MASTERARBEIT | MASTER'S THESIS

Titel | Title

Corporate Environmental Responsibility: The Case of Substantive Actions or Greenwashing in the Aviation Industry

verfasst von | submitted by

Tijana Martinovic, BSc (WU)

gemeinsam mit | in collaboration with

Nathaly Boric, B.A.

angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien | Vienna, 2025

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 914
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Internationale Betriebswirtschaft
Betreut von | Supervisor:	ao. Univ.-Prof. i.R. Mag. Dr. Josef Windsperger
Mitbetreut von | Co-Supervisor:	Aveed Raha BSc MSc PhD

Abstract

This thesis examines the intersection of Corporate Social Responsibility (CSR), Corporate Environmental Responsibility (CER), and the aviation industry, focusing on sustainability initiatives and challenges. The study first explores the early beginnings of aviation. Then, it focuses on the emergence of commercial flights and the evolution of low-fare flights and airlines. After exploring the historical development of the aviation sector, the research will focus on recent challenges and developments, including the industry's role in the global economy, environmental concerns, and exceptional situations like the COVID-19 pandemic.

Through a comprehensive review of literature, case studies, and industry reports, the research will delve into stakeholder engagement, advancing sustainability efforts, and the continuously growing role of technology. The research aims to provide insights into how the aviation industry can influence, adapt, and react to the complexities of CSR and CER while ensuring its economic viability and environmental stewardship.

Particular attention will be paid to sustainability and greenwashing misconceptions. Traces of greenwashing within the companies will be detected by elaborating and discussing a methodological part with a qualitative analysis.

The study contributes to the ongoing discourse on sustainable development in the aviation industry by examining key concepts, emerging trends, and best practices.

Keywords: Aviation, Corporate Social Responsibility, Corporate Environmental Responsibility, Greenwashing, Sustainability, Environmental Impact, Sustainable Reporting.

Kurzfassung

In der vorliegenden Arbeit wird der Schnittpunkt von Corporate Social Responsibility (CSR), Corporate Environmental Responsibility (CER) und der Luftfahrtindustrie untersucht, wobei der Schwerpunkt auf Nachhaltigkeitsinitiativen und Herausforderungen eben dieser liegt. Die Ausarbeitung beginnt mit einer Untersuchung der historischen Entwicklung der Luftfahrt und befasst sich mit der Entstehung des kommerziellen Flugverkehrs und der Entwicklung von Billigfluggesellschaften. Darüber hinaus werden die jüngsten Entwicklungen und Herausforderungen im Luftfahrtsektor untersucht, darunter auch die Auswirkungen der COVID-19-Pandemie, Umweltbelange und die Rolle der Branche in der Weltwirtschaft. Besonderes Augenmerk wird der Technologie bei der Förderung von Nachhaltigkeitsbemühungen, die Zusammenarbeit mit der Politik und die Einbeziehung von Interessengruppen gewidmet. Durch eine umfassende Auswertung der Literatur, Fallstudien und Branchenberichten soll diese Arbeit einen Einblick geben, wie Fluggesellschaften die Komplexität von CSR und CER bewältigen und gleichzeitig ihre wirtschaftliche Lebensfähigkeit und Umweltverantwortung sicherstellen können. Durch die Untersuchung von Schlüsselkonzepten, neuen Trends und bewährten Praktiken trägt die Studie zum laufenden Diskurs über nachhaltige Entwicklung in der Luftfahrtbranche bei.

Schlüsselwörter: Luftfahrt, soziale Verantwortung von Unternehmen, Umweltverantwortung von Unternehmen, Greenwashing, Nachhaltigkeit, Umweltauswirkungen, CSR, CER.

Table of Content

I. List of Abbreviations

A4E	Airlines for Europe
AEF	Aviation Environment Federation
ANA	All Nippon Airways
APU	Auxiliary Power Unit
ASA	Advertising Standards Authority
ATAG	Air Transport Action Group
BOAC	British Overseas Airways Corporation
C2C	Cradle to Cradle
CAAC	China’s Civil Aviation Administration
CSR	Corporate Social Responsibility
CSRD	European Union's Corporate Sustainability Reporting Directive
CEE	Central and Eastern Europe
CER	Corporate Environmental Responsibility
CLEEN	FAA’s Lower Energy, Emissions, and Noise program
CO2	Carbon Dioxide
CO2/RPK	Carbon emitted per passenger kilometer
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
COVID-19	Coronavirus Disease
CSP	Corporate Social Performance
DGCA	Directorate General of Civil Aviation
DOT	Department of Transportation
EEA	European Economic Area
EFB	Electronic Flight Bag
EMS	Environmental Management System
EPA	Environmental Protection Agency
ESG	Environmental, Social and Governmental performance
EU	European Union
EU ETS	European Union Emissions Trading System
FAA	Federal Aviation Administration
FSA	Full-Service Airline
FSC	Forest Stewardship Council
FTC	Federal Trade Commission
FY	Fiscal Year
GJ	Gigajoule

GRI	Global Reporting Initiative
G	Gram
g/tkm	gram per ton kilometer
IAG	International Airlines Group
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEnvA	IATA Environmental Assessment
ISO	International Organization for Standardization
JAL	Japan Airlines
KG	Kilogram
KLM	Koninklijke Luchtvaart Maatschappij
l/pkm	liter per passenger kilometer
LCA	Life Cycle Assessment
LCC	Low-Cost Carrier
LEED	Leadership in Energy and Environmental Design
MLIT	Japan’s Ministry of Land, Infrastructure, Transport and Tourism
MoU	Memorandum of Understanding
MWh	Megawatt-hour
NASA	National Aeronautics and Space Administration
NFRD	Non-Financial Reporting Directive
NGO	Non-Governmental Organization
NOx	Nitrogen oxides
MRV	Monitoring, reporting, and verification of emissions
PA	Particulate matter
Pan Am	Pan American World Airways
RPK	Revenue Passenger Kilometer
SAF	Sustainable Aviation Fuels
SAFUG	Sustainable Aviation Fuel Users Group
SAS	Scandinavian Airlines
SARP	Standards and Recommended Practices
SASB	Sustainability Accounting Standards Board
SBTi	Science Based Targets initiative
SDGs	Sustainable Development Goals
SET	Single Engine Taxiing
TAP	Transportes Aéreos Portugueses S.A.
TBL	Triple Bottom Line Framework

TCFD	Task Force on Climate-related Financial Disclosures
tCO_2e	tonnes of carbon dioxide equivalent
TWA	Trans World Airlines
UCO	Used Cooking Oils
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
UNGC	United Nations Global Compact
US	United States
USGBC	U.S. Green Building Council
WBCSD	World Business Council for Sustainable Development

II. List of Tables

III. List of Figures

1. Introduction

Aviation has undergone remarkable transformations since its inception, evolving from the pioneering flights of the early 20th century to the complex global network it is today (Pokhrel, 2024). This progression has revolutionized how people travel and significantly impacted global commerce, culture, and economies. The rise of commercial aviation brought unprecedented connectivity, fostering international trade, tourism, and cultural exchange. As the industry grew, so did its challenges and responsibilities, particularly concerning sustainability and corporate responsibility (Kiracı & Caliyurt, 2022).

In recent decades, the aviation industry has faced increasing scrutiny over its environmental and social impacts. The aviation sector significantly contributes to global greenhouse gas emissions, attracting attention from governments, environmental organizations, and the public. Addressing these concerns has become imperative for industry, leading to the development of Corporate Social Responsibility (CSR) and Corporate Environmental Responsibility (CER) frameworks. These frameworks are designed to ensure that airlines operate in a manner that is not only economically viable but also socially and environmentally responsible (Nature, 2024).

CSR in aviation encompasses a range of practices that benefit society, such as improving labor conditions, engaging in community development, and supporting philanthropic causes (Latapí et al., 2021). CER, a subset of CSR, focuses specifically on reducing the environmental footprint of aviation operations. This includes initiatives to decrease carbon emissions, manage waste, and use sustainable resources. Implementing these practices is crucial in mitigating aviation's harmful environmental effects and aligning the industry with global sustainability goals (IATA, 2024).

However, greenwashing, exaggerating or falsely presenting environmental efforts, significantly threatens genuine sustainability initiatives. This practice misleads consumers and stakeholders and undermines the credibility of the industry’s sustainability efforts. As a result, there is a growing need for transparency and accountability in how airlines report their CSR and CER activities (Covington & Burling LLP, 2024).

Sustainable reporting has emerged as a vital tool that provides a structured approach for airlines to disclose their environmental, social, and governance (ESG) performance (IATA, 2024). The adoption of international standards for sustainability reporting provides certainty that these disclosures are consistent, comparable, and reliable. Frameworks such as the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-related Financial Disclosures (TCFD) offer guidelines that facilitate comprehensive and transparent reporting (Seneca ESG, 2023).

Despite these advancements, the aviation industry continues to face significant challenges. For instance, the Coronavirus Disease (COVID-19) pandemic has drastically disrupted global air travel, resulting in substantial financial losses and operational difficulties for airlines worldwide (Elliott, n.d.). Additionally, the ongoing need to balance economic viability with environmental and social responsibilities remains a complex task. The industry's recovery and future growth depend on its ability to innovate and adapt to these evolving demands (Bouwer et al., 2022).

This thesis explores the intersection of CSR, CER, and the aviation industry and aims to provide a detailed analysis of how airlines can achieve sustainable development. The research highlights strategies for a more responsible and sustainable aviation sector by examining historical trends, current practices, and future directions. Through a thorough review of literature and case studies, the thesis will also address the broader implications of these practices for the global economy and the environment.

1.1. Structure of the Thesis

In the following chapters, the key concepts that form the basis of this master thesis are discussed. The initial section on theoretical foundations provides a comprehensive overview of the history of the aviation industry, from the invention of the first airplane, further focusing on the development of commercial flights and the rise of low-cost airlines. This historical context lays the foundation for understanding the subsequent sections. The thesis then delves into CSR, CER, and Greenwashing concepts, describing their historical development and relevance to the aviation industry. This examination includes a detailed review of these concepts, using the example of various global airlines, highlighting genuine efforts and instances of greenwashing. Following this, the thesis addresses sustainable reporting, introducing international standards and frameworks that guide airlines' sustainability practices. Key terms are defined, and pertinent literature is reviewed to provide a solid grounding in the subject matter.

The theoretical part of the thesis concludes with an overview of sustainability movements and the obligations of sustainable reporting within the airline industry, emphasizing the importance of transparency and accountability in achieving sustainable aviation.

The methodological part of the thesis delves into a qualitative analysis of selected companies in the aviation sector, examining their genuine sustainability initiatives in contrast to potential instances of greenwashing. This approach aims to uncover sustainability practices' authenticity and impact on industry credibility. The analysis will ultimately reveal whether greenwashing practices were identified within the individual companies and how the extent of these practices varies among them. The objective is to assess whether there are airlines that rely solely on truthful, transparent information and genuinely implement sustainable actions.

1.2. Critical Gaps in Aviation Environmental Research

In sustainable practices within business aviation, several crucial research areas require further attention to progress. Despite the industry’s continuous growth and development, there is a noticeable absence of knowledge and awareness regarding sustainability (Holtbrügge & Dögl, 2012; Gough, 2013). This gap highlights the significance of enhancing education and awareness surrounding sustainability within the aviation sector (Morrow & Rondinelli, 2002). Additionally, enhanced marketing efforts are urgently needed to focus on sustainability, including reporting economic impacts and accomplishments and environmental and social ones (Desjardins, 1998; Ruiz-Blanco et al., 2022).

The aviation industry, focusing on airlines, actively explores various sustainability strategies to address the existing gaps. These strategies encompass carbon offsetting, adopting Sustainable Aviation Fuels (SAFs), and formulating more extensive environmental policies (Chan et al., 2022; Crifo, 2014). Nevertheless, the tangible effects of these initiatives on the natural world still need to be determined. The pivotal research question arises from the crucial need for rigorous, longitudinal studies to accurately quantify the environmental benefits of implementing these strategies (Parguel & Johnson, 2021).

While some research in this area has been conducted, there remains a significant gap in studies focused on Europe. Given today's interconnected world, international literature is essential; however, it is equally important to include studies that specifically address companies based in Europe to provide relevant insights and context.

Research Question 1: How do examined airlines' environmental responsibility strategies and actions align with CER and CSR theoretical frameworks and principles?

This question examines how airlines' sustainability initiatives are rooted in established CER and CSR theories, exploring whether their actions reflect genuine commitment or are primarily driven by compliance and market demands (Morrow & Rondinelli, 2002).

Research Question 2: To what extent do airlines comply with environmental standards and rules?

This inquiry assesses the level of adherence by airlines to international, national, and industry-specific environmental regulations, aiming to determine the effectiveness and rigor of their compliance measures in reducing their environmental impact (Bakker et al., 2010; Holtbrügge & Dögl, 2012).

Research Question 3: To what extent do airlines effectively distinguish between genuine environmental stewardship and superficial marketing tactics?

This question investigates the prevalence of greenwashing in the aviation industry, focusing on how well airlines' sustainability claims match their actual environmental practices and identifying methods to discern genuine efforts from misleading marketing (Ruiz-Blanco et al., 2022; de Freitas Netto et al., 2020).

Research Question 4: How do the differing business models of Low-Cost Carriers (LCCs) and Full-Service Airlines (FSAs) affect their sustainability strategies, and what are the implications for environmental and social performance?

In the business aviation sector, it is essential to explore modern technologies and solutions supporting sustainable trends and understand the influence of different decision levels and stakeholders on factors like aviation fuel consumption (Albert et al., 2020; Goffetti et al., 2022). Equally important is comprehending how sustainability reporting affects performance. By addressing complex research gaps, sustainable practices within aviation can be enhanced. Concentrating efforts on these specific areas will propel the industry toward a future that is both environmentally responsible and sustainable (Chan et al., 2022).

Examining the preconceptions surrounding Low-Cost Carriers and Full-Service Airlines is vital to assess whether LCCs are more prone to greenwashing. At the same time, FSAs demonstrate a more substantial commitment to sustainability. The analysis should also explore whether FSAs make more extensive efforts and allocate more significant financial resources toward sustainability initiatives or if they exhibit similar behavior to LCCs. Additionally, the role of marketing tactics within published sustainability reports in shaping these perceptions and sustainability efforts warrants close consideration.

2. History and Development of Aviation

The history and development of aviation have been marked by remarkable technological advancements and pioneering efforts that have transformed air travel from a long-awaited vision into a global industry. This journey reflects human ingenuity, determination, and the relentless pursuit of innovation, leading to significant milestones that have shaped modern aviation as we know it today.

2.1. Early Beginnings and Pioneering Efforts

The birth of aviation can be traced back to ancient times. The initial aspiration to achieve human flight has been a long-standing and deeply rooted ambition throughout history, inspired by birds flying. Early myths and legends, such as those of Icarus and Daedalus, reflect humanity's long-standing fascination with the skies (Lewis, 2023). However, practical attempts to achieve flight began in earnest in the late 19th and early 20th centuries. The Montgolfier brothers' invention of the stifling air balloon in 1783 marked a significant milestone, as it allowed humans to ascend into the air for the first time, albeit without control over direction and speed (Petrescu et al., 2017).

The pursuit of controlled flight continued with various experiments and innovations. George Cayley, often called the "Father of Aviation," made significant contributions in the early 19th century by developing the concept of the modern airplane (Lewis, 2023). He identified the four aerodynamic forces of flight - lift, drag, thrust, and weight - and built a series of gliders that demonstrated the principles of controlled flight. Cayley's work laid the groundwork for future pioneers who would eventually achieve powered flight (Lewis, 2023).

The late 19th and early 20th centuries experienced a significant surge in activity and experimentation as early aviation innovators endeavored to realize sustained, powered flight. Otto Lilienthal emerged as a pivotal figure during this period of aviation history. He was a German engineer who conducted extensive research on gliding flight. Lilienthal's meticulous studies of bird flight and his development of gliders with fixed wings provided valuable insights into aerodynamics. His untimely demise in a gliding accident in 1896 underscored the risks and challenges faced by early aviators (Dalamagkidis et al., 2012).

A significant milestone in aviation history was achieved on December 17, 1903, when the Wright brothers, Orville and Wilbur, completed the first controlled, powered flight in Kitty Hawk, North Carolina. Their aircraft, the Wright Flyer, was a biplane with a wingspan of 12,3 meters, powered by a custom-built engine (Wright Brothers First Flight - NASA, n.d.). The Wright brothers' success was due to their systematic approach to solving flight problems, including developing three-axis control, which allowed the pilot to steer the aircraft effectively. This historic flight marked the beginning of the modern aviation era and paved the way for further advancements (Dalamagkidis et al., 2012).

2.2. Development of Jet-Powered Aircraft

2.2.1. The Advent of Jet Technology

The development of jet-powered aircraft revolutionized aviation, offering unprecedented speed, efficiency, and reliability. The concept of jet propulsion dates to the early 20th century, but considerable progress was made during World War II. Frank Whittle in the United Kingdom and Hans von Ohain in Germany independently developed the first operational jet engines in the late 1930s. These pioneering engineers recognized that traditional piston engines had limitations in speed and altitude, and they sought to harness the potential of jet propulsion (Tritton, 1977).

Whittle's and von Ohain's engines were initially tested in experimental aircraft, demonstrating the feasibility and advantages of jet propulsion. The Heinkel He 178, powered by von Ohain's engine, became the world's first jet aircraft to fly in 1939. Similarly, Whittle's engine was used in the Gloster E.28/39, which made its first flight in 1941. These early tests marked the beginning of a new era in aviation technology, setting the stage for the widespread adoption of jet engines (Maurice et al., 2001).

2.2.2. Military Applications

The military quickly recognized the potential of jet propulsion for combating aircraft, leading to rapid advancements during World War II. Jet fighters such as the German Messerschmitt Me 262 and the British Gloster Meteor entered service in the latter stages of the war, offering superior speed and performance compared to their piston-engine counterparts. The Me 262, for instance, could reach speeds of up to 900 km/h, making it the fastest aircraft of its time (Rubel, 2010).

