D2 - Report on the verification of the calculation of the 2004, 2005 and 2006 historical annual CO_2 aviation emissions estimates based on the process reviewed in D1

The Innaxis Foundation & Research Institute

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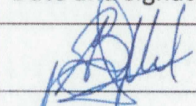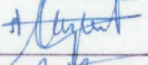Reference: INX-ETS-TR-09-02

Issue: 1

Date: May 27th, 2009

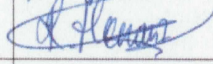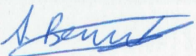|	Name	Date and signature
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1 INTRODUCTION

1.1 Purpose and scope

On 19 November 2008 the European Parliament and the Council of the European Union adopted Directive 2008/101/EC (hereafter referred to as "the Directive") amending Directive 2003/87/EC so as to include aviation activities in the European Union Emissions Trading Scheme (EU ETS).

On 30 December 2008, the European Community and the European Organisation for the Safety of Air Navigation (EUROCONTROL) concluded a cooperation agreement for the provision of support by EUROCONTROL to the European Commission for the inclusion of aviation in the EU ETS. One of the tasks for which EUROCONTROL is providing support is the estimation of "historical aviation CO_2 emissions". Historical aviation CO_2 emissions is to be understood as the average of the annual CO_2 emissions in the calendar years 2004, 2005 and 2006 from aircraft performing an aviation activity included in the EU ETS, and will serve as a basis to set the CO_2 emissions cap for aviation. Considering the financial implications of the total quantity of allowances to be allocated to the aviation sector, it is essential to ensure that the estimation of the historical aviation CO_2 emissions is of the highest possible quality.

EUROCONTROL has established a process for the estimation of the annual historical aviation CO_2 emissions in the EU-27 that consists of the following steps:

a. establishment of a process for the estimation of the annual historical aviation CO_2 emissions in the EU-27 relying on the air traffic management information available in EUROCONTROL;

b. calculation of the 2004, 2005, and 2006 annual historical aviation CO_2 emissions estimates based on the above process;

c. collection of actual fuel burn information from volunteer aircraft operators (AOs);

d. analysis of the fuel burn information and establishment of a methodology for reconciling the historical annual CO_2 aviation emissions estimates (phase b) relying on this actual fuel burn information;

e. adjustment of the 2004, 2005, and 2006 annual historical aviation CO_2 emissions estimates based on the above reconciliation methodology for EU-27;

f. establishment of a methodology for the reassessment, upon the extension of the EU ETS to other states, of the annual historical aviation CO_2 emissions .

The process established by EUROCONTROL within phase (a) has been reviewed in the technical report ref. INX-ETS-TR-09-01 "Report on the review of the process for the estimation of the historical annual CO_2 aviation emissions in line with the Directive prescriptions" and amended by EUROCONTROL according to the recommendations provided therein. The purpose of the present document is to verify the computations of 2004, 2005 and 2006 historical annual CO_2 aviation emissions estimates calculated by EUROCONTROL according to such process (phase (b)).

While D1 focused on validating the methodology used by EUROCONTROL with a view to ensure that it makes the most suitable use of the available data and derive recommendations for the improvement of the process, D2 covers the verifications activities, i.e. D2 deals with the correct implementation of such process by EUROCONTROL in order to ensure that the process is implemented through the right computing tools and code.

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A systematic requirements verification have been carried out, in order to check that every sub-process/step contemplated in the calculation process:

- is implemented through a specific function of the tool;

- is implemented in a manner that is consistent and does not conflict with the implementation of the rest of requirements;

- is implemented in such a way that the tool accesses the right data (air traffic data, CORINAIR data, etc.);

- is correctly implemented from the computation/mathematical requirements point of view.

1.2   Structure of the document

The document is organised as follows:

- In section 2, requirements verification is carried out, in order to check every sub-process/step contemplated in the calculation process.

- Section 3 presents the conclusions of the verification process, a verification summary and recommendations.

1.3   References

[1] Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community.

[2] EUROCONTROL Price Enquiry No. 09-110224-E. Technical specification.

[3] Review of the EUROCONTROL process for the estimation of the historical annual CO_2 aviation emissions in line with the Directive prescriptions. Innaxis-UPM. Ref. INX-ETS-TR-09-01.

[4] www.eurocontrol.int/prisme

[5] ECAC. Recommendation ECAC/27-3 Methodology for emissions calculation.

[6] EUROCONTROL. Calculation of Emissions by Selective Equivalencing (C.A.S.E.). Edition 1.0, 25 November 2003.

[7] EUROCONTROL. EU ETS aircraft operator allocation by EC Member State-Process description. Edition 1.0, 26 February 2009.

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2. REVIEW OF THE TOOLS USED BY EUROCONTROL

EUROCONTROL has chosen to implement the Historical Emissions computation methodology through queries to the different databases, implementing the different models through a set of database tables and querying those tables through SQL queries. SQL (Structured Query Language) is a computer language used to interact with relational database management systems as the ones that are used to store the different traffic data (see ref. [3]).

SQL is considered, in this context, as a suitable computer language for the goal of this activity and brings enough clarity and quality to the process to be recommended as the computer language to be used.

The verification activity consisted in analysing the compliance of the process with the requirements deriving from the Directive and verifying the code implementation.

In particular, the verification activity consisted of the following steps:

• Checking that the implementation is correct in respect to the procedure (as described in ref. [3]).

• Checking that the SQL code implementation is correct.

