



SWISS INTERNATIONAL AIRPORTS ASSOCIATION

**Aircraft Emissions Charges
at
Swiss Airports**

Consultation Documentation

05.10. 2009

Introduction

Swiss Airports intend to change from the current emission charges model of 1996 to the model as described in the FOCA Directive "Aircraft Engine Emissions Charges in Switzerland" (Reference 33-05-27). The FOCA Guidance is based upon ECAC Recommendation 27-4 (NO_x Emission Classification Scheme for Aircraft) of 2003 developed within the ECAC (European Civil Aviation Conference) by the ERLIG (Emission Related Landing charges Investigation Group). This documentation contains the relevant information provided by the Federal Office of Civil Aviation and the members of the Swiss International Airport Association.

Content of the Documentation

- Part I Aircraft Engine Emission Charges in Switzerland, Guidance Material by the Federal Office of Civil Aviation, Berne. This section gives an introduction and the legal provisions related to the engine emission model and describes the model in technical terms.
- Part II Emission charges application at the relevant airports. This section outlines for each airport its traffic, revenue and emission information and the planned emission tariff.
- Part III Aeronautical Information Publication. This section contains the anticipated wording for the changes/amendments of the relevant AIP of the airports.

Imprint

Publication:	Aircraft Engine Emission Charges at Swiss Airports
Published by:	SIAA (Swiss International Airports Association), www.siaa.ch
Date:	5. October 2009
Status:	Final



Directive

33-05-27

Subject:

Aircraft Engine Emissions Charges in Switzerland

Reference: 33-05-27

Applicable legislation: See Appendix 2 (Swiss legal text)

Target group: Airport operators
Airport users

Version: Published
Entry into effect of this version: 1st June 2009
This version: 1.0
Entry into effect of first version: 1st June 2009

Formulation of text: Theo Rindlisbacher, FOCA - LEUW

Date of approval / Approved by: 25th May 2009 / Board of Directors

Contents

1. Introduction

1.1 Short History of Emissions Charges in Switzerland

1.2 Motivation and Background for the Model Change

2. Description of the Model

2.1 General Principle

2.2 Aircraft fitted with Turbofan, Jet and Turboprop Engines

2.3 Piston Engine Aircraft and Helicopters

2.4 Calculation of the Emissions Charge

3. List of Engine and Aircraft Emission Values

4. Entry into Effect

Appendix 1: Model Calculation Details

Appendix 2: Swiss Legal Text

1. Introduction

1.1 Short History of Emissions Charges in Switzerland

Switzerland was (together with Sweden) one of the first countries in the world to introduce emissions charges. (1997 Zurich, 1998 Geneva, 2000 Berne, 2003 Basle (actually situated in France)). Switzerland introduced emissions charges with the primary focus on supporting and forcing the use of best available low emissions engine technology through financial incentives. The model was based on an engine classification scheme, with the best engine class paying no emissions charge and with the other classes paying corresponding additional percentages of the landing fee. At introduction of emissions charges, the previously existing landing fees had been reduced to the extent to ensure revenue neutrality for the airports. Up to now, emissions charges in Switzerland have been levied according to the Swiss engine classification scheme. This guidance describes the change to the European harmonised emission charging model, generally known as the "ERLIG model", "ECAC model" or the "ECAC 27/4 recommendation". The new model will be applied at major Swiss airports from spring 2010 in order to fulfil the need for European harmonisation.

1.2 Motivation and Background for the Model Change

In the year 2000, the European Aviation Industry called for harmonisation of existing emission charges models, as the models applied in Switzerland and in Sweden were different. Industry response addressed the engine classification scheme, as well: Putting engines into emission classes can lead to the situation that two engines with classification values near a class border may fall into different emission classes. So despite little differences in engine values, the emissions charge for such engines can be significantly different. In 2001, ECAC (European Civil Aviation Conference) installed the ERLIG (Emission Related Landing charges Investigation Group), tasked to develop a harmonised model. Swiss airport and FOCA representatives have significantly contributed to ERLIG. Taking industry response into account, ERLIG developed a model that could do without any engine emission classes or setting class borders. The new model was based on a pure emissions approach, reinforcing the "polluter pays principle": The higher the emissions, the higher the charge. As the primary concern for local airport air quality was still NO_x, the new model was primarily based on NO_x emissions. In 2003, ERLIG was dissolved and ECAC released the new model as recommendation ECAC 27/4 under the title of "NO_x Emission Classification Scheme for Aircraft". This was the birth of a European harmonised solution. Switzerland and Sweden went one step further and harmonised also the treatment of aircraft, which are not included in ECAC 27/4.

