# Sustainability in Aviation Industry- A Bibliometric Analysis

Pramod Kumar.T[1] and Dr. Rhytheema Dulloo[2]

School of Management, Hindustan Institute of Technology and Science, Chennai, India
dulloo.rhytheema@gmail.com

**Abstract.** Amid mounting concerns about environmental impact, social responsibility, and economic stability, the aviation industry stands as a critical nexus for the convergence of sustainability dimensions. With the persistent growth in air travel demand, the imperative for sustainable practices within the civil aviation sector has become increasingly pronounced. This bibliometric analysis scrutinizes sustainability within the aviation industry, encompassing its environmental, social, and economic facets. Leveraging data from the Web of Science (WoS) database, spanning 123 academic articles published from 2001 to 2023, the research model reveals significant trends, including a substantial uptick in publications in 2022 and 2023, likely catalyzed by heightened environmental awareness and the quest for more resource- efficient aviation in the aftermath of the global pandemic. Key journals, such as the International Journal of Sustainable Aviation and Sustainability, have played pivotal roles in this discourse. This study provides a structured framework to assess sustainability in aviation, furnishing valuable insights for aviation stakeholders, policymakers, and researchers, thereby enhancing comprehension of the current landscape of sustainable aviation research and practice and emphasizing the aviation industry's commitment to addressing sustainability challenges and fostering a more sustainable future for air travel.

**Keywords:** Aviation industry, Civil, Bibliometric analysis, Environmental awareness, Sustainability.

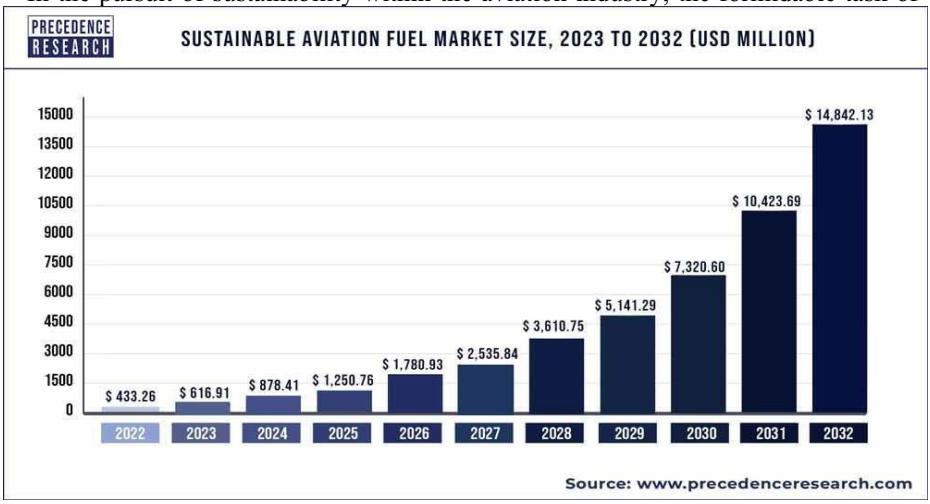
## 1 Introduction

Various industries in rising economies throughout the globe have endeavored to significantly decrease the emission of Greenhouse Gases (GHG) through the implementation of sustainable and carbon-neutral development strategies [1,2]. The airline sector is not an exception in this sense. The aviation industry has demonstrated a noteworthy reduction in its carbon footprint, achieving a 50% decrease in emissions compared to its activities during the late 1990s [3]. The implementation of novel technologies, such as sustainable fuel alternatives and zero-emission engine designs, has shown potential in reducing aviation emissions, particle soot, lead contrails, and cirrus clouds [4]. A reduction in aviation emissions corresponds to a concomitant reduction in the adverse effects associated with climate change, so contributing to the achievement of Sustainable Development Goal (SDGs) 13, which aims to address difficulties connected to climate


M. Rani Nimmagadda et al. (eds.), *Proceedings of the 3rd International Conference on Reinventing Business Practices, Start-ups and Sustainability (ICRBSS 2023)*, Advances in Economics, Business and Management Research 277,
https://doi.org/10.2991/978-94-6463-374-0_73

change. In spite of concerted efforts to substantially reduce carbon dioxide (CO2) emissions in the near future, it is anticipated that greenhouse gas(GHG) emissions will experience a considerable surge as a result of the aircraft industry's expansionary endeavors [5]. The global sustainable aviation fuel market size was valued at USD 433.26 million in 2022, and it is expected to hit around USD 14,842.13 million by 2032, poised to grow at a CAGR of 42.39% from 2023 to2032.

