


GREEN FINANCE FOR SUSTAINABLE AVIATION: STAKEHOLDER PERSPECTIVES AND SYSTEMATIC REVIEW

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 20 February 2023</p> <p>Accepted 18 May 2023</p>	<p>Purpose: This systematic literature review aims to examine the relationship between ESG ratings, sustainability performance, and green finance in the aviation industry. The primary purpose of this study is to provide insights into the opportunities and challenges of green and sustainable finance in the aviation industry.</p>
<p>Keywords:</p> <p>Environmental; Social; Governance (ESG); Rating; Sustainability Performance; Green Finance; Aviation Industry; Stakeholder Involvement; Sustainable Aviation Fuel; Low-Carbon Transition.</p>	<p>Theoretical framework: The study draws on the concept of green finance, which has gained significant attention in recent years. The theoretical framework of this study is based on the need for a comprehensive approach that includes policy incentives, technological innovation, and sustainable fuels to achieve sustainable aviation.</p> <p>Design/methodology/approach: The study adopted the systematic literature review (SLR) method to analyse the existing literature, following three steps for research; planning the review, conducting the review, and reporting.</p> <p>Findings: The study finds that sustainable finance and investment are critical in achieving sustainable aviation. The use of sustainable aviation fuel is essential, but investment is needed to scale up production and reduce costs. Stakeholder involvement in financing ESG factors and sustainability issues is crucial, with standardization, awareness, and incentives necessary to promote sustainable finance and ESG practices in the aviation industry. Green finance can support emissions reduction and promote sustainable development in aviation, but more investment and collaboration are required.</p>
	<p>Research, Practical & Social implications: The study recommends transitioning to a low-carbon industry, with sustainable finance playing a critical role in making this transition possible. The study has practical implications for understanding the subject in the context of ESG criteria and its contribution to sustainability in the aviation industry. The originality value lies in the comprehensive analysis of the existing literature, highlighting the importance of green and sustainable finance in achieving sustainability goals. The study's social implications are significant, given the critical role aviation plays in global emissions, underscoring the need for a sustainable aviation industry.</p> <p>Originality/value: The study's originality value lies in the comprehensive analysis of the existing literature, highlighting the importance of green and sustainable finance in achieving sustainability goals. It provides insights into the opportunities and challenges of green and sustainable finance in the aviation industry, making a significant contribution to the existing literature.</p> <p>Doi: https://doi.org/10.26668/businessreview/2023.v8i5.2085</p>

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FINANCIAMENTO VERDE PARA A AVIAÇÃO SUSTENTÁVEL: PERSPECTIVAS DAS PARTES INTERESSADAS E REVISÃO SISTEMÁTICA

RESUMO

Objetivo: Esta revisão sistemática da literatura tem como objetivo examinar a relação entre as classificações ESG, o desempenho da sustentabilidade e as finanças verdes no setor de aviação. O objetivo principal deste estudo é fornecer percepções sobre as oportunidades e os desafios das finanças verdes e sustentáveis no setor de aviação.

Estrutura teórica: O estudo se baseia no conceito de finanças verdes, que tem recebido atenção significativa nos últimos anos. A estrutura teórica deste estudo se baseia na necessidade de uma abordagem abrangente que inclua incentivos políticos, inovação tecnológica e combustíveis sustentáveis para alcançar a aviação sustentável.

Projeto/metodologia/abordagem: O estudo adotou o método de revisão sistemática da literatura (SLR) para analisar a literatura existente, seguindo três etapas de pesquisa: planejamento da revisão, realização da revisão e relatório.

Conclusões: O estudo conclui que o financiamento e o investimento sustentáveis são fundamentais para a obtenção de uma aviação sustentável. O uso de combustível de aviação sustentável é essencial, mas é necessário investimento para aumentar a produção e reduzir os custos. O envolvimento das partes interessadas no financiamento de fatores ESG e de questões de sustentabilidade é crucial, com padronização, conscientização e incentivos necessários para promover finanças sustentáveis e práticas ESG no setor de aviação. O financiamento verde pode apoiar a redução de emissões e promover o desenvolvimento sustentável na aviação, mas são necessários mais investimentos e colaboração.

Implicações sociais, práticas e de pesquisa: O estudo recomenda a transição para um setor de baixo carbono, com as finanças sustentáveis desempenhando um papel fundamental para tornar essa transição possível. O estudo tem implicações práticas para a compreensão do assunto no contexto dos critérios ESG e sua contribuição para a sustentabilidade no setor de aviação. O valor da originalidade está na análise abrangente da literatura existente, destacando a importância das finanças verdes e sustentáveis para atingir as metas de sustentabilidade. As implicações sociais do estudo são significativas, dado o papel fundamental que a aviação desempenha nas emissões globais, ressaltando a necessidade de um setor de aviação sustentável.

Originalidade/valor: O valor da originalidade do estudo está na análise abrangente da literatura existente, destacando a importância das finanças verdes e sustentáveis para atingir as metas de sustentabilidade. Ele fornece insights sobre as oportunidades e os desafios das finanças ecológicas e sustentáveis no setor de aviação, fazendo uma contribuição significativa para a literatura existente.

Palavras-chave: Ambiental, Social e Governança (ESG), Classificação, Desempenho de Sustentabilidade, Finanças Verdes, Setor de Aviação, Envolvimento das Partes Interessadas, Combustível de Aviação Sustentável, Transição de Baixo Carbono.

FINANCIACIÓN VERDE PARA UNA AVIACIÓN SOSTENIBLE: PERSPECTIVAS DE LAS PARTES INTERESADAS Y REVISIÓN SISTEMÁTICA

RESUMEN

Propósito: Esta revisión bibliográfica sistemática pretende examinar la relación entre las calificaciones ASG, los resultados en materia de sostenibilidad y la financiación ecológica en el sector de la aviación. El objetivo principal de este estudio es proporcionar información sobre las oportunidades y los retos de la financiación ecológica y sostenible en el sector de la aviación.

Marco teórico: El estudio se basa en el concepto de finanzas verdes, que ha recibido una atención significativa en los últimos años. El marco teórico de este estudio se basa en la necesidad de un enfoque global que incluya incentivos políticos, innovación tecnológica y combustibles sostenibles para lograr una aviación sostenible.

Diseño/metodología/enfoque: El estudio adoptó el método de revisión bibliográfica sistemática (RLS) para analizar la bibliografía existente, siguiendo tres pasos de investigación: planificación de la revisión, realización de la revisión y elaboración del informe.

Conclusiones: El estudio concluye que la financiación y la inversión sostenibles son fundamentales para lograr una aviación sostenible. El uso de combustible de aviación sostenible es esencial, pero se necesita inversión para aumentar la producción y reducir los costes. El compromiso de las partes interesadas en la financiación de los factores ASG y las cuestiones de sostenibilidad es crucial, siendo necesarias la normalización, la concienciación y los incentivos para promover las finanzas sostenibles y las prácticas ASG en el sector de la aviación. Las finanzas verdes pueden apoyar la reducción de emisiones y promover el desarrollo sostenible en la aviación, pero se necesita más inversión y colaboración.

Implicaciones sociales, prácticas y de investigación: El estudio recomienda una transición hacia un sector con bajas emisiones de carbono, en la que las finanzas sostenibles desempeñen un papel clave para hacer posible esta

transición. El estudio tiene implicaciones prácticas para entender la cuestión en el contexto de los criterios ASG y su contribución a la sostenibilidad en el sector de la aviación. El valor de la originalidad reside en la revisión exhaustiva de la bibliografía existente que pone de relieve la importancia de las finanzas verdes y sostenibles para alcanzar los objetivos de sostenibilidad. Las implicaciones sociales del estudio son significativas dado el papel clave que desempeña la aviación en las emisiones mundiales, lo que pone de relieve la necesidad de un sector de la aviación sostenible.

Originalidad/valor: El valor de originalidad del estudio radica en la revisión exhaustiva de la literatura existente, destacando la importancia de las finanzas verdes y sostenibles para alcanzar los objetivos de sostenibilidad. Aporta ideas sobre las oportunidades y los retos de las finanzas verdes y sostenibles en el sector de la aviación, lo que supone una contribución significativa a la bibliografía existente.

Palabras clave: Medio Ambiente, Social y Gobernanza (ESG), Calificación, Desempeño de Sostenibilidad, Finanzas Verdes, Sector de la Aviación, Compromiso de las Partes Interesadas, Combustible de Aviación Sostenible, Transición a Baja Emisión de Carbono.

INTRODUCTION

With Environmental, Social, & Governance (ESG) gaining global popularity among the public, regulators and investors, Green Finance is growing its presence in the aviation industry too.

