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Federal Department of the
Environment, Transport, Energy and Communications DETEC

Federal Office of Civil Aviation FOCA

ICAO Action Plan on CO_2 Emission Reduction of Switzerland

June 2012

Federal Office of Civil Aviation (FOCA)

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INTRODUCTION

I Introduction

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

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

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

e) In that context, it is the intention that all ECAC States submit to ICAO an Action Plan[2], regardless of whether or not the 1% de mimimis threshold (clause 12 of A37-19) is met, thus going beyond the agreement of ICAO Assembly Resolution A/37-19. This is the Action Plan of Switzerland.

f) Switzerland shares the view of all ECAC States that a comprehensive approach to reducing aviation emissions is necessary, and that this should include:
   i. emission reductions at source, including European support to CAEP work
   ii. research and development on emission reductions technologies, including public-private partnerships
   iii. the development and deployment of low-carbon sustainable alternative fuels, including research and operational initiatives undertaken jointly with stakeholders
   iv. the optimisation and improvement of Air Traffic Management, and infrastructure use within Europe, in particular through the Single European Sky ATM Research (SESAR), and also beyond European borders, through the Atlantic Initiative for the Reduction of Emissions (AIRE) in cooperation with the US FAA.
   v. Market-based measures, such as open emission trading schemes (ETS), which allow the sector to continue to grow in a sustainable and efficient manner, recognising that the measures at (i) to (iv) above cannot, even in aggregate, deliver in time the emissions reductions necessary to meet the global goals.

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

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

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

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

[2] ICAO Assembly Resolution A37-19 also encourages States to submit an annual reporting on international aviation CO_2 emissions. This is considered by Europe an important task, but one which is different in nature and purpose to the Action Plans, which are strategic in their nature. For that reason, the reporting to ICAO on international aviation CO_2 emissions referred to at paragraph 9 of ICAO Resolution A37/19 is not part of this Action Plan, nor of those submitted by other Member States of ECAC. This information will be provided to ICAO separately.

fect 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).

II Current State of Aviation in Switzerland

2.1 Legal basis

The primary aviation legislation of Switzerland is the Federal Aviation Act (LCA.SR 748.0)[3], promulgated by the National Assembly in 1948. The Federal Aviation Act, which has been updated several times, contains general rules which are the basic laws applicable to civil aviation. The last amendment to the Federal Aviation Act came into force on 1th June 2012. On the basis of the Act regulations are implemented in different domains such as infrastructure, airworthiness, air traffic regulations, operating rules, air transport and many more.
A detailed analysis of the primary aviation legislation was published in December 2010 in the final report on the safety oversight audit of the civil aviation system of Switzerland, ICAO Universal Safety Oversight Audit Programme[4].
Recognizing the integrated character of international civil aviation and desiring that intra-European air transport be harmonized, Switzerland ratified the Convention on International Civil Aviation on 6 February 1947 and at the European level an Agreement with the European Community on 21 June 1999 (Ref. 0.748.127.192.68) setting out rules for the Contracting Parties in the field of civil aviation.
In order to fully harmonize the legal system of Switzerland and the EU, the Agreement contains an Annex with all European Community legislation regarding civil aviation to be fully applicable in Switzerland.

Since 1th December 2006 Switzerland is a member state in the European Aviation Safety Agency. This active role within EASA guarantees the linking and recognition of the Swiss civil aviation sector in the European market. Switzerland is a member in the management board of the EASA, but has in common with any other non EU member, no right to vote. With its membership of the EASA, Switzerland is required to implement the current and the following rules established by the Agency[5].

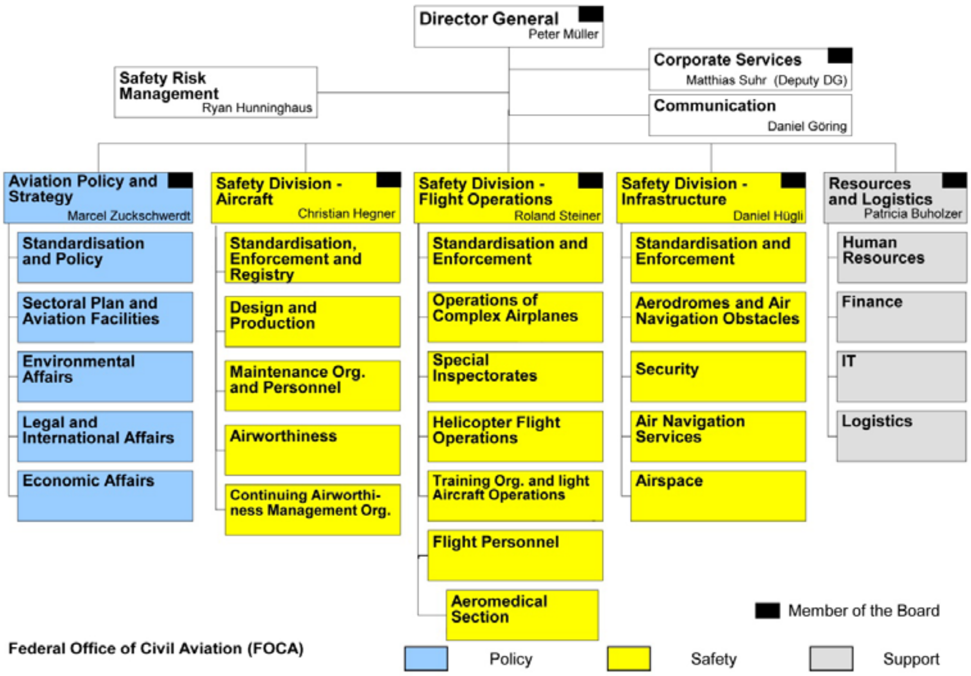

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Figure 2.1.1 Organisation chart FOCA

The Federal Office of Civil Aviation (FOCA) is responsible for monitoring the status and development of civil aviation in Switzerland. It is responsible for ensuring that civil aviation in Switzerland has a high

[3] Federal Aviation Act (SR 748.0) 2012: Bundesgesetz vom 21. Dezember 1948 über die Luftfahrt

[4] ICAO Universal Safety Oversight Audit Programme ICAOUSOAP 2010: Final Report

[5] FOCA website 2012: EASA

safety standard and one that it is in keeping with sustainable development. The FOCA aims to ensure the safe, best possible and environmentally friendly use of the infrastructure, which includes airspace, air traffic control and aerodromes. The Office also supervises aviation companies to which it issues an operating licence based on a technical, operational and financial evaluation.
As far as aviation personnel are concerned, the FOCA ensures that pilots, air traffic controllers and maintenance specialists receive the most comprehensive and up-to-date training or in-service training available. The FOCA inspects the technical requirements with which aircraft, from hot air balloons through gliders to wide-bodied aircraft, need to comply for safe operation.
The FOCA bases itself mainly on internationally agreed standards and practices for its supervisory activities.
In addition to the supervisory function in the four areas mentioned, which comprises a considerable part of its work, the FOCA is responsible for the formulation and implementation of aviation policy decisions. The Federal Office is also involved in various international organisations or collaborates closely with them.

2.2 Aviation Policy in Switzerland

Aviation policy is designed to set the framework for the development of civil aviation in Switzerland. It is oriented around the Federal Council's strategy of sustainability and takes into account the economic, environmental and social dimensions of sustainability. The main aim of aviation policy is to ensure that Switzerland has optimal connections to all major European and global centres.
The aviation policy report published at the end of 2004[6] marked the first time in fifty years that the Federal Council had conducted a situation appraisal of civil aviation in Switzerland. In it, the government expresses its desire for the sustainable development of aviation and to strive to ensure the highest safety standards that can be measured amongst the best in Europe.
Based on the superior strategies of the aviation policy the Federal Council defines the guiding principles in the sectors of Aerodromes, Air traffic control, Aviation industry and Education. Those sectors have to be considered as a whole system and are strongly linked. The state has the role of the regulator.

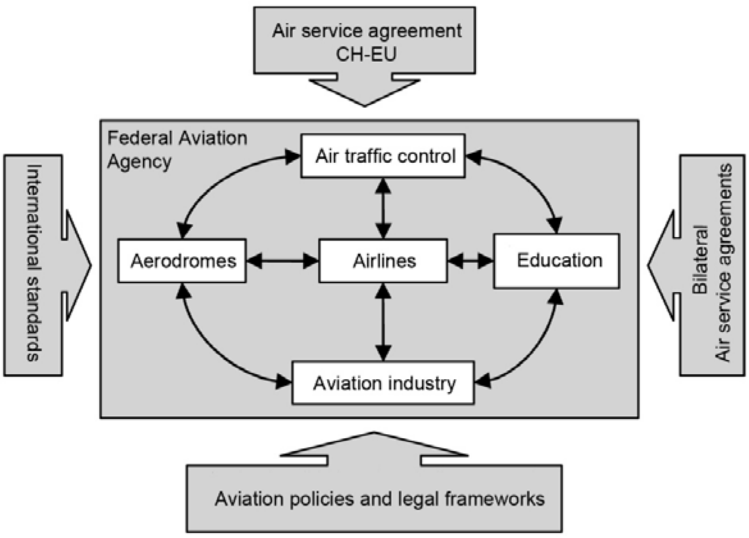

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Figure 2.1.2 Civil Aviation in Switzerland

The Civil Aviation Infrastructure Plan (SIL)[7] is the Federal government's planning and coordination instrument for civil aviation. It sets out the purpose, required perimeter, main aspects of use, equipment and general operating conditions for every aerodrome. The SAIP forms the basis for the planning, construction and operation of an aerodrome, in particular for concessions and operating regulations.

[6] FOCA 2004: Aviation Policy Report 2004

[7] FOCA 2012: Civil Aviation Infrastructure Plan (SIL)

2.3 Sustainability

The Swiss Confederation published in 2008 a report on the sustainability of the Swiss civil aviation sector[8]. The report evaluated the Swiss civil aviation system on the basis of three main sustainability dimensions: the economy, the environment and society.
Although the report was published four years ago, the main theses are still valid and are summarised below.
From an economic point of view, the impacts may mainly be regarded as positive. However, deficits exist, in terms of environmental impacts despite improvements that have been accomplished in the past, especially with respect to noise and effects on the climate. From a social point of view, the assessment is mixed: while it is positive with respect to safety and security, it points to certain deficits in the area of public health and with respect to development potentials of regions in the vicinity of Switzerland's main airports.
The analysis demonstrated that an evaluation of the civil aviation sector also always has to take its spatial impacts into account. This means that the findings obtained when all three sustainability dimensions are involved are of central interest. Depending on the level under observation (regional, national, international), different fundamental issues and conflicts of interest become apparent:

a. The local perspective encompasses the region surrounding each airport, as catchment areas for employment and as residential zones. From this perspective, the main problem (potential conflict of interests) for the development of the civil aviation sector concerns the balance between regional growth opportunities and the development potentials of municipalities that are exposed to aircraft noise.
b. From the national perspective, the main focus is on the contribution to the economy and the principle of "user pays". Here the main problem concerns the balance between maintaining an attractive and export-oriented national economy and minimising environmental impacts such as noise and air pollution. Here, internalising external costs is an important aspect.
c. From the international perspective, the main problem in the civil aviation sector is to find the right balance between preserving international competitiveness and minimising impacts on the global climate while at the same time meeting the growing demand for mobility. Increasing prosperity and the growing ease of worldwide travel result in increased emissions of greenhouse gases and thus greater risks for the global climate.

The analysis was closely co-ordinated with the activities involved in the process relating to the federal government's Civil Aviation Infrastructure Plan (SIL) and civil aviation policy. From these there could be identified the following challenges in the area of civil aviation policy:
Maintaining existing strengths:

- Underscoring the high value attached to safety and security.
- Pursuing a policy of developing aviation infrastructure on the basis of economic considerations, and acknowledging Swiss Int. Air Lines as the principal provider in Switzerland in a liberalised environment, thus securing the importance of civil aviation for the country's economy.
- The regional distribution of civil aviation infrastructure guarantees access to air travel for the entire population.

