# 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 and 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 Delta Airlines (DL) 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 aircraft onboard systems. 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 (calendar year 2010), 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 Delta Airlines or estimates (for flights operated by code share 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 passengers 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.

The two equipped masses were estimated for each type of operation (regional, medium haul and long haul). 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 ICAO calculator principles[2] and aligned with AF.

### 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

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

[2] ICAO Carbon Emissions Calculator, april 2008

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 7 months and to the average actual payload per trip per aircraft type.

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) and 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 3.15 (one tonne of fuel produces 3.15 tonnes of $CO_2$). This factor is based on EU-ETS regulations[3], to align the monitoring protocols.

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 in liters and the average amount of CO2 in kilograms (per passenger and per ton of cargo) and the "flying distance".

This file contains all the segments[4] 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 operate. For example, the value for AMS-CGK (Amsterdam to Jakarta) corresponds to the sum of the values for AMS-KUL (Amsterdam to Kuala Lumpur) and KUL-CGK (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 and DL and code share partners are also connected to our calculation interface. The segment based database of AF and DL 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[5]-performance, which amounts ca. 25% less efficient compared to the KLM/KLC-operations.

[3] EU-ETS regulations (DIRECTIVE 2008/101/EC): Annex XIV – Activity-specific guidelines for aviation activities as listed in Annex I to Directive 2003/87/EC –draft-

[4] 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.

[5] Association of European Airlines