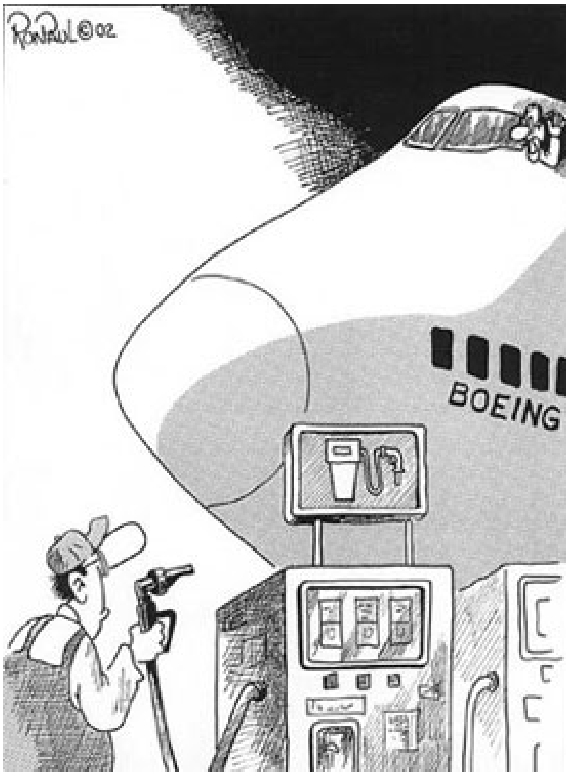
# Surviving the Fuel Crunch; A Review of Available Operating Cost Reduction Measures

The aviation industry is facing a looming crisis with spiraling fuel costs. For the first time ever, fuel replaced labor as the largest single cost item for the global airline industry in 2006. Based on a sample of the financial reports of 45 major global (passenger) airlines, fuel accounted for 25.5 per cent of total operating costs in 2006, up from 22.5 per cent in 2005. The rise in the fuel price reflects a sharp increase in the price of crude oil over the period, but also reflects a widening in the refinery margin between crude oil and jet fuel, largely due to capacity constraints at refineries. The widening of the refinery margin alone added an extra US$14.7 billion to the industry's fuel cost in 2006. IATA shows that jet fuel prices have increased by 100 per cent based on April 2007 week's prices. (IATA, 2007)

by: Bridget Ssamula

With each US$1 increase in the price of a barrel of oil adding an estimated US$26 million to Air Canada's annual fuel tab. Fuel is the carrier's single largest expense, accounting for more than 30 per cent of Air Canada's operating budget. Many airlines are grounding their fleet in order to reduce capacity and the amount of fuel being consumed by these aircraft, especially in the off-peak season. Many airlines are cutting their labor costs as a cost-reduction measure in this highly unprofitable operating environment. In the US alone, 10,000 job cuts have been announced since May, and there are dire predictions for the future, as is shown in the IATA (2007) report, which showed that, labor (including pension) expenses fell from 24.2 per cent in 2005 to 23.3 per cent in 2006. (Van Strateen, 2008)

The main aim of this paper is to analyze fuel consumption during the block time and the various initiatives, both through operations and aerospace research that are being used to reduce the amount of fuel consumed. It limits aerospace research initiatives to elements that can be controlled by the operators, thus excluding elements of aircraft design, drag and wind speed. The first section of the paper discusses fuel consumption and how it is measured, followed by a discussion on various initiatives that assist in lowering fuel burn. The usefulness of this article is in trying to merge aviation research with operations, with an aim to reduce spiraling operating costs in the aviation industry.



