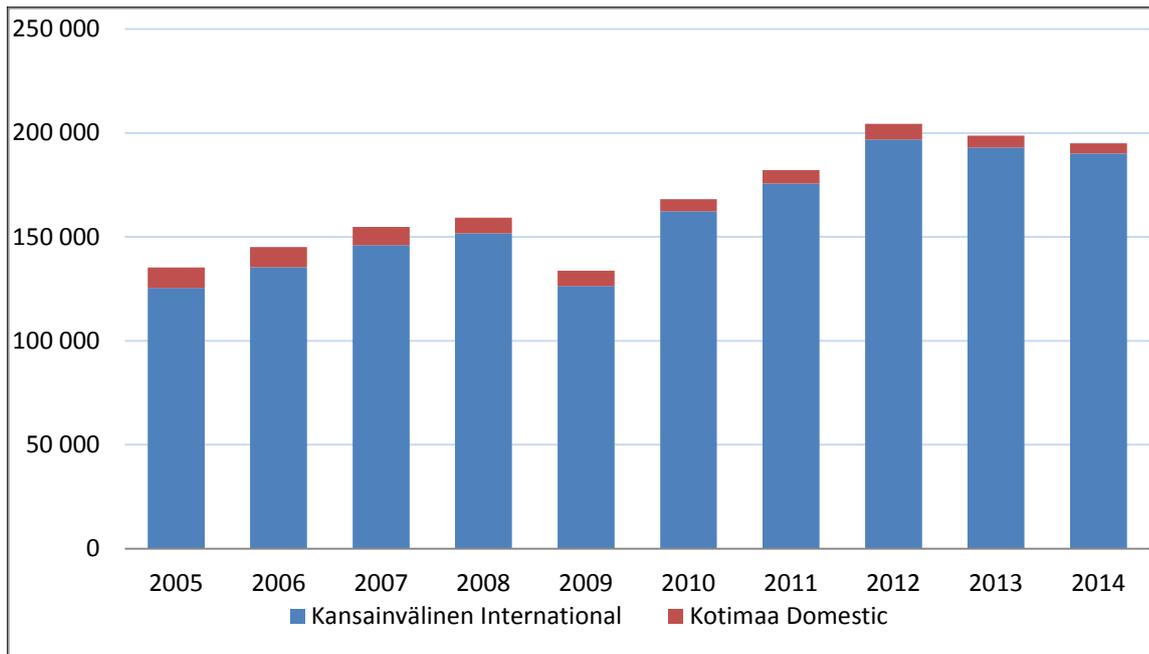
Due to the gateway position of Helsinki Airport (15.9 million passengers in 2014), Finland is able to offer and maintain an exceptionally wide range of destinations with regard to the size of the country (5.5 million inhabitants). Finland aims to further strengthen its position as a gateway between Europe and Asia.

Figure 1. Passenger traffic at Finnish airports 2006-2014



Tough competition, rapid changes in jet fuel prices and the poor economic outlook significantly affect airline operations. There are total of 11 commercial air carriers in Finland, out of which Finnair is still by far the largest. 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. Three largest Finnish airlines (Finnair, Blue1/SAS and Nordic Regional Airlines (former Flybe Finland)), together with Norway-registered Norwegian, operate nearly all of the domestic traffic, and over 70 % of international traffic.

Figure 2. Freight and mail at Finnish airports 2005-2014



The airport network is dense in Finland: there are 24 airports within the airport network maintained by state-owned company Finavia Ltd and two independent airports maintained by municipalities (Seinäjoki and Mikkelä). The Finnish airport network maintained by Finavia operates cost-effectively in accordance with the network principle, and the network principle 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.

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.

### 1.1.3 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<sub>2</sub> emissions from the air transport sector compose approximately 6% of Finland's total transport sector CO<sub>2</sub> 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<sub>2</sub>O 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-28. Altogether, the CO<sub>2</sub> emissions reported to Finland under the EU Emissions Trading System were a total of 0.9 million tonnes in 2014. 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. CO<sub>2</sub> emissions from international aviation 1990-2013<sup>3</sup>*

Year	CO <sub>2</sub> Emissions (kt CO <sub>2</sub> )	Year	CO <sub>2</sub> Emissions (kt CO <sub>2</sub> )
1990	1 008	2002	1 078
1991	948	2003	1 114
1992	838	2004	1 282
1993	788	2005	1 290
1994	829	2006	1 435
1995	897	2007	1 656
1996	960	2008	1 792
1997	998	2009	1 570
1998	1 022	2010	1 654
1999	1 094	2011	1 957
2000	1 063	2012	1 889
2001	1 090	2013	1 949

<sup>3</sup> Calculation is based on IPCC methodology, and this same data is reported to the UNFCCC as a part of Finland's greenhouse gas inventory report.

## 2 Section 1: European supra-national measures, including those led by the European Union

### 2.1 European baseline scenario

[The baseline scenario will be provided by EUROCONTROL including traffic in RPK of European international flights, fuel consumption, and average fuel efficiency. It also gives traffic and emissions forecasts for the years agreed. These will by default cover all of the ECAC Member States for incorporating in the table below:

#### European Baseline Scenario

	CO2 emissions, tons	Traffic in RTK**	Fuel consumption, in tons	Fuel efficiency
2010				
2020				
2030? Or 2035? Or 2050?*				

\* should the forecasts be for 2030, 2035 or 2050 ? (only 2 non-EU ECAC States provide forecasts for 2050 and 1 for 2025)

\*\* Level of accuracy (scope covered as compared to ECAC Scope) estimated on the basis of share of international traffic covered (see Decision 3 of AC-CAPEG6/SD)

The required data regarding the baseline scenario covering all ECAC member states, will not be available until Oct/Nov 2015 creating a caveat in the common section in relation to the baseline data. The common section to the State's Action Plans will be updated and completed by all ECAC Member States as soon as the necessary data are available. The data that are already available can now be viewed on the pages of the EUROCONTROL website in which statistical data is presented (<http://www.eurocontrol.int/articles/statistics>).

## 2.2 Actions taken at the supranational level

### 2.2.1 Aircraft related technology development

#### 2.2.1.1 Aircraft emissions standards [Europe's contribution to the development of the CO<sub>2</sub> standard in CAEP]

European Member States fully support the ongoing work in ICAO's Committee on Aviation Environmental Protection (CAEP), and welcomed the agreement of certification requirements for a global aeroplane CO<sub>2</sub> Standard at CAEP/9 in 2013. Assembly Resolution A38-18 requests the Council to develop a global CO<sub>2</sub> standard for aircraft aiming to finalize analyses by late 2015 and adoption by the Council in 2016. Europe continues to make a significant contribution to this task notably through the European Aviation Safety Agency (EASA) which co-leads the CO<sub>2</sub> Task Group within CAEP's Working Group 3, and which provides extensive technical and analytical support.

In the event that a standard, comprising of certification requirements and regulatory level, is adopted in 2016, it is expected to have an applicability date set at 2020 or beyond. In addition to being applicable to new aeroplane types, CAEP is discussing potential applicability options for in-production types. The contribution that such a standard will make towards the global aspirational goals will of course depend on the final applicability requirements and associated regulatory level that is set.

#### 2.2.1.2 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 7<sup>th</sup> Framework Programme (FP7) and continued within the Horizon 2020 Framework Programme 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 pulls together the research and technology resources of the European Union in a coherent programme, and contribute significantly to the 'greening' of aviation.

#### Clean Sky 1 (2011 to 2017)

**Budget: €1.6 billion**

**CO<sub>2</sub> emissions reduction: -20% to -40% (programme objective)**

**Fuel burn CO<sub>2</sub> target 2020 (2000 baseline):  
-50% per pax.km or tonne.km**

The first Clean Sky programme was set up in 2011 for a period up to 31 December 2017, with a budget of € 1.6 billion, equally shared between the European Commission and the aeronautics industry, and the aim to develop environmental friendly technologies impacting all flying segments of commercial aviation. Clean Sky objectives for the whole programme at aircraft

level are to reduce CO<sub>2</sub> aircraft emission between 20-40%, NO<sub>x</sub> by around 60% and noise by up to 10dB compared to year 2000 aircraft.

**Clean Sky 2 (2014-2024)**

**Budget: €4 billion**

**Fuel burn CO<sub>2</sub> target 2025 (baseline: state of the art 2014): - 20%**

**Fuel burn CO<sub>2</sub> target 2035 (baseline: state of the art 2014): - 30%**

A new programme – **Clean Sky 2** – was set up in 2014 for a period up to 31 December 2024 in order to make further advancements towards more ambitious environmental targets and to secure the competitiveness of the European aeronautical industry in the face of growing competition. The new Clean Sky 2 Joint Technology Initiative objectives are to increase the aircraft fuel efficiency and reduce aircraft emissions and noise by 20 to 30% with respect to the latest technologies entering into service in 2014. The current budget for the programme is approximately €4 billion with more than € 2 billion industrial commitment matched by a similar contribution from the Horizon 2020 transport budget.

It is estimated that the technology developments already made or in progress could reduce aviation CO<sub>2</sub> emissions by more than 20% with respect to baseline levels (in 2000), which represents an **aggregate reduction of 2 to 3 billion tonnes of CO<sub>2</sub> over the next 35 years.**

Technologies, Concept Aircraft and Demonstration Programmes form the three complementary instruments used by Clean Sky in meeting its goals:

- **Technologies** 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 and general aviation aircraft. The technologies are developed in Clean Sky by each Integrated Technology Demonstrators (ITD), and subject to TRL roadmaps. Some technologies may not directly provide an environmental outcome, being 'enabling technologies' without which the global achievements would not be feasible.
- **Concept Aircraft** are design studies dedicated to integrating technologies into a viable conceptual configuration. They cover a broad range of aircraft: business jets, regional and large commercial aircraft, as well as rotorcraft. They are categorized in order to represent the major future aircraft families. Clean Sky environmental results will be measured and reported mainly by comparing Concept Aircraft to existing aircraft and aircraft incorporating 'business as usual' technology in the world fleet.
- **Demonstration Programmes** include physical demonstrators that integrate several technologies at a larger 'system' or aircraft level, and validate their feasibility in operating conditions. This helps determine the true potential of the technologies and enables a realistic environmental assessment. Demonstrations in a relevant

operating environment enable technologies to reach the maturity level of 6, according to the scale of levels of technology maturity developed by NASA in 1995 and called Technology Readiness Level (TRL).