In this study ‘aviation industry’ or ‘commercial aviation’ refers to the segment of the civil aviation industry that involves aircraft operations (i.e., airline or commercial airline) for remuneration (e.g., passenger & cargo transport and excluding general/business & private aviation) and related major activities like aircraft lessors & financing companies, major infrastructure like airports. So, the study here is more focused around green financing with involvement of airlines, airports and aircraft lessors / investors & financing companies. Among most of the examples of green financing recently, two types of financing are used:

- Green Loans or Bonds and
- Sustainability-Linked Loans or Bonds

The key difference between the two is that sustainability-linked loans can be used for general financing but with the interest rates linked to ESG factors and whereas green bonds or loans must be used for specified green projects (usually with a fixed and predefined interest rate) (Watson Farley & Williams LLP, 2021). The sustainability-linked loans seem to be offering better terms or interest rates, which can motivate to seek for such loans to improve both financial and ESG performance. Despite various efforts by stakeholders to promote innovative financing and personal finance, investment in emissions control in commercial and private air transport is still limited (Juliet Angom, 2021). The current goals of climate-focused investment in the aviation industry may require a significant overhaul of the regulated financial system (Dhurba P. & Runa Sarkar, 2021). The aviation industry is seeing a growing shift

towards ESG-linked financing sources, which presents both opportunities and challenges for industries and investors alike. (White & Case, 2022). Despite the challenges and high financial costs associated with promoting Green Finance and Sustainable Development Goals in the Aviation Industry, investors are still hesitant to refuse financing due to the lack of a green score. (Can OZTURK, 2022)., The financing of oil and gas industry-related activities by funding institutions and helicopter lessors is facing increasing challenges, indicating a shift towards sustainable finance practices. (KPMG 2022). As (Juliet Angom) notes, major aviation stakeholders have already taken steps towards sustainable finance solutions, with a focus on aircraft financing, SAF, and infrastructure development. As (Yaghaub Abdi et al.) report, nearly 40% of the top airlines globally have made sustainability investments a part of their strategic plans. However, effective communication of these commitments and performance remains a challenge, as (Jadoon et al.) point out. Despite these challenges, ESG norms are being used to enhance corporate sustainability in the aviation industry, as (Sharma et al.) note.

Like the other industries or businesses globally, given the perceived benefits of Green Finance on climate change they are considered important in the aviation industry as well. Climate change and sustainability are some of the most growing concerns globally in aviation due to the guidelines and recommendations brought in by international organizations/agreements like; UNCC COP26, Paris Climate Agreement, CORSIA, COP 26, ICAO, EU, IATA, and other leading organizations. The combined goals were that we must control the rise of the global temperature below 2 °C and try to bring it below 1.5 °C. With the pressure by these organizations, and public activists to drive the goal to lower carbon footprints, some regulatory changes are proposed or being implemented in a positive direction in both aviation and financial markets, for example, EU Taxonomy Regulation. This has introduced the aircraft manufacturing technology development, leasing of aircraft, Fuel production, storage, and distribution of SAF and other advanced fuels, air traffic management (ATM) and airport operations and ground handling and construction of airport infrastructure as some of the qualifying criteria under the category of low-carbon activity or a transition activity (Norton Rose Fulbright, 2021). The reporting by the companies is expected to become mandatory by 2023. Like the many EU regulations, especially in aviation; given the potential of EU Taxonomy Regulation becoming more and more globally acceptable or based for such regulations worldwide, it would not only motivate the companies to help shift investments towards more environmentally friendly activities and as well as protect private investors from greenwashing as they would be able to refer a more widely acceptable reporting

regulation/system in place. The regulations, awareness and policies related to green & sustainable finance in the aviation industry are yet to achieve global standardizations to avoid greenwashing. ESG criteria assess a company's impact on the environment, society, and governance practices. Widely used frameworks include GRI, SASB, and TCFD. Sustainability ensures responsible resource use and minimizing negative impact on environment and society. Aviation's impact on the environment requires addressing carbon emissions, energy efficiency, renewable energy, noise pollution, waste, and water usage. The industry faces social and governance challenges such as safety, diversity, and labour practices. Implementing ESG criteria and frameworks can help address these challenges. The aviation industry has not been left behind in the adoption of Green and Sustainable Finance (GSF), which has become increasingly popular among investors, regulators, and the public. This study focuses on GSF in the commercial aviation industry, which includes airlines, airports, and aircraft lessors and financing companies. GSF is becoming more common in aviation, with green bonds or loans and sustainability-linked loans being the two most used financing methods. Given the growing concern about climate change and sustainability globally, the aviation industry is under pressure to reduce its carbon footprint. International organizations and agreements such as the UNCC COP26, Paris Climate Agreement, and CORSIA have recommended that aviation adopt low-carbon activities to help control the global temperature rise below 2 °C. The EU Taxonomy Regulation is also driving change in the aviation industry by introducing criteria for low-carbon activities or transition activities. However, there is still a lack of global standardization in policies related to GSF, which could lead to greenwashing. This study aims to contribute to the understanding of GSF in the aviation industry by exploring the relationship between ESG ratings, sustainability performance, and GSF. The study's objective is to provide insights into the role of GSF in achieving sustainable aviation and the policy incentives, technological innovation, and sustainable fuels necessary to make this possible. The study's practical implications include recommendations for stakeholder involvement in financing ESG factors and sustainability issues, standardization, awareness, and incentives to promote sustainable finance and ESG practices in the aviation industry. The study's theoretical contribution lies in exploring the relationship between ESG ratings, sustainability performance, and GSF in the aviation industry, which has not been extensively researched.

LITERATURE REVIEW

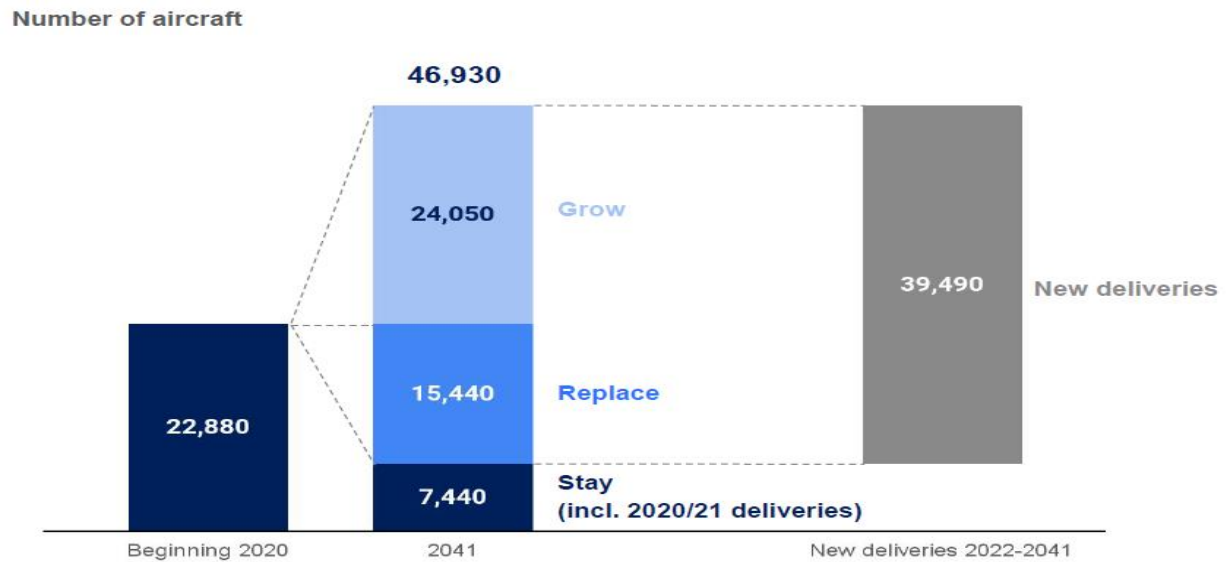
Theme based literature review for green finance in aviation is planned based on the following:

- General concepts of green and sustainability in other and aviation industry
- Current and evolving regulatory framework impacting the green and sustainability action or behaviour of the aviation industry
- Airline, airport, and aircraft financing
- Airport Infrastructure sustainability
- ESG in aviation / airline / aircraft leasing

The Paris Climate Agreement objectives in the long term would be more challenging. According to reports, it can be emphasised that there is a limited amount of time to enforce emission-reduction initiatives, so the spread of renewable energy, decrease of coal usage, advancement of energy efficiency, electric transitions in sectors like mobility, and carbon reduction attempts in energy-intensive sectors must all be accelerated (IRENA, 2019). In these conditions, green and sustainable finance, which provides funding for environmental initiatives, is becoming more and more important. Furthermore, (“Green Finance: Trends and Financial Regulations Prospects,” 2018, 9-17) analysed the trends and significant regulations pertaining to the prospects of green finance. The researchers tried to accomplish the research objectives by identifying the framework pertaining to green finance and addressing the innovations regarding the development of financial tools. The findings of the study indicated the practices of green finance that are adopted on a global level and the trends and characteristics of green funding and capital to ensure the development of a green economy. The researchers segregated the concept of green finance into two parts: the financial tools and green funding. The financial tools include green bonds, green insurance, green state procurements, green funds, green mortgage, and green taxes. While the Green funding includes funding of green projects, green companies funding, subsidisation, tax expenses, credit, private green projects funding and target budget funding. The results of these green finance initiatives are green growth and environmental sanitation. This further includes a framework for the development of carbon markets, initiation of green firms, decrease of financial risks, conservation and replication of natural wealth, and provision of rules and regulations for the sanitisation of the environment. Similarly, (Arkhipova, 2017, 312-332) asserted that the multidisciplinary approach and principles of environmental sustainability and ethical financing are captured in the growing discipline of “green” finance, which proves to be a vision and innovative path for international

development and solving a variety of global challenges. The active engagement of emerging nations in the designing, local testing, and worldwide promotion of "green" projects is emphasised by the green financing operations. The researcher asserts that Green financial reforms are expected to have a symbiotic impact and transnational advantages in the way of monetary recovery and environmental benefits for the international economy.

