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An Examination of the Sustainability Activities of Global Airline Collaborations within the Scope of IATA's Sustainability Goals

Volkan Mazıoğlu[1*], Habibe Güngör[2]

[1*] İstanbul Gelisim University, Aviation Management Department, İstanbul, Türkiye. (volkanm8@gmail.com)
[2]İstanbul Gelisim University, Aviation Management Department, İstanbul, Türkiye. (hgungor@gelisim.edu.tr)

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Corresponding Author: *Volkan Mazıoğlu*

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Abstract

This study aims to evaluate the sustainability activities of the global airline alliances Star Alliance, SkyTeam, and OneWorld within the framework of the International Air Transport Association's (IATA) sustainability goals. Specifically, it focuses on key areas such as achieving net-zero carbon emissions by 2050, promoting new aircraft technologies, enabling greener travel (in terms of noise and air quality), enhancing energy, resource, and operational efficiency, managing cabin waste and recycling, adopting sustainable aviation fuels (SAF), and protecting biodiversity. Using a content analysis methodology, data were gathered from publicly available sources, including airline sustainability reports, annual reports, and information from the IATA website. This systematic analysis provides an objective evaluation of how well these airline alliances are aligning their strategies with IATA's sustainability goals. The findings reveal significant disparities in the alliances' commitments. For instance, Star Alliance and OneWorld members exhibit deficiencies in biodiversity conservation, while SkyTeam members show slower progress towards achieving the net-zero carbon emissions target. Additionally, all three alliances demonstrate varying degrees of success in adopting SAF and implementing other sustainable practices, such as waste management and the promotion of new aircraft technologies. By identifying the strengths and weaknesses across the alliances, this research offers critical insights into how the aviation sector can more effectively contribute to global sustainability efforts.

1. Introduction

Globalization has eliminated borders and provided many international businesses with the opportunity to compete in the same markets and develop different strategies to achieve their goals. The intensity of competition has forced airlines to create new management styles and strategies to take the right steps and achieve sustainable existence. Global cooperation movements are emerging as one of these strategies and play a critical role in the success of airlines. Airlines have turned to modern management approaches to respond to changing passenger demands and needs. Global airline collaborations are strategies created to meet customer demands and strengthen their position in international markets. These collaborations can provide airlines with effective support in controlling their strengths and weaknesses, turning negative situations into advantages, and minimizing risks (Kanbur, Mazioglu, & Kanbur, 2023).

The aviation industry is a key driving force in facilitating the growth of the global economy and enabling people to move more swiftly and effectively around the world. However, aviation activities can also bring about environmental, social, and economic challenges. These challenges include environmental issues such as climate change, energy consumption, air pollution, and noise pollution.

Sustainable aviation represents a long-term approach developed in response to the aviation industry's need to build a cleaner, quieter, and smarter future. This approach sets various targets and commitments on issues such as climate change, noise pollution, and local air quality, with the aim of supporting a more sustainable future. Airline companies are taking significant steps, from carbon offsetting to reducing or eliminating single-use plastics, to address environmental concerns. This approach can reduce the environmental impact of aviation, enhance energy efficiency, promote innovation and technological development, and increase societal benefits. Sustainable aviation requires airline businesses to adopt various strategies to make their operations, flights, and services more environmentally friendly, respond more sensitively to community needs, and support the long-term growth of the sector. (Turkish Airlines, 2022).

IATA's goal of achieving net zero carbon emissions by 2050 is a cornerstone of global efforts to decarbonize the aviation industry. The aviation sector contributes approximately 2.5% of global CO2 emissions, and with projected increases in air traffic, these emissions are expected to rise significantly unless proactive steps are taken (World Economic Forum, 2022). This target aligns with the Paris Agreement, which aims to limit global temperature rise to

1.5°C, making IATA's goal essential in mitigating the aviation industry's impact on climate change (IATA, 2024).

Sustainable Aviation Fuel (SAF) is central to the International Air Transport Association's (IATA) strategy for achieving net-zero carbon emissions by 2050. SAF is regarded as one of the most effective tools for reducing the carbon footprint of the aviation industry, as it offers up to an 80% reduction in lifecycle greenhouse gas emissions compared to conventional jet fuels (IATA, 2024). The role of SAF in the industry is not merely one of technological adaptation but also a vital component of broader environmental and policy commitments aimed at curbing the aviation sector's significant contribution to global emissions. SAF is primarily derived from renewable sources such as agricultural waste, used cooking oil, and other sustainable biomass materials. Importantly, SAF can be utilised with existing aircraft engines and airport fueling infrastructure without requiring significant modifications. This feature allows for a more seamless integration of SAF into current airline operations, making it a practical short- to medium-term solution in the decarbonisation of the aviation sector (World Economic Forum, 2022). The successful deployment of SAF will rely on creating a market environment where SAF is cost-competitive with fossil fuels, and where supply can meet growing demand as airlines increasingly seek to fulfil their sustainability pledges (European Union Aviation Safety Agency, 2020).

IATA has placed significant emphasis on preventing wildlife trafficking, an issue that directly undermines biodiversity. Through collaborative efforts with governments and international organizations, IATA's Wildlife Trafficking Task Force is focused on disrupting illegal wildlife trade, which contributes to the decline of species populations and threatens global biodiversity. By working closely with various stakeholders, IATA aims to combat this global issue, highlighting the organization's commitment to not only addressing the ecological impacts of aviation but also promoting a holistic approach to environmental sustainability (IATA, 2024).

In this context, airline alliances can also play a significant role in achieving sustainable aviation goals. Alliances can encourage airline companies to share more resources, operate more efficiently, and collaborate towards sustainability objectives. Many airline alliances aim to enhance the industry's sustainability performance by encouraging member companies to collaborate in sustainability and share best practices. Airline alliances (Star Alliance, SkyTeam, and OneWorld) have become a crucial mechanism in transforming the dynamics of the sector and addressing these emerging challenges.

There are 58 companies that are members of global airline alliances. Of these, 26 are members of Star Alliance, 19 are affiliated with SkyTeam, and 13 are part of the OneWorld alliance. The sustainability activities of these companies are aligned with the (IATA) sustainability goals, which comprise seven key targets. This study examines the sustainability activities of the 58 member companies of these alliances to assess their alignment with these targets. The analysis was conducted using the content analysis method based on sustainability reports, annual reports, and information available on the websites of the companies, as well as the alliance groups (Star Alliance, SkyTeam, and OneWorld) and IATA. The study aims to explore how airline alliances contribute to sustainability efforts, with a particular focus on the contributions of major airline alliances such as Star Alliance, SkyTeam, and OneWorld. Alliances represent a significant strategy that enables airline companies to effectively reach passengers from different regions and utilize resources more efficiently. Additionally, this study aims to highlight the value proposition of such sustainability initiatives within the airline industry. The value of this study lies in providing a comprehensive assessment of the activities carried out by airline alliances towards sustainability goals. There is a limited amount of research in the existing literature that focuses on the impact of these alliances on sustainability. Hence, this study fills a significant gap by understanding how airline alliances contribute to sustainability efforts. Moreover, this in-depth analysis, utilizing sustainability reports, annual reports, and other publicly available information from airline companies, concretely outlines the sustainability commitments and practices of the alliances. Thus, it offers valuable insights to both the academic community and industry practitioners on the role played by airline alliances in achieving sustainability goals.

2.Conceptual Framework

2.1. The Concept of Globalisation in Airline Transport

Globalization is one of the most significant factors influencing change and development across all sectors. These factors transform people's lives and socio-economic phenomena, eliciting responses from both individuals and sectors. The air transport industry has become a part of the globalization process, experiencing considerable changes over time (Esin & Düzgün, 2021, p.20). The aviation sector is a vital component of the rapidly growing services category in the global economy. Due to technological innovations, lower fuel consumption, new employment opportunities, and lower ticket prices, aviation has become a key element of both individual lives and international trade. The aviation industry has become an intriguing subject for economic analyses (Bal, Manga, & Akar, 2017, p.354). With the increase in demand and globalization, airline companies observe a growth and globalization in the passenger market for business purposes. Today, passengers may desire to travel at any time, on any day or month, and at more convenient ticket prices, seeking a higher level of service. Airline companies must meet this demand. Therefore, air transport not only facilitates economic globalization but is also globalized by it, creating a mutually reinforcing cycle between air transportation and economic globalization. Since the early 1980s, the sector has increasingly trended towards globalization (Gerede, 2002, p.85).

2.2. Global Airline Collaborations in Air Transport

In the field of business management, collaboration refers to a business relationship established between two or more companies to achieve common goals and mutual benefits. In this definition, the creation of common objectives and mutual benefits forms the fundamental stages of the partnership. For a true partnership to exist, it is essential that each company derives certain benefits from the collaboration, operating within a win-win principle (Latrou, 2004, p.7).

For airline companies to be sustainable over the long term, it is crucial for them to participate in international strategic alliances, taking into account their current situation and aiming to maintain a sustainable competitive advantage. These alliances are vital for operating and achieving long-term success (Kanbur & Karakavuz, 2017, p.75). The primary goal of strategic partnerships is to merge the values each participant possesses in alignment with their common objectives, thereby creating synergy. Through these collaborations, members

strive to achieve their common goals more effectively and efficiently (Huxham & Macdonald, 1992, p.51).

