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Fuel Tankering: economic benefits and environmental impact

ABSTRACT

Fuel tankering is a practice whereby an aircraft carries more fuel than required for its flight in order to reduce or avoid refuelling at the destination airport. However, carrying more fuel than necessary increases the fuel consumption and thus the amount of CO_2 emitted.

So far, the very few studies on fuel tankering [1]-[6] focused mainly on its economic benefits for a single flight. As demand to accelerate the decarbonisation of transport becomes more and more pressing, the purpose of this study is to provide information on the extent of the environmental impact of fuel tankering at ECAC level.

The results obtained from simulations showed that per year, in the ECAC area, 16.5% of flights are able to perform full tankering and 4.5% partial tankering.

Consequently, in ECAC airspace, fuel tankering would result in the burning of 286,000 tonnes of additional fuel per year, and the production of 901,000 tonnes of unnecessary additional CO_2 emissions per year. This represents around 2,800 Paris-New York round-trips or the annual emissions of a European city of 100,000 inhabitants. But, at the same time it represents a net saving of 265M€ per year for the airlines.

POSSIBLE OPTIONS

An option for airlines to avoid fuel tankering is to be fully fuel hedged at a unique price at all airports at which they operate, which some of them already aim at doing as much as possible. Another option would be to increase the cost of CO_2 allowances to a dissuasive level, or potentially equalise the tax rates on fuel.

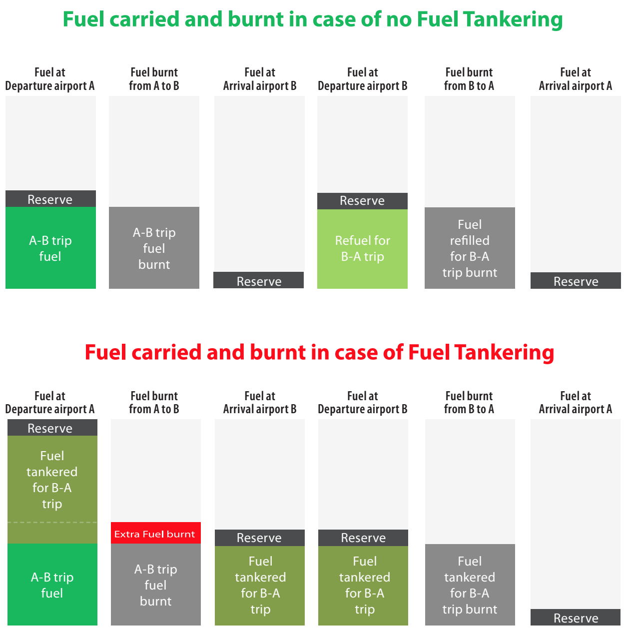
WHAT IS FUEL TANKERING?

Aviation is a very competitive market and each airline needs to minimise operating costs, in order to keep its ticket prices as competitive as possible. As today fuel costs account for between 17% and 25% of airlines' operating expenses [7], so saving fuel has become a major challenge for aviation, especially since this industry is also very committed to reducing its environmental footprint, particularly its contribution to climate change.

Fuel tankering is a practice whereby an aircraft carries more fuel than required for its next flight (trip fuel + reserve) in order to reduce or avoid refuelling at the destination airport. But, as illustrated in **Figure 1**, the additional fuel carried when doing fuel tankering increases the aircraft's weight and therefore increases its fuel consumption, resulting in additional CO_2 emissions.

Nevertheless, as demonstrated in this study, fuel tankering provides financial savings mainly due to fuel price differences at airports.

Figure 1:
Fuel carried and burnt in the case of no Fuel Tankering and Fuel Tankering. Trip fuel = Taxi + Climb Cruise Descent + Approach to Touchdown. Reserve = Contingency + Alternate + Final reserve.



HOW OFTEN IS FUEL TANKERED IN EUROPE?

Simulations taking into account aircraft performance, maximum take-off weight, landing weight, fuel tank capacity, legal fuelling minima, and information about negotiated fuel prices from some airlines, were performed to estimate how often fuel tankering could be used. The results showed that per year, in the ECAC area, full tankering could be performed on 16.5% of flights, whereas partial tankering could be performed on 4.5% of flights. In addition to the simulations, interviews with several pilots from airlines, business aviation dispatchers and handling agents, were conducted. They reported that in practice full tankering is performed on 15% of flights, and partial tankering performed on a further 15% of flights.