The post-war era was characterized by sustained technological advancements, innovations, and more advanced jet engines and aircraft development. The introduction of the afterburner, which increased thrust by injecting fuel into the exhaust stream, further enhanced the performance of military jets. By the 1950s, supersonic jet fighters like the North American F-86 Sabre and the MiG-15 had become the mainstay of air forces worldwide, solidifying the dominance of jet propulsion in military aviation (Rubel, 2010).

2.3. Transition to Civil Aviation

The transition of jet technology from military to civil aviation marked a pivotal moment in aviation history. The de Havilland Comet, introduced in 1952, was the world's first commercial jet airliner (BBC, n.d.). The Comet offered a smoother, faster, and more comfortable flight experience than propeller-driven aircraft, revolutionizing air travel. However, early models of the Comet suffered from structural issues that led to catastrophic failures, highlighting the challenges of adapting new technologies for commercial use (Maurice et al., 2001).

Despite these setbacks, the development of jet airliners continued, leading to the introduction of more reliable and efficient aircraft. The Boeing 707, which entered service in 1958, is often credited with ushering in the Jet Age (Bauer, 2024). The 707's robust design and ability to fly long distances at high speeds made it a commercial success and set the standard for future airliners. The success of the 707 demonstrated the economic viability of jet travel, prompting airlines worldwide to adopt jet aircraft for their fleets (Maurice et al., 2001).

The advent of wide-body jets, such as the Boeing 747, further transformed the aviation industry in the 1970s. These aircraft could carry hundreds of passengers' long distances, making air travel more accessible and affordable (Flightworx, 2023). The introduction of advanced avionics, improved engine efficiency, and aerodynamic innovations continued to enhance jet airliners' performance and reliability (Spaeth, n.d.).

2.4. Origin and Evolution of Commercial Flights

2.4.1. Early Commercial Flights

The inception of commercial aviation can be traced to the early 20th century when the burgeoning aviation industry began to explore the potential for passenger transportation. The first recorded commercial flight occurred on January 1, 1914, when a Benoist XIV biplane, piloted by Tony Jannus, carried a single passenger, Abram C. Pheil, from St. Petersburg to Tampa, Florida. This short flight marked the beginning of an era where aviation was no longer confined to experimental and military applications but could be used to connect people across distances (Goldstein, 2024).

After this initial success, they contributed to establishing a range of commercial air services in the post-World War I period. In 1919, KLM Royal Dutch Airlines (Koninklijke Luchtvaart Maatschappij) was founded and began operating flights between Amsterdam and London, making it the world's oldest airline today (KLM, 2024). Similarly, in the United States, the Air Mail Act of 1925, also known as the Kelly Act, allowed private airlines to bid for mail delivery contracts, providing a vital revenue stream that supported the growth of commercial passenger services (Ramón-Rodríguez et al., 2011).

2.4.2. Growth of the Airline Industry

Technological advancements and increasing demand for air travel in the 1920s and 1930s accelerated the airline industry's growth. The development of larger, more reliable aircraft made it possible to carry more passengers over longer distances (Torenbeek & Wittenberg, 2009). The introduction of the Douglas DC-3 in 1936 was a significant milestone, as it was one of the first aircraft to make passenger transport profitable without relying on government subsidies. The DC-3's efficiency and reliability made it famous with airlines worldwide, setting a standard for commercial aviation (Ramón-Rodríguez et al., 2011).

World War II significantly impacted the airline industry, as many technological advancements developed for military aviation were adapted for civilian use in the post-war era. The surplus of trained pilots and aircraft also facilitated the expansion of commercial airlines (Crouch et al., 2024). By the late 1940s and 1950s, air travel had become more accessible to the public, and airlines began offering transcontinental and transatlantic flights. This period marked the development of major airlines such as Pan American World Airways (Pan Am), British Overseas Airways Corporation (BOAC), and Trans World Airlines (TWA), which played fundamental roles in the globalization of air travel (Ramón-Rodríguez et al., 2011).

2.4.3. Technological Advancements

Technological advancements have continuously driven the evolution of commercial aviation, enhancing safety, efficiency, and passenger comfort. The introduction of jet engines in the 1950s revolutionized air travel, significantly reducing flight times and increasing aircraft performance (Commercial Aviation at Mid-Century, 2021). The Boeing 707, introduced in 1958, was the first commercially successful jet airliner and represented the inception of Jet Age. Air travel revolutionized its speed, range, and capacity and transformed air travel into an accessible and appealing option for the broader population (Bauer, 2024).

Subsequent technological developments further advanced the industry. The introduction of wide-body jets, such as the Boeing 747 in 1970, allowed airlines to carry more passengers and cargo, reducing costs per seat and making air travel more affordable (Flightworx, 2023). Innovations in avionics, materials science, and aerodynamics have continually improved aircraft performance, safety, and fuel efficiency. Modern aircraft, like the Boeing 787 Dreamliner and the Airbus A350, feature advanced composite materials, improved aerodynamics, and more efficient engines, contributing to significant reductions in fuel consumption and emissions (Dalamagkidis et al., 2012).

The evolution of navigation and communication technologies has also played a crucial role. Implementing satellite-based navigation systems like GPS has enhanced flight accuracy and safety. Advanced air traffic management systems have improved efficiency and reduced delays, enabling airlines to operate more effectively in increasingly congested airspace (Dovis et al., n.d.).

2.5. Evolution of Low-Cost Airlines

2.5.1. The Birth of Low-Cost Carriers

The concept of low-cost carriers emerged in the early 1970s as a response to the increasing demand for affordable air travel. The birth of this model is often attributed to Southwest Airlines, which was founded in 1967 and began operations in 1971 (Southwest Corporate Fact Sheet, n.d.). Southwest introduced a new business model focused on low operating costs, high aircraft utilization, and simplified services (Dobruszkes, 2006). By offering no-frills flights, operating a single aircraft type (the Boeing 737), and using secondary airports, Southwest significantly reduced costs and offered lower fares than traditional carriers (Moreno et al., 2015).

The deregulation of the airline industry in the United States in 1978 further catalyzed the growth of LCCs (Morrison & Winston, 2010). Deregulation removed government control over fares, routes, and market entry, allowing new airlines to enter the market and compete more freely. This led to increased competition and innovation, driving down fares and expanding the availability of air travel (Atallah et al., 2018).

2.5.2. Key Players in the Market

Following the success of Southwest Airlines, the low-cost carrier model spread globally, with several key players emerging in different regions. In Europe, Ryanair, EasyJet, and Wizz Air became prominent LCCs, revolutionizing air travel on the continent. Ryanair, founded in 1984, adopted many of Southwest's strategies, focusing on cost efficiency and secondary airports (Peters, 2024). EasyJet, established in 1995, also emphasized low fares and high-frequency flights, quickly becoming one of Europe's leading airlines (EasyJet Airline Company, n.d.). Wizz Air, launched in 2003, targeted the Central and Eastern European market with a similar low-cost model, rapidly expanding its network and offering affordable travel options across

Europe (Lomas, 2023). The primary strategy of these airlines is to eliminate business class to optimize aircraft capacity and ensure that every seat is utilized efficiently. This approach enables them to increase passenger volume and reduce operational costs, enhancing overall profitability.

In Asia, AirAsia, founded in 1993 and restructured as a low-cost carrier in 2001, transformed air travel in the region. By adopting innovative cost-cutting measures and expanding aggressively, AirAsia made air travel accessible to millions of Southeast Asian people (Hardiman & Bodell, 2023). Similarly, in Australia, Jetstar, launched by Qantas in 2003, became a significant player in the low-cost market, offering domestic and international flights at competitive prices (Hardiman & Bodell, 2023).

2.5.3. Impact on the Industry

The rise of low-cost carriers has profoundly impacted the airline industry. Their significance in the contemporary aviation landscape cannot be overstated. LCCs have democratized air travel, making it accessible to a broader population segment. These airlines have become integral to the travel experience, as they have made air travel accessible to a wider segment of society, allowing individuals to travel to destinations they may have previously deemed unattainable. This paradigm shift has transformed travel dynamics in economically weaker regions, such as Eastern Europe and various Asian countries, where low-cost flights have facilitated greater mobility and connectivity.

LCCs have stimulated demand and increased passenger traffic through lower fares, particularly in previously underserved markets (Dobruszkes, 2006). This has led to expanding air travel networks, connecting more destinations, and promoting tourism and economic growth (Alderighi et al., 2012).

As LCCs continue to expand their networks and service offerings, they are reshaping the aviation industry and contributing to the globalization of travel (Alamdari & Fagan, 2005).

The success of LCCs has also forced traditional full-service carriers to adapt. Many legacy airlines have established low-cost subsidiaries or adopted elements of the LCC model to remain competitive. For example, British Airways launched its low-cost subsidiary Go Fly in 1998, and Lufthansa created Germanwings (later rebranded as Eurowings) to compete in the low-cost segment (Sarker et al., 2012).

Moreover, the cost-cutting strategies pioneered by LCCs, such as unbundling services and optimizing fleet utilization, have influenced the entire industry. One of the most prominent distinctions between low-cost carriers and traditional airlines is the implementation of additional fees for services such as checked baggage and preferred seating selection. Unlike conventional airlines, which often include these services in ticket prices, LCCs adopt an unbundled pricing model that allows consumers to pay only for the services they choose (Stenstrom, 2009). Airlines now commonly offer a range of fare options, allowing passengers to pay only for their services needed (Sarker et al., 2012). This has led to a more dynamic pricing environment and increased operational efficiency across the industry (Rozenberg et al., 2014).

2.6. Differences Between Low-Cost and Full-Service Airlines

The business models of LCCs and FSAs differ significantly, shaping their service offerings and operational strategies (Rozenberg et al., 2014). LCCs like Ryanair and Wizz Air focus on minimizing operational costs to offer the lowest possible fares. This can be achieved by using a single aircraft type, simplifying maintenance and training, operating out of secondary airports to reduce landing fees, and unbundling services (Hunter, 2006). Passengers pay extra for amenities like in-flight meals, which allows LCCs to keep base ticket prices low (Lim & Lee, 2020).

Low-cost carriers often use strategies that serve secondary airports, strategically marketed with names that suggest proximity to major cities. For instance, Memmingen Airport in Germany is branded as "Munich West" despite being over an hour's drive from Munich. Similar tactics are observed in other regions, such as Frankfurt, where LCCs attract travelers seeking lower fares while implying closer access to prominent urban centers.

In contrast, FSAs like Lufthansa and KLM-Air France offer a broader range of services included in the ticket price. These services typically include complimentary meals and beverages, in-flight entertainment, and multiple cabin classes (economy, premium economy, business, and first-class). FSAs operate from primary airports and offer extensive route networks, including long-haul international flights. Their business model focuses on providing a premium travel experience, targeting leisure and business travelers who value comfort and convenience (Kim & Hwang, 2023).

It also must be mentioned that the comprehensive services traditionally offered by full-service airlines have notably evolved, particularly during the COVID-19 pandemic. Major carriers like the Lufthansa Group have significantly scaled back their service offerings, now providing essential services only. For example, meals on shorter flights in economy class are now available only for an additional fee, reflecting a shift toward minimizing costs.

The cost structures of LCCs and FSAs reflect their distinct business models. LCCs maintain a lean operational structure to minimize costs (Lim & Lee, 2020). They focus on high aircraft utilization, quick turnaround times, and direct sales channels, reducing the need for travel agent commissions. Using secondary airports and point-to-point routes helps avoid congestion and delays, reducing operational costs. Additionally, the unbundling of services allows LCCs to generate ancillary revenue from charges for checked baggage, seat selection, and on-board purchases (Hunter, 2006).

FSAs, on the other hand, have higher operational costs due to their broader service offerings and more complex operations. They invest in customer amenities, loyalty programs, and extensive route networks, which require significant infrastructure and staffing. FSAs generate revenue through ticket sales across multiple cabin classes and ancillary services. They also benefit from business and premium-class passengers, willing to pay higher fares for added comfort and services (Helmond, 2023).

Market segmentation and customer demographics for LCCs and FSAs also differ markedly. LCCs primarily target price-sensitive travelers, including budget-conscious tourists, young adults, and individuals traveling for personal reasons (Lim & Lee, 2020). The lower fares and simplified service offerings appeal to these passengers, who prioritize cost savings over additional amenities. LCCs have democratized air travel, making it accessible to a broader population segment and stimulating demand in previously underserved markets (Hunter, 2006).

FSAs cater to a more diverse customer base, including business travelers, high-income individuals, and international tourists (Helmond, 2023). These passengers often prioritize convenience, comfort, and service quality over price alone. FSAs offer loyalty programs, airport lounges, and premium cabin classes to attract and retain these customers (Lim & Lee, 2020). An example is the Star Alliance group, which facilitates passenger ticket booking through integrated reservation systems. This streamlined approach enables quicker and easier access to bundled tickets, alleviating concerns related to baggage transfer during connecting flights. The ability to provide seamless connections through significant hubs and partnerships with other airlines also enhances the appeal of FSAs to travelers seeking comprehensive travel solutions (Oven-Krockhaus & Albers, 2023).

2.7. Recent Developments and Challenges

2.7.1. The Impact of COVID-19 on Aviation

The COVID-19 pandemic has unprecedentedly impacted the aviation industry, leading to the most significant disruption in its history (Dube, 2022). The virus's rapid spread in early 2020 prompted governments worldwide to implement travel restrictions and lockdown measures, drastically reducing air travel demand (Bureau, 2020). Airlines faced massive financial losses due to grounded fleets, canceled flights, and a steep decline in passenger numbers. According to the International Air Transport Association, the industry experienced a revenue loss of over $370 billion in 2020 alone (Dube et al., 2021).

Airlines responded to the crisis by implementing various cost-cutting measures, including layoffs, furloughs, and reductions in operational capacity. Many sought governments aid to survive the downturn, while others were forced into bankruptcy or restructuring. The pandemic also accelerated the retirement of older, less efficient aircraft as airlines aimed to streamline their fleets to reduce costs and improve efficiency (Dube, 2022).

The long-term impact of COVID-19 on aviation is still unfolding. The industry has adapted to new health and safety protocols, such as enhanced cleaning procedures, mandatory mask-wearing, and social distancing measures, to restore passenger confidence (Melas & Melasova, 2020). The introduction of digital health passports and rapid airport testing has also facilitated the gradual resumption of international travel. However, the recovery remains uneven across regions. It heavily depends on the pace of vaccine rollouts and the lifting of travel restrictions (Rizzi et al., 2022.).

2.7.2. Environmental and Economic Challenge

Environmental concerns have become prominent on the aviation industry's agenda, driven by growing awareness of climate change and industry’s substantial carbon footprint. Aviation is responsible for approximately two to three percent of global Carbon dioxide (CO_2) emissions, which are projected to rise as air travel demand increases. The sector faces significant pressure from governments, environmental groups, and the public to reduce its ecological impact and transition to more sustainable practices (Lai et al., 2022).

Vital environmental challenges include reducing greenhouse gas emissions, managing noise pollution, and minimizing waste. Technological advancements exist, such as developing sustainable aviation fuels, electric and hybrid aircraft, aerodynamics, and engine efficiency improvements, but those are critical to addressing these challenges. However, these innovations' inflated costs and extended timelines pose significant hurdles (Martinez-Valencia et al., 2021).

Economically speaking, the aviation industry must navigate a complex landscape of fluctuating fuel prices, regulatory changes, and competitive pressures. The volatility of fuel prices, which constitutes a significant portion of operational costs, can significantly impact profitability (Lai et al., 2022). Additionally, regulatory frameworks aimed at reducing emissions, such as the European Union Emissions Trading System (EU ETS) and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), impose financial and operational burdens on airlines (Nhamo et al., 2020).

Nevertheless, airlines must balance cost reductions with the need to invest in sustainability. This requires strategic financial planning and the ability to innovate while maintaining profitability. With the rise of low-cost carriers and changing consumer preferences, the industry's competitive nature further complicates these efforts since customers increasingly favor companies with firm sustainability commitments while valuing eco-conscious options (Martinez-Valencia et al., 2021). If airlines successfully incorporate sustainability into their brand identity, they can stand a competitive advantage in the market.

3. Theoretical definition of CSR, CER, and Greenwashing and their beginnings

Corporate Social Responsibility, Environmental Responsibility, and greenwashing are pivotal concepts in contemporary business ethics and sustainability discourse. These frameworks have evolved over decades, shaping corporate practices and policies to balance economic growth with social equity and environmental stewardship. CSR encompasses a broad spectrum of activities companies undertake to operate economically, socially, and environmentally sustainable (Hamidu et al., 2015). CER, a subset of CSR, focuses explicitly on the environmental impacts of corporate operations and the strategies implemented to mitigate these effects (Lenzen & Murray, 2010). Conversely, greenwashing emerges as a critical challenge, reflecting deceptive practices where companies overestimate or fabricate their environmental credentials to mislead stakeholders (de Freitas Netto et al., 2020). Understanding these concepts' theoretical foundations and historical developments is essential for comprehensively analyzing their application and implications within various industries, particularly the aviation sector.

3.1. Corporate Social Responsibility

Corporate Social Responsibility is a business model in which companies integrate social and environmental concerns into their operations and stakeholder interactions (Hanke & Stark, 2009). It reflects businesses' commitment to contributing positively to society while pursuing profitability. By addressing ethical practices, community engagement, and sustainable development, CSR aims to align corporate activities with the broader goals of societal welfare and environmental preservation (Hamidu et al., 2015). This approach seeks to balance profitability with ethical responsibility and positive societal contributions. The focus is on creating value for shareholders and all stakeholders, including employees, customers, communities, and the environment (Hanke & Stark, 2009).

