

A.A. Prokopieva, PhD, A.A. Myslik, PhD student
(National Aviation University, Ukraine)

Aviation sustainability in the context of European security

The research is dedicated to the analysis of the main principles of environmentally safe land use in aviation transport, as well as the justification of modern problems of environmental security in this field and the ways to solve them in the context of European security.

Aviation sustainability is a key concern in the context of European security, as the aviation industry is not only essential to Europe's transport infrastructure but also a significant source of greenhouse gas emissions. Minimizing the environmental impact of aviation is closely connected to energy security, climate stability, and the EU's overarching security policies. Tackling the issues associated with aviation emissions is crucial for both lowering the sector's carbon output and fostering long-term sustainability within Europe's environmental and energy frameworks.

Aviation's heavy dependence on fossil fuels plays a major role in driving up global CO₂ emissions, which in turn accelerates climate change. As a result, transitioning to more sustainable and eco-friendly aviation practices is critical for achieving Europe's larger objective of decreasing reliance on finite energy resources and addressing environmental threats. To meet these goals, the European Union has implemented various measures, such as promoting sustainable fuels, advancing the development of electric and hybrid aircraft, and enhancing air traffic management systems to boost efficiency and cut emissions [1].

In summary, advancing aviation's environmental sustainability aligns with Europe's aims for greater energy independence and a stronger ability to cope with climate challenges, making it a vital part of the region's long-term security agenda.

Key Aspects of Aviation Sustainability in the Context of European Security:

1. Reduction of Greenhouse Gas Emissions

- Aviation is responsible for approximately 2-3% of global CO₂ emissions, yet its overall contribution to climate change is significantly higher. This is due to additional emissions such as nitrogen oxides, water vapor, and soot, which have a pronounced effect on the upper atmosphere and exacerbate global warming.
- The European Green Deal outlines an ambitious goal to achieve net-zero greenhouse gas emissions by 2050, with the aviation sector playing a crucial role in this plan.
- Various initiatives, including the European Green Aviation Initiatives and Clean Sky, are focused on advancing innovative technologies aimed at reducing the carbon footprint of aviation. These programs promote research into energy-efficient aircraft, sustainable aviation fuels (SAF), and more eco-friendly operational practices, such as optimized flight routes and improved air traffic management systems.

In addition to cutting CO₂ emissions, these initiatives also target reducing the aviation sector's impact on other atmospheric layers, acknowledging the broader role aviation plays in global environmental dynamics. Europe's effort to modernize the aviation industry reflects its commitment to meeting international climate targets,

including those set under the Paris Agreement, by fostering a transition to greener, low-emission air travel.

Reducing aviation emissions is not only essential for curbing climate change but also aligns with Europe's broader goals for energy security. By investing in cleaner technologies and sustainable energy sources, Europe aims to decrease its reliance on fossil fuels, ensuring greater energy independence and stability while simultaneously contributing to global environmental protection efforts.

2. Aviation Biofuels and Alternative Energy Sources

- Biofuels represent a key short-term solution for reducing CO₂ emissions from the aviation sector. These sustainable fuels, derived from organic materials, have the potential to significantly lower carbon output compared to traditional fossil-based jet fuels. The European Commission has taken an active role in promoting the research, development, and adoption of aviation biofuels, recognizing their importance in transitioning to greener air travel.

- In the long term, electric and hybrid aircraft are being developed as a means to further reduce the industry's reliance on fossil fuels. These new technologies hold promise for minimizing environmental impact, particularly for short-haul flights where electric propulsion systems could be more feasible. Several European countries are already investing in the development and testing of electric planes, aiming to introduce them for domestic and regional flights in the coming years.

Alongside the progress in biofuels, these advancements in electric and hybrid propulsion could lead to a future where air travel is not only more energy-efficient but also drastically reduces emissions. Europe's commitment to sustainable aviation reflects its broader ambition to lead the way in climate innovation and to ensure the aviation sector aligns with the continent's overall environmental goals. As electric and hybrid technologies advance, they could revolutionize short-distance flights, reducing noise pollution and fuel consumption, and making aviation a cleaner, more eco-friendly mode of transport.

3. EU Regulations and Initiatives

- The EU Emissions Trading System (ETS) encompasses the aviation sector, requiring airlines to purchase allowances for their CO₂ emissions. This cap-and-trade system incentivizes airlines to invest in cleaner technologies by imposing a financial cost on excessive emissions. As a result, it encourages carriers to adopt more sustainable practices, such as improving fuel efficiency, optimizing flight operations, and transitioning to alternative fuels.

- The ReFuelEU Aviation initiative is specifically designed to boost the usage of Sustainable Aviation Fuels (SAF). SAFs, made from renewable resources like biomass or waste products, have a significantly lower carbon footprint than traditional jet fuels. This initiative aims to increase the share of SAF in aviation fuel consumption, pushing the sector toward a greener future by promoting more widespread adoption of these environmentally friendly alternatives.