The following diagram illustrates the calculation process, indicating with numbers (1 to 9) each one of the steps of the calculation.
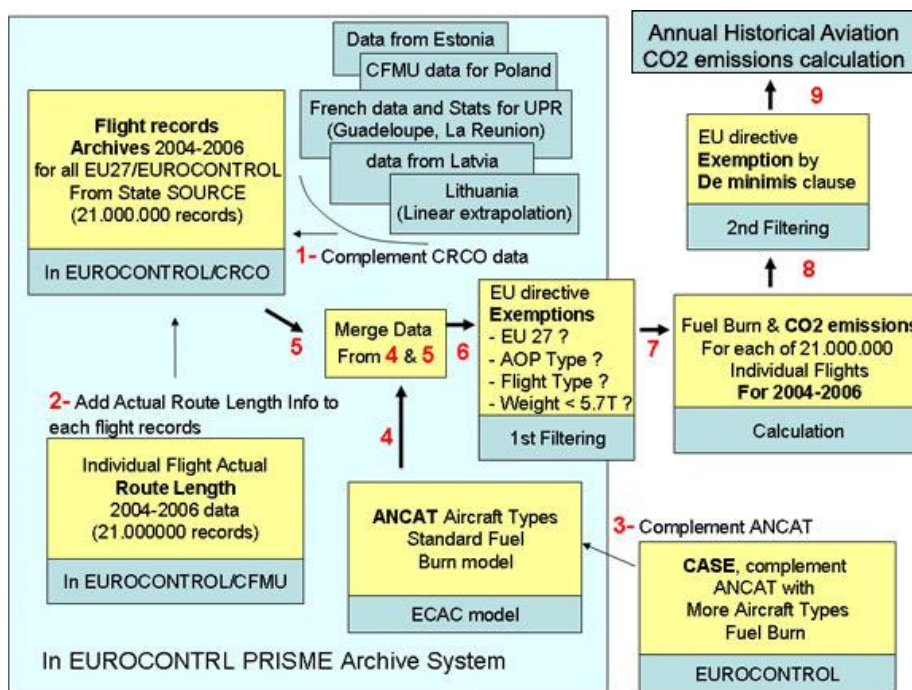

Figure 1. EUROCONTROL methodology for historical aviation CO_2 emissions estimation: flow chart (source: EUROCONTROL)

The following table tracks each requirement of the Directive, identifies the steps in which such requirement has been implemented and indicates the outcome of the verification, both in terms of how the procedure is implemented and the result of the verification of the actual computer code:

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Id	Requirement	Verified Procedures (see Figure 1)	Verified SQL code
R1	"Historical aviation emissions" means the mean average of the annual emissions in the calendar years 2004, 2005 and 2006 from aircraft performing an aviation activity covered by the ETS.	1, 2, 3, 4, 5, 6, 7, 8 ✅	✅
R2	The estimation of the historical aviation emissions shall be based on best available data, including estimates based on actual traffic information.	1, 2, 3, 4, 5, 6, 7, 8 ✅	✅
	All flights which arrive at or depart from an aerodrome situated in the territory of a Member State to which the Treaty applies shall be included, with the exemptions (a) to (j) listed below:	N/A	N/A
R3	a) flights performed exclusively for the transport, on official mission, of a reigning Monarch and his immediate family, Heads of State, Heads of Government and Government Ministers, of a country other than a Member State, where this is substantiated by an appropriate status indicator in the flight plan;	9 ✅	✅
R4	b) military flights performed by military aircraft and customs and police flights;	9 ✅	✅
R5	c) flights related to search and rescue, firefighting flights, humanitarian flights and emergency medical service flights authorised by the appropriate competent authority;	9 ✅	✅
R6	d) any flights performed exclusively under visual flight rules as defined in Annex 2 to the Chicago Convention;	9 ✅	✅
R7	e) flights terminating at the aerodrome from which the aircraft has taken off and during which no intermediate landing has been made;	9 ✅	✅
R8	f) training flights performed exclusively for the purpose of obtaining a licence, or a rating in the case of cockpit flight crew where this is substantiated by an appropriate remark in the flight plan provided that the flight does not serve for the transport of passengers and/or cargo or for the positioning or ferrying of the aircraft;	9 ✅	✅
R9	g) flights performed exclusively for the purpose of scientific research or for the purpose of checking, testing or certifying aircraft or equipment whether airborne or ground-based;	9 ✅	✅
R10	h) flights performed by aircraft with a certified maximum take-off mass of less than 5 700 kg;	9 ✅	✅
R11	i) flights performed in the framework of public service obligations imposed in accordance with Regulation (EEC) No 2408/92 on routes within outermost regions, as specified in Article 299(2) of the Treaty, or on routes where the capacity offered does not exceed 30 000 seats per year; and	9 ✅	✅
R12	j) flights which, but for this point, would fall within this activity, performed by a commercial air transport operator operating either: - fewer than 243 flights per period for three consecutive four-month periods; or - flights with total annual emissions lower than 10 000 tonnes per year. Flights performed exclusively for the transport, on official mission, of a reigning Monarch and his immediate family, Heads of State, Heads of Government and Government Ministers, of a Member State may not be excluded under this point.'	9 ✅	✅
R13	Fuel consumption shall include fuel consumed by the auxiliary power unit.	To be implemented in D3.1	N/A

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3. VERIFICATION SUMMARY AND RECOMMENDATIONS

The Project Team has verified that:

- the methodology is implemented in a correct manner, and

- the computing facilities (hardware and software) are correctly used to achieve the goals of the methodology.

The Project Team has not found any nonconformity in the implementation of the methodology and therefore, the procedure is considered verified.

Although out of the scope of the verification process, one area of potential improvement has been identified: EUROCONTROL has provided very detailed information about the computation process to be verified through technical meetings in Brussels, presentations on the process followed, access to their computing facilities as needed and direct access to the computer code. However, the Project team recommends EUROCONTROL to write and publish (at least internally) a technical document on the process followed to ensure all elements are correctly collected in a single document to be used for future reference in case any code modifications are needed.