Eliminating deficits:

- Need for action exists especially in connection with environmental protection and sustainable land use planning in the vicinity of airports, while the impacts of civil aviation on the climate are another important aspect.
- It is essential to incorporate sustainability considerations into balanced planning processes in Switzerland's civil aviation sector. For Zurich Airport, the Civil Aviation Infrastructure Plan is an exemplary process for balancing different interests and sustainability dimensions. Here it is especially important to separate the different spatial levels (local, national, global) of conflicts of interest, especially between the economy and the environment.

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[8] FOCA 2008: Sustainability of the Swiss Civil Aviation

2.4 Structure of the Civil Aviation Sector

The Swiss civil aerodromes are structured in 6 different categories[9]: national airport (3), regional airport (10), airfield (43; winter airfield 6), heliport (24) and mountain landing site (42).
Switzerland has three national airports: Zurich, Geneva and Basel-Mulhouse. They are the principal landing sites for international air traffic and are important for the national and international traffic system in Switzerland. Their function is to achieve optimal connections to all major European and global centres. Their remaining capacity can be used by any other national or international registered aircraft.

Apart from the national airports, there are 10 regional airports (Bern-Belp, Lugano-Agno, Sion, St. Gallen-Alternrhein, Birrfeld, Ecuvillens, Grechen, La Chaux-de-Fons-Les Eplatures, Lausanne-La Blécherette, Samedan). Regional airports are aerodromes with a concession (except St. Gallen-Altenrhein), for public use and they have a customs clearance. The technical standard is higher than at an airfield. The regional airports manly complement the national airports for the scheduled flights. They create direct connections between Switzerland and the foreign country. Besides that they are a regional centre for business, touristic, commercial and training flights.

The airfields are primary for private use and training flights.

Figures 2.4.1 and 2.4.2 are giving an overview of the Swiss national and regional airports.

Swiss Aerodromes: Overview 2010

Aerodrome	Foundation Year	Longest runway m	Concrete s. runway Numbers	Instrument Flight Rules (IFR) Procedures (y/n)
Zurich	1948	3,700	3	y
Geneva	1922	3,900	1	y
Basel-Mulhouse	1946	3,900	2	y
Total national airports			**6**	
Bern-Belp	1929	1,730	1	y
Lugano-Agno	1947	1,240	1	y
Sion	1935	1,960	1	y
St.Gallen-Altenrhein	1926	1,425	1	y
Birrfeld	1937	690	1	n
Ecuvillens	1953	800	1	n
Grenchen	1931	1,000	1	y
La Chaux-de-Fonds-Les Eplatures	1912	1,070	1	y
Lausanne-La Blécherette	1910	805	1	n
Samedan	1937	1,800	1	n
Total regional airports			**10**	
Total airfields			**16**	
Total airports and airfields			**32**	

Figure 2.4.1 Swiss Aerodromes: Overview 2010

[9] FOCA 2012: Civil Aviation Infrastructure Plan (SIL)

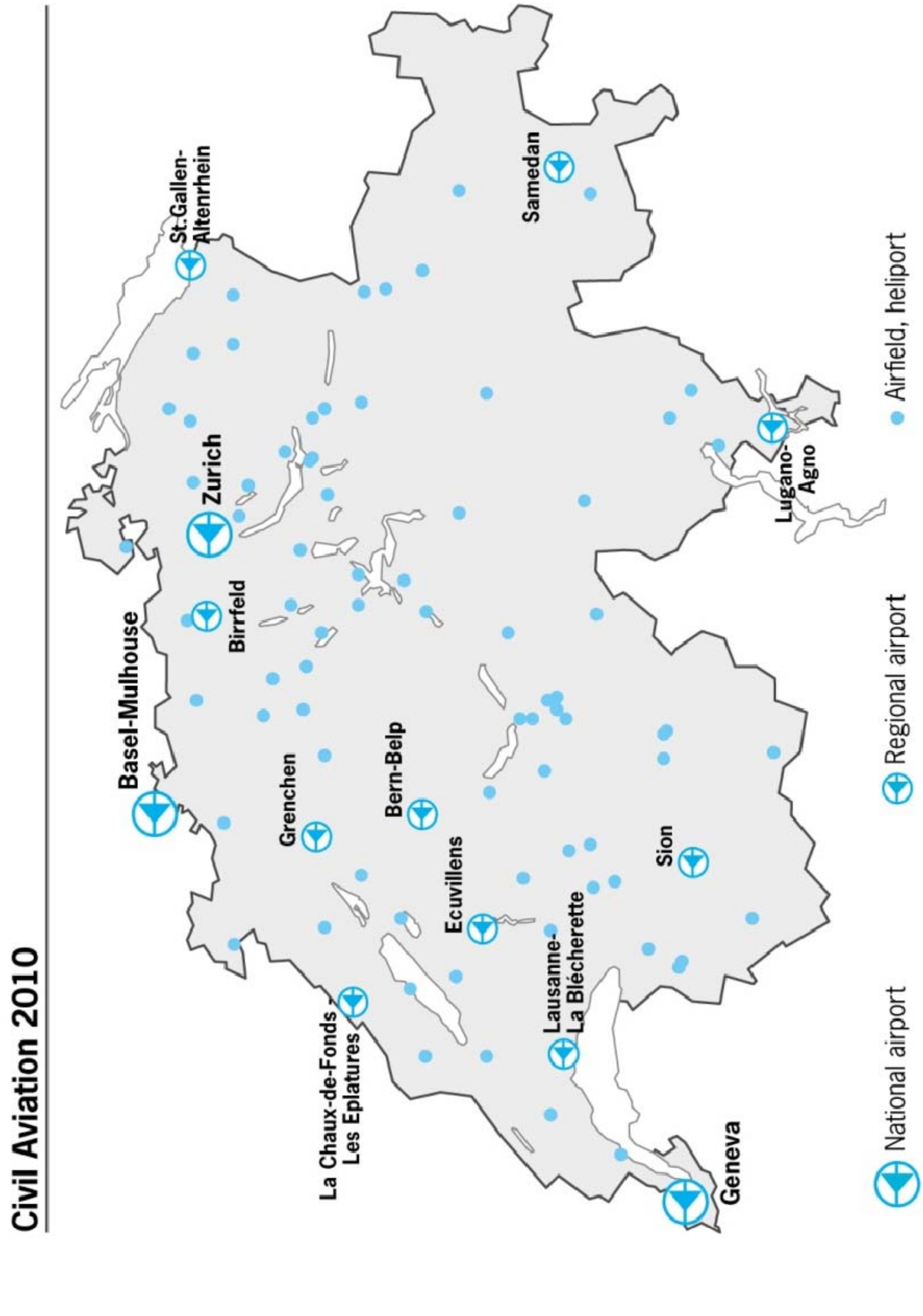

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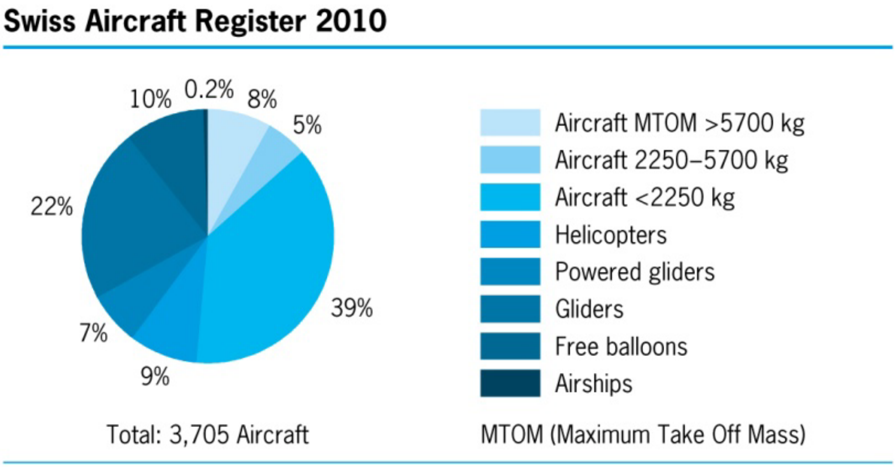
Figure 2.4.2 Civil Aviation 2010; National and regional airports

2.5 Swiss Aircraft Register

The Swiss Aircraft Registry shows all records of Swiss registered aircraft. It contains detailed information regarding owner and holder, type of aircraft, its year of construction, serial number and MTOM. The registry is managed by FOCA and published on the website of FOCA[10].



Swiss Aircraft Register

Aircraft	2005	2006	2007	2008	2009	2010
Max. take-off mass						
> 5700 kg	241	248	260	285	293	303
2250–5700 kg	149	148	161	147	140	197
< 2250 kg	1,502	1,497	1,492	1,468	1,436	1,413
Total fixed-wing aircraft	**1,892**	**1,893**	**1,913**	**1,900**	**1,869**	**1,913**
Helicopters	285	284	290	307	320	327
Gliders	949	941	908	875	843	824
Powered gliders	254	248	244	246	246	251
Airships	9	11	11	10	10	9
Free balloons	452	445	447	427	397	381
Total aircraft	**3,841**	**3,822**	**3,813**	**3,765**	**3,685**	**3,705**

Figure 2.5.1 Swiss Aircraft Register 2010, Aircrafts

2.6 Operations

A pilot, whether of aeroplanes, sailplanes, helicopters or balloons, has to complete a clearly defined training. This includes theory lessons as well as practical training on the aircraft concerned. The training is completed with an examination. After basic training, pilots can undergo further training to become an instructor, commercial pilot or airline pilot. Licences are issued according to EASA and thus ICAO regulations[11].
Aviation operators are required to hold an Air Operator Certificate (AOC), and as a rule also have to possess an operating license in order to fly in Switzerland. The practices are based on the recommendations of ICAO and EASA.

The Swiss civil and military airspace is managed by Skyguide[12], which performs its services under a legal mandate issued by the Swiss Confederation and the FOCA. This mandate requires Skyguide to ensure the safe, fluid and cost-effective management of air traffic in Swiss airspace and in the adjacent airspace of neighbouring countries that has been delegated to its control. Skyguide's legally-prescribed duties and tasks entail providing civil and military air navigation services, aeronautical in-

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[10] FOCA 2012: Swiss Aircraft Registry

[11] FOCA 2012: Flight Training, Legislation and Directives

[12] Federal Department of the Environment, Transport, Energy and Communications 2012: Bundesnahe Betriebe

formation and telecommunications services and the technical services required to install, operate and maintain the associated air navigation systems and facilities.
Skyguide has its head office in Geneva[13] and maintains further operations in Alpnach, Bern, Buochs, Dübendorf, Emmen, Grenchen, Locarno, Lugano, Meiringen, Payerne, St. Gallen-Altenrhein, Sion and Zurich.
Skyguide is an active member of Functional Airspace Block Europe Central (FABEC) and works closely with ICAO, Eurocontrol and CANSO.