In the Clean Sky programme 12 industry leaders, 74 associated members and more than 400 partners are working together in a number of technology domains to address the common environmental objectives and to demonstrate and validate the required technology breakthroughs in a commonly defined programme. All those technology domains have been integrated into 6 Integrated Technology Demonstrators (ITD) that cover the broad range of R&D work and able to deliver together more environmental friendly aircraft manufacturing and operations:

**Smart Fixed Wing Aircraft** – delivers active 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, are being integrated into the demonstration programmes and concept aircraft.

**Green Regional Aircraft**– develops 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** - – delivers 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** - designs and builds 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 threeshaft engine and a new turboshaft engine for helicopters.

**Systems for Green Operations** - focuses 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** - supports the ITDs with environmental impact analysis of the product life-cycle. Eco- Design focuses 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.

In addition, the **Technology Evaluator** programme, co-led by DLR and Thales, is a set of numerical models predicting the local and global environmental impact of developed technologies and allows independent analysis of the projects Part of the Clean Sky programme is performed by partners selected through open calls for proposals addressing specific tasks which fit into the overall technical Work Programme and time schedule.

By 2014 most down-selections of key technologies have been completed for integration in demonstrators that will enter the phase of detailed design, manufacturing and testing. Several demonstrators have passed the design phase and have started testing successfully. An Advanced Lip Extended Acoustic Panel, the technology to reduce the Fan noise of large turbofan engine was flown and validated in operational conditions in 2010 with an Airbus A380-800 aircraft. A flight test with Falcon F7X, which validated the technology to visualize laminar flow structure in flight by an infrared camera, was already performed in 2010. Two flight tests started in the last quarter of 2014, namely in the Sustainable and Green Engines ITD with SAGE 3 flight testing on Advanced Low Pressure System (ALPS) configuration and the flight

tests of an experimental Liquid Skin Heat Exchanger (LSHX) in the System for Green Operations ITD.

The two Interim Evaluations of Clean Sky in 2011 and 2013 acknowledged that the programme is successfully stimulating developments towards environmental targets and that it was highly successful in attracting a high level and wide participation from all EU key industries and a large number of SMEs. The preliminary assessments of the environmental benefits confirm the capability of achieving the overall targets at completion of the programme.

**Clean Sky: First Assessment (2011)**

The first assessment of the Technology Evaluator performed in 2011 demonstrated that short/medium range aircraft equipped with open rotor engines and laminar-flow wing technology could deliver up to **30% better fuel efficiency and related CO2 emissions** and important reductions in noise nuisance are foreseen.

**Clean Sky: Second Assessment (2012)**

The second assessment performed in 2012 showed similar results and demonstrated that **CO2 emission reduction is in the range of 20 to 30% depending on the type of aircrafts**. Reduction in NOx emissions is up to 70% and in noise footprint up to 68% depending on the concept aircraft.

Based on this success, the Clean Sky 2 programme builds upon contents and achievements of the Clean Sky programme and makes further advancements towards more ambitious environmental targets.

In terms of programme structure, Clean Sky 2 continues to use the Integrated Technology Demonstrators (ITDs) mechanism but also involves demonstrations and simulations of several systems jointly at the full vehicle level through Innovative Aircraft Demonstrator Platforms (IADPs). A number of key areas are coordinated across the ITDs and IADPs through Transverse Activities (TA) where additional benefit can be brought to the Programme through increased coherence, common tools and methods, and shared know-how in areas of common interest. As in Clean Sky, a dedicated monitoring function - the Technology Evaluator (TE) - is incorporated in Clean Sky 2.

- **Large Passenger Aircraft IADP** --TRL demonstration of the best technologies to accomplish the combined key ACARE goals with respect to the environment, fulfilling future market needs and improving the competitiveness of future products.
- **Regional Aircraft IADP** --focuses on demonstrating and validating key technologies that will enable a 90-seat class turboprop aircraft to deliver breakthrough economic and environmental performance and superior passenger experience.
- **Fast Rotorcraft IADP** --consists of two separate demonstrators, the NextGenCTR tilt-rotor and the FastCraft compound helicopter. These two fast rotorcraft concepts aim to deliver superior vehicle versatility and performance.

- **Airframe ITD** –demonstrates, as one of the key contributors to the different IADPs flight demonstrators, advanced and innovative airframe structures like a more efficient wing with natural laminar flow, optimised control surfaces, control systems and embedded systems, highly integrated in metallic and advanced composites structures. It will also test novel engine integration strategies and investigate innovative fuselage structures.
- **Engines ITD** –focuses on activities to validate advanced and more radical engine architectures.
- **Systems ITD** –develops and builds highly integrated, high TRL demonstrators in major areas such as power management, cockpit, wing, landing gear, to address the needs of future generation aircraft in terms of maturation, demonstration and Innovation.
- **Small Air Transport TA** –aims at developing, validating and integrating key technologies on small aircraft demonstrators up to TRL6 and to revitalise an important segment of the aeronautics sector that can bring key new mobility solutions.
- **Eco-Design TA** – coordinating research geared towards high eco-compliance in air vehicles over their product life and heightening the stewardship in intelligent Re-use, Recycling and advanced services.

In addition, the **Technology Evaluator** will continue and be upgraded to assess technological progress routinely and evaluate the performance potential of Clean Sky 2 technologies at both vehicle and aggregate levels (airports and air traffic systems).

## 2.2.2 Alternative fuels

### 2.2.2.1 European Advanced Biofuels Flightpath

Within the European Union, Directive 2009/28/EC on the promotion of the use of energy from renewable sources (“the Renewable Energy Directive” – RED) established mandatory targets to be achieved by 2020 for a 20% overall share of renewable energy in the EU and a 10% share for renewable energy in the transport sector. Furthermore, sustainability criteria for biofuels to be counted towards that target were established.<sup>4</sup>

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 SWAFEA final report was published in July 2011<sup>5</sup>. 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<sup>6</sup>) 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.

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<sup>4</sup> Directive 2009/28/EC of the European Parliament and of the Council of 23/04/2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Article 17 Sustainability criteria for biofuels and bioliquids, at pp. EU Official Journal L140/36-L140/38.

<sup>5</sup> <http://www.swafea.eu/LinkClick.aspx?fileticket=llISmYPFNxY%3D&tabid=38>

<sup>6</sup> 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

In March 2011, the European Commission published a White Paper on transport<sup>7</sup>. 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.**

ACARE Roadmap targets to share alternative sustainable fuels:

**2% in 2020**

**25% in 2035**

**at least 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<sup>8</sup>.

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 2<sup>nd</sup> Generation biofuel projects;
6. Accelerate targeted research and innovation for advanced biofuel technologies, and especially algae.
7. Take concrete actions to inform the European citizen of the benefits of replacing kerosene by certified sustainable biofuels.

<sup>7</sup> Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM(2011) 144 final

<sup>8</sup> [http://ec.europa.eu/energy/technology/initiatives/doc/20110622\\_biofuels\\_flight\\_path\\_technical\\_paper.pdf](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.

<b>Time horizons (Base year - 2011)</b>	<b>Action</b>	<b>Aim/Result</b>
<b>Short-term (next 0-3 years)</b>	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.
<b>Mid-term (4-7 years)</b>	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.
<b>Long-term (up to 2020)</b>	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.

When the Flightpath 2020 initiative began in 2010, only one production pathway was approved for aviation use; no renewable kerosene had actually been produced except at very small scale, and only a handful of test and demonstration flights had been conducted using it. During the four years since then, worldwide technical and operational progress of the industry has been remarkable. Three different pathways for the production of renewable kerosene are now approved and several more are expected to be certified. More than 1,600 flights using renewable kerosene have been conducted, most of them revenue flights carrying passengers. Production has been demonstrated at demonstration and even industrial scale for some of the pathways. Use of renewable kerosene within an airport hydrant system will be demonstrated in Oslo in 2015.

### Flights

IATA: 1600 flights worldwide using bio-kerosene blends  
Lufthansa: 1189 flights Frankfurt-Hamburg using 800 tons of bio-kerosene  
KLM: 18 flights Amsterdam-Aruba-Bonaire using 200 tons of bio-kerosene

### Production (EU)

**Neste** (Finland): by batches

- Frankfurt-Hamburg (6 months) 1189 flights operated by Lufthansa: 800 tons of bio-kerosene

- Itaka: €10m EU funding (2012-2015): > 1 000 tons

**Biorefly**: €13.7m EU funding: 2000 tons per year – second generation (2015) – BioChemtex (Italy)

**BSFJ Swedish Biofuels**: €27.8m EU funding (2014-2019)

#### 2.2.2.2 Research and Development projects on alternative fuels in aviation

In the time frame 2011-2016, 3 projects have been funded by the FP7 Research and Innovation program of the EU.

**ITAKA**: €10m EU funding (2012-2015) with the aim of assessing the potential of a specific crop (camelina) for providing jet fuel. The project aims entail the testing of the whole chain from field to fly, assessing the potential beyond the data gathered in lab experiments, gathering experiences on related certification, distribution and on economical aspects. As feedstock, ITAKA targets European camelina oil and used cooking oil, **in order to meet a minimum of 60% GHG emissions savings compared to the fossil fuel jetA1**.

**SOLAR-JET**: this project has demonstrated the possibility of producing jet-fuel from CO<sub>2</sub> and water. This was done by coupling a two-step solar thermochemical cycle based on non-stoichiometric ceria redox reactions with the Fischer-Tropsch process. This successful demonstration is further complemented by assessments of the chemical suitability of the solar kerosene, identification of technological gaps, and determination of the technological and economical potentials.