Global airline operations refer to airline companies that have an extensive flight route network covering a wide geographical area with numerous airports and intercity destinations within the aviation sector. These companies often become members of airline alliances such as Star Alliance, SkyTeam, or Oneworld and aim to increase the number of connected flights and destinations (Gerede, 2002, p.106). The formation of airline partnerships is associated with the development of supply chain design and the need for airlines to establish global and local networks. In particular, major airline companies in the United States have formed local partnerships by engaging in code-sharing agreements with more cost-effective local firms. This has enabled them to support more extensive and profitable regional and long-distance networks (Garcia, 2012, p.59).

2.3. Sustainable Business Concept

It is an undeniable fact that various factors encourage companies to promote sustainability. Some of these factors arise from companies' financial concerns, while others emphasize the importance of corporate identity in fostering a sense of social responsibility. However, when approaching the factors that promote sustainability from an economic perspective, it is essential to consider the primary goal of all commercial enterprises, which is profit maximization. In this regard, companies feeling responsible for preventing environmental pollution, responding to changing consumer habits with innovative production and marketing processes, or displaying a sustainable vision to remain competitive in the global market ultimately serve the purpose of profit maximization (Kuşat, 2012, p.228). Increased environmental awareness in society, customer environmental sensitivity, sensitivity to environmental events, and public reactions have led to a questioning of businesses' relationships with the environment today. This situation presents itself as both a necessity and an obligation. To ensure the suitability and continuity of the natural environment in which businesses operate, management strategies need to be adapted to these different situations. In this context, companies should give greater importance to environmental business activities within the framework of environmental sustainability while conducting their activities in line with the concept of environmental sustainability (Arı & Ergin, 2018, p.3). Business management strategists often focus on the concept of sustainability in the context of sustainable competitive advantage. According to this definition, firms successful in sustainability practices continually gain a competitive advantage. Additionally, researchers argue that if resources have valuable, rare, inimitable, and non-substitutable qualities, businesses can achieve sustainable competitive advantage with their resources (Kesen, 2016, p.556).

2.5. Similar Studies on the İssue

(Payan-Sanchez, Perez-Valls, & Plaza-Ubeda, 2019) In the literature, global alliances, particularly in the airline industry, have been associated with improvements in companies' economic and operational performance. However, there is limited information regarding the impact of such multilateral agreements on airlines' environmental performance. Some studies have employed various methods to examine whether membership in an alliance affects environmental performance. For instance, one study applied regression and Analysis of Variance (ANOVA) to data from 252 airlines (58 of which are members of the Star Alliance, Oneworld, and SkyTeam alliances), finding a strong and negative relationship between alliance membership and environmental performance. The same study provided empirical evidence on the impact of an airline's business model on its environmental performance. These findings offer important implications for airline managers facing sustainability challenges.

(Gursel & Orhan , 2023) The literature suggests that the environmental performance of airlines is currently measured on a mostly voluntary basis, though it is anticipated that these measurements will become mandatory in the future. Global strategic alliances impact the environmental performance of member airlines in different ways and at varying levels. Some studies indicate that membership in global alliances has the potential to contribute positively to environmental sustainability within airline operations. These alliances set common sustainability goals for their members and encourage them to share these objectives with stakeholders. For example, analyses conducted on members of alliances such as Oneworld, Star Alliance, and SkyTeam reveal that these alliances have significant effects on environmental performance. In this context, studies focusing on the environmental performance of Oneworld members demonstrate that the alliance's shared sustainability commitments significantly influence the environmental efforts of its member airlines.

(Kim & Rhee, 2021) Through this research, we examined whether airlines vicariously learn more from accidents of alliance members. We set organizational learning as our dependent variable and defined it as a reduction in the subsequent accident rate. Our research also examined the moderating effect of liability (U.S. air carriers) by hypothesizing that U.S. air carriers are more likely to learn from alliance memberships. In sum, the results of our analyses showed that an airline is more likely to learn from alliance members' failure experiences. Furthermore, findings of the moderating effect of liability (U.S. air carriers) revealed that U.S. air carriers are more likely to learn from alliance memberships. In addition, findings on the moderating effect of environmentally sustainable airlines revealed that an environmentally sustainable airline is more likely to learn from alliance memberships.

(Tanrıverdi & Doğan, 2022) The study reviewed the top 30 most cited studies out of 156 studies from the WoS database. In addition, all the studies in the dataset were subjected to citation network and co-word analysis, supporting the findings of the review of the most cited studies. The findings confirm that strategic alliances are seen as a network and that airlines achieve a sustainable competitive advantage through access to network resources. The study contributes to the literature by determining the conditions to be considered in the success of strategic alliances

(Seo & Itoh, 2020) This research seeks to assess whether global airline alliances outperform non-alliance airlines, explore the differences in passenger perceptions among the three major alliances, and identify their competitive advantages. A hybrid text mining approach was employed for the analysis. The methodology included frequency tests, t-tests, one-way ANOVA tests, and a three-step mediated regression analysis, utilizing 6,393 pieces of ordinal and word-of-mouth (WOM) data. The results indicate that passengers have a generally low perception of alliances, with non-alliance airlines outperforming those in alliances. Additionally, there were no notable differences in service ratings or sentiment scores across the alliances. Only oneworld showed a competitive edge tied to service ratings and sentiment scores.

(Steven & Merklein, 2013) In this paper we analyze the influence of a strategic alliance membership on determinants of carbon intensity in passenger transportation by using a unique data sample of the years 2004–2008. We find that alliance members on average had a higher utilization rate than non-aligned airlines, but their older average fleet age indicates that they did not take full advantage of the potentials offered through common aircraft investment activities. With regards to the planned Emissions Trading Scheme we show that European carriers on average had a better carbon intensity than Non-European airlines, so that competitive disadvantages for European airlines might be less than expected, if their carbon intensity maintains on this level.

3. Materials and Methods

3.1. Purpose and Importance of the Research

The aviation sector is a crucial part of global transportation infrastructure, essential for economic development and cultural exchange. Despite its importance, the sector faces significant sustainability challenges, including excessive energy consumption, greenhouse gas emissions, and broader environmental impacts. These challenges underscore the urgent need for improved sustainability practices within aviation to meet global environmental goals and foster a sustainable future.

Although the aviation industry has undertaken various initiatives to address these issues, a comprehensive understanding of these efforts, especially in the context of global collaborations, remains limited. This research aims to fill this critical gap by providing an in-depth analysis of sustainability initiatives within the aviation sector, with a particular focus on global airline alliances.

The primary objective of this research is to examine the sustainability initiatives of global airline alliances, specifically within the framework of the (IATA) sustainability goals. The study focuses on identifying and analyzing the activities and practices of leading airline alliances Star Alliance, SkyTeam, and OneWorld that align with these sustainability objectives. Furthermore, it evaluates how effectively these alliances are achieving sustainability goals and explores the methods they employ towards this end.

By concentrating on these areas, the research aims to offer a clearer understanding of the current status of sustainability practices within the aviation industry and to suggest pathways for their enhancement. This investigation is pivotal for advancing sustainability within the aviation sector, contributing to the broader efforts to mitigate environmental impact and promote sustainable development.

3.3. Scope and limitations of the research

This study aims to examine the sustainability initiatives of global airline alliances, specifically Star Alliance, SkyTeam, and OneWorld, within the framework of IATA's sustainability objectives. The research focuses on the strategies these alliances employ to achieve specific sustainability goals and assesses the extent to which they have succeeded in reaching these objectives.

The study primarily derives its data from publicly available sources, including airline company websites, sustainability reports, annual activity reports, and the IATA website. Consequently, the absence or non-disclosure of certain information in these sources may potentially influence the research findings. Sustainability encompasses various factors and criteria. Given that this study centres on the processes through which airline alliances attain particular goals, it may not encompass other facets of sustainability. Furthermore, the research evaluates the sustainability activities of airline alliances using the content analysis method. However, it is essential to acknowledge that this approach may not fully encapsulate the intricacies of qualitative data and the diversity of sustainability practices among different airline alliances.

3.2. Research Methodology

In this research, content analysis is employed as the method for data collection and analysis. Content analysis is a research technique used to examine and systematically analyze specific content within a defined framework. This method enables us to evaluate information related to the sustainability activities of airline alliances and relevant organizations in a systematic and objective manner.

The data have been gathered from publicly available sources of airline alliances such as Star Alliance, Sky Team, One World, and member airline companies. These sources include the companies' websites, sustainability reports, and annual activity reports. Additionally, the IATA website has played a significant role in the data collection process.

The collected data have been analyzed in association with IATA's sustainability objectives. Content analysis has been utilized to determine the extent to which specific sustainability goals have been adhered to. These analyses have helped us understand which airline alliance aligns with particular objectives and which strategies are more effective.

In qualitative research, the data coding process typically consists of several steps. Initially, researchers identify key elements within the data, conducting open codin (Younas, Cuoco, Vellone, Fabregues , & Barrios, 2022; Mutlu, 2024). These codes are then grouped under broader concepts to form themes (Brailas, Tragou, & Papachristopoulos, 2023). In this study, similar stages were applied during the data analysis process. Additionally, user codes were reported to indicate not only the identified themes and sub-themes but also the frequency of their occurrence.