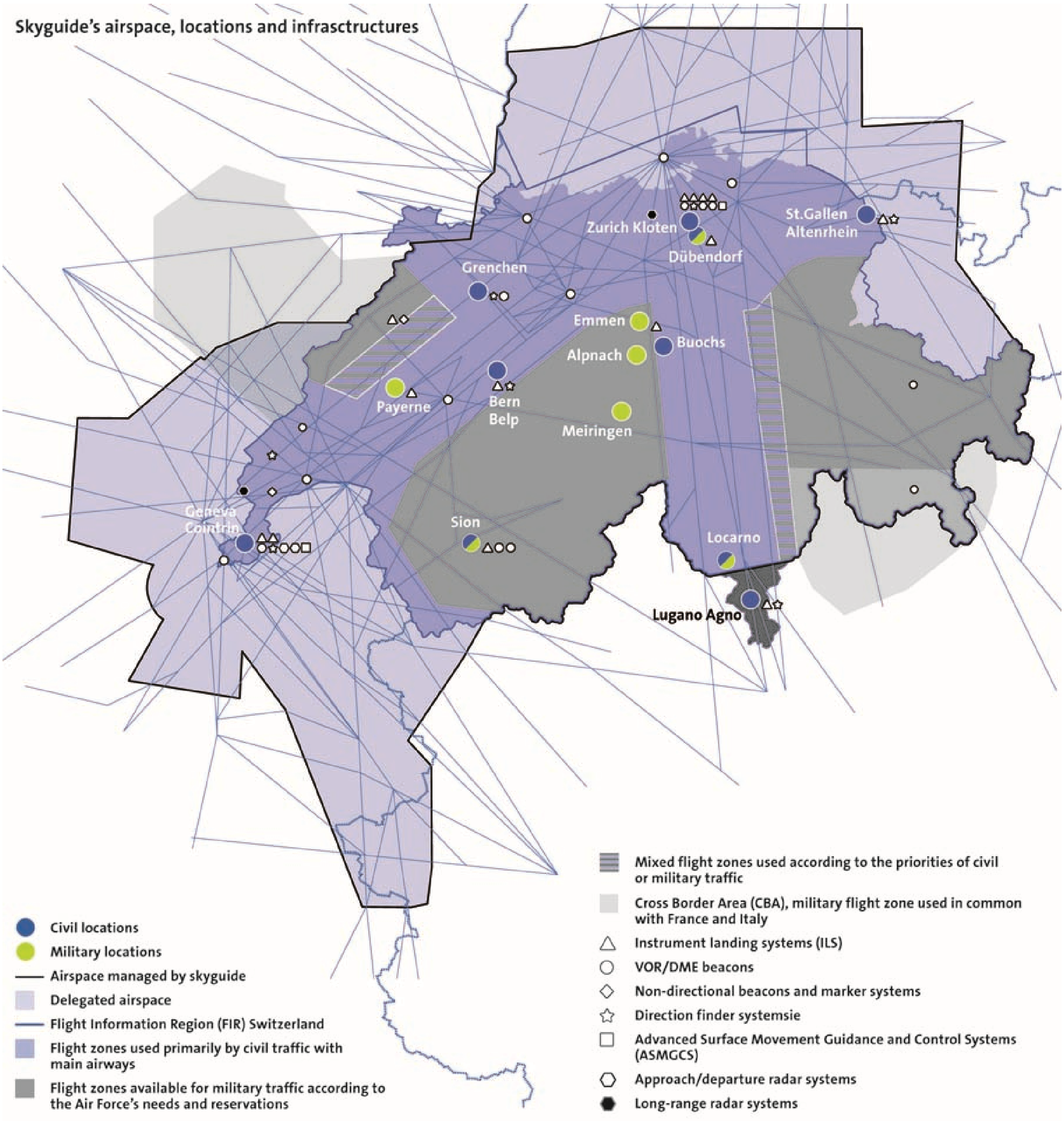

Figure 2.6.1 Skyguide's airspace, locations and infrastructures

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[13] Skyguide 2012: www.Skyguide.ch

Similar to the register of aircraft published by FOCA, the Federal Office of Statistics publishes yearly a list of all Swiss Companies with an AOC[14].

Swiss Companies

Companies	2005	2006	2007	2008	2009	2010
Total companies with scheduled traffic	5	7	8	8	9	9
Other companies with commercial traffic	109	105	104	93	90	81
Total maintenance companies	87	91	90	91	90	90
Total flying schools	154	158	166	162	143	142

Flying Personnel (Licences)

Type of licence	2005	2006	2007	2008	2009	2010
Private pilots	5,928	5,911	5,740	5,431	5,586	5,581
Commercial pilots	1,000	900	959	916	940	952
Airline transport pilots	2,086	2,055	2,076	2,133	2,203	2,266
Multi-Crew pilots					17	46
Helicopter pilots*	1,082	1,101	1,098	1,063	1,135	1,168
Glider pilots	2,764	2,796	2,663	2,616	2,453	2,617
Free balloon pilots	428	421	401	382	360	340
Validations	38	5	11	12	11	8
Flight engineers	8	3	4	2	2	2
Radio navigators	27	18	22	18	12	10

* Including Air Transport Pilot License ATPL (H)

Figure 2.6.2 Swiss Aircraft Register 2010, Swiss Companies, Flying Personnel (Licences)

Year 2010	Scheduled traffic	Charter traffic	Commercial traffic	Commercial freight helicopter	Commercial freight aircraft
ASFG Ausserschwyzerische Fluggemein-schaft Wangen			X		
Air Glaciers SA (Flugzeuge)			X		
Air Glaciers SA (Helikopter)			X	X	
Air Grischa Helikopter AG			X	X	
Air Zermatt AG			X	X	
Airport Helicopter Basel			X	X	
Albinati Aeronautics SA			X		
Alp-Air Bern AG			X		
Aéro-Club des Montagnes Neuchâteloises			X		
BB-HELI AG			X		
Belair Airlines AG	X	X			
Berner Oberländer Helikopter AG			X	X	
Bonsai Helikopter AG			X		
CAT Aviation AG			X		
CHS Central Helicopter Services AG			X	X	
Comlux Aviation AG			X		
Darwin Airline SA	X	X			
Dasnair SA			X		
Eagle Helicopter AG			X	X	
easyJet Switzerland SA	X				
Edelweiss Air AG	X	X			
Eliticino SA			X	X	
ExecuJet Europe AG			X		
FARNAIR Switzerland AG	X	X			X
Fliegerschule Birrfeld AG			X		
Flubag Flugbetriebs-AG			X		
Fluggruppe Mollis			X		
Flugschule Eichenberger AG			X		

[14] FSO 2011: Mobility and Transport, 409-1000, Swiss Civil Aviation 2010

Year 2010	Scheduled traffic	Charter traffic	Commercial traffic	Commercial freight helicopter	Commercial freight aircraft
Flugsportgruppe Zürcher Oberland			X		
Flybaboo SA	X	X			
Flying Devil SA			X		
Flying Ranch AG			X		
Robert Fuchs AG			X	X	
G5 Executive AG			X		
Gallair AG			X		
Heli Rezia AG			X	X	
Héli-Alpes SA			X	X	
Heli Bernina AG			X	X	
Heli Gotthard AG			X	X	
Heli-Link Helikopter AG			X		
Heli Linth AG			X	X	
Heli Partner AG			X	X	
Héli-Lausanne SA			X	X	
Heli-TV SA			X	X	
Helikopter-Service Triet AG			X	X	
Heliswiss International AG			X	X	
Heliswiss, Schweizerische Helicopter AG			X	X	
Helitrans AG			X	X	
Hello AG		X			
Helvetic Airways AG	X	X			
Hôpitaux Universitaires de Genève			X		
Jet Aviation Business Jets AG			X		
Jet-Link AG			X		
JU-Air (VFL)			X		
Karen SA			X	X	
Kantonspolizei Zürich			X		
Linth Air Service AG			X		
Lions Air AG			X		
Motorfluggruppe Oberengadin			X		
Motorfluggruppe Thurgau MFGT			X		
Motorfluggruppe Zürich			X		
Mountain Flyers 80 Ltd			X	X	
Nomad Aviation AG			X		
Parapro SA			X		
Premium Jet AG			X		
Privatair SA		X	X		
Rabbit-Air AG			X		
Rhein-Helikopter AG			X	X	
Rotex Helicopter AG			X	X	
SCENIC AIR AG			X		
Schaer Paul			X		
SkyWork Airlines AG	X	X	X		
Skymedia AG			X		
Sonnig SA			X		
Speedwings SA			X		
Swift Copters SA			X		
Schweizerische Luft-Ambulanz AG			X		
Swiss Flight Services SA			X		
Swiss Int. Air Lines	X	X			
Swiss Jet AG			X		
Swiss Private Aviation AG			X		
TAG Aviation SA			X		
Tarmac Aviation SA			X	X	
Valair AG			X	X	
Your Jet AG			X		
Zimex Aviation AG			X		X

Figure 2.6.3 Swiss Aircraft Register 2010, Swiss AOC Holders

2.7 Traffic Performance

The number of scheduled and charter traffic movements is delivered monthly by the airport authority to FOCA. This information facilitates the organisation of airport operations in the areas of safety, dispatching and passenger information. The information is also used to calculate airport landing fees. Figure 2.7.1 shows the movements of scheduled and charter traffic at the three national airports and at four regional airports. The share of scheduled and charter traffic operating through the regional airports (Bern-Belp, Lugano-Agno, Sion and St. Gallen-Altenrhein) is around 4 to 5 %. Just over 50% of all scheduled and charter departures and landings are at Zurich airport.

The curve of total scheduled and charter traffic shown in figure 2.7.1 has a clear peak in 2000. From 1995 to 2000 the aircraft movements grew every year by about 5 to 7 %. After the year 2000, the civil aviation sector experienced a major crisis, which caused a continuous decrease in movements and, from 2004, a stagnation at a level of around 400 000 movements per year.

Scheduled and Charter Traffic

Airport	Movements					
	2005	2006	2007	2008	2009	2010
Zurich	229,982	220,391	223,830	231,754	223,333	227,815
Geneva	116,545	117,615	127,909	130,852	123,050	123,173
Basel-Mulhouse	57,901	56,168	57,141	56,868	52,013	53,933
Total national airports	**404,428**	**394,174**	**408,880**	**419,474**	**398,396**	**404,921**
Bern-Belp	4,128	4,696	3,913	3,241	3,449	3,486
Lugano-Agno	7,741	6,610	6,299	5,541	5,516	5,479
Sion	80	78	52	102	24	92
St.Gallen-Altenrhein	2,579	2,581	2,636	2,585	2,462	2,133
Total regional airports	**14,528**	**13,965**	**12,900**	**11,469**	**11,451**	**11,190**
Total airports	**418,956**	**408,139**	**421,780**	**430,943**	**409,847**	**416,111**

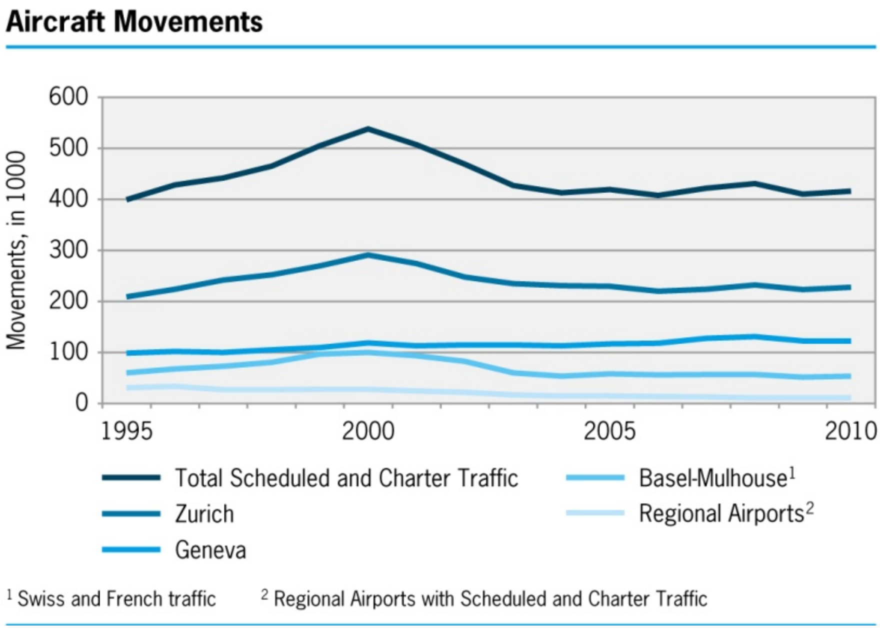


Figure 2.7.1 Scheduled and Charter Traffic; Aircraft Movements

The situation is completely different at the regional airports. Here, growth occurred from 1980 to 1995, after which the level of scheduled and charter traffic at regional airports decreased.