3.1.1. Definition and Conceptual Framework

CSR has emerged as a fundamental concept in modern business, encompassing the responsibilities companies have towards society beyond their economic and legal obligations (Dahlsrud, 2008). It entails a comprehensive approach where corporations focus on profitability and consider their impact on social and environmental dimensions. This multifaceted concept has been defined in numerous ways, reflecting its complexity and the evolving understanding of corporate ethics and sustainability (Schneider, 2015).

One of the most widely accepted definitions of CSR is provided by the European Commission, which describes it as "the responsibility of enterprises for their impacts on society" (European Commission, 2011). This definition emphasizes the need for businesses to integrate social, environmental, ethical, human rights, and consumer concerns into their operations and core strategy in close collaboration with stakeholders. Another influential definition comes from the World Business Council for Sustainable Development (WBCSD), which defines CSR as "the continuing commitment by business to contribute to economic development while improving the quality of life of the workforce and their families as well as of the community and society at large" (World Business Council for Sustainable Development, 2000).

3.1.2. Historical Development of CSR

The historical development of Corporate Social Responsibility can be traced through several key phases, each marked by evolving theories and models that reflect changes in societal expectations and business practices. Early theories laid the groundwork for CSR, emphasizing businesses' social responsibilities beyond profit maximization. As the concept evolved, various influential models emerged, providing a structured approach to understanding and implementing CSR in modern corporations (Schneider, 2015).

In the mid-20th century, CSR began to gain formal recognition as scholars and practitioners started to articulate the broader responsibilities of businesses. One of the seminal works in this period is Howard R. Bowen's "Social Responsibilities of the Businessman" (1953), which is often credited with founding the field of CSR (Bowen, 2013). Bowen argued that businesses should pursue policies, make decisions, and follow desirable lines of action regarding society's objectives and values. This perspective was revolutionary at that time, challenging the prevailing view that shareholders were the primary responsibility of businesses (Madrakhimova, 2013).

Carroll elaborates on Bowen's impact by examining the historical trajectory of CSR and highlighting how Bowen's work laid the groundwork for the modern era of CSR. Moreover, he notes that Bowen's contributions were theoretical and practical in setting the parameters for Corporate Social Responsibility (Caroll, 1999). Bowen's definition of CSR, which emphasized aligning business practices with societal expectations, served as a cornerstone for developing CSR as a legitimate academic field and a corporate practice. Furthermore, Carroll argues that Bowen's work established a baseline for subsequent models and theories, such as the emergence of Corporate Social Performance (CSP) frameworks in the 1970s and the integration of CSR into strategic management and governance structures in the 1980s and 1990s (Carroll, 1999). Through this historical lens, Carroll positions Bowen's contributions as foundational, asserting that his perspective on the broader social responsibilities of businesses influenced future scholars to explore further and expand the scope of CSR, ultimately paving the way for the evolution of more nuanced frameworks that integrate ethical, legal, and discretionary dimensions of corporate responsibilities (Carroll, 1999).

During the 1960s and 1970s, the concept of CSR continued to develop, influenced by the broader social movements of the era, including civil rights, environmentalism, and consumer advocacy. This period witnessed the development of several vital foundational theories. In 1960, Keith Davis introduced the Iron Law of Responsibility, asserting that social power brings social responsibility. He argued that businesses failing to meet their social obligations risk losing social power (Moura-Leite & Padgett, 2011). This era also encountered the emergence of the stakeholder theory, which broadened the focus of CSR to include a wide range of stakeholders, such as employees, customers, suppliers, and communities, rather than just shareholders (Tokoro, 2007). Carroll notes that these early developments set the core trajectory for CSR, moving from mere responsibility to responsiveness and, eventually, to performance measurement through CSP frameworks (Caroll, 2021).

Through the decades, the evolution of CSR can be seen in the increasing sophistication and formalization of the concept. In the 1980s, Archie B. Carroll introduced the CSR Pyramid, a model that provided a comprehensive framework for understanding corporate responsibilities (Schwartz & Carroll, 2003). Carroll's Pyramid outlines four layers of responsibility: economic, legal, ethical, and philanthropic (Baden, 2016). According to this model, economic responsibilities form the base of the pyramid, underscoring businesses' need to be profitable. Legal responsibilities form the second tier in the framework, emphasizing compliance with laws and regulations. Ethical responsibilities, identified as the third layer, involve acting beyond compliance to meet societal expectations of fairness and justice. The top layer, philanthropic responsibility, refers to voluntary actions taken by businesses to improve societal well-being and contribute to the welfare of society beyond businesses' core operations (Caroll, 2016).

Carroll later reflects on the enduring relevance of the CSR Pyramid model, amplifying its utility in both academic and practical contexts. He addresses critiques that the model disproportionately emphasizes economic responsibilities, often perceived as prioritizing profit over ethical or philanthropic actions. According to Caroll, financial obligations are foundational, but this does not imply that the other components are less significant. Instead, he contends that each pyramid layer should be viewed as interconnected and mutually reinforcing (Caroll, 2021). Legal and ethical responsibilities ensure businesses operate within societal norms and expectations, supporting their economic viability and long-term sustainability.

Furthermore, Carroll clarifies that the CSR Pyramid was never intended to implicate a sequential hierarchy of responsibilities but rather a simultaneous fulfillment of all four dimensions. This interpretation dispels the misconception that economic performance must precede other forms of responsibility. He underscores that companies should integrate economic, legal, ethical, and philanthropic responsibilities concurrently to achieve a holistic approach to CSR that balances profit-making with social contribution (Carroll, 2021). This broader understanding reinforces the model's continued applicability in diverse business environments and serves as a framework that guides companies in navigating complex social and ethical landscapes.

In the 1990s and 2000s, CSR became more integrated into corporate strategy and governance. The concept of sustainability began to intertwine with CSR, leading to the development of the Triple Bottom Line (TBL) framework by John Elkington (Zaharia & Zaharia, 2021). The TBL framework emphasized the need for businesses to integrate social and environmental considerations alongside economic ones, urging a balanced approach to sustainability that extends beyond mere financial performance. This integrated approach encouraged companies to adopt sustainable practices that benefit all stakeholders and the environment (Lenzen & Murray, 2010).

Influential models and frameworks have continued to shape the practice of CSR. The concept of shared value, introduced by Michael Porter and Mark Kramer in the 2010s, argues that businesses can generate economic value in a way that produces value for society by addressing its challenges (Menghwar & Daood, 2021). This model shifts the perspective from CSR as a cost or constraint to CSR as a source of innovation and competitive advantage (Porter & Kramer, 2015). Caroll further underscores the importance of aligning economic and social goals in CSR strategies, arguing that contemporary discussions have moved beyond the traditional view of CSR as merely a compliance requirement. He notes that integrating business objectives with societal expectations is now a strategic imperative, enabling companies to create shared value and long-term competitive advantages. This perspective highlights how the evolution of CSR has encouraged businesses to see social responsibility as an opportunity for growth and innovation rather than a cost or constraint (Caroll, 2021).

Contemporary CSR also reflects the growing importance of transparency and accountability. Reporting frameworks such as the GRI and the SASB have established standards for disclosing social and environmental performance influenced by Elkington's ideas on sustainability. These frameworks help stakeholders evaluate corporate behavior and encourage companies to adopt more responsible practices (Zaharia & Zaharia, 2021). Carroll observes that contemporary CSR practices are becoming increasingly integrated into core corporate policies, shifting from focusing solely on compliance and ethical responsibilities to a more comprehensive approach that actively contributes to societal well-being. He points out that companies are now expected to meet regulatory requirements and proactively address social and environmental issues as part of their strategic objectives. This shift reflects a more profound commitment to sustainability and transparency, positioning CSR as a fundamental element of business strategy and long-term success (Caroll, 2021).

3.2. Contemporary Perspectives on CSR

Contemporary perspectives on Corporate Social Responsibility accentuate the comprehensive integration of social and environmental goals into companies' strategies and operations (Porter & Kramer, 2015). Modern concepts of CSR reflect the complex relationships between businesses and their numerous stakeholders, including employees, customers, suppliers, communities, and the broader public (Morsing & Spence, 2019). Theoretical and practical approaches to CSR have significantly evolved, providing a deeper understanding of how companies can responsibly contribute to societal welfare while achieving their business objectives (Crane & Matten, 2016).

3.2.1. Explicit vs. Implicit CSR

The differentiation between explicit and implicit CSR represents a decisive aspect of contemporary research in this field. Explicit CSR refers to corporate policies, strategies, and actions that are consciously and deliberately aimed at achieving socially responsible goals. These activities often include formalized programs, initiatives, and publicly disclosed sustainability reports detailing corporate social responsibility efforts (Morsing & Spence, 2019). In countries that follow the Anglo-Saxon model of capitalism, companies often exhibit explicit CSR, as societal expectations surrounding corporate behavior are clearly articulated and formalized (Brown et al., 2016). These explicit efforts are driven by regulatory requirements, market incentives, and stakeholder pressures, leading companies to adopt initiative-taking measures in environmental sustainability, social equity, and ethical governance (Matten & Moon, 2008).

In contrast, implicit CSR refers to a broader, culturally embedded understanding of corporate responsibilities that are less formalized and more inherent to the social and economic systems within which companies operate (Hiss, 2009). This form of CSR is more common in countries with coordinated market economies, such as Europe, where social responsibilities are integrated into the legal framework and business practices (Hiss, 2009). Implicit CSR involves the unwritten expectations and norms that guide corporate behavior, shaped by cultural values, traditions, and institutional frameworks (Morsing & Spence, 2019). Companies in these contexts often engage in socially responsible practices as a natural extension of their business operations, reflecting a more ingrained commitment to societal well-being (Matten & Moon, 2008).

To directly compare, implicit CSR is more about society's informal, unspoken expectations regarding corporate behavior. This includes practices businesses adopt based on cultural norms and societal pressures rather than formal policies or regulations. Examples include supporting local charities or participating in community events (Matten & Moon, 2008). On the other hand, explicit CSR involves clear and formal commitments and practices. This includes established policies, initiatives, and reporting mechanisms that are publicly communicated and often driven by a desire to enhance corporate reputation or comply with regulations. An example of this would be a formulated sustainability strategy outlined in an annual report, in which initiatives are officially documented and regularly reviewed (Matten & Moon, 2008).

3.2.2. CSR in Modern Business Strategies

In contemporary business strategies, CSR has evolved from a peripheral activity to a core component of corporate strategy (Spence, 2014). Companies increasingly recognize that integrating CSR into their strategic planning can boost their competitive advantage, foster innovation, and build long-term sustainability. This strategic integration involves aligning CSR initiatives with business objectives, ensuring that social and environmental considerations are embedded in decision-making processes at all levels of an organization (Yuan et al., 2020).

Modern CSR strategies often incorporate the principles of ethical supply chain management, ensuring that the procurement of materials and the production processes cling to high environmental and social standards. This approach includes rigorous supplier audits, adherence to fair trade principles, and implementing green procurement policies that prioritize sustainable and ethically produced materials (Carroll, 2021). By embedding these practices into the core of their operations, companies can mitigate risks associated with supply chain disruptions, improve their corporate reputation, and contribute positively to global sustainability goals (Yuan et al., 2020).

Another innovative trend in contemporary CSR is the integration of circular economy principles (Geissdoerfer et al., 2016). Companies are increasingly adopting strategies that emphasize resource efficiency, waste reduction, and the reuse and recycling of materials. This involves redesigning products for longer lifecycles, promoting product take-back schemes, and investing in technologies that enable the regeneration of resources (Porter & Kramer, 2015).

By shifting towards a circular economy model, businesses reduce their environmental footprint, create new business opportunities, and drive innovation in sustainable product design and manufacturing (Yuan et al., 2020).

3.3. Stakeholder Theory

Stakeholder theory represents a change in basic assumptions in understanding the role and responsibilities of businesses within society (Friedman & Miles, 2002). Developed by R. Edward Freeman in the 1980s, this theory challenges the traditional shareholder-centric view that prioritizes maximizing shareholder value primarily (Dmytriyev et al., 2021). Instead, it posits that companies should create value for all their stakeholders, recognizing that the success of a business is inherently linked to its relationships with various groups and individuals who have a stake in the company's operations (Parmar et al., 2010).

Stakeholder theory expands the scope of corporate responsibility by emphasizing the interdependencies between a company and its diverse stakeholders, including humans and ecological systems. This theory posits that long-term business success and sustainability can only be achieved by fostering positive relationships and mutual benefits among all stakeholders rather than prioritizing short-term financial gains (Waheed & Zhang, 2022). It encourages companies to continuously dialogue with their stakeholders to understand and address their needs and concerns, creating a resilient and adaptable business model that can endure socio-economic and environmental challenges (Parmar et al., 2010).

The practical application of stakeholder theory involves identifying and mapping stakeholders, understanding their needs and expectations, and actively engaging with them to build mutually beneficial relationships (Friedman & Miles, 2002). This engagement can take various forms, such as stakeholder consultations, partnerships, and collaborations (Friedman & Miles, 2002). Companies can gain valuable insights, foster trust, and enhance their reputation by involving stakeholders in decision-making. Moreover, addressing stakeholder concerns can lead to more sustainable and resilient business practices, as companies are better equipped to anticipate and manage risks (Brown & Forster, 2012).

Contemporary research on stakeholder theory highlights the importance of dynamic and adaptive stakeholder management (Freeman, 2023). In an increasingly globalized and interconnected world, stakeholder expectations are continually evolving, influenced by societal trends, technological advancements, and regulatory changes (Waheed & Zhang, 2022). Companies must, therefore, adopt flexible and responsive strategies to remain aligned with stakeholder needs and maintain their social license to operate. This dynamic approach to stakeholder engagement underscores the necessity for ongoing dialogue and collaboration, ensuring that corporate actions are socially responsible and strategically sound (Freeman & McVea, 2001).

Although stakeholder theory and Corporate Social Responsibility have evolved as two vital theoretical frameworks in the study of social issues in management, there still needs to be a more comprehensive understanding of their relationship (Dmytriyev et al., 2021). According to Freeman and Dmytriyev, CSR is just one aspect of broader corporate responsibilities to stakeholders, while stakeholder theory encompasses the responsibilities of businesses to all stakeholders. This distinction is critical as it highlights that stakeholder theory does not simply focus on societal obligations but also addresses the mutual dependencies between various stakeholder groups, including employees, customers, suppliers, and communities (Freeman & Dmytriyev, 2017).

The primary difference between the two frameworks lies in their scope and focus. While CSR prioritizes social issues and societal expectations, often emphasizing businesses' ethical and philanthropic responsibilities, stakeholder theory provides a more comprehensive view of a company's overall responsibilities. It integrates economic, legal, and social dimensions (Freeman & Dmytriyev, 2017). This all-encompassing approach helps businesses align their objectives with the needs of all stakeholders, thereby fostering sustainable value creation and minimizing trade-offs between different stakeholder groups.

Freeman and Dmytriyev further note that while CSR is sometimes criticized for creating false distinctions, such as economic versus social responsibilities, stakeholder theory dissolves these dichotomies by recognizing that financial and social values are not mutually exclusive (Freeman & Dmytriyev, 2017). Instead, stakeholder theory suggests that creating value for one stakeholder group can enhance value for others, thereby supporting the notion of mutual stakeholder benefits. This perspective encourages businesses to adopt strategies that do not compromise the interests of any stakeholder group, leading to more inclusive and socially responsible business practices (Freeman & Dmytriyev, 2017).

3.4. CSR Reporting and Standards

CSR reporting has become a cornerstone of corporate transparency and accountability, reflecting the growing importance of social and environmental responsibility in business practices. The primary objective of CSR reporting is to provide stakeholders with a comprehensive overview of a company's social, environmental, and economic impacts (Halkos & Nomikos, 2021). This transparency enhances stakeholder trust and drives corporate performance by encouraging continuous improvement and accountability (Carroll, 1999).

CSR reporting encompasses the systematic disclosure of information regarding a company's activities, policies, and performance concerning its social and environmental impacts (Halkos & Nomikos, 2021). It is a communication tool between the company and its stakeholders, including investors, employees, customers, communities, and regulators. CSR reporting is essential because it provides an accurate picture of the company's contributions to sustainable development, highlighting achievements and areas needing improvement. Doing so fosters greater stakeholder engagement and enables informed decision-making (Olanipekun et al., 2021).

Various standards and guidelines have been established to ensure consistency, comparability, and reliability of CSR reports. The GRI is one of the most widely recognized frameworks, offering comprehensive guidelines for reporting various sustainability issues (Global Reporting Initiative, 2021). GRI Standards provide detailed metrics and indicators companies can use to measure and report their performance, covering energy use, emissions, labor practices, human rights, and community impacts (Halkos & Nomikos, 2021). The Sustainability Accounting Standards Board also provides industry-specific standards that help companies disclose financial material sustainability information to investors (Pizzi et al., 2022).

Another critical framework is the Task Force on Climate-related Financial Disclosures, which focuses on climate change's financial risks and opportunities (Nisanci, 2021). TCFD recommendations guide companies in disclosing climate-related information relevant to financial stakeholders, emphasizing the need for transparency in governance, strategy, risk management, and metrics related to climate change (Task Force on Climate-related Financial Disclosures, 2021). Similarly, the United Nations Global Compact (UNGC) encourages companies to align their operations with ten universally accepted human rights, labor, environment, and anti-corruption principles and report on their progress annually (Nisanci, 2021).

The content and structure of CSR reports typically follow a standardized format to ensure clarity and comprehensiveness (Pérez, 2015). Reports generally begin with an introductory section outlining the company's commitment to CSR and overall sustainability strategy. This is followed by detailed sections on specific impact areas, such as environmental performance, social responsibility, and governance practices (Nielsen & Thomsen, 2007). Each section includes qualitative and quantitative data, providing insights into the company's activities and outcomes (Moravcikova et al., 2015).

A significant development in CSR reporting is the European Union's Corporate Sustainability Reporting Directive (CSRD), adopted in 2022. The CSRD represents an important step in aligning sustainability reporting with broader financial and non-financial disclosures (European Union, 2022). This new directive replaces the previous Non-Financial Reporting Directive (NFRD). It introduces more comprehensive requirements for large companies operating within the EU, ensuring greater transparency and comparability of sustainability information. The CSRD obliges companies to provide detailed reports on ESG issues and their sustainability strategy, impacts, and risk management practices (European Parliament & Council of the European Union, 2022).