**Core-JetFuel**: €1.2m EU funding (2013-2017) this action evaluates the research and innovation "landscape" in order to develop and implement a strategy for sharing information, for coordinating initiatives, projects and results and to identify needs in research, standardisation, innovation/deployment, and policy measures at European level. Bottlenecks of research and

innovation will be identified and, where appropriate, recommendations for the European Commission will be elaborated with respect to re-orientation and re-definition of priorities in the funding strategy. The consortium covers the entire alternative fuel production chain in four domains: Feedstock and sustainability; conversion technologies and radical concepts; technical compatibility, certification and deployment; policies, incentives and regulation. CORE-JetFuel ensures cooperation with other European, international and national initiatives and with the key stakeholders in the field. The expected benefits are enhanced knowledge of decision makers, support for maintaining coherent research policies and the promotion of a better understanding of future investments in aviation fuel research and innovation.

**In 2015, the European Commission is launching projects under the Horizon 2020 re-search programme with capacities of the order of several 1000 tons per year.**

### ***2.2.3 Improved air traffic management and infrastructure use***

#### *2.2.3.1 The EU's Single European Sky Initiative and SESAR*

##### **SESAR Project**

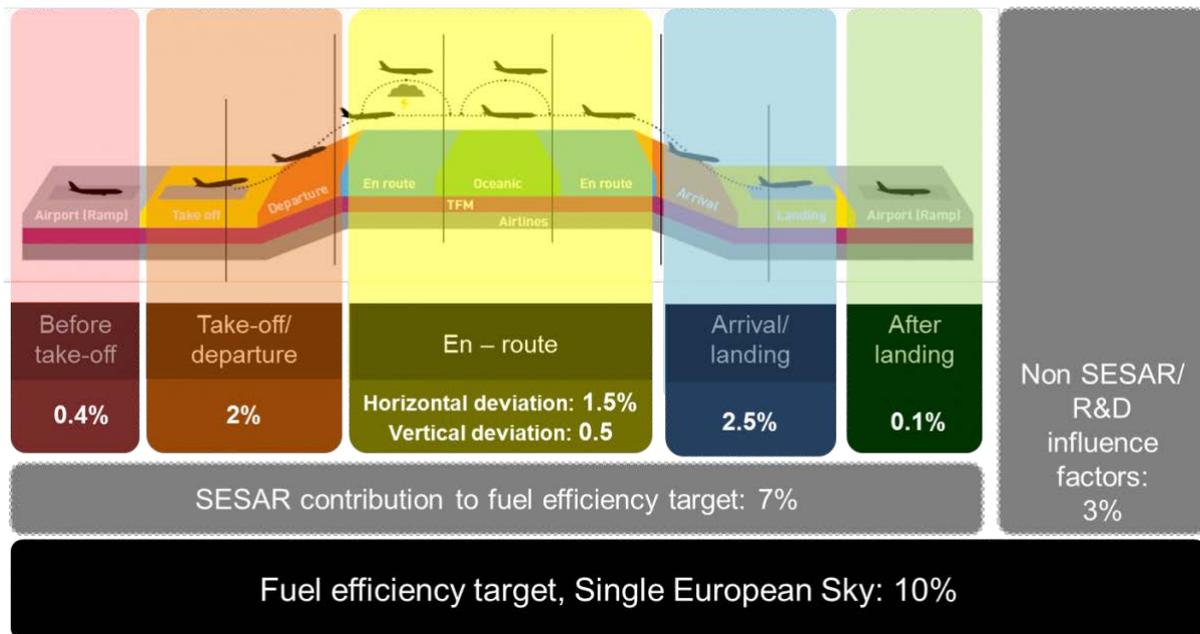
The European Union's Single European Sky (SES) policy aims to reform Air Traffic Management (ATM) in Europe in order to enhance its **performance** in terms of its capacity to manage larger volume of flights in a safer, more cost-efficient and environmental friendly manner. The SES aims at achieving 4 high level performance objectives (referred to 2005 context):

- Triple capacity of ATM systems
- Reduce ATM costs by 50%
- Increase safety by a factor of 10
- **Reduce the environmental impact by 10% per flight**

SESAR, the technological pillar of the Single European Sky, contributes to the Single Sky's performance targets by defining, developing, validating and deploying innovative technological and operational solutions for managing air traffic in a more efficient manner.

SESAR contribution to the SES high-level goals set by the Commission are continuously reviewed by the SESAR JU and kept up to date in the ATM Master Plan.

The estimated potential fuel emission savings per flight segment is depicted below:



**SESAR's contribution to the SES performance objectives** is now targeting for 2016, as compared to 2005 performance:

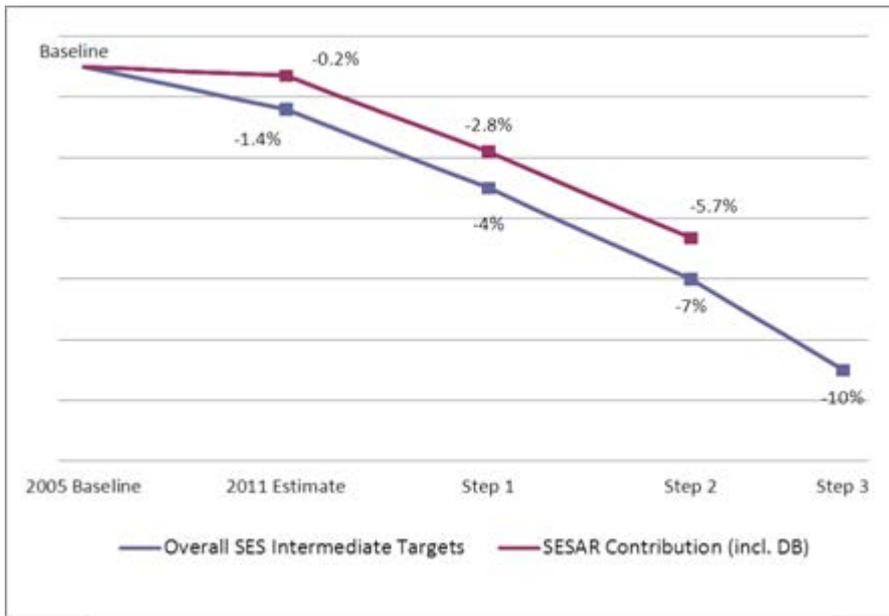
- 1) 27% increase in airspace capacity and 14% increase in airport capacity;
- 2) Associated improvement in safety, i.e. in an absolute term, 40% of reduction in accident risk per flight hour.
- 3) 2.8 % reduction per flight in gate to gate greenhouse gas emissions;**
- 4) 6 % reduction in cost per flight.

The projection of SESAR target fuel efficiency beyond 2016 (Step 1<sup>9</sup>) is depicted in the following graph:

<sup>9</sup> Step 1, "Time-based Operations" is the building block for the implementation of the SESAR Concept and is focused on flight efficiency, predictability and the environment. The goal is a synchronised and predictable European ATM system, where partners are aware of the business and operational situations and collaborate to optimise the network. In this first Step, time prioritisation for arrivals at airports is initiated together with wider use of datalink and the deployment of initial trajectory-based operations through the use of airborne trajectories by the ground systems and a controlled time of arrival to sequence traffic and manage queues.

Step 2, "Trajectory-based Operations" is focused on flight efficiency, predictability, environment and capacity, which becomes an important target. The goal is a trajectory-based ATM system where partners optimise "business and mission trajectories" through common 4D trajectory information and users define priorities in the network. "Trajectory-based Operations" initiates 4D-based business/mission trajectory management using System Wide Information Management (SWIM) and air/ground trajectory exchange to enable tactical planning and conflict-free route segments.

Step 3, "Performance-based Operations" will achieve the high performance required to satisfy the SESAR target concept. The goal is the implementation of a European high-performance, integrated, network-centric, collaborative and seamless air/ground ATM system. "Performance-based Operations" is realised through the achievement of SWIM and collaboratively planned network operations with User Driven Prioritisation Processes (UDPP).



It is expected that there will be an ongoing performance contribution from non-R&D initiatives through the Step 1 and Step 2 developments, e.g. from improvements related to FABs and Network Management: The intermediate allocation to Step 1 development has been set at -4%, with the ultimate capability enhancement (Step 3) being -10% . 30% of Step 1 target will be provided through non-R&D improvements (-1.2% out of -4%) and therefore -2.8% will come from SESAR improvements. Step 2 target is still under discussion in the range of 4.5% to 6%.

The SESAR concept of operations is defined in the European ATM Master Plan and translated into SESAR solutions that are developed, validated and demonstrated by the SESAR Joint Undertaking and then pushed towards deployment through the SESAR deployment framework established by the Commission.

## **SESAR Research Projects (environmental focus)**

Within the SESAR R&D activities, environmental aspects have mainly been addressed under two types of projects: Environmental research projects which are considered as a transversal activity and therefore primarily contribute to the validation of the SESAR solutions and SESAR demonstration projects, which are pre-implementation activities. Environment aspects, in particular fuel efficiency, are also a core objective of approximately 80% of SESAR's primary projects.

### **Environmental Research Projects:**

4 Environmental research projects are now completed:

- Project 16.03.01 dealing with Development of the Environment validation framework (Models and Tools);
- Project 16.03.02 dealing with the Development of environmental metrics;
- Project 16.03.03 dealing with the Development of a framework to establish interdependencies and trade-off with other performance areas;
- Project 16.03.07 dealing with Future regulatory scenarios and risks.