Figure 1 - Demand of aircraft in next 20 years



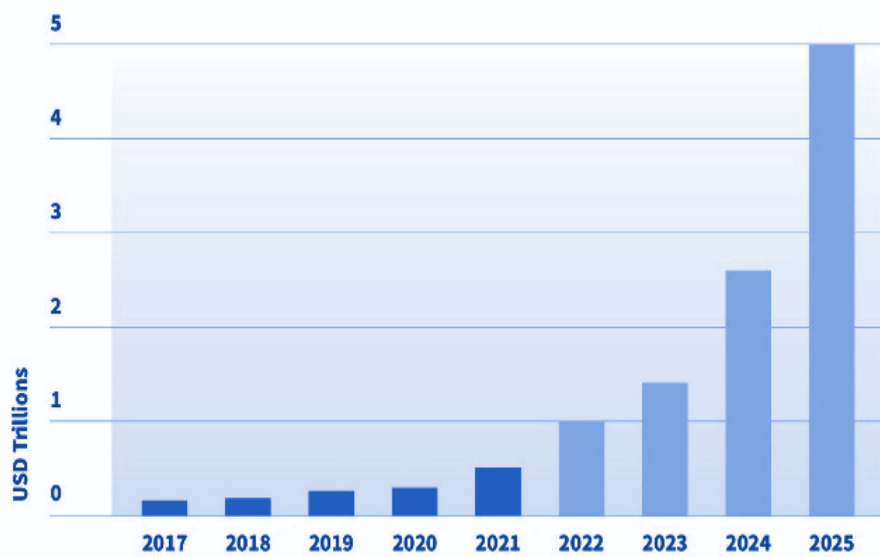
Source: Airbus

In line with the passenger forecast, the current commercial aircraft fleet, which is about 23000-25000 as suggested by various sources from OEMs or independent agencies, could grow nearly double by 2040 with approx. 80% fleet renewal, from 25,900 to 49,405 (Statista, 2022) and approx. 47,000 commercial aircraft in service by 2041, including approx. Forty thousand new deliveries (Airbus, 2022) (Boeing, 2022). Switching to a renewable and low-carbon fuel like SAF is an ample opportunity in the aviation sector. However, a colossal foot scale is a real challenge to execute; significant investments in new production facilities and operating costs must be reduced. The global investment needs for the airport and traffic management infrastructure are additional investments to support the industry's future growth, and ESG will also remain a compelling factor for them. Is a flight-free future impossible? Likely no. so the pressure on stakeholders keeps mounting on the steps it should take to support the initiatives for net zero and bring the capital needed from alternate sources. With the conventional or historical financing ways in the aviation industry, financed by equity and debt investors, it has yet to see profitability in short cycles, mainly due to the long development cycles of aircraft and airline business models. Especially the critical activities like large aircraft orders (almost

50%) come from leasing companies; they ultimately financed the developments of new technologies for conventional aircraft and future aircraft like hydrogen-powered, EVTOLs or UAM by OEMs. Now with given recent examples of disruption or slow recovery of airlines and mounting losses after Covid-19, reduced active players. More than 75 lessors/investors were active before the pandemic of COVID-19 in bidding on new sales & leaseback from airlines and acquiring portfolios from other lessors. After the pandemic of COVID-19 reduced to 10-12 players (Wadhawan, 2021), future aircraft financing to meet future passenger demand, development of new technology aircraft including EVTOLs, infrastructure development, fuel, and other market-driven objectives, the capital demand of the industry is unlikely to be met through conventional or historical financing. Narrowing the research to the aviation industry, it has been observed that in the context of sustainability, the aviation industry continues to be under the limelight, notably in terms of carbon emissions. As per the article of (Watson Farley & Williams LLP, 2021) to achieve a substantial decrease in carbon emissions across the European aviation industry, the airlines must be provided with the incentives of green financing in order to make an alternative that is less-carbon intensive. Especially in the reference and effect of the European taxonomy on green finance, it is critical that the European Commission establishes a practical screening criterion for the aviation industry in a logical and functional manner. Moreover, the Aviation Advisory Committee has sent an online petition to the European Commission outlining a precepts approach on how the taxonomy might be implemented to aviation finance and leasing. It is believed that the Commission's approach would push the aviation sector to move toward a greener future, within the limits of what is achievable. Similarly, in another article published by (Norton Rose Fulbright, 2021), airline companies have long recognised the need of reducing carbon emissions, with advances in fleet fuel economy which assists in minimising their vulnerability to frequently unpredictable fuel prices. The article highlighted the most prominently used green products for financing the airline industry which included green bonds, green loans, and sustainability linked loans. Apart from the opportunities and benefits of green financing, there also exist several challenges pertaining to the same. Particularly, implementation of green financing and green funding is not an easy task and involves several issues like ambiguity regarding the policies incorporated by the government, weak institutional aid for the commercial viability of technological developments: minimal financial supplier participation, distinct expected returns for capital providers, limited information pertaining to the financing options and more (Falcone & Sica, 2019). Green finance is a rapidly growing area, and many countries around the world have

implemented policies and initiatives to support sustainable finance. As of 2021, there are over 40 countries that have issued green bonds or have plans to do so. Some of the country's leading in green finance include China, the United States, France, and Germany.

Figure 2: Climate Bond Initiative 2022: (Green bond issuance in USD Trillion)



Source: Airbus

Globally approximately \$257.7bn in green bonds were issued in 2019, with a growth rate of 51% from the year before (Blanshard's& Vohra, 2020) and reached an all-time high of \$500 bn in 2021 (Oxford Business Group, 2021), exceeding \$500 billion in 2022 and \$1tn is expected between 2022 and 2025 (Jones, 2022). This exponential growth and dominance define the importance of green/sustainable finance for shaping the future of key global industries, especially the prominent and capital-intensive aviation industry. The aviation industry contributes about 2.1%-2.4% of carbon emissions annually, representing an approximately 32% increase over the previous five-year period (Graver et al., 2019). The contribution of carbon emissions by aviation is 12% among the transport sectors. It may look much smaller ratio compared to other industries impacting the environment, but do not ignore the exponential historical (as well as forecasted) growth of aviation, from 310 million trips in 1970 to 4.4 billion trips in 2019 and rising to 8 billion by 2037 and 10 billion in 2050, says IATA. Based on current projections, it may raise 15–25% of the global CO₂ emissions by 2050, and the scenarios will exceed the carbon budget ultimately (Thummala & Hiremath, 2022). Airlines were expected to lose \$118 bn in 2020 and a further \$38 in 2021, but later, IATA revised those global airline industry losses in 2020-2022 to reach \$201 bn (IATA, 2021). These investments are essential for shaping future air travel and green or sustainable finance can help (Tettamanti, 2022, 211–

228). Sustainable finance is essential for aviation's growth, as the growing desire by regulators and investors to monitor the integration of finance and sustainability into a single report. So, these two areas of finance and sustainability must be compatible (IATA, 2022)

RESEARCH METHODOLOGY

TABLE 1 (SYSTEMATIC LITERATURE REVIEW METHOD)

S No	Research Paper Title	Author	Year	Inference	Tools
1	Environmental Finance: An Interdisciplinary Review	Hu Tao a, Shan Zhuang a, Rui Xue b, Wei Cao c, Jinfang Tian d,e, Yuli Shan f,g,	2022	This paper talks about Environmental finance is a growing interdisciplinary research area and has seen an exponential increase in publications over the past decade. Major research streams include CSR, climate negotiations, natural gas price volatility, national policy, and emerging topics such as climate finance, sustainable finance, firm value, climate risk, and green bonds	bibliometric analysis.
2	Net-zero aviation: Time for a new business model?	Stefan Gossling ^{a,b} , , Andreas Humpe ^c	2023	The paper discusses the challenges of achieving carbon-neutral flight in the aviation industry due to various barriers such as uncertain scalability of transition technologies and airlines' profitability. It highlights the need for reassessing capacity and the	Modeling

				business model to stay within the 1.5°C warming limit.	
3	Sustainability reporting in the airline industry: Current literature and future research avenues	Malgorzata Zieba * , Eljas Johansson	2022	This paper discusses the need for improved sustainability reporting in the aviation industry, as a systematic literature review reveals a lack of unified policy and common understanding of how to define and measure sustainability.	systematic literature review
4	A review of studies on green finance of banks, research gaps and future directions	Isaac Akomea-Frimpong a , David Adeabahb , Deborah Ofosuc and Emmanuel Junior Tenakwaha	2020	This paper talks about reviews existing literature on green finance in the banking sector, identifying key products such as green securities and green credit, and determinants including environmental policies and banking regulations. The results can guide further research and assist banks in adopting and developing green finance.	Content analysis approach
5	Benchmarking Key Success Factors for the Future Green Airline Industry	Muhammad-Azfar Abdullaha*, Boon-Cheong Chewb , Syaiful-Rizal Hamidc	2015	Airlines are increasingly expected to become more environmentally friendly and a research has been conducted to identify the key success factors toward Green Airlines	secondary data analysis
6	DEFINING AND MEASURING GREEN INVESTMENTS: IMPLICATIONS FOR	Inderst, G., Kaminker, Ch., Stewart, F.	2012	This paper provides a review of current definitions of "green" investments	literature review or a survey of existing documents and publications

