State Action Plan of Finland
International Aviation CO2 Emissions

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International Aviation CO2 Emissions

Liikenteen turvallisuusvirasto (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 ilmastonmuutosta koskeva päätöslauselma sisältää päästövähennystavoitteet ja yleiset suuntaviivat taloudellisille ohjauskeinoille kansainvälisen lentoliikenteen CO2-päästöjen hillitsemiseksi. Lentoliikenteen päästöjen osalta pyritään hiilineutraaliin kasvuun vuodesta 2020 lähtien.

Liikenteen turvallisuusvirasto Trafi oli Suomen ilmailuviranomaisena mukana yleiskokouksessa vuonna 2013 sopimassa siitä, että lentoliikenteen energiatehokkuutta parannetaan vuosittain kahdella prosentilla vuoteen 2050 saakka. Valtioiden tulee raportoida kansainvälisen lentoliikenteen CO2-päästönsä ICAO:lle. Kunkin valtion on myös laadittava toimintasuunnitelma, jossa se linjaa toimensa ilmastonmuutoksen hillitsemiseksi lentoliikenteen osalta.

Suomen kansallinen toimintasuunnitelma

Suomen päivitetty toimintasuunnitelma (State Action Plan) annettiin tänään sähköisesti ICAO:lle. Suomi laati suunnitelmansa EU / ECAC -valtioiden sopiman mallin mukaisesti, jossa 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, lentoasemien pitäjän ja lennonvarmistuspalveluiden tarjoajan 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

Vuonna 2015 Suomen toimintasuunnitelmaa työstänyttä työryhmää veti erityisasiantuntija Joonas Laukia Trafista ja toimintasuunnitelman päivittämisestä vuonna 2016 vastasi erityisasiantuntija Tiia Jyräsalo Trafista. Työryhmään/päivittämiseen osallistuivat hallitussihteeri Janne Mänttäri 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 sekä Sales Development Manager Virpi Kröger Nesteeltä.

Helsingissä 23.6.2016
Pekka Henttu
ilmailujohtaja

Index

1 Common introductory section 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 organization covering the widest grouping of Member States[1] of any European organization 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 recognizes 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[2]. 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 optimization 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 coopera-

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

[2] ICAO Assembly Resolution A38-18 also encourages States to submit an annual reporting on international aviation CO2 emissions, which is a task different in nature and purpose to that of Action Plans, strategic in their nature. Also this requirement is subject to different deadlines for submission and updates as annual updates are expected. For that reason, the reporting to ICAO on international aviation CO2 emissions referred to in paragraph 11 of ICAO Resolution A38/18 is not necessarily 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.

tion with the US FAA.

v. Market-based measures, 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 of carbon units that foster emission reductions in 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.

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

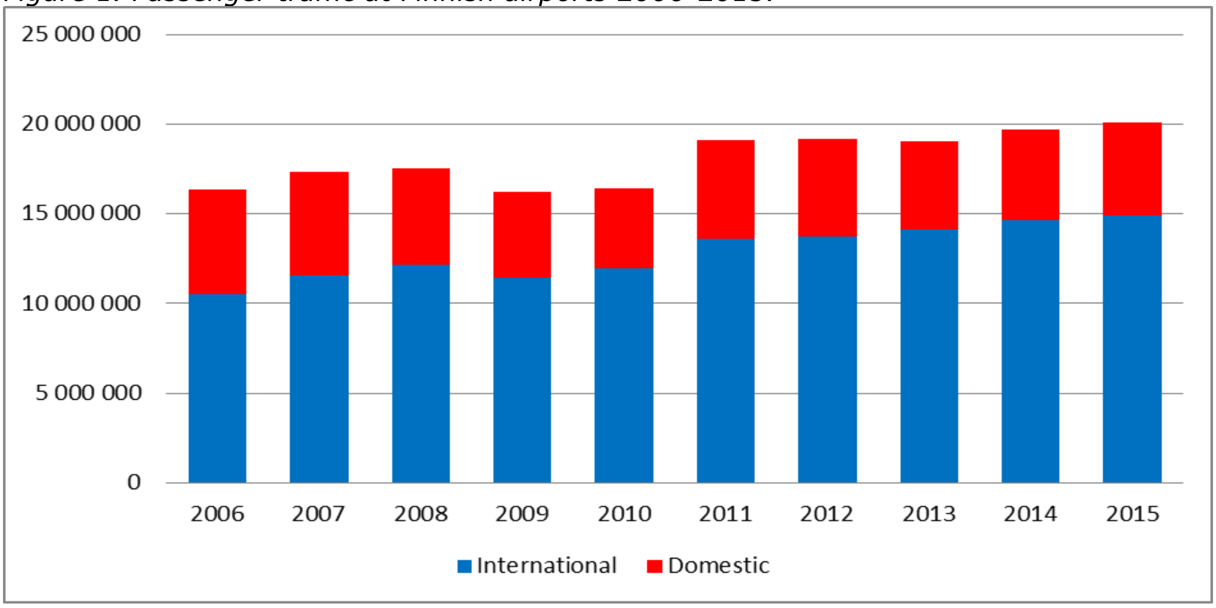
1.1.1 General

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 20 million passengers and 167 980 tonnes of air freight went through Finnish airports in 2015. 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 (16.4 million passengers in 2015), 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.

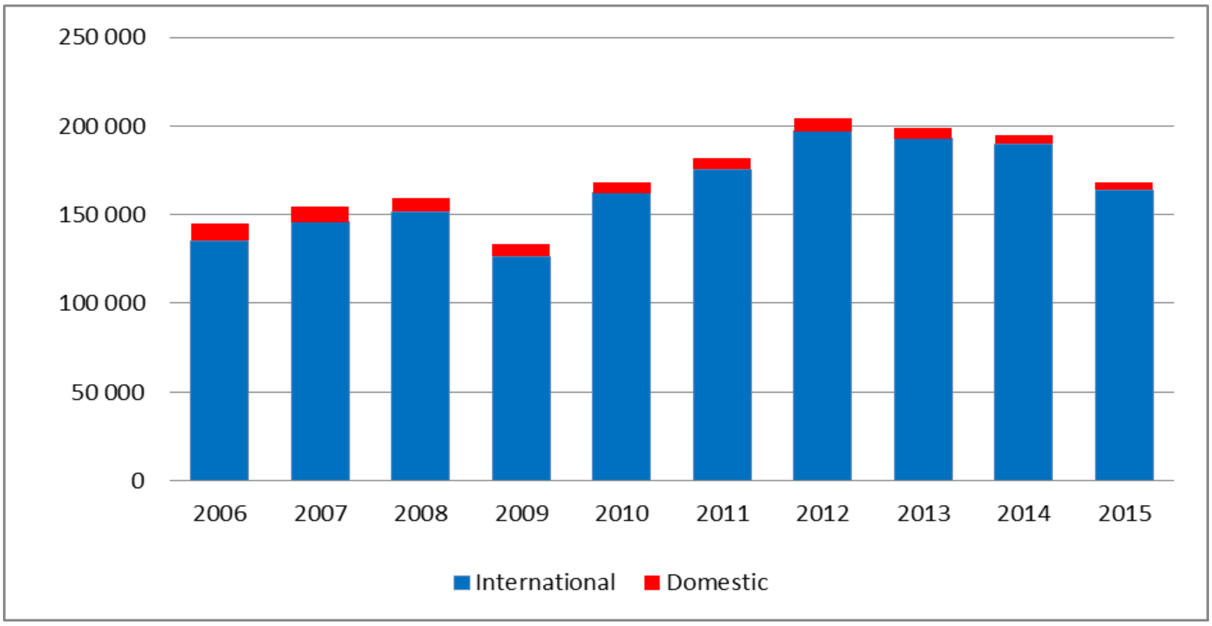
Figure 1. Passenger traffic at Finnish airports 2006-2015.