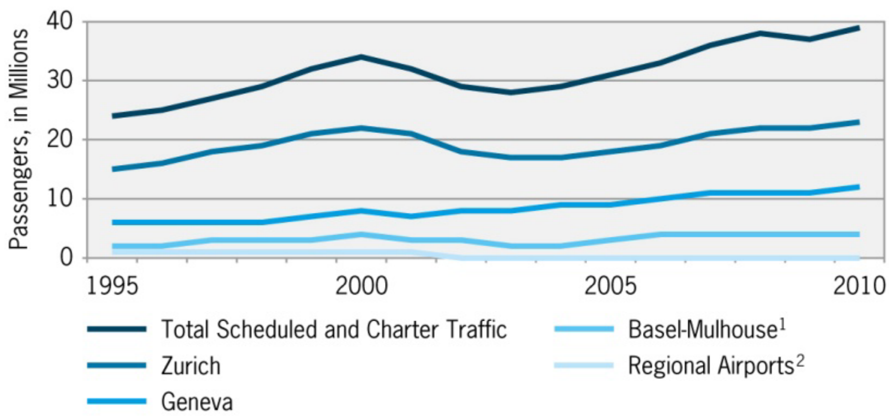
As with aircraft movements, the level of passenger movements is reported regularly to FOCA, with the information coming from ticket sales or directly from the airline company.

Figure 2.7.2 shows the total passenger numbers for scheduled and charter traffic. The passenger numbers increased in line with traffic increase until 2000, after which both traffic movements and passenger numbers decreased. After three to four years the market recovered and in 2007 the number of passengers was higher than in 2000. The ‘dip’ in 2009 was caused by the financial crisis.

Total Passengers: Scheduled and Charter Traffic

Airport	2005	2006	2007	2008	2009	2010
Zurich	17,877,978	19,298,560	20,717,105	22,075,378	21,914,287	22,854,358
Geneva	9,360,621	9,816,477	10,734,901	11,316,567	11,175,056	11,748,972
Basel-Mulhouse	3,261,762	3,984,957	4,236,519	4,234,874	3,818,984	4,087,931
Bern-Belp	78,423	98,398	88,961	91,983	95,077	85,981
Lugano-Agno	181,453	185,605	186,764	180,316	157,005	159,497
Sion	4,843	5,847	3,923	5,590	1,339	3,912
St.Gallen-Altenrhein	94,971	98,039	98,991	91,136	73,279	68,395
Total airports	**30,860,051**	**33,487,883**	**36,067,164**	**37,995,844**	**37,235,027**	**39,009,046**

Number of Passengers to Airport



[1] Swiss and French traffic [2] Regional Airports with Scheduled and Charter Traffic

Figure 2.7.2 Total Passengers: Scheduled and Charter Traffic; Number of Passengers to Airport

Dividing the total distance in kilometres travelled in a given period by the number of passengers results in the passenger-kilometres performed. In figure 2.7.3 the passenger-kilometres for the years 2009 and 2010 and its change in Switzerland are shown.

Passenger-kilometers performed: Scheduled and Charter Traffic

Airport	Scheduled traffic: Passenger-km performed, in millions			Charter traffic: Passenger-km performed, in millions		
	2009	2010	%	2009	2010	%
Zurich	45,787	49,384	8	1,348	743	-45
Geneva	12,468	13,791	11	565	413	-27
Basel-Mulhouse	3,194	3,561	11	734	685	-7
Bern-Belp	26	26	0	28	29	4
Lugano-Agno	26	26	0	0	0	
Sion	0	2		1	1	0
St.Gallen-Altenrhein	36	34	-6	2	1	-50
Total	**61,537**	**66,824**	**9**	**2,678**	**1,871**	**-30**

Figure 2.7.3 Passenger-kilometres performed; Scheduled and Charter Traffic

Information from the tickets sold and from the airline companies gives data not only about the number of passengers at airports but also about the passengers' destination and departure point. In figure 2.7.4 the main destinations of departing passengers are shown. Some 77% are travelling from Switzerland to Europe, 9% to Asia, 8% to North America, 5% to Africa, 1% to South America and under 1% to Oceania and Central America.

Destinations of Departing Passengers: Scheduled and Charter Traffic 2010

Destination Continent	Origin			
	Zurich	Geneva	Basel-Mulhouse	Total
Europe	8,518,362	4,761,550	1,775,525	15,055,437
Africa	544,931	325,947	181,377	1,052,255
Asia	1,284,716	379,349	27,964	1,692,029
Oceania	67,439	6,418	353	74,210
North America	1,040,062	387,145	66,000	1,493,207
Central America	59,249	13,364	5,569	78,182
South America	147,358	45,546	6,741	199,645
Total	**11,662,117**	**5,919,319**	**2,063,529**	**19,644,695**

Passenger traffic flows by continent of destination, 2010

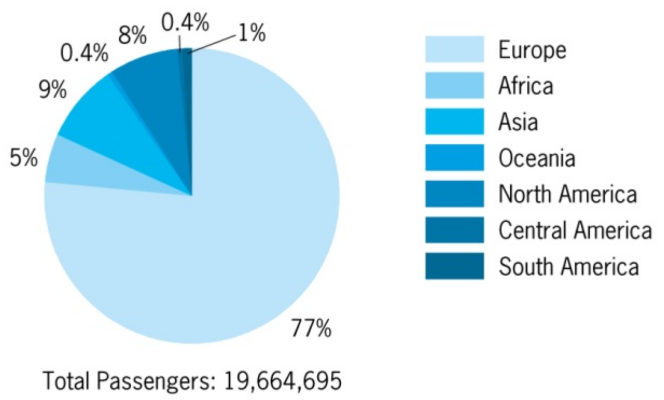


Figure 2.7.4 Destinations of Departing Passengers: Scheduled and Charter Traffic 2010; Passenger traffic flows by continent or destination, 2010

The freight and mail traffic in tonnes is reported by the airports four times a year. The annual mean values since 1950 are shown in figures 2.7.5 and 2.7.6.
The curve of freight and mail traffic corresponds strongly with the aircraft movements and the number of passengers. The decrease after the peak in 2000, the increase after 2004 and the dip in the curve in 2009 mirrors the economic development of the civil sector.

Freight and Mail since 1950 (scheduled and charter traffic)
(Local and transfer traffic without transit)

	Freight and Mail in tons									
	Total	National Airports				Regional airports [1]				
		Total	Basel-Mulhouse [2]	Genève	Zürich	Total	Bern-Belp	Lugano-Agno	Sion	St.Gallen-Altenrhein
Freight and Mail in tonnes										
1950	8'439	8'364	753	3'419	4'192	75	75	0	0	0
1960	31'667	31'619	4'248	7'595	19'776	48	48	0	0	0
1970	146'773	146'513	12'573	31'176	102'764	260	260	0	0	0
1980	231'247	231'081	22'436	42'059	166'586	166	28	0	138	0
1985	296'402	296'359	14'106	55'246	227'007	43	43	0	0	0
1990	366'474	366'047	28'967	65'884	271'196	427	68	359	0	0
1995	463'777	462'901	40'779	78'073	344'049	876	31	806	0	39
1996	463'692	462'573	49'483	72'790	340'300	1'119	25	1'053	0	41
1997	466'675	465'689	49'584	61'244	354'861	986	43	938	0	5
1998	484'278	483'417	73'240	60'412	349'765	861	52	803	0	6
1999	503'099	502'279	72'579	52'599	377'101	820	71	728	0	21
2000	532'045	531'346	79'760	45'138	406'448	699	62	614	0	23
2001	469'762	469'092	70'280	37'414	361'398	670	41	612	0	17
2002	359'490	359'087	31'258	37'312	290'517	403	32	353	0	18
2003	330'347	330'060	31'250	39'253	259'557	286	14	255	0	17
2004	326'029	325'887	34'214	40'215	251'458	141	2	118	0	21
2005	340'794	340'658	32'085	38'774	269'799	137	0	108	0	29
2006	338'588	338'477	35'931	37'000	265'546	111	0	78	0	33
2007	359'542	359'440	43'994	36'426	279'020	101	0	67	0	34
2008	352'559	352'462	38'945	31'108	282'409	97	0	60	0	37
2009	319'450	319'353	31'329	29'497	258'527	97	0	65	0	32
2010	379'389	379'310	43'739	31'405	304'166	79	0	67	0	12

[1] with scheduled and charter traffic
[2] including french traffic / possible rounding errors

Figure 2.7.5 Freight and mail since 1950 (scheduled and charter traffic)

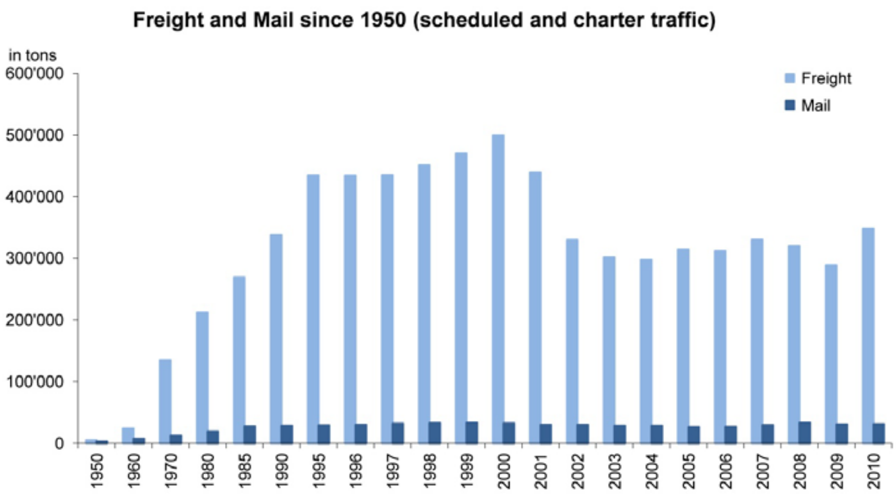


Figure 2.7.6 Total freight and mail since 1950 (scheduled and charter traffic)

III Historical Emissions and Prognoses

3.1. Historical Emissions

Switzerland submits annually the fuel consumption and gaseous emissions under the UNFCCC on GHG emissions and removals[15].

The emissions of civil aviation are modelled by a Tier 3a method developed by FOCA. The Tier 3a method follows standard modelling procedures at the level of single movements based on detailed movement statistics. The primary key for all calculations is the aircraft tail number, which allows calculation at the most precise level, namely on the level of the individual aircraft and engine type. Every aircraft is linked to the FOCA engine-data base containing emission factors for more than 600 individual engines with different power settings. Emissions in the landing and take-off cycle (LTO) are calculated with aircraft category-dependent flight times and corresponding power settings. Cruise emissions are calculated based on the individual aircraft type and the trip distance for every flight.

The movement database from Swiss airports contains departure and destination airport. With this information, all flights from and to Swiss airports are separated into domestic (national) and international flights prior to the emission calculation.

The emission factors used are country specific or are taken from the ICAO engine emissions databank, from EMEP/CORINAIR databases (EEA 2002), Swedish Defence Research Agency (FOI) and Swiss FOCA measurements (precursors). Cruise emission factors are generally calculated from the values of the ICAO engine emissions databank, adjusted to cruise conditions by using the Boeing Fuel Flow Method 2. For N_2O, the IPCC default emission factor is used.