In the context of 16.03.01 the IMPACT tool was developed providing SESAR primary projects with the means to conduct fuel efficiency, aircraft emissions and noise assessments at the same time, from a web based platform, using the same aircraft performance assumptions. IMPACT successfully passed the CAEP MDG V&V process (Modelling and Database Group Verification and Validation process). Project 16.06.03 has also ensured the continuous development/maintenance of other tools covering aircraft GHG assessment (AEM), and local air quality issues (Open-ALAQS). It should be noted that these tools have been developed for covering the research and the future deployment phase of SESAR.

In the context of 16.03.02 a set of metrics for assessing GHG emissions, noise and airport local air quality has been documented. The metrics identified by 16.03.02 and not subject of specific IPRs will be gradually implemented into IMPACT.

Project 16.03.03 has produced a comprehensive analysis on the issues related to environmental interdependencies and trade-offs.

Project 16.03.07 has conducted a review of current environmental regulatory measures as applicable to ATM and SESAR deployment, and another report presenting an analysis of environmental regulatory and physical risk scenarios in the form of user guidance. It identifies both those Operation Focus Areas (OFA) and Key Performance Areas which are most affected by these risks and those OFAs which can contribute to mitigating them. It also provides a gap analysis identifying knowledge gaps or uncertainties which require further monitoring, research or analysis.

The only Environmental Research project that is still ongoing in the current SESAR project is the SESAR Environment support and coordination project which ensures the coordination and facilitation of all the Environmental research projects activities while supporting the SESAR/AIRE/DEMO projects in the application of the material produced by the research projects. In particular, this project delivered an Environment Impact Assessment methodology providing guidance on how to conduct an assessment, which metrics to use and do and don'ts for each type of validation exercise with specific emphasis on flight trials.

New environmental research projects will be defined in the scope of SESAR 2020 work programme to meet the SESAR environmental targets in accordance to the ATM Master Plan.

### **Other Research Projects which contribute to SESAR's environmental target:**

A large number of SESAR research concepts and projects from exploratory research to pre-industrial phase can bring environmental benefits. Full 4D trajectory taking due account of meteorological conditions, integrated departure, surface and arrival manager, airport optimised green taxiing trajectories, combined xLS RNAV operations in particular should bring significant reduction in fuel consumption. Also to be further investigated the potential for remote control towers to contribute positively to the aviation environmental footprint.

Remotely Piloted Aircraft (RPAS) systems integration in control airspace will be an important area of SESAR 2020 work programme and although the safety aspects are considered to be the most challenging ones and will therefore mobilise most of research effort, the environmental aspects of these new operations operating from and to non-airport locations would also deserve specific attention in terms of emissions, noise and potentially visual annoyance.

**SESAR demonstration projects:**

**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 based on existing technologies. 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 CO2 emissions for surface, terminal and oceanic operations to substantially accelerate the pace of change. 3 AIRE demonstration campaigns took place between 2007 and 2014.

The **AIRE 1** campaign (2008-2009), has demonstrated, with 1,152 trials performed, that significant savings can already be achieved using existing technology. **CO<sub>2</sub> savings per flight ranged from 90kg to 1250kg and the accumulated savings during trials were equivalent to 400 tons of CO<sub>2</sub>.** Another positive aspect of such pre implementation demonstrations is the human dimension. Indeed the demonstration flight strategy established in AIRE is to produce constant step-based improvements, to be implemented by each partner in order to contribute to reaching the common objective. Hence the AIRE projects boost crew and controller's motivation to pioneer new ways of working together focusing on environmental aspects, and enables cooperative decision making towards a common goal.

The **AIRE 2** campaign (2010-2011) showed a doubling in demand for projects and a high transition rate from R&D to day-to-day operations. 9416 flight trials took place. Table 2 summarises AIRE 2 projects operational aims and results.

**Table 2:** Summary of AIRE 2 projects

Project	Location	Operation	Objective	CO2 and Noise benefits per flight (kg)	Nb of flights
CDM at Vienna Airport	Austria	CDM notably pre-departure sequence	CO2 & Ground Operational efficiency	54	208
Greener airport operations <u>under adverse conditions</u>	France	CDM notably pre-departure sequence	CO2 & Ground Operational efficiency	79	1800

B3	Belgium	CDO in a complex radar vectoring environment	Noise & CO2	160-315; -2dB (between 10 to 25 Nm from touchdown)	3094
DoWo - Down Wind Optimisation	France	Green STAR & Green IA in busy TMA	CO2	158-315	219
REACT-CR	Czech republic	CDO	CO2	205-302	204
Flight Trials for less CO2 emission during transition from en-route to final approach	Germany	Arrival vertical profile optimisation in high density traffic	CO2	110-650	362
RETA-CDA2	Spain	CDO from ToD	CO2	250-800	210
DORIS	Spain	Oceanic : Flight optimisation with ATC coordination & Data link (ACARS, FANS CPDLC)	CO2	3134	110
ONATAP	Portugal	Free and Direct Routes	CO2	526	999
ENGAGE	UK	Optimisation of cruise altitude and/or Mach number	CO2	1310	23
RlongSM (Reduced longitudinal Separation Minima)	UK	Optimisation of cruise altitude profiles	CO2	441	533
Gate to gate Green Shuttle	France	Optimisation of cruise altitude profile & CDO from ToD	CO2	788	221
Transatlantic green flight PPTP	France	Optimisation of oceanic trajectory (vertical and lateral) & approach	CO2	2090+1050	93
Greener Wave	Switzerland	Optimisation of holding time through 4D slot allocation	CO2	504	1700
VINGA	Sweden	CDO from ToD with RNP STAR and RNP AR.	CO2 & noise	70-285; negligible change to noise contours	189
AIRE Green Connections	Sweden	Optimised arrivals and approaches based on RNP AR & Data link. 4D	CO2 & noise	220	25

		trajectory exercise			
Trajectory based night time	The Netherlands	CDO with pre-planning	CO2 + noise	TBC	124
A380 Transatlantic Green Flights	France	Optimisation of taxiing and cruise altitude profile	CO2	1200+1900	19
				Total	9416

CDOs were demonstrated in busy and complex TMAs although some operational measures to maintain safety, efficiency and capacity at an acceptable level had to developed.

The AIRE 3 campaign (2012-2014)

Table 3 below summarises the nine projects of the third AIRE campaign. Seven of them are completed. A detailed analysis of the results is on-going.

AIRE III projects			
Project name	Objectives	Expected results	Location
CANARIAS	Reduction of track miles, fuel consumption (and therefore CO <sub>2</sub> ) through optimised vertical and horizontal paths compared with existing arrival procedures.	Reduction of: <ul style="list-style-type: none"> <li>• 90-180 kg of fuel burn per flight.</li> <li>• 285-570 kg of CO<sub>2</sub> emissions per flight.</li> </ul>	La Palma Lanzarote
AMBER	Design, validation and test RNAV STARS and RNP-AR arrivals, in order to reduce CO <sub>2</sub> emissions and noise in the airport's vicinity.	Reduction of: <ul style="list-style-type: none"> <li>• 70-120 kg of fuel burn per flight.</li> <li>• 220-380 CO<sub>2</sub> emissions per flight.</li> </ul>	Riga Airport
REACT-PLUS	Introduction of more efficient flight profiles by identifying and implementing Continuous Descent Approaches (CDA) and Continuous Climb Departures (CCD).	Reduction of: <ul style="list-style-type: none"> <li>• 70-120 kg of fuel burn per flight.</li> <li>• 220-380 CO<sub>2</sub> emissions per flight.</li> </ul>	Budapest Airport
OPTA-IN	Achieve optimised descent procedures (with current systems) using the OPTA speed control concept and an ad-hoc air traffic control tool.	Reduction of: <ul style="list-style-type: none"> <li>• 22-30% of fuel burn per flight.</li> <li>• 126-228 CO<sub>2</sub> per flight.</li> </ul>	Palma de Mallorca Airport

SMART	Optimisation of oceanic flights by seeking the most economical route under actual meteorological conditions. It involves integration of various flight plans, position and meteorological data between the ATM system and Airline Operations Centre.	Reduction of: <ul style="list-style-type: none"> <li>• 2% fuel burn per flight.</li> <li>• 2% CO<sub>2</sub> emissions per flight.</li> </ul>	Lisbon FIR Santa Maria FIR New York Oceanic
SATISFIED	Trial and assess the feasibility of implementing flexible optimised oceanic routes.	Reduction of CO <sub>2</sub> emissions per flight.	EUR-SAM corridor
ENGAGE PHASE II	Expands on the work of ENGAGE (AIRE II) and aims at demonstrating safety and viability of progressive step climb or continuous altitude change.	Reduction of: <ul style="list-style-type: none"> <li>• 416 kg of fuel per flight.</li> <li>• 1310 kg of CO<sub>2</sub> emissions per flight.</li> </ul>	North Atlantic
WE FREE	Flight trials for free route optimisation during weekends using flights between Paris CDG and airports in Italian cities.	Reduction of CO <sub>2</sub> emissions per flight.	France Switzerland Italy
MAGGO	Foster quick implementation of enhancements in the Area Control Centres (ACC) and Tower (TWR) communications and surveillance.	Fuel savings of 0.5% per flight.	Santa Maria FIR Santa Maria TMA

Everyone sees the “AIRE way of working together” as an absolute win-win to implement change before the implementation of SESAR solutions.

SESAR next programme (SESAR 2020) includes very large scale demonstrations which should include more environmental flight demonstrations and go one step further demonstrating the environmental benefits of the new SESAR solutions.

### **SESAR solutions and Common Projects for deployment**

SESAR Solutions are operational and technological improvements that aim to contribute to the modernisation of the European and global ATM system. These solutions are systematically validated in real operational environments, which allow demonstrating clear business benefits for the ATM sector when they are deployed. 17 solutions have already been identified in the key

areas of the ATM Master Plan. SESAR Solutions according to a study conducted by the SJU will **help saving 50 million tons of CO<sub>2</sub> emissions**. However to fully achieve SESAR benefits the SESAR solutions must be deployed in a synchronised and timely manner.