Tough competition, rapid changes in jet fuel prices and the poor economic outlook significantly affect airline operations. There are total of 15 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.

Two largest Finnish airlines, Finnair and Nordic Regional Airlines, together with Norwegian and SAS, operate nearly all of the domestic traffic, and over 70 % of international traffic.

Figure 2. Freight and mail at Finnish airports 2006-2015.



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 Mikkeli). 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_2 emissions from the air transport sector compose approximately 6% of Finland’s total transport sector CO_2 emissions.

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

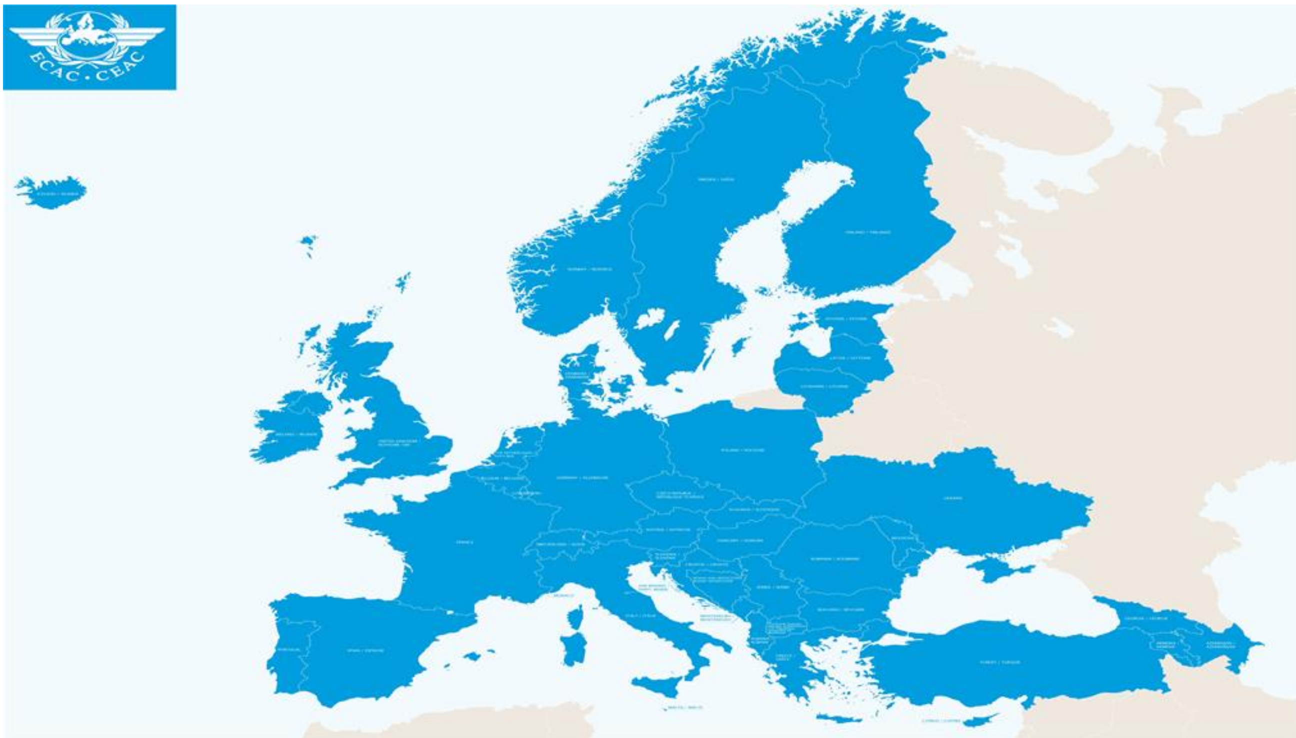
Air traffic consumes roughly 5 % of all energy used in traffic sector in Finland (in 2011). Also the N_2O emissions from aviation are about 5% of total traffic sector emissions, and less for other greenhouse gases. The emissions from all flights departing from and arriving in Finland, excluding overflights, are roughly one per cent of the emissions of flights from the current EU-28. Altogether, the CO_2 emissions reported to Finland under the EU Emissions Trading System were a total of 0.95 million tonnes in 2015. 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_2 emissions from international aviation 1990-2014[3]

Year	CO_2 Emissions (kt CO_2)	Year	CO_2 Emissions (kt CO_2)
1990	1 008	2003	1 114
1991	948	2004	1 282
1992	838	2005	1 290
1993	788	2006	1 435
1994	829	2007	1 656
1995	897	2008	1 792
1996	960	2009	1 570
1997	998	2010	1 654
1998	1 022	2011	1 957
1999	1 094	2012	1 889
2000	1 063	2013	1 949
2001	1 090	2014	1 921
2002	1 078		

[3] 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: ECAC/EU Common section for European State Action Plans



2.1 ECAC BASELINE SCENARIO

The baseline scenario of ECAC States presents the following sets of data (in 2010) and forecast (in 2020 and 2035), which were provided by EUROCONTROL:

- European air traffic (includes all international and national passenger flight departures from ECAC airports, in number of flights, and RPK calculated purely from passenger numbers, which are based on EUROSTAT figures. Belly freight and dedicated cargo flights are not included),
- its associated aggregated fuel consumption (in million tonnes)
- its associated emissions (in million tonnes of CO_2), and
- average fuel efficiency (in kg/10RPK).

The sets of forecasts correspond to projected traffic volumes and emissions, in a scenario of “regulated growth”.

Scenario “Regulated Growth”, Most-likely/Baseline scenario
As in all 20-year forecasts produced by EUROCONTROL, various scenarios are built with a specific storyline and a mix of characteristics. The aim is to improve the understanding of factors that will influence future traffic growth and the risks that lie ahead. In the 20-year forecast published in 2013 by EUROCONTROL, the scenario called ‘Regulated Growth’ was constructed as the ‘most-likely’ or ‘baseline’ scenario, most closely following the current trends. It considers a moderate economic growth, with regulation reconciling the environmental, social and economic demands.

