SUSTAINABLE AVIATION: FUEL ECONOMY

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Key words: *aviation, fuel economy, sustainable development, environment, pollution.*

Aviation industry plays an important role in our modern life. It is an essential part not only in the economy and other fields of our life, but also it has extremely large effects on the environment system. Global warming, ozone depletion and other changes in nature are the results of the engine noises, air emissions. Approximately 2.46% of the global human-made CO2 emissions are from the aviation industry, and this number is increasing faster and faster as the demand for air transportations is skyrocketing. So, one of the main challenges in our days is to reduce CO_2 emissions in the aviation industry. Also, this direction is strongly connected with the 17 United Nations Sustainable Development Goals. To protect, restore the environment and provide sustainable development, some airlines have started using biofuels. For instance, the Lufthansa Group made Sustainable Aviation Fuels (SAF), with the help of which flights have become CO_2 - neutral. But not every airline can afford it because of large expanses. To reduce CO_2 emissions, other methods for fuel economy are used in the aviation industry. Because when an airline reduces fuel consumption, then air emissions are also reduced [1].

One of the methods is to reduce fuel consumption with the help of Auxiliary Power Units (APU). Auxiliary Power Units is usually located in the tail of the aircraft. It allows operation of aircraft without ground support equipment, such as Ground Power Units (GPU) and others. During flight, Auxiliary Power Units provide different functions, and one of them is bleed air for air conditioning. With the help of this function the fuel consumption can be reduced. If there is temperature 19-25℃, according to the environmental control system synoptic, the Auxiliary Power Units can be off, because of suitable temperature conditions for passengers. If there is Embraer - 190 in the Ukrainian International Airlines, then, according to the calculations, approximately 21 kg of fuel can be saved per ground stop. And for five Embraer-190 aircrafts 196 500 kg of fuel is saved per year [2].

Also, one of the most efficient methods is to use a 4D trajectory of an aircraft during the flight. The 4D trajectory concept is based on the integration of time into the 3D aircraft trajectory. It is being researched by Single European Sky ATM Research in the EU and NextGen in the US. It aims to ensure flight on a practically unrestricted, optimum trajectory for as long as possible in exchange for the aircraft being obliged to meet very accurately an arrival time over a designated point. So, it has three spatial dimensions and the fourth is time. 4D trajectory is used to predict the flight and to choose the optimal trajectory. For example, if there is heavy traffic for aircrafts, then

controllers divert it to holding patterns, when the aircraft has to fly a little bit more time than it is planned. As a result, there is larger fuel consumption during the flight. If A320 Neo is considered flying in a holding pattern, it consumes 25 kg of fuel per minute, so it will increase fuel expenses and CO_2 emissions. In these cases, 4D trajectory gives the opportunity to plan an optimal queuing system during heavy traffic and obtain optimal cruise speed, when fuel consumption is minimum for the certain types of aircraft. According to the calculations for the European fleet with 5500 aircrafts, 65 000 tons of fuel could be saved using this technology.

Other similar methods started to be used in the aviation industry of different countries. Let's compare fuel consumption and CO_2 emissions in Ukraine in 2010 and 2020 [3].

The formula for calculation of year fuel consumption:

$$Volume\ of\ fuel_{year\ n+1} = efficiency\ factor_{year\ n} \times RTK_{year\ n+1}$$

	2010	2020
RTK (2010/2020)	703 000 000,00	391 152 915,42
Efficiency factor (2009/2019)	0.63988	0.354648

After calculations we obtain:

$$Volume\ of\ fuel_{2010} = 703\ 000\ 000,00 \times 0.63988 = 449\ 835\ 640\ (L)$$

$$Volume\ of\ fuel_{2020} = 391\ 152\ 915,42 \times 0.354648 = 138\ 721\ 599.15\ (L)$$

So, after methods for fuel economy in the aviation industry started to be used, a lot of airlines has an opportunity to decrease fuel expenses, which are one of the largest. Also, if the fuel consumption is reduced, then CO_2 emissions are reduced too. These methods help to provide sustainable development and environmental balance in the aviation industry.

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