Fuel Consumption and Gaseous Emissions

Fuel Consumption [t]	1990	2000	2005	2008	2009
Filled up in Switzerland	1,054,448	1,540,307	1,152,388	1,382,835	1,324,224
Consumed in the Swiss airspace		513,678	496,760	557,774	589,376

Gaseous Emissions [t]	1990	2000	2005	2008	2009
CO_2	3,321,512	4,851,967	3,630,023	4,352,613	4,168,127
NOx	12,549	18,470	13,952	17,653	16,239
CO	7,183	8,782	6,483	6,863	6,685
HC	991	905	707	789	761

The calculation is based on the fuel quantity actually filled up in Switzerland

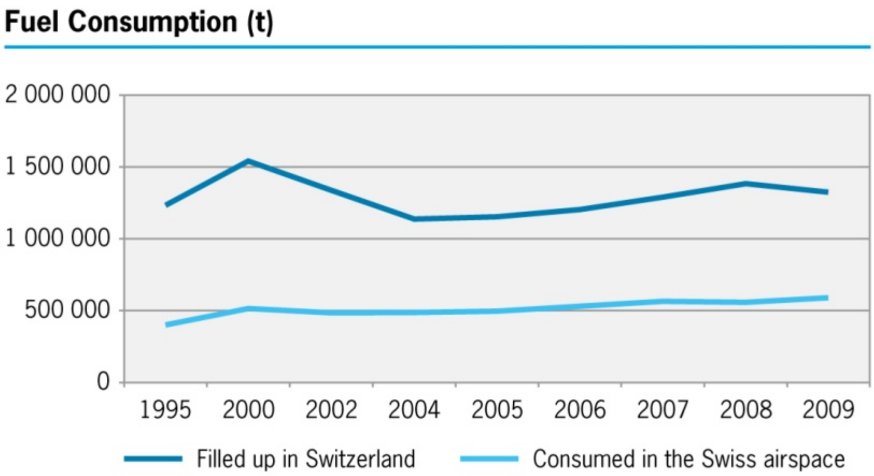


Figure 3.1.1 Fuel Consumption and Gaseous Emissions

15 FOEN 2012: Swiss Greenhouse Gas Inventories 2010

Activity data are derived from detailed movement statistics. The statistical basis has been extended after 1996, thus the modelling details are not exactly the same for the years 1990-1995 as for the subsequent years. The source for the 1990 and 1995 modelling is the movement statistics, which record information for every movement on airline, number of seats, Swiss airport, arrival/departure, origin/destination, number of passengers, distance. From 1996 onwards, every movement in the FOCA statistics also contains the individual aircraft tail number (aircraft registration). This is the key variable to connect airport data and aircraft data. The statistics may contain more than one million records with individual tail numbers. All annual aircraft movements recorded are split into domestic and international flights.

Fuel Consumption and Gaseous Emissions of Swiss Civil Aviation

	Traffic	Fuel consumption [t]	Combustion products		Polluants				
			CO_2 [t]	H_2O [t]	SO_2 [t]	Pb [t]	NOx [t]	VOC [t]	CO [t]
1990	International	974'211	3'068'765	1'198'367	975	1.1	11'724	875	4'036
	Domestic	80'237	252'747	99'244	80	3.8	826	116	3'147
	Total	1'054'448	3'321'512	1'297'611	1'054	4.9	12'549	991	7'183
1995	International	1'161'044	3'657'283	1'428'189	1'161	0.6	13'461	658	3'904
	Domestic	71'502	225'231	88'364	72	3.5	651	98	3'037
	Total	1'232'546	3'882'514	1'516'553	1'233	4.0	14'112	756	6'941
2000	International	1'481'262	4'665'977	1'821'952	1'481	1.0	17'744	774	4'607
	Domestic	59'045	185'990	72'625	59	6.0	726	131	4'175
	Total	1'540'307	4'851'967	1'894'577	1'540	7.0	18'470	905	8'782
2002	International	1'290'115	4'063'864	1'586'842	1'290	1.0	15'468	679	4'117
	Domestic	47'154	148'536	58'000	47	5.0	587	106	3'407
	Total	1'337'269	4'212'400	1'644'842	1'337	6.0	16'055	785	7'524
2004	International	1'090'689	3'435'670	1'341'548	1'091	0.9	13'099	598	3'384
	Domestic	45'659	143'827	56'161	46	4.0	594	104	3'001
	Total	1'136'348	3'579'497	1'397'709	1'137	4.9	13'693	702	6'385
2005	International	1'112'887	3'505'595	1'368'851	1'113	1.0	13'445	608	3'499
	Domestic	39'501	124'428	48'586	40	4.0	507	99	2'984
	Total	1'152'388	3'630'023	1'417'437	1'153	5.0	13'952	707	6'483
2006	International	1'165'318	3'667'954	1'433'341	1'165	0.6	14'100	621	3'605
	Domestic	38'550	121'341	47'416	34	4.0	479	92	2'653
	Total	1'203'868	3'789'295	1'480'757	1'198	4.6	14'579	713	6'258
2007	International	1'245'184	3'919'341	1'531'576	1'245	0.6	15'564	666	3'956
	Domestic	43'968	138'393	54'081	39	3.9	531	106	2'654
	Total	1'289'152	4'057'735	1'585'657	1'284	4.5	16'095	772	6'610
2008	International	1'345'209	4'234'179	1'654'607	1'345	0.5	17'221	662	4'148
	Domestic	37'627	118'434	46'281	33	3.8	431	127	2'715
	Total	1'382'835	4'352'613	1'700'887	1'378	4.3	17'653	789	6'863
2009	International	1'284'598	4'043'401	1'580'056	1'284	0.5	15'761	636	3'979
	Domestic	39'626	124'726	48'740	35	3.9	478	125	2'707
	Total	1'324'224	4'168'127	1'628'796	1'319	4.4	16'239	761	6'685
2010	International	1'351'572	4'254'208	1'662'434	1'351	0.5	17'153	606	4'101
	Domestic	39'252	123'550	48'280	34	3.9	481	128	2'601
	Total	1'390'824	4'377'758	1'710'714	1'386	4.3	17'635	734	6'701

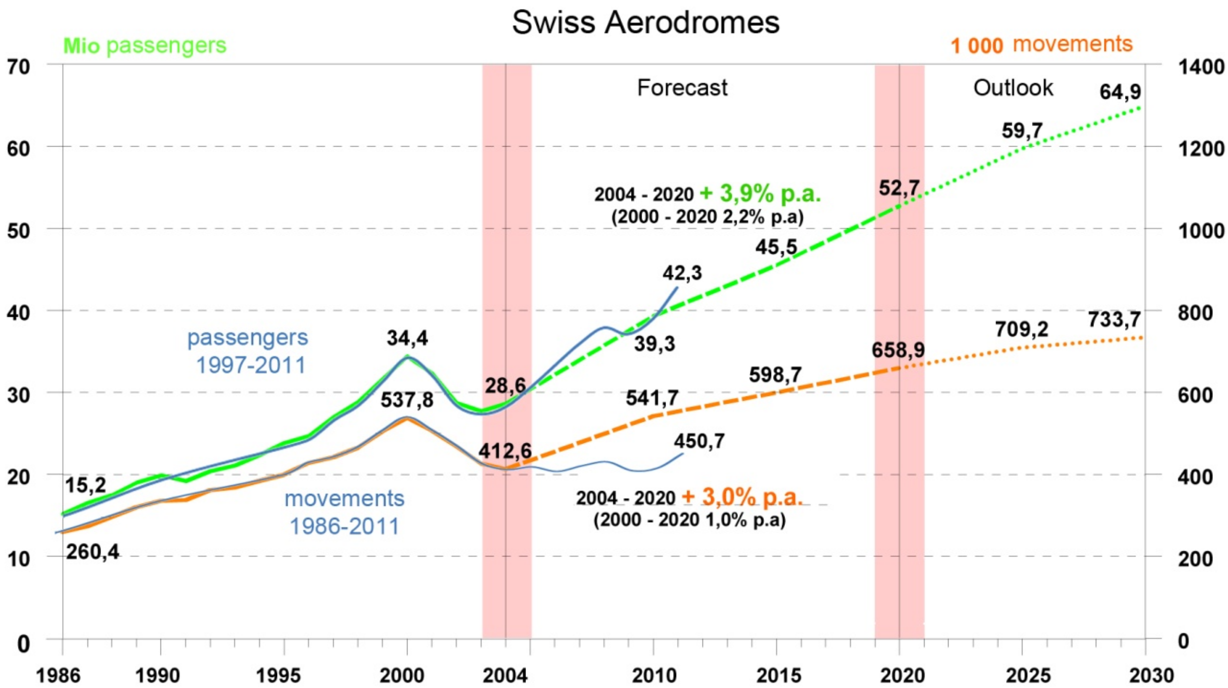
Since 2004 the emissions are calucated with a more precise model. The comparison to the previous year isn't always possible

Figure 3.1.2 Fuel Consumption and Gaseous Emissions of Swiss Civil Aviation

3.2 Forecast

FOCA has published a forecast of the long-term development in Swiss air traffic until 2030 (Intraplan 2005[16]). For further details about the assumptions and models used in developing this forecast, please see the report on the website of FOCA:

The calculations were based on statistical information for the year 2004 and earlier. In figure 3.2.1 the actual movements and passenger numbers have been added as a blue line.



©Intraplan 2005, modified by FOCA 2012

Figure 3.2.1 Forecast of scheduled and charter traffic for Swiss aerodromes

After 2003 the number of passengers has increased and, with the exception of the financial crisis period, the aircraft movements fluctuate around 400 000 movements per year. This trend is due to bigger aircraft and better load factors.

[16] FOCA 2005: Entwicklung des Luftverkehrs in der Schweiz bis 2030 – Nachfrageprognose

SECTION 1 – Supranational Measures

4 Supranational Measures

The Directors General (DGCA) of the European Civil Aviation Conference (ECAC) agreed on a common language for the supra-national elements of the Action Plan of each member state. This section includes the this common language elaborated by the European Coordination Group ACCAPEG (Aviation Climate Change Action Plan Expert Group). Switzerland had the co-lead of the ACCAPEG and was therefore closely involved in the process of writing the supranational section.

4.1 Aircraft related technology development

4.1.1 Aircraft emissions standards

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

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

Switzerland participates in the Working Group 3 of ICAO's Committee on Aviation Environmental Protection (CAEP) responsible for the development of a CO_2 standard. Its work within this group is mainly focused on the development on a PM Standard.

4.1.2 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) in order to allow the achievement of ambitious and complex research goals. Set up as a Public Private Partnership between the European Commission and the European aeronautical industry, Clean Sky will pull together the research and technology resources of the European Union in a coherent, 7-year, €1.6bn programme, and contribute significantly to the 'greening' of aviation.

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

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

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

- Technologies. These are selected, developed and monitored in terms of maturity, or "technology readiness level" (TRL). A detailed list of more than one hundred key technologies has been set. The technologies developed by Clean Sky will cover all major segments of commercial aircraft.
- Concept Aircraft. These are design studies dedicated to integrating technologies into a viable conceptual configuration, and assessing their potential and relevance. They cover a broad range of aircraft: business jets, regional and large commercial aircraft, as well as rotorcraft. They have been grouped and categorised in order to represent the major future aircraft families. Clean Sky's environmental results will be measured and reported upon principally by Concept Aircraft.

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

The environmental objectives of the programme are determined by evaluating the performance of concept aircraft in the global air transport system (when compared to 2000 level technology and to a "business as usual" evolution of technology). The ranges of environmental improvements result from the sum of technologies which are expected to reach TRL5-6 within the programme timeframe. While not all of these technologies will be developed directly through the Clean Sky programme, it is neither feasible nor relevant at this stage to isolate the benefits derived purely from Clean Sky technologies, as Clean Sky will achieve a significant synergy effect in European Aeronautics Research by maturing closely linked technologies to a materially higher TRL through demonstration and integration.
Clean Sky activities are performed within six “Integrated Technology Demonstrators” (ITDs) and a “Technology Evaluator”.
The three vehicle-based ITDs will develop, deliver and integrate technologies into concrete aircraft configurations. The two “transversal” ITDs are focused on propulsion and systems, and will deliver technologies, which will be integrated in various aircraft configurations by the vehicle ITDs. A further ITD will focus specifically on the life cycle assessment and 'eco-design' philosophy.

