CALCULATION METHODOLOGY OF KLM'S CO_2 CALCULATOR

The purpose of KLM's CO_2 calculator is to calculate the amount of CO_2 emissions of passengers or cargo loads during a specific flight defined by the departure airport and the arrival airport. Only regular (scheduled) flights are taken into account. For the flights operated by KLM's integrated network with Air France (AF) and Northwest Airlines (NW) the aligned data based on their own CO_2 emission calculations have been added. For code share partners the average emissions are estimated related to the overall efficiency of the KLM operations for short, medium and long haul flights

I. OBTAINING THE DATA

The necessary data are based on actual flight data gathered at each flight by the Airborne Condition And Reporting System (ACARS). All these data are automatically transferred to the KLM data warehouse for use in calculations and analysis.

The operational figures used for the emission calculator are based on the fuel consumption data per aircraft type used by KLM and KLC: Actual fuel use per 100 kg payload per 100 km 'bird eye distance", the passenger-kilometres travelled (PKT) and the ton-kilometres travelled (TKT). The principles of IPCC 2006[1], TIER 3A are being used in collecting and calculating data on fuel burn and actual load per O&D-segment and aircraft type. O&D stands for origin and destination.

These fuel consumption data, as abstracted over a specified period (financial year 2006-2007), are translated into fuel-efficiency data for the fleet of KLM and KLC. These data have been part of the assurance engagement for KPMG and are used for the CO_2-calculator. For the non KLM/KLC operated flights we based ourselves on data provided by Air France and Northwest Airlines or estimates (for flights operated by codeshare partners).

II. PRINCIPLES OF CALCULATION

The methodology is based upon determination of the average fuel consumption per passenger and per ton of cargo for each flight of the network of KLM.

a) KLM methodology to split up fuel burnt between pax and cargo

The allotment of fuel between passengers and cargo is proportional to the respective overall masses of passengers and cargo. The **overall mass** is constituted by the mass of the payload (passengers – luggage included - or cargo) to which is added the mass of the specific equipments necessary to the transportation of this kind of payload, named the equipped mass (as abstracted for the Air France operation).

The "**equipped passenger mass**" amounts to the mass of seats, racks, galleys, food trolleys, food, to which the weight of the cabin staff is added.

The "**equipped cargo mass**" corresponds to mass of all the equipment in the cargo bulks used for the transportation of cargo.

The aircraft's structure, the weight of the flight crew and the cockpit equipment are not taken into account, as they are necessary to transport both the passengers and the cargo load.

The two equipped masses were calculated for each aircraft type. These masses are used to get the average fuel efficiency per passenger and the average fuel efficiency per ton of cargo for each type of aircraft. KLM is using average factors for the equipment weights per passenger and amount of cargo load as derived from AF-data.

[1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Chapter 3.6 Civil Aviation

b) How to evaluate flight distances

The bird eye distance between the departure airport and the arrival airport is not the same as the actual "**flying distance**", the distance effectively flown by the aircraft, which depends upon the flight plan which takes into account operational constraints like military air zones and waiting loops above airports. KLM uses the flying distance to express amounts of CO2 per km.

c) Calculation of the CO_2 emissions per Origin and Destination

First we determine the expected fuel efficiency per passenger (or 100 kg cargo) on a specified O&D (Origin and Destination). This is done by taking the weighted fuel efficiency of all aircraft types that will be used on this O&D. The weighting is according to the frequencies of the aircraft types on this O&D in the next scheduled plan period of 10 month.

The average amount of fuel per passenger (or 100 kg cargo) for an O&D can then be calculated by multiplying the weighted average fuel efficiency per passenger (or 100 kg cargo) by the distance.

Finally the amount of CO_2 emissions of a flight can be calculated by multiplying the average amount of fuel burn per passenger (or cargo) in tons on this flight by the factor 3.157 (one tonne of fuel produces 3.157 tonnes of CO_2). This factor has been used for calculating CO_2-emissions of commercial jet fuel of KLM during the last decade, and it has been confirmed in recent publications of ICAO and IPCC[2].

The **origin and destination entry file** for the calculator comprises for each segment the IATA code of the departure airport and of the arrival airport (these codes define the segment), the average fuel consumption per passenger in kilograms, the average fuel consumption per ton of cargo in kilograms and the "flying distance".

This file contains all the segments[3] of the KLM and KLC network, but it does not contain all the lines of this network, since a line can consist of two or more segments in case of stopovers. Consequently this file has been manually completed to include all the lines KLM and KLC operates. For example, the value for AMS-CKG (Amsterdam to Jakarta) corresponds to the sum of the values for AMS-KUL (Amsterdam to Kuala Lumpur) and KUL-CKG (Kuala Lumpur to Jakarta).

d) Implementation for KLM and KLC

The method described in section II. is integrally applied to calculate the emissions of KLM/KLC flights run by KLM/KLC aircrafts. The output of this calculation is connected to our booking tool and other web based information to show our customers what emissions their trips and travels are causing.

The networks of AF, NWA and code share partners are also connected to our calculation interface. The segment based databases of AF and NWA have not been part of the KLM validation process and have been calculated by these airlines. The code share flights have been estimated on the average emission of short haul, medium haul and long haul performance of the KLM-fleet, corrected with an average efficiency-correction. This is based on the average AEA[4]-performance, which amounts 25% less efficient compared to the KLM/KLC-operations.

[2] 2006 IPCC Guidelines for National Greenhouse Gas Emissions, table 3.6.9 (page 3.71), footnote (11)
[3] A segment is a direct flight –without any stopover- between a departure airport and an arrival airport For example, AMS-JFK counts as one segment.
[4] Association of European Airlines