	INSTITUTIONAL INVESTORS' ASSET ALLOCATIONS			across different asset classes and sizes of these investments. It concludes that due to a lack of consensus on the definition of "green," a flexible and dynamic approach should be adopted with a focus on governance in green investments	
7	EUROPEAN GREEN DEAL — RESEARCH DIRECTIONS. A SYSTEMATIC LITERATURE REVIEW	Danuta Szpilk Joanna Ej dys	2022	This article presents a systematic literature review based on bibliometric analysis to identify and classify scientific research related to the European Green Deal (EGD) issues, which resulted in the identification of eight thematic clusters covering different topics, such as energy, circular economy, industry, and mobility, among others.	Bibliometric analysis
8	Green Finance Performance and Role of Sustainability Engineers in the Greater Bay Area	Hei Yan Lee ¹ , Gladys So ² , Ellie Tang ³ , Tony Lam ¹ , Vincent Cheng ¹	2022	The paper talks about the promotion of green finance in Hong Kong and the role of sustainability engineers in green finance projects, including the need for a standardized benchmarking system for green building environmental impacts and benefits.	Case Study

9	Green property finance and CO2 emissions in the building industry	Hassan F. Gholipour a,* , Amir Arjomandi b , Sharon Yam a	2022	The paper talks about the Green property finance expansion is significantly and negatively related to building industry's CO2 emissions, especially in developing nations, emphasizing the need for policies to maintain this development during the COVID-19 pandemic	Regression analysis
10	Green Finance: A Step towards Sustainable Development	Sharif Mohd. Vijay Kumar Kaushal	2018	Green finance can help balance economic development and environmental degradation by providing financial support for green projects that reduce greenhouse gas and air pollution emissions.	Literature review
11	Green Finance in India Scope and Challenges	Abhishek Ranjan	2021	The paper reviews the development of green finance globally and in India, emphasizing the need for better information management and coordination amongst stakeholders to enable sustainable economic growth	Literature review
12	A review of studies on green finance of banks, research gaps and future Directions	Isaac Akomea-Frimpong, David Adeabah, Deborah Ofosu, Emmanuel Junior Tenakwah	2021	This study reviews existing literature on green finance in the banking sector, identifying key products such as green securities and investments, and determinants	The content analysis approach

				including environmental policies, interest rates, and banking regulations. The results can guide further studies and assist banks in adopting and granting green finance	
13	A Systematic Literature Review of Green and Sustainable Logistics: Bibliometric Analysis, Research Trend and Knowledge Taxonomy	Jianjun Dong, Rui Ren, Wanjie Hu, Bo Sun	2019	The paper reviews the research field of green and sustainable logistics, using a science mapping approach to analyze 306 major papers published from 1999 to 2019. It identifies 50 sub-branches of knowledge, discusses them thematically, and suggests current obstacles and future research opportunities	Science mapping approach.
14	Research on the Sustainable Development and Dynamic Capabilities of China's Aircraft Leasing Industry Based on System Dynamics Theory	Weiwei Lin *, Jing Lu , Jinfu Zhu and Li Xu	2022	This paper applies system dynamics theory to explore the sustainable development of China's aircraft leasing industry and proposes policy recommendations to promote its growth.	System Dynamics theory
15	A systematic literature review concerning the different interpretations of the role of sustainability in project management	Kevin Friedrich1	2021	This paper conducts a systematic literature review to identify and define three different interpretations of the role of sustainability in project management. The authors provide	Systematic literature review

				recommendations for reflecting on the existing literature and redefining the concept of sustainable project management.	
16	Impact of Sustainability on Firm Value and Financial Performance in the Air Transport Industry	Yaghoub Abdi, , Xiaoni Li and Xavier Càmarà-Turull	2020	This paper examines the impact of ESG disclosures on firm value and financial performance of airlines. The results suggest a positive relationship between the environmental and governance pillars and market value and financial efficiency, while the social pillar has a negative association with these variables.	Panel data analysis
17	Sustainable development – the key for green aviation	Maria MRAZOVA*	2014	This paper explores the need for technological progress in the aviation industry to optimize economic, operational, and environmental efficiency, with a focus on the impact of CO2 emissions on climate change. The paper also introduces Airbus's approach to sustainable growth and provides examples of fuel consumption and CO2 emissions measurements for selected airlines	Environmental Analysis

18	The Disruptive Effects of COVID-19 on the Aviation Industry, Food Industry, and E-commerce Industry	Cheng Dai	2020	The article discusses the impact of COVID-19 on the aviation, food, and e-commerce industries, and suggests what local governments and companies should do during the outbreak. COVID-19 has caused serious harm to the aviation and food industries, but has brought great benefits and challenges to the e-commerce industry.	Statistical analysis
19	Opportunities, barriers and issues with renewable energy development – A discussion	Souvik Sen, Sourav Ganguly	2017	Renewable energy sources are essential for sustainable socioeconomic development as they offer a cleaner way to meet energy demands.	Renewable energy (RE) forms
20	Sustainable finance: the European Union's approach to increasing sustainable investments and growth – opportunities and challenges	DUCO CLARINGBOULD, MARTIN KOCH, AND PHILIP OWEN Duco	2019,	The article discusses EU initiatives contributing to sustainable finance, including the definition and theoretical perspective of sustainable finance, as well as existing EU initiatives such as the Action Plan on financing sustainable growth and the EU Emissions Trading System. It also addresses the challenges and political implications of current	Literature review

				sustainable finance policies for the EU	
21	Sustainable Finance: Political Challenges of Development and Implementation of Framework	Claudia Kemfert ^{1,2,3} and Sophie Schmalz ^{1,2} ,	2019	The article highlights the challenges of aligning financial flows with climate change objectives and the state's role in promoting sustainability through direct and indirect means. It also discusses existing challenges and provides a case study on Divestment Strategies	Case study
22	Recent Trends, Opportunities and Challenges of Sustainable Aviation Fuel	<u>Libing Zhang, Terri L. Butler, Bin Yang*</u> ,	2020	This chapter provides an overview of current opportunities for the development of biojet fuels, and the status of several specific challenges facing the industry. Coproduction of jet fuel from waste lignin can dramatically improve the overall economic viability of an integrated process for corn stover ethanol production.	Overview of several reports
23	The EU sustainable finance taxonomy and its contribution to climate neutrality	Franziska Schütze and Jan Stede	2021	The EU Taxonomy is a comprehensive classification system for sustainable economic activities that covers up to 80% of EU greenhouse gas emissions. However, the technical performance	Survey

				thresholds for some sectors are not stringent enough to support the transition towards climate neutrality, and stricter criteria should be applied to new investments than to current activities of companies	
24	Green aviation in India: Airline's implementation for achieving sustainability	Vasavi Thummala, Rahul B. Hiremath	2022	The paper examines the sustainability initiatives and views of airlines operating in India through analysing their websites, annual reports, and media communications. Using frame analysis and NVivo software, the paper categorizes the sustainable initiatives into themes to identify areas for improvement and expansion towards a greener and more sustainable aviation industry	airline's websites, their annual reports, and the media
25	Soaring sustainably: Promoting the uptake of sustainable aviation fuels during and post-pandemic	Kristiana Santos a, Laurence Delian	2021	The aviation industry needs to reduce emissions to meet climate goals. Sustainable aviation fuel (SAF) is a transformative resource to achieve this. Governments and airlines should work together to promote SAF through partnerships and measures such as	Frame analysis.

				policy, financing, and incentives.	
26	Sustainable aviation fuels and imminent technologies - CO2 emissions evolution towards 2050	Ivo Abrantes a, Ana F. Ferreira b, André Silva a, Mário Costa b	2021	The paper discusses the strategies for decarbonizing the aviation industry, which includes improving aircraft technology and deploying sustainable low-carbon fuels. The assessment results reveal that the goals proposed by IATA, carbon-neutral growth from 2020 and a reduction of 50% in net emissions by 2050 compared to 2005 levels, cannot be met only with the combined action of imminent aircraft technologies and the use of alternative fuels	Numerical model
27	Sustainable alternative fuels in aviation	Nadir Yilmaz a, Alpaslan Atmanli	2017	The aviation sector's need for sustainable fuels is increasing due to the negative impacts of petroleum-based fuels on air quality and greenhouse gas emissions. Biofuels have the potential to replace petroleum fuels and reduce costs and emissions, while also supporting social and economic development. Research is being conducted to develop cost-effective biofuel	Survey

				production processes for air and ground vehicles.	
28	Sustainable Aviation Fuels: the challenge of decarbonization	David Chiaramonti	2019	Aviation is a crucial area to reduce greenhouse gas emissions and switching to sustainable aviation fuels (SAF) is the main opportunity. However, large-scale deployment of SAF faces challenges such as high production costs, ASTM certification, and investment in new production facilities	Review
29	Greening aviation in era of COVID-19: Towards conceptualizing and operationalizing decarbonization	Joseph Amankwah-Amoah a, Yaw Debrah b, Sarah Anang a	2023	The abstract describes a study that identifies challenges in achieving net-zero greenhouse gas emissions, with a focus on the global airline industry during the COVID-19 era. The challenges are categorized into policy, organizational, and external factors, including fleet modernization, reliance on fossil fuels, slow development of new technology, and risk of corporate greenwashing	Framework analysis
30	Aviation Legal and Regulatory Framework	Author links open overlay panelVitaly S. Guzhva, Sunder Raghavan, Damon J. D'Agostino	2019	The abstract discusses the unique legal and regulatory issues associated with aircraft financing and leasing,	Case study

