ECONOMIC ANALYSIS OF THE USE OF BIOFUELS IN AVIATION

Marián Hocko - Martina Žofčáková

This article addresses the problem of implementation and sustainability of biofuels. It addresses the issues of cost of production, transport biofuels and their impact on aircraft engines and aircraft fuel systems. The main problem to be solved is the economic analysis of the use of biofuels, ie assessment of biofuels economically and quantify the total cost of biofuels.

K e y w o r d s: biofuels, biofuel, biofuels, transportation, aero-engines

1 INTRODUCTION

Air transport of the emissions caused by high production of nitrogen oxides and carbon monoxide consumption of kerosene, but it is still only a small part of total transport emissions. Currently, air transport accounts for 4 - 9% of the trigger climate change caused by humans. Greenhouse gas emissions worldwide airlines in Europe have doubled since 1990. Even though technical improvements aircraft engines can reduce fuel consumption and thereby reduce emissions, there is a problem of increasing the demand for air travel, which means that emissions from aircraft engines will increase rather than decrease. Emissions from the combustion of petrol and diesel have a negative impact on the environment, also to human health and global climate change. [1]

Options for reducing greenhouse gas emissions, alternative fuels. Alternative fuels understand natural gas, liquefied petroleum gas, hydrogen, electricity and various fuel blends containing less than 85% ethanol or methanol, a fuel mixture containing less than 20% vegetable oil. Reducing greenhouse gas emissions from the use of fuels from renewable and sustainable sources results in a reduction of emissions from the extraction, production and combustion of the fuel. Biofuel is an alternative fuel that originated targeted production or preparation of biomass and biowaste and is one way of using biomass. [2]

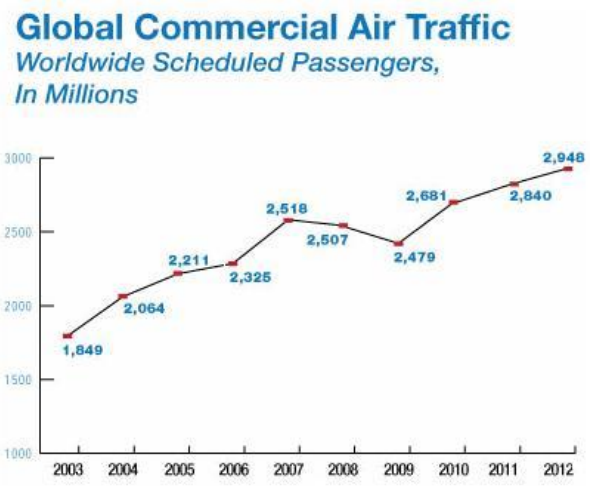

Figure 1 Global commercial air traffic

There are some ways to reduce aviation emissions through the biofuel mentioned. The main problem is the solution of biofuels economically advantageous, because if these fuels are not economically viable will not be able to keep even the fuel market. Economic benefit of biofuels understand effective production of these fuels below the cost of production and transportation of these fuels and reasonable prices for the fuel market. The main advantage of biofuels is that this fuel is renewable. Biofuels can replace dependence on imported oil and natural gas and the second fact is that they help mitigate the effect of global warming. Each plant during its growth because it absorbs CO_2. If the gas gets the burning of biofuels back into the atmosphere, thus not increase the total amount of greenhouse gas in the atmosphere. The atmosphere is thus returns only what was in it originally.

Support organizations in the development and production of biofuels is very important. The most important organization engaged in the development of alternative fuels as the International Civil Aviation Organization (ICAO). The International Civil Aviation Organization is developing a set of standards, policies and guidelines for application for inclusion of provisions relating to aircraft noise and engine emissions. Increasing knowledge documents brings new challenges while working to minimize the impact of aviation on the environment. ICAO regularly organizes meetings and trying to find advice on new emerging issues such as the impact of alternative fuels on future industry and its growing potential, which will reduce pollutant emissions footprint. ICAO works with many governmental and non-governmental organizations such as the UN, IATA (International Air Transport Association), ECAC (European Civil Aviation Conference) and other organizations. [3]

The introduction of biofuels should be made of economic analysis to justify economic sustainability in the global aviation industry.