Table 1. Summary characteristics of EUROCONTROL scenarios:

	A: Global Growth	C: Regulated Growth	D: Fragmenting World	C': Happy Localism
2019 traffic growth	High ↗	Base →	Low ↘	Base →
Passenger				
Demographics (Population)	Aging UN Medium-fertility variant	Aging UN Medium-fertility variant	Aging UN Zero-migration variant	Aging UN Medium-fertility variant
Routes and Destinations	Long-haul ↗	No Change →	Long-haul ↘	Long-haul ↘
Open Skies	EU enlargement later +Far & Middle-East	EU enlargement earliest	EU enlargement latest	EU enlargement earliest
High-speed rail (new & improved connections)	54 city-pairs faster implementation	54 city-pairs	42 city-pairs later implementation	54 city-pairs faster implementation
Economic conditions				
GDP growth	Stronger ↗	Moderate →	Weaker ↘↘	Weaker ↘
EU Enlargement	Later	Earliest	Latest	Earliest
Free Trade	Global, faster	Limited, later	None	More limited, even later
Price of travel				
Operating cost	Decreasing ↘↘	Decreasing ↘	No change →	Decreasing ↘
Cost of CO_2	Lowest	Lower	Highest	Lower
Price of oil	Lower	Low	High	High
Other charges	Noise: ↗ Security: ↘	Noise: ↗ Security: →	Noise: → Security: ↗	Noise: ↗ Security: →
Structure				
Network	Middle-East hubs ↗↗ Europe ↘ Turkey ↗	Middle-East hubs ↗↗ Europe and Turkey ↗	No change →	Middle-East hubs ↗↗ Europe and Turkey ↘
Market Structure	Medium ↗↗ Large - Very Large ↗	Medium to Very Large ↗	Large ↗ Very Large ↗	Large ↗ Very Large ↗

The table above presents a summary of the social, economic and air traffic-related characteristics of the different scenarios developed by EUROCONTROL for the purposes of EUROCONTROL 20-year forecast of IFR movements1.

ECAC baseline scenario

The ECAC baseline scenario presented in the following tables was generated by EURO-CONTROL for all ECAC States including the Canary Islands. Over-flights of the ECAC area have not been included.

The baseline scenario, which is presented in the following tables, does not include business and dedicated cargo traffic. It covers only commercial passenger flight movements for the area of scope outlined in the previous paragraph, using data for airport pairs, which allows for the generation of fuel efficiency data (in kg/RPK). Historical fuel burn (2010) and emission calculations are based on the actual flight plans from the PRISME data warehouse, including the actual flight distance and the cruise altitude by airport pair. Future year fuel burn and emissions (2020, 2035) are modelled based on actual flight distances and cruise altitudes by airport pair in 2014. Taxi times are not included. The baseline is presented along a scenario of engine-technology freeze, as of 2014, so

[1] The characteristics of the different scenarios can be found in Task 4: European Air Traffic in 2035, Challenges of Growth 2013, EUROCONTROL, June 2013 available at ECAC website

aircraft not in service at that date are modelled with the fuel efficiency of comparable-role in-service aircraft (but with their own seating capacities).

The future fleet has been generated using the Aircraft Assignment Tool (AAT) developed collaboratively by EUROCONTROL, the European Aviation Safety Agency and the European Commission. The retirement process of the Aircraft Assignment Tool is performed year by year, allowing the determination of the amount of new aircraft required each year. This way, the entry into service year (EISY) can be derived for the replacement aircraft. The Growth and Replacement (G&R) Database used is largely based on the Flightglobal Fleet Forecast - Deliveries by Region 2014 to 2033. This forecast provides the number of deliveries for each type in each of the future years, which are re-scaled to match the EUROCONTROL forecast.

The data and forecasts for Europe show two distinct phases, of rapid improvement followed by continuing, but much slower improvement after 2020. The optimism behind the forecast for the first decade is partly driven by statistics: in the 4 years 2010-2014, the average annual improvement in fuel efficiency for domestic and international flights was around 2%, [Source: EUROCONTROL] so this is already achieved. Underlying reasons for this include gains through improvements in load factors (e.g. more than 3% in total between 2010 and 2014), and use of slimmer seats allowing more seats on the same aircraft. However, neither of these can be projected indefinitely into the future as a continuing benefit, since they will hit diminishing returns. In their place we have technology transitions to A320neo, B737max, C-series, B787 and A350 for example, especially over the next 5 years or so. Here this affects seat capacity, but in addition, as we exit from the long economic downturn, we see an acceleration of retirement of old, fuel-inefficient aircraft, as airline finances improve, and new models become available. After that, Europe believes that the rate of improvement would be much slower, and this is reflected in the 'technology freeze' scenario, which is presented here.

Table 2. Total fuel burn for passenger domestic and international flights (ECAC)

Year	Traffic (millions of departing flights)	Total Fuel burn (in million tonnes)
2010	7,12	40,34
2020	8,48	48,33
2035	11,51	73,10

Table 3. CO_2 emissions forecast

Year	CO_2 emissions (in million tonnes)
2010	127,47
2020	152,72
2035	231,00

Table 4. Traffic in RPK (domestic and international departing flights from ECAC airports, PAX only, no freight and dedicated cargo flights)

Year	Traffic (in billion RPK)
2010	1 329,6
2020	1 958,7
2035	3 128,2

Table 5. Fuel efficiency (kg/10RPK)

Year	Fuel efficiency (in kg/10 RPK)
2010	0,3034
2020	0,2468
2035	0,2337

Table 6. Average annual fuel efficiency improvement

Period	Fuel efficiency improvement
2020 - 2010	-2,05%
2035 - 2020	-0,36%
2035 - 2010	-1,04%

In order to further improve fuel efficiency and to reduce future air traffic emissions beyond the projections in the baseline scenario, ECAC States have taken further action. Supranational measures in order to achieve such additional improvement will be described in the following sections.

It should be noted, however, that a quantification of the effects of many measures is difficult. As a consequence, no aggregated quantification of potential effects of the supranational measures can be presented in this action plan.

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_2 standard in CAEP)

European Member States fully supported the work achieved in ICAO’s Committee on Aviation Environmental Protection (CAEP), which resulted in an agreement on the new aeroplane CO_2 Standard at CAEP/10 meeting in February 2016, applicable to new aeroplane type designs from 2020 and to aeroplane type designs that are already in-production in 2023. Europe significantly contributed to this task, notably through the European Aviation Safety Agency (EASA) which co-led the CO_2 Task Group within CAEP’s Working Group 3, and which provided extensive technical and analytical support.

The assessment of the benefits provided by this measure in terms of reduction in European emissions is not provided in this action plan. Nonetheless, elements of assessment of the overall contribution of the CO_2 standard towards the global aspirational goals are available in CAEP.

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 7th Framework Programme (FP7) and continued within the Horizon 2020 Framework Programme. 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.

The first Clean Sky programme (**Clean Sky 1 -** 2011-2017) has a budget of € 1,6 billion, equally shared between the European Commission and the aeronautics industry. It aims to develop environmental friendly technologies impacting all flying-segments of commercial aviation. The objectives are to reduce CO_2 aircraft emissions by 20-40%, NO_x by around 60% and noise by up to 10dB compared to year 2000 aircraft.

What has the current JTI achieved so far?