				including applicable governing law, conventions and treaties, registration and ownership, liens, and regulatory considerations. It also provides a mini case study to illustrate the applicability of conventions in this industry	
31	Climate ambitions for European aviation: Where can sustainable aviation fuels bring us	Inge MayeresStef ProostEef DelhayePhilippe NovelliSjaak ConijnInmaculada Gomez-JimenezDaniel Rivas-Brousse	2023	The paper evaluates the cost-effectiveness of policies aimed at promoting the uptake of sustainable aviation fuels to reduce greenhouse gas emissions in the EU. It concludes that policies aiming for a minimum sustainable aviation fuel share of 3.5% or 5.25% by 2030 are significantly more expensive than a simpler emission trading mechanism like CORSIA	surveys, interviews, and analysis of existing data sources.
32	Air traffic flow management under emission policies: Analyzing the impact of sustainable aviation fuel and different carbon prices	Sadeque Hamdan a,b,*, Oualid Jouini b, Ali Cheaitou c, Zied Jemai b,d, Tobias Andersson Granberg e, Billy Josefsson	2022	The study investigates the impact of sustainable aviation fuel (SAF) on air traffic flow management (ATFM), considering fuel costs and carbon dioxide emissions, and reveals that SAF can be advantageous from an ATFM perspective, but an appropriate	Optimization model.

				carbon price needs to be set to make it economically and environmentally attractive	
33	Carbon tax or sustainable aviation fuel quota	Changmin Jiang, Hangjun Yang	2021	The paper compares the effectiveness of a carbon tax and a sustainable aviation fuel (SAF) quota in reducing greenhouse gas emissions and maximizing social welfare. It finds that the SAF quota outperforms the carbon tax in emission control when the emission target is more ambitious, and the realized price of traditional aviation fuel (TAF) is lower than the expected value, while carbon tax can lead to higher social welfare when there is no uncertainty in the TAF price	development and analysis of a mathematical model.
34	Climate change, where do we come from and where are we going? European aviation sector behaviour	Esteban Perez-Calderon Patricia Milanes-Montero Cristina Gutiérrez-Perez	2021	This paper examines whether the European aviation sector has adapted since the launch of the EU Emissions Trading Scheme and predicts the sector's future behavior. The results suggest a trend towards minimal eco-efficiency in CO2 emissions, and it is advisable to encourage investments in	Cluster analysis.

				biofuels, international agreements to optimize flight routes, or projects to improve engine efficiency	
35	A review of Corporate Social Responsibility assessment and reporting techniques in the aviation industry	Ivan Stevenzona, Kristina Marintseva	2019	The paragraph discusses the issues related to assessing and reporting Corporate Social Responsibility (CSR) in the aviation industry. It highlights the need for effective CSR assessment techniques, including rating and self-assessment, and presents a theoretical basis for forming such techniques. The use of Fuzzy Theory in forming criteria for assessing a company's CSR activity is also discussed, which could be beneficial for air transport stakeholders making investment decisions	survey of the recent literature on CSR assessment technique
36	Towards greener airports: Development of an assessment framework by leveraging sustainability reports and rating tools	Jegan RamakrishnanTingting LiuRongrong YuKarthick SeshadriZhonghua GouLyster,	2022	This paper aims to develop a green rating framework for airports due to the increasing number of airports and their potential environmental impact. Content analysis approach was used to retrieve environmental information from airport sustainability	Content Analysis approach

				reports to develop the framework.	
37	Analysing the opportunities and challenges for mitigating the climate impact of aviation: A narrative review	.Y. LaiE. ChristleyA. KulanovicC.C. TengA. BjorklundJ. NordensvardE. KarakayaF. Urban.	2022	This paper analyzes the challenges and opportunities of mitigation measures to reduce the climate impact of aviation in Sweden, focusing on limiting travel volume, energy and emission intensity. The study adopts a comprehensive approach, considering the aviation industry as a socio-technical system, with a myriad of stakeholders and actors, in need of complex changes at multiple levels.	Narrative review and semi-systematic approach
38	Strategies towards a more sustainable aviation: A systematic review	Frederico AfonsoMartin SohstCarlos M.A. DiogoSimão S. RodriguesAna FerreiraInês RibeiroRicardo MarquesFrancisco F.C. RegoAbdolrasoul SohoulJoana Portugal-PereiraHugo PolicarpoBruno SoaresBruna FerreiraEdgar C. FernandesFernando LauAfzal Suleman	2023	The paragraph discusses the importance of networking in modern business and how it can be used to generate opportunities and growth. It emphasizes the need to build and maintain genuine relationships, engage in continuous learning and share ideas with a diverse group of people to create a supportive network. Effective networking can lead to new business opportunities, access to resources, and help individuals	Literature review

				grow both personally and professionally	
39	Synthetic fuels in aviation – Current barriers and potential political measures	Janina Scheelhaase*, Sven Maertens and Wolfgang Grimme	2019	The paper discusses the potential of biofuels and synthetic fuels (PtL or e-fuels) to reduce aviation emissions and suggests that synthetic fuels may be more favorable in the long run. The paper also investigates current barriers to the use of e-fuels in air transport and political measures that could facilitate their use	Interviews
40	Study of the current incentive rules and mechanisms to promote biofuel use in the EU and their possible application to the civil aviation sector	Hazariah M. Noh Arturo Benito Gustavo Alonso	2016	The abstract discusses the need to introduce biofuels for the civil aviation sector due to its impact on climate change, and explores various incentive mechanisms for their promotion. The paper also presents a historical review of EU regulations and compares incentive policies worldwide to offer recommendations for the future	Historical Review
41	Stakeholder Views of the Factors Affecting the Commercialization of Aviation Biofuels in Europe	Per Gegg a, Lucy Budd a, Stephen Ison	2015	This paper discusses the potential of biofuels as a substitute for conventional Jet A1 kerosene in the aviation industry to reduce greenhouse gas	Interviews

				emissions and fossil-fuel dependency. However, barriers such as competition for feedstocks, impact on global water resources and biodiversity, and uncertainty surrounding true life-cycle emissions savings must be addressed before widespread commercial deployment can occur.	
42	Stepping up and stepping out of COVID-19: New challenges for environmental sustainability policies in the global airline industry	Joseph Amankwah-Amoah	2020	The paper examines the challenges of adopting and implementing environmental sustainability policies in the global airline industry in the wake of COVID-19, revealing that some airlines have deprioritized environmental sustainability initiatives due to cost pressures and survival threats.	Literature review
43	Aviation biofuel from renewable resources: Routes, opportunities and challenges	Thushara Kandaramath HariZahira YaakobNarayanan N.Binitha	2015	The abstract discusses the need for introducing and industrializing alternative aviation fuels generated from renewable resources, especially biomass, due to the unsustainability of using petroleum fuels in air transport and aviation's contribution to	Literature Review

				greenhouse gas emissions. The paper provides an overview of the opportunities and challenges in developing alternative fuels for aviation and reviews the production process, feedstock, and promising global projects.	
44	Recent development in studies of alternative jet fuel combustion: Progress, challenges, and opportunities	Chi Zhang Xin Hui Yuzhen Lin Chih-Jen Sung	2016	This paper discusses the use of alternative jet fuels to achieve sustainable aviation. Hydrocarbon-based 'drop-in' fuels that are fully interchangeable with current fuels are preferred, and research on their combustion characteristics is highlighted.	previous research and activities on alternative jet fuels.
45	Exploring the green image of airlines: Passenger perceptions and airline choice	Carmen Hagmann Janjaap Semeijn David B. Vellenga	2015	This study examines the impact of companies marketing their products as environmentally friendly, particularly in the airline industry. The findings suggest that the green image of airlines does influence airline choice during booking, but passengers are more willing to pay extra for amenities than for eco-friendliness	validated self completion questionnaire
46	Europe's ambition for biofuels in aviation - A strategic review of	J.P. Deane Steve Pye	2018	Europe's Biofuel FlightPath Initiative aimed to produce 2	Literature review, Survey

	challenges and opportunities			million tons of biojet fuel for the aviation industry by 2020, but this has not yet materialized due to higher costs, investor uncertainty, and poor policy awareness. A clear and stable policy landscape for biojet fuel is needed, along with other non-policy measures, to stimulate the sector	
47	Firms' capabilities for sustainable innovation: The case of biofuel for aviation	Seyedesmaeil Mousavi, Bart A.G. Bossink	2017	The paragraph is about the ways in which companies can use their organizational and managerial capabilities to innovate for sustainability. It identifies critical capabilities that enable the realignment of a firm's dynamic capabilities with sustainable innovation strategies	expert interviews and archival sources
48	Sustainability reporting in the aviation industry: worldwide evidence	<u>Abdullah S. Karaman, Merve Kilic, Ali Uyar</u>	2018	The purpose of this study is to investigate empirically what affects Global Reporting Initiative (GRI)-based sustainability reporting and its relationship with firm performance in the aviation industry between 2006 and 2015	GRI Sustainability Disclosure Database
49	Green aviation industry sustainable development towards an integrated support system	<u>Rui Qiu, Shuhua Hou, Xin Chen, Zhiyi Meng</u>	2021	The study proposes an integrated support system for sustainable development of the green aviation industry	bibliometric database

				that involves stakeholder engagement, business strategies, innovative technologies, environmental policies, and public support. The roles of various factors such as strategy improvement, technology integration, policy support, and public participation are examined to form this system.	
50	Enhancing the Sustainability of the Aviation Industry: Airlines' Commitment to "Green" Practices	Vera Amicarelli, Giovanni Lagioia, Antonio Patruno, Raluca Mariana Grosu, Christian Bux	2021	The study investigates the commitment of airlines operating in Karol Wojtyła Airport, Italy towards adopting sustainable aviation fuel and sustainable development strategies. Traditional airlines, particularly flag carriers, and American companies are more aware of aviation environmental consequences and offer passengers opportunities to participate in reducing climate change impacts. Low-cost companies are less attentive to environmental issues. The study highlights the need to enhance carbon offsets programs and digital technologies.	a systematic analysis of the International Air Transport Association report

