Reserch Paper on:

BIOFUEL: AN INNOVATIVE BOON FOR AVIATION INDUSTRY

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ABSTRACT

Over the past few years, a wide range of debates have been raised regarding the aviation industry starting from the effect of the emission on climate, including ozone layer depletion to whispering jets to infernal noise. Environmental documentation is the key component in these discussions. A larger number of people have been exposed to the aviation fuel pollution.

Basically, civil aviation industry plans three phases to curb this problem: improving fuel efficiency, carbon-neutral growth and reducing emissions to half by 2050. So the need for alternate fuel arises which has the properties similar to crude oil-based fuels to be used for aircraft and this will head for the problem of more carbon emission. So on moving to the point of an alternative source, sustainably produced biofuels can help reduce carbon emission. Biofuel use in aviation is technically possible. Second generation biofuel could be made available from diverse geographical locations, helping the developing nations utilize its unviable land for growing biofuel crops.

This paper seeks to evolve out the future of Biofuels in Aviation Industry worldwide.

INTRODUCTION

All over the world energy plays a vital role in the economic growth and development of any country. But Current energy supplies in the world are limited and not sustainable from environmental, economic, and societal point of view. So there is need of some sources which fulfill the need of energy without much hassle. For that very reason the governments throughout world have taken multiple steps to fulfill their need. They have initiated the use of alternative sources of energy for ensuring energy security, generating employment, and mitigating CO2 emissions keeping in mind the environmental issues. Biofuels have emerged as an ideal choice to meet these requirements. The origin of Biofuels is primarily as an alternative for using petroleum-derived fuels products. It is promoted at large scale because of its multitasking and efficiency. The current crisis of oil market/ fuel and energy compel world to think about an alternative which can fill the gap. Natural product namely the production of oil is depleting day by day. And biofuel is such an alternative which have capability to curb the problem of fuel crisis without harming the global environment at large extent. Biofuels are products that can be processed into liquid fuels for either transport or heating purposes.[1] The product bethanol is produced from agricultural products including starchy and cereal crops such as corn, beets, wheat, sugarcane, and sorghum. The product Biodiesel is made from oil- or tree-seeds such as rapeseed, sunflower, soya, palm, coconut or jatropha. Although efforts to produce Biofuels date back to the early days of the automobile (particularly the successful experience of the PROALCOOL Programme launched by Brazil in 1975), from last seven year Biofuels have only started to be seen as a serious alternative to oil worldwide.[2] The advantage of biofuel compared to conventional fuels are higher, it reduces carbon emissions together with the current high oil prices, are key elements behind their market development.

The perceived benefits of Biofuels are reflected in the increasing number of countries introducing or planning to introduce policies to increase the proportion of Biofuels within

1 Other types include biomethanol, biodimethylether and biogas

2 Annie Duffey, Biofuel Production, Trade And Sustainable Development: Emerging Issues, Sustainable Market Discussion Paper 2 (2006)

their energy portfolio. If this is to be achieved, significant increases in production are required rapidly to satisfy greater global demand. For instance, the EU's goal of 5.75 per cent biofuel content in the fuel transport blend by 2010 will require a fivefold increase in EU production. With the coming into force of the Kyoto Protocol and the implementation of the different domestic measures for Biofuels, global biofuel production is expected to quadruple in the next twenty years, accounting for about 10 per cent of world motor petroleum.[3]

The aviation sector is one of the fastest growing sectors within the transport sector.[4]The growth and demand of aviation sector lead to demand of aviation turbine fuel (ATF) which is increasing day by day. The aviation sector is also facing problem resulting in emission of fuel which is detrimental to the global environment. International Air Trans-port Association (IATA) on its part has launched a fuel action campaign. In 2000, IATA adopted a voluntary goal and committed to improve its fuel efficiency by 10 per cent between 2000 and 2010. Such intervention in the face of growing air travel will help reduce the fuel use per aircraft**.** Such intervention and imposition compel aviation industry to think of something which can be use as an alternative to ATF. So the biofuel is pretended after an extensive research which is both compatible with environment and price also.

Biofuels is an efficient option to compete with oil in the transportation system as compared to other available technologies such as hydrogen, because biofuel technologies are already well developed and functioning at large scale in many countries. Bioethanol and biodiesel can be mixed with the petroleum products (gasoline and diesel) they are substituting for and can be burned in traditional combustion engines with blends containing up to 10 per cent biofuels without the need for engine modifications. Flexi-fuel vehicle (FFV) technology is now sufficiently well developed to allow the gradual introduction of biofuels in any country. [5]FFV cars can run with any type of fuel blend from pure gasoline to up to

3 *Supra note 2, p.*3.