To ensure the validity and reliability of the study, the data were reviewed multiple times. Furthermore, providing a detailed report of the collected data and explaining how the researcher arrived at the conclusions is one of the validity criteria in qualitative research (Yıldırım & Şimşek, 2021). Expert review, which is a method used to enhance the accuracy and reliability of the data, is one of the approaches recommended by Holloway & Wheeler, 1995. In this study, an academic specializing in sustainability in aviation was selected as the expert, and they were asked to assess the accuracy of the coding. Both the expert and the researcher confirmed the consistency of the coding.

Defining the Coding Scheme

In the tables, seven main categories have been identified to evaluate the sustainability performance of each airline:

- Net zero carbon emissions
- Sustainable aviation fuels (SAF)
- Promotion of new aircraft technologies
- Waste management and recycling in the cabin
- Greener travelling (noise and air quality)
- Energy resources and operational efficiency
- Biodiversity conservation

For each category, two symbols were used to indicate performance: a checkmark (✓) for success and a cross (×) for failure. To ensure consistency and reliability, the coding criteria for each category have been clearly defined:

A checkmark (✓) signifies that the sustainability targets in that category have been met by the airline.

Conversely, a cross (×) indicates that the company has deficiencies in that specific category.

4. Findings

Aegean Airlines is undertaking sustainability efforts within the framework of IATA to achieve net-zero carbon emissions by 2050. These efforts encompass various sustainability activities, including the promotion of sustainable aviation fuels (SAFs), the encouragement of new aircraft technologies, cabin waste management and recycling, greener travel practices (noise and air quality), energy, resource, and operational efficiency, as well as biodiversity conservation. In the realm of waste management and recycling, the airline is adopting strategies to reduce waste generation and ensure proper disposal. In the domain of water management, Aegean Airlines is focusing on water conservation and efficient water management practices to reduce water usage and enhance its efficient utilization. Within the scope of biodiversity conservation and support activities, the company aims to contribute to the preservation of natural habitats and the prevention of biodiversity loss. In the field of social responsibility, Aegean Airlines supports various social responsibility projects with the goal of giving back to the community and contributing to social needs.

Table 1. Examination of Sustainability Activities of Star Alliance Member Companies within the Scope of IATA's Sustainability Goals

Number	Companies	Achieve net zero carbon emissions by 2050	Sustainable aviation fuels (SAFs)	Promoting new aircraft technologies	Cabin waste management and recycling	Greener travelling (noise and air quality)	Energy, resource and operational efficiency	Protecting biodiversity
1	Aegean Airlines	✓	✓	✓	✓	✓	✓	✓
2	Air Canada	✓	✓	✓	✓	✓	✓	✓
3	Air China	✓	×	✓	✓	✓	✓	✓
4	Air İndia	✓	✓	×	✓	✓	✓	×
5	Air New Zealand	✓	✓	✓	✓	✓	✓	✓
6	All Nippon Airways	✓	✓	✓	✓	×	×	✓
7	Asiana	✓	✓	✓	✓	✓	✓	✓
8	Austrian Airlines	✓	✓	✓	✓	✓	✓	×
9	Avianca Airlines	×	×	×	✓	✓	✓	×
10	Brussels Airlines	×	✓	✓	✓	✓	✓	✓
11	Copa Airlines	✓	✓	✓	✓	✓	✓	×
12	Croatia Airlines	×	×	✓	✓	×	✓	×
13	EgyptAir	✓	×	×	×	×	×	×
14	Ethiopian Airlines	×	×	×	✓	✓	×	×
15	EVA Air	✓	✓	✓	✓	✓	✓	✓
16	LOT Polish Airlines	✓	✓	✓	×	✓	✓	✓
17	Lufthansa	✓	✓	✓	✓	✓	✓	×
18	Scandinavian Airlines	✓	✓	✓	✓	✓	✓	✓
19	Shenzhen Airlines	×	✓	✓	✓	✓	×	✓
20	Singapore Airlines	✓	✓	✓	✓	✓	✓	✓
21	South African Airways	✓	✓	✓	✓	✓	✓	✓
22	Swiss Airlines	✓	✓	✓	×	✓	×	×
23	TAP Portugal	✓	✓	×	✓	✓	✓	×
24	Thai Airways	×	✓	✓	✓	✓	✓	✓
25	Turkish Airlines	✓	✓	✓	✓	✓	✓	✓
26	United Airlines	✓	✓	×	✓	×	✓	×

Aegean Airlines is also taking measures to enhance the efficiency of its aviation operations, with the aim of reducing energy and resource consumption. By incorporating new aircraft technologies that are more environmentally friendly and fuel-efficient into its fleet, the airline strives to reduce carbon emissions. Additionally, Aegean Airlines collaborates with its business partners to strengthen sustainability strategies through joint efforts. Regarding energy and resource efficiency, the airline is developing practices to reduce energy consumption and make more efficient use of resources. Moreover, Aegean Airlines is making efforts to use sustainable aviation fuels, and it is actively engaged in related initiatives and projects. Overall, Aegean Airlines is committed to a comprehensive sustainability agenda that encompasses various aspects of environmental and social responsibility while also focusing on operational efficiency and the reduction of carbon emissions.

Air Canada, like other major players in the aviation sector, is committed to achieving the goal of net-zero carbon emissions by 2050 within the framework of IATA objectives. To reach this target, the company is implementing various strategies, including increasing fuel efficiency, collaborating in the use of sustainable aviation fuels, and engaging in carbon offset projects. Simultaneously, the airline is adopting environmental objectives such as improving waste management, increasing the use of recyclable materials, and reducing single-use plastics. It also places importance on embracing innovative technologies to contribute to technological advancements in the aviation sector and enhance operational efficiency. This includes the adoption of new aircraft technologies that produce fewer carbon emissions. Furthermore, Air Canada aims to collaborate with airports, ground service providers, and other airlines to work collectively towards achieving sustainability objectives

Air China has committed to achieving the goal of net-zero carbon emissions by 2050 under the IATA framework. Additionally, the company aims to improve its sustainability performance by implementing various strategies in areas such as waste and water management, biodiversity conservation, and social responsibility.

The company is actively working to reduce waste generation and promote the use of recyclable materials. Efforts are also being made to minimize water usage and enhance water management practices. Furthermore, Air China is investing in new aircraft technologies, collaborating with other companies, supporting sustainable airports, promoting sustainable travel, and undertaking initiatives to improve energy efficiency.

When evaluated within the framework of IATA goals, Air India commits to achieving the target of net-zero carbon emissions by 2050 and implements various strategies to reach this goal. The company focuses on waste management and recycling policies, promoting employee well-being, and enhancing operational efficiency. It engages in sustainability efforts for airports, greener travel, energy and resource efficiency, and sustainable aviation fuels (SAFs). However, upon reviewing the company's published reports and official website, it is observed that Air India does not invest in new aircraft technologies and activities related to biodiversity conservation.

Within the IATA context, Air New Zealand has established policies in waste management and demonstrated environmental sensitivity by striving to preserve local biodiversity. The company develops strategies to use energy and resources efficiently, takes measures to enhance operational efficiency, and adopts aircraft technologies that reduce carbon emissions. Providing sustainable options to customers and reducing the environmental impact of airport operations are among the company's key sustainability objectives.

In the IATA framework, ANA strengthens its commitments by setting concrete and measurable goals in sustainability. ANA adopts a proactive approach to achieve the target of net-zero carbon emissions by 2050. Notably, the company is committed to reducing the use of single-use plastics in flights and promoting recycling. ANA's activities in these areas contribute to IATA goals and exemplify a proactive approach. The company also strives to improve operational efficiency and embrace innovation in the aviation sector. Promoting the use of aircraft that produce fewer carbon emissions by adopting innovative flight technologies is a significant step towards advancing sustainable aviation. ANA's commitments reflect both a pioneering role and a spirit of collaboration in the field of sustainability. However, there is no official information regarding its efforts to improve noise and air quality or enhance efficiency.

Within the framework of IATA goals, Asiana Airlines has declared its commitment to achieving net-zero carbon emissions by 2050 and is implementing various strategies to attain this objective. In the context of waste management and recycling, the airline has put in place a concrete program that focuses on reducing the use of single-use plastics and promoting waste recycling. Regarding water management, it has adopted strategies to reduce water consumption and waste. To support biodiversity conservation, Asiana Airlines is actively involved in various projects aimed at preserving biodiversity and habitats, playing a significant role in this regard. In the realm of social responsibility, the company fulfills its social responsibilities by investing in employee education and development and providing support to local communities. To enhance operational efficiency, the airline takes measures to improve fuel efficiency and actively works to make its operations more efficient. Asiana takes a pioneering role in investing in new aircraft technologies aimed at reducing carbon emissions and enhancing energy efficiency. To achieve sustainability goals, the company adopts a strategy of collaborating with suppliers and other business partners. In efforts to increase the sustainability of airports, the company collaborates with airport operators to enhance airport operations' sustainability. Asiana also continues its efforts to promote carbon offset programs and support greener travel options for customers. Furthermore, in alignment with its goal of using energy and resources more efficiently, the company embraces energy-efficient technologies and works towards making its operations more efficient.

