ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 10, Issue 3, March 2023

"Are Electric Planes the Answer to Sustainable Fuel and Solution to the Impact on Environment"

[1] Prema Venkatraman

[1] Assistant Professor/ Program In-charge, Department of Business Administration – Aviation
Corresponding Author Email: [1] prema@soundaryainstitutions.in

Abstract*— The constant growth of air traffic, the demand for performance optimization and the need for decreasing both operating and maintenance cost has encouraged the aviation industry to move towards electric planes, taking into account even the effect on environment. It holds tremendous potential to solve the issues of the impact on environment and move towards net zero CO_2 emission and also intersects with Sustainable Fuel and the answer to the rising cost. The paper revies the various technological areas, the challenges and opportunities, the regulatory frame work for the aviation industry to move towards electric aircrafts.

Keywords: air traffic, performance optimization, electric planes, environment, net zero CO2 emission, Sustainable Fuel, technological areas, regulatory framework, aviation industry.

I. INTRODUCTION

Aviation is a significant contributor to global carbon emissions, and its impact on the environment has been a growing concern in recent years. With the aviation industry projected to grow in the coming decades, there is an urgent need to find sustainable fuel and technology solutions to minimize its carbon footprint. Electric planes have emerged as a potential solution, and this paper will examine whether electric planes are the answer to sustainable fuel and a solution to the impact on the environment.

Besides the problem of pollution and emission, the amount of oil is limited. Taking into account the growing demand and the depletion in the reserve due to war and cost , electric planes are a clear answer for the future of the aviation industry. Data from 2018 shows that the sector is responsible for around 2.5% of the global carbon dioxide emission, and 3.5% of global warming if non carbon dioxide contributions are also accounted for. In 2019, emission from jet kerosene combustion reached a new high of 1027MtCo2, though these numbers represent only 12% of CO2 emission for the combines transport industry . The aviation industry is widely seen as the hardest sector to de carbonize, whether it is looked at from a technological or economical standpoint.

As the climate crisis depend since the signing of the Paris Agreement, numerous other proposals and plans were developed by other organizations. Though the consensus regarding the need for both short and long term reduction in carbon foot print remains unchanged, most of the plans and schemes are conceives based on models that predicted a continuous growth in commercial air traffic. It did not account for the abrupt halt in flights caused by Covid 19 pandemic , which brought the biggest drop in global air passenger in history. Research has also been conducted in enabling a reduction in emission in specific stages. Naturally flight emission are higher at take off and climb stages, but engine start up and warm up emission are also of particular importance as the inefficiency associated with cold starts originated high emission and energy losses.

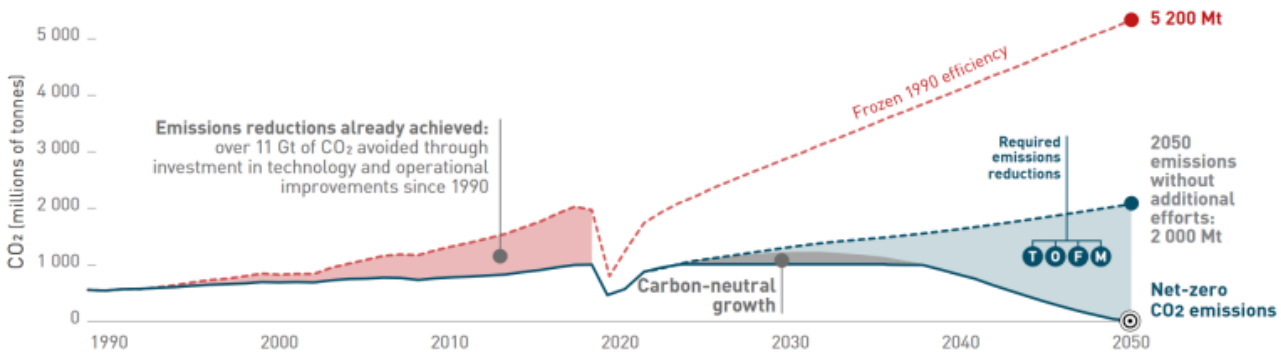

Figure 1.