The deployment of the SESAR solutions which are expected to bring the most benefits, sufficiently mature and which require a synchronised deployment is mandated by the Commission through legally binding instruments called Common Projects.

The first Common Projects identify six ATM functionalities, namely Extended Arrival Management and Performance Based Navigation in the High Density Terminal Manoeuvring Areas; Airport Integration and Throughput; Flexible Airspace Management and Free Route; Network Collaborative Management; Initial System Wide Information Management; and Initial Trajectory Information Sharing. The deployment of those six ATM functionalities should be made mandatory.

1. The Extended Arrival Management and Performance Based Navigation in the High Density Terminal Manoeuvring Areas functionality is expected to improve the precision of approach trajectory as well as facilitate traffic sequencing at an earlier stage, **thus allowing reducing fuel consumption and environmental impact in descent/arrival phases**.
2. The Airport Integration and Throughput functionality is expected to improve runway safety and throughput, **ensuring benefits in terms of fuel consumption** and delay reduction as well as airport capacity.
3. The Flexible Airspace Management and Free Route functionality is expected to enable a more efficient use of airspace, thus providing significant **benefits linked to fuel consumption** and delay reduction.
4. The Network Collaborative Management functionality is expected to improve the quality and the timeliness of the network information shared by all ATM stakeholders, thus ensuring significant benefits in terms of Air Navigation Services productivity gains and delay cost savings.
5. The Initial System Wide Information Management functionality, consisting of a set of services that are delivered and consumed through an internet protocol-based network by System Wide Information Management (SWIM) enabled systems, is expected to bring significant benefits in terms of ANS productivity.
6. The Initial Trajectory Information Sharing functionality with enhanced flight data processing performances is expected to improve predictability of aircraft trajectory for the benefit of airspace users, the network manager and ANS providers, implying less tactical interventions and improved de-confliction situation. This is expected to have a positive impact on ANS productivity, **fuel saving** and delay variability.

The fuel efficiency expected benefits from the deployment of these solutions is **66% reduction of fuel burn resulting in EUR 0.8 billion (6%) CO<sub>2</sub> credit savings**.

## **2.2.4 Economic/market-based measures**

### *2.2.4.1 The EU Emissions Trading System*

The EU Emissions Trading System (EU ETS) is the cornerstone of the European Union's policy to tackle climate change, and a key tool for reducing greenhouse gas emissions cost-effectively, including from the aviation sector. It operates in 31 countries: the 28 EU Member States, Iceland, Liechtenstein and Norway. The EU ETS is the first and so far the biggest international system capping greenhouse gas emissions; it currently covers half of the EU's CO<sub>2</sub> emissions, encompassing those from around 12,000 power stations and industrial plants in 31

countries, and, under its current scope, around 600 commercial and non-commercial aircraft operators that have flown between airports in the European Economic Area (EEA)<sup>10</sup>.

The EU ETS began operation in 2005; a series of important changes to the way it works took effect in 2013, strengthening the system. 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, other installations and aircraft operators in the system. Within this cap, companies can sell to or buy emission allowances from one another. The limit on allowances available provides certainty that the environmental objective is achieved and gives allowances a market value.

By the 30<sup>th</sup> April each year, companies, including aircraft operators, have to surrender allowances to cover their emissions from the previous calendar year. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or 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 reduces over time so that total emissions fall.

As regards aviation, following more than a decade of inaction with respect to the introduction of a global market based measure aiming at reducing the impact of aviation on climate change on the level of the International Civil Aviation Organization (ICAO), legislation to include aviation in the EU ETS was adopted in 2008 by the European Parliament and the Council<sup>11</sup>. The 2006 proposal to include aviation in the EU ETS was accompanied by detailed impact assessment<sup>12</sup>. After careful analysis of the different options, it was concluded that this was the most cost-efficient and environmentally effective option for addressing aviation emissions.

In October 2013, the Assembly of the International Civil Aviation Organization (ICAO) decided to develop a global market-based mechanism (MBM) for international aviation emissions. This is an important step and follows years of pressure from the EU for advancing global action. The global MBM design is to be decided at the next ICAO Assembly in 2016, including the mechanisms for the implementation of the scheme from 2020. In order to sustain momentum towards the establishment of the global MBM, the European Parliament and Council have decided to temporarily limit the scope of the aviation activities covered by the EU ETS, to intra-European flights<sup>13</sup>. The temporary limitation applies for 2013-2016, following on from the April 2013 'stop the clock' Decision<sup>14</sup> adopted to promote progress on global action at the 2013 ICAO Assembly.

The legislation requires the European Commission to report to the European Parliament and Council regularly on the progress of ICAO discussions as well as of its efforts to promote the international acceptance of market-based mechanisms among third countries. Following the 2016 ICAO Assembly, the Commission shall report to the European Parliament and to the Council on actions to implement an international agreement on a global market-based measure from 2020, that will reduce greenhouse gas emissions from aviation in a non-discriminatory manner. In its report, the Commission shall consider, and, if appropriate, include proposals on the appropriate scope for coverage of aviation within the EU ETS from 2017 onwards.

Between 2013 and 2016, the EU ETS only covers emissions from flights between airports which are both in the EEA. Some flight routes within the EEA are also exempted, notably flights involving outermost regions.

<sup>10</sup> Estimate from Eurocontrol, to be updated following reporting of 2013 and 2014 emissions by 31 March 2015.

<sup>11</sup> Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0101>

<sup>12</sup> [http://ec.europa.eu/clima/policies/transport/aviation/documentation\\_en.htm](http://ec.europa.eu/clima/policies/transport/aviation/documentation_en.htm)

<sup>13</sup> Regulation (EU) No 421/2014 of the European Parliament and of the Council of 16 April 2014 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emissions <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32014R0421>

<sup>14</sup> Decision No. 377/2013/EU derogating temporarily from Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32013D0377:EN:NOT>

The complete, consistent, transparent and accurate monitoring, reporting and verification of greenhouse gas emissions remain fundamental for the effective operation of the EU ETS. Aviation operators, verifiers and competent authorities have already gained experience with monitoring and reporting during the first aviation trading period; detailed rules are prescribed by Regulations (EU) N° 600/2012<sup>15</sup> and 601/2012.<sup>16</sup>

The EU legislation establishes exemptions and simplifications to avoid excessive administrative burden for the smallest aircraft operators. Since the EU ETS for aviation took effect in 2012 a *de minimis* exemption for commercial operators – with either fewer than 243 flights per period for three consecutive four-month periods or flights with total annual emissions lower than 10,000 tonnes CO<sub>2</sub> per year – applies, which means that many aircraft operators from developing countries are exempted from the EU ETS. Indeed, over 90 States have no commercial aircraft operators included in the scope of the EU ETS. From 2013 also flights by non-commercial aircraft operators with total annual emissions lower than 1,000 tonnes CO<sub>2</sub> per year are excluded from the EU ETS up to 2020. A further administrative simplification applies to small aircraft operators emitting less than 25,000 tonnes of CO<sub>2</sub> per year, who can choose to use the small emitter's tool rather than independent verification of their emissions. In addition, small emitter aircraft operators can use the simplified reporting procedures under the existing legislation.

The EU legislation foresees that, where a third country takes measures 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 ETS. 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 the EU legislation regarding aviation under the EU ETS are necessary.

### **Impact on fuel consumption and/or CO<sub>2</sub> emissions**

The environmental outcome of an emissions trading system is determined by the emissions cap. Aircraft operators are able to use allowances from outside the aviation sector to cover their emissions. The absolute level of CO<sub>2</sub> emissions from the aviation sector itself can exceed the number of allowances allocated to it, as the increase is offset by CO<sub>2</sub> emissions reductions in other sectors of the economy.

Over 2013-16, with the inclusion of only intra-European flights in the EU ETS, the total amount of annual allowances to be issued will be around 39 million. Verified CO<sub>2</sub> emissions from aviation activities carried out between aerodromes located in the EEA amounted to 54.9 million tonnes of CO<sub>2</sub> in 2014. This means that the EU ETS will contribute to achieve around 16 million tonnes of emission reductions annually, or almost 65 million over 2013-2016, partly within the sector (airlines reduce their emissions to avoid paying for additional units) or in other sectors (airlines purchase units from other sectors, which would have to reduce their emissions consistently). While some reductions are likely to be within the aviation sector, encouraged by the EU ETS's economic incentive for limiting emissions or use of aviation biofuels, the majority of reductions are expected to occur in other sectors.

Putting a price on greenhouse gas emissions is important to harness market forces and achieve cost-effective emission reductions. In parallel to providing a carbon price which incentivises emission reductions, the EU ETS also supports the reduction of greenhouse gas emissions through €2.1 billion funding for the deployment of innovative renewables and carbon capture and storage. This funding has been raised from the sale of 300 million emission allow-

<sup>15</sup> Commission Regulation (EU) No 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council, <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0600&from=EN>

<sup>16</sup> Regulation (EU) No 601/2012 of the European Parliament and of the Council of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council, <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32012R0601>

ances from the New Entrants' Reserve of the third phase of the EU ETS. This includes over €900 million for supporting bioenergy projects, including advanced biofuels<sup>17</sup>.

In addition, through Member States' use of EU ETS auction revenue in 2013, over €3 billion has been reported by them as being used to address climate change<sup>18</sup>. The purposes for which revenues from allowances should be used encompass mitigation of greenhouse gas emissions and adaptation to the inevitable impacts of climate change in the EU and third countries, to reduce emissions through low-emission transport, to fund research and development, including in particular in the fields of aeronautics and air transport, to fund contributions to the Global Energy Efficiency and Renewable Energy Fund, and measures to avoid deforestation.

In terms of contribution towards the ICAO global goals, the States implementing the EU ETS will together deliver, in "net" terms, a reduction of at least 5% below 2005 levels of aviation CO<sub>2</sub> emissions for the scope that is covered. Other emissions reduction measures taken, either at supra-national level in Europe or by any of the 31 individual states implementing the EU ETS, will also contribute towards the ICAO global goals. Such measures are likely to moderate the anticipated growth in aviation emissions.