2 ANALYSES OF THE COSTS ASSOCIATED WITH BIOFUEL PRODUCTION

Analysis of costs associated with the production of biofuels includes the costs for the production of raw materials, their processing and final production of biofuels. Analysis is focused on biofuel, which is based on unsaturated fatty acid methyl esters of vegetable origin. This alternative fuel is produced by refining processes in which methanol is mixed with sodium

hydroxide and then the oil pressed from the seeds of rapeseed, sunflower and soybean.

The costs of biofuels are calculated using the cost of production, but financial incentives and subsidies are omitted from the calculations. Calculated production costs of biofuels are equal to the raw materials in time, plus the calculated conversion costs and less value in the time. The most important variable that must be taken into account when we calculate the production costs are supplied raw materials needed for the production of biofuels. Production costs are very sensitive to the cost of raw materials for biofuels, which have been designated commodity prices of raw materials. The production of biofuels should be about 231 million hectares, which constitutes 16% of all arable land in the world. Furthermore, it is estimated more than 386 million hectares of land around the edge of the world. Crop residues have a certain value and such that a significant portion of the majority returned to the soil, making the soil more fertile and more organic. Some agricultural crop residues are used as fodder and a few developing countries are the remains of burned as fuel. Jatropha and other oil plants can flourish on marginal soils with low rainfall. However, economic issues remain, the required inputs and potential yields when growing these perennial shrubs for biofuel. [4]

A large number of soybean production and its use for different products in the United States may result in the soybean oil can become predominant raw material for biofuel spite of low oil content soybean which means that the crop is not the most effective in terms of biofuel per hectare. Many factors contribute to the use of soybean oil as the dominant raw material in the production of biofuels in the United States, including wide availability, high levels of domestic production, previous subsidies and grants. The five-year average raw material costs are $ 753 per tonne, corresponding to the previous price trends soybean oil.

Sugar and ethanol are produced on the basis of a comprehensive and production distribution is constantly adjusted to maximize profit at the world's oil and sugar prices. In 2007-2008, the production ratio of 45,5% to 54.5% sugar, ethanol, and projections for 2008-2009 should be in a ratio of 43,5% to 56,5% sugar ethanol. Due to strong demand for ethanol in the Brazilian domestic market, the share of ethanol. [5]

The average price of raw palm oil calculated and used to produce biofuels for the last 5 years is $ 597. Even though crude palm oil prices have dramatically decreased in 2008, the selling price of the product seems to be even significantly higher. The estimated cost of palm oil for the production of oil suggest that a healthy profit margin realized by the producers of palm oil. Decline in palm oil prices will have a major impact on the future viability of the production of palm oil in Malaysia.

Cellulosic biomass is used for ethanol production by a wide variety of plant species and types. Agricultural residues such as straw, corn fodder, wheat straw and forest residues for manufacture of logging, providing the largest volume of raw cellulosic biomass. If the market price exceeds the biomass production costs and market principles suggest that a significant amount of these resources will be available to producers of cellulosic biofuels. For the purposes of this analysis, the cost of production is generally calculated price ligno-cellulosic biomass and average of the three basic types of biomass: wood biomass, agricultural residues and energy crops. Each type is listed in the equally weighted average price and total price of raw materials ligno-cellulosic biomass is about $ 72 per ton and dry. The term includes all forest biomass feedstock derived from harvested trees. Includes hull, main trunk, as well as twigs and branches that remain mostly from logging. Other reports have concluded that the delivery price should be $ 30 per ton, and in the future should reduce the cost of collection methods, the supply lines, the equipment and therefore to increase the attractiveness of forest residues. Corn straw feed is among the most fertile crop residues in the United States, and because of that it has become very attractive material. Tested as input for the production of heat input to the use of electricity as well as a raw material for cellulosic ethanol. Straw, corn fodder potentially be used as a raw material for a range of bio-products. [5]

Biofuel production also requires special technological equipment that will still generate harmful emissions. Biofuels can be produced from various plant sources, such as from the plant camelina, jatropha, soya, maize, wheat, sugarcane and many others. Some plants can be grown only in specific locations, such as in the tropics or sub marginal areas. Production of these fuels will require significant costs, but it is necessary to compare the production of ordinary kerosene aviation fuel. Although the production of biofuels will exceed production of conventional fuels and biofuels can still bring some savings may be cheaper on fuel markets, we will post them greater demand than the conventional petroleum fuels, it will mean the Aerospace something new that will want to try each airline.

