

TRANSFORMING AVIATION TO GREEN

By Amartya De

Asia Pacific Market Insights

Frost & Sullivan's commentary on the Asia Pacific Aerospace & Defense industry, addressing opportunities, best practices, and major events



“We accelerate growth”

Green Aviation is about efficiency gains as well as reducing the absolute emissions by aircrafts. Hence, part of the solution to the problem is to find alternative fuels which would not need any modification to existing aircraft designs or fueling infrastructure in the short run; emit less carbon than traditional crude oil based kerosene; and yet prove to be more economical than fossil fuels.

The present problem is that, firstly, fossil fuels create an enormous economic drain on the country because it is largely imported, barring few oil producing countries. Secondly, we are dumping huge amounts of carbon, which was trapped inside the earth's crust for millions of years, back into the atmosphere everyday. This is responsible for the rapidly increasing global temperatures and natural calamities.

“Green aviation could revolutionize and transform the travel & transportation business from being a part of the global warming problem to becoming a part of the global warming solution”

The impact of alternative fuels need to be judged not only at the stage of combustion but right from the stage of production as to what kind of refining system it uses and what are the energy inputs in the entire process till the point of consumption. In the long run, the best practices for the aviation industry could be adopted in other industries as well.

Commercial Aviation Fuel Dynamics

To understand the problem of pollution caused by the aviation industry, it is important to understand the fuel dynamics and how grave the situations could become in the future.

In 2008 alone, U.S. passenger and cargo airline operations required 16.1 billion gallons or approximately 382.4 million barrels of jet fuel. The global jet fuel consumption by commercial airlines for 2008 was 45.8 billion gallons. This large volume of jet fuel needs to be replaced by an alternative fuel sooner or later as this volume is only going to increase in the future. If one were to compare the fuel consumption of a commercial airline aircraft, we observe that a A380 consumes less than three liters per 100 seat km, averaged across all OECD countries, and that for the average car is 8 liters per 100 km. Commercial aviation consumes 3.0 million barrels of jet fuel every day, which is close to 3.4% of the entire global liquid fuel consumption and this is only going to increase in the future.

The financial impact and CO₂ emissions are only going to increase in the future due to ever increasing commercial aircraft fleet numbers which will almost double from its present strength of 16,800 to reach 32,000 by 2025. This consists of both passenger (14,900) and cargo (1,900) aircrafts. 21,400 new aircraft will be delivered to be included in the future fleet that will consist of 27,720 passenger aircraft and 4,280 freight aircraft. In order to curb CO₂ emissions of this large fleet, a cleaner fuel is indispensable.

Commercial Aviation Carbon Footprint

Presently the airline industry contributes only 2.0% of the overall man-made global CO₂ emissions compared to other forms of transport that contribute 16.0% of the global man-made CO₂ emissions. Airlines are putting in conscious effort &