**Fig. 1.** A Sustainable Aviation Fuel Market Size




In the pursuit of sustainability within the aviation industry, the formidable task of mitigating carbon emissions takes center stage. This challenge is further compounded by the pivotal role that air travel, encompassing both passenger and freight transportation, plays in stimulating economic growth [6]. A critical facet of addressing sustainability concerns within this specific industry revolves around achieving equilibrium between the non-CO2 related consequences and the emissions attributed to aviation [7]. Consequently, the imperative for a comprehensive comprehension of the economic aspects related to sustainability and eco-efficiency within the airline business is starkly evident. The aviation sector has already established ambitious objectives for reducing CO2 emissions by 2050, emphasizing the promotion of economic advancement through enhanced connectivity, the adoption of clean and sustainable energy sources, and the improvement of climatic conditions [8]. Furthermore, the promotion of sustainable operations within the global aviation sector through the incorporation of Sustainable Development Goals (SDGs) holds the potential to not only foster economic development but also bolster the industry's corporate image. These overarching considerations underscore the significance of sustainable practices within the aviation industry, a subject that this bibliometric analysis seeks to illuminate.

# 2 Literature Review

## 2.1 Sustainability Systems in Aviation

Aviation, a fundamental aspect of global connectivity and economic development, faces mounting pressure to address its negative environmental impact. As apprehensions about climate change heighten, the aviation sector is actively implementing sustainability systems to decrease its environmental footprint while maintaining its crucial international role in transportation and commerce. Numerous undertakings have been established to enhance aviation's sustainability. These factors entail the implementation of greener aviation technologies such as fuel-efficient planes, cutting-edge aerodynamics and propulsion systems, and the accommodation of alternative fuels like biofuels [9]. Furthermore, airlines and airports are stepping up their game by adopting more efficient operational practices that reduce wastage and energy usage. This involves designing energy-efficient terminals, installing solar power systems, and providing sustainable ground transport options like electric shuttles [10].

Sustainable airport operations have come up in recent years which help in reducing the carbon footprint of air travel. Alternative fuels, especially biofuels and sustainable aviation fuels (SAFs), are becoming cleaner alternatives to conventional jet fuels. SAFs have the potential to considerably reduce carbon emissions over the life cycle [11]. For example, such as Turkish Airlines and United Airlines, have started to implement SAFs in their operations. in airplane technology have been influential in sustainability endeavours. In an effort to be more fuel-efficient and environmentally friendly, manufacturers are stil developing aicrafts. The 787 Dreamliner by Boeing, for instance, employs inventive materials and aerodynamics to lessen fuel consumption and emissions [12]. Aircraft operations produce substantial noise pollution, which impacts communities situated close to airports. The Federal Aviation Administration (FAA) acknowledges prolonged exposure to aircraft noise can cause harmful health impacts, including stress and sleep disruption. Addressing noise pollution is a social, public health, and environmental responsibility. Furthermore, aircraft emissions lead to the deterioration of air quality. Emissions of nitrogen oxides (NOx) and particulate matter in the vicinity of airports can intensify air quality challenges in densely populated regions [13]. This underscores the necessity for comprehensive sustainability measures to lessen the aviation sector's ecological footprint. [14] in their study, shed light on the intertwined challenges of sustainability and climate change within the global tourism and aviation industries.