- Smart Fixed Wing Aircraft (SFWA) – co-led by Airbus and SAAB - will deliver innovative wing technologies together with new aircraft configurations, covering large aircraft and business jets. Key enabling technologies from the transversal ITDs, for instance Contra Rotating Open Rotor, will be integrated into the demonstration programmes and concept aircraft.
- Green Regional Aircraft (GRA) – co-led by Alenia and EADS CASA - will develop new technologies for the reduction of noise and emissions, in particular advanced low-weight & high performance structures, incorporation of all-electric systems, bleed-less engine architecture, low noise/high efficiency aerodynamics, and finally environmentally optimised mission and trajectory management.
- Green Rotorcraft (GRC) – co-led by Agusta Westland and Eurocopter - will deliver innovative rotor blade technologies for reduction in rotor noise and power consumption, technologies for lower airframe drag, environmentally friendly flight paths, the integration of diesel engine technology, and advanced electrical systems for elimination of hydraulic fluids and for improved fuel consumption.
- Sustainable and Green Engines (SAGE) - co-led by Rolls-Royce and Safran - will design and build five engine demonstrators to integrate technologies for low fuel consumption, whilst reducing noise levels and nitrous oxides. The ‘Open Rotor’ is the target of two demonstrators. The others address geared turbofan technology, low pressure stages of a three-shaft engine and a new turboshaft engine for helicopters.
- Systems for Green Operations (SGO) - co-led by Liebherr and Thales - will focus on all electrical aircraft equipment and system architectures, thermal management, capabilities for environmentally-friendly trajectories and missions, and improved ground operations to give any aircraft the capability to fully exploit the benefits of the “Single European Sky”.
- Eco-Design - co-led by Dassault and Fraunhofer Gesellschaft - will support the ITDs with environmental impact analysis of the product life-cycle. Eco-Design will focus on environmentally-friendly design and production, withdrawal, and recycling of aircraft, by optimal use of raw materials and energies, thus improving the environmental impact of the entire aircraft life-cycle.

Complementing these six ITDs, the Technology Evaluator (TE) is a dedicated evaluation platform

cross-positioned within the Clean Sky project structure. The TE is co-led by DLR and Thales, and includes the major European aeronautical research organisations. It will assess the environmental impact of the technologies developed by the ITDs and integrated into the Concept Aircraft. By doing this, the TE will enable Clean Sky to measure and report the level of success in achieving the environmental objectives, and in contributing towards the ACARE environmental goals. Besides a mission level analysis (aircraft level), the positive impact of the Clean Sky technologies will be shown at a relevant hub airport environment and across the global air transport system.
The first assessment by the Technology Evaluator on the way to meeting Clean Sky's environmental objectives is planned for the end of 2011. The ranges of potential performance improvement (reduction in CO_2, NO_X and Noise) will be narrowed or evolved during the life of the programme based on the results from the key technologies developed and validated through the demonstrations performed.
Clean Sky is a 'living' programme: each year, Annual Implementation Plans are produced and agreed, and research priorities are (re-)calibrated based on results achieved. The best approach to progressing the technologies is pursued. The Clean Sky JU uses regular Calls for Proposals to engage with the wider aeronautical industry, research organisations and universities in order to bring the best talent on board and enable broad collaborative participation. A very significant share of the Clean Sky research programme is already being taken on by Europe's aerospace related SMEs, and by September 2011 nine Calls for Proposals will have been completed, demonstrating the JU's commitment to involving all competent organisations in the European aeronautics research arena. In June 2011, a major and exciting milestone was reached with the 400th partner joining the Clean Sky programme.

4.1.3 Participation of Switzerland in the 7th Framework Programme (FP7)

In 2010 the Swiss State Secretariat for Education and Research (SER) published a report about the Swiss participation in FP7[17]. At the time the report was published roughly CHF 1.22 billion in grant funding had been secured for Swiss research projects. This amount corresponds to around 4.3% of the total FP7 budget. The Cooperation program, one of the 4 core programs, includes the research theme Transport (including Aeronautics), where CHF 34.1 million grant funding was awarded to Switzerland.

4.2 Alternative Fuels

4.2.1 European Advanced Biofuels Flightpath

In February 2009, the European Commission's Directorate General for Energy and Transport initiated the SWAFEA (Sustainable Ways for Alternative Fuels and Energy for Aviation) study to investigate the feasibility and the impact of the use of alternative fuels in aviation. The goal was to provide the European Commission with information and decision elements to support its future air transport policy, in the framework of the European commitment to promote renewable energy for the mitigation of climate change, security of supply and also to contribute to Europe's competitiveness and economic growth.
The study team involved 20 European and international organisations, representing all players in alternative aviation fuels: aircraft and engine manufacturing, air transport, oil industry, research and consulting organisations covering a large spectrum of expertise in the fields of fuel, combustion, environment as well as agriculture.
The SWAFEA final report was published in July 2011[18]. 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[19]) and economic aspects. It includes a number of recommendations on the steps that should be taken to promote the take-up of sustainable biofuels for aviation in Europe.

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[17] SER 2011: Swiss participation in the EU's Seventh Research Framework Programme - Interim Report, 2007-2011. Facts and Figures

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

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

In March 2011, the European Commission published a White Paper on transport[20]. In the context of an overall goal of achieving a reduction of at least 60% in greenhouse gas emissions from transport by 2050 with respect to 1990, the White Paper established a goal of low-carbon sustainable fuels in aviation reaching 40% by 2050.
As a first step towards delivering this goal, in June the European Commission, in close coordination with Airbus, leading European airlines (Lufthansa, Air France/KLM, & British Airways) and key European biofuel producers (Choren Industries, Neste Oil, Biomass Technology Group and UOP), launched the European Advanced Biofuels Flightpath. This industry-wide initiative aims to speed up the commercialisation of aviation biofuels in Europe, with the objective of achieving the commercialisation of sustainably produced paraffinic biofuels in the aviation sector by reaching a 2 million tons consumption by 2020.
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[21].
More specifically, the initiative focuses on the following:

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

Take concrete actions to inform the European citizen of the benefits of replacing kerosene by certified sustainable biofuels.
The following “Flight Path” provides an overview about the objectives, tasks, and milestones of the initiative.

Time horizons	Action	Aim/Result
Short-term (next 0-3 years)	Announcement of action at International Paris Air Show	To mobilise all stakeholders including Member States.
	High level workshop with financial institutions to address funding mechanisms.	To agree on a "Biofuel in Aviation Fund".
	> 1,000 tons of Fisher-Tropsch biofuel become available.	Verification of Fisher-Tropsch product quality. Significant volumes of synthetic biofuel become available for flight testing.
	Production of aviation class biofuels in the hydrotreated vegetable oil (HVO) plants from sustainable feedstock	Regular testing and eventually few regular flights with HVO biofuels from sustainable feedstock.
	Secure public and private financial and legislative mechanisms for industrial second generation biofuel plants.	To provide the financial means for investing in first of a kind plants and to permit use of aviation biofuel at economically acceptable conditions.

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

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

	Biofuel purchase agreement signed between aviation sector and biofuel producers.	To ensure a market for aviation biofuel production and facilitate investment in industrial 2G plants.
	Start construction of the first series of 2G plants.	Plants are operational by 2015-16.
	Identification of refineries & blenders which will take part in the first phase of the action.	Mobilise fuel suppliers and logistics along the supply chain.
Mid-term (4-7 years)	2000 tons of algal oils are becoming available.	First quantities of algal oils are used to produce aviation fuels.
	Supply of 1.0 M tons of hydrotreated sustainable oils and 0.2 tons of synthetic aviation biofuels in the aviation market.	1.2 M tons of biofuels are blended with kerosene.
	Start construction of the second series of 2G plants including algal biofuels and pyrolytic oils from residues.	Operational by 2020.
Long-term (up to 2020)	Supply of an additional 0.8 M tons of aviation biofuels based on synthetic biofuels, pyrolytic oils and algal biofuels.	2.0 M tons of biofuels are blended with kerosene.
	Further supply of biofuels for aviation, biofuels are used in most EU airports.	Commercialisation of aviation biofuels is achieved.

It has to be mentioned that the Swiss legislation on the taxation of mineral oils provides for a tax exemption of bio fuels used for domestic purposes if these bio fuels fulfil certain sustainability related criteria (Treibstoff-Ökobilanzverordnung).

4.3 Improved Air Traffic Management and Infrastructure Use

4.3.1 The EU's Single European Sky initiative and SESAR

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

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

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

4.3.1.1 SESAR

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

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

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

Implementation of SESAR in general will facilitate the following:

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

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

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

1. Achieve emission improvements through the optimisation of air traffic management services. The SESAR target for 2020 is to enable 10% fuel savings per flight as a result of ATM improvements alone, leading to a 10% reduction of CO_2 emissions per flight;
2. Improve the management of noise emissions and their impacts through better flight paths, or optimised climb and descent solutions;
3. Improve the role of ATM in enforcing local environmental rules by ensuring that flight operations fully comply with aircraft type restrictions, night movement bans, noise routes, noise quotas, etc.;
4. Improve the role of ATM in developing environmental rules by assessing the ecological impact of ATM constraints, and, following this assessment, adopting the best alternative solutions from a European sustainability perspective.
5. Accompany the development of new procedures and targets with an effective regulatory framework in close cooperation with the European Commission;
6. Implement more effective two-way community relations and communications capabilities at local and regional levels including a commonly agreed environmental strategy and vision.

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

4.3.1.2 Functional Airspace Block Europe Central (FABEC)

The FABEC members (Belgium, Germany, France, Luxembourg, the Netherlands and Switzerland) have developed and signed in 2010 a Treaty relating to the establishment of the Functional Airspace Block "Central Europe"[22]. The treaty involves all relevant civil and military authorities that take decisions on the establishment and modification of the FABEC, on establishing specific arrangements in the FABEC and on the ensuing FABEC operations. The treaty is a legal instrument facilitating direct cooperation and coordination among the authorities and Air Navigation Service Providers (ANSP). FABEC airspace covers 1.7 million km^2 and handles about 5.5 million flights per year – 55% of European air traffic. FABEC will considerably reduce the environmental impact per flight by improving routes, flight profiles and distances flown, in line with broader European programs.
The FABEC environmental case includes environmental contributions of Early Implementation Packages, Airspace Design Projects and Airspace Strategy Projects (Free Route Airspace Project agreed by the Matterhorn Declaration September 2011).

4.3.2 Operational improvements: AIRE

The Atlantic Interoperability Initiative to Reduce Emissions (AIRE) is a programme designed to improve energy efficiency and lower engine emissions and aircraft noise in cooperation with the US FAA. The SESAR JU is responsible for its management from a European perspective.
Under this initiative ATM stakeholders work collaboratively to perform integrated flight trials and demonstrations validating solutions for the reduction of CO_2 emissions for surface, terminal and oceanic operations to substantially accelerate the pace of change.
AIRE has demonstrated in 2009, with 1,152 trials performed, that significant savings can be achieved using existing technology. CO_2 savings per flight ranged from 90kg to 1250kg and the accumulated savings during trials were equivalent to 400 tons of CO_2. Another positive aspect is the human dimension - the AIRE projects boost crew and controller motivation to pioneer new ways of working together focusing on environmental aspects, and enabled cooperative decision-making towards a common goal.
The strategy is to produce constant step-based improvements, to be implemented by each partner in order to contribute to reaching the common objective. In 2010 demand for projects has more than doubled and a high transition rate from R&D to day-to-day operations, estimated at 80%, from AIRE 2009 projects was observed (expected to further increase with time). Everyone sees the "AIRE way of working together" as an absolute win-win to implement change before the implementation of more technology intensive ATM advancements expected for the period 2013 onward. A concrete example of the progress achieved is that, due to AIRE, both FAA and NAV Portugal offer lateral optimisation over the transatlantic routes to any user upon request. In July 2010, the SESAR JU launched a new call for tender and had an excellent response - 18 projects were selected involving 40 airlines, airport, air navigation service providers and industry partners. More than 5,000 trials are expected to take place.