To calculate the optimum tankering, most airlines use operations centre software (e.g. Lido and Sabre) taking into account the cost of fuel at the airports served. A patent has recently been published by Honeywell for a tool to further enhance fuel tankering and fully exploit its economic benefits [8].

Interviewees reported that fuel tankering is done in 90% of cases for fuel price reasons, and only in 10% of cases for social disruption, technical failures at the refuelling facility, fuel shortages, risks of delays, or contaminated fuel at destination airports.

All these elements confirmed that fuel tankering is a common practice and that it is worth comparing economic benefits against its environmental impact.

CALCULATIONS OF THE ECONOMIC AND ENVIRONMENTAL IMPACT OF FUEL TANKERING

To calculate the economic and environmental impact of fuel tankering, simulations have been performed with the EUROCONTROL BADA (Base of Aircraft Data) models based on typical types of aircraft flying in ECAC airspace, taking into account the distribution of ECAC flights per distances flown and the fuel prices negotiated by two major European airlines. The payload has been calculated with a load factor of 80.3% and 124 kg/passenger as used in the European Aviation Environmental Report 2019 [9]. One month of ECAC traffic data was used in the simulations (June 2018).

Table 1 shows the fuel consumption (A-B trip and the return B-A trip), the extra cost and CO_2 by doing full tankering and its cost, for 300 NM and 600 NM maximum range trips, which correspond respectively to 30% and 50% of all ECAC flights.

Table 1:
Example of Extra fuel and extra cost for 300 NM and 600 NM.

Round trip distance (each leg)	Practice	Fuel consumption (kg)		% extra fuel burnt for A-B trip	Extra fuel burnt for A-B trip (kg)	Extra CO_2 emitted for A-B trip (kg)	Cost of extra fuel burnt (€) for A-B trip
		A-B Trip	B-A Trip				
300 NM	no tankering	2,037	2,037				
	full tankering	2,082	2,037	2.21%	45.1	142	24.8
600 NM	no tankering	3,592	3,592				
	full tankering	3,760	3,592	4.66%	167.5	528	92.1

Round trip distance (each leg)	Fuel price diff. airport A and B	Practice	Extra fuel burnt for A-B trip (kg)	Cost of extra fuel burnt for A-B trip (€)	Cost of purchasing CO_2 allowances (€)	Cost of the trip including extra fuel and CO_2 allowances (€)		Total cost of fuel used for A-B + B-A trip (€)	Net saving (€)
						A-B Trip	B-A Trip		
300 NM	0%	no tankering				1,120	1,120	2,240	0.0
		full tankering	45.1	24.8	2.8	1,148	1,120	2,268	-27.6
	10%	no tankering				1,120	1,232	2,352	0.0
		full tankering	45.1	24.8	2.8	1,148	1,120	2,268	84.4
	20%	no tankering				1,120	1,344	2,464	0.0
		full tankering	45.1	24.8	2.8	1,148	1,120	2,268	196.4
	30%	no tankering				1,120	1,456	2,576	0.0
		full tankering	45.1	24.8	2.8	1,148	1,120	2,268	308.4
600 NM	0%	no tankering				1,976	1,976	3,952	0.0
		full tankering	167.5	92.1	10.6	2,078	1,976	4,054	-102.7
	10%	no tankering				1,976	2,173	4,149	0.0
		full tankering	167.5	92.1	10.6	2,078	1,976	4,054	94.9
	20%	no tankering				1,976	2,371	4,347	0.0
		full tankering	167.5	92.1	10.6	2,078	1,976	4,054	292.5
	30%	no tankering				1,976	2,569	4,544	0.0
		full tankering	167.5	92.1	10.6	2,078	1,976	4,054	490.1