4 [IEA 2006]

5 Coelho, 2005

85% biofuel blend.[6] In addition, the distribution of liquid biofuels can easily be accommodated by the existing infrastructure for petroleum fuel distribution and retailing.[7] Furthermore, the current level of oil prices makes production from the most efficient producing countries competitive. The above factors indicate that biofuels are an important challenge to the oil industry, and explain the rapid increase in global production and use in recent years. Global biofuel production is estimated to be over 35 billion liters.[8]

Biofuels Technology and its impact on Aviation industry:

From past few years we experienced a lot of changes in market throughout the globe. The best example can be commercial viability of technology and telecommunication etc. Many advanced biofuel producers have shown the commercial viability of their technologies at demonstration scale. The crucial next step for these companies is building commercial production facilities. Seeing the current scarcity of natural oil and volatility in oil market there is a need of advancement in production of alternate energy for better future growth. There is need of innovation and advancement in biomass feedstock development, sustainable use of cellulosic ethanol while keeping in mind the production and economic growth; the regulatory need is to spread awareness and do marketing of biofuel in such a manner that people understand the benefit and compel to think beyond conventional method, and adopt a next generation into the fuel tank of conventional and flex-fuel vehicle.[9] The future of aviation bio-fuels should be able to link the components of the total chain (leading to the production of aviation bio-fuels). Refiners need feedstock availability,

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6 Brazilian FFVs are built to operate with any percentage of ethanol-gasoline blend and even with pure (hydrated) ethanol.

7 Doering, 2004

8 EC 2006

9 Eckhard Dinjus, *Syngas-based Fuels and Chemicals Gain Industrial Relevance,* Karlsruhe Institute of Technology (2012)

the reality of where the industry is today and the needs of tomorrow. Ideally it could cover airline needs; the main focus in aviation industry is emission of harmful gases which have potential to affect our environment and the cost effectiveness to an extent. And both could be cover through bio based fuels and refine method of biomass feedstock development. The use of biofuels has been gaining popularity over the past few years because of their ability to reduce the dependence on fossil fuels. As a renewable energy source, biofuels can be a viable option for sustaining long-term energy needs if they are managed efficiently. The use of ethanol, cellulosic ethanol, biodiesel (palm oil, algae, and halophytes), and synthetic fuel blends can be potentially used as fuels for aviation industry. Synthetic fuel is any liquid kind of fuel mainly obtained from coal, natural gas, or biomass. It can also draw from other solid waste such as oil shale, tar sane, or waste from plastics. Depending on the initial feedstock, the process of producing synthetic fuel can be referred to as coal form to liquid form, gas to liquids, or biomass to liquids. An intermediate step in the production of synthetic fuel is often synthetic gas, which is a stoichiometric mixture of carbon monoxide and hydrogen and is directly used as an industrial fuel. Coming of biofuel for industrial purpose give a new strength to industries and can play a major role in sustainable mobility. It has potential to reduce the demand of oil and replaces itself to a large extent. Sustainable biofuels could benefit the agricultural sector broadly, leading to more productive and environmentally sound land use. If we talk about aviation industry there is a need of alternate energy resource which should have capability to reduce the emission of carbon with cost effectiveness.

Carbon emission:

Air transport's contribution to climate change represents 2% of man-made CO2 emissions and this could reach 3% by 2050.[10]This evolution is based on a growth in aviation CO2 emissions of 2-3% per year, with an annual traffic growth of 5%. The air transport industry is now working towards carbon-neutral growth (no increase in carbon emissions in spite of traffic growth) as a first step towards a carbon-free future. Aviation under business-as-usual is likely to generate a sharp increase in greenhouse gas emissions and radiative forcing

10 According to updated figures from the Intergovernmental Panel on Climate Change (IPCC)

through 2050 because of the particularity of its emissions. The combined effect is that aviation's impact on global warming is likely to grow more swiftly than other sectors. Because of that growth, there is a strong likelihood that governments will face pressure to take action to curb radiative forcing resulting from aircraft emissions.[11] Developing sustainable alternate fuel for aviation will enable the industry to reduce its carbon footprint by reducing its greenhouse gas emissions. The use of biofuel will have a check on aviation industry because of its capability to emit less amount of carbon compare to fossil fuel. A new generation of sustainable biofuels could provide over a quarter of the world's total transport fuel, according to a recent report by the International Energy Agency. And biomass-based fuels offer the only viable low-carbon alternative to high energy density liquid fuels, including diesel and jet fuel.[12] Biofuels are the main alternative for reducing carbon emissions from cars, trucks, tractors, planes and ships, which for now require liquid fuel. In May, the International Energy Agency published a roadmap projecting that biofuels can meet 27 per cent of global transport's fuel demands by 2050, up from 2 per cent today.