## **2.2.5 EU initiatives in third countries**

### *2.2.5.1 Multilateral projects*

At the end of 2013 the European Commission launched a project of a total budget of €6.5 million under the name "*Capacity building for CO<sub>2</sub> mitigation from international aviation*". The 42-month project, implemented by the ICAO, boosts less developed countries' ability to track, manage and reduce their aviation emissions. In line with the call from the 2010 ICAO Assembly, beneficiary countries will submit meaningful state action plans for reducing aviation emissions, and also receive assistance for establishing emissions inventories and piloting new ways of reducing fuel consumption. Through the wide range of activities in these countries, the project contributes to international, regional and national efforts to address growing emissions from international aviation. The beneficiary countries are the following:

**Africa:** Burkina Faso, Kenya and Economic Community of Central African States (ECCAS) Member States: Angola, Burundi, Cameroon, Central African Republic, Chad, Republic of Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, Sao Tome and Principe.

**Caribbean:** Dominican Republic and Trinidad and Tobago.

### **2.2.6 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.

The underlying aim of the programme is to encourage and enable airports to implement best practice carbon and energy management processes and to gain public recognition of their achievements. It requires airports to measure their CO<sub>2</sub> emissions in accordance with the World Resources Institute and World Business Council for Sustainable Development GHG Protocol and to get their emissions inventory assured by an independent third party.

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.

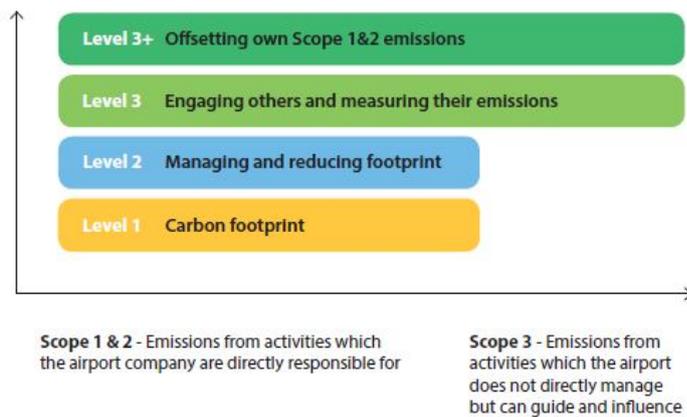
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<sup>15</sup> For further information, see [http://ec.europa.eu/clima/policies/lowcarbon/ner300/index\\_en.htm](http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm)

<sup>16</sup> For further information, see [http://ec.europa.eu/clima/news/articles/news\\_2014102801\\_en.htm](http://ec.europa.eu/clima/news/articles/news_2014102801_en.htm)

Now covering ACI member airports in three ACI regions, Europe, Asia-Pacific, Africa, it is poised to move to Latin America and North America in the coming years. The number of airports participating in the programme has grown from 17 in Year 1 (2009-2010) to 102 at the end of Year 5 – an increase of 85 airports or 500% in participation. Airport participation in the programme now covers 23.2% of world passenger traffic.

*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”.



#### Levels of certification (ACA Annual Report 2013-2014)

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 CO2 reduction associated with the activities they control.

In 2014, 5 years after the launch of the programme, 85 European airports were accredited, representing 62.8% of European passenger traffic.

**Anticipated benefits:**

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

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Total aggregate scope 1 & 2 reduction (tCO2)	51,657	54,565	48,676	140,009	129,937
Total aggregate scope 3 reduction (tCO2)	359,733	675,124	365,528	30,155	223,905

Variable	Year 4		Year 5	
	Emissions	Number of air-ports	Emissions	Number of air-ports
Aggregate carbon footprint for 'year 0' <sup>19</sup> for emissions under airports' direct control (all air-ports)	2,553,869 tonnes CO2	75	2,044,683 tonnes CO2	85
Carbon footprint per passenger	2.75 kg CO2		2.01 kgCO2	
Aggregate reduction in emissions from sources under airports' direct control (Level 2 and above) <sup>20</sup>	158,544 tonnes CO2	43	87,449 tonnes CO2	56
Carbon footprint reduction per passenger	0.22 kg CO2		0.11 kg CO2	
Total carbon footprint for 'year 0' for emissions sources which an airport may guide or influence (level 3 and above) <sup>21</sup>	12,176,083 tonnes CO2	26	6,643,266 tonnes CO2 <sup>22</sup>	31
Aggregate reductions from emissions sources which an airport may guide or influence	30,155 tonnes CO2		223,905 tonnes CO2	
Total emissions offset (Level 3+)	66,724 tonnes CO2	15	181,496 tonnes CO2	16

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.

<sup>19</sup> '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.

<sup>20</sup> This figure includes increases in emissions at airports that have used a relative emissions benchmark in order to demonstrate a reduction.

<sup>21</sup> These emissions sources are those detailed in the guidance document, plus any other sources that an airport may wish to include.

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.

### 3 Section 2: National actions in Finland

In addition to the supranational actions introduced in Section 1 of this action plan, a number of actions are taken at a national level in Finland. This section introduces Finnish stakeholders' CO<sub>2</sub> reduction actions. Text in Section 2 describes selected actions, and estimated emissions reductions resulting from these actions are listed in Appendix I of this action plan.

Following stakeholders have contributed to this section: Finnish Ministry of Transport and Communications, Finnish Transport Safety Agency, Finavia Corporation, Finnair Plc, Nordic Regional Airlines, Blue1 Oy and Neste.

#### 3.1 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 10.4 years. As Finnair continues to retire older aircraft and welcome to the fleet state-of-the-art, eco-efficient aircraft like the Airbus A350 XWB, the company plans to continue staying ahead of the curve. Finnair has ordered a total of 19 A350s, which will be delivered to the airline between 2015 and 2023. Entry into service of A350s allows the company to phase out seven A340s from its long-haul fleet by the end of 2017.

Blue1 also develops its fleet continuously. In 2015 Blue1 will replace its five Boeing 717 aircraft with Boeing 737-600s.

#### 3.2 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 90 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.

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 looked into possible future alternative fuels for the entire Finnish transport sector as well as their availability. The group also made suggestions for actions to be taken for the introduction of alternative fuels. The group gave its final report in May 2013. According to the study's recommendations, biokerosene should replace 40 per cent of the current aviation fuels by 2050.

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.

Neste 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 billion in 2014 and employs around 5,000 people. Neste's share is listed on the NASDAQ OMX Helsinki.

Neste 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's NEXBTL renewable aviation fuel is a pure hydrocarbon and therefore very similar to fossil-based aviation fuels. NEXBTL renewable aviation fuel fully complies with ASTM D7566-14c 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 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 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 joined the EU-supported ITAKA project (Initiative Towards sustainable Kerosene for Aviation). The project has been launched to support the development of aviation biofuels in an economically, socially and environmentally sustainable manner as well as improving the readiness of existing technology and infrastructures. This aim should be achieved through a first of its kind collaborative project in the EU, developing a full value chain to produce sustainable drop-in fuel at large scale. Neste is part of an international consortium working to promote the project's goals and will produce a quantity of renewable jet fuel (NEXBTL renewable jet fuel) for the project.

BioPort Holland sustainable jet biofuel supply chain initiative was set up about two years ago. SkyNRG signed a Letter of Intent with the Dutch government, KLM, Neste, Schiphol Airport and Port of Rotterdam to scale up production of sustainable renewable jet fuel in the Netherlands at Neste's renewable diesel plant in Rotterdam.

Neste 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<sub>2</sub> reduction goals. Neste has been an active member in developing ASTM standard specifications for renewable aviation fuel.

Neste'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. Neste's procurement processes and systems are fine-tuned to ensure that all its renewable inputs are produced sustainably.

Examples of Neste's waste and residue-based raw materials include animal and fish fats, used cooking oil and various residues generated during vegetable oil refining, such as palm fatty acid distillate (PFAD) and technical corn oil. These raw materials accounted for 62% of Neste's renewable inputs in 2014 (52% in 2013, 35% in 2012).

The production of fuels from waste-based feedstock is resource-efficient, and Neste's aim is to have the capability to use 100% waste and residues by 2017. Neste is constantly searching for new waste-based raw materials of increasingly poorer quality.

Additionally, Neste manufactures renewable products from vegetable oils, mainly from crude palm oil. Its proportion of the total feedstock usage has decreased markedly over the past few years and currently stands at 38% (47% in 2013, 65% in 2012). In all, Neste is already able to produce renewable diesel from more than ten different raw materials.

All of the company's renewable raw materials are sustainably produced and comply with both the requirements set out by legislation and the company's own stringent sustainability criteria. With regard to crude palm oil, Neste only uses certified feedstock.

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 GHG emissions are 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 tonnes in CO<sub>2</sub> 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 fuel because it does not contain any aromatics. The sulphur content is also close to zero.

Neste's aim is to increase commercial production of NEXBTL renewable aviation fuel and generate growth as a supplier of this new fuel. However, Neste now aims to produce a slightly different quality, based on same technology; a diesel type of renewable aviation fuel, where a winter grade renewable diesel already has been successfully tested by an aircraft manufacturer (OEM), and where the fuel currently is in the ASTM fuel specification approval process as a bio component to be blended into fossil jet fuel. Currently renewable aviation fuel can be produced as batch production at the Porvoo refinery in Finland. In the upcoming years, the intention would be to make use of the running renewable diesel production at the plants, since the demand of this new fuel is expected to increase.

Continuous industrial-scale production of both renewable diesel and diesel type of aviation fuel at Neste's refineries would, however, require some additional investments. In order to support the commercialisation of renewable aviation fuel globally, cooperation is required among all stakeholders. As a fuel producer, Neste supports targets of various projects and initiatives by actively participating in the work and various workgroups, and by aims to develop common roadmaps with airlines, OEMs, and authorities.