In the context of IATA goals, Austrian Airlines has set sustainability goals as a significant step in addressing environmental issues in the aviation industry. Particularly, the commitment to achieving net-zero carbon emissions demonstrates the company's dedication to environmental concerns. In pursuit of this goal, Austrian Airlines takes steps such as using more efficient aircraft and opting for sustainable fuels. Additionally, its efforts in waste management and recycling contribute to reducing the aviation industry's environmental impact. With a sense of social responsibility, the company invests in employee education and development and provides support to local communities, aiming to enhance operational efficiency and contribute to economic

sustainability. However, there is no official information regarding Austrian Airlines' activities related to biodiversity conservation.

In accordance with IATA guidelines, Avianca Airlines embraces a sustainable aviation vision. The company takes various measures to achieve this goal, focusing on minimizing the environmental impact of operational processes and services. This includes various activities such as waste management and recycling programs. Additionally, Avianca assists customers in reducing their environmental footprint by offering sustainable travel options. By leading the transformation of the aviation industry as a whole, it makes a significant contribution to creating a more sustainable air transportation model for future generations. However, the company lacks sufficient information on sustainability activities, reports, annual activity reports, and its website regarding zero carbon goals, sustainable aviation fuels, new aircraft technologies, and biodiversity conservation.

Brussels Airlines, in line with IATA objectives, represents airline companies and carries the mission of promoting sustainability throughout the industry. The promotion of alternative fuels, investment in energy efficiency projects, and technological advancements reflect IATA's determination to contribute to a sustainable aviation industry in the future. Moreover, its efforts to establish collaboration and partnerships among all industry stakeholders demonstrate how IATA strives to achieve its sustainability objectives. The company does not have a zero carbon emission target.

In line with IATA's sustainability mission, Copa Airlines has been a decisive factor in reducing the environmental impact of the aviation industry. By embracing significant commitments such as IATA's net-zero carbon emission goal, it contributes to the evolution of the aviation sector towards a sustainable future. Copa Airlines' efforts, such as fuel efficiency strategies and waste management programs, align with IATA's roadmap, contributing to environmentally friendly flight operations. This reflects IATA's commitment to promoting sustainability standards among airline companies and minimizing environmental impact across the industry. Collaboration among airlines like Copa Airlines assists in making sustainable aviation a global priority. However, the company has not made specific commitments related to biodiversity conservation.

When examined in the context of IATA goals, Croatia Airlines partially assumes a role in sustainability within the aviation sector compared to other companies. The company's efforts in waste management and recycling, as well as its support for energy and resource efficiency, new aircraft technologies in aviation, energy and resource efficiency, operational efficiency, and social responsibility projects, contribute to the development of sustainability. Additionally, its collaborations in the industry help to promote the understanding of sustainability and strengthen the sense of social responsibility.

Within the framework of IATA, EgyptAir exhibits a low profile regarding sustainability in the aviation sector. It commits to minimizing environmental impact by adopting the net-zero carbon emission goal. However, there is no evidence of any initiatives or support in their official sources related to waste management, water management, biodiversity, or investment in new technologies. The company aims to provide social benefits by investing in employee education and development within the context of social responsibility and by collaborating with local communities. This places EgyptAir behind other companies in the industry in terms of sustainability activities when compared

In line with IATA's goals, Ethiopian Airlines is actively engaged in sustainability efforts within the aviation sector. The company collaborates with local communities and undertakes initiatives to promote green travel programs and reduce carbon emissions through projects aimed at energy efficiency and environmental efficiency at airports. Additionally, the company engages in sustainable practices and social responsibility activities in partnership with its business associates.

Within the framework of IATA, EVA Air is an airline company that is committed to reducing its environmental impact in the aviation sector with significant commitments and strategies in sustainability. Efforts to renew its fleet and invest in efficient aircraft are crucial steps in reducing carbon emissions. Moreover, its goal of promoting sustainable aviation fuels and focusing on research and development reflects its commitment to reducing its carbon footprint. Waste management and recycling programs mirror EVA Air's commitment to waste reduction and recycling. Water management strategies highlight its efforts to reduce water consumption and protect sustainable water resources. The company is dedicated to conserving biodiversity and preserving sensitive ecosystems. Its social responsibility commitments and emphasis on employee education and development demonstrate its efforts to provide societal benefits and enhance operational efficiency. EVA Air aims to expand sustainability goals across its entire supply chain through collaboration with suppliers and business partners. Sustainability efforts for airports aimed at reducing their environmental impact also align with EVA Air's environmental commitments. Awareness campaigns promoting green travel and carbon reduction programs underscore the company's commitment to offering environmentally friendly travel options. Similarly, policies aimed at enhancing energy and resource efficiency reflect its commitment to sustainable energy sources.

Within the framework of IATA, LOT has committed to achieving net-zero carbon emissions by 2050 and has taken significant steps towards environmental sustainability. Playing a crucial role in strategies such as investing in more efficient aircraft and using sustainable aviation fuels is paramount. Furthermore, the company adopts and implements policies related to sustainability in various other areas. LOT is focused on making its operations more sustainable by implementing policies and projects to reduce its environmental impact in terms of biodiversity and social responsibility. Providing education and development opportunities for its employees and collaborating with business partners and suppliers are also part of its social responsibility commitment. Strategies in areas such as operational efficiency, energy and resource efficiency, and promoting greener travel are important steps to both enhance cost efficiency and reduce environmental impacts. Lastly, efforts to invest in and use sustainable aviation fuels aim to transition to sustainable energy sources that can replace fossil fuels, a significant commitment in reducing the airline's carbon emissions.

Within the scope of IATA, Lufthansa aims to achieve net-zero carbon emissions by 2050. To reach this goal, the airline is adopting various strategies such as improving fuel efficiency, using sustainable aviation fuels (SAFs), and implementing carbon offset programs. Additionally, Lufthansa aims to reduce waste and increase recycling by

implementing waste management and recycling policies. The company respects the rights of its employees, communities, and suppliers within the framework of social responsibility. Lufthansa is focused on reducing operational costs and carbon emissions by concentrating on operational efficiency and energy efficiency and by investing in new aircraft technologies. It also collaborates with business partners to make its supply chain more sustainable. In the context of sustainability at airports, Lufthansa adopts policies and strategies to increase energy efficiency and improve waste management. The airline aims to offer greener travel options and provide carbon offset choices to customers. Lastly, Lufthansa is committed to reducing carbon emissions by investing in and expanding the use of sustainable aviation fuels that can replace fossil fuels.

International Air Transport Associationis an organization committed to reducing the environmental impacts of the aviation sector through commitments and strategies in sustainability. Member airlines of IATA are making various efforts to reduce carbon emissions. They focus on adopting innovative technologies, improving fuel efficiency, using sustainable aviation fuels, and waste management. Additionally, they engage in activities in the realm of social responsibility with the aim of contributing to society. IATA's commitment to reducing environmental impacts and sustainability plays a significant role in the aviation sector. In this context, Scandinavian Airlines (SAS) is in full compliance with commitments such as achieving net-zero carbon emissions by 2050, promoting sustainable aviation fuels (SAFs), encouraging new aircraft technologies, managing cabin waste and recycling, promoting greener travel (noise and air quality), enhancing energy, resource, and operational efficiency, and conserving biodiversity.

From the perspective of IATA, Shenzhen Airlines places significant importance on new aircraft technologies, waste management, and recycling policies to support environmental sustainability. Similarly, it actively engages in cabin waste management and recycling, promoting greener travel (noise and air quality), conserving biodiversity, and focusing on various initiatives to improve the well-being of employees and the community.

Within the framework of IATA's sustainability goals, airlines such as Singapore Airlines are supported in their sustainability efforts, promoting a green transformation across the industry. In this context, the focus of Singapore Airlines, a major player in the aviation industry, on achieving net-zero carbon emissions by 2050 aligns with IATA's global environmental sustainability goals. IATA encourages airlines to adopt more sustainable practices in areas such as waste management and recycling, water usage, energy efficiency, clean energy usage, and sustainable aviation fuels. Additionally, social responsibility projects and community service initiatives are seen as integral parts of the aviation sector's sustainability efforts.

Under the umbrella of the IATA, South African Airways is committed to reducing its carbon footprint in line with its environmental sustainability goals. The company places significant emphasis on waste management and recycling practices to work towards waste reduction and minimizing environmental impact. SAA also demonstrates a conscientious approach to water management, aiming to optimize water usage and operate sustainably in regions facing water scarcity. Biodiversity conservation is among the company's priorities, with a focus on preserving biodiversity areas and designing operations accordingly. Within the framework of social responsibility, SAA aims to increase societal impact through community projects and sharing sustainability standards with its business partners. Embracing technological innovations and offering environmentally friendly travel options to customers are integral parts of SAA's sustainability commitment. In this context, SAA's sustainability strategies encompass significant steps toward minimizing the environmental and societal impacts of the aviation industry.