51	The Use of Aviation Biofuels as an Airport Environmental Sustainability Measure: The Case of Oslo Gardermoen Airport	Glenn Baxter, Panarat Srisaeng, Graham Wild	2020	This paper examines the successful implementation of sustainable aviation biofuels at Oslo Airport Gardermoen, which has resulted in a 10-15% reduction of greenhouse gases. The Norwegian government has mandated that the aviation fuel industry mix 0.5% advanced biofuel into jet fuel from 2020 onwards, and both the government and Avinor have set a goal for 30% of aviation fuel in Norway to be sustainable biofuel by 2030	instrumental case study
52	Sustainable Aviation—Hydrogen Is the Future	alal Yusaf 1,* , Louis Fernandes 2 , Abd Rahim Abu Talib 3 , Yazan S. M. Altarazi 3,4 , Waleed Alrefae 5 , Kumaran Kadirgama 6 , Devarajan Ramasamy 6 , Aruna Jayasuriya 1 , Gordon Brown 2 , Rizalman Mamat 6 , Hayder Al Dhahad 7 , F. Benedict 8 and Mohamd Laimon 9	2022	renewable hydrogen technologies would be mature, and hydrogen would be widely implemented by 2030 in many sectors, particularly the aviation industry	Review
53	Ready for take off: Airline engagement with the United Nations Sustainable Development Goals	Michael Perryman Laurel Besco Carina Suleiman Lindsay Lucato	2022	airlines could play an important role in achieving the United Nations Sustainable Development Goals (SDGs) but little is known about how individual airlines engage with the SDGs	examining airline reports, websites, and other published documents for explicit mention of the SDGs

FINDINGS OF THEME WISE LITERATURE REVIEW

Sustainable Development and Green Finance

Several studies have reviewed the Sustainable Development and Green Finance related to the European Green Deal and highlighted the need for better information management and coordination among stakeholders (Szpilk et al., 2020). Moreover, the impact of ESG disclosures on the financial performance and firm value of airlines has been examined (Ejdys et al., 2021). However, the underlying mechanism of the relationship between sustainability initiatives and value outcomes of airlines remains poorly understood, and further research is needed to identify specific challenges and barriers hindering the integration of renewable energy with other sectors to achieve ambitious climate mitigation targets (Ofosu et al., 2021). Furthermore, research has shown that ESG disclosures can have a significant impact on the firm value and financial performance of airlines (Lu and Zhu, 2021). This finding suggests that airlines must focus on enhancing their ESG performance and disclosure practices to remain competitive in the market. Despite the growing interest in sustainable development and green finance, several challenges and barriers hinder the integration of renewable energy with other sectors to achieve ambitious climate mitigation targets (Tenakwah et al., 2021). Further research is needed to identify specific challenges and develop appropriate policies and strategies to address them. Moreover, the underlying mechanism of the relationship between sustainability initiatives and value/financial performance outcomes of airlines is still poorly understood. Thus, more research is needed to gain a better understanding of this relationship and its implications for the aviation industry.

Political and Regulatory Challenges of Sustainable Finance

In their literature review, Kemfert et al. (2021) highlight the political and regulatory challenges of aligning financial flows with climate objectives. They specifically address the need for stricter criteria in the EU Taxonomy to support the transition towards climate neutrality. Additionally, the article compares the effectiveness of a carbon tax and a sustainable aviation fuel quota in reducing greenhouse gas emissions, finding that the SAF quota outperforms the carbon tax in emission control when the emission target is more ambitious. However, the authors also note research gaps in implementing a comprehensive framework for sustainable finance and in comparing the effectiveness of SAF quota mandates to other policies (Guzhva et al., 2022). The article by Kemfert et al. (2021) highlights the challenges facing the implementation of sustainable finance in the aviation industry, particularly in aligning financial

flows with climate change objectives. The authors discuss the need for stricter criteria in the EU Taxonomy to support the transition towards climate neutrality, as the regulations, awareness and policies related to green & sustainable finance in the aviation industry are yet to achieve global standardizations to avoid greenwashing. Furthermore, Guzhva et al. (2021) argue that research gaps exist in implementing a comprehensive framework for sustainable finance in aviation, as well as in comparing the effectiveness of SAF quota mandates for aviation GHG emissions to other policies. They compare the effectiveness of a carbon tax and a sustainable aviation fuel (SAF) quota in reducing greenhouse gas emissions and maximizing social welfare and found that the SAF quota outperforms the carbon tax in emission control when the emission target is more ambitious. Similarly, Raghavan et al. (2021) suggests that a combination of SAF quota mandates and carbon pricing mechanisms may be necessary to effectively reduce aviation emissions in a socially equitable manner. More flights using sustainable aviation fuel (SAF), as part of efforts to achieve net-zero carbon emissions by 2050 (Izatul Husna Zakaria et al.(2023)

Sustainability in Business and Industries

Sustainability in the aviation industry has become increasingly important due to global environmental concerns and regulations. According to Friedrich et al. (2021), the need for sustainable project management and technological progress in the aviation industry is highlighted. The aviation industry is one of the major sources of carbon emissions, and therefore, it is crucial to adopt sustainable practices to reduce its impact on the environment. The adoption of green and sustainable financing in the aviation industry can help finance projects that aim to reduce carbon emissions and promote sustainable development. Furthermore, the COVID-19 pandemic has had a significant impact on the aviation industry, as well as on the food and e-commerce industries. The pandemic has highlighted the need for resilience and adaptability in these industries, especially in the face of global challenges. According to Hu et al. (2021), the e-commerce industry has both benefits and challenges, as it promotes sustainability through reducing carbon emissions but also has negative effects on the environment due to increased packaging and transportation. To promote sustainable development in the aviation industry, EU initiatives on sustainable finance and the evaluation of cost-effectiveness policies for sustainable aviation fuels have been introduced. These policies aim to support and promote green and sustainable financing in the aviation industry, which can help finance projects that promote sustainability and reduce carbon emissions. However, limitations in industry coverage and suggestions for COVID-19 impact studies need further

exploration (Claringbould et al., 2021). In addition, there is a need for further exploration of effective approaches and comprehensive evaluations of policies in promoting sustainable finance and aviation fuels (Ren et al., 2021). Overall, the literature suggests that the adoption of green and sustainable financing in the aviation industry can promote sustainable development and reduce carbon emissions. The COVID-19 pandemic has highlighted the need for resilience and adaptability in industries, while EU initiatives and policies aim to support and promote sustainable financing in the aviation industry. However, there are still limitations and challenges that need to be addressed in promoting sustainable development in the aviation industry.

Sustainable Aviation and Decarbonization

The literature review of this research paper focuses on the challenges and potential solutions for reducing emissions in the aviation industry through sustainable aviation fuel (SAF), carbon taxes, and the EU Taxonomy. The authors also highlight the need for further research to identify effective methods for carbon capture, utilization, and storage (CCUS) in the aviation industry. (Zhang et al., 2021) Additionally, the review discusses the challenges faced by SAF deployment, such as high production costs and certification, and analyses the effectiveness of carbon taxes and SAF quotas in reducing emissions and maximizing social welfare. The authors stress the importance of stricter criteria for the EU Taxonomy to support the transition towards climate neutrality. (Zhang et al., 2021). The aviation industry is one of the largest contributors to greenhouse gas emissions, and the need for decarbonization has become more urgent. Sustainable aviation fuel (SAF) has been identified as a crucial element in achieving this goal (Zhang et al., 2021). However, the deployment of SAF at a large scale is still facing challenges such as high production costs and ASTM certification requirements. Green and sustainable finance (GSF) can play a significant role in addressing these challenges by providing financial support for research and development of new technologies and infrastructure. GSF involves investing in projects that have both financial and environmental benefits (Schützea et al., 2021). The aviation industry can benefit from green loans or bonds, which can provide low-cost funding for sustainable aviation projects. In addition, sustainability-linked loans or bonds that tie interest rates to ESG performance can provide financial incentives for companies to improve their sustainability practices (Zhang et al., 2021). The effectiveness of a carbon tax and SAF quota in reducing emissions and maximizing social welfare have also been studied (Jemai et al., 2021). A carbon tax can provide a financial

incentive for airlines to reduce their emissions, while a SAF quota system can ensure that a minimum amount of SAF is used in aviation. The EU Taxonomy is a comprehensive classification system for sustainable economic activities, but stricter criteria are needed to support the transition towards climate neutrality (Novelli et al., 2021). Further research is needed to identify the most effective and efficient methods for carbon capture, utilization, and storage (CCUS) in the aviation industry to reduce greenhouse gas emissions and achieve net-zero emissions targets (Zhang et al., 2021). GSF can play a crucial role in funding such research and development, and the aviation industry can benefit from the availability of low-cost funding for such projects. In conclusion, decarbonizing the aviation industry is a critical challenge for achieving global climate goals. Green and sustainable finance can be a valuable tool for providing financial support for research and development of new technologies and infrastructure, as well as for incentivizing companies to improve their sustainability practices. The effectiveness of carbon taxes, SAF quotas, and the EU Taxonomy in supporting the transition towards climate neutrality has been studied, but further research is needed to identify the most effective and efficient methods for CCUS in the aviation industry.