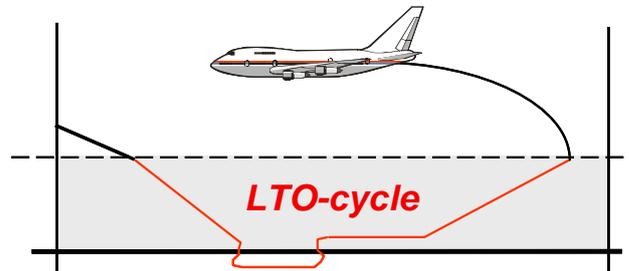
Sweden changed to the new model in 2004. In the same year, the UK started to apply emission charges at Heathrow airport, based on the ECAC model and the Swiss/Swedish addition for small aircraft. In 2008, emission charges were introduced in Germany, namely at Frankfurt, Munich and Cologne Airport, again based on the ECAC model and the Swiss/Swedish addition. In 2007, ICAO published ICAO Doc 9884: "*Guidance on Aircraft Emission Charges Related to Local Air Quality*", which contains the ECAC model as an example.

Swiss FOCA has supported the development and the application of a harmonised emissions charges model since 2000. The model change in Switzerland is a logical consequence of this activity and is enforced by the Swiss Confederation. FOCA initiated an adaptation of the legal bases in Switzerland. Under the Swiss ordinance of infrastructure, Swiss airports are obliged not only to levy an emissions charge but also to follow the recommendation of the Federal Department of the Environment, Transport, Energy and Communications DETEC for the model that has to be applied. The obligation to levy an emissions charge is laid down under the terms of Article 39 Paragraph 2 of the Law on Aviation (LFG; SR 748.0) and Article 32 Paragraphs 2 and 3 of the Ordinance on Aviation Infrastructure (VIL; SR 748.131.1) as shown in Appendix 2 of this document.

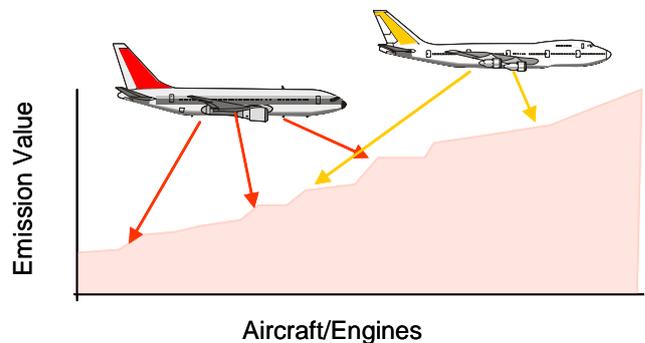
2. Description of the Model

2.1 General Principle

- **The basis for the model** is the calculation of the **absolute aircraft engine NOx emissions in the standardised landing and take-off cycle (LTO)** used for ICAO aircraft engine emissions certification. (For consideration of additional pollutants, see the footnote below.)
- An emission value is assigned to the absolute emission mass of an aircraft. **The greater the emissions mass of an aircraft, the higher the emission value.**¹ If different engine options are available for a certain aircraft type, the emission value varies linearly and according to a continuous scale with the emissions.
- The charge is levied with an emission value related surcharge and therefore **the emissions charge varies linearly and according to a continuous scale with the emissions.**



Basis: LTO NOx Emissions



An Aircraft Emission Value is assigned to the aircraft according to the actually fitted propulsion engines.

¹ In most cases, the emission value is identical to the LTO NOx emissions. Some very rare old engines with lower combustion efficiency have comparatively low NOx emissions but do not comply with current emissions standards for unburned hydrocarbon pollutants. In such cases, a correction factor "a" is applied taking pollutants from incomplete combustion into account (see Appendix 1 for details).

2.2 Aircraft fitted with Turbofan, Jet and Turboprop Engines

a) Regulated engines

Aircraft Emission Value = Number of Engines * a * LTO NOx Emissions

(Calculated according to formula in Appendix 1.)

b) Unregulated engines with emissions data available to FOCA

Aircraft Emission Value = Number of Engines * LTO NOx Emissions

(Calculated according to formula in Appendix 1)

c) Unregulated engines with no emissions data available to FOCA

Aircraft Emission Value = Value indicated in the Business-Jet and Turboprop section of the FOCA Matrix below

For Business-Jet aircraft with unknown engine emissions, aircraft emission values are assigned from table 1 below according to

- Maximum thrust rating per engine (depending on whether it is below 16 kN (kilonewton) or between 16 and 26.7 kN rated thrust).
- Number of engines.