The CSRD also mandates that companies integrate sustainability reporting into their management reports, thus embedding sustainability considerations into the core of corporate governance and decision-making processes (European Union, 2022). By standardizing the reporting framework across the EU, the directive aims to create a level playing field for companies and provide stakeholders with consistent, reliable, and easily comparable information. Furthermore, the directive introduces requirements for external assurance, ensuring that sustainability data is verified and trustworthy (European Parliament & Council of the European Union, 2022).

In addition to enhancing transparency, the CSRD also seeks to address greenwashing by establishing clear guidelines and metrics for reporting (European Union, 2022). This directive represents a significant shift in how companies are expected to communicate their sustainability performance and will likely serve as a model for other jurisdictions considering similar regulations (Stoop, 2024). The implementation of the CSRD underscores the growing importance of sustainability as a fundamental aspect of corporate strategy, and it encourages companies to adopt more proactive and responsible business practices that contribute to the EU's broader sustainability goals (European Parliament & Council of the European Union, 2022).

4. Corporate Environmental Responsibility

Corporate Environmental Responsibility encompasses businesses' obligations and practices to mitigate environmental impact and promote sustainability (Holtbrügge & Dögl, 2012). It reflects the commitment of companies to go beyond mere regulatory compliance, integrating proactive measures to protect and enhance the natural environment (Wang, 2016). CER is rooted in the recognition that long-term business success is intrinsically linked to the health of the planet, necessitating a strategic approach to managing environmental resources and reducing ecological footprints (Wang, 2016).

4.1. Definition and Scope

Corporate Environmental Responsibility extends beyond traditional compliance by embedding environmental stewardship into a company's strategic framework. This involves proactive initiatives such as developing innovative technologies for pollution reduction, implementing circular economy practices to minimize waste, and engaging in reforestation projects to restore ecosystems (Wang, 2016). Additionally, CER emphasizes the importance of transparent environmental reporting and integrating sustainability metrics into corporate performance evaluations, fostering a culture of accountability and continuous improvement in environmental practices (Desjardins, 1998).

Understanding the scope and CER's various dimensions requires appreciation. CER involves proactive measures that exceed legal requirements, meaning it is not limited to compliance with environmental regulations. Companies committed to CER engage in activities such as adopting renewable energy sources, implementing energy-efficient processes, and investing in sustainable technologies (Chan et al., 2022). These efforts aim to reduce greenhouse gas emissions, minimize waste, and conserve natural resources. Moreover, CER encompasses developing environmentally friendly products and services, which help reduce the overall environmental impact of consumption and production patterns (Crifo, 2014).

The relationship between CSR and CER is intricate and complementary (Lu, 2018). While CSR covers a broad range of social, ethical, and environmental responsibilities, CER focuses explicitly on the ecological dimension of this more comprehensive framework. CSR can be viewed as the umbrella under which CER resides, with CER addressing the environmental aspects of a company's operations. This distinction highlights the importance of integrating environmental considerations into a company's CSR strategy (Yadav et al., 2020).

In practice, CER often involves aligning business operations with internationally recognized standards and frameworks, such as the International Organization for Standardization (ISO) 14001 for environmental management systems and adhering to guidelines set forth by organizations like the GRI (International Organization for Standardization, 2015). These standards provide a structured approach for companies to manage their environmental responsibilities systematically, ensuring continuous improvement and accountability (Lu, 2018).

Engaging with various stakeholders, including employees, customers, suppliers, and communities, is also included in the scope of CER to foster a collaborative approach to environmental sustainability. Companies can reach their goals, enhance their effectiveness, and leverage diverse perspectives and expertise by involving stakeholders in ecological initiatives. For example, engaging employees in sustainability programs can lead to innovative solutions and a more significant commitment to environmental goals, while collaborating with suppliers can ensure the sustainability of the entire supply chain (Wang, 2016).

Climate change, biodiversity loss, and resource depletion were increasingly recognized in the context of global challenges, which led to CER's strategic importance. In an interconnected world, businesses must realize that their environmental practices have significant implications for sustainability and the health of the global ecosystem. Companies that embrace CER are better positioned to mitigate risks associated with environmental degradation, regulatory changes, and shifting market expectations (Lu, 2018). Moreover, they can capitalize on the growing demand for sustainable products and services, strengthening their competitive advantage and resilience in the market (Matuszek, 2013).

4.2. Historical Context and Evolution

A broader environmental movement has profoundly influenced corporate practices over the past several decades and can be traced back to CERs in a historical context and evolution (Lu & Faure, 2016). Environmental responsibility as a corporate imperative emerged from the growing recognition that sustainable business practices are essential for long-term economic and ecological viability and the increasing awareness of industrial activities' negative impacts on the natural world (Kim et al., 2015).

The 1960s and 1970s, marked by heightened ecological awareness and activism, led to the emergence of environmental responsibility (Gough, 2013). Within this era, Rachel Carson's seminal work "Silent Spring" was published in 1962. It highlighted the detrimental effects of pesticides on ecosystems and ignited public concern about environmental degradation (Lu & Faure, 2016). Earth Day was subsequently established in 1970, further underscoring the rising environmental consciousness, leading to numerous environmental protection laws and regulatory bodies worldwide (Earth Day, 2024).

Initial reactions to this ecological awakening within the corporate sector were largely reactive, focusing solely on compliance with emerging regulations. Companies began to recognize the need to address environmental issues to adhere to legal requirements, mitigate risks associated with environmental liabilities, and safeguard their reputations. This period marked the beginning of environmental management systems, with businesses adopting practices to reduce pollution, manage waste, and improve resource efficiency (Morrow & Rondinelli, 2002).

Significant advancements in CER were made in the 1980s and 1990s, driven by major environmental incidents and the subsequent regulatory and public pressure. Catastrophic events such as the Bhopal gas tragedy in 1984 and the Exxon Valdez oil spill in 1989 highlighted the severe consequences of environmental neglect. Both were devastating disasters that caused extensive environmental damage and led to thousands of deaths and long-term health issues for many residents (Morris & Loughlin, 2013; Desai, 1993).
They prompted a more proactive approach to environmental responsibility (Kim et al., 2015). In response, many companies began to institutionalize ecological management practices, leading to the development of standards such as the ISO 14001 Environmental Management System, which provides a framework for systematic environmental performance improvement (Morrow & Rondinelli, 2002).

During this period, sustainable development gained prominence, particularly with the publication of the Brundtland Report in 1987, officially titled *Our Common Future*. This report defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs (Cochran, 2007). This report underscored the interdependence of economic growth, social equity, and environmental protection, shaping the discourse around corporate sustainability and responsibility (Hajian & Kashani, 2021).
The Brundtland Report remains a foundational document in the discourse on sustainability and has had a lasting impact on environmental policy and practice worldwide. It emphasizes sustainable development, global challenges, policy recommendations, and frameworks for international efforts (Brundtland, 1985).

In the late 1990s and early 2000s, CER was integrated into broader corporate strategies as companies began to recognize the competitive advantages of sustainability. The rise of globalization and the proliferation of multinational corporations amplified the impact of corporate activities on the environment, necessitating a more comprehensive approach to CER (Weaver et al., 2012). Companies started to adopt voluntary sustainability initiatives, such as the United Nations Global Compact and the Global Reporting Initiative, which provided guidelines and standards for reporting environmental performance (Cochran, 2007).

Significant milestones in the evolution of CER include the establishment of the Kyoto Protocol in 1997, which set binding emission reduction targets for developed countries and highlighted the need for corporate action on climate change (Lu & Faure, 2016). This was followed by adopting the Paris Agreement in 2015, which further reinforced the role of businesses in achieving global climate goals (Delbeke et al., 2019). Introducing carbon markets and emissions trading schemes also spurred companies to innovate and invest in low-carbon technologies. Carbon markets are systems where countries or companies can buy or sell carbon emission allowances, providing financial incentives to reduce greenhouse gases (Lu & Faure, 2016). Emissions trading schemes, a type of carbon market, set a cap on the total amount of greenhouse gases covered entities can emit. Companies that reduce their emissions below their allotted cap can sell their excess allowances to other companies struggling to meet their caps (Laing et al., 2014). This market-driven approach incentivizes emissions reductions and promotes investment in cleaner technologies and energy efficiency (Lu & Faure, 2016).

In recent years, the scope of CER has expanded to encompass a broader range of environmental issues, including biodiversity conservation, water stewardship, and circular economy principles (Sindhi & Kumar, 2012). Companies are increasingly adopting holistic approaches to sustainability, integrating environmental considerations into product design, supply chain management, and corporate governance (Lu & Faure, 2016). The emphasis on transparency and accountability has grown, with stakeholders demanding more rigorous and credible reporting on environmental impacts (Holtbrügge & Dögl, 2012).

4.3. Theoretical Models and Frameworks

Theoretical models and frameworks play a crucial role in shaping the understanding and implementation of CER. These models provide structured approaches for integrating environmental considerations into business operations and strategies, guiding companies toward more sustainable practices. Among the most influential frameworks are the Triple Bottom Line and The Natural Step Framework, alongside other relevant theories that offer diverse perspectives on sustainability and corporate responsibility (Chen et al., 2018).

The Triple Bottom Line framework, introduced by John Elkington in the 1990s, fundamentally redefines the concept of business success (Zaharia & Zaharia, 2021). Traditionally, corporate performance was assessed primarily based on financial outcomes. However, the TBL framework expands this assessment to include social and environmental dimensions, advocating for a balance between profit, people, and the planet (Pires et al., 2016). This tripartite approach encourages companies to measure their performance by financial gains and contributions to societal well-being and environmental sustainability.

The Natural Step Framework, developed in Sweden in the late 1980s, offers another robust approach to sustainability (Upham, 2000). It is based on scientific principles defining the conditions necessary for a sustainable society (Karassin & Bar-Haim, 2016). These principles provide a clear and actionable roadmap for companies to reduce their environmental impact and contribute to sustainable development. The framework emphasizes a systems-thinking approach, recognizing the interconnectedness of economic, social, and environmental systems (Upham, 2000).

The Natural Step Framework is grounded in four sustainability principles: reducing the extraction of finite resources, minimizing the accumulation of synthetic substances, limiting the physical degradation of nature, and meeting human needs globally (Albert et al., 2020). These principles guide companies in identifying and addressing the root causes of environmental degradation, encouraging them to redesign products, processes, and business models to align with sustainable practices (Karassin & Bar-Haim, 2016). By adopting this framework, companies can systematically assess their environmental performance, set strategic goals for sustainability, and implement effective measures to achieve these goals (Albert et al., 2020).

Other relevant theories and models also contribute to the understanding of CER. The Circular Economy model, for instance, promotes the idea of closing the loop in production and consumption processes by designing out waste and keeping products and materials in use for as long as possible (Bîrgovan et al., 2022). This model contrasts with the traditional linear economy, which follows a 'take, make, disposed' approach. By embracing circular economy principles, companies can increase resource efficiency, reduce environmental impact, and create new economic opportunities through innovative business models, such as product-as-a-service or industrial symbiosis (Bîrgovan et al., 2022).

Eco-efficiency, another important concept, focuses on creating more value with less environmental impact (Caiado et al., 2017). It motivates companies to optimize resource use, reduce emissions and waste, and augment the efficiency of their operations. The goal is to achieve economic and environmental benefits, driving sustainable growth and competitiveness (John et al., 2020). Eco-efficiency is often measured through energy intensity, carbon footprint, and material efficiency indicators, providing a quantitative basis for assessing and improving environmental performance (Caiado et al., 2017).

The Cradle to Cradle (C2C) design philosophy, developed by William McDonough and Michael Braungart, further advances sustainable innovation by advocating for the design of products with their entire lifecycle in mind (Bakker et al., 2010). C2C principles encourage the creation of products that can be fully recycled or composted at the end of their life, eliminating the concept of waste. This approach promotes the use of safe, renewable materials and processes that positively impact human health and the environment (Awan et al., 2020).

Incorporating these theoretical models and frameworks into corporate strategies enables companies to navigate the complexities of environmental responsibility effectively. They provide a structured foundation for identifying sustainability challenges, setting strategic goals, and implementing actionable solutions (Bakker et al., 2010). By leveraging these models, businesses can mitigate their environmental impact and unlock new opportunities for innovation, resilience, and long-term success.

4.4. Implementation of CER

Integrating CER into corporate strategy begins with a clear commitment from top management. Leadership plays a crucial role in setting the tone and prioritizing environmental goals. Companies must develop an unobstructed vision and mission statement that includes sustainability as a core value. This strategic alignment ensures that ecological objectives are embedded in the company's overall business strategy rather than being treated as peripheral concerns (Mamun & Shaikh, 2018).

One effective strategy is establishing an Environmental Management System (EMS), such as ISO 14001. An EMS provides a structured framework for managing environmental impacts, setting measurable targets, and ensuring continuous improvement (Balzarova & Castka, 2008). The process typically involves conducting an initial environmental review to identify significant impacts, setting objectives and targets, implementing operational controls, and conducting regular audits to track progress and ensure compliance (Santos-Reyes & Lawlor-Wright, 2001).

Another censorious strategy is incorporating sustainability into product design and development. This approach, often called eco-design or green design, involves considering environmental impacts throughout the product lifecycle, from raw material extraction to disposal (Dahmani et al., 2021). Companies can reduce their ecological footprint by selecting sustainable materials, improving energy efficiency, and designing for recyclability and reusability. Lifecycle assessment (LCA) tools are valuable for evaluating the environmental performance of products and identifying areas for improvement. LCA is a systematic process that assesses the environmental aspects and potential impacts of a product, process, or service (Tukker, 2000). It involves compiling an inventory of relevant energy and material inputs and environmental releases, evaluating the potential impacts of these inputs and releases, and interpreting the results to help make more informed decisions. By using LCA, companies can pinpoint stages in the product lifecycle where significant environmental impacts occur and develop strategies to mitigate these impacts, thus enhancing overall sustainability (Toniolo et al., 2020).

Supply chain management also plays a vital role in CER implementation. Companies must work closely with suppliers to meet environmental standards throughout the supply chain. This can involve setting clear expectations, conducting supplier audits, and supporting suppliers' adoption of sustainable practices (Balzarova & Castka, 2008). Engaging in initiatives such as responsible sourcing and sustainable procurement helps minimize the environmental impacts of upstream activities (Meehan & Bryde, 2010).

4.5. Challenges and Opportunities of CER

Implementing Corporate Environmental Responsibility can be challenging due to various factors. One significant obstacle is the potential for increased costs associated with adopting sustainable practices (Ekins & Zenghelis, 2021). Investments in renewable energy, eco-friendly materials, and waste management systems can be substantial. However, long-term savings can offset these costs, such as reduced energy consumption, lower waste disposal fees, and increased resource efficiency. Additionally, many companies find that the initial investment in sustainability leads to innovation, opening new markets and creating competitive advantages (Ekins & Zenghelis, 2021).

Another challenge is the complexity of measuring and reporting environmental performance. Accurate data collection and analysis are vital for setting targets, tracking progress, and demonstrating transparency. Companies often face difficulty standardizing metrics and ensuring data reliability (Pizzi et al., 2023). Adopting recognized reporting frameworks, such as the GRI or the Sustainability Accounting Standards Board, can help overcome these challenges by providing clear guidelines and standardized indicators (Pizzi et al., 2023).

Despite these challenges, there are significant opportunities associated with CER. Companies proactively managing environmental impacts can nourish their reputation and build stronger stakeholder relationships. Consumers, investors, and employees increasingly prefer companies committed to sustainability (Slavova & Ivanova, 2019). This preference can translate into increased brand loyalty, employee engagement, and investor confidence (Eccles et al., 2014).

Technological advancements also present opportunities to improve environmental performance. Innovations in renewable energy, energy storage, and resource management enable companies to reduce their environmental footprint more effectively. For example, advancements in solar and wind energy technologies have made renewable energy more accessible and cost-effective, allowing companies to transition away from fossil fuels

(Balzarova & Castka, 2008). Similarly, developments in waste management technologies, such as recycling and composting systems, help companies reduce landfill waste and promote circular economy principles (Shang et al., 2022).

5. Greenwashing

Greenwashing refers to companies misleadingly presenting their products, services, or overall operations as environmentally friendly to gain a competitive advantage or enhance their public image (De Freitas Netto et al., 2020). This deceptive tactic can undermine genuine sustainability efforts and erode consumer trust, making it a significant issue within the context of corporate environmental responsibility. As stakeholders became more environmentally conscious, the scrutiny of corporate claims has intensified, highlighting the importance of transparency and authenticity in corporate communications about environmental practices (Ruiz-Blanco et al., 2022).

5.1. Definition and Characteristics

Greenwashing applies when companies mislead consumers and stakeholders about the environmental benefits of their products, services, or overall operations (Ruiz-Blanco et al., 2022). This deception is often executed through marketing and public relations tactics that exaggerate or falsely claim environmental responsibility. The primary goal of greenwashing is to capitalize on the growing consumer demand for sustainable and eco-friendly products without making substantial or genuine efforts to reduce environmental impact. As a result, greenwashing can weaken consumer trust and diminish the legitimacy of genuine sustainability initiatives (Mitchell & Ramey, 2010).

Understanding greenwashing involves recognizing the various forms it can take and the motivations behind it. Companies may engage in greenwashing to attract environmentally conscious consumers, intensify their brand image, or meet regulatory requirements without incurring the costs of genuine environmental improvements. This practice is particularly prevalent in industries with significant environmental impact, such as manufacturing, energy, and aviation (Verma & Bharti, 2023). The commonness of greenwashing reflects a broader challenge in the corporate world: balancing the pressure to appear sustainable with the need to implement meaningful and sometimes costly environmental changes (Mitchell & Ramey, 2010).