Fuel prices:

The higher prices of jet fuel are one of the main concerns of aviation industry and an increased cost of jet fuel increases costs for airlines industry. The recent price increases for Jet A have resulted, fuel as the primary expense for airlines. With the coming of alternate kind of fuel, supply of low cost aviation fuel is possible in future.[13] The manufacturing of biofuel is entirely depend on the food prices and trees like jatropha so the production of these resources will have impact on the price of jet fuel used for aviation industry and it can be hold that the price will can be control by using biofuel. The key to improving the economics of using biofuels for air transport will significantly reduce unit production costs of jet fuel. This does look possible but it is not simple, not least because many of the biofuel technologies are in a very early stage of development and the industry is not yet

11 For a further discussion of the aviation sector, see OECD (2010).

12 IEA 2008

13 http://www.abraba.com.br/documents/downloads/PoweringthefutureofFlight.pdf

matured. Feedstock costs are a large proportion of costs in many of the newer biofuel technologies reliant on biological or chemical processes to convert biomass into fuel. Rising food prices today are indicative of the competition for arable land. Surface transport and power generation are also a source of increasing demand for energy crops.[14] Put these competing demands together with a limited stock of land and the result is likely to be rising feedstock costs for aviation biofuels.[15] So reducing the unit production costs of aviation biofuels is likely to be dependent on big improvements in the productivity of feedstock, the extraction of oil or sugars from those crops, and the conversion into fuel. This means improved technology and innovation. Much has already been achieved. Venture capital and government funding is being sunk into a number of ventures. However, there are numerous different biofuel technologies being developed but few have yet been tested at commercial scale, and scale is one of the keys to getting unit costs down.[16]

14 Köhler, J. (2010), Air Transport: marginal abatement costs and cost reduction through learning, Fraunhofe ISI.

15 IATA Director General and CEO Tony Tyler announced expected future fuels costs:www.iata.org/pressroom/Documents/iata-letter-south-china-morning-sept2011.pdf

16 *Supra note 5*.p.7

Contribution of Aviation Industry: Global Economy and Future Emissions

Aviation plays a major and an essential role in global economic development[17] by linking people for business and tourism, sustaining the trade of goods, defence and a large assortment of political and humanitarian concerns.[18] Throughout world trade, commerce and employment are significantly dependent on the aviation sector. In 2007, according to the World Economic Forum (WEF), the aviation industry contributed USD 426 billion to global GDP directly, an additional USD 490 billion indirectly, and another USD 620 billion through facilitating global tourism In sum, the total contribution is equal to 3.2% of global GDP. For 2007, the aviation industry accounted for 33 million jobs.[19] These figures will increase significantly in the future if the demand for aviation rises by an expected 4.5% annually to 2050. By 2026, studies suggest that the contribution to global GDP from aviation could rise to USD 973 billion directly, another USD 1.1 trillion indirectly, and USD 1.5 trillion through direct support of global tourism. There is strong and growing global demand for expanding air travel and air freight shipments. Although emissions from aviation currently account for approximately 3% of the total global carbon emissions, they are expected to increase significantly in the near future. The demand for aviation will be especially strong in China, India, and the Middle East. Growth in aviation is largely determined by growth in GDP. The WEF has observed that: "increased GDP is enlarging the middle class of these countries that have the disposable income to spend in travel- and tourism–related activities.[20]Current estimates suggest that there will be 3 billion more middle class consumers by 2050, taking today's total of approximately 1.8 billion to 4.8

17 Approximately 2 billion people and more than 43 million tons of freight (35% of exported goods by value) are transported by aviation, see: WEF *Policies and Collaborative Partnership for Sustainable Development:* http://www3.weforum.org/docs/WEF_ATT_SustainableAviation_Report_2011.pdf.

18 For a further discussion of the aviation sector, see OECD (2010).

19 According to the WEF, —aviation's contribution to employment equalled 5.6 million jobs directly and 33 million jobs in total, including direct, indirect, induced and catalytic jobs.

billion.[21] The growth in global population from 7 billion today to 9-10 billion in 2050 will be accompanied by an increase in global GDP from USD 55 trillion today to USD 300 trillion by 2050. This nearly six-fold increase in global economic output over the next 40 years is twice as large as the increase that occurred between 1970 and 2010.

Debate on greenhouse gas reductions from biofuels:

As in aviation industry the biofuels are not likely to be cost effective if the production is based on kerosene, but the expected climate benefits are the key issue for the interest of market in aviation biofuels. The potential greenhouse gas benefits and emission of carbon are the focus of on-going discussion and almost certainly depend heavily on the types of biomass used.