Within the context of IATA's sustainability initiatives, Swiss Airlines is committed to focusing on environmental sustainability goals, aiming to achieve net-zero carbon emissions by 2050. The airline is engaged in various initiatives in water management and social responsibility to minimize its environmental impact. It is taking steps such as researching sustainable fuel options and aligning its supply chain with sustainability. Embracing eco-friendly policies for airports, offering green travel options to customers, and adopting technological advancements are also part of its efforts.

TAP Air Portugal, under the IATA framework, is intensifying its efforts to achieve the goal of net-zero carbon emissions by 2050. To accomplish this objective, the airline is adopting comprehensive strategies, including energy efficiency and operational improvements. Additionally, it demonstrates a determined approach to waste management and recycling, aiming to reduce plastic usage and promote waste recycling. TAP Air Portugal also commits to areas like water resource management, social responsibility projects, and sustainable supply chain management. By embracing technological innovations and collaborating with others, the airline supports efforts to reduce its environmental impact and strengthen sustainability. In this regard, TAP Air Portugal is promoting a transformation, both in its own operations and across the aviation industry, to achieve sustainability goals.

Within the framework of the IATA, Thai Airways is taking significant steps in waste management, aiming to minimize waste and promote recycling. In terms of water management, the airline is adopting strategies to reduce water consumption and preserve water quality. Its commitment to biodiversity conservation and efforts to support local ecosystems are among the company's priorities. The social responsibility policies demonstrate a strong commitment to diversity, equal opportunities, and community service. The strategies for reducing carbon emissions include fleet modernization and the adoption of efficient aircraft technologies. Efforts to spread sustainability standards across the supply chain involve collaboration with business partners and suppliers. The efforts shown for the sustainability of airport operations contribute to the overall sustainability goals. By aiming to reduce the environmental impact of travel, the airline offers options such as carbon offset programs to its customers. The more efficient use of energy and resources is a significant step towards reducing environmental impact and also targets cost reduction.

From the perspective of IATA, Turkish Airlines has set a goal of achieving net-zero carbon emissions by 2050 in line with IATA's sustainability objectives and is implementing various strategies to reach this target. These strategies include modernizing the aircraft fleet, developing operations to reduce carbon emissions, and research and development on Sustainable Aviation Fuels. Significant efforts are also made in waste management and water management. The airline shows a substantial commitment to biodiversity conservation and aims to reduce the impact of its operations on biodiversity through environmental impact assessments.

Aligned with IATA goals, United Airlines has adopted the target of achieving net-zero carbon emissions by 2050 and is working on various strategies to reach this goal. These include investing in low carbon emission technologies and improving the efficiency of flight operations. In waste management and recycling, United Airlines places special emphasis on reducing waste and promoting recycling. The airline aims to reduce waste and encourage recycling through various strategies. With a commitment to social responsibility, the airline places great importance on employee welfare and promoting equality and diversity. It also supports social responsibility projects by collaborating with local communities and engaging in community services. United Airlines' strategies for airport sustainability involve making the airline's airport operations more sustainable. The airline aims to provide greener travel options by offering carbon offset programs and green flight alternatives to its customers. In terms of energy and resource efficiency, the airline seeks to reduce its environmental impact while lowering costs and aims to use energy and resources more effectively.

Table 2. Examination of the Sustainability Activities of SkyTeam Member Companies within the Scope of IATA's Sustainability Goals

Number	Companies	Achieve net zero carbon emissions by 2050	Sustainable aviation fuels (SAFs)	Promoting new aircraft technologies	Cabin waste management and recycling	Greener travelling (noise and air quality)	Energy, resource and operational efficiency	Protecting biodiversity
1	Aerolíneas Argentinas	✓	✓	✓	×	✓	✓	×
2	Aeromexico	✓	✓	✓	✓	✓	✓	✓
3	Air Europa	×	×	✓	✓	✓	✓	×
4	Air France	✓	✓	✓	✓	✓	✓	×
5	China Airlines	✓	✓	✓	✓	✓	✓	×
6	China Eastern Airlines	✓	✓	✓	✓	✓	✓	✓
7	Czech Airlines	×	×	✓	✓	×	✓	✓
8	Delta Airlines	✓	✓	✓	✓	✓	✓	×
9	Garuda Indonesia	×	×	✓	✓	✓	✓	✓
10	ITA Airways	✓	✓	✓	✓	✓	✓	×
11	Kenya Airways	✓	✓	✓	×	✓	✓	✓
12	KLM Royal Dutch Airlines	✓	✓	✓	✓	✓	✓	✓
13	Korean Air	✓	✓	✓	✓	✓	✓	✓
14	Middle East Airlines	×	×	×	×	✓	×	×
15	Saudia	×	×	×	✓	✓	×	✓
16	The Romanian Air Transport	×	×	×	×	×	×	✓
17	Vietnam Airlines	×	×	✓	✓	✓	✓	×
18	Virgin Atlantic	✓	✓	×	✓	✓	✓	✓
19	XiamenAir	×	×	✓	✓	✓	✓	×

Within the framework of the IATA, Aerolineas Argentinas is adopting various strategies to achieve IATA's sustainability objectives. Foremost among these strategies are the use of sustainable aviation fuels to reduce carbon emissions and efforts to increase energy efficiency. Additionally, significant steps are being taken in waste management and recycling, as well as investment in water-saving technologies. In terms of social.

Aligned with IATA's goals, Aeromexico is also adopting various strategies to realize IATA's sustainability targets. Primary among these are the use of sustainable aviation fuels to reduce carbon emissions and efforts to increase energy efficiency. The airline is making significant strides in waste management and recycling, and is investing in technologies for water conservation. In the realm of social responsibility, Aeromexico is committed to fair employment practices and community giving programs, supporting both its workforce and local communities. To boost business efficiency, the airline employs more efficient flight routes and energy-efficient aircraft technologies, along with digitizing its operations.

Within the IATA framework, Air Europa is prioritizing energy-efficient aircraft to achieve the goal of net-zero carbon emissions. The company reduces waste and encourages recycling through its waste management and recycling programs. Air Europa is fulfilling its water management objectives by adopting water-saving technologies and practices to reduce water consumption. Its social responsibility goals are realized through fair and equitable policies and programs aimed at employees and communities. Air Europa enhances operational efficiency through methods such as more efficient flight routes, energy-efficient aircraft, and digitized operations. The company supports its emissions reduction goal by investing in new aircraft technologies. To achieve its sustainability targets, it collaborates with suppliers, airport operators, and other business partners. Air Europa reduces the environmental impact of airport operations by collaborating with airport operators. It offers greener travel options by providing carbon offset choices to customers and promoting energy-efficient flights. The company achieves its energy and resource efficiency objectives by investing in energy-saving technologies and flight methods. Ultimately, Air Europa integrates sustainable practices into its operations and collaborates with partners, a commitment that can facilitate its steady progress towards a sustainable future.

Under the auspices of the IATA, Air France is contributing to sustainable aviation. The company, in line with IATA's defined targets, is conducting a series of initiatives to achieve the net-zero carbon emissions goal by 2050, focusing on reducing carbon emissions through the use of energy-efficient aircraft. Air France has taken serious steps in waste management and recycling, adopting policies to reduce waste and prioritize eco-friendly practices. It is also fulfilling its responsibilities in areas like water management, maintaining its commitment to sustainability. Additionally, the airline is engaged in social responsibility projects aimed at generating societal benefits.

Within the context of the IATA, China Airlines is taking comprehensive steps towards the development of sustainable aviation. The airline is focusing on incorporating energy-efficient aircraft into its fleet as a means to reduce carbon emissions. It is adopting waste management and recycling policies to diminish waste and encourage recycling, reflecting its commitment to environmentally friendly practices. In the realm of water management, China Airlines follows strategies to lessen the impact of its operations on natural ecosystems, employing water-saving technologies and practices. The company collaborates with partners in the supply chain to broaden its sustainability objectives and foster innovation. By working with airport operators, it is reducing the environmental impact of airport operations. Offering customers carbon offset options and promoting more eco-friendly travel, China Airlines aims to spread awareness about sustainability. Investing in efficient utilization of aviation fuels and renewable energy, the airline seeks to enhance energy and resource efficiency. In this framework, it aims to lay a solid foundation for future sustainable aviation by expanding its strategies for reducing environmental impacts.

China Eastern Airlines operates in line with IATA's sustainability standards. By adding high energy-efficient aircraft to its fleet and improving operational efficiency, the airline contributes to sustainable aviation goals. These high energy-efficient aircraft form part of its strategy to reduce carbon emissions. Additionally, China Eastern actively contributes to reducing its carbon footprint through participation in carbon offset programs. Adopting waste management and recycling policies, it aims to contribute to the sustainable use of natural resources. Optimizing waste management processes is crucial for minimizing environmental impacts. Measures taken to adopt water-saving technologies and improve water management contribute to the sustainable use of water resources. China Eastern Airlines employs various strategies to support biodiversity goals, including policies and awareness activities to prevent illegal wildlife trade. Noise pollution reduction strategies are an essential part of the airline's social responsibilities. In this regard, China Eastern contributes to reducing noise pollution around airports by opting for modern aircraft with quieter engines. Its goal of improving air quality is a reflection of its efforts to minimize environmental impacts, with steps like using low-emission aircraft and transitioning to alternative fuels. Acting with a social responsibility ethos, China Eastern Airlines adopts strategies such as paying fair wages to its employees and investing in local communities, demonstrating its commitment to responsible interactions with society. Its economic sustainability goal involves making operations more efficient and reducing costs to operate sustainably from an economic perspective. Achieving this goal necessitates embracing innovation and new business models. Promoting technology and assuming technological responsibility reflects the company's approach to investing in environmentally friendly technologies and using technology ethically. China Eastern Airlines aims to achieve sustainability goals in alignment with IATA, collaborating with suppliers, business partners, and other aviation companies. These collaborations aim to spread sustainable practices across the industry. Additionally, developing sustainability strategies for airports, China Eastern collaborates with airport operators to take steps towards reducing the environmental impact of airports. By offering green travel options and encouraging more eco-friendly travel with carbon offset options, the airline supports environmentally friendly practices.