Tactics and strategies employed in greenwashing are diverse and often sophisticated. One common tactic is using vague or ambiguous language in marketing materials. Terms such as "eco-friendly," "green," and "natural" are frequently used without clear definitions or evidence to support the claims (de Freitas Netto et al., 2020). This ambiguity allows companies to project an image of environmental responsibility while avoiding specific commitments or measurable outcomes. For instance, a product might be labeled "eco-friendly" because it contains a small percentage of recycled material. At the same time, the overall environmental impact of its production and disposal remains significant.

Another essential strategy is the selective disclosure of information. Companies might highlight a few environmentally friendly attributes of their products or operations while downplaying or omitting more harmful aspects (de Freitas Netto et al., 2020). This tactic creates a skewed perception of the company's environmental performance. For example, an airline might promote its investment in carbon offset programs while neglecting to address the more significant issue of its overall carbon emissions. By focusing on positive but minor initiatives, companies can divert attention from more substantial environmental impacts (Mitchell & Ramey, 2010).

Greenwashing can also involve the use of certification labels and endorsements that appear to validate a company's environmental claims. Some companies create eco-labels or seek endorsements from third-party organizations with low credibility or weak standards (Nygaard, 2023). This strategy can mislead consumers into believing that a product or service has met rigorous environmental criteria when, in fact, it has not. The proliferation of such labels complicates the consumer's ability to discern genuine sustainability from superficial claims (Shahrin et al., 2017).

Additionally, greenwashing may manifest itself through misleading imagery and branding. Companies often use nature imagery, such as trees, animals, and pristine landscapes, to evoke an environmental ethos (Pendse et al., 2023). This visual strategy can create an impression that sustainability needs to be substantiated by the company's actual practices. For example, advertisements featuring lush forests and clean rivers accompany a product with minimal environmental benefits.

5.2. Historical Emergence of Greenwashing

The historical emergence of greenwashing can be traced back to the rise of environmental awareness and the subsequent regulatory and consumer pressures on companies to adopt sustainable practices. As a deceptive marketing practice, greenwashing has evolved alongside the ecological movement, reflecting the tensions between genuine corporate responsibility and the pressures to maintain profitability and market share (Delmas & Burbano, 2011).

The term "greenwashing" itself was coined in the 1980s by environmentalist Jay Westerveld (Pendse et al., 2023). At the time, he observed that many hotel chains were ostensibly promoting towel reuse programs to "save the environment" while their overall environmental practices remained unchanged. This marked the beginning of greenwashing as a recognized phenomenon, where companies would highlight minor, often superficial, environmentally friendly initiatives to distract from their broader, less sustainable practices (Pendse et al., 2023).

Increasing environmental awareness during the 1960s and 1970s led to significant societal and regulatory changes. Public concern about ecological degradation surged, culminating in the establishment of Earth Day in 1970, a global movement advocating for environmental protection (Watson, 2016). In response, governments introduced stringent regulatory measures such as the Clean Air Act and the Clean Water Act in the United States, which set new standards for pollution control and environmental preservation. These regulations compelled businesses to integrate environmental considerations into their operations, marking the beginning of a more structured approach to corporate environmental responsibility (Pendse et al., 2023).

However, as consumer awareness and demand for environmentally responsible products grew, so did the temptation for companies to exaggerate their environmental credentials without making substantial changes. The oil industry provides a notable early example of this trend. In the 1980s, oil companies, facing criticism of their environmental impact, began producing advertisements highlighting their investments in renewable energy and conservation efforts (Meade, n.d.). These campaigns were often misleading, portraying the companies as environmentally proactive while their core operations continued to contribute significantly to pollution and environmental degradation (Oreskes & Supran, 2023).

The 1990s saw greenwashing practices escalating as environmental concerns became more mainstream. Companies across various industries began to realize the market potential of "green" products and the competitive advantage of appearing environmentally friendly (de Freitas Netto et al., 2020). Marketing campaigns increasingly featured claims of sustainability, eco-friendliness, and reduced environmental impact. However, many of these claims were vague, unsubstantiated, or false. For example, certain automobile manufacturers touted the fuel efficiency of new car models without addressing the broader environmental impact of their production processes or the overall lifecycle emissions of their vehicles (Gottlieb et al., 1995).

The proliferation of green marketing claims led to increased scrutiny by regulators and non-governmental organizations (NGOs). In response, regulatory bodies began to develop guidelines to prevent misleading environmental claims (Terceiro, 2008). In the United States, the Federal Trade Commission (FTC) issued the first version of its Green Guides in 1992, providing guidelines for marketers to make truthful and substantiated environmental claims.

These guides aimed to protect consumers from deceptive advertising and promote fair business competition (de Freitas Netto et al., 2020).

Despite these efforts, greenwashing continued to evolve, becoming more sophisticated. The early 2000s saw the advent of corporate sustainability reports, where companies began to disclose their environmental performance and initiatives. While these reports were intended to increase transparency, they also provided opportunities for greenwashing. Companies often focus on positive achievements while downplaying or omitting significant adverse impacts. This selective disclosure created an incomplete picture of their environmental performance, misleading stakeholders about the true extent of their sustainability efforts (Parguel & Johnson, 2021).

The rise of social media and digital communication in the 2010s further complicated the landscape of greenwashing. Companies could rapidly disseminate green messages to a broad audience, often without rigorous verification. The speed and reach of digital marketing amplified the potential for misleading claims, as consumers were bombarded with messages about the purported sustainability of products and services (Pendse et al., 2023). In this environment, the challenge for consumers to discern genuine efforts from greenwashing became even more pronounced.

There has been a growing backlash against greenwashing in recent years, driven by increasing environmental awareness and activism. High-profile scandals, such as the Volkswagen emissions scandal 2015, where the company admitted to using software to cheat emissions tests, have highlighted the severe repercussions of deceptive environmental practices (Parguel & Johnson, 2021). These incidents have spurred calls for greater accountability and transparency in corporate ecological claims.

Academic research has also contributed to understanding greenwashing and exploring its prevalence, motivations, and impacts. Studies have shown that greenwashing not only undermines consumer trust but also poses risks to companies' reputations and long-term viability. Researchers have emphasized the need for stricter regulations, improved standards for environmental claims, and more outstanding consumer education to combat greenwashing (Pendse et al., 2023).

5.3. Detection and Prevention of Greenwashing

Detection and prevention of greenwashing are crucial for maintaining consumer trust and ensuring that corporate environmental claims are credible and substantive. Given the complexity and prevalence of greenwashing, various methods have been developed to identify and mitigate its effects (Kurpierz & Smith, 2020). Combined with the best practices for authenticity and regulatory measures, these methods form a comprehensive approach to greenwashing.

5.3.1. Identification Methods

Identifying greenwashing requires a critical and systematic approach. One primary method involves scrutinizing the language and terminology used in marketing materials. Vague and ambiguous terms such as "eco-friendly," "green," and "natural" should be carefully examined to determine if they are supported by specific, measurable, and verifiable claims (Kurpierz & Smith, 2020). Companies genuinely committed to sustainability will typically provide detailed explanations and evidence to support their environmental assertions.

Third-party certifications and eco-labels are essential tools in identifying greenwashing. Credible certifications, such as those provided by recognized organizations like the Forest Stewardship Council (FSC), Energy Star, and Leadership in Energy and Environmental Design (LEED), indicate that a product or service has met established environmental standards (Vázquez & Lanero, 2021). However, it is essential to differentiate between legitimate certifications and self-created labels that lack rigorous verification. Consumers and stakeholders should verify the credibility of these certifications by researching the certifying body's standards and processes (Miller et al., 2008).

Another method involves conducting life cycle assessments to evaluate the environmental impact of a product from raw material extraction to disposal (Goffetti et al., 2022). LCAs provide a comprehensive view of the ecological footprint and can reveal whether a company's claims are consistent with the overall impact of their products. Companies that engage in greenwashing often highlight minor environmental benefits while ignoring more significant adverse impacts, which can be uncovered through thorough life cycle assessments (Toniolo et al., 2020).

5.3.2. Best Practices for Authenticity

To prevent greenwashing, companies should adopt best practices ensuring transparency, accountability, and commitment to sustainability. One of the most effective practices is to provide clear, specific, and verifiable information about environmental claims. This involves providing comprehensive information on resource consumption, emissions, and waste management and clearly explaining the methods and criteria employed. Transparency fosters trust and allows stakeholders to make informed decisions based on accurate information (Kurpierz & Smith, 2020).

Another critical practice is engaging stakeholders in developing and implementing sustainability initiatives (Feinstein, 2013). Companies should involve employees, customers, suppliers, and community members in their environmental efforts, seeking their input and feedback. This collaborative approach strengthens the credibility of sustainability initiatives and ensures they are relevant and impactful. Regular communication and updates on progress further demonstrate a company's commitment to continuous improvement (Kurpierz & Smith, 2020).

Third-party audits and verification add a layer of credibility to environmental claims. Independent audits conducted by reputable organizations can validate the accuracy of a company's reported data and assess the effectiveness of its sustainability initiatives. These audits provide an objective assessment, reducing the likelihood of greenwashing and increasing stakeholder confidence in the company's environmental performance (Nordhaug, 2017).

Companies should also align their sustainability goals with internationally recognized frameworks and standards, such as the United Nations Sustainable Development Goals (SDGs) and the GRI (Goffetti et al., 2022). These frameworks provide clear guidelines and benchmarks for measuring and reporting sustainability performance, helping companies to set meaningful targets and track their progress transparently.

5.3.3. Regulatory Measures

Regulatory measures are critical in preventing greenwashing by establishing clear guidelines and standards for environmental claims and marketing practices. Governments and regulatory bodies have implemented various measures to protect consumers from deceptive green marketing. For instance, the United States FTC has issued the Green Guides, which provide detailed guidance on how companies can make truthful and non-misleading environmental claims (Sun & Zhang, 2019). These guides outline specific requirements for substantiating claims, avoiding deceptive representations, and using clear and understandable language.

In the European Union, the Unfair Commercial Practices Directive prohibits misleading marketing practices, including greenwashing. This directive requires companies to provide truthful information about their products' environmental benefits and prohibits omitting critical information that could mislead consumers (Incardona & Poncibò, 2007). The EU Ecolabel also provides a voluntary certification scheme that sets high environmental standards for products and services, helping consumers identify sustainable options (EU Ecolabel, n.d.).

Enforcement of these regulatory measures is vital for their effectiveness. Regulatory bodies must actively monitor the market, investigate complaints, and act against companies that engage in greenwashing. Penalties for non-compliance, such as fines and public disclosures, serve as deterrents and reinforce the importance of adhering to established standards (Incardona & Poncibò, 2007).

The detection and prevention of greenwashing requires a multifaceted approach that combines identification methods, best practices for authenticity, and robust regulatory measures. By implementing these strategies, companies can build trust with stakeholders, strengthen their credibility, and contribute to genuine environmental sustainability. Stakeholders, in turn, can make more informed decisions, supporting businesses that demonstrate a genuine commitment to environmental responsibility (Feinstein, 2013).

6. Evolution and Development of CSR, CER, and Greenwashing in the Airline Industry

The evolution and development of Corporate Social Responsibility, Corporate Environmental Responsibility, and greenwashing in the airline industry reflect the sector's responses to increasing environmental and societal pressures. As one of the most scrutinized industries due to its substantial carbon footprint and resource consumption, the aviation sector has faced significant challenges and opportunities in adopting sustainable practices. This chapter explores the historical trajectory, key initiatives, and emerging trends in how airlines address their social and environmental responsibilities while navigating the complexities of genuine sustainability versus superficial greenwashing (Cowper-Smith & De Grosbois, 2010).

6.1. Historical Overview

The airline industry's approach to CSR and CER has evolved significantly over the decades. This progression has been shaped by regulatory pressures, technological advancements, and increasing public awareness of environmental and social issues (Upadhaya et al., 2018). Understanding the historical context of CSR and CER in aviation provides valuable insights into how airlines have adapted their strategies to meet growing expectations for sustainable and responsible business practices.

6.1.1. Early Adoption of CSR and CER in Aviation

The early adoption of CSR and CER in the airline industry was driven primarily by regulatory requirements and the need to address public concerns about environmental and social impacts (Upadhaya et al., 2018). In the late 20th century, the growing recognition of the ecological consequences of air travel, particularly concerning carbon emissions and noise pollution, prompted initial steps towards greater corporate responsibility.

One of the pioneering airlines in environmental responsibility was Scandinavian Airlines (SAS) (Zieba & Johansson, 2022). In the early 1990s, SAS introduced comprehensive environmental management systems to reduce its ecological footprint. These efforts included initiatives to improve fuel efficiency, reduce emissions, and manage waste more effectively (SAS, n.d.). SAS's approach was holistic, incorporating environmental considerations into its broader business strategy and setting a precedent for other airlines.

British Airways also emerged as a leader in early CSR and CER initiatives (Coles et al., 2009). In the 1990s, the airline began to focus on reducing its environmental impact through various measures, such as investing in more fuel-efficient aircraft and implementing recycling programs. British Airways was one of the first airlines to publish an environmental report detailing its efforts and progress in reducing its ecological footprint. This move towards transparency helped to build trust with stakeholders and set a standard for environmental reporting in the industry (Coles et al., 2009).

The Lufthansa group took significant steps towards corporate responsibility by integrating environmental sustainability into its operations. Early initiatives included publishing detailed sustainability reports outlining its environmental goals and achievements. These reports included carbon emissions, waste management, and resource usage metrics. Further, it offered carbon offset programs, explored the use of sustainable aviation fuels, and implemented waste reduction initiatives (Saini et al., 2022).

The regulatory landscape influenced the early adoption of CSR and CER in aviation. Government regulations, particularly in Europe and North America, mandated emissions reductions and operational efficiency improvements. For instance, the European Union introduced strict aircraft noise and emissions rules, compelling airlines to invest in newer, cleaner technologies. In response to these regulations, airlines began to develop and implement environmental management systems, ensuring compliance while enhancing their sustainability credentials (Cowper-Smith & De Grosbois, 2011). While not an airline, IATA was crucial in promoting sustainability in the aviation industry. Their initiatives and frameworks have encouraged airlines to adopt CSR and CER practices (Mazıoğlu & Güngör, 2024).

Technological advancements facilitated the early adoption of CSR and CER in the airline industry. Innovations in aircraft design, such as developing more fuel-efficient engines and using lightweight materials, significantly reduced fuel consumption and emissions. Airlines that invested in these technologies demonstrated their commitment to sustainability, gaining a competitive advantage in an increasingly environmentally conscious market (Zieba & Johansson, 2022).

The integration of CSR and CER into the core strategies of pioneering airlines set the stage for the broader industry to follow. These early adopters demonstrated that it was possible to balance profitability with environmental and social responsibility, paving the way for more comprehensive and ambitious sustainability initiatives in the years to come. As a result, CSR and CER have become integral components of the strategic planning processes for many airlines, reflecting a long-term commitment to sustainable growth and corporate responsibility (Zieba & Johansson, 2022).

6.1.2. Key Milestones and Developments

Several key milestones and significant developments have marked the development of CSR and CER in the airline industry. These milestones reflect the industry's growing commitment to sustainability, adaptation to evolving environmental regulations, and heightened public expectations (Gangi et al., 2022).

One of the earliest significant milestones was the establishment of the International Civil Aviation Organization (ICAO) in 1944, which laid the groundwork for international cooperation in aviation safety and environmental standards. In 1972, ICAO began addressing aviation's environmental impact, marking the beginning of formal efforts to regulate aircraft noise and emissions. This led to the development of the first set of standards and recommended practices (SARPs) to reduce aviation's environmental footprint (International Civil Aviation Organization, n.d.).

The 1980s and 1990s saw significant technological advancements that facilitated the adoption of more sustainable practices in aviation. Introducing high-bypass turbofan engines dramatically improved fuel efficiency and reduced noise pollution. Airlines that adopted these technologies could significantly lower their environmental impact, setting a new standard for the industry. The development of the Boeing 777 and the Airbus A320 families, for example, represented significant forward steps regarding fuel efficiency and emissions reduction (Gangi et al., 2022).

The Kyoto Protocol of 1997 was a pivotal moment for the aviation industry, as it highlighted the need for all sectors, including aviation, to address their greenhouse gas emissions. Although international aviation was not included in the Protocol's targets, the agreement increased awareness and spurred voluntary initiatives within the industry. In response, many airlines began to develop their carbon reduction strategies and engage in carbon offset programs (Gangi et al., 2022).

The early 2000s witnessed the introduction of more rigorous environmental regulations and voluntary commitments from airlines to reduce their environmental impact. The EU ETS, implemented in 2005, required European airlines to monitor and report on their CO2 emissions and purchase allowances to cover them. This market-based approach incentivized airlines to invest in more efficient technologies and operational practices (European Commission, n.d.).

Another key milestone was the adoption of the Carbon Offsetting and Reduction Scheme for International Aviation by ICAO in 2016. CORSIA aims to stabilize CO2 emissions from international aviation at 2020 levels by requiring airlines to offset their emissions growth beyond these levels (Scheelhaase & Maertens, 2020). This global market-based measure represents a significant step towards achieving carbon-neutral growth in the aviation sector.

The development of sustainable aviation fuels has also been a crucial milestone in the evolution of CER in aviation. SAFs can reduce lifecycle greenhouse gas emissions by up to 80% compared to conventional jet fuel. Airlines such as KLM and United Airlines have pioneered SAFs into their operations, demonstrating their viability as a critical component of sustainable aviation (Abrantes et al., 2021).

6.2. Greenwashing Practices in the Aviation Industry

Greenwashing in the aviation industry has become critical as airlines increasingly market their environmental and social initiatives to appeal to environmentally conscious consumers (Neureiter & Matthes, 2023). While some airlines genuinely invest in sustainable practices, others engage in greenwashing, creating a misleading perception of their environmental responsibility.

