Green technologies in aviation: Trends, benefits and challenges

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Abstract. Aviation industry has a significant impact on the environment, particularly due to adverse greenhouse gas emissions. In order to reduce the harmful environmental impact of aviation and contribute to the global goals of sustainable development, great attention is focused on the development of green technologies in aviation. Green technologies include innovations in aircraft design, the use of alternative sustainable fuels, the optimization of operations and the sustainable development of infrastructure. For example, Lufthansa Group and United Airlines use sustainable aviation fuels (SAF) on certain routes. The industry's goal is for SAF to replace most conventional fuels by 2050. Electric aircraft such as the Pipistrel Velis Electro and the Rolls-Royce ACCEL "Spirit of Innovation" have also been developed, while Airbus plans the first commercial hydrogen-powered aircraft by 2035. In route optimization, SESAR and NASA are developing systems to reduce fuel consumption and emissions. Aircraft such as the Boeing 787 Dreamliner use lightweight composite materials for greater efficiency, while airports such as Oslo, Heathrow and Schiphol are implementing renewable energy sources and electric vehicles. Despite these advances, challenges remain in the form of technical system limitations, dependence on limited sustainable fuels, infrastructure adaptation needs, and high initial investments. This paper presents current trends in the development of green technologies in aviation, with a focus on the benefits and challenges. The future of green technologies in aviation is based on sustainable fuels, electrification, digitalization, and sustainable infrastructure.

Figure 1. Rolls-Royce ACCEL "Spirit of Innovation" electric aircraft

Figure 2. Pipistrel Velis Electro electric aircraft

Figure 3. Oslo Gardermoen Airport – first in the world to offer biojet fuel

Figure 4. Amsterdam Airport Schiphol – runs entirely on renewable electricity and is committed to achieving carbon neutrality by 2030

Figure 5. Airbus ZEROe concept – fully-electric aircraft

Figure 6. Boeing 787 Dreamliner – composite materials

Conclusions. **T**rends of green technologies in aviation include the development of electric and hybrid aircraft, sustainable aviation fuels (SAF), and improvements in aerodynamics and engine efficiency. The benefits include reduced greenhouse gas emissions, reduced dependence on fossil fuels, and increased energy efficiency. Challenges include high development costs, limited range of electric aircraft, and slower infrastructure adaptation. Future plans include wider deployment of SAF, commercialization of electric aircraft, and stricter environmental regulations, with the goal of achieving climate neutrality in aviation by the mid-21st century.