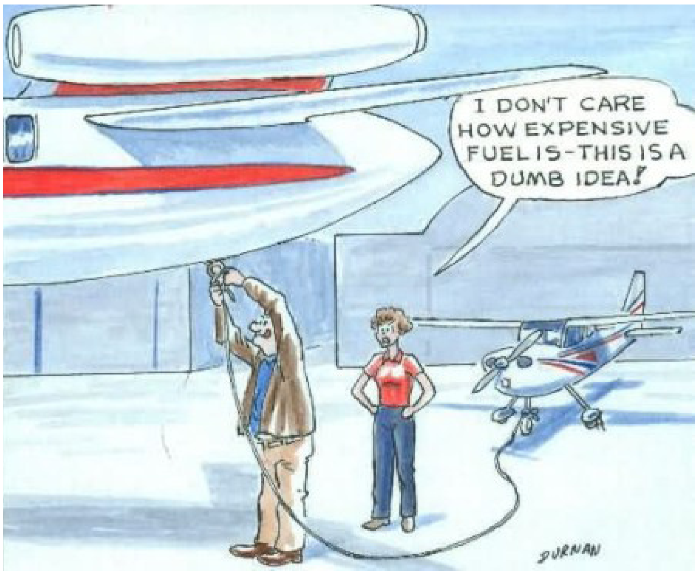

## Reducing Fuel Burn

In order to lower the costs spent of fuel, the first most practical method of doing this would be to fly in a fuel-efficient manner. The amount of fuel burnt by an aircraft during block time can be calculated at various stages of the journey. Filippone (2008) states that one of the most valuable flight performance data are the fuel flow at cruise conditions, along with the weight, flight altitude and Mach number. In fact, from this data, it is possible to extract the drag, the net thrust, the thrust specific fuel consumption (TSFC) and the specific air range (SAR) — all of them are critical parameters in lowering fuel consumption. The various stages at which fuel that is burnt include: (Filippone, 2008)

- The taxi-out fuel.
- The take-off fuel to clearing of screen at 50 ft.
- The climb to international cruising altitude fuel.
- The cruise fuel for required range minus en-route climb and descent.
- The descent fuel.
- The landing fuel.
- The taxi-in fuel.
- The contingency fuel.

The various initiatives that can lower the amount of fuel consumption based on the fuel consumption calculations discussed above include:

*Payload Reduction:* The weight reduction involves reducing how much weight the aircraft carries, because it has an impact on how much fuel is burnt. The formula for calculating fuel burn during block time is a function of the gross weight of the aircraft, from take-off to landing. This is in turn related to the position of the centre of gravity (CG) and is essential in flight performance. It affects fuel, primarily fuel consumption through the drag, but also the stall speed, maneuver characteristics and other aspects of the flight. Airlines worldwide are looking at the various elements in the plane whose weight can be reduced so as to lower the fuel burn. The payload and the weight of the passenger service items are calculated from the number of passengers and the bulk cargo. The weight per passenger is fixed; the weight of the service items (food, drinks, magazines, on-board entertainment and associated overheads) depends on the type of operators; likewise, the number of crew members depends on the type of service. (Filippone, 2008)




*Reserve fuel:* Even though the International Civil Aviation organization (ICAO) International Annex 6 stipulates a mandatory fuel reserve to take contingencies like, diversions, delays in landing and emergency rerouting procedures during flying into account. The policy to determine the reserve fuel changes depending on the route, distance, alternative airports, etc. This has now become a method of reducing the weight of an aircraft depending on the block time for the trip.

*Tankering:* Tankering is the practice of ferrying enough fuel for a return flight, in order to make up for the additional cost of purchasing fuel at the destination point. Although the practice has been discouraged because of the environmental consequences, the operation has economic advantages. Like the changes in landing weight, cost of fuel at destination, etc.

*Cruising Altitude:* More specifically, the specific air range (SAR) charts in terms of flight altitude are important in the definition of the optimal cruise altitude. SAR charts in terms of the Mach number are important in the definition of the long-range cruise. The weight is an essential parameter, because, as the aircraft becomes lighter due to fuel burn, the SAR increases. Thus, the optimum cruise range must be found by point-by-point integration of the SAR, based on weight of the aircraft. Restricting cruise altitude for a flight depending on weight has operational implications like traffic management, increasing possibility of accidents.

*Cruising Speed:* In aerodynamics, at cruising level, aircraft have an optimum cruising speed, which is termed as the economic mach number. The economic mach number is defined as the highest mach number corresponding to 99 per cent of the maximum Specific Air Range (SAR). In general, there can be a significant increase in cruise Mach number at a cost of only 1 per cent of additional fuel consumption. Changes in the aircraft speed raise additional operational issues associated with journey time.

*Landing Technology:* Newer planes are now using GPS technology to fly the most direct routes into airports. Airbus (2004) suggests that avoiding early descents, diminishing descent speeds, linear holdings and avoiding extending gear unnecessarily early are all measures for landing technology that can reduce fuel burn.

*Increasing income and lowering operating costs:* Airlines are finding more ways to increase their revenue during these times. KLM and Air France are looking at increasing the number of seats in economy on their Boeing 777s. If implemented, expect 10 seats instead of nine in a row. (Van Strateen, 2008) Fuel surcharges, a contentious issue, are also being imposed on the fares. Last-minute tickets cost more; peak-travel tickets are more expensive. Grounding aircraft during off-peak seasons and lowering labor costs through capacity lay-offs are some cost-reduction measures airlines worldwide are undertaking.

*Ground delay time efficiencies:* Taxi time is defined as the time when the aircraft lands to the time it parks and the time before the aircraft takes off again when the engine is on. A good estimate of the taxi time is required for a correct flight planning. The calculation of the corresponding fuel component depends on the size of the aircraft, on the distance between gate and start of the runway, and on the amount of traffic. Airbus (2004), suggests that if considered operationally acceptable, taxi can be done with one engine out, to lower the fuel burn.