*It is estimated that Clean Sky resulted in a reduction of aviation CO_2 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_2 over the next 35 years***

This was followed up by a second programme (**Clean Sky 2** – 2014-2024) with the objective to 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.

The two Interim Evaluations of Clean Sky in 2011 and 2013 acknowledged that the programme is successfully stimulating developments towards environmental targets. These preliminary assessments confirm the capability of achieving the overall targets at completion of the programme.

Main remaining areas for RTD efforts under Clean Sky 2 are:

- **Large Passenger Aircraft**: demonstration of best technologies to achieve the environmental goals while fulfilling future market needs and improving the competitiveness of future products.

- **Regional Aircraft:** 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:** demonstrating new rotorcraft concepts (tilt-rotor and FastCraft compound helicopter) technologies to deliver superior vehicle versatility and performance.

- **Airframe:** demonstrating the benefits of 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). In addition, novel engine integration strategies and investigate innovative fuselage structures will be tested.

- **Engines:** validating advanced and more radical engine architectures.

- **Systems:** demonstrating the advantages of applying new technologies 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:** demonstrating the advantages of applying key technologies on small aircraft demonstrators and to revitalise an important segment of the aeronautics sector that can bring key new mobility solutions.

- **Eco-Design:** 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).
More details on Clean Sky can be found at the following link:
http://www.cleansky.eu/

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.[3]

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[4]. 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[5]) 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.

[3] 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.

[4] http://www.icao.int/environmental-protection/GFAAF/Documents/SW_WP9_D.9.1%20Final%20report_released%20July2011.pdf

[5] 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 transport6. 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 regarding share alternative sustainable fuels:

Aviation to use:

- **at minimum 2%** sustainable alternative fuels **in 2020**;

- **at minimum 25%** sustainable alternative fuels **in 2035**;

- **at minimum 40%** sustainable alternative fuels **in 2050**

Source: ACARE Strategic Research and Innovation Agenda, Volume 2

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 tonnes 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[7].

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 2nd Generation biofuel projects;

6. Accelerate targeted research and innovation for advanced biofuel technologies, and especially algae.

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

[7] http://ec.europa.eu/energy/technology/initiatives/doc/20110622_biofuels_flight_path_technical_paper.pdf

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

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

Time horizons (Base year - 2011)	**Action**	**Aim/Result**
Short-term (next 0-3 years)	Announcement of action at International Paris Air Show	To mobilise all stakeholders including Member States.
	High-level workshop with financial institutions to address funding mechanisms.	To agree on a "Biofuel in Aviation Fund".
	> 1 000 tonnes 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 hydro-treated vegetable oil (HVO) plants from sustainable feedstock	Regular testing and eventually few regular flights with HVO biofuels from sustainable feedstock.
	Secure public and private financial and legislative mechanisms for industrial second generation biofuel plants.	To provide the financial means for investing in first of a kind plants and to permit use of aviation biofuel at economically acceptable conditions.
	Biofuel purchase agreement signed between aviation sector and biofuel producers.	To ensure a market for aviation biofuel production and facilitate investment in industrial 2G plants.
	Start construction of the first series of 2G plants.	Plants are operational by 2015-16.
	Identification of refineries & blenders which will take part in the first phase of the action.	Mobilise fuel suppliers and logistics along the supply chain.
Mid-term (4-7 years)	2000 tonnes of algal oils are becoming available.	First quantities of algal oils are used to produce aviation fuels.
	Supply of 1,0 M tonnes of hydrotreated sustainable oils and 0,2 tonnes of synthetic aviation biofuels in the aviation market.	1,2 M tonnes of biofuels are blended with kerosene.
	Start construction of the second series of 2G plants including algal biofuels and pyrolytic oils from residues.	Operational by 2020.
Long-term (up to 2020)	Supply of an additional 0,8 M tons of aviation biofuels based on synthetic biofuels, pyrolytic oils and algal biofuels.	2,0 M tonnes 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 Flight-path 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. Since then, worldwide technical and operational progress of the industry has been remarkable. Four different pathways for the production of renewable kerosene are now approved and several more are expected to be certified. A significant number of 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 was demonstrated in Oslo in 2015.

Performed flights using bio-kerosene

IATA: 2000 flights worldwide using bio-kerosene blends performed by 22 airlines between June 2011 and December 2015

Lufthansa: 1189 flights Frankfurt-Hamburg using 800 tonnes of bio-kerosene (during 6 months – June/December 2011)

KLM: a series of 200 flights Amsterdam-Paris from September 2011 to December 2014, 26 flights New York-Amsterdam in 2013, and 20 flights Amsterdam-Aruba in 2014 using bio-kerosene

Production (EU)

Neste *(Finland): by batches*

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

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

Biorefly*: €13,7m EU funding: 2000 tonnes 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_2 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 launched projects under the Horizon 2020 research programme with capacities of the order of several 1000 tonnes 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.

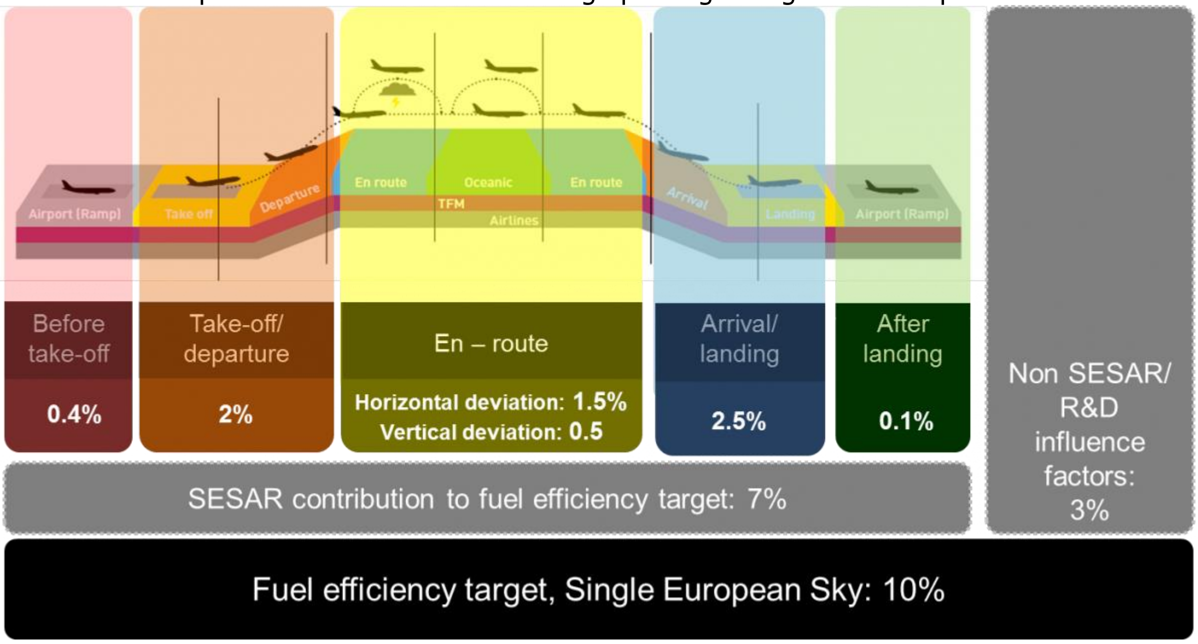
The SES aims at achieving 4 high level performance objectives (referred to 2005 context):