Sustainability Reporting and Practices in Aviation

Sustainability reporting and practices have become increasingly important in the aviation industry. According to Karaman et al. (2021), sustainability reporting has a positive impact on firm performance in aviation. However, the study found that most airlines have not engaged with the United Nations Sustainable Development Goals (UN SDGs), with only 30% of airlines engaging with these goals. To overcome barriers and improve sustainability and financial performance, partnerships are recommended. While sustainability reporting is becoming more common in the aviation industry, there is still a lack of research on the relationship between standalone Global Reporting Initiative (GRI)-based sustainability reports and firm performance in the aviation industry (Karaman et al., 2021). Additionally, the sample size in existing studies is limited, which highlights the need for further research. Moreover, there is still a lack of knowledge regarding individual airline engagement with UN SDGs and the factors driving increased engagement levels (Karaman et al., 2021). This indicates a need for more research and attention to be paid to the individual actions and contributions of airlines towards achieving sustainability goals. In the context of green and sustainable finance, sustainability reporting and practices can have a significant impact. Airlines that engage with sustainability practices and reporting may be viewed more positively by investors who are

interested in sustainable and socially responsible investments. This can result in increased access to green finance and lower borrowing costs, which can ultimately improve financial performance (European Investment Bank, 2021). A deeper analysis of sustainable finance disclosure score reveals that the disclosure practice is also still considerably low for all sustainable finance information category both purpose, policies, processes, people, products, and portfolio (Mara Maheresmi et al., 2023) In conclusion, sustainability reporting and practices are crucial for the aviation industry to achieve sustainability goals and improve financial performance. However, there is still a need for further research to fully understand the relationship between sustainability reporting, firm performance, and engagement with UN SDGs in the aviation industry. Moreover, the importance of sustainability reporting and practices in accessing green finance highlights the significance of this topic in the broader context of green and sustainable finance.

Alternative Jet Fuels and Green Image of Airlines

The aviation industry's reliance on traditional fossil fuels for powering aircraft contributes significantly to greenhouse gas emissions and environmental degradation. As such, alternative jet fuels (AJFs) generated from renewable resources, such as biomass and biofuels, have emerged as a viable solution for achieving sustainability in the aviation industry. Studies have shown that the production and use of AJFs can significantly reduce the aviation industry's carbon footprint and help to achieve sustainable development goals (Zhang et al., 2020). To facilitate the transition towards a sustainable aviation industry, an integrated support system is required. This system should involve the engagement of stakeholders, innovative technologies, environmental policies, and public support (Hari et al., 2021). Furthermore, green and sustainable finance has been identified as a crucial component in supporting the development and deployment of AJFs. Financing mechanisms, such as green bonds and green loans, can provide the necessary capital to invest in the research and development of AJFs and the necessary infrastructure to support their production and use (Semeijn et al., 2021). While significant progress has been made in the development and deployment of AJFs, limited research has been conducted on implementing circular economy principles in the aviation industry. Circular economy principles involve the recycling and repurposing of materials and components to reduce waste and promote sustainable resource use. In the aviation industry, this can involve the repurposing of retired aircraft components for use in new aircraft or the recycling of materials used in the construction of aircraft. Further research is needed to identify

the most effective and efficient methods for implementing circular economy principles in the aviation industry (Zhang et al., 2020). In summary, the aviation industry's shift towards alternative aviation fuels generated from renewable resources is critical to achieving sustainability goals. An integrated support system involving stakeholder engagement, innovative technologies, environmental policies, public support, and green and sustainable finance is necessary to facilitate this transition. Moreover, the implementation of circular economy principles in the aviation industry can further support sustainable resource use and reduce waste.

TABLE 2

THEME	AUTHOR	INFERENCE	ICC-Initial Conceptual Construct/Sub Construct	RESEARCH GAP
Sustainable Development and Green Finance	Danuta Szpilk Joanna Ejdys, Abhishek Ranjan, Isaac Akomea-Frimpong, David Adeabah, Deborah Ofosu, Emmanuel Junior Tenakwah, Weiwei Lin *, Jing Lu , Jinfu Zhu and Li Xu, Souvik Sen, Sourav Ganguly	The article reviews scientific research related to the European Green Deal and identifies eight thematic clusters covering different topics. It emphasizes the need for better information management and coordination amongst stakeholders. The study reviews existing literature on green finance in the banking sector and proposes policy recommendations to promote the growth of China's aircraft leasing industry. It also examines the impact of ESG disclosures on the firm value and financial performance of airlines. Finally, it emphasizes the importance of renewable energy sources for	1) Green Finance and Sustainable Development" a.Green Finance in India", b. "Green Finance in Banking Sector", c."Sustainable Development of China's Aircraft Leasing Industry" d. "Impact of ESG Disclosures on Firm Value of Airlines". 2) European Green Deal (EGD) framework, energy, circular economy, industry, mobility.	The underlying mechanism of the relationship between sustainability initiatives and value/financial performance outcomes of airlines is still poorly understood. Further research is needed to identify specific challenges and barriers hindering the integration of renewable energy with other sectors to achieve ambitious climate mitigation targets.

		sustainable socioeconomic development.		
Political and Regulatory Challenges of Sustainable Finance:	Claudia Kemfert ^{1,2,3} and Sophie Schmalz ^{1,2} , Franziska Schütze and Jan Stede, Author links open overlay panel Vitaly S. Guzhva, Sunder Raghavan, Damon J. D'Agostino, Changmin Jiang, Hangjun Yang	The article emphasizes the challenges of aligning financial flows with climate change objectives and discusses the need for stricter criteria in the EU Taxonomy to support the transition towards climate neutrality. It also compares the effectiveness of a carbon tax and a sustainable aviation fuel quota in reducing greenhouse gas emissions and maximizing social welfare, finding that the SAF quota outperforms the carbon tax in emission control when the emission target is more ambitious	Financial flows Sustainability Divestment EU Taxonomy Aircraft financing Carbon tax Sustainable aviation fuel	Research gaps exist in implementing a comprehensive framework for sustainable finance and in comparing the effectiveness of SAF quota mandates for aviation GHG emissions to other policies
Sustainability in Business and Industries	Kevin Friedrich ¹ , Maria MRAZOVA, Cheng Dai, DUCO CLARINGBOULD, MARTIN KOCH, AND PHILIP OWEN Duco, Jianjun Dong, Rui Ren, Wanjie Hu, Bo Sun	The need for sustainable project management and technological progress in the aviation industry are highlighted, while COVID-19 has impacted the aviation and food industries, and the e-commerce industry has both benefits and challenges. EU initiatives on sustainable finance and the evaluation of cost-effectiveness policies for sustainable	Sustainable project management Sustainable aviation COVID-19 impact EU sustainable finance initiatives Green and sustainable logistics Sustainable aviation fuel policies	Need for research on obstacles to implementing green technologies in aviation, limitations in industry coverage and suggestion sections in COVID-19 impact studies. A need for further exploration of effective approaches and comprehensive evaluations of policies in promoting sustainable finance and aviation fuels.

