THE IMPORTANCE OF LIFE-CYCLE ANALYSIS IN ECONOMIC ANALYSIS OF ENVIRONMENTAL IMPACT OF ALTERNATIVE AIRCRAFT FUEL

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Abstract: *In the coming years, the projected increase in air passenger and freight transport will put the climate and the environment at greater risk. In the aviation sector, greenhouse gases and air pollutants such as carbon dioxide (CO_2), nitrogen oxides (NO_X) and sulfur dioxide (SO_X) are expected to increase. The aviation sector intends to address some of these problems by improving fuel efficiency through improved engine and aircraft design, air traffic management and the use of alternative fuels. The ICAO sample is the main organization that sees the ways to solve the problem in these tools. One type of alternative fuels is biofuels, which have a key role to play, as their use ensures the smallest air pollution, taking into account the entire supply chain. The article analyzed the issues and the importance of Life-Cycle analysis (LCA) of alternative jet fuels can be used in the future with regard to these issues and some aspects of Hungary.*

Keywords: *alternative jet fuel, biofuel, life cycle analysis, modelling*

1. INTRODUCTION

Reducing emissions of greenhouse gases (GHG) from the transport sector is an important challenge in the fight against climate change. Emissions from the sector have temporarily decreased as a result of the economic crisis of 2008, but the rebound in production has brought about an increase in demand for goods and travel. The ICAO recently agreed to develop a Global Market-based Measure (GMBM) to achieve carbon neutral growth after 2020 [1]. In this scheme, aircraft operators should offset any annual increase in the GHG emissions beyond 2020 from international aviation between participating states using the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The scheme is currently approved until 2035. Consumption of alternative jet fuels may also be included as part of a basket of measures [2].

The Aircraft emissions will give the impact surface to air quality through the formation of ozone and Particulate Matter (PM) (Fig. 1).

A lot of study has shown the changes in the fuel efficiency are analyzed and the potential reasons for those changes are investigated [1].The aviation biojet fuel was solely depending on its feasibility studies to compare with the rail and road transport, where electric propulsion systems do not offer an alternative way to reduce the emissions. While batteries remain too weak and too heavy for aircraft. The possibility of using renewable wind, hydro, and solar power in commercial aviation, unfortunately, is ruled out for the foreseeable future. So, the capability to offer climate-friendly mobility from renewable energies in aviation is the only mode of transport that has to rely on the use of biofuel [1].

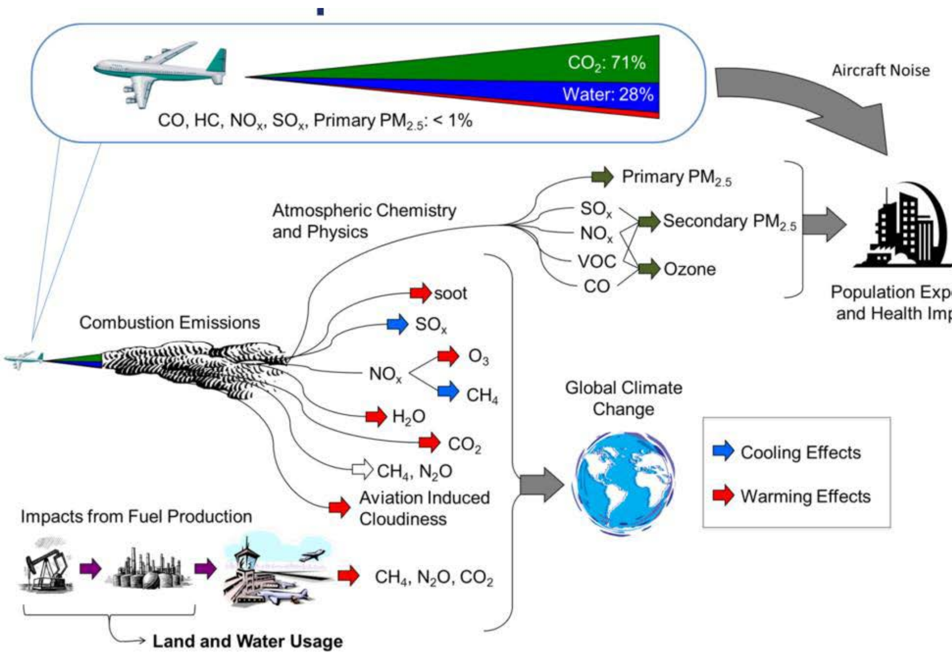

FIG. 1. Environmental impact of Aviation [2]

At decisions related hereby the distinguished importance economic viewpoint analysis and valuation of the application. The decision at the public aviation means choosing between alternatives, in contradistinction to the profit maximization at the commercial aviation.