- 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[8]) is depicted in the following graph:

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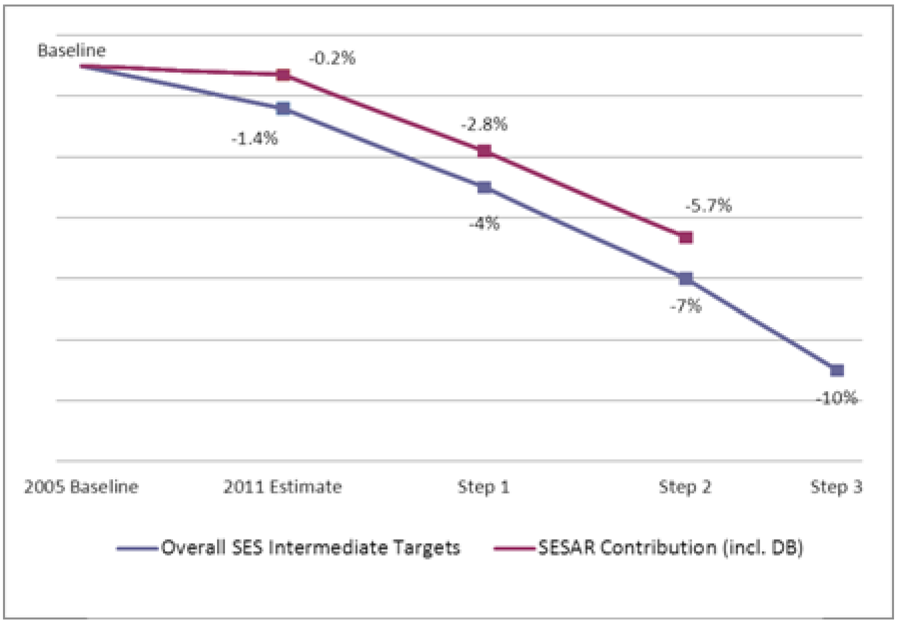
[8] Step 1, "Time-based Operations" is the building block for the implementation of the SESAR Concept and is focused on flight efficiency, predictability and the environment. The goal is a synchronised and predictable European ATM system, where partners are aware of the business and operational situations 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



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:
Four 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;

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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).

- Project 16.03.07 dealing with Future regulatory scenarios and risks.

In the context of Project 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 Project 16.03.02 a set of metrics for assessing GHG emissions, noise and airport local air quality has been documented. The metrics identified by Project 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 on-going 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 preindustrial 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.

<u>SESAR demonstration projects:</u>
In addition to its core activities, the SESAR JU co-finances projects where ATM stakeholders work collaboratively to perform integrated flight trials and demonstrations validating solutions for the reduction of CO_2 emissions for surface, terminal and oceanic operations to substantially accelerate the pace of change. Since 2009, the SJU has co-financed a total 33 "green" projects in collaboration with global partners, under the Atlantic Interoperability Initiative to Reduce Emissions (AIRE), demonstrating solutions on commercial flights.

A total of 15767 flight trials were conducted under the AIRE initiative involving more than 100 stakeholders, demonstrating savings ranging from 20 to 1000kg fuel per flight (or 63 to 3150 kg of CO_2), and improvements to day-to-day operations. Other 9 demonstration projects took place from 2012 to 2014 focusing also on environment and during 2015 and 2016 the SESAR JU is co-financing 15 additional large-scale demonstrations projects more ambitious in geographic scale and technology. More information can be found at http://www.sesarju.eu

AIRE – Achieving environmental benefits in real operations
AIRE was designed specifically to improve energy efficiency and lower engine emissions and aircraft noise in cooperation with the US FAA, using existing technologies by the European Commission in 2007. SESAR JU has been managing the programme from an European perspective since 2008. 3 AIRE demonstration campaigns took place between 2009 and 2014.

A key feature leading to the success of AIRE is that it focused strongly on operational and procedural techniques rather than new technologies. AIRE trials have almost entirely used technology which is already in place, but until the relevant AIRE project came along, air traffic controllers and other users hadn't necessarily thought deeply about how to make the best use operationally of that technology. In New York and St Maria oceanic airspace lateral [separation] optimisation is given for any flight that requests it because of the AIRE initiative and the specific good cooperation between NAV Portugal and FAA.

Specific trials have been carried for the following improvement areas/solutions as part of the AIRE initiative:

a. Use of GDL/DMAN systems (pre departure sequencing system / Departure Manager) in Amsterdam, Paris and Zurich;

b. Issue of Target-Off Block time (TOBT), calculation of variable taxi out time and issue of Target-Start-up Arrival Time (TSAT) in Vienna;

c. Continuous Descent Operations (CDOs or CDAs) in Amsterdam, Brussels, Cologne, Madrid, New York, Paris, Prague, Pointe a Pitre, Toulouse, and Zurich;

d. CDOs in Stockholm, Gothenburg, Riga, La Palma; Budapest and Palma de Majorca airports using RNP-AR procedures;

e. lateral and vertical flight profile changes in the NAT taking benefit of the implementation of Automatic Dependent Surveillance-Broadcast (ADS-B) surveillance in the North Atlantic;

f. Calculation of Estimated Times of Arrival (ETA) allowing time based operations in Amsterdam;

g. Precision Area Navigation - Global Navigation Satellite System (PRNAV GNSS) Approaches in Sweden;

h. Free route in Lisbon and Casablanca, over Germany, Belgium, Luxembourg, Netherlands in the EURO-SAM corridor, France, and Italy;

i. Global information sharing and exchange of actual position and updated meteorological data between the ATM system and Airline AOCs for the vertical and lateral optimisation of oceanic flights using a new interface;

The **AIRE 1** campaign (2008-2009) has demonstrated, with 1152 trials performed, that significant savings can already be achieved using existing technology. **CO_2 savings per flight ranged from 90kg to 1250kg and the accumulated savings during trials were equivalent to 400 tonnes of CO_2.** This first set of trials represented not only substantial improvements for the greening of air transport, but high motivation and commitment of the teams involved creating momentum to continue to make progress on reducing aviation emissions.

Domain	Location	Trials performed	CO_2 benefit/flight
Surface	Paris, France	353	190-1200 kg
Terminal	Paris, France	82	100-1250 kg
	Stockholm, Sweden	11	450-950 kg
	Madrid, Spain	620	250-800 kg
Oceanic	Santa Maria, Portugal	48	90-650 kg
	Reykjavik, Iceland	48	250-1050 kg
	Total	1152	

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. 18 projects involving 40 airlines, airports, ANSPs and industry partners were conducted in which surface, terminal, oceanic and gate-to-gate operations were tackled. 9416 flight trials took place. Table 2 summarises AIRE 2 projects operational aims and results.