With a rigorous bibliometric analysis of 772 articles, the researchers unveiled a critical issue: the energy-intensive nature of tourism activities, contributing significantly to greenhouse gas emissions. Notably, they underscored the aviation sector's substantial carbon footprint, which poses a pressing need for action. While the aviation industry has shown commitment to the Paris Agreement targets through initiatives like Sustainable Aviation Fuels (SAF), the study also raised concerns about the industry's consistent, long-term dedication to these sustainability goals. This research, therefore, serves as a clarion call for the aviation industry to reinforce its efforts to combat climate change and contribute to a more sustainable future. [15] introduced a unique perspective on sustainability by unveil-

ing the Comprehensive Strategic Analysis for Sustainability framework. This comprehensive framework aimed to address the complex challenge of climate risks and organizational resilience. Through a real-world case study, they uncovered the intricate interplay of factors affecting sustainable innovation within the aviation industry. The case study revealed that the scope of sustainability challenges goes beyond individual organizations and requires a systemic approach, emphasizing the importance of considering external factors and stakeholders in the pursuit of sustainability. The framework offers valuable insights into the kind of holistic, integrated approaches necessary to tackle sustainability challenges in the aviation sector effectively.

[16] delved into an often-overlooked aspect of sustainability in aviation: the end-of-life management of bio composites. Their structured approach to evaluating various recycling technologies provided concrete evidence of the technical, economic, and environmental viability of solvolysis and pyrolysis for bio composite waste treatment. This research not only highlighted the practicality of these methods but also underscored their potential to significantly reduce the aviation industry's environmental footprint. It stands as a testament to the innovative solutions that can contribute to sustainability within the industry. [17] addressed one of the most crucial aspects of sustainability in aviation - the pursuit of environmentally sustainable policies and net-zero emissions. While acknowledging the industry's growing commitment to environmental goals, they emphasized the formidable challenges that lie ahead. This research invites a critical examination of the aviation industry's efforts, underscoring the need for robust strategies and collaborative actions to realize a sustainable aviation future. [18] offered an insightful perspective on the role of material selection in aviation sustainability. Their innovative decision support tool, which considers both ecological and economic dimensions, demonstrated the importance of selecting materials that align with specific criteria. This approach not only contributes to environmental sustainability but also has economic implications, potentially driving more sustainable practices within the aviation industry. [19] delved into the promising realm of hydrogen as an alternative fuel for aviation, emphasizing its potential to reduce environmental impact and carbon emissions. However, the research highlighted significant challenges in terms of storage, cost, and the entire value chain. This analysis prompts an examination of the practicality and readiness of alternative fuels in the aviation industry, shedding light on the need for further technological and infrastructural developments.

[20]focused on the externalities of air transport and proposed strategies to internalize these external impacts. This research underscores the complexities of balancing the economic and social benefits of the aviation industry with its environmental costs. It highlights the importance of adopting a sustainable approach to mitigate environmental impacts while ensuring the industry's continued vitality. [21] offered a comprehensive review of technological advancements aimed at reducing emissions and noise in aviation. By emphasizing the role of engine technology, aerodynamics, combustors, and exhaust systems, the research illuminated the aviation industry's continuous efforts to meet increasingly stringent emissions and noise standards. It showcased the industry's commitment to embracing technological innovations to enhance sustainability. [22] presented a forward-looking analysis of the green aviation industry. They explored trends related to noise, environmental impact, and green image, offering a roadmap for the industry's sustainable development. Their emphasis on the need for an integrated green aviation industry support system, involving

stakeholders, innovative technologies, environmental policies, and public support, highlights the multifaceted approach required to promote sustainability within the aviation sector. This research serves as a strategic guide for the industry as it navigates the sustainability challenges and opportunities.

## 3 Research Model

In a time when there is a growing concern about environmental impact, social responsibility, and economic stability, the aviation industry has become a crucial intersection of sustainability dimensions [23]. As demand for air travel continues to rise, it is now essential for the civil aviation sector to scrutinize and implement sustainable practices. This study aims to provide an objective analysis of sustainability in civil aviation by examining the environmental, social, and economic aspects of sustainability within the sector. The research objectives framed for the study are:

To analyze the distribution of published articles by year, with a specific emphasis on identifying trends and changes in the field over time, especially in light of the increased interest in sustainable aviation and

To determine the top journals and authors in the field, as well as their contributions to the body of knowledge related to sustainability in civil aviation.