For Turboprop aircraft with unknown engine emissions

- only the number of engines needs to be known.

Table 1: FOCA Aircraft Emission Value Matrix

# Eng.	Piston: Turbodiesel Microlight Ecolight	Piston: Conventional	Piston: Conventional	Piston: Conventional	Helicopter	Helicopter	Business-Jets	Business-Jets	Turboprops
		up to 200 hp	200-400 hp	>400 hp	<1000 shp	>1000 shp	(<16 kN)	(>16 but < 26.7 kN)	
1	0.1	0.2	0.4	0.5	0.2	0.7	0.5	1.0	0.8
2	0.2	0.4	0.8	1	0.4	1.4	1.0	2.0	1.6
3	-	0.6	1.2	1.5	-	2.1	1.5	3.0	2.4
4	-	0.8	1.6	2	-	2.8	-	-	3.2

Examples:

A business Jet with three turbofan engines, each rated at 14 kN (kilonewton) thrust, and unknown emissions data is given an Aircraft Emission Value of 1.5

A turboprop engine powered aircraft with two turboprop engines and unknown emissions data is given an Aircraft Emission Value of 1.6

2.3 Piston Engine Aircraft and Helicopters

Aircraft Emission Value = Value indicated in the Piston and Helicopter section of the FOCA Matrix below

For piston engine aircraft and helicopters, aircraft emission values are assigned from table 1 below according to

- Engine type (piston engine of a microlight/ecolight aircraft, conventional piston engine, turbodiesel piston engine, helicopter engine (piston and turboshaft))
- Engine size (rated horsepower resp. shaft horsepower)
- Number of engines.

Table 1: FOCA Aircraft Emission Value Matrix

# Eng.	Piston: Turbodiesel Microlight Ecolight	Piston: Conven- tional	Piston: Conven- tional	Piston: Conven- tional	Helicopt er	Helicopt er	Business- Jets	Business- Jets	Turboprops
		up to 200 hp	200-400 hp	>400 hp	<1000 shp	>1000 shp	(<16 kN)	(>16 but < 26.7 kN)	
1	0.1	0.2	0.4	0.5	0.2	0.7	0.5	1.0	0.8
2	0.2	0.4	0.8	1	0.4	1.4	1.0	2.0	1.6
3	-	0.6	1.2	1.5	-	2.1	1.5	3.0	2.4
4	-	0.8	1.6	2	-	2.8	-	-	3.2

Examples:

A turbodiesel engine powered aircraft with one engine is given an Aircraft Emission Value of 0.1

A Microlight aircraft (called Ecolight in Switzerland) is given an Aircraft Emission Value of 0.1

A conventional piston engine powered aircraft with an engine rated at 257 horsepower is given an Aircraft Emission Value of 0.4

A twin engine powered helicopter with each engine rated at 750 shaft horsepower is given an Aircraft Emission Value of 0.4

2.4 Calculation of the Emissions Charge

- **Emission Charge (CHF) = Aircraft Emission Value * Tariff in CHF**

3. List of Engine and Aircraft Emission Values

FOCA provides the Swiss airports and the binational airport of Bale-Mulhouse with two sets of databases:

A)

- The **FOCA engine emissions data bank**, which contains individual engine data of all public and non-public sources, including data from FOCA measurements and APU. The detailed data are used by large airports to calculate advanced emission inventories. At the same time, the data bank contains calculated engine emission values, according to Appendix 1 and the emission value matrix (see table 1) for each individual engine.
- Since non-public data are included in the FOCA data bank, it is not publicly available. Airports are required to sign a confidentiality agreement with FOCA, which basically prohibits sharing the data with third parties.
- However, the list of **engine names with corresponding emission values** is publicly available and can be downloaded at www.bazl.admin.ch → for specialists → environment → emissions charges.
- Large airports assign engines to aircraft tail numbers themselves, but crosscheck their assignment with the following list:

B)

- The **FOCA aircraft engine combinations list**, which contains more than 20 000 tail numbers and assigned engine codes, number of engines and the aircraft emission value for all individual aircraft that have been flying in Switzerland during the last couple of years. This list is the primary source of information for small airports, which do not need individual engine data and merely require information linking tail number, aircraft and engine type to an aircraft emission value.
- This list is not publicly available. It is shared solely between FOCA and the airports, and in return for airports' efforts to continuously provide FOCA with detailed statistical data.