Table 1 Costs of biofuel production

	$/liter
Corn	0,46
Soybeans	0,87
Sugar cane	0,18
Palm oil	0,73
Celulose biomas	0,6

3 ANALYSES OF THE COSTS ASSOCIATED WITH BIOFUEL TRANSPORT

Currently, the production of biofuels normally concentrated in regions dominated by grain cultivation and palm trees. This means that the markets are growing and production expands by absorbing capacity of local and regional markets, where biofuels must be transported

over long distances. Almost all ethanol and biodiesel fuels are currently transported by truck, rail or ship. Dedicated pipelines for biofuels can deliver significant savings because they allow transport of large volumes of ethanol at a much lower cost. Moreover, it is also preferable mode of transport in terms of greenhouse gas emissions. Trucks, ships and railways can be used extensive network of existing road transport infrastructure, which allows great flexibility in transporting ethanol among a large number of manufacturing and distribution sites. Biofuels and biofuel blends are mostly carried by tankers and rail wagons. If the tank truck or rail car previously used to transport diesel fuel, so it need not be washed prior to transport biofuels. However, if transported another type of fuel it is necessary prior to transport biofuels wash tank. [6]

There are some basic means of transport, which could be used for the transport of biofuels, ethanol and mixtures thereof into the target stores. Biofuels are now mainly transported by rail, by truck or by sea, but these modes of transport have greater adverse effects on the environment and higher cost than pipelines. Some data and proposals argue that rail can be more cost-effective and can produce less carbon dioxide emissions than pipeline transport. Blended biofuels are typically distributed by trucks from mixing and storage terminals, as well as petrol and diesel. Original body fuel pipe petroleum products are not always connected to the places where the biofuels are produced. One way to solve this problem, the construction of new pipelines dedicated biofuels, which would facilitate greater distribution of biofuels in retail stores. This could particularly benefit consumers and the environment.

Pipes can be an effective way to transport and distribution of biofuels, but there is a certain volume threshold necessary for economic viability. If the line can carry only certain biofuels, then the development of such a pipe is less attractive. Construction of pipelines for biofuels is mentioned only possible, except when specific safeguards can ensure the long-term market. Dedicated lines are smaller in diameter, since the total amount of fuel is smaller in comparison with the pipe to carry a lot of products. Pipeline is also facing difficulties because of the terrain and environment, which could force them to use more gas stations, in the case where the terrain is mountainous or bridges are in large valleys and rivers. Economy pipeline transport must therefore be assessed case by case, taking into account the intended volume, market, topography and roads. [6]

Trucking can be cost competitive at shorter distances, particularly where they are not available rail. However, long-distance trucks are less attractive because of higher costs of fuel and labor costs.

Most regions have been formed railway infrastructure, but many lack the tank wagons or rail transport capacity units. Trainset 100 wagons could carry 3 million gallons of biofuel. On an annual basis, each tanker wagon could pass about 750 000 gallons of biofuel. The Environmental Protection Agency states cost 90 000 dollars for tanker wagon, while the company wagons indicates costs 114 000 USD. During a typical lifetime railway wagon 30 to 50 years, could be transported 22 - 37000000 gallons of biofuel. Price for biofuel transported by railway wagon was around 0,3 to 0,5 cents per gallon. [6]

The main costs of maritime transport biofuels would be the cost to ship or boat designed to carry and cost of transport terminals. It is only a small difference in cost between the tanks and tanks of marine terminals, the current railways. However, marine terminals would need to restore the equipment, piping, pumps and valves at an estimated cost of 3,5 million USD for the device. Reservoir tank 200 000 barrels will bring the total cost of 12 million USD for the device. If marine terminal needed for distribution and rail infrastructure, so the total cost would increase by a further 0,5 million USD.