The figure predicts the CO2 emission until 2050 without additional efforts , compared to 2050 net zero goal and to the 1990 efficiency trend .Required emission reduction are obtained through technology development, operations and infrastructure improvements , use of sustainable aviation fuel, and offsets and other carbon mitigation options.

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 10, Issue 3, March 2023

Introducing electric propulsion system into ground transportation is more simpler compared to the implementation in aviation. The mass ground vehicle is not as critical as aerial vehicles, so additional mass of batteries means less problems. Aerial vehicles have significantly higher typical travel distance, hence storing more energy is necessary. Aerial safety standards are very high which makes the implementation of electric planes harder. The paper shows possible steps to fight for cleaner and greener aviation.

II. AIRCRAFT ELECTRIC PROPULSION SYSTEM CONCEPTS

The aviation industry is under increasing pressure to reduce its carbon footprint and emissions, and electric propulsion systems for aircraft have emerged as a promising solution. Electric propulsion systems offer several benefits, including lower emissions, improved fuel efficiency, and reduced noise. In this research paper, we will discuss the different types of electric propulsion system concepts being developed for aircraft. Hybrid electric propulsion systems combine a traditional internal combustion engine with an electric motor to power an aircraft. The system allows for a more efficient and flexible power source, leading to reduced emissions, lower fuel consumption, and improved performance. Hybrid electric propulsion systems are currently used in smaller aircraft, such as general aviation planes, and are being developed for larger commercial airliners. All-electric propulsion systems use an electric motor powered by batteries or fuel cells to propel an aircraft. This type of system offers zero emissions, as there is no combustion involved, and reduces noise levels, making it an ideal solution for urban air mobility. However, the current limitation of all-electric propulsion systems is their limited range, which makes them only suitable for short-haul flights. Distributed electric propulsion systems utilize several small electric motors located along the wings or fuselage of the aircraft. The system offers a more distributed power source, increasing efficiency and reducing emissions. It also offers greater design flexibility, allowing for smaller engines and improved aerodynamics. The NASA X-57 Maxwell is an example of an aircraft that utilizes distributed electric propulsion systems. Turbo-electric propulsion systems use a gas turbine engine to generate electricity that powers an electric motor. This system offers greater efficiency, as the gas turbine engine can operate at a constant speed, leading to reduced emissions and improved fuel efficiency. The General Electric GE9X engine is an example of an engine that can be used in a turbo-electric propulsion system.

The development of electric propulsion systems is crucial to the aviation industry's efforts to reduce emissions and improve sustainability. Hybrid electric propulsion systems, all-electric propulsion systems, distributed electric propulsion systems, and turbo-electric propulsion systems are all being developed to meet different aviation needs. Although electric propulsion systems face challenges such as battery technology, range, and infrastructure, they offer significant potential to revolutionize the aviation industry and pave the way for more sustainable and environmentally friendly air travel. Further research and development are necessary to overcome these challenges and make electric propulsion systems a viable option for commercial aviation.