→ The centralised distribution of the FOCA engine data base, the collection, review and re-distribution of aircraft engine assignments - normally on an annual basis – contributes to uniform application of the emissions charges model and helps to ensure that a given aircraft is assigned the same emission value at all airports.

→ FOCA also actively exchanges aircraft-engine and emission value lists with foreign authorities to further improve consistency in the application of the ECAC Model.

4. Entry into Effect

This directive enters into effect on 1st June 2009

Federal Office of Civil Aviation



Marcel Zuckschwerdt, Director
Head Aviation Policy and Strategy Division



Theo Rindlisbacher
Environmental Affairs Section

Appendix 1: Model Calculation Details

a) Mathematical formula for all regulated engines and for unregulated turbofan, jet and turboprop engines with known emissions data:

$$\text{EmissionValue Aircraft} = a * \# \text{Engines} * \sum_{LTO\text{-modes}} (60 * \text{time} * \text{fuelflow} * \text{NOx}_{\text{Emissionfactor}} \div 1000)$$

where:

- a = 1 if the characteristic certification LTO Hydrocarbon emissions per rated thrust (HC Dp/Foo) is less than or equal to the current ICAO standard of 19.6 g/kN rated thrust or for unregulated engines.
- a > 1 if the characteristic certification LTO Hydrocarbon emissions per rated thrust (HC Dp/Foo) is greater than the current ICAO standard.
a = HC Dp/Foo /19.6, with a maximum value for 'a' of 4.0

LTO-Modes: ICAO Certification LTO Modes: Take-off, Climb, Approach, Taxi

Table 2: LTO-Modes, associated times and thrust or power settings

LTO Modes	Regulated and unregulated turbofan or jet engines		Turboprop engines	
	time in mode (Minutes)	% of maximum rated thrust	time in mode (Minutes)	% of maximum rated shaft horsepower
Take-off	0.7	100%	0.7	100%
Climb	2.2	85%	2.2	85%
Approach	4.0	30%	4.0	30%
Taxi	26	7%	26	Idle*

*Difference in the standard ICAO LTO mode, as shown in the Swedish Defence Research Agency (FOI) study, FOI Memo 01-4245

- time: time in mode as shown in table 2 (in minutes)
- # Engines: number of engines fitted to the aircraft
- fuelflow: fuel flow per mode (in kg/sec)
- NOx_{Emissionfactor} Measured NOx-Emission factor per mode (in g/kg fuel)

Emission factors and fuel flow for the four modes and the hydrocarbon certification value are taken from the ICAO engine database (regulated engines). Emissions data for unregulated engines are taken from the FOCA and FOI emissions database. The FOCA website provides additional information:

For engine emission data sources:

www.bazl.admin.ch → For Specialists → Environment → Aircraft Engine Emissions

For engine lists with calculated engine emission values and the ECAC 27/4 recommendation:

www.bazl.admin.ch → For Specialists → Environment → Emissions Charges

Appendix 2: Swiss Legal Text

The obligation to levy an emission charge is laid down under the terms of Article 39 Paragraph 2 of the Law on Aviation (LFG; SR 748.0) and Article 32 Paragraphs 2 and 3 of the Ordinance on Aviation Infrastructure (VIL; SR 748.131.1)

Application of the polluter pays principle is laid down under the terms of Article 2 of the Law on Environment (USG; 814.01):

German legal text

Art. 39 LFG

² Bei der Gebührengestaltung berücksichtigt der Flugplatzhalter auch die unterschiedliche Lärmerzeugung und Schadstoffemission der Luftfahrzeuge.

Art. 32 VIL

² Bei der Festlegung der Gebühren sind emissionsarme Luftfahrzeuge bevorzugt zu behandeln.

³ Das Departement kann die Einzelheiten regeln. Es kann insbesondere die Gebühren- und die Emissionsberechnungen festlegen.

Art. 2 USG

Wer Massnahmen nach diesem Gesetz verursacht, trägt die Kosten dafür.

French legal text

Art. 39 LFG

² Lors de la formation des tarifs, l'exploitant de l'aérodrome tient aussi compte des différents degrés des émissions de bruit et de substances nocives des aéronefs.

Art. 32 VIL

² Les aéronefs à faible taux d'émission bénéficient d'un traitement de faveur lors de l'établissement des tarifs.

³ Le département peut régler les détails. Il peut en particulier définir le calcul des redevances et des émissions.

Art. 2 USG

Celui qui est à l'origine d'une mesure prescrite par la présente loi en supporte les frais.