- Under the "Fit for 55" program, the EU has set ambitious targets to reduce CO₂ emissions by 55% by 2030 compared to 1990 levels, with aviation being a critical part of this goal. The plan includes strict regulations for the aviation industry, driving progress towards carbon neutrality through the implementation of more rigorous emissions standards, increased use of sustainable fuels, and enhanced technological

innovations.

These regulatory efforts and initiatives not only aim to curb emissions but also to accelerate the transformation of the aviation industry. By fostering innovation in sustainable energy and operational practices, the EU is positioning aviation as a leader in the global shift towards climate resilience. Moreover, the introduction of stringent environmental standards ensures that the industry remains aligned with the EU's broader climate and energy goals, contributing to a more sustainable and secure future.

4. Infrastructure Modernization

- Enhancing Europe's airspace management through the Single European Sky initiative will lead to more efficient flight operations by optimizing air traffic routes and reducing the number of unnecessary flights. This streamlining of air traffic control not only helps to lower fuel consumption but also significantly cuts CO₂ emissions by minimizing detours and delays.

- The implementation of more advanced air navigation systems can further reduce flight delays and eliminate unnecessary flights, leading to more direct and fuel-efficient routes. By improving coordination across Europe's airspace, the initiative aims to reduce congestion, increase airspace capacity, and enhance overall efficiency in aviation operations.

These upgrades in infrastructure will play a crucial role in reducing the aviation sector's environmental footprint. By optimizing routes and leveraging cutting-edge navigation technologies, airlines will be able to operate more sustainably, lowering both operational costs and environmental impact. Additionally, this modernization aligns with the EU's broader goals of making aviation safer, more efficient, and more environmentally friendly, thus supporting the long-term objectives of energy conservation and emissions reduction across the continent.

5. European Energy Security

- The adoption of eco-friendly fuels and advanced technologies is crucial for reducing Europe's dependence on imported energy sources, particularly traditional fossil fuels such as coal, oil, and gas. By transitioning to cleaner alternatives, Europe can mitigate its vulnerability to fluctuations in global energy markets and enhance its energy sovereignty.

- Investing in renewable energy sources for the production of synthetic aviation fuels represents a strategic move towards achieving greater energy independence for Europe. These synthetic fuels, produced from renewable resources or through innovative processes, can help reduce reliance on imported petroleum products and align with broader energy transition goals.

- By fostering the development and use of sustainable energy solutions, Europe aims to create a more resilient and self-sufficient energy system. This not only supports the continent's efforts to reduce greenhouse gas emissions but also enhances its capacity to manage energy needs effectively. Such advancements contribute to a more secure and stable energy landscape, ensuring that Europe remains competitive in the global economy while addressing the challenges of climate change.

6. Climate Security and Disaster Resilience

- Reducing greenhouse gas emissions is essential in the fight against global warming, which is a key element of Europe's climate security strategy. By curbing emissions, Europe aims to mitigate the impacts of climate change and support global efforts to

limit temperature rises.

- Aviation's environmental strategies are designed not only to cut emissions but also to adapt to the effects of climate change. This includes preparing for increased frequency of extreme weather events that can impact infrastructure and aviation operations. Such adaptation measures may involve enhancing the resilience of airport facilities, improving weather forecasting and management systems, and developing more robust operational procedures to ensure safe and efficient air travel during adverse conditions.

By integrating climate resilience into aviation planning, Europe seeks to protect its infrastructure and maintain operational continuity in the face of evolving climatic challenges. These efforts are part of a broader strategy to build a more adaptable and secure aviation system, capable of withstanding and recovering from the impacts of climate-related disruptions [2].

Conclusion

Addressing aviation sustainability within the framework of European security is a multifaceted challenge encompassing environmental, economic, and technological dimensions. Investing in innovative green technologies, alternative fuels, and upgrading infrastructure is essential for minimizing aviation's environmental impact and supporting Europe's climate and energy security goals.

Advancements in these areas are crucial not only for reducing greenhouse gas emissions and enhancing energy efficiency but also for ensuring the aviation sector's resilience against climate change and energy disruptions. By fostering the development and adoption of sustainable practices and technologies, Europe aims to align its aviation industry with broader environmental objectives and contribute to global efforts in combating climate change [3].

Overall, achieving a sustainable aviation sector involves a coordinated approach that integrates regulatory measures, technological innovation, and strategic investments. This comprehensive strategy is vital for safeguarding Europe's environmental health, enhancing its energy independence, and securing its transportation infrastructure against future climate-related challenges.

References

1. Information on the environmental impact of aviation [Електронний ресурс]: URL: <https://www.caa.co.uk/Consumers/Environment/Information-on-the-environmental-impact-of-aviation/#4294984360-accordioncollapse-4>
2. Information on aviation's environmental impact [Електронний ресурс]: URL: <http://publicapps.caa.co.uk/docs/33/>
3. Innovation Process Management in Ukraine: problems in commercialization of scientific and technical developments: Monograph / Yuriy Vovk, Oleh Karyy, Ihor Kulyniak, Yosyf Petrovych, and other / Edited by Yuriy Vovk, Oleh Karyy. Lviv : LLC «Rastr-7», 2018. 266 p.