The ultimate aim is to clarify the factors that influence sustainability in civil aviation and their impact on industrial performance. The following research model strives to serve as a well-organized framework to scrutinize these complex associations and furnish noteworthy perspectives for aviation stakeholders, policymakers, and researchers.

## 4 Research Methodology

As scientific research increasingly relies on data, the availability and interpretability of this data have become essential components of the scientific process. Importantly, transitioning from raw or retrieved data to usable information presents a significant challenge. As with other fields, bibliometric analysis workflows involve multiple distinct stages, each of which utilizes software tools [24]. Bibliometric analyses are easier to conduct and require less effort using web services and software specifically designed for this purpose. Many databases containing citation data are available online. The foremost publishers of such databases, including Clarivate Analytics and Elsevier, advertise their products, such as the Web of Science (WoS) and Scopus, through online and in-person seminars. It is worth noting that the number of articles dedicated to bibliometric analysis has quadrupled since 2000 [25]. The R 4.3.1 software package was utilized for data analysis. This open-source program offers researchers a complimentary platform for research and analysis and includes numerous add-ons for further development. To conduct the Bibliometric analysis, we utilized the sub-plugin named bibliometrix within the R program and analyzed data.

The data for the present study was acquired from the Web of Science (WoS) database on 31st August 2023 by searching for the keyword block "sustainability" and "aviation"

and undergoing a filtering process. The filtering process only took into account English-language articles indexed in SSCI and SCI-Exp. A total of 123 academic articles that met these criteria were identified. Research Universe comprised of the 123 articles obtained cover the years 2001 to 2023. Over the period between 2022 and 2023, 26 and 14 articles respectively were accepted for publication and included in the research as they are going through the early access process. Because the assignment of the articles to a specific issue after acceptance for publication in indexed journals can take approximately 2-3 years, the articles were published in early visibility to make the authors' work available without delay. These articles appeared in 57 journals. There were 5,708 references to publications in the articles.

# 5 Results and Discussion

## 5.1 Results

Researchers have used different qualitative and quantitative literature review methods to understand and organize previous research. Bibliometric analysis, which depends on statistical measurement of science, scientists, or scientific activity, is one method that has the potential to introduce a precisely defined, transparent, and replicable review process. Compared to other approaches, bibliometrics provides impartial and dependable analyses. It facilitates the methodical appraisal of extensive amounts of data, thereby rendering possible the identification of trends that become discernible over prolonged periods, the detection of shifts in disciplinary divisions, the recognition of influential scholars and institutions, and the presentation of comprehensive research [26]. In this context, a comprehensive analysis has been carried out on the yearly rate of article publications, top journals concerning publications. Table 1 displays basic information on the articles included in the research pool.

**Table 1.** Data Set Profile

| Description | Results |
|---|---|
| Main Information about the Data | |
| Timespan | 2001:2023 |
| Sources (Journals, Books, etc) | 57 |
| Documents | 123 |
| Annual Growth Rate % | 12.74 |
| Document Average Age | 3.92 |
| Average citations per doc | 10.62 |
| References | 5.708 |
| Document Contents | |
| Keywords Plus (ID) | 313 |
| Author's Keywords (DE) | 568 |
| Authors | |

| | |
|---|---|
| Authors | 339 |
| Authors of single-authored docs | 16 |
| **Authors Collaboration** | |
| Single-authored docs | 18 |
| Co-Authors per Doc | 3.28 |
| International co-authorships % | 18.7 |
| **Document Types** | |
| Article | 97 |
| Article; Early access | 3 |
| Article; Proceedings paper | 4 |
| Editorial material | 5 |
| Proceedings paper | 4 |
| Review | 9 |
| Review; Early access | 1 |

As can be seen from table 1, Timespan considered for the study is from 2001 to 2023.The 123 documents sourced for the analysis in Table 1 have come from 57 different journals and books. While co-author per document is an impressive number of 3.28, the international co-authorship stands at 18.7, which is relatively low as compared to other global phenomena.