Italian legal text

Art. 39 LFG

² Per la fissazione delle tasse, l'esercente dell'aerodromo tiene parimenti conto delle emissioni foniche e di sostanze nocive degli aeromobili.

Art. 32 VIL

² Nella determinazione delle tasse, gli aeromobili a basso livello di emissioni beneficiano di un trattamento di favore.

³ Il Dipartimento può disciplinare i dettagli. In particolare, può stabilire le modalità di calcolo delle tasse e delle emissioni.

Art. 2 USG

Le spese delle misure prese secondo la presente legge sono sostenute da chi ne è la causa.

English text²

Art. 39 LFG

2 When defining charges, the airport must also take into account the different levels of noise and pollutants emitted by aircraft.

Art. 32 VIL

2 When defining charges, low-emission aircraft must be given preferential treatment.

3 The Department³ can rule the details. In particular, it can specify the calculation of charges and emissions.

Art. 2 USG

Whoever causes action to be taken as defined under the terms of this law shall bear the costs thereof.

² The official legal text is written in German, French and Italian. The English translation is not legally binding.

³ Federal Department of the Environment, Transport, Energy and Communications (DETEC)

SWISS INTERNATIONAL AIRPORTS ASSOCIATION

Aircraft Emissions Charges at Swiss Airports

Airport Specific Information:

Zurich Airport	(change of existing emission charges model)
Geneva Airport	(change of existing emission charges model)
Berne Airport	(change of existing emission charges model)
Lugano Airport	(change of existing emission charges model)

Zurich Airport

Unique (Flughafen Zürich AG) is the operator of Zurich Airport under the concession granted by the Federal Department of Environment, Transport, Energy and Communications (DETEC).

1. Current Emission Charges Structures and Revenues

Zurich Airport Authority introduced an emission charges scheme on September 1st, 1997, based on the recommendation by the Federal Office of Civil Aviation of August 1996. In order to levy the charges revenue neutral for the airport, Zurich Airport Authority reduced the weight based landing charge by a flat 5.0% for all aircraft. The reduction of the revenues has then been compensated by the introduction of the emission charge based on the five classes. The charge modulation was in such a way that classes 4 and 5 had no increase or even a decrease of the net charges, while only aircraft in emission classes 1-3 were subject to a net increase in landing charges.

The following table shows the distribution of the aircraft movements by emission classes as well as the actual revenues from the emission classes and the share they have on the overall landing charges.¹

Emission Charges Current Model (1996)

		2006	2007	2008	Average
Total Emission Charges paid	CHF/a	2,854,994	2,807,986	3,052,759	2,905,246
Share of emission charge on landing charge	%	3.8%	3.6%	3.6%	3.7%
Emission Classes Distribution	(Charge)				
- Class 5	(0%)	65.9%	66.0%	65.2%	
- Class 4	(5%)	17.4%	19.0%	20.3%	
- Class 3	(10%)	14.6%	13.1%	13.1%	
- Class 2	(20%)	0.4%	0.4%	0.4%	
- Class 1	(40%)	1.8%	1.4%	1.1%	

As can be seen, the emission charges represented an average 3.7% of the weight based aircraft landing charge (compared to the 5% upfront rate reduction prior to introduction of the emission charge).

The emission charges revenues have been used for financing local air quality mitigation plans that were required under the Swiss clean air act and Zurich Airport construction permits:

- Installation, operation and maintenance of a regional air quality measurement network;
- Improvements in GSE/airside vehicle technology and infrastructure (e.g. for CNG);
- Contributions to fixed energy support systems for aircraft;

¹ The landing charges includes the weight based airport landing charge only.

2. New Emission Charges Scheme

The new emission charge, based on the FOCA guidance (Reference 33-05-27), will be modulated in such a way as to maintain the revenue neutrality for the airport. This is done by determining the applicable emission charges rate (CHF/Emission Value); this emission charges rate again is calculated with the total emission revenues and the total emissions. The following table lists the relevant parameters:

- Total Emission Values: Total emissions, calculated according to the FOCA guidance (Reference 33-05-27).
- Total Emission Charges: Actual revenues (from existing model).
- Exact Emission Charge Rate: Quotient of those two figures.

Emission Charges New Model

		2006	2007	2008	Average
Total Aircraft Movements		260,792	268,476	274,991	
Total Emission Values	EmVal/a	1,089,604	1,178,098	1,247,298	
Total Emission Charges (past)	CHF/a	2,854,994	2,807,986	3,052,759	2,905,246
Exact Emission Charge Rate	CHF/EmVal	2.62	2.38	2.45	2.48

By rounding the emission charge rate, Zurich Airport plans to apply an emission rate of:

CHF 2.50 per EmissionValue

The individual emission charge calculation is done by calculating each individual aircraft take-off and summarising the charges over the fleet. The technical systems will be adapted to reflect the changes.