Under the guidance of the IATA, Czech Airlines is exerting efforts in the realm of sustainability by incorporating energy-efficient aircraft into its fleet and optimizing flight routes. Additionally, environmental measures such as waste reduction, recycling, and water management policies reflect Czech Airlines' commitment to the efficient use of clean water, waste management, and environmental protection. IATA supports the airline's objectives to preserve biodiversity, promote social responsibility, and encourage technological advancement, believing these efforts will contribute to the development of a sustainable aviation sector.

Within the framework of the IATA, Delta Airlines sets a precedent in the industry by adopting sustainable aviation practices. Delta is progressing towards its goal of net-zero

carbon emissions by renewing its fleet with more energy-efficient aircraft and optimizing flight routes. The airline balances its environmental impacts by participating in carbon offset programs and investing in waste management programs. Additionally, Delta demonstrates exemplary efforts in water efficiency, making it a model practitioner in water management. Reflecting IATA's vision for sustainability, Delta offers environmentally friendly travel options to its customers.

In line with IATA standards, Garuda Indonesia plans to invest in projects that support carbon offsetting to reduce its environmental impact and continues its efforts in waste reduction and recycling through its waste management programs. In the context of social responsibility, the airline adopts policies focused on equality, diversity, and social benefit. Garuda Indonesia focuses on technological advancement, supporting innovative solutions and collaborating with business partners to achieve sustainability goals. The airline aims to offer green travel opportunities by promoting eco-friendly flights and plans to use sustainable aviation fuels to enhance energy and resource efficiency.

ITA Airways, in alignment with IATA objectives, adopts strategies to reduce and offset carbon emissions in pursuit of the Net Zero Carbon Emissions goal. The airline is taking steps in waste management and recycling policies to reduce and recycle waste. In terms of social responsibility, ITA Airways aims to provide societal benefits by implementing equality and diversity policies and investing in communities. The airline targets support for eco-friendly technologies through its efforts in technological advancement and investment in sustainable aviation technologies. Collaborating with business partners and suppliers, ITA Airways aims to achieve sustainability goals. The airline adopts strategies for environmentally friendly airport operations and collaboration to operate sustainably. ITA Airways is committed to reducing carbon emissions through the use of sustainable aviation fuels and enhancing energy and resource efficiency.

Kenya Airways is supporting the IATA efforts to reach net-zero carbon emissions. The airline is continuing its efforts to balance carbon emissions by investing in more efficient aircraft and participating in sustainable projects. Additionally, it plans to take responsibility by investing in water-saving technologies to reduce water usage and developing strategies to minimize its impact on biodiversity. The company is contributing to sustainability by conducting activities in areas such as water management, biodiversity, social responsibility, operational efficiency, new aircraft technologies, collaboration with business partners, greener travel, energy and resource efficiency, and sustainable aviation fuels (SAFs).

Within the scope of IATA, KLM is implementing various initiatives in sustainability in line with IATA's goal of net-zero carbon emissions by 2050. To this end, it is accelerating the transition to low-carbon flight operations by investing in more efficient aircraft. KLM is focusing on waste reduction and recycling efforts by raising passenger awareness through waste management and recycling programs. The airline is also actively participating in biodiversity projects to reduce its impact on the natural environment. In terms of social responsibility, KLM is adopting policies of diversity, equality, and inclusivity, aiming to collaborate with local communities. These efforts by KLM significantly contribute to achieving IATA's sustainability goals.

Under the IATA framework, Middle East Airlines (MEA) is enhancing its societal impact by investing in more energy-efficient aircraft and supporting local communities with a sense of social responsibility, as well as promoting workforce diversity. The company's sustainability reports, annual activity reports, and website indicate various initiatives to reduce noise pollution and improve air quality as part of its greener travel efforts. However, there is a lack of activities towards achieving other IATA goals.

From an IATA perspective, Saudia's efforts in using sustainable aviation fuels, considering its ties with the petrochemical industry, play a critical role in reducing carbon emissions. Its sustainable goals, when aligned with the petrochemical industry, hold vital importance for both the company's and the aviation sector's sustainability. Economic sustainability and collaboration, through seeking innovative solutions for cost savings, are key aspects of Saudia's approach.

Regarding IATA's objectives, TAROM reflects its commitment to biodiversity and ecosystem protection through policies aimed at reducing its impact on biodiversity, in consideration of the European Union's stringent environmental policies. The airline's social responsibility goals are prominent in its commitment to and activities supporting the rights of its employees and local communities. Efforts to increase operational efficiency will enhance TAROM's competitiveness. However, TAROM appears to lag behind other companies in the sector, and achieving these goals is critical for both the airline's long-term success and environmental sustainability.

Vietnam Airlines' approach, in the context of IATA, represents a significant example of reducing the environmental impact of air transport. The airline demonstrates its commitment to waste reduction and recycling targets through various effective strategies in waste management and recycling. Thus, it successfully fulfills IATA's emphasized goals like waste management.

From the perspective of IATA, Virgin Atlantic's sustainability efforts offer a model example in reducing the environmental impact of air travel. The airline is working determinedly towards the goal of net-zero carbon emissions, taking steps such as using more efficient aircraft, employing sustainable aviation fuels, and enhancing energy efficiency. Active steps in waste management, recycling, and water management support environmental sustainability. Virgin Atlantic plays a crucial role in collaborating with business partners to contribute to making the aviation sector overall more sustainable.

Xiamen Air operates in alignment with IATA's sustainable aviation goals. The airline adopts significant strategies to reduce carbon emissions, such as enhancing energy efficiency and using sustainable fuels. Incorporating more efficient aircraft into its fleet and increasing the use of sustainable aviation fuels are effective methods to reduce its environmental impact. Its efforts in waste management and recycling support environmental sustainability, and steps in areas such as water management continue its efforts to minimize environmental impacts. Xiamen Air aligns with sustainability goals through strategies to increase operational efficiency and reduce energy consumption.

Table 3. Examination of OneWorld Member Companies' Sustainability Activities in the Scope of IATA's Sustainability Goals

Number	Companies	Achieve net zero carbon emissions by 2050	Sustainable aviation fuels (SAFs)	Promoting new aircraft technologies	Cabin waste management and recycling	Greener travelling (noise and air quality)	Energy, resource and operational efficiency	Protecting biodiversity
1	Alaska Airlines	✓	✓	✓	✓	✓	✓	×
2	American Airlines	✓	✓	✓	✓	✓	✓	×
3	British Airways	✓	✓	✓	✓	✓	✓	×
4	Cathay Pacific	✓	✓	✓	✓	✓	✓	✓
5	FinnAir	✓	✓	✓	✓	✓	✓	✓
6	Iberia Airlines	✓	✓	✓	✓	✓	✓	×
7	Japan Airlines	✓	✓	✓	✓	✓	✓	✓
8	Malaysia Airlines	✓	×	×	✓	✓	✓	×
9	Qantas Airways	✓	✓	✓	✓	✓	✓	✓
10	Qatar Airways	×	✓	✓	✓	✓	✓	✓
11	Royal Air Maroc	×	×	×	×	×	×	×
12	Royal Jordanian	×	×	✓	✓	×	✓	×
13	SriLankan Airlines	×	×	✓	×	×	✓	×

Within the framework of the (IATA), Alaska Airlines has committed to combatting climate change. In 2020, the airline set a goal to reduce the carbon emissions of its flights to net-zero by 2040, a plan that precedes the 2050 target set by IATA by a decade. Alaska Airlines has adopted various strategies to achieve this goal, including using more efficient aircraft, employing sustainable aviation fuels (SAFs), balancing carbon emissions, and enhancing operational efficiency. For instance, in 2017, Alaska Airlines led the aviation industry in the use of biofuels with its first biofuel flight from Seattle-Tacoma International Airport to San Francisco International Airport. The airline has also adopted an environmentally friendly approach to waste management and recycling. Its "Fill Before You Fly" program encourages passengers to fill their reusable water bottles to reduce plastic waste. While the company may not have articulated a specific strategy on water management, it continues to work towards reducing its overall environmental impact. It is also thought that Alaska Airlines could collaborate with airports on sustainability and new aircraft technologies. However, for current and more detailed information, it is important to refer to Alaska Airlines' official website or relevant sustainability reports. Lastly, Alaska Airlines is taking significant steps in social responsibility. With community service programs and commitments to diversity and inclusion, the airline aims to create a positive impact in the social sphere.