Table 6: Summary of AIRE 2 projects

Project name	Location	Operation	Objective	CO_2 and Noise benefits per flight (kg)	Nb of flights
CDM at Vienna Airport	Austria	CDM notably pre-departure sequence	CO_2 & Ground Operational efficiency	54	208
Greener airport operations under adverse conditions	France	CDM notably pre-departure sequence	CO_2 & Ground Operational efficiency	79	1800
B3	Belgium	CDO in a complex radar vectoring environment	Noise & CO_2	160-315; -2dB (between 10 to 25 Nm from touchdown)	3094
DoWo - Down Wind Optimisation	France	Green STAR & Green IA in busy TMA	CO_2	158-315	219

REACT-CR	Czech re-public	CDO	CO_2	205-302	204
Flight Trials for less CO_2 emission dur-ing transition from en-route to final ap-proach	Germany	Arrival verti-cal profile optimisation in high densi-ty traffic	CO_2	110-650	362
RETA-CDA2	Spain	CDO from ToD	CO_2	250-800	210
DORIS	Spain	Oceanic: Flight optimi-sation with ATC coordi-nation & Data link (ACARS, FANS CPDLC)	CO_2	3134	110
ONATAP	Portugal	Free and Direct Routes	CO_2	526	999
ENGAGE	UK	Optimisation of cruise alti-tude and/or Mach number	CO_2	1310	23
RlongSM (Re-duced longi-tudinal Sepa-ration Mini-ma)	UK	Optimisation of cruise alti-tude profiles	CO_2	441	533
Gate to gate Green Shuttle	France	Optimisation of cruise alti-tude profile & CDO from ToD	CO_2	788	221
Transatlantic green flight PPTP	France	Optimisation of oceanic trajectory (vertical and lateral) & approach	CO_2	2090+1050	93
Greener Wa-ve	Switzerland	Optimisation of holding time through 4D slot allo-cation	CO_2	504	1700
VINGA	Sweden	CDO from ToD with RNP STAR and RNP AR.	CO_2 & noise	70-285; negligible change to noise contours	189
AIRE Green Connections	Sweden	Optimised arrivals and approaches based on RNP AR & Data link. 4D tra-jectory exer-cise	CO_2 & noise	220	25

Trajectory based night time	The Netherlands	CDO with pre-planning	CO_2 + noise	TBC	124
A380 Transatlantic Green Flights	France	Optimisation of taxiing and cruise altitude profile	CO_2	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 comprised 9 projects (2012-2014) and 5199 trials summarised in table 3

Project name	Location	Operation	Number of Trials	Benefits per flight
AMBER	Riga International Airport	turboprop aircraft to fly tailored Required Navigation Performance – Authorisation Required (RNP-AR) approaches together with Continuous Descent Operations (CDO),	124	230 kg reduction in CO_2 emissions per approach; A reduction in noise impact of 0.6 decibels (dBA)
CANARIAS	La Palma and Lanzarote airports	CCDs and CDOs	8	Area Navigation-Standard Terminal Arrival Route (RNAV STAR) and RNP-AR approaches 34-38 NM and 292-313 kg of fuel for La Palma and 14 NM and 100 kg of fuel for Lanzarote saved.
OPTA-IN	Palma de Mallorca Airport	CDOs	101	Potential reduction of 7-12% in fuel burn and related CO_2 emissions
REACT plus	Budapest Airport	CDOs and CCOs	4113	102 kg of fuel conserved during each CDO
ENGAGE Phase II	North Atlantic – between Canada & Europe	Optimisation of cruise altitude and/or Mach number	210	200-400 litres of fuel savings; An average of 1-2% of fuel conserved
SATISFIED	EUR-SAM Oceanic corridor	Free routing	165	1578 kg in CO_2 emissions
SMART	Lisbon flight information region (FIR), New York Oce-	Oceanic: Flight optimisation	250	3134 kg CO_2 per flight

	anic and Santa Maria FIR			
WE-FREE	Paris CDG, Venice, Verona, Milano Linate, Pisa, Bologna, Torino, Genoa airports	free routing	128	693 Kg of CO_2 for CDG-Roma Fiumicino ; 504 kg of CO_2 for CDG Milano Linate
MAGGO*	Santa Maria FIR and TMA	Several enablers	100*	*

*The MAGGO project couldn't be concluded

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 including the **reduction by up to 500 kg of fuel burned per flight by 2035 which corresponds to up to 1,6 tonnes of CO_2 emissions per flight, split across operating environments**.

By end of 2015 twenty-five SESAR Solutions were validated targeting the full range of ATM operational environments including airports. These solutions are made public on the SESAR JU website in a datapack form including all necessary technical documents to allow implementation. One such solution is the integration of pre-departure management within departure management (DMAN) at Paris Charles de Gaulle, resulting in a 10% reduction of taxi time, 4 000-tonne fuel savings annually and a 10% increase of Calculated Take Off Time (CTOT) adherence and the Implementation. Another solution is Time Based Separation at London Heathrow, allowing up to five more aircraft per hour to land in strong wind conditions and thus reduces holding times by up to 10 minutes, and fuel consumption by 10% per flight. By the end of SESAR1 fifty-seven solutions will be produced.

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.

- 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.**
- 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.
- 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.
- 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.

- 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.
- 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 deconfliction situation. This is expected to have a positive impact on ANS productivity, **fuel saving** and delay variability.

SESAR 2020 programme

SESAR next programme (SESAR 2020) includes in addition to exploratory and industrial research, very large scale demonstrations which should include more environmental flight demonstrations and goes one step further demonstrating the environmental benefits of the new SESAR solutions.

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_2 emissions, encompassing those from around 12 000 power stations and industrial plants in 31 countries, and, under its current scope, around 640 commercial and non-commercial aircraft operators that have flown between airports in the European Economic Area (EEA).

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 30th 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, legislation to include aviation in the EU ETS was adopted in 2008 by the European Parliament and the Council[9]. The 2006 proposal to include aviation in the EU ETS was accompanied by detailed impact assessment[10]. 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. 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[11]. The temporary limitation applies for 2013-2016, following on from the April 2013 'stop the clock' Decision[12] 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.

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[13] and 601/2012.[14]

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_2 per year –applies, which means that

[9] 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

[10] http://ec.europa.eu/clima/policies/transport/aviation/documentation_en.htm

[11] 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

[12] 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

[13] 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

[14] 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

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_2 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_2 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_2 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_2 emissions from the aviation sector itself can exceed the number of allowances allocated to it, as the increase is offset by CO_2 emissions reductions in other sectors of the economy covered by the EU ETS.

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_2 emissions from aviation activities carried out between aerodromes located in the EEA amounted to 56,9 million tonnes of CO_2 in 2015. This means that the EU ETS will contribute to achieve more than 17 million tonnes of emission reductions annually, or around 68 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 ETS 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[15], 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 allowances 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[16].

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[17]. 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

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[15] The actual amount of CO_2 emissions savings from biofuels reported under the EU ETS from 2012 to 2014 was 2 tonnes

[16] For further information, see http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

[17] For further information, see http://ec.europa.eu/clima/news/articles/news_2014102801_en.htm

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_2 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.