The implementation date will be coordinated with other Swiss airports and is planned for 1st April, 2010 (change of airline schedules).

Geneva Airport

AIG (Aéroport International de Genève) is the operator of Geneva Airport under the concession granted by the Federal Department of Environment, Transport, Energy and Communications (DETEC).

1. Current Emission Charges Structures and Revenues

AIG introduced an emission charges scheme on November 1st, 1998, based on the recommendation by the Federal Office of Civil Aviation of August 1996. In order to levy the charges revenue neutral for the airport, AIG reduced the weight based landing charge by a flat 5.0% for all aircraft. The reduction of the revenues has then been compensated by the introduction of the emission charge based on the five classes. The charge modulation was in such a way that classes 4 and 5 had no increase or even a decrease of the net charges, while only aircraft in emission classes 1-3 were subject to a net increase in landing charges.

The following table shows the distribution of the aircraft movements by emission classes as well as the actual revenues from the emission classes and the share they have on the overall landing charges.²

Emission Charges Current Model (1996)

		2006	2007	2008	Average
Total Emission Charges paid	CHF/a	736'014	801'427	811'231	
Share of emission charge on landing charge	%	2.9%	2.8%	2.7%	2.8%
Emission Classes Distribution	(Charge)				
- Class 5	(0%)	64.0%	63.2%	66.0%	
- Class 4	(5%)	21.4%	23.7%	22.5%	
- Class 3	(10%)	10.2%	9.6%	8.3%	
- Class 2	(20%)	2.3%	1.7%	1.5%	
- Class 1	(40%)	2.2%	2.0%	1.5%	

As can be seen, the emission charges represented an average 2.8% of the weight based aircraft landing charge (compared to the 5% upfront rate reduction prior to introduction of the emission charge in 1998).

The emission charges revenues have been used for financing local air quality mitigation plans that were required under the Swiss clean air act and Geneva Airport construction permits:

- Installation, operation and maintenance of a local and regional air quality measurement network;
- Contributions to fixed energy support systems for aircraft;
- Contributions to air mitigation measures airside: passenger bus retrofitting with particle filter, fuel delivery trucks retrofitting with batteries.

² The landing charges include the weight based airport landing charge only.

2. New Emission Charges Scheme

The new emission charge, based on the FOCA guidance (Reference 33-05-27), will be modulated in such a way as to maintain the revenue neutrality for the airport. This is done by determining the applicable emission charges rate (CHF/Emission Value); this emission charges rate again is calculated with the total emission revenues and the total emissions. The following table lists the relevant parameters:

- Total Emission Values: Total emissions, calculated according to the FOCA guidance (Reference 33-05-27).
- Total Emission Charges: Actual revenues (from existing model).
- Exact Emission Charge Rate: Quotient of those two figures.

Emission Charges New Model

		2006	2007	2008	Average
Total Aircraft Movements		172'618	187'336	190'120	
Total Emission Values	EmVal/a	534'775	578'128	609'284	
Total Emission Charges (past)	CHF/a	736'014	801'427	811'231	
Exact Emission Charge Rate	CHF/EmVal	1.38	1.39	1.33	1.37

By rounding the emission charge rate, Geneva Airport plans to apply an emission rate of:

CHF 1.40 per EmissionValue

The individual emission charge calculation is done by calculating each individual aircraft take-off and summarising the charges over the fleet. The technical systems will be adapted to reflect the changes.

The implementation date will be coordinated with other Swiss airports and is planned for 1st April, 2010 (change of airline schedules).

Berne Airport

Alpar AG is the operator of Berne Airport under the concession granted by the Federal Department of Environment, Transport, Energy and Communications (DETEC).

1. Current Emission Charges Structures and Revenues

Alpar AG introduced an emission charges scheme on April 1st, 2001, based on the recommendation by the Federal Office of Civil Aviation of August 1996. In order to levy the charges revenue neutral for the airport, Alpar AG reduced the weight based landing charge by a flat 5.0% for all aircraft. The reduction of the revenues has then been compensated by the introduction of the emission charge based on the five classes. The charge modulation was in such a way that classes 4 and 5 had no increase or even a decrease of the net charges, while only aircraft in emission classes 1-3 were subject to a net increase in landing charges.

