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Prospects of using biofuels and renewable energy sources in the aviation industry

Sustainable ways of conducting international passenger transportation and maintenance of the airports are proposed. Alternatives for using non-renewable energy sources in the aviation industry are provided.

The problem of mitigating climate change is being widely discussed during the last decades. A big role in this process plays the aviation industry, which causes a great amount of greenhouse gas emissions. For example, a return flight from London to New York emits more carbon emissions than the average person in 56 countries would produce in an entire year [1].

Globally, the industry continuously expands. The rising population and increasing middle-class population's earnings have significantly increased the demand for air transportation in various developed and developing countries across the world. It's also expected that the number of airline passengers will increase by 5 percent yearly by the year 2050 [2]. As airlines search for ways to reduce their impact on climate, 100% sustainable aviation fuel made from renewable sources can help them cut emissions by up to 80% [2].

Aviation biofuels (biojet or renewable jet fuel) are liquid fuels that are produced from biomass including plant materials, vegetable oils, or animal waste [4]. The net carbon emissions from using aviation biofuels can be less than the emissions from the process of burning fossil fuels. The thing is plants sequester carbon from the atmosphere as they grow, over multiple cycles of growth and harvest. The key requirement for biofuels is high energy density.

Most of the carbon dioxide emissions in the aviation industry come from fossil jet fuels that are burnt in the engine (up to 84%) [4]. Carbon dioxide emits from biojet burning as well but the point of use is recorded as zero in the energy sector [4].

According to the International Energy Agency Sustainable Development Scenario, the aviation industry aims to reduce carbon dioxide emissions by 20% by 2040 [5]. It can be done by replacing fossil jet fuels with aviation biofuels (Fig 1).

One of the main barriers to the wider use of biojet is the cost. Spending on fuel takes around 22% of the direct costs of airlines [5]. So, it's quite challenging to cover the costs of utilizing aviation biofuels. In the long-term perspective, the working option for the airlines is to include the biojet cost within the ticket costs. Nowadays a big role in the transition to zero carbon emissions has such companies as American Airlines, Qatar Airways, Airports Council International, Boeing, Shell, bp, and others [6].

Not only the process of burning fuels causes a lot of carbon emissions in the aviation industry. A significant amount of energy is required for lighting within airport buildings, heating, cooling, and information technology. The use of

renewables for the needs of airports and terminals is important as well in achieving sustainable development and coping with climate change.

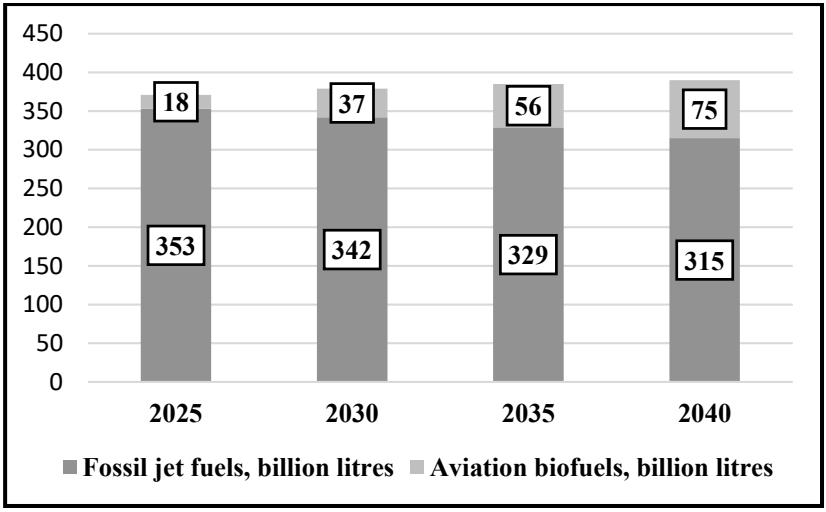

Fig. 1. Aviation fuel consumption in the Sustainable Development Scenario, 2025-2040

Airports can be widely used for locating solar panels and generating electricity because they usually have flat surfaces. For example, solar panels installed at Brisbane Airport produce an estimated 125 MWh/year of green energy. They directly save 118 tons of carbon dioxide per year compared to using grid electricity [7]. Moreover, a lot of other agents work at airports besides the civil aviation authority and airport authority, including airlines, gate operators, and tourism companies. Successful emissions reduction efforts require cooperation among these various parties.

Additionally, the future of the aviation industry might be in electric planes that can carry out long-distance flights. The process is complicated now because of the weight ratio of Li-ion batteries that are needed to complete the flight. Despite this, a short-distance electric flight has already been conducted. The cost of electricity for the MagniX Cessna Caravan electric plane is approximately 6 USD for a 160 km local flight compared to approximately 400 USD if powered by a liquid fuel [8]. So, it's not only a "greener" option for the industry but also a cheaper one.

The electric aircraft market is expected to reach 27.7 billion USD by 2030 [9]. The growth of this market is mainly driven by the deployment of urban air mobility aircraft and the increasing use of electric aircraft for cargo applications and different aerial mission-specific activities. The US is the largest manufacturer, operator, and exporter of electric aircraft globally, thereby resulting in the largest share of the North American region in the electric aircraft market.

The market growth in North America can be attributed to the presence of leading manufacturers of electric aircraft and to the growing need for cleaner and quieter planes. The advances in batteries, electric motors, and power electronics and the rise in demand for Unmanned Aerial Vehicles are other key factors driving the market. Moreover, new product launches and contracts are expected to offer opportunities to market players in the next ten years [9].

For now, a great alternative to fully electric planes is a hybrid model that allows using aviation biofuels (or fossil fuels) and batteries. Liquid chemical fuels coupled with fuel cell electricity can continuously charge batteries, as is done in hybrid-electric vehicles [8]. In different European countries, companies are focused on various solutions. For example, renewable fuels are more discussed in Germany, Norway focuses on battery electric planes, the UK on hybrid electric models with biofuels, and Sweden on biofuels [10].

Achieving zero-carbon growth by 2030 would require 40 billion USD to 50 billion USD in funding annually, and about 175 billion USD would be required by 2050. About 80–90 percent of these investments would go to the production of aviation biofuel. The remaining amount would be used for the development of battery-electric, hybrid-electric, and hydrogen aircraft, as well as the renewable electricity and green-hydrogen production plants required to power them [11].

To sum up, in order to further significantly decrease its emissions while keeping healthy economic growth, the aviation sector needs to reduce its current exclusive reliance on fossil jet fuel and accelerate its transition to innovative and sustainable types of fuels and technologies. Aviation biofuel has the potential to reduce carbon dioxide emissions for a greener future. It's important to continue to support critical programs on research, development, demonstration, and deployment of testing, analysis, and coordination on aviation biofuels directly with the aviation industry. Also, new aircraft technologies dedicated to zero-emission such as electric-powered aircraft are very promising. Such an alternative will be available in the long-term perspective because of the complexity of the industry.

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