In line with the (IATA), American Airlines has made significant commitments regarding carbon emissions, adopting the goal of achieving net-zero carbon emissions by 2050. This commitment encompasses emissions from both flights and ground operations. The company plans to follow various strategies to achieve this goal; these include using more efficient aircraft, employing sustainable aviation fuels (SAFs), enhancing operational efficiency, and increasing carbon offsetting. American Airlines has also taken significant steps in waste management and recycling. For example, in 2020, it became the first airline to initiate an in-flight plastic recycling program. Additionally, the airline is working on innovative solutions such as recycling used uniforms and repurposing them for new products.

In terms of water management, American Airlines has implemented water conservation and energy efficiency measures at many airports. In the area of social responsibility, the airline places importance on community service programs and commitments to diversity and inclusion. It has made commitments to sustainability at airports, greener travel, and energy and resource efficiency. Regarding new aircraft technologies and collaboration with business partners, American Airlines commits to using advanced technologies and strategies to make its flights more efficient and reduce emissions. This includes significant steps like using next-generation aircraft, optimizing flight paths, and enhancing air traffic control technologies. Finally, active in sustainable aviation fuels, American Airlines aims to increase the commercial use of these fuels through collaboration with biofuel producers and suppliers, thereby contributing to a more environmentally friendly and sustainable future in the aviation industry.

Aligned with the (IATA) goals, British Airways can be considered a committed airline in achieving sustainability targets within the aviation industry. It has pledged to reach net-zero carbon emissions by 2050, in line with the objectives set by IATA. To attain this goal, the airline plans to adopt strategies such as using more efficient aircraft, enhancing operational efficiency, and employing sustainable aviation fuels (SAFs). In terms of waste management and recycling,

British Airways continues efforts to reduce and recycle waste generated from its flights. The company has also committed to reducing plastic waste from its operations.

As part of its sustainability strategy, British Airways supports various environmental conservation projects. It has made commitments to sustainability at airports and greener travel options. For example, it is taking measures to increase energy efficiency at airports and also offers passengers the opportunity to offset their carbon emissions. In terms of operational efficiency, British Airways commits to optimizing energy and resource usage through new aircraft technologies and efficient operations.

Lastly, in the realm of social responsibility, ritish Airways is dedicated to supporting local communities and addressing various social issues. This comprehensive approach underlines the airline's commitment to contributing to a more sustainable and responsible aviation sector.

In line with the (IATA) targets, Cathay Pacific has committed to achieving net-zero carbon emissions by 2050, a goal that mirrors IATA's objectives. To reach this target, the airline plans to adopt strategies such as utilizing more efficient aircraft and operations, using sustainable aviation fuels (SAFs), and implementing carbon emission balancing strategies. Regarding waste management and recycling, Cathay Pacific has set a goal to reduce waste generated from its flights by 50% by 2030. To achieve this, the airline will offer reusable or recyclable products to passengers and improve waste management on its aircraft to reduce its environmental impact. In water management and biodiversity, Cathay Pacific continues efforts to reduce its environmental footprint, focusing on reducing water usage and supporting biodiversity conservation projects and programs. In social responsibility, the airline is committed to various community service programs and diversity and inclusion initiatives. Cathay Pacific has also made significant commitments to sustainability at airports and greener travel options. In terms of operational efficiency and new aircraft technologies, it is committed to adopting various technologies and strategies to make flights more efficient and reduce emissions. Finally, Cathay Pacific is actively committed to energy and resource efficiency and sustainable aviation fuels, supporting various projects and initiatives to develop and utilize SAFs, contributing to a more environmentally friendly future in aviation.

Under IATA targets, Finnair has pledged to reach net-zero carbon emissions by 2050 and is taking various measures to achieve this goal. The airline plans to reduce carbon emissions by incorporating more efficient aircraft into its fleet and making its operations more efficient. It also aims to increase the use of sustainable aviation fuels (SAFs) and implement emission balancing strategies. Finnair has made significant commitments in waste management and recycling, focusing on reducing waste from its flights and increasing recycling to lessen its environmental impact. In water management and biodiversity, Finnair is dedicated to reducing water consumption and preserving biodiversity, while also supporting environmental conservation projects. In the realm of social responsibility, Finnair implements various programs and policies related to diversity and inclusion, community service, and employee welfare, aiming to create a positive social impact. For operational efficiency and new aircraft technologies, Finnair plans to reduce emissions by incorporating more efficient aircraft into its fleet, optimizing flight paths with modern navigation technologies. In energy and resource efficiency, the airline commits to using energy-efficient technologies and renewable energy sources to reduce energy and resource consumption. Finally, regarding sustainable aviation fuels, Finnair aims to increase the use of SAFs and support projects for the development and commercialization of these fuels, contributing to a greener future in aviation.

Under the auspices of the (IATA), Iberia is actively monitoring significant developments in the industry and contributing to sustainable aviation goals. The company has set its commitments towards achieving net-zero carbon emissions by 2050, adopting various strategies to this end. These include embracing innovative technologies, utilising more efficient aircraft, preferring sustainable aviation fuels, and enhancing operational processes. Additionally, Iberia is aligning with IATA's sustainable development goals in areas like waste management and recycling, water management, gender equality, and economic growth.

Japan Airlines (JAL), another member within the IATA framework, has committed to a net-zero carbon emission target by 2050. It adopts diverse strategies to achieve this objective, including a commitment to reduce flight-generated waste through waste management and recycling. In water management, JAL pledges to reduce water consumption, focusing on efficient use and recycling of water. For biodiversity conservation, JAL supports projects aimed at preserving and sustaining biodiversity, including the protection of natural habitats and support for local ecosystems. In social responsibility, JAL prioritises community service projects and commitments to diversity and inclusion. Regarding operational efficiency and new aircraft technologies, JAL adopts various technologies and strategies to promote more efficient aircraft and operations. This encompasses embracing new technologies for more efficient aircraft and flight operations. In airport sustainability, JAL is committed to increasing energy and resource efficiency, which involves adopting energy-efficient technologies and optimising the use of energy and resources. In its commitment to offering more sustainable travel options, JAL aims to provide passengers with options to offset carbon emissions and promote the use of sustainable aviation fuels. Lastly, JAL is committed to sustainable aviation fuels (SAFs), which entails increasing the use and development of SAFs to contribute to a more sustainable and environmentally friendly future for the aviation industry.

Within the scope of the (IATA), Malaysia Airlines is a leading airline aiming to achieve net-zero carbon emissions by 2050. The company is committed to reducing its environmental impact through comprehensive strategies such as waste management, water conservation, energy efficiency, and the use of sustainable fuels. It also pledges to address areas like employee health and safety, gender equality, diversity promotion, and social responsibility. The company aims to contribute to the sustainable future of the aviation industry by investing in modern technologies and innovative solutions.

Under IATA, Qantas has made significant commitments in waste management and recycling. It aims to reduce waste from its flights and ground services and to promote recycling. In this regard, it adopts waste reduction and recycling strategies with a specific focus on reducing plastic usage. In water management, the company is committed to reducing water consumption and promoting more effective water use. Additionally, Qantas places importance on environmental and societal sustainability by contributing to biodiversity

conservation projects and social responsibility initiatives. For operational efficiency, Qantas aims to adopt modern technologies, use more efficient aircraft, and renew its fleet.

Qatar Airways, another IATA member, has committed to achieving net-zero carbon emissions by 2050. To reach this goal, it is taking various steps in waste management and recycling. Within its waste reduction and recycling strategies, the airline aims to decrease plastic usage, thereby minimising its environmental impact. Similarly, in water management, it pledges to encourage water conservation and reduce water consumption. The airline also supports projects aimed at protecting and sustaining biodiversity. In the realm of social responsibility, Qatar Airways aims to support local communities and provide educational opportunities. For operational efficiency and technology usage, the airline plans to adopt strategies for more efficient flight operations and energy efficiency.

Regarding social responsibility within the IATA framework, Royal Air Maroc (RAM) aims to support local communities and promote economic and social development. In terms of operational efficiency, RAM has adopted strategies to enhance energy and operational efficiency. With regard to new aircraft technologies, RAM continues its efforts to incorporate more efficient and environmentally friendly aircraft into its fleet. Specific policies and practices related to sustainability at airports, greener travels, and energy and resource efficiency for RAM have not been detailed.

Under the (IATA) framework, RJ (Royal Jordanian Airlines) is aiming to achieve net-zero carbon emissions by 2050. In line with this objective, the company plans to reduce carbon emissions by using more efficient aircraft and operations. However, specific commitments regarding the net-zero target are not detailed. General information exists about RJ's waste management and recycling strategies, but specific targets or initiatives are not sufficiently detailed. There is a lack of precise information about RJ's specific goals or initiatives in water management. Regarding biodiversity, there is no specific information available on RJ's efforts to minimize its impact on biodiversity. Socially, RJ commits to contributing to local communities and supporting the social and economic development of Jordan. RJ aims to increase operational efficiency by optimizing more efficient aircraft and flight operations. In terms of new aircraft technologies, RJ aims to reduce carbon emissions by using more efficient and environmentally friendly aircraft. Information on RJ's specific targets or strategies regarding collaboration with business partners, sustainability at airports, greener travel, and energy and resource efficiency is limited. There is no definitive information on RJ's strategy or commitment to the use or development of Sustainable Aviation Fuels (SAFs).