The following table shows the distribution of the aircraft movements by emission classes as well as the actual revenues from the emission classes and the share they have on the overall landing charges.³

Emission Charges Current Model (1996)

		2006	2007	2008	Average
Total Emission Charges paid	CHF/a	60 113	64 569	79 128	67 937
Share of emission charge on landing charge	%	4.2%	4.3%	4.9%	4.5%
Emission Classes Distribution	(Charge)				
- Class 5	(0%)	20.0%	16.9%	12.5%	
- Class 4	(5%)	1.4%	1.4%	5.0%	
- Class 3	(10%)	73.7%	76.9%	78.0%	
- Class 2	(20%)	2.3%	1.9%	1.6%	
- Class 1	(40%)	2.6%	2.9%	2.9%	

The emission charges revenues have been used for financing local air quality mitigation plans that were required under the Swiss clean air act and Berne Airport construction permits:

- Improvements in airside vehicle technology and infrastructure;
- Contributions to fixed energy support systems for aircraft;

³ The landing charges includes the weight based airport landing charge only.

2. New Emission Charges Scheme

The new emission charge, based on the FOCA guidance (Reference 33-05-27), will be modulated in such a way as to maintain the revenue neutrality for the airport. This is done by determining the applicable emission charges rate (CHF/Emission Value); this emission charges rate again is calculated with the total emission revenues and the total emissions. The following table lists the relevant parameters:

- Total Emission Values: Total emissions, calculated according to the FOCA guidance (Reference 33-05-27).
- Total Emission Charges: Actual revenues (from existing model).
- Exact Emission Charge Rate: Quotient of those two figures.

Emission Charges New Model

		2006	2007	2008	Average
Total Aircraft Movements		51 279	51 217	48 901	
Total Emission Values	EmVal/a	20 719	19 920	22 073	
Total Emission Charges (past)	CHF/a	60 113	64 569	79 128	
Exact Emission Charge Rate	CHF/EmVal	2.90	3.24	3.58	3.25

By rounding the emission charge rate, Berne Airport plans to apply an emission rate of:

CHF 3.30 per EmissionValue

The individual emission charge calculation is done by calculating each individual aircraft take-off and summarising the charges over the fleet. The technical systems will be adapted to reflect the changes.

The implementation date will be coordinated with other Swiss airports and is planned for 1st April, 2010 (change of airline schedules).

Lugano Airport

The City of Lugano, Department of Transportation, is the operator of the airport of Lugano under a license granted by the Federal Department of Environment, Transport, Energy and Communications (DETEC).

1. Current Emission Charges Structures and Revenues

Lugano Airport has introduced the emission charges model on June 1st, 2007. It has applied the model as specified in the recommendation by the Federal Office of Civil Aviation in August 1996. The emission charge is intended as an incentive charge. Thus, the weight based aircraft landing charge has been reduced by a flat 2% for all aircraft and an emission charge introduced in a way that all class 5 aircraft result in an unchanged total landing fee and only classes 1-4 are subject to a moderate increase in charges.

The following table shows the analysis of the traffic at Lugano Airport between July 2007 and June 2008.

Emission Charges Current Model (1996)

Total number of departures	11,791	100%	
Movements per Emission Class:			Emission Charge
- Class 5	3,745	31.8%	2%
- Class 4	168	1.4%	4%
- Class 3	7,193	61.0%	6%
- Class 2	81	0.7%	8%
- Class 1	604	5.1%	10%
Total Emission Charges	CHF 30,097		
- Share on Landing Charges	3.0 %		

2. New Emission Charges Scheme

The new emission charge, based on the FOCA guidance (Reference 33-05-27), will be modulated in such a way as to maintain the revenue neutrality for the airport. This is done by determining the applicable emission charges rate (CHF/Emission Value); this emission charges rate again is calculated with the total emission revenues and the total emissions. The following table lists the relevant parameters:

- Total Emission Values: Total emissions, calculated according to the FOCA guidance (Reference 33-05-27).
- Total Emission Charges: Actual revenues (from existing model).
- Exact Emission Charge Rate: Quotient of those two figures.

Emission Charges New Model

		2007/2008
Total Aircraft Movements		11,791
Total Emission Values	EmVal/a	9,103.71
Total Emission Charges (past)	CHF/a	30,097
Exact Emission Charge Rate	CHF/EmVal	3.31

By rounding the emission charge rate, Lugano Airport plans to apply an emission rate of:

CHF 3.40 per EmissionValue

The individual emission charge calculation is done by calculating each individual aircraft take-off and summarising the charges over the fleet. The implementation date will be coordinated with other Swiss airports and is planned for 1st April, 2010 (change of airline schedules).