**Table 2.** Distribution of Articles by Years

| Year | Articles | Year | Articles |
|---|---|---|---|
| 2001 | 1 | 2013 | 2 |
| 2002 | - | 2014 | 3 |
| 2003 | - | 2015 | 5 |
| 2004 | - | 2016 | 7 |
| 2005 | - | 2017 | 3 |
| 2006 | - | 2018 | 10 |
| 2007 | - | 2019 | 10 |
| 2008 | - | 2020 | 12 |
| 2009 | 1 | 2021 | 20 |
| 2010 | - | 2022 | 26 |
| 2011 | 1 | 2023 | 14 |
| 2012 | 8 | | |
| Total | | | 123 |

Table 2 displays the yearly distribution of published articles. The first publication regarding sustainability in aviation was issued in 2001. Although the number of publications has fluctuated in subsequent years, there was a significant rise in 2022, with 26 articles published, comprising 21% of the total publications recorded to date. Since the outbreak of the pandemic, increased environmental awareness and a desire for more efficient resource utilization have heightened interest in sustainable aviation.

The 123 scholarly articles used in this study were published in 57 journals. Table 3 displays the magazines with the greatest number of publications.

**Table 3.** Journals with the Highest Number of Publications

| Journals with the Highest number of Publications | Articles |
|---|---|
| International Journal of Sustainable Aviation | 14 |
| Sustainability | 14 |
| Transportation Research Record | 8 |
| Energy | 5 |
| Journal of Air Transport Management | 5 |
| Energies | 4 |
| Journal of Cleaner Production | 4 |
| Technology in Society | 4 |
| Aerospace | 3 |
| Frontiers in Energy Research | 3 |
| International Journal of Sustainable Aviation | 14 |

The International Journal of Sustainable Aviation and Sustainability boasts the largest number of publications (14). IJSA covers a variety of aviation topics with a focus on environmental concerns and sustainability. Sustainability is a cross-disciplinary, peer-reviewed, open-access journal that investigates the environmental, cultural, economic, and social sustainability of humankind. It offers a demanding forum for research on sustainability and sustainable development and is accessible bi-monthly online via MDPI. Of all the papers published, 64 were submitted by the top ten journals, constituting 52% of the overall total.

### 5.2 Discussion

In the discussion, we have systematically examined the evolving landscape of sustainability within the aviation industry through rigorous bibliometric analysis. The research objectives have provided valuable insights into the field's trends, key contributors, and prevalent themes. Notably, the substantial increase in publications in 2022 and 2023 underscores a growing interest in sustainable aviation, likely driven by heightened en-

vironmental awareness and the imperative for more resource-efficient aviation practices in the wake of the global pandemic. This analysis offers a comprehensive framework for aviation stakeholders, policymakers, and researchers to understand the current state of research and practice in sustainable aviation. The distribution of articles by year, top journals, and prolific authors further illuminates the academic landscape, enhancing academic and practical understanding.

## 6 Conclusion

In conclusion, this research serves as a valuable resource for stakeholders and scholars engaged in the aviation industry. The study's comprehensive analysis of sustainability within aviation, supported by bibliometric methods, has unveiled key trends and identified the central players in this field. The surge in publications in recent years indicates a positive shift toward addressing sustainability concerns within the aviation sector. This not only contributes to the academic understanding of sustainable aviation but also offers practical implications for industry professionals working to create a more sustainable future for air travel. The study underlines the urgent need for sustainable practices in aviation and offers a roadmap for future research and policy developments in this critical intersection of environmental impact, social responsibility, and economic stability.