6.2.1. Definition and Context

In the aviation industry context, greenwashing refers to conveying a false impression or providing misleading information about how a company's products, services, or overall operations are environmentally sound. Some airlines employ this deceptive strategy to capitalize on the growing consumer demand for sustainable travel options without making substantive changes to reduce their environmental impact (Neureiter & Matthes, 2023). Understanding greenwashing in aviation is necessary for identifying and challenging these misleading practices.

Airlines often operate under significant public scrutiny due to their substantial carbon footprint and other environmental impacts. In response, many have launched high-profile sustainability campaigns highlighting their efforts to reduce emissions, improve fuel efficiency, and invest in sustainable aviation fuels (Neureiter & Matthes, 2023). While some of these claims are based on genuine initiatives, others may be exaggerated or selectively presented to paint a greener picture than reality.

For example, an airline might advertise its investment in a small fleet of fuel-efficient aircraft while operating many older, less efficient planes. Similarly, claims about the use of sustainable aviation fuels might focus on a few test flights or limited routes, creating the impression of widespread use when, in fact, these fuels represent a negligible portion of the airline's total fuel consumption. Such practices exploit consumer goodwill toward sustainability without delivering meaningful environmental benefits (Neureiter & Matthes, 2023).

The importance of distinguishing genuine CSR efforts from greenwashing cannot be overstated. Authentic CSR initiatives in aviation involve comprehensive strategies that integrate environmental and social responsibility into every aspect of the airline's operations. Measurable goals, transparent reporting, and a commitment to continuous improvement typically characterize these strategies. Genuine efforts are supported by substantial investments in technology, infrastructure, and practices that significantly reduce environmental impact over the long term (Gürçam, 2022).

In contrast, greenwashing erodes trust and can have several negative consequences. It not only deceives consumers but also creates unfair competition by allowing airlines that engage in deceptive practices to appear more responsible than they are. This can detract from the efforts of airlines that are honestly committed to sustainability, potentially discouraging further investment in meaningful environmental improvements (Gürçam, 2022).

6.2.2. Examples of Greenwashing in Aviation

Greenwashing practices in the aviation industry are often sophisticated and subtle, making it challenging for consumers to discern actual sustainability efforts from misleading claims. Examining specific instances of greenwashing provides insights into the tactics used and their implications for consumer trust and company reputation.

British Airways' "Plant More Trees" campaign was one notable case involving greenwashing. The campaign highlighted the airline's commitment to planting trees to offset flight carbon emissions. However, closer scrutiny revealed that the scale of the tree-planting initiative was minimal compared to the airline's overall carbon footprint (Greenpeace, 2020). Additionally, the campaign needed detailed information on the number of trees planted, their locations, or the timeline for their growth to maturity, making it difficult to verify the actual environmental benefits. This lack of transparency led to criticism from environmental groups and raised questions about the sincerity of the airline's sustainability commitments (Greenpeace, 2020).

Another example can be found in Ryanair's advertising campaigns, which have claimed the airline to be the "greenest" or "lowest emission" airline in Europe. These claims were based on comparing emissions per passenger kilometer, which favors airlines operating with high load factors and short-haul flights (Schmidt, 2023). However, the UK's Advertising Standards Authority (ASA) banned some of these adverts, ruling that they were misleading because they did not account for the absolute emissions produced by the airline or the environmental impact of its operations (Politico, 2020). This case highlighted how selective use of data and metrics can create a misleading impression of an airline's environmental performance.

Emirates faced accusations of greenwashing by promoting the Airbus A380 as an environmentally friendly aircraft. While the A380 is more fuel-efficient per passenger than older models, Emirates' marketing did not address the broader environmental impact of operating a large fleet of such aircraft or the emissions associated with long-haul flights. Furthermore, the emphasis on a single aircraft model's efficiency diverted attention from the overall environmental impact of the airline's extensive operations, which continued to rely heavily on fossil fuels (CMS, 2023).

Recently published articles showed the latest greenwashing activities in Europe. There were actions against KLM and Austrian Airlines for false advertising practices (Carbon Credits, 2024). The rulings found that both airlines made misleading claims about their environmental initiatives, particularly regarding the effectiveness of their carbon offset programs. In addition to the rulings, the European Union is investigating 20 airlines, including KLM, Air France, and Brussels Airlines, for potential greenwashing practices. The investigation assesses whether these airlines have exaggerated their environmental credentials or failed to substantiate their sustainable actions. Those Airlines may risk reputational damage, legal penalties, or increased regulatory oversight if found guilty of greenwashing (European Commission, 2024).

The impact of these greenwashing practices on consumer trust and company reputation can be significant. When consumers perceive their misled, their confidence in the brand can erode rapidly. This erosion of faith can lead to negative publicity, reduced customer loyalty, and potential revenue declines (Aji & Sutikno, 2015). For instance, the backlash against British Airways and Ryanair's misleading claims resulted in widespread media coverage and criticism, damaging their reputations and prompting calls for greater transparency and accountability in their environmental claims (Greenpeace, 2020).

Adopting comprehensive and transparent reporting practices is essential for airlines. Providing detailed, independently verified information about environmental initiatives and their impact can help rebuild trust with consumers and stakeholders. Additionally, engaging in open dialogue with environmental organizations and participating in third-party audits can demonstrate a commitment to genuine sustainability (Pirson & Malhotra, 2008).

One recent case involves KLM and its "Fly Responsibly" campaign, which was found to be misleading by a Dutch court in 2024. The court ruled that KLM's advertisements painted an overly optimistic picture of its sustainability efforts, such as using Sustainable Aviation Fuel and reforestation projects. These measures were deemed insufficient in addressing the airline's overall environmental impact, and the court stated that KLM’s claims could create a false impression of the company’s commitment to sustainability. The ecological group Fossil Free filed the lawsuit, highlighting airlines' need for greater transparency and accountability in sustainability marketing. The court specifically criticized KLM's use of vague and general statements, which gave customers the impression that flying with KLM was sustainable despite the airline's significant contribution to carbon emissions (Deutsche Welle, 2024).

Although the court did not impose any penalties, the verdict represents a landmark decision against greenwashing in aviation. It underscores the importance of honest and transparent communication in sustainability claims, setting a precedent for other airlines. KLM responded by stating that it would work on ensuring more transparent and accurate communication regarding its environmental efforts in the future (Deutsche Welle, 2024).

Furthermore, the case reminds airlines to back up their sustainability claims with concrete evidence and independently verified data to avoid misleading customers and stakeholders. This example and cases involving British Airways and Ryanair illustrate how selective use of data and metrics can misrepresent a company’s proper environmental performance, ultimately eroding consumer trust and damaging the airline’s reputation (Deutsche Welle, 2024).

6.3. Detection and Prevention of Greenwashing

Identifying and preventing greenwashing in the airline industry is vital for maintaining consumer trust and ensuring genuine environmental responsibility. Given the sophistication of some greenwashing tactics, robust methods and tools to detect deceptive practices and implement best practices to promote authentic sustainability efforts are essential.

6.3.1. Methods and Tools for Identifying Greenwashing in the Airline Industry

Detecting greenwashing requires analytical tools, critical evaluation, and independent verification. As mentioned earlier, one effective method is to scrutinize the specifics of environmental claims made by airlines. This would include vague or ambiguous language, such as "eco-friendly" or "green," without clear definitions or measurable outcomes (Guix et al., 2022). Detailed analysis of these claims should involve looking for specific, quantifiable data that supports the assertions. Supposing an airline claims to be reducing emissions. In that case, it should provide exact figures on emission reductions, the methods used to achieve them, and the period over which these reductions occurred.

At this point, third-party certifications and endorsements from reputable environmental organizations should also be mentioned. They provide a more reliable measure of an airline's environmental performance. Examples would be the previously explained certifications such as ISO 14001 for environmental management systems, the GRI standards, and compliance with the CORSIA (Guix et al., 2022). Checking whether such certifications back an airline's claims can help differentiate between genuine efforts and greenwashing.

The lifecycle assessment tool helps to evaluate the environmental impact of a product or service throughout its entire lifecycle, from raw material extraction to disposal (Toniolo et al., 2020). By examining the total ecological footprint of an airline’s operations, LCAs can reveal inconsistencies between the airline's claims and its actual environmental impact. For instance, an airline that boasts about using sustainable aviation fuels but fails to account for emissions from other operational areas may engage in greenwashing.

Moreover, independent audits and third-party verification by third-party organizations must also be checked when detecting greenwashing (Nemes et al., 2022). These audits thoroughly examine an airline’s environmental claims, policies, and practices to see if they adhere to established environmental standards. Some guidelines to follow when looking for greenwashing include comprehensive reports and disclosures on environmental practices. Authentic efforts typically encompass specific metrics, clearly defined goals, and regular progress updates. The supply chain evaluation shows if genuine environmental responsibility includes all production and service delivery stages rather than focusing solely on the final product. By comparing the company's claims against industry standards and those of competitors, it can be seen if they align with broader best practices. In that case, exaggerated claims or those emphasizing minor green initiatives can be seen while probably neglected significant environmental impacts elsewhere were hidden (Aggarwal & Kadyan, 2014).

6.3.2. Best Practices for Airlines to Ensure Authentic Environmental Responsibility

Airlines should adopt several best practices emphasizing transparency, accountability, and continuous improvement to prevent greenwashing and demonstrate environmental responsibility.

One fundamental practice is the adoption of comprehensive and transparent environmental reporting. Airlines should regularly publish detailed sustainability reports that disclose their environmental impacts, initiatives, and progress toward sustainability goals. These reports should follow recognized reporting frameworks, such as the GRI or the SASB, which provide standardized metrics and guidelines for reporting (Sengur & Altuntas, 2023). Transparent reporting allows stakeholders to evaluate the airline's performance critically and ensures that verifiable data back environmental claims.

Engaging in continuous stakeholder dialogue is another critical practice. Airlines should actively involve stakeholders in their sustainability efforts, including customers, employees, regulators, and environmental organizations. This engagement can include regular consultations, feedback mechanisms, and collaborative initiatives (Nordhaug, 2017). By involving stakeholders in developing and implementing sustainability strategies, airlines can ensure that their efforts are relevant, impactful, and aligned with stakeholder expectations.

Setting specific, measurable, and time-bound sustainability goals is crucial for demonstrating a commitment to environmental responsibility (Alameeri et al., 2017). Airlines should establish clear targets for reducing emissions, improving fuel efficiency, increasing the use of sustainable aviation fuels, and other vital environmental metrics (Gonzalez-Garay et al., 2022). These goals should be ambitious yet achievable, reflecting a genuine commitment to continuous improvement. Progress towards these goals should be regularly monitored, reported, and adjusted as necessary to reflect changing conditions and new opportunities.

Integrating sustainability into the core business strategy is vital for authentic environmental responsibility. This integration involves aligning sustainability objectives with overall corporate goals and ensuring that environmental considerations are embedded in decision-making processes at all levels of the organization. Airlines should invest in sustainable technologies, such as more fuel-efficient aircraft and renewable energy sources, and prioritize sustainability in their procurement and operational practices (McManners, 2015).

Airlines should also participate in industry-wide sustainability initiatives and collaborate with other stakeholders to drive collective progress. Initiatives such as the International Air Transport Association's Fly Net Zero program, which aims to achieve net-zero carbon emissions by 2050, provide a platform for airlines to share best practices, develop joint solutions, and collectively address environmental challenges (Sengur & Altuntas, 2023). Collaboration enhances the effectiveness of individual efforts and contributes to broader industry transformation.

Education and training programs for employees are indispensable to fostering a culture of sustainability within the airline (Alameeri et al., 2017). Employees at all levels should understand the importance of environmental responsibility and be equipped with the knowledge and skills to contribute to sustainability initiatives. Regular training and awareness programs can embed sustainability into the organizational culture and ensure that employees are actively engaged in achieving environmental goals (Alameeri et al., 2017).

Lastly, airlines should adopt innovations and continually seek ways to increase their environmental performance. This could involve exploring emerging technologies, such as electric or hydrogen-powered aircraft, investing in research and development for sustainable aviation fuels, and implementing advanced data analytics to optimize flight operations for fuel efficiency. By staying at the forefront of technological advancements, airlines can maintain a competitive edge while significantly reducing their environmental impact (Gonzalez-Garay et al., 2022).

6.4. The Pyramid of CSR in Aviation

The Pyramid of Corporate Social Responsibility provides a structured framework for understanding businesses' various levels of responsibility towards society. In the context of the aviation industry, this model highlights how airlines can balance their economic, legal, ethical, and philanthropic obligations (Kim et al., 2020). By examining aviation's unique challenges and opportunities, the Pyramid of CSR offers insights into how airlines can integrate comprehensive CSR strategies into their operations, fostering sustainable development and strengthening their contributions to societal well-being (Kim et al., 2020).

6.4.1. Economic Responsibilities

Economic responsibilities form the foundational layer of the Pyramid of CSR, underscoring the fundamental role of businesses in being profitable and economically viable. For the aviation industry, economic responsibilities involve generating profit and ensuring financial stability, competitiveness, and long-term sustainability of society (Kim et al., 2020). These responsibilities are crucial as they enable airlines to invest in advanced technologies, improve operational efficiencies, and provide employment, all contributing to broader economic growth.

Maintaining economic health is imperative in the highly competitive and capital-intensive aviation sector. Airlines must strategically manage their finances to cover high operating costs, such as fuel, maintenance, and labor while investing in fleet renewal and innovation (Saleh, 2022). Effective fiscal management includes optimizing routes, improving fuel efficiency, and enhancing customer service to attract and retain passengers. Profitability ensures that airlines can continue to operate, expand services, and contribute to the economy by paying taxes, creating jobs, and supporting ancillary industries like tourism and hospitality (Lu & Wang, 2018).

Economic responsibilities also involve balancing cost management with investments in sustainability (Lee et al., 2019). Airlines increasingly recognize that sustainable practices can drive financial performance by reducing operational costs and opening new revenue streams. For instance, investments in fuel-efficient aircraft and alternative fuels can lower fuel expenses, while sustainable practices can improve brand reputation and customer loyalty, leading to increased revenue (Saleh, 2022). Airlines that integrate sustainability into their economic strategies can achieve a competitive edge, attracting environmentally conscious consumers and investors.

6.4.2. Legal Responsibilities

Legal responsibilities represent the second layer of the Pyramid of CSR, emphasizing businesses' need to comply with the laws and regulations governing their operations (Lee et al., 2019). The aviation industry's legal responsibilities encompass various regulatory requirements related to safety, environmental protection, labor standards, consumer rights, and competition laws (Zein & Zein, 2020). Compliance with these regulations is vital for preserving operational integrity, safeguarding stakeholder interests, and providing fair market practices (Lee et al., 2019).

Aviation is one of the most heavily regulated industries due to its critical role in transportation and its potential impacts on safety and the environment. Legal responsibilities in aviation begin with stringent safety regulations set by national and international bodies, such as the Federal Aviation Administration (FAA) in the United States and the ICAO (Alameeri et al., 2017). Airlines must comply with rigorous safety standards in aircraft maintenance, pilot training, and operational procedures to secure the safety of passengers and crew (Zein & Zein, 2020). Compliance with safety regulations not only prevents accidents and incidents but also builds public trust and confidence in air travel.

Environmental regulations are another significant aspect of airlines' legal responsibilities. Governments and international organizations have implemented various laws to mitigate aviation's environmental impact, including emissions standards, noise restrictions, and waste management requirements. The EU ETS and CORSIA are vital regulatory frameworks that mandate airlines to monitor and reduce carbon emissions (Zein & Zein, 2020). Compliance with these environmental laws necessitates investments in cleaner technologies, operational efficiencies, and sustainable practices, ensuring that airlines contribute to global climate goals.

6.4.3. Ethical Responsibilities

Ethical responsibilities occupy the third tier of the Pyramid of CSR, encompassing the expectation that businesses will conduct fairly, justly, and respectfully respect stakeholders' rights (Lee et al., 2019). The aviation industry's ethical responsibilities extend beyond mere compliance with laws and regulations, including moral obligations towards passengers, employees, communities, and the environment (Saleh, 2022).

One critical aspect of ethical responsibility in aviation is ensuring the safety and well-being of passengers and crew. This involves adhering to rigorous safety regulations and going beyond them to foster a safety culture and continuous improvement. Airlines must be transparent about safety records, promptly address any issues, and communicate openly with passengers about safety measures. Ethical considerations include fair pricing strategies, transparent communication about fares and fees, and avoiding consumer exploitation practices (Streimikiene et al., 2020).

Employee treatment is another significant area where ethical responsibilities come into play. Airlines must ensure that their labor practices are legal but also equitable and humane. This includes providing fair wages, safe working conditions, opportunities for career advancement, and respecting workers' rights (Streimikiene et al., 2020). Airlines should also cultivate an inclusive and diverse work environment, recognizing and valuing employees' contributions from various backgrounds. Ethical responsibility ensures that all employees are treated with dignity and respect and that discriminatory practices are actively eliminated (Saleh, 2022).

6.4.4. Philanthropic Responsibilities

Philanthropic responsibilities form the top layer of the Pyramid of CSR, reflecting the voluntary activities that businesses undertake to contribute to societal well-being (Lee et al., 2019). In the aviation industry, philanthropic responsibilities involve initiatives beyond economic, legal, and ethical obligations to actively improve the quality of life for various stakeholders (Phillips, 2006).

Airlines often engage in philanthropy through charitable donations, sponsorships, and support for non-profit organizations. These contributions can take many forms, including financial support for education, healthcare, disaster relief, and cultural programs. By investing in these areas, airlines can help address societal challenges and contribute to the development and prosperity of the communities they serve. For example, some airlines have established foundations to support educational initiatives, providing scholarships and funding for schools in underserved regions (Saleh, 2022).

Community engagement is another critical aspect of philanthropic responsibility. Airlines can significantly impact local communities by supporting them through volunteer programs, partnerships with community organizations, and participation in local events. Employees often play a vital role in these efforts, volunteering their time and expertise to support various causes (Phillips, 2006). By fostering a culture of volunteerism, airlines can build strong relationships with communities and demonstrate their commitment to social responsibility.