Truck and maritime transport appears to be the lowest cost transport for distances less than 500 km. However, freight transportation by boat is often combined, so using a shorter haulage. Consequently, the actual cost of ocean freight often aggregate cost of shipping and truck transport. At a distance of 500 km, the cost of rail, sea and truck transportation comparable. At this distance truck transport costs are escalating rapidly, while the cost of rail transport are at the lowest level compared with the three modes of transport. The cost of shipping to be competitive with the cost to transport by rail over a distance of 2 000 kilometers and it if is not necessary combined transport. However, at distances greater than 1,500 km of pipeline transport is able to compete with rail and shipping cost 4,2 to 5 cents per liter. [6]

Retail storage of biofuels can take several forms. Some biofuels blended with fuel tanks may require replacement due to incompatibility or retirement of some older tanks. Some pumps can have problems with compatibility of materials, depending on the age of the pump and plasma mixture biofuels, given the specific characteristics of biofuels. The so-called hydrocarbon fuels might be able to use existing infrastructure with little or no change.

Storage of biofuels at the airport is possible only in the short term, because during prolonged storage of the decomposed plant biofuels. It follows that the latter are not durable and therefore need more frequent delivery of such fuels to the airport.

Transportation biofuels can be done in different modes of transport such as pipelines, maritime, rail and car. According to the examination of reports that evaluated the possible modes of transport biofuels is probably the cheapest rail transport. The only serious problem that arises in the transport of biofuels is that biofuels can not be stored long-term in the fuel tanks, they could begin to break down plant of biofuels. It follows that the airports that air tank into the engine biofuels have often ordered these fuels and therefore to fuel them for a long time did not stand in the fuel tanks and to prevent their possible disassembly.

Table 2. Comparison of different modes of transport biofuels

	Transport costs of 1 liter		
Distance, km	Cargo car	Cargo ship	Rail-way wagon
200	1,6	1,3	-
500	3,2	2	3
1 000	5,9	3,2	3,6
1 500	-	4,5	4,1
2 000	-	5,7	4,7
2 500	-	7	5,2
3 000	-	8,2	5,8

4 ANALYSES OF THE COSTS ASSOCIATED WITH REGULATING AIR ENGINE AND FUEL SYSTEM ENGINE AIRCRAFT

The world's manufacturers of aircraft engines are constantly trying to design and manufacture the most perfect, safest and most efficient air turbosupercharged engines. Manufacturers are trying to use to drive these motors unconventional fuels that reduce greenhouse gas emissions. Trend of biofuels depends on the gradual erosion of traditional stocks of petroleum fuels and the increase in the price of aviation fuels.

Direct transition from conventional aviation fuels to biofuels is possible through existing aircraft engines. But, there arise some problems with the rubber gasket engine temperature and fuel during the flight.

Project examining the behavior of the MERA fuel was measured on long-term monitoring of the impact of fuel mixture on rubber seals and fuel behavior at low temperatures. Fuel and showed poor filterability at low temperatures, very low calorific value, which affects engine performance. This type of biofuel causes great damage to the friction of engine parts, which did not allow its use in most conventional diesel engines. At the time of the first attempts to launch biofuels market was great distrust of this fuel. Precipitation of biofuels in contact with water and mixing with conventional diesel fuel across depreciated. After a failed project of ecological alternative fuels I. Generation II project was created. generation biofuels. Biofuel, MERO 'II. generation is still currently the only alternative fuel that is used in diesel engines. Some properties overcomes the traditional diesel fuel especially when dealing wear fuel system and engine. This alternative fuel is produced by refining processes in which methanol is mixed with sodium hydroxide and then the oil pressed from the seeds of rapeseed, sunflower and soybean. This fuel is then further modified ingredients oil nature, which must be sweetened and dearomatized and therefore, to maintain the biodegradability. Biofuel retains the essential characteristics of the oil, but besides that looks very organic to the environment, the engine and fuel system. The current biofuels II. generation are considered great progress in the field of alternative aviation fuels and are also well on the road much better than I. biofuels generation. [7]