2. LIFE-CYCLE ANALYSIS

Safety is paramount to aviation authority, hence there will be no requirement of any changes to aircraft engine fuel systems, distribution methods, or storage facilities. Therefore, aviation biofuel can be a “drop-in” fuelthat meets or exceeds internationally recognized as biojet fuel. As ASTM D4054 is where the approval for biojet fuel specification with unchanged operating. [2]

In our time the entire life-cycle approach is the basis for investment decisions on alternative fuels. The Life-cycle analysis (LCA) includes all stages in a product’s life — from the extraction of law materials through the materials’ processing, manufacture, distribution, use, and disposal or recycling. For this analysis, we have to account for all the stages in the life cycle of aviation fuels, including feedstock recovery and transportation, fuel production and transportation, and fuel consumption in an aircraft.

The exploration and recovery activities from the well to fuel production and the subsequent transportation to the pump constitute the well-to-pump (WTP) stage. The combustion of fuel during aircraft operation constitutes the pump-to-wake (PTWa) stage. These two stages combined comprise the well-to-wake (WTWa) fuel cycle [4].

As shown in Fig. 2, the WTWa analysis system boundary includes feedstock recovery and extraction of mineral oil (e.g., crude recovery, corn farming and harvesting, and corn stover harvesting), feedstock transport, fuel production (e.g., petroleum refining to jet, ethanol production, ETJ production), fuel transportation and distribution, and aircraft fuel combustion.

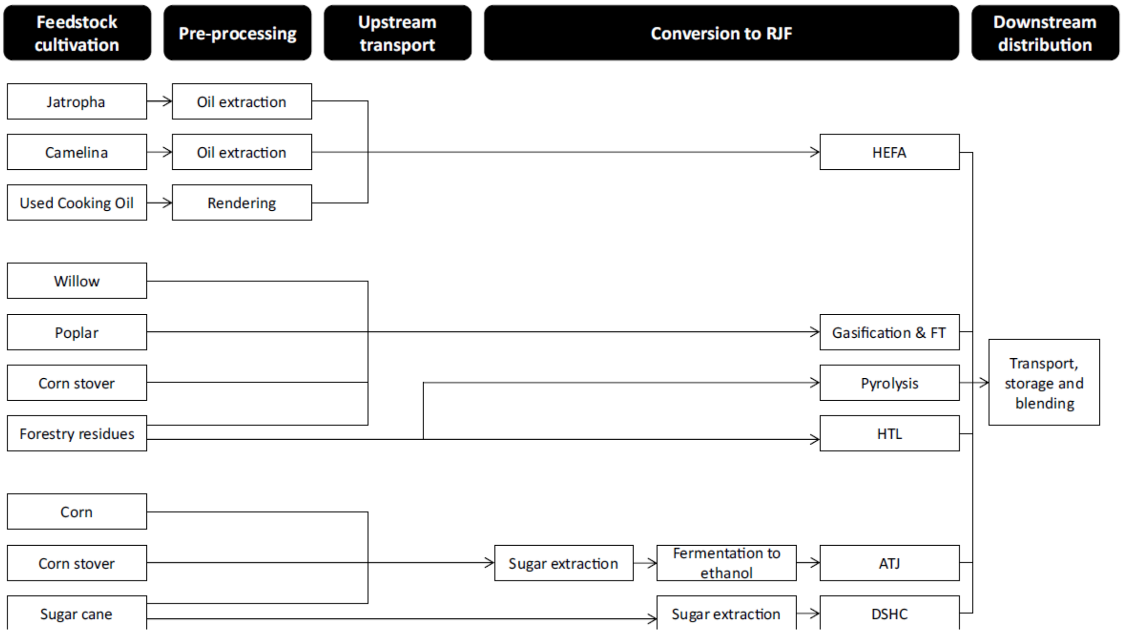

FIG. 2. A schematic overview of the renewable jet fuel supply chain [3]

With the alternative renewable fuels refer in Fig. 2. we present as example the „Well to Wake" model of ethanol-to-jet fuel.

Among alternative fuels one solution can be the use of biofuels, which can be produced from various kinds of biomass, like photosynthetic microorganisms, that is, algae. Oil produced by them may be the appropriate source material for producing biodiesel, moreover, for this process the carbon dioxide from the atmosphere is used [4]. Nowdays the biodiesel is keeping his spread within limits more factor, featured high cost of his production. It can be told , that more and more research are in this topic on large part of the world , and increases the number of the companies, what consider with fuel analysis, development of the biodiesel, or with its establishment [5].