To have a better understanding of the greenhouse gas discussion we must start with the question of how biofuel able to reduce emission. Generally, greenhouse gas comparisons with biofuels and fossil fuels use lifecycle assessments (LCAs) which calculate the level of emission from both way firstly process for production of biofuel (such as the emissions from mining and refining crude oil and the emissions from growing and refining crops into biofuels) secondly emissions from burning the fuel. There is large concurrence that production emissions especially crop-based biofuels exceed those for fossil fuels, and the combustion of both emits carbon dioxide from the vehicle or jet. Then how can biofuels reduce greenhouse gas emissions? The response is an accounting convention that LCAs should not count emissions from the combustion of biofuel while they should count emissions from fossil fuel combustion. This is based on the premise that while fossil fuels introduce new carbon into the atmosphere, biofuels are only recycling into the atmosphere carbon that was absorbed from it in growing the biofuel crop. In this way, the combustion of biofuel has come to be regarded as —carbon neutral.[22]

20 (WEF, 2011).

21 (McKinsey, 2011).

22 http://www.oecd.org/dataoecd/13/38/49482790.pdf

GHG emissions from biofuels, such as ethanol and biodiesel, may be lower down the estimated rate, according to a new study. But the findings could further start the debate, whether biofuels actually reduce greenhouse-gas emissions compared to gasoline, and if so, by how much? Until or unless the emissions take place during the production of biofuel exceed the combined emissions from both producing and burning a fossil fuel, the biofuel is deemed to reduce greenhouse gas emissions. The above debate is still going on and still there is no any conclusive prove which is certain.

Algae, which can directly produce oil, provide one potential opportunity for producing aviation biofuels in ways that do not occupy otherwise productive, area covered with plant and tree, do not displace carbon appropriation or food or fibre for human use, and therefore have the potential to be low-carbon. Algae face a number of key challenges. First, standard existing tools for removing oil from algae require large quantities of energy to dry them. That energy is both expensive and likely to lead to large carbon emissions.[23]However, experimental technologies that extract the oils while the material is still wet have the potential to address these concerns substantially.[24]

Second, at this time many experts argue both that the only potentially economical and energy-generating form of algal production requires production in open ponds.[25] Several analyses have found that the construction and use of constructed —bioreactors requires so much energy that algae become net energy consumers.[26] However, open ponds, particularly in dry, hot areas that would maximize production and avoid displacing good land, results in enormous levels of evaporation, over 1000 liters of water for each litre of biofuel.[27] Given

23 (Shirvani, 2011; Sheehan, 2011).

24 (Sheehan, 2011).

25 (Sheehan, 2011; Huesemann *et al.*, 2010)

26 (Huesemann *et al*., 2010).

27 *Supra note.*24 p.12

the demand for water that is implied it might be necessary to use saltwater and focus production in dry hot areas in proximity to coastlines.

Third, algae are presently extremely expensive – as of 2006, costs were estimated at over USD 1000 per barrel (Sheehan, 2011). Reducing costs to any reasonable levels require a series of technological breakthroughs, including extremely high rates of reproduction and simple oil extraction.

Finally, it should be noted that increased biofuel production could also lead to large increases in use of nitrogen and phosphorus — even algae need large quantities of nitrogen. Nitrogen is a major source of greenhouse gas emissions and water pollution, and there are concerns that phosphorus supplies are limited and so should be husbanded for food production.

Conclusion:

Proponents of biofuels, which are often made from plants such as corn or sugar cane, often point to their many advantages over fossil fuels like gasoline. Biofuels are less toxic or non-toxic in comparison to fossil fuels. They are a renewable resource, whereas once fossil fuels are gone, they're gone. And biofuels can be grown just about anywhere you can grow crops, reducing the need for giant pipelines or oil tankers, and potentially helping to reduce conflicts in areas like the Middle East.

So far so good. But things start to get complicated when you look more closely. Much has already been debated about the energy requirements to produce some biofuels, especially corn-based ethanol. Ethanol made from corn only contains marginally more energy than what is needed to produce it. Many people argue that making corn-based ethanol is more of an agricultural subsidy for farmers than it is a sound environmental policy.Things gets even dodgier for biofuels when you look at the land area that would be needed to grow fuel crops. We use a lot of fossil fuels. Switching to biofuels would not reduce the demand for fuel, just change the way we get it. And that would require a lot of land. In fact, substituting just 10 per cent of fossil fuels to biofuels for all our vehicles would require about 40 per cent of the entire cropland in Europe and North America. That is simply not sustainable. Of course, reducing the amount of fuel we use, no matter what the type, is very important. But the authors of [a] recent article in *Science* say that if our primary motive in switching to biofuels is to reduce global warming, then we have to look at all our options for the land that would be needed to grow fuel crops.

In other words, biofuels alone are not the quick-fix answer to global warming. In fact, strong legislated policies to improve the efficiency of our cars, homes and industries are a much more effective strategy. In the longer term, biofuels may certainly play an important role. Some technologies, like cellulosic ethanol, which is made from woody debris, are very promising and they need to be supported by government and industry now, so they can be available on a larger scale in the coming years. Biofuels have many advantages, but we have to look at all our options and make sure we make the best choices to ensure a more sustainable future."