In terms of Nordic co-operation, NISA (Nordic Initiative for Sustainable Aviation) has been established. NISA is an active Nordic association working to promote and develop a more sustainable aviation industry, with a specific focus on alternative sustainable fuels for the aviation sector.

To affect the development of sustainable biofuels and move intensions forward, NISA is required to co-ordinate initiatives at different maturity levels (R&D, approval, demonstration plants, airport integration), as well as involving different parts of the entire supply chain: investments into production facilities, feedstock, biofuels production, logistics, distribution, investors, demonstration plants, customer relationships, and the like. The initiatives of NISA are likely to positively affect a transition to cleantech development and contribute to the creation of jobs and knowhow within the area, thereby strengthening the market position for all the parties involved and society overall.

The goal of NISA is to accelerate the development and the commercialisation of sustainable aviation fuels. This is achieved by organising activities, strengthening the co-operation across the value chain and by focusing on opportunities in the Nordic region.

In addition to that, The Nordic Council of Ministers has launched a study of the climatic impact and commercial potential of using biofuels for aircraft. This Nordic approach will identify if there is potential for green growth in biofuels for aircraft, and the outcome of the efforts will be presented at a conference in 2016. In addition to their positive climatic impact, biofuels for aircraft may also have significant commercial potential.

### **3.3 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.

### ***3.3.1 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 must 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, maintaining a high level of safety and contributing to the overall performance of the air transport system and a reduced environmental impact.

NEFAB is one of nine functional airspace blocks in Europe established in response to the EU's Single European Sky initiative. NEFAB's airspace is composed of the following flight information regions (FIR) and upper information regions (UIR) of the North European airspace: Estonia, Finland, Latvia, Norway, and Bodø Oceanic. The States are responsible for creating in this area a seamless airspace across their national borders and supervising the cooperation of air navigation service providers and other stakeholders in order to maintain safe and efficient airspace management, whilst respecting the sovereign interests of the contracting States.

NEFAB has set strategic objectives within the four key performance areas (safety, capacity, cost-efficiency, and environment) in line with the target setting of the Reference Period 2 for 2015-2019. The planned projects and activities are initiatives defined to ensure that the strategic objectives are met and user expectations fulfilled. Improved flight efficiency and better environmental performance is a must in the years to come. This results in a more systematic approach to environmental consequences of airspace management and airspace design solutions. Hence, within this strategic planning period until 2019, the focus is to a large extent on airspace and service provision where the benefit potential is considered to be the largest within this timeframe.

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 tonnes (2015) and 18 800 tonnes (2020) lower compared to 2011, leading to CO<sub>2</sub> reductions of 46 000 tonnes (2015) and 62 500 tonnes (2020).

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

The Borealis Alliance of nine (Finland, Latvia, Estonia, Norway, Sweden, Denmark, United Kingdom, Ireland and Iceland) European Air Navigation Service Providers (ANSPs) has announced the launch of a programme to deliver seamless and integrated free route airspace across the whole of Northern Europe by 2020.

Airlines and business aviation operators will in future be able to plan and take the most cost effective, fuel efficient and timely routes across the entire airspace managed by Borealis members rather than following pre-defined 'routes' within each member country's airspace, saving time, money and fuel. The programme will create free route airspace extending from the eastern boundary of the North Atlantic to the western boundary of Russian airspace in the North of Europe.

The programme will build on work initiated through the three existing Functional Airspace Blocks (FABs) – the Danish-Swedish, UK-Ireland and North European FABs – and the North European Free Route Airspace (NEFRA) programme, but is voluntarily being expanded by the ANSPs to maximise the benefits for customers.

The programme will build on the existing areas of free route airspace that already exist in Iceland, Ireland, Denmark and Sweden, with the airspace of Estonia, Finland, Latvia and Norway in 2015 and the particularly complex airspace of the UK in stages, starting from 2017. The interface with the oceanic airspace, beyond 2020, will also be considered as part of the programme.

The Borealis Alliance covers the airspace of nine countries – Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Norway, Sweden and the UK. They provide air traffic services for 3.5m flights a year, across 12.5 million km<sup>2</sup> of north European airspace and between them form Europe's major transatlantic gateway.

The National Supervisory Authorities (NSAs) responsible for regulating civil aviation in nine North European States have agreed to work together to support a major Borealis programme delivering Free Route Airspace across Northern Europe, in what is a major step forward for the Single European Sky initiative.

In March 2015, following a workshop jointly organised by the Borealis Alliance and the NSAs and hosted by the UK's Civil Aviation Authority, the regulators of the nine ANSPs have established a working group to explore the best way to improve regulatory cooperation across all nine States for the Borealis Alliance Free Route Airspace programme and its subsequent projects.

While regulatory cooperation already takes place through existing mechanisms including bilateral agreements between States and the existing three Functional Airspace Blocks (FAB), today's commitment to explore a consistent regulatory approach for a programme of this scale, represents a significant step forward in regulatory cooperation.

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

According to a study carried out in October 2012, average horizontal en-route flight efficiency between city pairs in Finland was extremely good. The en-route part of the flights was on average 1.7% (0.5% better than in 2010) longer than the optimum trajectory, while at the same time the European reference level for en-route extensions is 5.2% on an average.

Finland's new airspace structure was introduced smoothly in November 2014. The airspace structure and flight route policy changed throughout Finland. Prior to the introduction, Finavia cooperated closely and extensively with different users of the airspace as well as the authorities. The previous airspace reform of such magnitude was conducted in 1999.

The reasons for the airspace reform include establishing the Single European Sky and the restructuring of the Finnish Defence Forces. The goal is to allocate an even more optimal departure, arrival, and flight path for all flights in Finnish airspace. The optimisation of flight routes will improve the efficient use of the airspace, shorten flight times in some cases, and reduce fuel consumption and therefore also emissions. At the same time, the operating conditions for recreational aviation improve as uncontrolled airspace grows.

The airspace reform was a prerequisite for the uniform airspace of the NEFAB area, Sweden, and Denmark to be implemented in 2015. In the long run, the goal of coordinating the airspace of different countries is to lower the costs for European airspace control. During the performance plan period 2015–2019, Finavia has to improve its flight route efficiency by 1.7 per cent per year and its cost-efficiency by 3 per cent per year. The costs for air navigation also affect airfares, and therefore improved efficiency benefits the passengers as well. The Free Route Airspace Concept will be implemented progressively during years 2014-2015 together with other NEFAB states.

### **3.3.4 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 24 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, SAS/Blue1 and Nordic Regional).

At Helsinki Airport, the percentage of CDOs during 2014 was 66% (+11% compared to 2011) of all approaches. Even during parallel runway operations, 44% (+15% compared to 2011) of the aircraft approaching a runway for which the procedure allows altitude to be adjusted according to the CDO technique were able to perform CDO. During night time (22 – 07) the proportion of CDO was 69% (+10% compared to 2011). 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<sub>2</sub>) can be saved by performing CDO with a narrow body aircraft. The amount of CO<sub>2</sub> 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 co-operation 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.

## **3.4 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.

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<sub>2</sub>. APU is an on-board auxiliary power unit which provides electricity, compressed air and hydraulic power for the aircraft's systems.

The most significant factor affecting the fuel consumption of an aircraft is its weight. The use of new technology and high-quality lightweight materials have enabled Finnair to reduce the empty weight of its aircraft. For example, Finnair replaced all baggage containers used in its narrow-body aircraft with lightweight composite containers in 2014. Weight is one of the key considerations in all procurement activities related to aircraft equipment.

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™, organized 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.

Nordic Regional Airlines has established a Flight Efficiency Programme (FEP). The main focus in the programme is in optimising aircraft operations and reducing fuel consumption, but also other cost and environmental aspects are considered. The main objective of the FEP programme is to improve and ensure efficient and optimised flight operations and continuous improvements in key processes, offering cost reductions and reduced environmental impact. As a result of the programme new operational procedures have been implemented, and existing procedures have been re-evaluated and revised accordingly. Flight efficiency training for flight crew is arranged annually.

Also Blue1 has adopted a fuel saving programme, which includes flight crew training in pro-environmental flying, operational procedures with consideration to the environment, a new flight planning system has been introduced. Actions such as maintenance and washing of aircraft engines to reduce emissions are also included into planning system.

### **3.5 Economic/market-based measures**

As a member of the European Union, Finland is implementing the EU Emissions Trading Scheme (EU ETS). See Section 1 for a detailed introduction to the scheme.

### **3.6 Regulatory measures/other**

Finland's Air Transport Strategy<sup>23</sup> for years 2015-2030 outlines future directions also for environmental issues. In respect of CO<sub>2</sub> emissions, the strategy emphasizes the importance of a global solution to reduce aviation greenhouse gas emissions. Aviation is global business, and a global market-based-measure would guarantee a level playing-field between airlines. In addition to this, the strategy underlines the importance of sustainable biofuels in reducing aviation emissions. Finland has a manufacturer that is capable of producing aviation biofuels in a large

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<sup>23</sup> The strategy is publicly available through the following link (in Finnish, abstract in English): [http://www.lvm.fi/c/document\\_library/get\\_file?folderId=3759144&name=DLFE-26363.pdf&title=Julkaisu 2a-2015](http://www.lvm.fi/c/document_library/get_file?folderId=3759144&name=DLFE-26363.pdf&title=Julkaisu 2a-2015)

scale. Helsinki Airport could serve as a “biofuel hub” between Europe and Asia in the future – however, this requires finding solutions to the price gap between biofuels and fossil kerosene.