Within the scope of IATA's objectives, SriLankan Airlines supports the goal of net-zero carbon emissions by 2050. The company has made commitments to reduce carbon emissions and use sustainable aviation fuels. However, it is unclear whether there is a specific commitment to the net-zero emission target by 2050. SriLankan Airlines has developed waste management and recycling strategies, but detailed information on specific targets and initiatives in these areas is lacking. There is no information available on SriLankan Airlines' specific goals or initiatives in water management. There is no specific information about SriLankan Airlines' efforts to minimize its impact on biodiversity. In terms of social responsibility, SriLankan Airlines commits to contributing to community services and social responsibility projects. The company has taken various steps to increase operational efficiency and reduce energy consumption. SriLankan Airlines aims to reduce carbon emissions through the use of more efficient aircraft. Information on the airline's specific targets or strategies regarding collaboration with business partners, sustainability at airports, greener travel, and energy and resource efficiency is limited. While SriLankan Airlines may have shown interest in the use or development of Sustainable Aviation Fuels (SAFs), specific information on this is not available.

5. Discussion and Conclusion

This study's analysis, rooted in the sustainability commitments of airlines within the Star Alliance, SkyTeam, and OneWorld alliances, under the (IATA) sustainability framework, has illuminated varied levels of commitment to achieving the outlined sustainability goals by 2050. Key findings across these alliances reveal a concerted focus on adopting sustainable aviation fuels, enhancing energy and operational efficiency, and advancing in the adoption of new aircraft technologies. However, disparities emerge in commitments to biodiversity conservation and the achievement of net-zero carbon emissions, with these objectives being less frequently embraced. The variability in commitments can be attributed to several factors. Firstly, the technological and financial challenges associated with transitioning to sustainable aviation fuels and achieving net-zero carbon emissions are substantial, possibly hindering more aggressive adoption. Secondly, the less frequent adoption of biodiversity conservation goals may reflect a narrower focus on direct operational impacts over broader environmental considerations. This discrepancy underscores a potential underestimation of the aviation sector's influence on global biodiversity.

As a member of Star Alliance, Lufthansa has played a leading role in sustainability initiatives, particularly through its commitment to Sustainable Aviation Fuel (SAF). Lufthansa has actively invested in SAF to reduce carbon emissions by up to 80%, as well as exploring carbon-neutral flight options. The airline also incorporates energy-efficient aircraft and is committed to reducing its overall environmental impact through cabin waste management and recycling programmes (Lufthansa Group, 2021). Moreover, Lufthansa has made significant progress in reducing cabin waste, improving operational efficiency, and reducing its carbon footprint through technology advancements (Lufthansa Group, 2023).

Air Canada: Air Canada has committed to achieving **net-zero carbon emissions by 2050**. This commitment includes investments in SAF, fleet modernisation, and carbon offset initiatives. The airline has also introduced measures to enhance fuel efficiency, optimise flight routes, and improve overall operational sustainability (Air Canada, 2023).

Delta, a prominent member of SkyTeam, has undertaken several sustainability initiatives, including a strong commitment to SAF. Delta is investing in the development and large-scale procurement of SAF, which has a significantly lower carbon footprint than traditional jet fuels. In addition, Delta has implemented various waste reduction strategies and energy efficiency measures in its operations, alongside offering carbon offsetting options for passengers (Delta Airlines, 2023).

Air France has also embraced sustainability as a key strategic priority. The airline has committed to reducing its emissions by incorporating SAF into its operations and by

modernising its fleet with more fuel-efficient aircraft. Additionally, Air France has engaged in initiatives to reduce cabin waste and improve overall operational sustainability (Air France-KML, 2024).

Within the Oneworld alliance, British Airways has been a frontrunner in sustainability efforts. The airline has integrated SAF into its fuel supply, launched initiatives to achieve **net-zero emissions by 2050**, and promoted carbon offsetting schemes for passengers. British Airways has also invested heavily in technology that supports energy efficiency and waste reduction (British Airways , 2021). Its comprehensive sustainability strategy focuses on minimizing carbon emissions, waste, and noise pollution.

As part of its commitment to sustainability, Qantas has pledged to achieve **net-zero emissions by 2050**. The airline's initiatives include extensive investment in SAF, reducing cabin waste, and implementing energy-saving measures. Qantas has also invested in more fuel-efficient aircraft and optimised its operations to reduce overall emissions (Qantas, 2023).

Notably, airlines within the Star Alliance network demonstrate a relatively higher engagement with sustainability goals, compared to their counterparts in SkyTeam and OneWorld. This variation may be influenced by the alliances' strategic priorities, the geographical and regulatory environments of member airlines, and the availability of resources to implement sustainability initiatives. Such differences highlight the complex interplay between global sustainability ambitions and localized operational realities. Future research should explore the barriers to adopting more comprehensive sustainability measures, particularly in the areas of biodiversity conservation and net-zero carbon emissions. Investigating the economic, regulatory, and technological challenges that airlines face in these domains will provide deeper insights into how the aviation industry can more effectively contribute to global sustainability efforts.

Enhanced Collaboration: Airlines should seek greater collaboration with technology providers, governments, and international organizations to overcome barriers to sustainability. Sharing best practices and innovations in fuel efficiency, carbon offsetting, and sustainable aviation fuels could accelerate progress.

Biodiversity Conservation Initiatives: Given the lower adoption of biodiversity conservation goals, airlines and alliances should integrate these into their sustainability strategies more robustly. This could involve supporting conservation projects and adopting flight and ground operations that minimize impact on natural habitats.

Public Engagement and Transparency: Increasing transparency about sustainability efforts and actively engaging the public and stakeholders can build trust and support for the airlines' sustainability initiatives. Public awareness campaigns and sustainability reporting can enhance accountability and encourage broader participation in sustainability efforts.

Policy Advocacy: Airlines and alliances should advocate for supportive policies and incentives that facilitate the transition to sustainable aviation, including investment in research and development for new technologies and sustainable fuels, and policies that support carbon pricing and biodiversity conservation.

By addressing these recommendations, the aviation industry can make more substantial contributions to global sustainability goals, ensuring that efforts to enhance operational efficiency and innovation are balanced with the imperative to reduce environmental impact and promote biodiversity conservation.

Based on the findings from the evaluation of global airline alliances and their sustainability initiatives, several promising areas for future research are apparent. These areas are critical for both advancing academic knowledge and providing practical insights for the industry as it strives to meet global sustainability goals.

Firstly, scaling the use of Sustainable Aviation Fuels (SAF) remains a significant challenge. While SAF can dramatically reduce carbon emissions, its widespread adoption has been hindered by economic and technical barriers. Future research should investigate these obstacles in depth, focusing on how policy frameworks and investments can drive SAF production and adoption. Comparative studies across different global regions and alliances would provide valuable insights into the varying levels of SAF integration and the factors contributing to its success or failure.

Secondly, technological innovations in aircraft design, such as electric and hydrogen-powered planes, represent a critical frontier in reducing aviation's environmental impact. However, the feasibility, cost implications, and readiness of the industry to adopt these technologies remain underexplored. Further studies could assess the role of collaborations within alliances to accelerate the development and deployment of these technologies, particularly examining how shared investments can reduce costs and risks for individual airlines.

Thirdly, the effectiveness of carbon offset programmes offered by many airlines requires more rigorous analysis. While carbon offsetting is widely promoted as a tool for reducing environmental impacts, the actual effectiveness and transparency of these schemes are often questioned. Future research could examine the real-world outcomes of carbon offset programmes, including their ethical implications and how passengers perceive their value. Investigating the role of customer perceptions in the success of these programmes would provide insights into their long-term viability.

The protection of biodiversity also emerges as a crucial but under-researched area. Airlines' operations, particularly around major airports, can have significant impacts on local ecosystems. Future studies could explore how airlines are managing these impacts and the effectiveness of their biodiversity protection efforts. This research would contribute to a better understanding of how aviation can align with broader environmental conservation goals, especially in terms of habitat preservation and wildlife protection.

Another area of inquiry is customer perception and behaviour regarding airline sustainability initiatives. While airlines increasingly promote their environmental efforts, it remains unclear how these initiatives influence passenger choices. Future studies could explore whether passengers are willing to pay more for environmentally responsible flights and how airlines' sustainability marketing shapes customer behaviour. This research could provide airlines with actionable insights into how to effectively communicate their sustainability efforts to build customer loyalty.

Lastly, there is an opportunity to explore the role of airline alliances in setting and enforcing sustainability standards. Global alliances such as Star Alliance, SkyTeam, and Oneworld play a crucial role in shaping the sustainability practices of their member airlines. Future research could assess the extent to which alliances influence individual airline policies and the potential for collaborative sustainability projects within alliances. Understanding how alliances can drive industry-wide sustainability standards would provide critical insights into the future of sustainable aviation.

These research areas are essential for helping the aviation industry navigate its path towards greater sustainability. By addressing these issues, future studies will not only deepen academic understanding but also offer practical solutions for airlines striving to meet international sustainability targets.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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