Estimated emissions reductions resulting from the EU-ETS

Year	*Reduction in CO_2 emissions*
2013-2016	*65 million tonnes*

The table presents projected benefits of the EU-ETS based on the current scope (intra-European flights).

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_2 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 2013 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

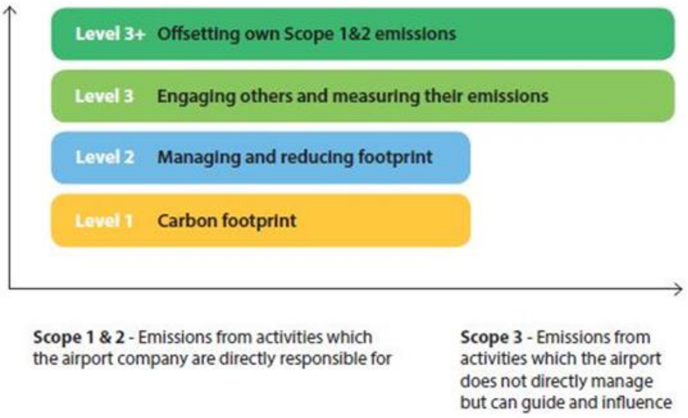
2.2.6.1 ACI Airport Carbon Accreditation
Airport Carbon Accreditation is a certification programme for carbon management at airports, based on carbon mapping and management standard specifically designed for the airport industry. It was launched in 2009 by ACI EUROPE, the trade association for European 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_2 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.

In 2014 the programme reached global status with the extension of the programme to the ACI North American and Latin American & Caribbean regions, participation has increased to 125 airports, in over 40 countries across the world – an increase of 23% from the previous year, growing from 17 airports in Year 1 (2009-2010). These airports welcome 1,7 billion passengers a year, or 27,5% of the global air 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 2014-2015)

One of its essential requirements is the verification by external and independent auditors of the data provided by airports. Aggregated data are included in the *Airport Carbon Accreditation* Annual Report thus ensuring transparent and accurate carbon reporting. At level 2 of the programme and above (Reduction, Optimisation and Carbon Neutrality), airport operators are required to demonstrate CO_2 reduction associated with the activities they control.

In Europe, participation in the programme has increased from 17 airports to 92 in 2015, an increase of 75 airports or 441% since May 2010. 92 airports mapped their carbon footprints, 71 of them actively reduced their CO_2 emissions, 36 reduced their CO_2 emissions and engaged others to do so, and 20 became carbon neutral. European airports participating in the programme now represent 63,9% of European air passenger traffic.

Anticipated benefits:
The Administrator of the programme has been collecting CO_2 data from participating airports over the past five years. This has allowed the absolute CO_2 reduction from the participation in the programme to be quantified.

Emissions reduction highlights

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
Total aggregate scope 1 & 2 reduction (tCO_2)	51 657	54 565	48 676	140 009	129 937	168 779
Total aggregate scope 3 reduction (tCO_2)	359 733	675 124	365 528	30 155	223 905	550 884

Emissions performance summary

Variable	2013 -2014		2014-2015	
	Emissions	**Number of air-ports**	**Emissions**	**Number of airports**
Aggregate carbon footprint for 'year 0'[18] for emissions under airports' direct control (all air-ports)	22 044 683 tonnes CO_2	85	2 089 358 tonnes CO_2	92
Carbon footprint per passenger	2,01 kg CO_2		1,89 kg CO_2	
Aggregate reduction in emissions from sources under airports' di-rect control (Level 2 and above)[19]	87 449 tonnes CO_2	56	139 022 tonnes CO_2	71
Carbon footprint reduction per passenger	0,11 kg CO_2		0,15 kg CO_2	
Total carbon footprint for 'year 0' for emissions sources which an airport may guide or influence (level 3 and above)[20]	12 777 994 tonnes CO_2	31	14 037 537 tonnes CO_2	36
Aggregate reductions from emis-sions sources which an airport may guide or influence	223 905 tonnes CO_2		550 884 tonnes CO_2	
Total emissions offset (Level 3+)	181 496 tonnes CO_2	16	294 385 tonnes CO_2	20

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 aforemen-tioned costs.

The scope of *Airport Carbon Accreditation,* i.e. emissions that an airport operator can control, guide and influence, implies that aircraft emissions in the LTO cycle are also covered. Thus, airlines can benefit from the gains made by more efficient airport opera-tions 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 emis-sions.

[18] 'Year 0' refers to the 12 month period for which an individual airport's carbon footprint refers to, which according to the Airport Car-bon Accreditation requirements must have been within 12 months of the application date.

[19] This figure includes increases in emissions at airports that have used a relative emissions benchmark in order to demon-strate a reduction.

[20] These emissions sources are those detailed in the guidance document, plus any other sources that an airport may wish to include.

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' CO2 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 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.

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 40 to 80 per cent, depending on how they are produced and which feedstocks they come from. Biofuel refers to fuel made from renewable organic raw materials, such as waste and residue or plant oils. 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.

Finnair first operated flights using biofuel in 2011 - second in the world after certification. On 23 September 2014, world leaders met in New York at the UN Climate Summit to discuss climate change. Finnair's flight from Helsinki to New York on the same day was operated using a more environmentally friendly biofuel mixture that was partly manufactured from used cooking oil. Finnair was the sole airline to take up the challenge from ICAO and IATA for the biofuel flights to NY.

Finnair is evaluating the possibility of establishing a biofuel hub at Helsinki Airport. The company is part of a project led by the Finnish Ministry of Transport and Communications that also includes Finavia and Neste Oil as partners.

Finnair is also an active member of the Nordic Initiative for Sustainable Aviation working group comprised of Nordic airlines, airport operators and government ministries who are working together with aircraft manufacturers to expedite the development of biofuel in the aviation industry. http://www.icao.int/environmental-protection/GFAAF/Pages/Project.aspx?ProjectID=25. It is important for Finnair to find an ecologically, financially and socially sustainable fuel solution. The projects that are currently underway play a significant role in achieving this objective.

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 11 billion in 2015 and employs around 5,000 people. Neste's share is listed on the NASDAQ OMX Helsinki.

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

Neste Renewable Jet Fuel is a pure hydrocarbon and therefore very similar to fossil-based aviation fuels. Neste Renewable Jet Fuel complies with ASTM D7566 (latest version) fuel standard specification. 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.

Neste Renewable Jet 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.

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 is partner in the EU-supported ITAKA project (Initiative Towards sustAinable Kerosene for Aviation). The project's target is 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 has produced a quantity of Neste Renewable Jet Fuel for the project. Since January 2016, the fuel is available at Gardermoen airport in Oslo, Norway, where airlines KLM, Lufthansa, and SAS use it. First in World, renewable jet fuel is distributed via the airport's existing hydrant system.