This is a biofuel that much greasier than conventional diesel and reduces frictional wear of engine parts, thus extending the life of the fuel injection nozzles. Biofuels may be stored in the same tanks as the oil and the combustion process burns better and thus redu engine smoke emission, carbon dioxide, sulfur and hydrocarbons. Biofuel can release carbon and completely clean the engine and the entire fuel system and thereby prevent clogging fuel filters. Before the first use of biofuels need to clean the fuel system from water and sediment and to inspect the fuel system. If such cleaning has not been done before using biofuels could come loose dirt, damage to the fuel system and could clog cleaners. When storing biofuels is necessary to ensure the cleanliness of storage tanks and avoid contact with water biofuel. The disadvantage of biofuels is a short-term storage, because during prolonged storage may decompose plant of biofuels. Biofuel is aggressive to rubber, easily oxidizable to the gradual formation of sediments, acidic products and is easily attacked by bacteria. [7]

Impact of classical mixture of kerosene and RME fuel on the rubber seal was tested for typical sealing rings of circular and square cross-section. Long-term follow-up samples arrive at the following result:

- with increasing concentrations of RME fuel were intensive napučávaniu which proved to increasing the volume of rubber seals,
- with increasing concentrations of FAME fuel there was a reduction in the strength of rubber seals,
- with increasing concentrations of FAME fuel there was a dissolution of the surface structures of rubber seals.

Activity aircraft engines leads to two specific limitations and minimum inlet temperature and fuel management system limitations. Fuel characteristics that best describes the lower limit temperature using aircraft engines is not zero fuel, but limit prečerpávateľnosti. This limit is very close to the freezing point of the fuel, but it is difficult to determine precisely the point. Since the fuel is a mixture of different hydrocarbons, all fuels do not solidify at the same temperature. If the fuel is cooled and growing proportion of crystals in the fuel, which can block the flow of fuel causing engine instability, loss of power and eventually his outburst. Freezing point fuel is commonly measured using automated optical test methods. This test method is based on the observation of crystals gradually disappear entirely heated fuel samples that previously frozen. The method emphasizes such a temperature at which the particles appear first during the

cooling process. Specification freezing point of the fuel is influenced by the level of the fuel distillation and the higher the degree of distillation, and the lower the yield of the fuel oil. Experimental evidence indicates that the fuel mixture does not behave like an ideal fluid, and the resulting freezing point of the fuel is mostly affected. [8]

In aircraft engines have their oil entering the cooling system, which is used as a heat sink for the incoming fuel. The minimum initial temperature difference is expressed by the fuel freezing point and the minimum flow temperature engine. During the flight, the fuel temperature decreases rapidly as airplanes fly at high altitudes, where temperatures are very low. Fuel temperature drops below the freezing point of water which is always included in aviation fuels, and this water can be converted into ice crystals, which could clog the filter engine. To avoid this, so fuel is heated in an oil cooling system. The use of biofuels in existing aircraft engines has a major impact on reducing fuel temperature. This means that when flying at high altitudes, where the temperature is about -50 ° C biofuel has a tendency to reduce the freezing point of the fuel and biofuel that can start as it freezes at -40 ° C, which could adversely affect the safe flight. Ordinary kerosene fuel in aircraft engines freezes at much lower temperatures than biofuel. For airplanes that have a fuel system for measuring the temperature at the fuel temperature has dropped below the minimum acceptable temperature in the tank ECAM warning triggers. The minimum acceptable temperature is not the same for all cylinders. [8]

Realized experiments showed that with decreasing temperature is rapidly changing the density of the fuel mixture. This process is more intense, the larger the share of RME fuel mixed with kerosene. The resulting mixture of fuel with conventional jet kerosene is without any special additives that would alter the freezing point of the fuel, and thus can not be used for air turbosupercharged engines in aircraft. The use of such mixtures is only suitable for stationary engines as power units for powered air turbo engines, which operate in frost-free conditions.

