Report on the environmental performance class of airlines flying at Swedish airports

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Methodological introduction
The objective of this report is to distribute stars for environmental performance with respect to climate change to the main airlines serving Swedish airports. The main parameter determining the impact of a flight on climate change is the amount of fuel burnt and emissions of carbon dioxide associated with that. Though other emissions and phenomena like contrails and the forming of contrail induced cirrus clouds may increase the radiative forcing of all aviation by a factor two or more as compared to the effect of aviation related carbon dioxide emissions alone, these other effects also are a function of fuel burnt. Therefore average fleet fuel consumption per seat-kilometre is a fair proxy for the environmental efficiency of an airline.

The average fleet fuel consumption per seat-kilometre depends on the age of the fleet and on the average seat density of the aircraft. The energy consumption per skm is a function of the technology age of the fleet. The design age is the number of years ago of first market introduction of the specific aircraft design. The seat density is the other important factor. For example, the 737-800 has a maximum certified capacity of 189 passengers. This number can normally be reached in a high density single economy class cabin layout. Most airlines apply a mixed class and than the number of seats is much lower. It is clear that a high capacity aircraft will have a lower fuel consumption per seat-kilometre. Finally the fuel consumption per passenger-kilometre depends on the the occupancy rate. The average for world aviation is between 70% and 75%. Generally charter airlines and low cost carriers reach a higher rate than other airlines. Differences can be large between different routes. In this report we focussed on the technical efficiency (per seat-kilometre) and not the operational efficiency (per passenger-kilometres), because its results are to be used by the passengers themselves to help them choose the most efficient airline. If they do so this will help to use the technically most efficient fleets at higher occupancy rates, thus further enhancing the environmental performance.

A model has been developed using data from the Jet Information Services World Jet Inventory 2007 Q2 (WJI-Q2), Jane's All the world Aircraft (Jackson, 1998), data given by Boeing and Airbus websites and data from the airlines involved. The following parameters were determined based on the fleet data from the WJI-Q2:

Weighted technology age: the average age of the fleet in terms of the age of the technology based, which has been based on the first delivery year of the aircraft models used. The average has been weighted for the number of seats (that means that the performance of one aircraft with 400 seats is counted four times the performance of an aircraft with only 100 seats when averaging the fleet performance. The resulting data are given in Figure 1.

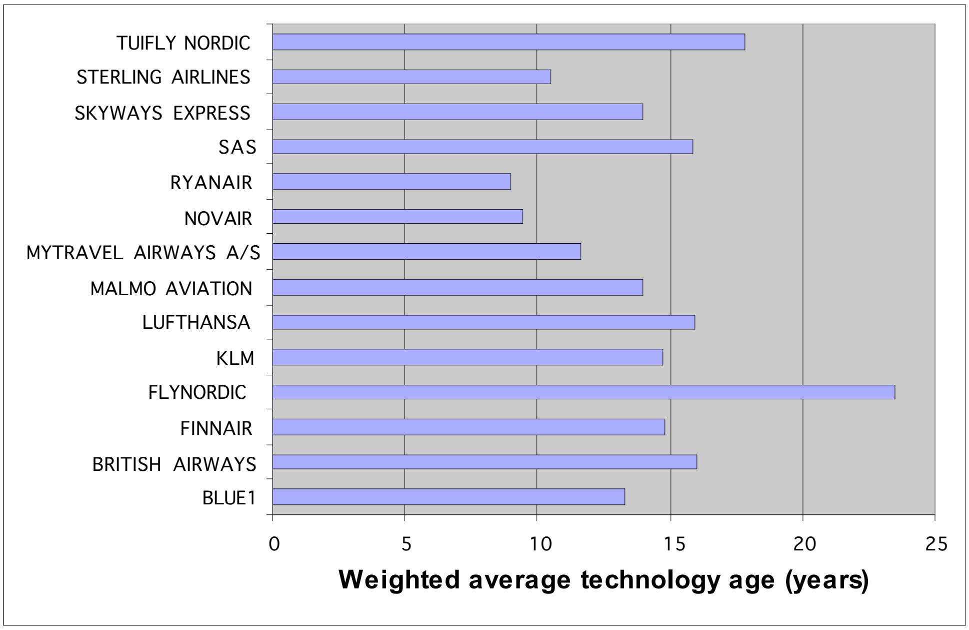

Figure 1: Weighted average fleet technology age.

Weighted and corrected energy consumption: this parameter is based on the actual technology age and a generalised regression for energy consumption per seat kilometre as function of the year of market introduction (as published by Peeters & Middel, 2006). First for every single aircraft in the fleet this generalised energy consumption per seat-kilometre has been calculated. As the values from the regression are valid for the average cabin layout, we corrected these values per individual aircraft for the actual number of seats as operated by each airline in that specific aircraft type. These actual seat-layouts are all based on the figures given n annual or environmental reports at websites of the airlines. The average seat capacity has been taken from Jane's as the 'typical mixed class layout' capacity. Finally then the fleet average has been calculated, again weighting for the actual number of seats for each aircraft used by that specific airline. This gives the best indication of the technology level of the fleet. See Figure 2 for the results.