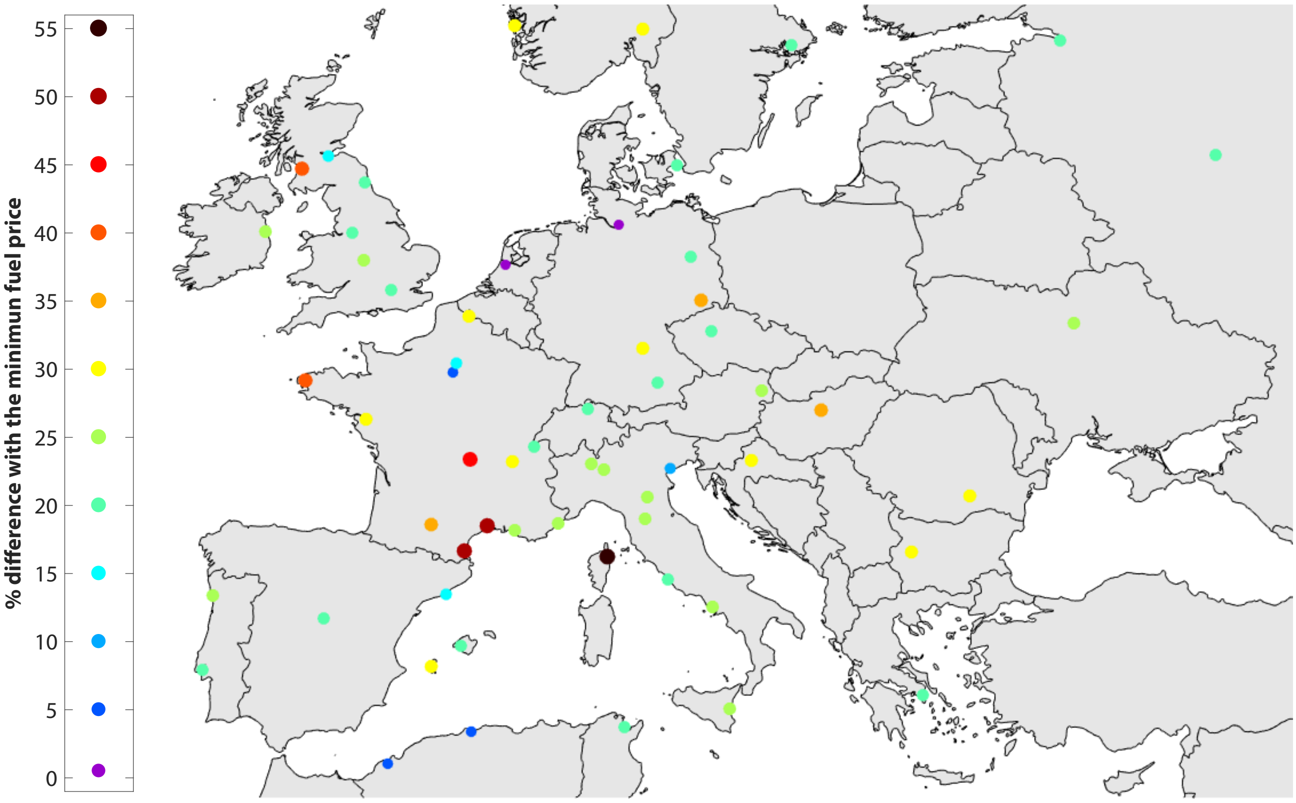
Table 2:
Example of savings
for 300 NM and 600 NM.

Table 2 shows the impact of different tankering scenarios based on the fuel prices at the departure airport A and at the destination airport B. Here, the IATA price of jet fuel for February 2019 (550€/tonne) has been used. Furthermore, it is assumed that the CO_2 generated by the extra fuel burnt will have to be compensated through the purchase of CO_2 allowances at 20 euros/tonne[1], which is rarely the case since 82% of EU ETS CO_2 allowances are free for aircraft operators, at least until 2020 [10]. Despite this extra cost, it can still be economically viable to carry more fuel than strictly necessary for a flight leg depending on the difference in cost of fuel at the departure and destination airports.

The average worldwide price of jet fuel is largely influenced by the demand and supply of crude oil, taxes, and refining costs. **Figure 2** shows the fuel price difference at various airports. The variation in fuel price depends on, inter alia, the country, the airports, the purchasing power and size of the aircraft operator's fleet, the negotiation period, the distribution technique, marketing, profit, quantities and supply competition at airports. There are considerable fuel price differences between European airports e.g.: 30% between Amsterdam and Ibiza or Hamburg and Oslo airports, 20% between Heathrow and Glasgow airports.