### References

1. Alsarayreh MMM, AlSuwaidi MF, Al Sharif RA, Kutty AA. The factors affecting CO 2 emission in the European union countries: A statistical approach to sustainability across the food industry. In: IEEE; 2020:599-604.
2. Kutty AA, Yetiskin Z, Abraham MM, Nooh MA, Kucukvar M, Abdella GM. An empirical assessment on the transportation sustainability indicators and their impact on economic productivity. In: ; 2020:10-14.
3. ATAG, Aviation Supporting the UN Sustainable Development Goals. https://aviationbenefits.org/un-sustainable-development-goals/, August 2020.
4. García-Olivares A, Solé J, Samsó R, Ballabrera-Poy J. Sustainable European transport system in a 100% renewable economy. Sustainability. 2020;12(12):5091.
5. Wang Z, Huang W, Chen Z. The peak of CO2 emissions in China: a new approach using survival models. Energy Econ. 2019;81:1099-1108.
6. Hadi-Vencheh A, Wanke P, Jamshidi A, Chen Z. Sustainability of Chinese airlines: A modified slack-based measure model for CO2 emissions. Expert Syst. 2020;37(3):e12302.
7. Kucukvar M, Onat NC, Haider MA. Material dependence of national energy development plans: The case for Turkey and United Kingdom. J Clean Prod. 2018;200:490-500.
8. Reducing emissions from aviation. Eur Comm. Published online 2020. Accessed July 19, 2023. https://ec.europa.eu/clima/policies/transport/ aviation_en
9. Ng KS, Farooq D, Yang A. Global biorenewable development strategies for sustainable aviation fuel production. Renew Sustain Energy Rev. 2021;150:111502.
10. Airport Sustainability.; 2023. Accessed July 8, 2023. https://www.aci-europe.org/industry-topics/industry-topics/28-airport-sustainability.html

11. Developing Sustainable Aviation Fuel (SAF). IATA. Accessed January 9, 2023. https://www.iata.org/en/programs/environment/sustainable-aviation-fuels/
12. BOEING 787 DREAMLINER.; 2020. https://www.boeing.com/commercial/787/
13. EPA in North Dakota. EPA. Published online 2023. https://www.epa.gov/nd
14. Leal Filho W, Ng AW, Sharifi A, et al. Global tourism, climate change and energy sustainability: assessing carbon reduction mitigating measures from the aviation industry. Sustain Sci. 2023;18(2):983-996.
15. Heyes G, Urquhart C, Hooper P, Thomas C. Comprehensive Strategic Analysis for Sustainability: An Aviation Industry Case Study. Sustainability. 2023;15(11):8806.
16. Ferjan Š, Jovičić M, LardiésMiazza N, et al. Sustainability Assessment of the End-of-Life Technologies for Biocomposite Waste in the Aviation Industry. Polymers. 2023;15(12):2689.
17. Sengur FK, Altuntas O. Taking Off for Net-Zero Aviation: Sustainability Policies and Collaborative Industry Actions. In: Achieving Net Zero. Vol 20. Emerald Publishing Limited; 2023:233-250.
18. Markatos DN, Pantelakis SG. Assessment of the impact of material selection on aviation sustainability, from a circular economy perspective. Aerospace. 2022;9(2):52.
19. Yusaf T, Fernandes L, Abu Talib AR, et al. Sustainable aviation—Hydrogen is the future. Sustainability. 2022;14(1):548.
20. Ekici F, Orhan G, Gümüş Ö, Bahce AB. A policy on the externality problem and solution suggestions in air transportation: The environment and sustainability. Energy. 2022;258:124827.
21. Barbosa FC. Aircraft Emissions and Noise Review–Technological Paths for Pursuing Sustainability in the Aviation Industry. SAE Technical Paper; 2021.
22. Qiu R, Hou S, Chen X, Meng Z. Green aviation industry sustainable development towards an integrated support system. Bus Strategy Environ. 2021;30(5):2441-2452.
23. Ranjbari M, Esfandabadi ZS, Zanetti MC, et al. Three pillars of sustainability in the wake of COVID-19: A systematic review and future research agenda for sustainable development. J Clean Prod. 2021;297:126660.
24. Guler AT, Waaijer CJ, Mohammed Y, Palmblad M. Automating bibliometric analyses using Taverna scientific workflows: A tutorial on integrating Web Services. J Informetr. 2016;10(3):830-841.
25. Gureyev VN, Mazov NA. Detection of information requirements of researchers using bibliometric analyses to identify target journals. Inf Technol Libr. 2013;32(4):66-77.
26. Aria M, Cuccurullo C. bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetr. 2017;11(4):959-975.