Aeronautical Information Publication

AIP

Switzerland

Changes to the AIP GEN 4.1 AERODROME/HELIPORT CHARGES
due to the change of the aircraft engine emission charges at several airports.

1. Proposed text to the AIP

Art. (x) **Emission-related landing charges**

Art. (x.1) **Principle**

An emission related landing surcharge is applied to all aircraft equipped with a combustion engine and that are subject to a weight-based landing charge. The emission charge is based on the absolute emission characteristic of the engine as described in the FOCA Guidance "Aircraft Engine Emission Charges in Switzerland" (Reference 33-05-27).

Art. (x.2) **Aircraft with turbofan, turbojet or turboprop engines with emission data available to the FOCA**

Aircraft, equipped with turbofan, turbojet or turboprop engines that are:

- regulated under the ICAO Annex 16, Volume II, or
- not regulated, but have detailed emission data for the LTO cycle available to the FOCA,

are subject to the emission calculation as specified in ECAC Recommendation 27/4. Specifically, the following emission calculation formula applies:

$$\text{EmissionValue Aircraft} = a * \# \text{Engines} * \sum_{LTO\text{-modes}} (60 * \text{time} * \text{fuelflow} * \text{NOx}_{\text{Emissionfactor}} \div 1000)$$

where:

a = 1 if the characteristic certification LTO Hydrocarbon emissions per rated thrust (HC Dp/Foo) is less than or equal to the current ICAO standard of 19.6 g/kN rated thrust or for unregulated engines.

a > 1 if the characteristic certification LTO Hydrocarbon emissions per rated thrust (HC Dp/Foo) is greater than the current ICAO standard. a = HC Dp/Foo /19.6, with a maximum value for 'a' of 4.0

LTO-Modes: ICAO Certification LTO Modes:

<u>Mode</u>	<u>Time</u> (in minutes)
Take-off	0.7
Climbout	2.2
Approach	4.0
Taxi/Idle	26.0

Engines: number of engines fitted to the aircraft

Time: time in mode (s. above) (in minutes)

Fuelflow: fuel flow per mode (in kg/sec)

NOx_{Emissionfactor} Measured NOx-Emission factor per mode (in g/kg fuel)

Emission factors and fuel flow for the four modes and the hydrocarbon certification value are taken from the ICAO engine database (regulated engines). Emissions data for unregulated engines are taken from the FOCA and FOI emissions database. The FOCA website provides additional information:

www.bazl.admin.ch → For Specialists → Environment

Art. (x.3) **Aircraft with piston engines, helicopter and aircraft with engines without emission data available to the FOCA**

Aircraft, equipped with

- piston engines
- rotary wing engines

- any other engine without emission data available to the FOCA are also subject to an emission charge. Specifically, they are assigned an emission value derived from the following table 1 and depending on the type, performance and number of engines fitted to the aircraft.

Table 1: FOCA Aircraft Emission Value Matrix

# Eng.	Piston: Turbodiesel Microlight Ecolight	Piston: Conven- tional	Piston: Conven- tional	Piston: Conven- tional	Helicopt er	Helicopt er	Business- Jets	Business- Jets	Turboprops
		up to 200 hp	200-400 hp	>400 hp	<1000 shp	>1000 shp	(<16 kN)	(>16 but < 26.7 kN)	
1	0.1	0.2	0.4	0.5	0.2	0.7	0.5	1.0	0.8
2	0.2	0.4	0.8	1	0.4	1.4	1.0	2.0	1.6
3	-	0.6	1.2	1.5	-	2.1	1.5	3.0	2.4
4	-	0.8	1.6	2	-	2.8	-	-	3.2

Art. (x.4) **Emission tariff**

The applicable tariff is CHF x.xx per Emission Value_{Aircraft}.

2. Airport AIP sections

The following table provides an overview over the airport specific AIP sections that are subject to the changes:

Airport	Relevant AIP Section
LSZB	Section 2.5: Emission-related landing charges (12.05.2005)
LSGG	Art. 5c: Emission-related landing charges (18.12.2008)
LSZA	Section C, Art. 26-29: Emission-related landing charges (27.09.2007)
LSZH	Section C, Art. 18-21: Emission surcharge on landing charge
App C.	Appendix C - Emission surcharge on landing charges - Classification for turbofan engines
App D.	Appendix D - Emission surcharge on landing charges - Classification for turboshaft and piston engines

App C and D: as of June 2006 with the remark that an updated version is available on the internet website of Zurich Airport (www.unique.ch).