Nowadays a lots of study compares the well-to-wake (WtWa) GHG emission performance of various RJF conversion pathways and shows the impact of different co-product allocation procedures [3][4][5].

Conversion pathways based on residues or lignocelluloses crops yield low WtWa GHG emissions, irrespective of allocation method. The FT pathway shows the highest GHG emission savings (86–104%) of the pathways considered, followed by HTL (77–80%), pyrolysis (54–75%), UCO-based HEFA (68%), and sugarcane- (71–75%) and corn stover-based ATJ (60–75%) [4].

3. BIOFUEL PRODUCTION POTENTIAL IN HUNGARY

The European Parliament and Council Directive (Renewable Energy Directive, hereinafter referred to as "RED") sets a binding target for all Member States to represent at least 10% of the total energy used by 2020 in the transport sector, including biofuels. There are a number of alternatives to reduce CO_2 emissions in the transport sector, with biofuels playing a key role in the European Union. Biofuels are liquid or gaseous transport fuels produced from biomass, ie. biodegradable agricultural, forestry or fishery products, waste, residues or biodegradable industrial and household waste [4].

The use of biofuels can bring many benefits:

- reduces GHG emissions as a function of raw material and production technology;
- reduces the release of certain harmful substances (carbon monoxide, solids) that do not directly affect climate change but cause local air pollution and present serious health risks;
- reduces energy dependency, increases security of supply;
- contribute to the development of agriculture and related industries

A basic factor is that biofuels have lower GHG emissions than fossil fuels if their production does not result in additional emissions from land use change [6].

The importance of sustainability has also become an important requirement. The main elements of the sustainability criteria system are:

- From 2017, GHG savings from the use of biofuels should be at least 50% compared to fossil fuels. In 2018, the minimum value for new production facilities will increase to 60 percent. GHG savings are needed to calculate the full life cycle of biofuels.
- Biofuels should not be made from raw materials of high biodiversity value or land with significant carbon stocks. It belongs to the former category eg. the primary forest or the high diversity grassland, for example the latter. wetlands and intermittent forest areas [4].

In Hungary, the possible ethanol raw materials are wheat and maize, sugar beet, sugar currants, potatoes and Jerusalem artichokes. With regard to raw materials, there is no doubt that maize with higher yields than wheat in Hungary and available in bulk can be the main source of bioethanol production, at least in the medium term.

Most bioethanol can be extracted from the Jerusalem artichoke (4,200 l / ha), sugar beet (4000 l / ha) and sugar circus (3500 l / ha), but this requires a crop of between 50 and 35 tonnes. In addition, these products can be poorly stored, which is detrimental to the continuity of bioethanol production. The value of the main product per unit area is very high in the case of potatoes, but due to the high price of the raw material and the relatively small amount of alcohol that can be extracted from it, only an exceptional situation can justify the use of potatoes as raw material for bioethanol. Sugar beet is still outstanding in terms of the main product value of the area. The economical position of sugar beet is significantly improved by the production of agricultural by-products of 180-240 Euro (60-80 thousand HUF) per hectare. However, this latter use must be accompanied by an appropriate livestock sector. As a usable agricultural by-product, straw is still the corn stalk in the corn. They are currently used mainly as feed and litter [7].

Among the examined raw materials, sugar circus, Jerusalem artichoke and maize are the most favorable for the cost of producing bioethanol.

To be able to produce one liter of bioethanol economically, taking into account all the conditions, the price per tons of maize should be "normal" for 100-120 Euro, for 25-30 thousand HUF, but not more than 35-37 thousand HUF. It can only exceed 10-20 percent in exceptional and exceptional years, so that bioethanol production can be profitable under current technological conditions [7].

CONCLUSIONS

Depending on the feedstock source, fuel conversion technology, and allocation or displacement credit methodology applied to co-products, preliminary WTWa results show that alternative bio-jet fuel pathways can reduce life-cycle GHG emissions by 55–85 percent compared with petroleum-based jet fuel [7].

At modelling of the life-cycle analysis on beyond the estimation of the individual cash flows serious difficulty appears the setting of recourse of dates.

According to the source material it can also be concluded that the production of biofuels, in addition to investment decisions related natural resources of a country depends to a large extent on the state market regulation.

Hungary is one of the poor countries in energy-producing raw materials, but it has the right potential for agricultural to produce agricultural raw materials for biofuels.

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