[1] *Since 2012, Aviation has been included in the EU ETS, which is a cap and trade scheme, and one of the key climate policy instruments that has been implemented in the European Union (EU) to achieve its objectives of reducing greenhouse gas (GHG) emissions in a cost-effective manner.*

Figure 2: Example of differences in jet fuel price at airports.



According to the simulations conducted, fuel tankering would be responsible for 286,000 tonnes of extra fuel burnt in ECAC each year, costing an additional 157M€ and generating 901,000 tonnes of additional CO_2 emissions which could result in 18M€ of additional CO_2 emission trading costs. But, fuel tankering would also give an estimated net saving of 265M€, as shown in **Table 3** below.

Table 3:
Estimations of ECAC extra fuel burnt, CO_2 generated and net saving per year (values have been rounded).

	Extra fuel burnt (tonnes/year)	Cost to transport extra fuel (M€/year)	Extra CO_2 emitted (tonnes/year)	Cost of purchasing CO_2 allowances (M€/year)	Net saving = Tankering saving - [Extra fuel + CO_2 cost] (M€/year)
Full tankering	160,000	88	504,000	10	217
Partial tankering	126,000	69	397,000	8	48
Total tankering	**286,000**	**157**	**901,000**	**18**	**265**

LIMITATIONS OF THE STUDY

Simulations were performed with the EUROCONTROL BADA (Base of Aircraft Data) models based on typical types of aircraft flying in ECAC airspace, representing 66% of the total ECAC flights.

The negotiated fuel price data from 2 major airlines were used, covering 140 of the main ECAC airports and representing a total of about 400 aircraft. These simulation results were extrapolated to all ECAC flights by applying the same amount of fuel tankering per distance flown.

For full tankering, flight legs of more than 1,500 NM were not considered. For partial tankering, flight legs of more than 2,500 NM were not considered.

The impact of fuel tankering for reasons other than fuel price differences at airports was not considered (e.g.: shortening turnaround times or fuel shortages).

The possibility to tanker fuel for more than one leg, which some airline software is able to calculate, has not been estimated.

Therefore, the environmental impact of fuel tankering could be larger than that estimated in this study.

FUEL TANKERING IMPACT

Over the 10 million annual flights in ECAC, it was estimated that 2.1 million are able to perform fuel tankering, distributed as follows: 1.6 million flights are able to perform full tankering (16.5%) and 0.45 million flights are able to perform partial tankering (4.5%).

To avoid double counting, the ability to perform partial tankering was considered only when full tankering was not possible.

As a result, in ECAC, fuel tankering would represent 136kg of additional fuel burnt per flight concerned (costing 75€), generating 428kg of additional CO_2 (i.e. 9€ in purchased CO_2 allowances). Nevertheless, despite the additional cost, fuel tankering would still result in a net saving of 126€ per flight on average.

It should be noted that the values above are averaged and could vary significantly between airlines due to negotiated fuel price, type of aircraft used, and distances flown.

CONCLUSIONS

As aviation is a highly competitive market, airlines must do everything possible to minimise their operating costs. In particular, tools have been developed for identifying the value of performing fuel tankering, a practice whereby an aircraft carries more fuel than required for its flight in order to save costs.

However, fuel tankering is not without environmental consequences, as the more fuel an aircraft carries, the more fuel it burns and the more CO_2 it emits.

Based on the elements of information available to this study and simulations conducted with the BADA model, it was estimated that fuel tankering could result in a net saving of 265M€ per year for the airlines. However, it would generate 286,000 additional tonnes of fuel burnt and 901,000 tonnes of CO_2 emissions at ECAC level per year. This represents about 2,800 round-trips between Paris and New York or the annual emissions of a European city of 100,000 inhabitants. This represents a substantial economic benefit and a significant environmental impact.

Therefore, fuel tankering could offset the benefit of initiatives to save fuel and reduce aviation CO_2 emissions. At a time when aviation is challenged for its contribution to climate change, a practice, such as fuel tankering, that generates significant additional CO_2 emissions is questionable.

An option for airlines to avoid fuel tankering is to be fully fuel hedged at a unique price at all airports at which they operate, which some of them already aim at doing as much as possible [11]. Another option would be to increase the cost of CO_2 allowances to a dissuasive level [12], or potentially equalise the tax rates on fuel.

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