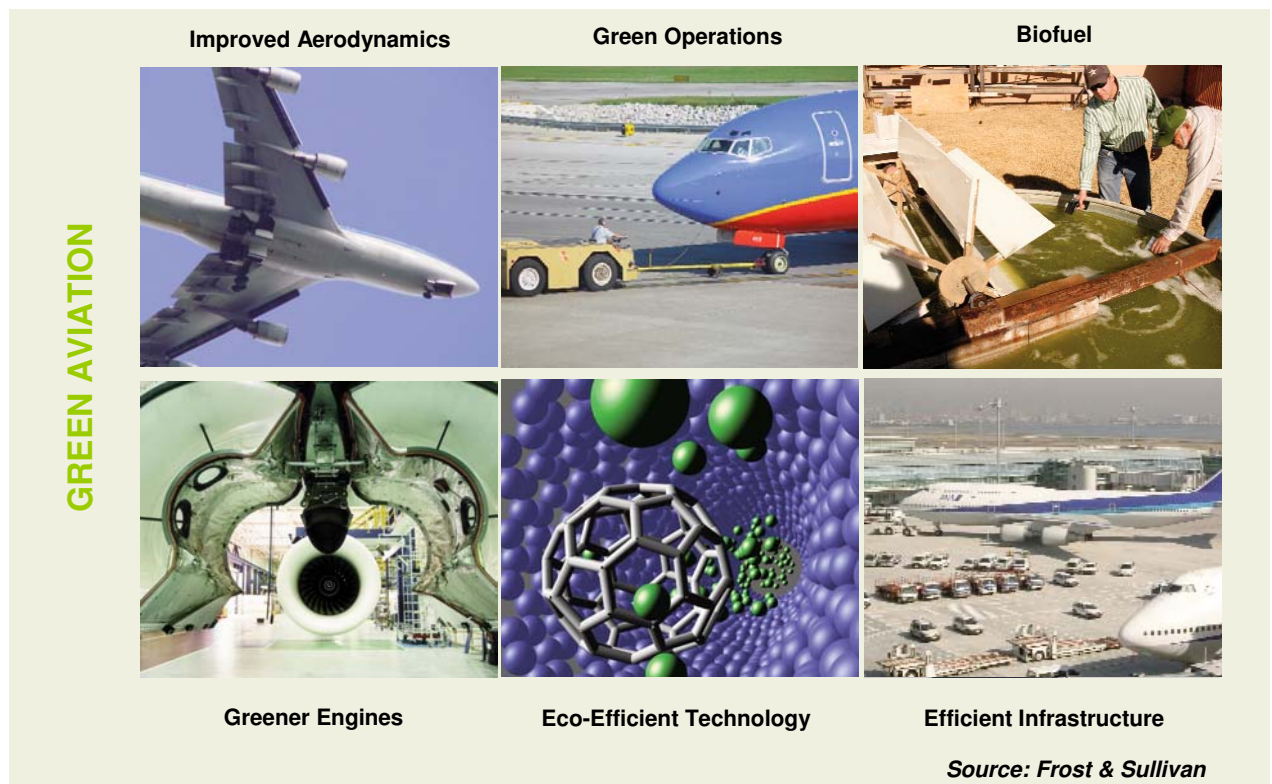
resources to curb this problem at a nascent stage whereas other industries, though appreciably mature, hardly pay it the due concern. However, this 2.0% contribution to CO2 emissions is likely to touch 3.0% by 2050.

A Boeing 737 burns about 3,000 liters of fuel and emits 6.5 tons of CO2 every flight hour. This is as good as the pollution caused by 1,540 small cars for a day. This is just a rough estimate as under actual conditions, fuel consumption depends on a number of factors including fuel usage during take-off and landing, winds and jet streams that affect an aircraft's fuel efficiency.

“A one way flight between Hong Kong and London would dump 1 Ton of CO2 per passenger into the atmosphere for the 9,600 km journey”

Green Aviation Components

Green Aviation is a continuous process and the milestones can be achieved only by collective efforts from various spheres such as better aerodynamics in aircraft design and manufacturing; alternative and greener fuel sources such as fuel cells and biofuels; efficient engines; route optimization and network development; efficient air traffic management; coercive legislative policies; and positive economic measures.



“Technological advances over the last forty years in the commercial aviation sector have reduced fuel consumption and CO2 emissions by 70%, noise by 75% and unburned hydrocarbons by 90%.”

Biofuels

Biofuels is an important step in achieving a greener aviation industry as the combustion of fossil fuels increases the amount of CO₂ in the atmosphere. Biofuels are the only fuel type which plants absorb CO₂ from the atmosphere when they are burnt to derive energy, helping to offset the emissions produced. Biofuels differ from fossil fuels in the way that they are not taken out from the earth, but rather, derived from plant matter. At this juncture of time, we are on the path of gradual transformation from fossil fuels to cleaner and greener fuel alternatives.

The solution does not solely lie in providing an alternative, clean biofuel and showing the world that the concept works; it is not purely academic. Rather, the solution lies in evaluating its marketability and economic feasibility over the long run. The distinctiveness of biofuel lies in the fact that it does not emit more carbon into the atmosphere than what it absorbs from the atmosphere during photosynthesis, making it possible to achieve a carbon neutral energy system. There are critics of presently available biofuels, like the one used in the Virgin Atlantic demonstration flight where estimates say that if all aircraft in the world were to fly on biofuels then Europe's entire arable land would be required for it. However, there are alternative green fuels which could be derived from algae or halophyte, which are known as second generation biofuels.