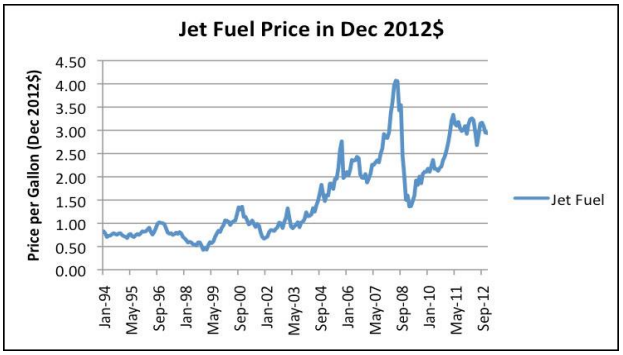

Figure 2 Jet fuel price

Biofuels impact on aircraft engines and aircraft fuel system. These effects are manifested only during prolonged use, so if you are currently being conducted various test flights that showed no problems, that does not mean that problems will not occur in the next few months. Biofuels have a negative effect on rubber seals engines that completely destroys the gum that is deformed. This may be due to the fact that the rubber seal will not fulfill its purpose and fuel to get to other parts of the aircraft which has nothing to do. Another negative manifestation of biofuels is its solidification at lower temperatures than traditional jet fuel, which may also have disastrous consequences during flight.

5 CONCLUSIONS

The introduction of biofuels can be made on the basis of economic analysis. Biofuels, however, are economically less advantageous than traditional jet fuel. Conventional fuels are more efficient despite the high prices. Economic impact of biofuels as we understand the volatility of the market for such fuels. In the production of biofuels will certainly move the prices of raw materials such as soy, wheat, maize, oilseed rape and many others that are essential ingredients for all mankind. To carry out the production of biofuels will require large financial injections, because of the need to build a new manufacturing facility that will produce such fuels. Very important economic factor is the demand for biofuels, and will be more convenient for airlines that will yield and whether they will be friendly. Biofuels are pros and cons and their implementation and use in aviation is very interesting, because it is the place that they should continue to pay many organizations that help them establish and maintain.

High oil prices caused by the fact that demand for biofuels could be high, that biofuels can be relatively competitive. Low oil prices could cause a drop in demand for biofuels, because the demand for biofuels is very sensitive to overall market conditions. The recent economic crisis has led to a decline in oil prices and thus reduce the demand for first generation biofuels, affecting various production facilities.

Overall assessment conducted economic analysis says that biofuels deliver to the aviation industry something new and greener, but in the long term biofuels are not a good alternative for reducing greenhouse gas emissions. This claim is justified by the increase in prices of raw materials for all of humanity, what has in recent years turned out well enough. Another important justification is not growing these raw materials for the production of staple foods for humans but the cultivation of raw materials for biofuels. Each grower a farmer sells his crop rather perhaps three times higher producer of biofuels, as if it had a leading manufacturer of staple foods for a much lower price. It seems clear that despite the fact that biofuels can reduce emissions from aviation and for mankind are not good options because it will cause a continuous increase in the prices of raw materials, which will have an adverse impact on any functioning household.

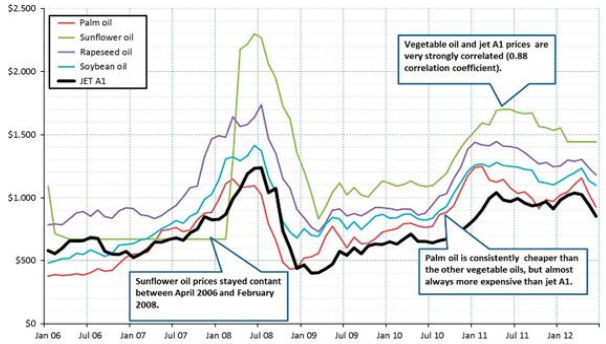

Figure 3 Price of biofuel

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AUTHOR(S)´ ADDRESS(ES)

Marián Hocko, Ing., PhD. Department of Avation Engineering, Faculty of Aeronautics Technical university of Košice, Rampová 7, 041 01 Košice, marian.hocko@tuke.sk

Martina Žofčáková, Bc. Department of Air Traffic Management Faculty of Aeronautics Technical university of Košice, Rampová 7, 041 01 Košice, martinazofcakova@gmail.com