In order to speed up biofuel usage, the Ministry of Transport and Communications, alongside with several stakeholders, has ordered a feasibility study on the deployment of aviation biofuels in Finland. The study examines different business models that would make the use of biofuels profitable. According to the study, around 10 000 tonnes (around 2 % of total sold fuel) of biofuel could be in use at Helsinki Airport in the third operating year of the business model. This, however, depends highly on the number of customers using biofuel. The study states that a potential alternative to biokerosene could be a renewable bio-based diesel (produced with Neste Oil’s NEXBTL technology), which is less expensive than previously estimated and the investments required for continuous production would be smaller than those for biokerosene. The fuel has not yet been internationally approved as aviation fuel but the process is ongoing. If it proceeds smoothly, a renewable biodiesel could be approved for aviation by 2016 at the latest. However, the schedule is uncertain. The use of NEXBTL renewable diesel has been proven to reduce greenhouse gas (GHG) emissions by 40–90% over the product’s entire life cycle when compared to traditional, fossil fuel.

### 3.7 Airport improvements

Finavia implemented Airport CDM (collaborative decision making) for Helsinki Airport in October 2012. The operating model is based on making communication between different operators at the airport smoother and more effective. CDM produces exact and current information about the take-offs and landings of aircraft, which improves the predictability of air traffic. As a result of CDM, idling and taxiing times at Helsinki Airport are now shorter. Until now, planes may have had to wait for their turn while taxiing, but more effective communication now allows them to wait at the gate with engines down. After receiving permission, the aircraft starts the engines, taxis to the runway and takes off without unnecessary idling. This has reduced fuel consumption and engine emissions at Helsinki Airport.

Other measures at the airports include:

- Helsinki Airport and the six Lapland Airports are at Level 2 (reduction) of the Airport Carbon Accreditation (ACA) programme of the Airports Council International (ACI). At the “reduction” level, the airport must reduce its carbon dioxide emissions every year. In 2014, the emissions reduction at ACA airports was 3 per cent.
- The remaining incandescent light fittings in the parking garage P5 were replaced with LED lamps. Compared to the previous lighting solution, LED lighting and the automated lighting control system generate energy savings of over 80 per cent. Carbon dioxide emissions are predicted to decrease by about 180,000 kg per year, corresponding to a reduction of approximately 1 per cent in emissions from Finavia’s own operations at Helsinki Airport. The pay-back period of the investment is about 3–5 years.
- In Oulu, the renewal of parking area lighting began with the introduction of LED lights and an automatic lighting control system. The project will be finalised in 2015, and it will generate annual energy savings of approximately 70 per cent.
- At Helsinki Airport, improvements to the efficiency of the fan technology used in the air conditioning system reduced electricity consumption by 40 per cent.
- Finavia is looking into utilising geothermal power in the heating and cooling solutions of the terminals. In Rovaniemi, the introduction of geothermal systems reduced the airport CO<sub>2</sub> emissions by 200 tonnes (80 000 liters of fuel).
- The wood chip powered heating plant in Kittilä produces CO<sub>2</sub>-free energy in a cost-effective way.
- Finavia introduced four charging stations for electric vehicles at Helsinki Airport, and six in Pori. Remote-controlled outlets for engine-block heaters and charging stations for electric vehicles will be installed in the parking areas at Oulu Airport. After the installa-

tion, Oulu Airport will have the largest sustainable recharging area in northern Europe, with almost 300 recharging spaces.

- Train connection to Helsinki Airport will be opened in summer 2015. The railway will provide easier access to the airport services and flights from Helsinki Airport. The ring rail line will connect Helsinki Airport to the national railway network and improve public transport in the Helsinki metropolitan area.

### 3.8 Appendix I: Estimated emission reductions from selected measures<sup>24</sup>

Title	Finnair Fuel Savings Programme
Category	More Efficient Operations
Date of implementation	2011 onwards
Action	Improving fuel efficiency
Economic cost	Considerable
List of stakeholders involved	Finnair
Reduction in CO2 emissions	Approx. 44 000 tonnes of CO2 annually

Title	Reduced Use of APU
Category	More Efficient Operations
Date of implementation	2011 onwards
Action	A reduction of slightly over 20 per cent in using APU in the Airbus 320 fleet
Economic cost	Low
List of stakeholders involved	Finnair
Reduction in CO2 emissions	Approx. 3 500 tonnes of CO2 annually

Title	Replacing A340s with A350XWBs
Category	Fleet Renewal
Date of implementation	2015–2023
Action	Finnair to phase out seven A340s by the end of 2017, replacing them with A350 XWB aircraft. Total number of Finnair A350 orders to be delivered by 2023 is currently 19.
Economic cost	High
List of stakeholders involved	Finnair
Reduction in CO2 emissions	25% less when replacing A340

<sup>24</sup> Please note that the emission reductions listed here are for illustrative purposes only. They have already been taken into account at the European-level baseline scenario, presented in Section 1 of this Action Plan.

<b>Title</b>	<b>Reducing Aircraft Empty Weight</b>
<b>Category</b>	More Efficient Operations
<b>Date of implementation</b>	2012 – 2014
<b>Action</b>	Replacing containers used in narrow and wide body aircraft with lightweight composite containers
<b>Economic cost</b>	Medium
<b>List of stakeholders involved</b>	Finnair
<b>Reduction in CO2 emissions</b>	Approx. 4 500 tonnes of CO2

<b>Title</b>	<b>City-specific Taxi Fuel</b>
<b>Category</b>	More efficient operations
<b>Date of implementation</b>	May 2013
<b>Action</b>	City-specific taxi fuel implemented in flight planning system
<b>Economic cost</b>	Low
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 315 tonnes of CO2 annually

<b>Title</b>	<b>Reduction of Contingency Fuel</b>
<b>Category</b>	More efficient operations
<b>Date of implementation</b>	December 2014
<b>Action</b>	Reduced contingency fuel based on route-specific, statistical data. Reduced contingency fuel on flights where applicable.
<b>Economic cost</b>	Low
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 190 tonnes of CO2 annually

<b>Title</b>	<b>Center of Gravity Optimization</b>
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<b>Category</b>	More efficient operations
<b>Date of implementation</b>	July 2013
<b>Action</b>	Center of gravity optimized to reduce fuel consumption
<b>Economic cost</b>	Low
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 315 tonnes of CO2 annually

<b>Title</b>	<b>More Efficient Climb Profile</b>
<b>Category</b>	More efficient operations
<b>Date of implementation</b>	May 2013
<b>Action</b>	New more efficient climb profile implemented in Embraer fleet
<b>Economic cost</b>	Low
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 1 140 tonnes of CO2 annually

<b>Title</b>	<b>New Software for ATR fleet</b>
<b>Category</b>	More efficient operations
<b>Date of implementation</b>	April 2014
<b>Action</b>	Introduction of software for IOS platform for calculating optimized and fuel efficient flight profiles (climb, cruise, descent) in ATR fleet, ATR Flight Optimizer
<b>Economic cost</b>	Medium
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 350 tonnes of CO2 annually

<b>Title</b>	<b>New Software for Embraer fleet</b>
<b>Category</b>	More efficient operations
<b>Date of implementation</b>	May 2014

<b>Action</b>	Introduction of software for IOS platform for calculating optimized and fuel efficient flight profiles (climb, cruise, descent) in Embraer fleet, ERJ Flight Optimizer
<b>Economic cost</b>	Medium
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 470 tonnes of CO2 annually

<b>Title</b>	<b>Single Engine Taxi</b>
<b>Category</b>	More efficient operations
<b>Date of implementation</b>	2015
<b>Action</b>	Training to remind flight crew on the conditions for single engine taxi-in
<b>Economic cost</b>	Low
<b>List of stakeholders involved</b>	Nordic Regional Airlines
<b>Reduction in CO2 emissions</b>	Approx. 160 tonnes of CO2 annually

<b>Title</b>	<b>Continuous Descent Operations</b>
<b>Category</b>	Improved Air Traffic Management and Infrastructure Use
<b>Date of implementation</b>	Started in 2008, continuous
<b>Action</b>	Offering CDOs at all of Finavia's 24 airports
<b>Economic cost</b>	Medium
<b>List of stakeholders involved</b>	Finavia, Airlines
<b>Reduction in CO2 emissions</b>	Approx. 13 000 tonnes of CO2 annually

<b>Title</b>	<b>NEFAB</b>
<b>Category</b>	Improved Air Traffic Management and Infrastructure Use
<b>Date of implementation</b>	2012

<b>Action</b>	More efficient airspace structure and more direct routes
<b>Economic cost</b>	High
<b>List of stakeholders involved</b>	Finavia, Trafi, Airlines
<b>Reduction in CO2 emissions</b>	46 000 tonnes (by 2015) and 62 500 tonnes (by 2020)

<b>Title</b>	<b>Biokerosene to Replace Current Aviation Fuels</b>
<b>Category</b>	Alternative fuels
<b>Date of implementation</b>	By 2050
<b>Action</b>	Implementing EU level target of 40% sustainable biofuels in use for aviation by 2050. Also recommended by the working group established by the Ministry of Transportation and Communications.
<b>Economic cost</b>	Currently: high
<b>List of stakeholders involved</b>	All stakeholders
<b>Reduction in CO2 emissions</b>	Significant

<b>Title</b>	<b>Airport Collaborative Decision Making (A-CDM)</b>
<b>Category</b>	Improved Air Traffic Management and Infrastructure Use
<b>Date of implementation</b>	Started in 2012, continuous
<b>Action</b>	Offering shorter taxiing times at Helsinki-Vantaa airport
<b>Economic cost</b>	Medium
<b>List of stakeholders involved</b>	Finavia, Airlines
<b>Reduction in CO2 emissions</b>	Approx. 2 000 tonnes of CO2 annually

<b>Title</b>	<b>Helsinki Airport as a "Bio-hub"</b>
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<b>Category</b>	Alternative fuels
<b>Date of implementation</b>	Continuous
<b>Action</b>	Providing around 10 000 tonnes (around 2 % of total sold fuel) of bio-fuel at Helsinki Airport.
<b>Economic cost</b>	High
<b>List of stakeholders involved</b>	All stakeholders
<b>Reduction in CO2 emissions</b>	Significant, the use of NEXBTL renewable diesel has been proven to reduce greenhouse gas (GHG) emissions by 40–90% over the product's entire life cycle when compared to traditional, fossil fuel