[22] FABEC 2012: www.fabec.eu

4.4 Economic / Market-Based Measures

4.4.1 The EU Emission Trading System

The EU Emissions Trading System (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively. Being the first and biggest international scheme for the trading of greenhouse gas emission allowances, the EU ETS currently covers some 11,000 power stations and industrial plants in 30 countries.
Launched in 2005, the EU ETS works on the "cap and trade" principle. This means there is a "cap", or limit, on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. Within this cap, companies receive emission allowances which they can sell to or buy from one another as needed. The limit on the total number of allowances available provides certainty that the environmental objective is achieved and ensures that the allowances have a market value.
At the end of each year each company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or else sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so. The number of allowances is reduced over time so that total emissions fall.
The EU ETS now operates in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway). It currently covers CO_2 emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Between them, the installations currently in the scheme account for almost half of the EU's CO_2 emissions and 40% of its total greenhouse gas emissions.
Airlines join the scheme in 2012. The EU ETS will be further expanded to the petrochemicals, ammonia and aluminium industries and to additional gases (PFCs and N_2O) in 2013, when the third trading period starts. At the same time a series of important changes to the way the EU ETS works will take effect in order to strengthen the system.
The legislation to include aviation in the EU ETS was adopted in November 2008, and entered into force as Directive 2008/101/EC of the European Parliament and of the Council on 2 February 2009. The proposal to include aviation in the EU ETS, made by the European Commission in December 2006, was accompanied by a detailed impact assessment.
Under the EU ETS, the emissions cap is increased to accommodate the inclusion of aviation. This addition to the cap establishes the total quantity of allowances to be allocated to aircraft operators. This quantity is defined as a percentage of historical aviation emissions, which is defined as the mean average of the annual emissions in the calendar years 2004, 2005 and 2006 from aircraft performing an aviation activity falling within the scope of the legislation. In July 2011, it was decided that the historical aviation emissions are set at 221,420,279 tonnes of CO_2.
The additional cap to be added to the EU ETS in 2012, the first year of operation for aviation, will be set at 97% of the historical aviation emissions. For the period from 2013 to 2020 inclusive the additional cap will be set at 95% of the historical aviation emissions.
Aircraft operators flying to and from airports in 30 European states from 2012 will be required to surrender allowances in respect of their CO_2 emissions on an annual basis. The large majority of allowances will be allocated to individual aircraft operators free of charge, based on their respective aviation output (rather than emissions) in 2010, thus rewarding operators that have already invested in cleaner aircraft. In 2012, 85% of the total quantity of the additional allowances (or “cap”) will be allocated free of charge according to this benchmarking methodology, while in the 2013-2020 trading period 82% of the additional allowances will be allocated free of charge in this way. In the 2013-2020 trading period, an additional 3% of the total additional allowances for aviation will be set aside for allocation free of charge via the special reserve, to new entrants and fast-growing airlines. The remaining 15% of allowances will be allocated each year by auction.
Aircraft operators that choose to emit more than their free allocation of allowances will be able to source allowances from other participants in the ETS (including those outside the aviation sector), from intermediaries who trade allowances, from Member States via auctions, or they can use specific quantities of international credits from emissions reduction projects in third countries (e.g. CDM credits and ERUs).

The system also includes a de minimis provision under which commercial aircraft operators with a low level of aviation activity in Europe are excluded from its scope. This is likely to mean that many aircraft operators from developing countries will be unaffected by the scheme and, indeed, over 90 ICAO states have no commercial aircraft operators included in the scope of the EU ETS.
The EU legislation foresees that, where a third country takes measures of its own to reduce the climate change impact of flights departing from its airports, the EU will consider options available in order to provide for optimal interaction between the EU scheme and that country's measures. In such a case, flights arriving from the third country could be excluded from the scope of the EU scheme. The EU therefore encourages other countries to adopt measures of their own and is ready to engage in bilateral discussions with any country that has done so.
The legislation also makes it clear that if there is agreement on global measures, the EU shall consider whether amendments to this Directive as it applies to aircraft operators are necessary.

4.4.2 Anticipated change in fuel consumption and/or CO_2 emissions
The environmental outcome of an emissions trading system is pre-determined through the setting of an emissions cap. In the case of the EU ETS, an addition to the overall cap is established for aviation emissions. However, aircraft operators are also able to use allowances allocated to other sectors to cover their emissions. It is therefore possible (indeed highly likely given traffic growth forecasts) that the absolute level of CO_2 emissions from aviation will exceed the number of allowances allocated to aviation. However, any aviation emissions will necessarily be offset by CO_2 emissions reductions elsewhere, either in other sectors within the EU that are subject to the EU ETS, or through emissions reduction projects in third countries. The "net" aviation emissions will however be the same as the number of allowances allocated to aviation under the EU ETS.
In terms of contribution towards the ICAO global goals, the states implementing the EU ETS will together deliver, in "net" terms, a 3% reduction below the 2005 level of aviation CO_2 emissions in 2012, and a 5% reduction below the 2005 level of aviation CO_2 emissions in the period 2013-2020.
Other emissions reduction measures taken, either at supra-national level in Europe or, by any of the 30 individual states implementing the EU ETS, will of course make their own contribution towards the ICAO global goals. Such measures are likely to moderate the anticipated growth in aviation emissions in Europe and therefore reduce the extent to which the absolute level of CO_2 emissions from aviation will exceed the number of allowances allocated to aviation. However, assuming that absolute aviation emissions will nonetheless in future exceed the additional aviation cap, the aggregate contribution towards the global goals is likely to remain that which is determined by the EU ETS cap.

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

4.4.4 The Swiss ETS
On 23 December 2011 the Swiss parliament passed the CO_2 act. This legal framework allows the Federal Council to define sectors, for example that of civil aviation, which will be included in the Swiss emission trading system (ETS). Negotiations with the EU about linking the Swiss ETS and the EU ETS are currently being conducted[23].

[23] FOCA 2012: European Union emission trading scheme

4.5 Support to Voluntary Actions: ACI Airport Carbon Accreditation

Airport Carbon Accreditation is a certification programme for carbon management at airports, based on carbon mapping and management standard specifically designed for the airport industry. It was launched in 2009 by ACI EUROPE, the trade association for European airports.
This industry-driven initiative was officially endorsed by Eurocontrol and the European Civil Aviation Conference (ECAC). It is also officially supported by the United Nations Environmental Programme (UNEP). The programme is overseen by an independent Advisory Board. ACI EUROPE is looking at expanding the geographical scope of the programme through the other ACI regions. Discussions are currently under way with ACI Asia Pacific for a possible extension of the programme to the Asia Pacific region.
Airport Carbon Accreditation is a four-step programme, from carbon mapping to carbon neutrality. The four steps of certification are: Level 1 “Mapping”, Level 2 “Reduction”, Level 3 “Optimisation”, and Level 3+ “Carbon Neutrality”. One of its essential requirements is the verification by external and independent auditors of the data provided by airports. Aggregated data are included in the Airport Carbon Accreditation Annual Report thus ensuring transparent and accurate carbon reporting. At level 2 of the programme and above (Reduction, Optimisation and Carbon Neutrality), airport operators are required to demonstrate CO2 reduction associated with the activities they control.
In June 2011, 2 years after the launch of the programme, 43 airports were accredited, representing 43% of European passenger traffic. ACI/Europe’s objective for the end of the 3rd year of the programme’s operation is to cover airports representing 50% of European passenger traffic. Programme’s implementation is twofold: on top of recruiting new participants, individual airports should progress along the 4 levels of the programme.

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

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

Variable	Year 1		Year 2	
	Emissions	Number of airports	Emissions	Number of airports
Aggregate carbon footprint for ‘year 0’ for emissions under airports’ direct control (all airports)	803,050 tonnes CO_2	17	2,275,469 tonnes CO_2	43
Carbon footprint per passenger	2.6 kg CO_2		3.73 kg CO_2	
Aggregate reduction in emissions from sources under airports’ direct control (Level 2 and above)	51,657 tonnes CO_2	9	51,819 tonnes CO_2	19
Carbon footprint reduction per passenger	0.351 kg CO_2		0.11 kg CO_2	
Total carbon footprint for ‘year 0’ for emissions sources which an airport may guide or influence (level 3 and above)	2,397,622 tonnes CO_2	6	6,643,266 tonnes CO_2	13

Aggregate reductions from emissions sources which an airport may guide or influence	359,733 tonnes CO_2		675,124 tonnes CO_2	
Total emissions offset (Level 3+)	13,129 tonnes CO_2	4	85,602 tonnes CO_2	8

Its main immediate environmental co-benefit is the improvement of local air quality.
Costs for design, development and implementation of Airport Carbon Accreditation have been borne by ACI EUROPE. Airport Carbon Accreditation is a non-for-profit initiative, with participation fees set at a level aimed at allowing for the recovery of the aforementioned costs.
The scope of Airport Carbon Accreditation, i.e. emissions that an airport operator can control, guide and influence, implies that aircraft emissions in the LTO cycle are also covered. Thus, airlines can benefit from the gains made by more efficient airport operations to see a decrease in their emissions during the LTO cycle. This is coherent with the objectives pursued with the inclusion of aviation in the EU ETS as of 1 January 2012 (Directive 2008/101/EC) and can support the efforts of airlines to reduce these emissions.

SECTION 2 – National Measures

V National Measures

FOCA organised in February 2012 an event for aerodromes, air traffic control and aviation industry stakeholders. The aim of this event was to inform all relevant parties in the Swiss aviation system about the ICAO action plan and to evaluate possible measures to reduce CO_2 emissions undertaken by these stakeholders.
The result of this meeting is a wide collection of different measures undertaken in different categories. Most of those measures are done on a voluntary basis to optimise operations and business in general. All these measures are summarised in chapter V. Where possible calculations were done of the estimated achievable reduction in CO_2 emissions.

5.1 Aircraft related technology development

5.1.1 Lighter material

Airline operators are continuously optimizing the interior of their aircraft in terms of weight gain. A weight reduction can be achieved by installing lighter materials such as new seats, lighter freight/baggage containers or lighter on-board equipment. Calculations of CO_2 reduction due to weight gain were carried out by some Swiss operators. The installation of new seats led to an estimated reduction of 2400 t CO_2 per year in comparison with 2009. The replacement of freight/baggage containers with lighter models will remove about 3000 t CO_2 per year starting in 2014. Started in 2011, lighter on-board equipment has been installed and is reducing 800 t CO_2 per year. In 2009 a replacement of on-board equipment was done and could reduce approx. 1200 t CO_2 per year (with high uncertainty).

5.1.2 Substitution of engines, replacement of aircraft or renewal of fleets

The substitution of existing engines with more fuel efficient engines reduces mainly the fuel flow and with that the CO_2 emissions of the aircraft of the respective operators. An estimation of CO_2 reduction due to such substitution results in 8600 t CO_2 per year. This measure started in 2011 and will be completed in 2016.
The introduction of new aircraft with more efficient engines can lead to reductions in CO_2 emission; however the seating capacity will usually be increased as well and the reduction effect will be nullified. A measure taken by Swiss operators in conjunction with the goal to increase fuel efficiency and hence to reduce their CO_2 emissions is to partly renew their fleet. One such project starts in 2014 and will end in 2017 leading to an estimated reduction of 63000 t CO_2 per year.

5.2 Alternative Fuels

At the moment there are no measures taken by aerodromes, air traffic control or aviation industry to introduce alternative fuels.
It has to be mentioned that the Swiss legislation on the taxation of mineral oils provides for a tax exemption of bio fuels used for domestic purposes if these bio fuels fulfil certain sustainability related criteria (Treibstoff-Ökobilanzverordnung).