Environmental philanthropy is particularly relevant to the aviation industry. Airlines can support ecological conservation efforts, such as reforestation projects, wildlife protection initiatives, and research into sustainable technologies. By funding and participating in these programs, airlines can help preserve natural ecosystems and promote biodiversity. Environmental philanthropy addresses the industry's ecological impact and enhances its reputation as a responsible and forward-thinking sector (Saleh, 2022).

Philanthropic initiatives can also promote social equity and inclusion. Airlines can support programs to reduce social disparities, such as initiatives to improve access to air travel for individuals with disabilities, support for minority-owned businesses, and efforts to promote gender equality within industry. These initiatives reflect a commitment to creating a more inclusive and equitable society, aligning with broader social justice goals (Phillips, 2006).

Airlines can make significant philanthropic contributions in the context of global crises. For instance, during natural disasters or humanitarian emergencies, airlines can provide critical support by transporting aid supplies, facilitating the movement of relief workers, and offering free or discounted flights to affected individuals (Saleh, 2022). These actions demonstrate solidarity and compassion, reinforcing the airline's role as a responsible corporate citizen.

By fulfilling their philanthropic responsibilities, airlines can strengthen their social license to operate, build stronger relationships with stakeholders, and contribute to society's welfare. These efforts complement CSR's economic, legal, and ethical dimensions, creating a comprehensive approach to corporate responsibility that benefits the company and its communities (Phillips, 2006).

6.5. The Triple Bottom Line Theory in Aviation

The Triple Bottom Line theory, introduced by John Elkington in the 1990s, expands the traditional framework of business success by emphasizing the importance of social and environmental performance alongside economic performance (Gupta et al., 2020). The TBL approach in the aviation industry is pivotal for sustainable development, as it requires airlines to balance profitability with social equity and environmental stewardship (Guan et al., 2022). This holistic perspective fosters long-term viability and resilience, aligning corporate goals with societal values.

6.5.1. Economic Dimension

The Triple Bottom Line theory's economic dimension is fundamental to the aviation industry's sustainability. It involves achieving financial profitability and ensuring long-term economic health and resilience. Airlines must navigate a complex landscape of high operational costs, competitive pressures, and regulatory requirements while maintaining profitability and contributing to economic development (Gupta et al., 2020).

An analysis of airlines' financial performance reveals several critical aspects that impact their sustainability efforts. Financial health is paramount, enabling airlines to invest in innovative technologies, enhance operational efficiency, and undertake sustainability initiatives. For instance, adopting fuel-efficient aircraft, implementing advanced navigation systems, and integrating renewable energy sources require substantial capital investment. Airlines with strong financial performance are better positioned to make these investments, which can lead to significant reductions in operating costs and environmental impact over time (Kuo et al., 2021).

Profitability is intricately linked to an airline's ability to manage costs and revenues effectively. Critical strategies for achieving economic sustainability include optimizing route networks, improving fuel efficiency, and improving customer service. Route optimization involves analyzing market demand and adjusting flight schedules to maximize load factors and minimize fuel consumption. This approach reduces operational costs and lowers carbon emissions per passenger-kilometer (Kuo et al., 2021).

Fuel efficiency is another critical element of economic sustainability. Since fuel costs represent a sizable portion of airline operating expenses, enhancing fuel efficiency can substantially impact profitability (Alameeri et al., 2017). Strategies to improve fuel efficiency include investing in modern, fuel-efficient aircraft, implementing fuel-saving operational practices, and using sustainable aviation fuels. Airlines like Delta and Southwest have significantly reduced fuel consumption through fleet modernization and adopting SAFs, demonstrating these investments' economic and environmental benefits (Guan et al., 2022).

Customer service excellence also plays a crucial role in economic sustainability. By providing a high-quality travel experience, airlines can strengthen customer loyalty, attract repeat business, and command premium pricing. Strategies to improve customer service include investing in staff training, upgrading in-flight amenities, and leveraging technology to streamline the passenger experience. Enhanced customer satisfaction can lead to increased revenue and a stronger competitive position in the market (Gupta et al., 2020).

Revenue diversification is another relevant strategy for economic sustainability. Airlines can explore new revenue streams beyond passenger services, such as cargo operations, ancillary services, and partnerships with other businesses. For example, the growth of e-commerce has led to increased demand for air cargo services, providing airlines with opportunities to expand their cargo operations and generate additional revenue. Ancillary services, such as premium seating, onboard sales, and loyalty programs, contribute to revenue diversification and financial stability (Lu & Wang, 2018).

Operational efficiency is vital for achieving economic sustainability. Airlines can improve efficiency by adopting advanced data analytics and digital technologies to optimize operations. Predictive maintenance, for instance, uses data analytics to identify potential aircraft maintenance issues before they become critical, reducing downtime and maintenance costs. Real-time data on weather conditions and air traffic can help pilots make informed decisions to optimize flight paths, improving fuel efficiency and reducing delays (Saleh, 2022).

6.5.2. Environmental Dimension

The Triple Bottom Line theory's environmental dimension addresses the airline industry's need to mitigate its significant environmental impacts. Aviation is a major contributor to greenhouse gas emissions, noise pollution, and resource consumption, presenting substantial challenges that require innovative solutions and dedicated efforts to achieve sustainability (Gupta et al., 2020).

The airline industry's vital environmental challenges include high carbon emissions, noise pollution, and resource-intensive operations. Carbon emissions from aviation account for a substantial share of global greenhouse gas emissions, contributing to climate change. Aircraft engines release carbon dioxide and other pollutants, such as nitrogen oxides (NOx), exacerbating the greenhouse effect and impacting air quality. The industry's passenger and cargo traffic growth further amplify these emissions, posing a significant challenge to sustainability (Guan et al., 2022).

Noise pollution is another pressing issue, particularly affecting communities near airports. Aircraft operations generate significant noise levels, disrupting residents' lives and contributing to adverse health outcomes such as stress, sleep disturbances, and cardiovascular problems. Managing noise pollution requires technological advancements in aircraft design and operational strategies to mitigate the impact on affected communities. The aviation sector consumes considerable resources, with ample fuel, materials, and water required for aircraft manufacturing, maintenance, and operations. The production and disposal of aircraft involves substantial energy use and generation of waste, necessitating more sustainable resource management practices (Orikpete et al., 2024).

To address these challenges, the airline industry has undertaken various initiatives and adopted advanced technologies to reduce its environmental impact. Sustainable aviation fuels represent a critical innovation in this effort. SAFs, derived from renewable sources such as biofuels, waste materials, and synthetic fuels, can significantly reduce lifecycle greenhouse gas emissions compared to conventional jet fuel (Seber et al., 2014). Airlines such as KLM, United Airlines, and British Airways have taken a leading role in incorporating SAFs into their operations, positioning themselves as early adopters of this alternative fuel source aimed at reducing carbon emissions. By investing in SAF infrastructure and establishing partnerships with fuel producers, airlines can reduce their carbon footprint and promote the development of a sustainable fuel supply chain (Guan et al., 2022).

Carbon offset programs are another essential initiative for mitigating environmental impact. These programs allow airlines to invest in projects that reduce or remove carbon emissions, such as reforestation, renewable energy, and energy efficiency projects (Varma, 2021).

There are several European examples of carbon offset programs. One would be KLM's CO2ZERO program. This program allows passengers to calculate and offset the carbon emissions from their flights by contributing to certified environmental projects. KLM's focus lies in sustainable reforestation and renewable energy. For instance, passengers can fund forest conservation projects in Panama, which help reduce carbon emissions while supporting local biodiversity and communities (KLM Royal Dutch Airlines, n.d.).

Another prominent example is Lufthansa Group's “Compensaid” platform. This tool enables passengers to offset the carbon footprint of their flights through various means, including funding reforestation projects like KLM and investing in SAF. With such projects, Lufthansa aims to promote carbon neutrality by offering passengers flexible options to make their flights eco-friendlier (Lufthansa Innovation Hub, n.d.).

Technological advancements in aircraft design and operations also play a pivotal role in reducing environmental impact. The development of more fuel-efficient aircraft, such as the Boeing 787 Dreamliner and the Airbus A350, incorporates advanced materials, aerodynamics, and engines that consume less fuel and emit fewer pollutants. These aircraft also feature noise-reducing technologies, helping to mitigate noise pollution around airports (Trivedi et al., 2024).

Operational improvements, such as optimized flight paths, continuous descent approaches, and single-engine taxiing, increase fuel efficiency and reduce emissions. Airlines increasingly use data analytics and real-time monitoring to optimize flight operations, minimize fuel consumption, and improve efficiency. For instance, EasyJet, a British low-cost airline, implemented advanced flight planning and fuel efficiency software to optimize routes, minimize fuel burn, and reduce emissions. This system, SkyBreathe, analyzes data from every flight to identify areas where fuel efficiency can be improved. Since its introduction, EasyJet has achieved significant fuel savings and reduced CO2 emissions (Etchebehere, 2023).

Ground operations also present opportunities for decreasing environmental impact. Airports and airlines invest in sustainable infrastructure, such as renewable energy installations, energy-efficient buildings, and electric ground support equipment. For example, London Heathrow Airport has committed to becoming carbon neutral by 2030 by installing solar panels, improving energy efficiency, and transitioning to electric vehicles for ground operations (Trivedi et al., 2024).

6.5.3. Social Dimension

The Triple Bottom Line theory's social dimension emphasizes airlines' responsibilities towards their employees, passengers, and the communities they serve. This aspect of CSR requires airlines to foster fair labor practices, ensure customer safety and satisfaction, and contribute positively to the social fabric of the communities impacted by their operations. Effective social sustainability programs and policies enhance stakeholders' well-being and build a strong, ethical, and reputable corporate culture (Guan et al., 2022).

Airlines bear significant social responsibilities towards their employees, essential to operational success. Ensuring fair labor practices is a fundamental obligation. This involves providing fair wages, safe working conditions, and opportunities for professional development. Airlines must also respect workers' rights to organize and engage in collective bargaining. By fostering a supportive and equitable workplace, airlines can contribute to employee satisfaction, reduce turnover rates, and build a motivated and loyal workforce (Gittell et al., 2015).

Lufthansa Group is a robust European example of comprehensive employee wellness programs. Lufthansa has implemented various initiatives to support the well-being of its employees, addressing physical, mental, and financial health. Their Health Management and

Occupational Safety program focuses on maintaining and improving employee health, offering psychosocial counseling, medical services, and health promotion campaigns. The company also emphasizes work-life balance through flexible working conditions, stress management resources, financial health, and financial planning workshops and support services. These measures aim to improve employees' overall job satisfaction and productivity, reflecting their commitment to fostering a supportive and healthy work environment (Lufthansa Group, n.d.).

Safety is another vital aspect of social responsibility, particularly in an industry where passenger trust is paramount. Airlines must adhere to rigid safety standards and continuously invest in safety training, equipment, and technologies. Ensuring the safety of passengers and crew requires an initiative-taking approach, including regular safety audits, rigorous maintenance protocols, and effective emergency response plans. Transparency in safety practices and open communication with passengers about safety measures are essential for maintaining trust and confidence (Streimikiene et al., 2020).

Customer satisfaction is intricately linked to safety and is vital to an airline's social responsibility. Providing high-quality service involves ensuring comfort, accessibility, and respect for all passengers. Airlines must accommodate the needs of diverse passenger groups, including those with disabilities, elderly passengers, and families with young children. Policies that promote inclusivity and accessibility, such as offering special assistance and ensuring barrier-free travel, are vital for meeting social sustainability goals.

Ryanair, for example, has been recognized for its customer-centric approach, including a range of initiatives to enhance passenger experience despite its low-cost model. These initiatives encompass offering reserved seating and extra legroom for an additional fee, introducing a customer service charter to outline their commitment to passengers, including policies on delays and compensation for service disruptions, and upgrading its in-flight experience by improving digital services like mobile boarding passes and more personalized communications, contributing to smoother journeys. Moreover, Ryanair's Always Getting Better program has aimed to enhance customer satisfaction by focusing on on-time performance, more transparent fees, and improved onboard service (Ryanair, 2018).

Airlines also have a responsibility towards the communities they serve and impact. Community engagement and investment are crucial for building positive relationships and contributing to local development. Airlines can support communities through various initiatives, such as sponsoring local events, funding educational programs, and partnering with non-profit organizations. Community-focused CSR efforts benefit local populations and enhance the airline's social license to operate (Smyth et al., 2012).

Environmental justice is an emerging area within the social dimension of CSR for airlines. This involves addressing specific communities' disproportionate ecological impacts due to airport operations and flight paths. Airlines can engage with affected communities to develop strategies that mitigate negative consequences, such as noise pollution and air quality issues. Collaborative efforts with local governments and environmental organizations can lead to more sustainable and equitable outcomes (Varma, 2021).

Corporate transparency and ethical governance are also integral to fulfilling social responsibilities. Airlines must ensure that their operations are conducted ethically and transparently, with accountability to stakeholders. This includes honest reporting of operational and financial performance, adherence to ethical business practices, and robust governance structures that prevent corruption and misconduct (Kuo et al., 2016).

6.6. Regulatory and Compliance Frameworks

The regulatory and compliance frameworks governing CSR and CER in the aviation industry ensure that airlines adhere to international standards and contribute to sustainable development. These frameworks provide guidelines, standards, and enforcement mechanisms that help align airline operations with global sustainability goals, fostering a more responsible and accountable aviation sector (Hooper & Greenall, 2005).

6.6.1. International Regulations and Standards

International regulations and standards shape airlines' CSR and CER practices. Vital regulatory bodies and agreements, such as the ICAO, the EU ETS, and the CORSIA, establish comprehensive guidelines and requirements that airlines must follow to mitigate their environmental impact and enhance social responsibility (European Commission, n.d.).

The International Civil Aviation Organization, a specialized agency of the United Nations, sets global standards for aviation safety, security, efficiency, and environmental protection. ICAO's role in environmental regulation is particularly significant, as it develops policies and practices to reduce the ecological footprint of international aviation (Scheelhaase & Maertens, 2020). One of the critical initiatives under ICAO is the introduction of the Carbon Offsetting and Reduction Scheme for International Aviation. CORSIA aims to stabilize CO2 emissions from international aviation at 2020 levels by requiring airlines to offset their emissions growth beyond these levels. This market-based mechanism compels airlines to purchase carbon offsets from verified projects, contributing to global efforts to combat climate change.

Compliance with CORSIA involves rigorous monitoring, reporting, and verification (MRV) of emissions, ensuring transparency and accountability (Scheelhaase & Maertens, 2020).

The European Union Emissions Trading System is another central regulatory framework impacting European airlines (Flachsland et al., 2020). The EU ETS is a cap-and-trade system that limits the total amount of greenhouse gases covered entities, including airlines, can emit. Within this cap, companies receive or buy emission allowances, which they can trade with one another as needed (European Commission, n.d.). The cap is reduced over time, leading to a gradual decrease in overall emissions. Airlines must monitor and report their CO2 emissions and surrender enough allowances to cover them yearly. Failure to comply with EU ETS requirements can result in substantial fines and other penalties, making airlines need to adopt effective emissions management strategies (Fox & Martín-Domingo, 2020).

In addition to ICAO and EU ETS, other international standards and guidelines influence CSR and CER in aviation. The GRI provides a widely recognized framework for sustainability reporting, enabling airlines to disclose their environmental, social, and governance performance standardized and transparently. The GRI Standards help airlines communicate their sustainability efforts to stakeholders, enhancing transparency and accountability (Halkos & Nomikos, 2021).

Compliance with these international regulations and standards involves demanding requirements and robust enforcement mechanisms. Airlines must establish comprehensive environmental management systems to meet regulatory obligations and improve environmental performance. These systems typically include detailed procedures for monitoring and managing emissions, waste, and resource use, as well as mechanisms for regular auditing and reporting (Santos-Reyes & Lawlor-Wright, 2001).

Regulatory bodies enforce compliance through various mechanisms, including audits, inspections, and penalties for non-compliance. For instance, under CORSIA, airlines are subject to regular MRV audits to verify the accuracy of their emissions reporting. Similarly, the EU ETS involves rigorous monitoring and verification processes, with penalties imposed on airlines that fail to surrender sufficient allowances to cover their emissions (Fox & Martín-Domingo, 2020).

Moreover, international collaborations and partnerships are essential for strengthening compliance and enforcement. Regulatory bodies, industry associations, and airlines often work together to develop the best practices, share knowledge, and enhance capacity-building efforts. Initiatives such as the International Air Transport Association's Environmental

Assessment (IEnvA) program provide airlines with frameworks and tools to achieve and maintain high environmental standards, facilitating compliance with international regulations (Blišťanová & Tirpáková, 2021).

In 2001, the first edition of the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard was published as the primary framework for companies to report their greenhouse gas emissions and provide guidance on reducing them (The Greenhouse Protocol, n.d.). The standard classifies emissions into three categories, or "scopes," based on the different sources of carbon emissions that companies create through their operations and across their wider value chain. According to this standard, Scope 1 emissions encompass all direct emissions a company generates from its owned or controlled sources, such as CO2 output during flights (Greenhouse Gas Protocol, n.d.). On the contrary, Scope 2 covers all emissions indirectly from generating acquired and consumed electricity (GHG Protocol Scope 2 Guidance, n.d.). They are considered indirect because they are owned or controlled by another organization (electricity generator), even though they are the consequence of the company's activities. Scope 3 emissions, also categorized as indirect, are produced by the company's partners along the value chain, such as suppliers, and include both upstream and downstream emissions (Greenhouse Gas Protocol, n.d.).
Scope 1 and 2 emissions are primarily within a company's direct control and are more straightforward to improve. However, Scope 3 emissions are usually the most significant for many businesses, as they account for the most considerable portion of their carbon footprint (Greenhouse Gas Protocol, n.d.). Despite their importance, these emissions are challenging to address, as they stem from external partners in the value chain, leaving companies with limited direct influence over their most significant environmental impact.

