Policy Brief:

Electric Aviation as Alternative to Fossil-Based Jet Fuel

Introduction

The aviation industry is heavily dependent on fossil fuels and accounts for about five percent of global greenhouse gas emissions that contribute to climate change (Lai et al, 2022a; Grewe et al, 2021). Possible solutions to reduce the aviation sector's carbon footprint include replacing fossil jet fuel with Sustainable Aviation Fuels (SAF), electric aircrafts and green hydrogen. Electric aviation represents a transformative opportunity for the aviation sector to significantly reduce greenhouse gas emissions and enhance regional connectivity (Urban et al, 2024).

This policy brief outlines the opportunities and challenges for electric aviation, based on research findings from the Sustainable Energy Transformations in Aviation (SETA) project funded by the Swedish Energy Agency.

Opportunities for Electric Aviation

Electric aircrafts contribute to emission reduction as they are powered by electricity and require no fossil jet fuel. The emissions during operation can be reduced to near zero for fully electric aircrafts, if the electricity comes from renewable and low carbon energy (Lai et al., 2022a). Hybrid electric aircrafts can use SAF, including advanced biofuels and electro-fuels, for start-up and landing, while using electric propulsion during the remaining journey. Ongoing innovations in battery technology, particularly lithium-ion batteries, are expected to enhance the performance and feasibility of electric aircraft for short-haul flights (Christley et al., 2024). Electric aircrafts have lower operational costs than conventional aircrafts, hence potentially lowering costs for operators and customers.

Electric aviation has the potential to stimulate economic growth in rural and semi-urban areas by improving connectivity. The introduction of electric aircraft can facilitate new regional routes, enhancing access to underserved locations such as islands or urban areas that lack other infrastructure such as railways (Christley et al., 2024; Kulanovic & Nordensvärd, 2021). At the same time, electric drones offer opportunities for low emissions logistics operations to deliver goods to customers by drones, which also avoids traffic congestion and local air pollution.

Challenges to Implementation

Electric aviation requires significant investment in infrastructure, including new types of aircrafts, charging stations, adequate electric grids and sufficient electric capacity. The existing airport and energy infrastructure must be re-evaluated and expanded to accommodate new operational needs (Lai et al., 2022a). As electric aviation scales, managing the lifecycle of batteries including recycling and second-life applications, will be vital to ensuring sustainability and minimizing environmental impacts (Lai et al., 2022a). Current electric aircraft face limitations in range and payload compared to traditional aircraft, restricting routes to short-haul and few passengers. These technical hurdles must be addressed to realise the full potential of electric aviation (Christley et al., 2024). Understanding consumer attitudes towards electric aviation is critical. Research into awareness and willingness to pay for electric flights is necessary to build market demand (Lai et al., 2022a). Comprehensive assessments of electric aviation's environmental impacts should consider potential burden-shifting from aviation to the energy sector, particularly regarding the sustainability of electricity sources used for electric aircraft (Lai et al., 2022b). A collaborative approach involving government, industry and academia is essential for addressing the multifaceted challenges of electric aviation (Kulanovic & Nordensvärd, 2021). Strategic planning will facilitate the necessary infrastructure and regulatory adaptations (Christley et al., 2024).

Conclusion

Electric aviation presents a significant opportunity to reduce the climate impact of air travel while potentially fostering regional connectivity and economic development. There is also potential for lower operational costs. However, addressing infrastructure needs, technical challenges and consumer acceptance is essential for successful implementation and up-scaling of electric aviation.

Did you know that:

- At the moment electric two-seaters are operating, including for training pilots how to fly electric aircrafts. Within the next 5-10 years it is likely that larger electric aircrafts and hybrid electric aircrafts will be operating commercially, covering ranges of 200 to 800 km and carrying about 30 passengers. Planned routes include Stockholm – Gotland (Visby) (Christley et al, 2024).
- Current policy such as the European Union's ReFuel EU Aviation policy, the European Emission Trading System (EU ETS) and the international Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) support a transition to lower emissions from the aviation sector. Using fossil-based jet fuel results in greenhouse gas emissions which occur carbon taxes per ton of emitted CO_2 under the EU ETS, while electric aviation creates a financial advantage due to near zero emissions.

Find out more about our research on Sustainable Energy Transformations in Aviation (SETA) here:

https://liu.se/en/research/graduate-school-in-energy-systems/energiomstallning-for-en-mer-hallbar-flygindustri

https://www.kth.se/indek/side/current-projects/seta-sustainable-energy-transformations-in-aviation-1.1017817

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Read more about our publications:

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Urban, F. and Nordensvärd, J., 2023. Handbook on Climate Change and Technology. Edward Elgar Publishing, London. Chapter on energy transitions in aviation, co-authored by Aneta Kulanovic. https://www.e-elgar.com/shop/gbp/handbook-on-climate-change-and-technology-9781800882102.html