		aviation fuels are also discussed		
Sustainable Aviation and Decarbonization	<u>Libing Zhang</u> , <u>Terri L. Butler</u> , <u>Bin Yang*</u> , Franziska Schütze and Jan Stede, Vasavi Thummala, Rahul B. Hiremath, Kristiana Santos a, Laurence Delian , Ivo Abrantes a, Ana F. Ferreira b, André Silva a, Mário Costa b, Nadir Yilmaz a, Alpaslan Atmanli , David Chiaramonti, Joseph Amankwah-Amoah a, Yaw Debrah b, Sarah Anang a, Inge MayeresStef ProostEef DelhayePhilippe NovelliSjaak ConijnInmaculada Gomez-JimenezDaniel Oualid Jouini b, Ali Cheaitou c, Zied Jemai b,d, Tobias Andersson Granberg e, Billy Josefsson, Changmin Jiang, Hangjun Yang	The aviation industry needs to reduce emissions and sustainable aviation fuel (SAF) is crucial to achieving this. The challenges to large-scale deployment of SAF include high production costs and ASTM certification. The effectiveness of a carbon tax and SAF quota in reducing emissions and maximizing social welfare have been studied. The EU Taxonomy is a comprehensive classification system for sustainable economic activities, but stricter criteria are needed to support the transition towards climate neutrality.	Biojet fuels for aviation industry EU Taxonomy for sustainability Sustainable aviation fuel promotion Decarbonizing aviation through technology Challenges facing sustainable aviation fuels	Further research is needed to identify the most effective and efficient methods for carbon capture, utilization, and storage (CCUS) in the aviation industry to reduce greenhouse gas emissions and achieve net-zero emissions targets.
Sustainability Reporting and Practices in Aviation	<u>Abdullah S. Karaman</u> , <u>Merve Kilic</u> , <u>Ali Uyar</u> , <u>Rui Qiu</u> , <u>Shuhua Hou</u> , <u>Xin Chen</u> , <u>Zhiyi Meng</u> , Vera Amicarelli, Giovanni Lagioia, Antonio Patrino, Raluca Mariana Grosu, Christian Bux	Sustainability reporting impacts firm performance in aviation. Most airlines haven't engaged with UN SDGs, with 30% engagement. Partnerships recommended to overcome barriers and improve sustainability and financial performance.	GRI-based sustainability reporting Relationship with firm performance Engagement of airlines with SDGs Barriers to engaging with SDGs Developing partnerships across the sector	lack of research on the relationship between standalone GRI-based sustainability reports and firm performance in the aviation industry, with a limited sample size. lack of knowledge regarding individual airline engagement with UN SDGs and the factors driving increased engagement levels.
Alternative Jet Fuels and Green Image of Airlines	Chi ZhangXin HuiYuzhen LinChih-Jen Sung, Carmen HagmannJanjaap SemeijnDavid B. Vellenga, Thushara Kandaramath HariZahira YaakobNarayanan N.Binitha	The aviation industry needs to shift to alternative aviation fuels	1)Alternative Aviation Fuels Feedstock Production process	Limited research on implementing circular economy principles in aviation industry,

		generated from renewable resources to achieve sustainability. An integrated support system involving stakeholder engagement, business strategies, innovative technologies, environmental policies, and public support is crucial to achieve sustainable development in the green aviation industry	Challenges and opportunities Hydrocarbon-based drop-in fuels Combustion characteristics 2) Green Image of Airlines Influence on airline choice Willingness to pay for eco-friendliness Passenger preferences for amenities Integrated support system for sustainable development	particularly with regard to recycling and repurposing aircraft components and materials.
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LIMITATIONS OF STUDY

Current study involves narrow focus on specific aspects of green and sustainable finance in the aviation industry and potential exclusion of relevant sources due to search term limitations. The sources also lack historical perspective and may contain bias from industry or company perspectives. In addition, the studies rely on literature reviews and case studies, potentially limiting the capture of current sustainable aviation practices. Furthermore, there is a lack of standardized definitions and taxonomies for green finance, hindering the evaluation and comparison of different sustainable finance initiatives. Finally, there is a need for greater collaboration, investment, and policy support to promote the adoption of sustainable aviation finance practices and ESG principles in the industry.

CONCLUSIONS AND IMPLICATIONS FOR RESEARCH

Table 3: Funding & Investor activities identified in the industry linked to Green & Sustainable Finance

Green or Sustainable Finance related Transactions	Main framework or Use of proceeds	GSF KPI or Eligibility Criteria identified			
		Non aviation assets (buildings)	Corporate ESG rating	New Technologies supporting reduced emission or fuel efficient aircraft	S A F

Sept 2016	Mexico, \$2 bn Green Bond	GBP - to finance airport; \$1 billion in 10-yr and \$1 billion 30-yr bonds are backed by passenger charges	✓			
Sep 2018	ANA Green Bonds, \$87 mn/ Yenn 10 bn	GBP - Building an eco friendly training centre	✓			
Oct 2018	Royal Schiphol Group, \$500 mn Green Bond	GBP - clean transportation and green buildings	✓	✓		
Nov 2018	Slovenia SID Green Bond, €75 mn	GBP – Electrified light passenger aircraft			✓	
Apr 2018	Royal Schiphol Group, €750mn Green bond	GBP - for investments in sustainable buildings at Dutch airports it operates	✓			
Jun 2018	Sydney Airport, \$ 960 mn sustainability-linked loan by BNP & ANZ	SLLP - interest will depend on an annual assessment of the firm’s overall ESG rating		✓		
Dec 2018	Swedavia Airports, SEK 1 bn green bond loan	GBP - contribute to the UN Sustainable Development Goals and Paris Agreement’s goal	✓			
Dec 2018	Deutsche Bank Green Loan fo 5x ATR 72-600	GLP – ‘Climate change mitigation & ‘pollution prevention’ - lease from Avation to BRA			✓	
Feb 2020	JetBlue Sustainability Linked Loan, \$550 mn	SLLP – Not specified / general corporate purposes		✓		
Oct 2020	Etihad 5yr Transition Sukuk, \$600 million	SLBP – ‘Energy efficiency’ projects incl. B787 & A350			✓	
May 2021	Aeroflot Sustainability Linked Loan, \$320 mn	SLLP - Not specified / general corporate purposes		✓		
May 2021	ANA Sustainability Linked Bonds 10 bn yen	SLBP - Not specified / general corporate purposes, 5 yr		✓		
Jun 2021	Korean Air Green Bonds, KRW 200 billion (\$167 million)	GBP – “Eco-friendly” B787 to “greatly reduce” GHG emissions			✓	
Jul 2021	British Airways EETC, \$554 mn, (JOLCOs)	SLBP - x3 A320neos, x1 A350-1000, x3 B787-10			✓	

Oct 2021	Volaris Sustainability Linked Bond, 1.5 billion pesos (\$30 mn)	SLBP – To finance “the company’s sustainable growth”		✓	✓	
Oct 2021	Etihad raises us\$1.2 billion, sustainability linked loan	SLLP - to reduce CO2 emissions, increase corporate governance & promote female participation		✓	✓	✓
Nov 2021	Crianza's Sustainability-Linked Operating Lease	Undisclosed – B787 and A350 on lease to MSCI ESG-rated airline		✓	✓	
Nov 2021	ALC order for 111 Airbus aircraft launches Sustainability Fund	SLBP - to finance new aircraft with better fuel efficiency		✓	✓	
Dec 2021	Flying Green - new ‘green’ airline	SAF - with plans to start operating in 2023.				✓
Jan 2022	SocGen / Air France Sustainability Linked	SLLP – Loan to acquire Airbus A350-900 aircraft			✓	✓
Jan 2022	\$15 bn investment, Breakthrough Energy Capital (BEC), Bill Gates	Clean Aviation technology		✓	✓	✓
Feb 2022	JAL Transition Bond, 10 billion yen	GBP – ‘Clean Transport’ such as A350 or B787/\$87mn		✓		✓
Mar 2022	UK Govt announced £1 bn funding	Development of zero-carbon and ultra-low-emission aircraft			✓	
Apr 2022	Pilot training school in Sweden plans	electric planes – eco friendly training for pilots			✓	
Apr 2022	Saudi Arabia's Alfanar invests \$1.32 bn in SAF	SAF production				✓
Aug 2022	American Airlines invests in ZeroAvia hydrogen electric	low/zero emission aircraft		✓	✓	
Oct 2022	American Airlines, invest in Universal Hydrogen	low/zero emission aircraft, meeting Paris Agreement targets		✓	✓	

Green Bond Principles (GBP), Green Loan Principles (GLP), Sustainability-Linked Bond Principles (SLBP), Sustainability-Linked Loan Principles (SLLP)

Source: Developed by Author from different reports on green or sustainable finance. (2023)

In conclusion, the analysis of the table 1. shows a growing interest in green and sustainable finance in the aviation industry. The increasing number of transactions and investments in sustainable initiatives, such as electrified aircraft, sustainable buildings, and sustainable aviation fuel production, highlight the industry's efforts to promote environmentally friendly practices and technologies. The use of green finance and the identification of GSF KPIs and eligibility criteria also indicate a trend towards sustainability and a low-carbon economy. Overall, the aviation industry is taking steps towards meeting climate goals and promoting sustainable growth. The aviation sector faces several challenges in achieving sustainability performance linked with ESG criteria or ESG ratings. These challenges include the sector's high carbon footprint, the lack of binding regulations for environmental and social sustainability, the cost of implementing sustainability measures, the public's perception of the industry's efforts, the lack of standardization for measuring sustainability performance, limited data availability, complex supply chains, and limited stakeholder engagement. Addressing these challenges will require significant efforts from aviation companies, investors, regulators, and other stakeholders to transition towards a more sustainable future for the industry. While sustainable aviation finance is currently a growing trend, there are potential risks and challenges for investors, such as uncertain regulatory frameworks and high initial costs. Respondents suggested that ESG disclosures and reporting standards could be improved by standardizing metrics and reporting frameworks, better aligning ESG disclosures with financial reporting, and clearer communication of ESG activities and impacts. Government policies and regulations could play a significant role in promoting green and sustainable finance in the aviation sector by providing incentives and financial support for green projects, establishing mandatory ESG reporting requirements, and setting carbon reduction targets for the industry.

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