5.3 Improved Air Traffic Management and Infrastructure Use

5.3.1 More efficient ATM planning, ground operations, terminal operations

5.3.1.1 Greener Wave

Working within the SESAR (AIRE) framework, SWISS Int. Air Lines, Skyguide and Zurich Airport have developed an innovative approach procedure that significantly reduces CO_2 emissions[24]. Like many other airports around the world, Zurich Airport is subject to a night curfew. The first aircraft to arrive in the morning is permitted to land from 6.04 a.m. The long-haul flights on approach to Zurich have historically done so on a ‘first come, first served’ basis, which is the standard (hitherto uncontested) procedure at airports around the world. Cockpit crews are thereby motivated to fly as fast as they can in order to arrive as early as possible. The result, however, is often a backlog of flights in the early morn-

[24] SWISS Int. Air Lines 2011: Greener Wave; http://www.youtube.com/watch?v=br5bJ-KSi0o

ing sky over Zurich – which entails unnecessary noise and CO_2 emissions. To tackle this problem, SWISS Int. Air Lines have introduced in corporation with Zurich airport and Skyguide an alternative approach system defined as “Greener Wave” – a system coordinated by all partners whereby a specific time slot is assigned for arrival at Zurich Airport. This means that every aircraft of SWISS Int. Air Lines involved in the first wave of arrivals between 6.10 and 6.30 a.m. is assigned a Tactical Time of Arrival (TTA) in the form of a three-minute arrival time window. Success depends on the complex coordination of all aircraft of SWISS Int. Air Lines approaching Zurich Airport. This new method allows pilots to modify the flight in accordance with operational conditions – by timing their take-off time and adjusting the speed of the flight. By flying at a slower speed and scheduling their arrival to avoid being backlogged on arrival and subsequently having to fly a holding pattern ahead of landing, the cockpit crew can reduce CO_2 emissions substantially. The analysis of some 10,000 flights has determined that the Greener Wave system reduces by approximately one tonne the amount of CO_2 emissions per flight during the first morning wave of incoming air traffic. In total this is a reduction of 1800 t CO_2 per year. The project started in 2009 and is ongoing. If the project would be expanded to all flights in the morning wave, the savings would be significantly higher.

5.3.1.2 CHIPS

In 2009 FOCA created a working group with the Zurich airport and Skyguide named CHIPS, meaning CH-wide Implementation Program for SESAR oriented Objectives, Activities and Technologies. Other participants in CHIPS are the Swiss Air Force, the Geneva airport, plus SWISS Int. Air Lines and easyJet Switzerland SA. At the moment 20 projects in 15 different places have been realised, including the implementation of performance based navigation (PBN), improved flight efficiency in lower sectors and improved vertical flight efficiency measures such as CDO/CCO.

5.3.2 Flexible Use of Airspace, Improve Airspace Design and CDR

Almost all of the measures concerning airspace are embedded in the wider context of projects such as FABEC and SESAR. Therefore, estimates of CO_2 reduction are calculated on an international level and estimations on a regional level might thus be difficult.

5.3.3 Conversion of airport infrastructure and ground support equipment to cleaner fuels

The measures that are listed in this part are not directly reducing the CO_2 emissions of international aviation and therefore cannot be added to the total reduction from those measures described above. Nonetheless these measures are directly linked to the aviation sector and the undoubtedly have a positive effect on CO_2 emissions of Switzerland.

Geneva airport has acquired 282 UHV flat thermal solar panels based, on a technology developed at CERN (Organisation européenne pour la recherche nucléaire) and the company SRB Energy. These panels will be installed on the roofs of airport buildings. The elements, which have an area of 1200 square metres and produce 600 megawatt hour of solar energy per year, will heat a fluid to 130° C that will then feed a district heating network. This will make it possible to heat buildings during the winter and cool them in summer[25].

Another measure is to refurbish airport buildings, such as with thermal insulation, with several buildings at airports undergoing further refurbishment programs until 2020. This will lead to a reduced demand for central heating and can reduce approximately 3000 t CO_2 per year.

Optimizing space also leads to reduction of CO_2 emissions. A company situated at Zurich airport has sub-leased a third of their hangar to other companies and the optimisation of the space used saved about 1800 t CO_2 in the previous years.

Reduction in the CO_2 emissions from ground support vehicles can be achieved by renewing the fleet with more economic engines and (where suitable) by CNG engines. The use of electric vehicles is also encouraged and subsidized. A quantified calculation of the associated CO_2 reduction is difficult but has been provisionally estimated at 25 t CO_2 per year.

5.3.4 Construction of additional runway exits

The building of a rapid exit is one measure to reduce the CO_2 emissions due to decreasing the rotation time. This project will start in 2014 and will save an estimated 357 t CO_2 per year.

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[25] Airport Geneva 2012: Airport Geneva invests in the largest solar roof in Europe Information and News March 2012

5.3.5 Enhanced terminal support facilities

In the course of the future apron developments, aircraft stands will be equipped with stationary 400Hz-systems and pre-conditioned air supply; this measure will reduce either directly the use of aircraft built-in APU or the use of diesel-powered ground power units. At the moment, 23 aircraft positions at Geneva Airport are equipped with fixed 400 Hz and pre-conditioned air. Seven aircraft positions will be equipped with new fixed electricity installation in 2012. This measure reduced emissions of about 25000 t CO_2 per year, in the future up to 30000 t CO_2 per year. At the moment, 63 aircraft positions at Zurich Airport are equipped with fixed 400 Hz and pre-conditioned air, 5 aircraft positions with fixed 400 Hz (saved CO_2 emissions in previous years about 30000 t). Beginning in 2013 the airport of Zurich estimates a reduction of 5300 t CO_2 per year from their new aircraft stands.

5.3.6 Improved public transport access

Geneva Airport manages an ambitious mobility plan both for the airport's employees and for the passengers, with the goal of reaching 45% of sustainable mobility for both categories. For the employees, both incentive and restrictive measures are enforced. For arriving passengers, free tickets for public transportation are financed by the airport.
Moreover, high level lobbying is being pursued to get improvements to the airport public transportation network. The estimate of the associated emissions reduction is about 45000 t CO_2 per year.

A company working at Zurich Airport increased the parking charge for the staff to motivate people to come by train. The total estimated reduction is about 524 t CO_2 from the beginning of the measure until today.

Zurich Airport is pursuing until 2030 a target share of 46% of passengers, visitors and employees travel on public transport to the airport[26]. This so-called modal split indicates the relative proportions of people using public transport and private vehicles based on the total traffic volume of passengers, visitors and staff. The modal split at the airport has already reached a level of 46.3% in 2009. On one hand, this welcome development is explained by the excellent rail, bus and Glatttal light railway connections to the airport. On the other, targeted support measures have contributed to the increase in staff using public transport to travel to work.

5.4 More efficient operators

5.4.1 Best practices in operations

The periodic updating of flight management and planning systems brings benefits to different aspects of flight operations, such as optimized performance calculation, new functionalities, optimized flight level profiles and so on. A calculation of CO_2 reductions was done for 2012 and indicated a total saving of initially 8700 t CO_2 per year, going up to 27700 t CO_2 in 2016. Special flight planning tools to save fuel can reduce CO_2 emissions by up to 6000 t CO_2 per year.

On 7 February 2012, a Swiss Int. Air Lines A330-300, equipped with a certified Airborne Traffic Situational Awareness (ATSAW) system from Airbus and a Honeywell traffic computer, flew from Zurich Airport to Montreal[27].
This aircraft was taking part in EUROCONTROL's CASCADE Programme ATSAW Pioneer Project initiative. A total of 25 Airbus and Boeing aircraft belonging to British Airways, Delta Airlines, Swiss Int. Air Lines, US Airways and Virgin Atlantic are participating in the programme. It also involves the UK and Icelandic air navigation service providers NATS and ISAVIA, as they provide ATC services for a large area of the North Atlantic.
ATSWA provides pilots with a real-time picture of the surrounding traffic during all phases of flight. Procedures using ATSAW will give the crew the ability to move to more efficient altitudes when operating outside ground surveillance coverage. ATSAW will also support visual separation on approach and provide traffic situational awareness on the airport surface. ATSAW is expected to bring concrete

[26] Airport Zurich 2010: Modal split survey published

[27] Eurocontrol 2012: Cockpit surveillance now operational

benefits in terms of safety and capacity, as well as significant fuel savings per airliner, along with corresponding reductions in CO_2 emissions (approximately 600-700 t CO_2 per year at the moment in Switzerland).
The air operators encourage their pilots to reduce noise and emissions from the auxiliary power unit when on the ground and enforces ground power usage wherever possible. The savings in kerosene consumption lead to a reduction of about 26000 t CO_2 per year.

Another measure to reduce noise and emissions after landing is to shut down one engine after landing and perform a single engine taxi; this saves about 1500 t CO_2 per year.

5.4.2 Optimized aircraft maintenance

Aircraft belonging to operators regularly receive an engine wash and are also regularly checked for their aerodynamic efficiency. These actions save around 0.5% of fuel, which leads to about 1220 t fewer CO_2 emissions per year.

5.5 Economic / Market-Based Measures

5.5.1 Carbon offset

SWISS Int. Air Lines offers its customers to offset the CO_2 emissions generated each time they travel by air[28]. SWISS Int. Air Lines and Lufthansa have entered into a partnership with the non-profit foundation myclimate, a Swiss-based charitable foundation, which provides carbon offsetting measures. The airlines work with myclimate to calculate the cost of offsetting the volume of CO_2 emissions that can be ascribed to each passenger on a flight. This “carbon offset” amount will be invested by myclimate in climate protection projects selected by SWISS Int. Air Lines. The foundation assures that this will save the same amount of CO_2 as was generated by the passenger’s flight.

5.6 Regulatory Measures / Other

5.6.1 Special financing of civil aviation: distribution of funds

In 2009, the Swiss electorate voted in favour of an amendment to Article 86 of the Swiss Federal Constitution which created the basis whereby revenue from aviation fuel tax can be used to support the civil aviation sector[29]. In the past, this revenue had been used in the road transport sector.
The relevant details regarding this form of special financing are regulated in the Federal Act on the use of earmarked oil tax and in the Federal Ordinance on the use of earmarked oil tax for measures in the civil aviation sector.
Special financing is intended to support measures to limit the impacts of civil aviation on the environment, to prevent unlawful acts against civil aviation operations (enhancement of security) and to promote a high standard of technical safety. In order to qualify for special financing, a planned measure must:

- be voluntary, i.e. not based on a legal requirement
- be purposeful and effective
- be designed to take effect throughout Switzerland
- be implemented cost-effectively
- not be realisable without federal government support

The FOCA is to draw up four-year programmes in which it prioritises those measures in the areas of environmental protection, security and safety that are to qualify for financial support. As long as there is sufficient available revenue from the aviation fuel tax, the amounts concerned will be paid out in the form of non-repayable financing (i.e. on an à fonds perdu basis). In its examination of applications, the FOCA assesses whether the measure concerned qualifies for financial support and the necessary funding is available, and specifies the maximum amount to be granted.

[28] SWISS Int. Air Lines 2007: www.swiss.myclimate.org

[29] FOCA 2012: Special financing of civil aviation; distribution of funds

CONCLUSION

VI Conclusion

Switzerland is fully committed to and involved in the fight against climate change, and works towards a resource-efficient, competitive and sustainable multimodal transport system.

Swiss civil aviation has a high safety standard and at the same time pursues a sustainable development strategy. For this reason the Action Plan has also been made part of the Swiss Sustainable Development Strategy 2012-2015 of the Federal Council.

The Action Plan provides an overview of past and future actions by Switzerland to reduce the CO_2 emissions of its civil aviation sector on a supranational as well as on a national level.

On the supranational level all flights between Switzerland and the EU are subject to the EU ETS. This measure causes about 35% of all CO_2 emissions by the Swiss civil aviation sector. In terms of contribution towards the ICAO global goals, Switzerland will by this measure deliver, in “net” terms, approximately a 3% reduction below the 2005 level of aviation CO_2 emissions in 2012, and a 5% reduction below the 2005 level of aviation CO_2 emissions in the period 2013-2020.

On the national level FOCA evaluated possible measures to reduce CO_2 emissions in collaboration with stakeholders of aerodromes, air traffic control and aviation industry. Most of those measures are done on a voluntary base and are mostly also targeted at optimising operations and business. The quantification of these measures is only possible with limitations. Nonetheless the results show the willingness and effort of the civil aviation sector to reduce CO_2 emissions.

Switzerland shares the view that environmental concerns represent a potential constraint on the future development of the international aviation sector, and fully support ICAO’s ongoing efforts to address the full range of these concerns, including the key strategic challenge posed by climate change, for the sustainable development of international air transport.

Section 2 of this Action Plan was finalised on June 2012 and shall be considered as subject to update after that date.

APPENDIX

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