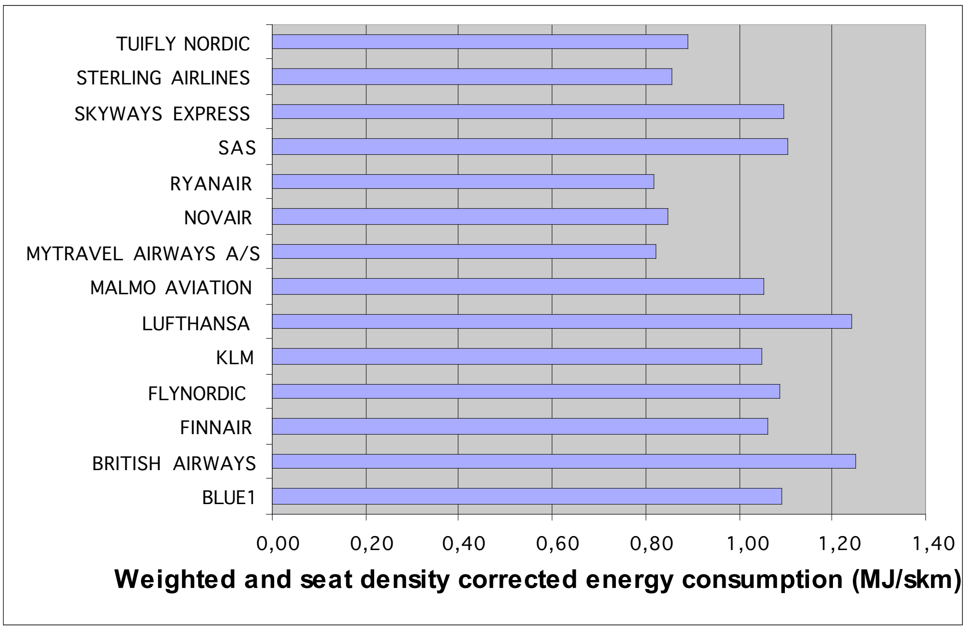

Figure 2: Fleet weighted and seat density corrected average energy consumption in MJ per seat-kilometre (MJ/skm).

Results

Finally the fleets have been given stars using a bench-mark system based on the lowest and the highest weighted and corrected average fleet energy consumption in a three star system. We choose a three star system because the airlines clearly fall in three groups (see Figure 2).

	Weighted technology age (year)	Weighted and corrected energy consumption (MJ/skm)
Minimum	9.0	0.820
Maximum	23.5	1.250
Value for one star	4.8	0.144

Table 1: Overview of the value of a star for the two calculated parameters.

Table 2 shows the final results for the stars in the most right column. The airlines with the lowest energy consumption per skm are all low cost carriers or charters with a high density seating and in most cases a relatively new fleet. The worst energy efficiency per skm is found with the two big flag carriers Lufthansa and British Airways. However, the technical state of these two airlines has two stars and is of medium quality. The one star for energy efficiency is mainly caused by the low seating density/high comfort cabin layouts. The airline with the oldest fleet, FlyNordic, applies a high seat density and therefore reaches two stars in energy efficiency.

Airline	Weighted technology age (year)	Weighted and corrected energy consumption (MJ/skm)
MYTRAVEL AIRWAYS A/S	***	***
NOVAIR	***	***
RYANAIR	***	***
STERLING AIRLINES	***	***
TUIFLY NORDIC	**	***
BLUE1	**	**
FINNAIR	**	**
FLYNORDIC	*	**
KLM	**	**
MALMO AVIATION	**	**
SAS	**	**
SKYWAYS EXPRESS	**	**
BRITISH AIRWAYS	**	*
LUFTHANSA	**	*

Table 2: Final result. The most direct parameter is the energy consumption given in the third column.

Some final notes

The above rating is based on publicly available data. Information on the exact types of aircraft actually used at Swedish Airports has not been incorporated. For the Swedish Airlines this is not a large problem as these will use all their aircraft from the Swedish airports. However, for the non-Swedish airlines like Lufthansa, KLM and British Airways, this might shift the picture slightly. On the other side there is a mix in the age of the short and medium haul aircraft actually used by these carriers to Sweden.

The airlines are rated on their technical performance. The main parameters riving the fuel efficiency are the age of the technology used and the seat density of the cabins. Therefore low cost carriers and charters reach almost all the three stars rating. However, it must be reminded that at a macro scale specifically the high seat density is one of the (important) means for low cost carriers and charters to reduce the cost per seat-kilometre. The low ticket prices offered by these airlines mean a strong incentive for people to fly more often. The net impact of low cost carriers/charters on the environment therefore might be not different as for a flag carrier with the same technology age. If the impacts of these low cost tickets on the market for rail, coach and ferries is included, the overall impact might even be negative. In this study we took the individual traveller as the point of departure, for whom such macro considerations are of less importance.

Finally: we have only included the jet aircraft of the fleets. Some of the airlines operate also turboprop aircraft like the Fokker 50 or the Embrear 170 or the ATR 72. such propeller driven aircraft generally use less fuel per seat-kilometre on distances up to 1000 km than jet aircraft and if an airline operates a connection with propeller aircraft, these should be rated with four stars, whatever the type.

References

Jackson, P. (Ed.). (1998). *Jane's All the world's aircraft 1998-1999* (Vol. 89). London: DPA.

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