*Auxiliary Power Unit (APU) usage:* The APU is self-contained power plant that delivers energy for on-board services (air conditioning, heating, and lighting). The APU fuel consumption is calculated at each flight segment and added step-by-step in the fuel planning. The fuel consumption of this unit depends on the atmospheric conditions and on the load selection. On average an increase of APU operation by 1 min at an average level of 240 kg/h means a saving of 4 kg of fuel. This figure, multiplied by the number of movements per year leads to a considerable wastage of fuel. (Filippone, 2008) For example, some smaller aircraft do not use APU on landing and take-off (LTO). It is possible to use compressor air bleed from the engines, but the practice depends on many specific factors that is not possible to take into account. Furthermore, Airbus (2004) recommends that keeping the APU running during short turnarounds (45 minutes on average) tends to reduce fuel consumption during the APU start cycles.

*Aircraft type:* Newer more fuel-efficient planes are becoming a good investment, for airlines and leasing companies. During the cruise section, on all the wide-body airbus aircraft, the FCMC (Fuel Control and Management Computer) on the airbus A330 and the airbus A340 is used. The FCMC calculates the centre of gravity of the aircraft from various parameters including input values (Zero Fuel Weight or Gross Take-off Weight and the associated CG) and the fuel tank contents. It continuously calculates the CG in flight. From this calculation, the FCMC decides the quantity of fuel to be moved aft or forward in flight to maintain the CG between the target value and 0.5 per cent forward of the target band. While the CGCC (Centre of Gravity Control Computer) on the A300-600 and the A310 controls the CG position by transferring fuel in the trim tank. The aircraft therefore flies with an aft CG, thus giving better in-flight performance. (Airbus, 2004)

*Greener Aircraft:* Greener aircraft research implies aircraft that do not depend on aviation fuels and use technology that does not release carbon emissions. Some of the aircraft on the market include: solar aircraft, electric aircraft, and fuel cells aircraft.

*Alternative Fuel Research:* with carbon trading becoming an alternative income source for airlines, a lot of research is being undertaken in the area of use of alternative fuels or additives of aviation fuels. The research is mainly driven by the carbon emissions from the aviation industry, because the amount of pollutants emitted is to a large extent dependent on aero engine technology but to some extent also on jet fuel formulation. Some of the alternatives fuels include: bio diesel, ethanol, synthetic fuels, algae, liquid hydrogen/methane, use of fuel additives and sulphur removal.

## Conclusion

Many of these methods of reducing fuel burn and looking for alternative fuel sources so as to gain revenue from carbon-trading have risks and trade-offs. The balance therefore lies in airlines making decisions as to whether to adopt different operational procedures with the main aim of reducing fuel costs. Most of the procedures like flying at lower speeds, taxiing with one engine, flying at optimum cruising altitude may result in fuel savings but increase the block time. The risks of reducing the weight through fuel pose a trade-off in case of emergencies and a foreign currency risk when buying fuel at destination airports for return journeys. Alternative fuel research has trade-offs pertaining to sustainability, availability, cost and practicalities of engine retrofitting. Airlines are therefore cautioned to use whatever fuel saving measures will cause minimal disruptions to their operations, retain market share and not increase operational costs. Therefore, non-aeronautical sources of revenue, streamlining efficiencies in operations and growing market shares then become the most practical way to respond to the fuel crisis in the short term. The alternatives that could fall under medium-term to long-term options include purchasing more fuel-efficient aircraft, and retro-fitting aircraft with modern technologies that could save fuel costs in the long run. Besides, most of the alternative fuel and green aircraft research is still ongoing.

## About the Author

Bridget Ssamula is a senior researcher at the Council for Scientific and Industrial Research (CSIR) in South Africa. The areas in aviation that she is involved in, span from technical to operational and institutional issues, specifically in the African region.

## References

Airbus, (2004), Getting to grips with fuel economy, Airbus: Flight Support & Line Assistance, Issue No. 3, July 2004.

Filippone A., (2008), Comprehensive analysis of transport aircraft flight performance, Progress in Aerospace Sciences, Vol. 44, pp.192-236

IATA (2007), IATA Economics Briefing: Airline Fuel and Labor Cost share, June 2007, www.iata.org/economics

Van Strateen T., (2008), Transportation sector struggling with energy costs, Business Edge, Vol. 8, No. 14- Calgary/ red deer edition, 07/11/2008. www.businessedge.ca/printarticle.cfm/newsID/18261.cfm

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