III. BATTERY SYSTEM IN ELECTRIC PLANES

Electric planes are gaining popularity as a promising solution to reduce the aviation industry's carbon footprint and emissions. One of the critical components of electric planes is the battery system, which provides the necessary power to the electric motor. In this research paper, we will discuss the battery system in electric planes, its challenges, and its potential for future aviation. There are several types of batteries that can be used in electric planes, including Lithium-ion, Nickel-Cadmium, and Zinc-Air batteries. Lithium-ion batteries are the most commonly used in electric planes due to their high energy density, low self-discharge rate, and long life cycle. The battery capacity is a critical factor in determining the range and performance of an electric plane. The current limitation of electric planes is their limited range, which is mainly due to the limited battery capacity. Increasing the battery capacity is essential to improve the range and performance of electric planes. One of the main challenges of electric planes is the lack of charging infrastructure. Unlike traditional fossil fuel planes, electric planes require charging stations or battery-swapping facilities. Developing an efficient and widespread charging infrastructure is critical to the growth and adoption of electric planes. Battery safety is another significant challenge in electric planes. The high energy density of batteries makes them susceptible to thermal runaway, which can cause fires and explosions. Developing advanced battery management systems and safety features is crucial to ensure the safe operation of electric planes. Advancements in battery technology, such as solid-state batteries and ultra-fast charging, offer significant potential for the future of electric planes. Solid-state batteries offer higher energy density, longer life cycle, and improved safety compared to traditional lithium-ion batteries. Ultra-fast charging technology can significantly reduce the charging time and increase the efficiency of electric planes. These advancements could help electric planes achieve longer ranges, higher performance, and wider adoption. The battery system is a critical component of electric planes, and its development is crucial to the success of the electric aviation industry. Although the current battery technology has limitations, such as limited range and charging infrastructure, advancements in battery technology offer significant potential for the future of electric planes. Further research and development are necessary to overcome the challenges and make electric planes a viable and sustainable option for commercial aviation.

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 10, Issue 3, March 2023

IV. RESEARCH METHODOLOGY

In this study we have considered secondary data gathered from different online sources.

V. SCOPE OF THE STUDY

Objectives

1. To provide an overview of the current state of the aviation industry's environmental impact and the need for sustainable fuel solutions.
2. To examine the potential of electric planes as a solution to reduce the aviation industry's carbon footprint and emissions.
3. To explore the technical feasibility of electric planes, including the battery system, electric motor, and charging infrastructure.

VI. LIMITATIONS

Electric planes are certainly a promising solution to reducing the environmental impact of air travel, but they do have some limitations that may prevent them from being the sole answer to sustainable fuel and the impact on the environment. Here are some key limitations to consider:

1. Limited range: Electric planes currently have a limited range, which may make them unsuitable for longer flights. While advancements are being made in battery technology, it may still be several years before electric planes can fly as far as traditional planes.
2. Battery weight: Batteries are heavy, which can limit the amount of cargo and passengers that an electric plane can carry. This may make them impractical for larger commercial flights.
3. Infrastructure: There is currently limited infrastructure to support electric planes, such as charging stations and maintenance facilities. This may make it challenging to scale up electric plane travel on a large scale
4. Cost: Electric planes are currently more expensive than traditional planes, and the cost of developing and manufacturing them may make them unaffordable for some airlines and passengers.

Overall, while electric planes have the potential to be an important part of a sustainable aviation system, it is likely that a range of solutions will be needed to address the environmental impact of air travel. This may include the use of biofuels, improvements in traditional plane technology, and changes to air travel policies and practices.

VII. CONCLUSION

Electric planes have the potential to be a sustainable solution to the environmental impact of air travel. While they currently have some limitations, such as limited range and infrastructure, advancements in battery technology and increasing investment in electric aviation suggest that electric planes will continue to improve in performance and become more widely adopted. However, it is important to recognize that electric planes are only one piece of a larger puzzle in achieving sustainable aviation, and a range of solutions will be needed to address the environmental impact of air travel. This may include the use of biofuels, improvements in traditional plane technology, and changes to air travel policies and practices. Ultimately, the transition to sustainable aviation will require a collaborative effort among industry leaders, policymakers, and the public, and a commitment to finding innovative solutions that prioritize environmental sustainability while maintaining safe and efficient air travel.

REFERENCES

[1] Sustainable Aviation: Progress and Challenges" by S. Leishman and S. Doherty. Annual Review of Environment and Resources, Volume 43, 2018.

[2] Electric Aviation - A Review of Technology and Market Development" by Alexander Engel and Felix Roesel. Energy Policy, Volume 140, November 2020.

[3] Electric aviation and climate change: Opportunities and challenges" by Gregor H. Henze, John M. O. Paul, and Thomas E. Murphy. Transportation Research Part D: Transport and Environment, Volume 66, February 2019.