Another important aspect of biofuels is that it should not compete with food crops because if they do, it will lead to increased clearings of rain forests and that would in fact aggravate global warming. First generation biofuels such as ethanol and biodiesel are primarily derived from corn and soybeans. However, corn and soybeans are staple food crops and require large amounts of arable land, water and fertilizers making them unsustainable sources for biofuel. Second-generation biofuels, such as algae and to some extent jatropha, do not compete with food or fresh water resources or cause deforestation. Jatropha can be grown on marginal land in arid conditions.

In order to understand the sustainability of biofuel, we show the comparison of both first & second generation biofuels in the table below. Second generation fuels such as those derived from algae hold huge potential for the future replacement of fossil fuel.

CROP	Kgs of CO ₂ per MJ of energy	% of existing US crop land enough to fuel to meet half of US demand	Pros & Cons
Corn	81-85	157% - 262%	Technology ready and relatively cheap, reduces food supply
Sugarcane	4-12	46% - 57%	Technology ready, limited as to where will grow
Soybeans	49	180% - 240%	Technology ready, reduces food supply
Algae	-183	1% - 2%	Potential for huge production levels, technology in infancy
Rapeseed	37	30%	Technology ready but reduces food supply

Source: Frost & Sullivan

Green Trends

Significant accomplishments have been achieved in green aviation over the last three years and Frost & Sullivan has kept a close watch on these green trends.

Green Trends

Carbon offset programs with many airlines such as Virgin Atlantic started in 2007 wherein one can contribute to carbon offset initiatives with a few dollars on every trip

Airbus successfully demonstrates fuel cell operation in an A320 in Feb 2008



2007 - 2008

Airbus public demonstration of A320 fuel cell demonstrator at Berlin in May 2008

ACARE (2001) and Clean Sky (2008-2014) initiatives of continuously finding eco-efficient technologies

2008 - 2009



Virgin Atlantic that did a biofuel test flight in early 2008 with a Boeing 747

Air New Zealand flew another Boeing 747 with a 50-50 blend of jet fuel and jatropa biofuel in December 2008 with Rolls Royce engines

Continental Airlines being the first US commercial airliner to fly with a 50-50 combination of jatropa and algae based fuel in January 2009

2009 & Beyond

The 4th Aviation and Environment Summit declaration in April 2009 to see market viability of a significant supply of biofuel in the jet fuel mix before 2020

IATA's target for certification of sustainable biofuels by 2010

Aviation industry to be included in the European Emissions Trading Scheme and trading to start in 2012

Source: Frost & Sullivan

Stakeholders in Green Aviation

The stakeholders in green aviation range from aircraft assemblers, commercial airline companies, engine manufacturing companies, biofuel manufacturing companies, carbon credit traders to regulatory bodies.

Aircraft Manufacturing	Airlines	Engine Manufacturing
Boeing Airbus	Continental Airlines Air New Zealand Virgin Atlantic JetBlue British Airways Japan Airlines	Honeywell Rolls Royce Int. Aero Engines CFM International GE Engines Pratt & Whitney
Biofuel Manufacturing	Carbon Credit Agencies	ATM & Regulatory Bodies
Honeywell UOP Chevron Shell Imperium Renewables Sapphire Energy Terasol Energy	Carbon Credit Traders	IATA EU Commission EASA Civil Aviation Authorities ICAO Airport Authorities

Source: Frost & Sullivan

Green Aviation in Future

Frost & Sullivan examines that paying for carbon emissions post 2012 will not make great business sense; rather, it would be wiser to investigate lower carbon alternatives to existing technologies and fuel sources. Secondly, for biofuels to become prevalent in aviation, the existing supply chain needs to be incorporated rather than have a new one developed. Thirdly, biofuels will not replace traditional jet fuel even within the next five years. The use of biofuels will continue to be complementary to petroleum fuels for a reasonable time to come. The sustainability, efficient distribution, and cost effectiveness of these alternative fuels will be key determinants of their market acceptability.

Frost & Sullivan envisages that we will be using a biofuel and regular fuel mix by 2014.

Imposing overly stringent climate legislation on the aviation industry in a difficult financial climate will not move business, jobs or markets to other countries. Rather, earlier acceptability by major value chain owners will ensure their long term existence in the aviation market.

Just to put things into perspective – ***“A one way Hong Kong – London flight would contribute 1 ton of CO2 per passenger and if there is no definite way to offset this amount of carbon very soon, we are surely not far from the tipping point.”***

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