BioPort Holland sustainable jet biofuel supply chain initiative was set up in 2013. Neste signed a Letter of Intent with the Dutch government, KLM, Schiphol Airport, SkyNRG and Port of Rotterdam to scale up production of sustainable renewable jet fuel in the Netherlands at Neste NEXBTL 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_2 reduction goals. Neste has been an active member in developing ASTM standard specifications for renewable aviation fuel.

Neste Renewable Jet 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 68% of Neste's renewable inputs in 2015 (62% in 2014, 52% in 2013, 35% in 2012).

The production of fuels from waste-based feedstock is resource-efficient, and Neste already now has the capability to use 100% waste and residues. Neste is constantly searching for new waste-based raw materials of increasingly poorer quality.

Additionally, Neste produces 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 32% (38% in 2014, 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.

Neste Renewable Jet Fuel can significantly reduce an aircraft’s greenhouse gas (GHG) emissions. 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 Neste Renewable Jet Fuel was 60%, resulting in a reduction of 1500 tonnes in CO2 emissions during the program. In addition to a smaller carbon footprint, the fuel also offers lower emissions of other pollutants. Neste Renewable Jet 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 Neste Renewable Jet Fuel and generate growth as a supplier of this new fuel. In collaboration with the aircraft manufacturer Boeing, Neste now aims to amend the existing ASTM D7566 standard specification to cover a wider range of high quality renewable fuel in lower blend ratios than the current renewable jet fuel that can be blended to fossil jet up to 50%. This amendment is expected to decrease the fuel price compared to the current renewable jet fuel and to improve the availability of the 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 fuel production at the plants, since the demand of this new fuel is expected to increase.

Continuous industrial-scale production of both renewable diesel and renewable jet fuel at Neste’s refineries would, however, require some additional investments. In order to support the commercialization of renewable jet 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 contracting 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 CO2 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. The Borealis Alliance members provide air traffic services for 3.5m flights a year, across 12.5 million km2 of north European airspace and between them form Europe's major transatlantic gateway.

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 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 to maximise the benefits for customers.

The key focus of the coming years are requirements set forth by the SES II+ and the Reference Period 2 of the Performance Scheme, contribution to the Borealis Free Route Airspace Programme, arising competing markets, and enhanced business angle of the NEFAB Programme.

The NEFAB air navigation airspace providers will continue series of activities aimed to improve airspace and service performance in terms of cost efficiency, airspace efficiency for civil and military users, and reduced environmental impact.

The coming years will bring greater scale benefits for airspace users, through seamless Free Route operations within the NEFRA region, i.e. NEFAB and DK/SE FAB, and the Borealis Free Route Airspace programme extending Free Route operations to a large portion of the Northern Europe by 2020.

The Target Concept 2020+ will be based on the identified improvement areas in alignment with European ATM Master Plan and the Borealis vision of a large Free Route Airspace. The Programme is initiated by the cooperating partners in the Borealis Alliance.

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. This 9-State NSA Group is chaired by Finland.

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 was implemented in 2015. It will be further developed together with other NEFAB states and Borealis ANSP partners.

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 23 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 2015 was 68% (+11% compared to 2011) of all approaches. Even during parallel runway operations, 48% (+19% 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 70% (+11% 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_2) can be saved by performing CDO with a narrow body aircraft. The amount of CO_2 emissions savings by CDO is roughly 13 000 tonnes per year at Helsinki Airport.

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

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 CDO 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_2. 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.

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[20] for years 2015-2030 outlines future directions also for environmental issues. In respect of CO2 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 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 renewable fuel (produced with Neste's NEXBTL technology), which is less expensive than previously estimated and the investments required for continuous production would be smaller than those for the currently approved biokerosene. The fuel has

[20] 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=Julkaisuja 2a-2015

not yet been internationally approved as aviation fuel but the process is ongoing. If it proceeds smoothly, a wider range of high quality renewable jet fuels could be approved for aviation by 2017 at the latest. However, the schedule is uncertain. Neste Renewable Jet Fuel has a significant potential to reduce greenhouse gas (GHG) emissions over the product's entire life cycle.

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. The reduction of CO2 emissions is approximately 2000 tonnes annually.

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 2015, the emissions reduction at ACA airports was 1 per cent.

- The BREEAM goals are taken comprehensively into account in all planning and implementation of the Helsinki Airport development programme, for example with regard to energy efficiency. The new terminal buildings are the first object that Finavia will enter into the BREEAM environmental certification system for buildings. Utilisation of solar energy is also one of the planned actions.

- Illumination of the parking area at Oulu Airport was renovated. LED lighting and automatic control will reduce the annual energy consumption by about 70 per cent. Remote controlled outlets for engine-block heaters and charging stations for electric vehicles were also installed in the parking areas at Oulu Airport. 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 CO2 emissions by 200 tonnes (80 000 liters of fuel).

- The wood chip powered heating plant in Kittilä produces CO2-free energy in a cost-effective way.

- Train connection to Helsinki Airport was 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[21]

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

[21] 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.

Reduction in CO2 emissions	25% less when replacing A340

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

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

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

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

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

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

Title	New Software for Embraer fleet
Category	More efficient operations
Date of implementation	May 2014
Action	Introduction of software for IOS platform for calculating optimized and fuel efficient flight profiles (climb, cruise, descent) in Embraer fleet, ERJ Flight Optimizer
Economic cost	Medium
List of stakeholders involved	Nordic Regional Airlines
Reduction in CO2 emissions	Approx. 470 tonnes of CO2 annually

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

Title	Continuous Descent Operations
Category	Improved Air Traffic Management and Infrastructure Use
Date of implementation	Started in 2008, continuous
Action	Offering CDOs at all of Finavia's 23 airports
Economic cost	Medium
List of stakeholders involved	Finavia, Airlines
Reduction in CO2 emissions	Approx. 13 000 tonnes of CO2 annually at Helsinki Airport

Title	**NEFAB**
Category	Improved Air Traffic Management and Infrastructure Use
Date of implementation	2012
Action	More efficient airspace structure and more direct routes
Economic cost	High
List of stakeholders involved	Finavia, Trafi, Airlines
Reduction in CO2 emissions	46 000 tonnes (by 2015) and 62 500 tonnes (by 2020)

Title	**Biokerosene to Replace Current Aviation Fuels**
Category	Alternative fuels
Date of implementation	By 2050
Action	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.
Economic cost	Currently: high
List of stakeholders involved	All stakeholders
Reduction in CO2 emissions	Significant

Title	**Airport Collaborative Decision Making (A-CDM)**
Category	Improved Air Traffic Management and Infrastructure Use
Date of implementation	Started in 2012, continuous
Action	Offering shorter taxiing times at Helsinki-Vantaa airport
Economic cost	Medium
List of stakeholders involved	Finavia, Airlines

Reduction in CO2 emissions	Approx. 2 000 tonnes of CO2 annually

Title	**Helsinki Airport as a "Bio-hub"**
Category	Alternative fuels
Date of implementation	Continuous
Action	Providing around 10 000 tonnes (around 2 % of total sold fuel) of bio-fuel at Helsinki Airport.
Economic cost	High
List of stakeholders involved	All stakeholders
Reduction in CO2 emissions	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