6.6.2. National and Regional Regulations

National and regional regulations play a significant role in shaping the airlines' CSR and CER practices. These regulations vary significantly across substantial markets, such as the European Union, the United States (US), and Asia, reflecting differing priorities, economic conditions, and political landscapes. Understanding these specific regulations and their impact on airline operations is essential for navigating the complexities of the global aviation industry.

The European Union's regulatory framework for aviation is comprehensive and rigorous, reflecting the EU's strong commitment to environmental protection and sustainability. In addition to the EU ETS, which applies to all flights within the European Economic Area, the EU has implemented various other environmental regulations (Fox & Martín-Domingo, 2020). These include directives on noise pollution, waste management, and air quality. For instance, the EU’s noise directive sets strict limits on airport noise, requiring airports and airlines to adopt noise reduction measures and engage with affected communities. Compliance with these regulations often necessitates significant investments in technology and operational changes, influencing airline strategies and financial planning (European Parliament & Council of the European Union, 2002).

The EU also emphasizes consumer protection through regulations such as Regulation No 261/2004 (Fox & Martín-Domingo, 2020), which establishes standard rules on compensation and assistance to passengers in denied boarding, cancellations, or prolonged delays. This regulation mandates that airlines provide compensation, re-routing, and care (such as meals and accommodation) to affected passengers, ensuring high customer service and accountability standards. The stringent enforcement of these consumer protection laws requires airlines to maintain robust customer service policies and contingency plans (Fox & Martín-Domingo, 2020).

In the United States, the regulatory environment for aviation is governed primarily by the Federal Aviation Administration and the Environmental Protection Agency (EPA). The FAA enforces safety and operational standards, while the EPA regulates environmental impacts, including aircraft emissions and noise. The US has implemented the Aircraft Emissions Rule, which sets standards for aircraft engines' pollutants such as nitrogen oxides and particulate matter (PM). These regulations align with international standards set by the ICAO but are tailored to the US's specific environmental and economic conditions (Shanks, 2017).

The US also places significant emphasis on consumer rights and protection. The Department of Transportation (DOT) enforces regulations that require airlines to disclose total fare prices, including all mandatory fees, at the time of booking (Edelman, 2021). Additionally, the DOT mandates compensation for passengers in cases of overbooking and tarmac delays. Airlines operating in the US must navigate these consumer protection laws while ensuring compliance with environmental and safety regulations and balancing operational efficiency with regulatory requirements (Edelman, 2021).

In Asia, regulatory frameworks for aviation vary widely across countries, reflecting diverse economic and environmental priorities. In major markets such as China, Japan, and India, governments have introduced regulations aimed at reducing the environmental impact of aviation and enhancing safety and consumer protection. For example, China’s Civil Aviation Administration (CAAC) has implemented measures to reduce carbon emissions and promote SAFs. The CAAC’s Green Airport initiative encourages airports to adopt environmentally friendly practices, such as energy-efficient infrastructure and waste reduction programs (He & Sun, 2023).

Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) enforces strict noise and emissions standards for aircraft, which are in line with ICAO guidelines. Japanese airlines must also adhere to rigorous safety standards and provide comprehensive customer service, including compensation for delays and cancellations. The emphasis on high-quality service and environmental sustainability is reflected in the operational practices of major Japanese airlines, such as All Nippon Airways (ANA) and Japan Airlines (JAL) (Kito et al., 2020).

In India, the Directorate General of Civil Aviation (DGCA) oversees the regulation of aviation safety, environmental impact, and consumer rights. India has introduced policies to promote the use of biofuels in aviation, aiming to reduce dependence on fossil fuels and mitigate carbon emissions. The DGCA also enforces noise regulations and standards for air quality around airports, requiring airlines to adopt measures to minimize their environmental footprint (Dwivedi, 2023).

The impact of these regional regulatory frameworks on airline operations is significant. Compliance with diverse and often rigorous regulations requires airlines to adopt flexible and adaptive strategies. For example, airlines operating in multiple regions must ensure their fleet and operational practices meet the highest standards across different regulatory environments. This may involve investing in more fuel-efficient aircraft, adopting advanced noise reduction technologies, and implementing comprehensive environmental management systems (U.S. Department of Transportation, n.d.).

Complying with varying consumer protection laws necessitates robust customer service policies and effective communication strategies. Airlines must be prepared to handle compensation claims, provide timely information to passengers, and maintain high service quality standards. This requires investment in staff training, customer service infrastructure, and technology to manage customer interactions efficiently (U.S. Department of Transportation, n.d.).

6.6.3. Voluntary Standards and Certifications

Voluntary standards and certifications play a significant role in promoting environmental responsibility within the aviation industry. These frameworks provide airlines with structured methodologies to improve their sustainability efforts, achieve operational excellence, and demonstrate their commitment to environmental stewardship. Among the most prominent voluntary standards are ISO 14001 for environmental management systems and Leadership in Energy and Environmental Design for sustainable building operations (Brem et al., 2020).

ISO 14001 is an internationally recognized environmental management system standard. It provides a systematic approach for organizations, including airlines, to identify and manage their environmental impacts. The ISO 14001 certification process involves several key steps, beginning with an initial environmental review to assess current practices and identify areas for improvement. Based on this review, airlines develop an environmental policy and objectives, implement procedures to achieve these goals, and establish metrics to monitor performance. Regular internal audits and management reviews ensure continuous improvement and compliance with the standard's requirements (Brem et al., 2020).

The benefits of ISO 14001 certification for airlines are manifold. Firstly, it enhances regulatory compliance by providing a structured framework for meeting environmental regulations. This proactive approach helps airlines avoid potential fines and legal issues associated with non-compliance. Secondly, ISO 14001 certification can save significant costs by improving resource efficiency and reducing waste. For example, implementing more efficient fuel management practices can lower fuel consumption, which is a substantial operational cost for airlines. Additionally, certification can improve an airline's reputation, demonstrating to stakeholders - including customers, investors, and regulatory bodies - that the airline is committed to environmental sustainability (Balzarova & Castka, 2008).

The Leadership in Energy and Environmental Design certification, administered by the U.S. Green Building Council (USGBC), is another critical voluntary standard relevant to the aviation industry, particularly for airport infrastructure and airline facilities. LEED certification assesses the sustainability of building projects based on criteria such as energy efficiency, water use, indoor environmental quality, and materials selection. Airports and airline facilities that achieve LEED certification benefit from reduced operational costs, improved indoor air quality, and enhanced occupant comfort (Brem et al., 2020).

For airlines, the adoption of LEED-certified buildings and facilities offers numerous advantages. Environmentally sustainable buildings consume less energy and water, lowering utility costs. Additionally, they provide healthier and more comfortable environments for employees and passengers, which can improve productivity and customer satisfaction. LEED certification enhances an airline's brand image, signaling a solid commitment to environmental responsibility and sustainable development (Hsu & Chiu, 2013).

Beyond ISO 14001 and LEED, other voluntary standards and certifications significantly promote environmental responsibility in aviation. The GRI provides a comprehensive framework for sustainability reporting, enabling airlines to disclose their environmental, social, and governance performance transparently and standardized (Hoffmann, 2011). GRI standards guide airlines in reporting on key sustainability metrics, such as carbon emissions, resource use, and social impacts, fostering accountability and stakeholder trust.

The International Air Transport Association offers the Environmental Assessment program, a voluntary environmental management system tailored explicitly for airlines. IEnvA provides a structured approach for airlines to improve their environmental performance, covering emissions reduction, waste management, and biodiversity protection. The program includes an independent assessment and certification process, ensuring that participating airlines meet high environmental standards (Blišťanová & Tirpáková, 2021).

Certification under programs like IEnvA gives airlines a competitive advantage, demonstrating leadership in environmental sustainability. It also facilitates benchmarking and continuous improvement, as airlines can compare their performance against industry with best practices and identify areas for further enhancement. Moreover, IEnvA certification can strengthen relationships with stakeholders, including customers, employees, and regulators, who increasingly prioritize sustainability in their decision-making processes (Blišťanová & Tirpáková, 2021).

Adopting voluntary standards and achieving certifications requires significant commitment and resources. Airlines must invest in training, process improvements, and new technologies to meet the rigorous requirements of these standards. However, the long-term benefits—such as improved regulatory compliance, operational efficiencies, cost savings, and better stakeholder relations—far outweigh the initial investments (Feige & Pforte, 2017).

6.7. Stakeholder Engagement and Reporting

Stakeholder engagement and reporting are integral to CSR and CER in the aviation industry. Effective engagement with stakeholders ensures that airlines can address their concerns, incorporate diverse perspectives, and build trust. Transparent and accountable reporting practices further demonstrate an airline's commitment to sustainability, fostering credibility and accountability (Gangi et al., 2022).

Identifying and engaging with key stakeholders is vital for airlines striving to improve their CSR and CER initiatives. Airlines' stakeholders include passengers, employees, investors, regulatory bodies, local communities, suppliers, and environmental organizations. Each group has distinct interests and concerns, so airlines must tailor their engagement strategies accordingly (Ringham & Miles, 2018).

Passengers are the most visible stakeholders, whose satisfaction and safety are paramount. Engaging with passengers involves soliciting feedback on service quality, safety measures, and environmental initiatives. Airlines can use surveys, focus groups, and social media platforms to gather insights and address passenger concerns promptly. Effective communication about sustainability efforts, such as carbon offset programs and eco-friendly practices, can increase passenger trust and loyalty (Davison et al., 2014).

Employees are another critical stakeholder group, as their well-being and engagement directly impact an airline's performance. Strategies for engaging employees include regular communication, transparent management practices, and opportunities for professional development. Airlines can foster a culture of sustainability by involving employees in environmental initiatives and providing training on sustainable practices. Employee feedback mechanisms, such as suggestion boxes and internal surveys, can also help identify areas for improvement and innovation (Gangi et al., 2022).

Investors and shareholders are increasingly focused on ESG criteria when making investment decisions. Airlines must engage with investors through regular financial reporting, sustainability disclosures, and investor meetings. Clear communication about CSR and CER strategies, progress, and future goals is essential to maintain investor confidence and attract responsible investment (Ringham & Miles, 2018).

Regulatory bodies like the ICAO and national aviation authorities require airlines to comply with various regulations and standards. Effective engagement with regulators involves proactive communication, participation in industry forums, and collaboration on policy development. By working closely with regulatory bodies, airlines can ensure compliance and shape future regulations supporting sustainable aviation (Gangi et al., 2022).

Local communities around airports are directly affected by airline operations, particularly in terms of noise pollution and air quality. Engaging with these communities involves regular dialogue, impact assessments, and community development initiatives. Airlines can establish community advisory boards, conduct public consultations, and support local projects to address community concerns and build positive relationships (Heyes et al., 2021). Environmental organizations and advocacy groups are vital in promoting sustainable practices and holding airlines accountable. Collaborating with these groups can provide valuable insights and elevate an airline's environmental initiatives. Airlines can participate in joint projects, share data and research, and support conservation efforts to demonstrate their commitment to environmental responsibility (Heyes et al., 2021).

The SASB offers another valuable framework, focusing on information on financial material sustainability. SASB standards are industry-specific and provide relevant metrics to investors, helping airlines communicate how sustainability issues impact financial performance. For example, SASB standards for the airline industry include metrics on fuel efficiency, greenhouse gas emissions, and noise pollution, which are critical for assessing environmental performance (Waheed & Zhang, 2022).

The TCFD provides guidelines for reporting climate-related financial risks and opportunities. TCFD recommendations emphasize the importance of transparency in governance, strategy, risk management, and metrics related to climate change. Airlines can use TCFD guidelines to disclose how climate risks, such as regulatory changes and physical impacts, affect their financial performance and strategic planning (Waheed & Zhang, 2022).

Involving stakeholders in the reporting process can improve the relevance and impact of CSR reports. Airlines can seek input from key stakeholder groups, such as passengers, employees, and investors, to identify priority issues and ensure the reported information addresses their concerns. Engaging stakeholders in materiality assessments and determining the most significant sustainability issues can help airlines focus their reporting on areas that matter most to their audience (Manetti & Toccafondi, 2011).

7. Future Directions and Innovations in CSR and CER

As the aviation industry continues to evolve, so do the approaches to Corporate Social Responsibility and Corporate Environmental Responsibility. Future directions and innovations in these areas are essential for tackling the ongoing and emerging challenges related to sustainability. By anticipating trends and implementing cutting-edge practices, airlines can improve their environmental and social performance, securing long-term viability and positive societal impact.

7.1. Emerging Trends in Sustainability

Current and emerging trends in CSR and CER within the aviation industry reflect a growing emphasis on comprehensive sustainability strategies and the adoption of innovative technologies. These trends are shaping the future of aviation, driving significant changes in how airlines operate and engage with stakeholders (Zhang et al., 2020).

One of the most prominent trends is the increasing focus on carbon neutrality and net-zero emissions targets. Airlines commit to ambitious goals to reduce their carbon footprints, often aligning with international agreements such as the Paris Agreement. This agreement details an international treaty adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), aiming to limit global warming to below 2 degrees Celsius above pre-industrial levels, with efforts to limit the temperature increase to 1,5 degrees Celsius (United Nations, 2015). This shift drives investments in sustainable aviation fuels, which offer significant reductions in lifecycle greenhouse gas emissions compared to conventional jet fuels. Airlines like the Lufthansa Group, KLM, and British Airways are leading the way in incorporating SAFs into their operations, setting the stage for broader industry adoption (Zhang et al., 2020).

Electrification of aviation is another critical trend. While electric aircraft are currently limited to short-haul routes due to battery technology constraints, advancements in this area hold promise for substantial reductions in aviation emissions. Companies like Airbus and Boeing and startups like Eviation and Ampaire are developing electric and hybrid-electric aircraft. These innovations could revolutionize regional air travel, providing a zero-emission alternative to traditional jet-powered flights (Avogadro & Redondi, 2024).

In addition to electrification, hydrogen propulsion is emerging as a potential game-changer for industry. Hydrogen-powered aircraft, which produce water as their only byproduct, could offer a viable solution for reducing aviation's environmental impact. Airbus's ZEROe initiative aims to develop hydrogen-powered commercial aircraft by 2035, highlighting the industry's commitment to exploring diverse technological pathways for sustainability (Zieb & Johansson, 2022).

Integrating digital technologies and data analytics transforms how airlines manage their environmental responsibilities. Advanced data analytics enable airlines to optimize flight paths, improve fuel efficiency, and reduce emissions. Real-time monitoring systems provide actionable insights into operational performance, allowing for proactive adjustments that boost sustainability. For example, predictive maintenance systems use data analytics to identify potential issues before they become critical, reducing aircraft downtime and improving operational efficiency (Weerasinghe & Ahangama, 2018).

Circular economy principles are gaining traction in the aviation industry as airlines seek to minimize waste and maximize resource efficiency. This approach involves rethinking the entire aircraft lifecycle, from design and manufacturing to maintenance and end-of-life disposal. Airlines are increasingly adopting practices such as using recycled materials, implementing efficient waste management systems, and designing aircraft components for easy disassembly and recycling. These efforts contribute to a more sustainable industry by reducing resource consumption and environmental impact (Modarress et al., 2020).

Social sustainability is also becoming a focal point for airlines. There is a growing recognition of the need to address social issues such as labor rights, diversity and inclusion, and community engagement. Airlines are implementing policies and programs that promote fair labor practices, support employee well-being, and foster inclusive workplaces. Initiatives such as diversity training, mental health support, and community outreach programs are integral to building a socially responsible corporate culture (Zieb & Johansson, 2022).

The rise of environmental, social, and governance investing influences how airlines approach sustainability. Investors increasingly prioritize companies with strong ESG performance, driving airlines to enhance their sustainability practices and reporting. This trend encourages greater transparency and accountability as airlines seek to attract and retain investment by demonstrating their commitment to sustainability (Zhang et al., 2020).

Advancing sustainability in aviation heavily relies on collaborative efforts and industry partnerships. Airlines work with governments, research institutions, and technology providers to develop and implement innovative solutions. Initiatives such as the Clean Sky Joint Undertaking in Europe and the FAA's Continuous Lower Energy, Emissions, and Noise (CLEEN) program in the US exemplify how cooperative efforts can drive technological advancements and reduce environmental impact (Zhang et al., 2020).

Looking ahead, the future of CSR and CER in aviation will likely be shaped by continued technological advancements, evolving regulatory frameworks, and increasing stakeholder expectations. Airlines will need to remain agile and proactive, embracing innovation and collaboration to navigate the complexities of sustainability. By staying at the forefront of emerging trends and adopting best practices, airlines can ensure their operations are economically viable, environmentally, and socially responsible.

7.2. Technological Innovations

Technological innovations are leading the way in advancing sustainability efforts within the aviation industry. These advancements, from the development of electric aircraft to the use of advanced biofuels, are instrumental in reducing the environmental footprint of air travel. By investing in and adopting these technologies, airlines can significantly mitigate their environmental impact while maintaining operational efficiency and profitability (Schwab et al., 2021).

Electric aircraft represent a groundbreaking advancement in aviation technology. Electric propulsion systems offer the potential for zero-emission flights, particularly for short-haul routes. Companies like Eviation and Ampaire are pioneering electric aircraft development, with Eviation's Alice and Ampaire's hybrid-electric EEL aircraft leading the charge. These aircraft are designed to operate on regional routes, providing a sustainable alternative to traditional jet-powered planes. Implementing electric aircraft could drastically reduce carbon emissions and noise pollution, creating a cleaner and quieter aviation industry (Schwab et al., 2021).

Airlines like KLM, United Airlines, and British Airways have been the leaders in SAFs adoption, integrating these fuels into their operations to reduce their carbon footprint. For example, KLM has been operating flights using SAFs produced from used cooking oil, demonstrating these fuels' feasibility and environmental benefits (Shahriar & Khanal, 2022).

The development and deployment of these pioneering technologies require substantial investment and collaboration. For instance, the European Union's Clean Sky Joint Undertaking is a public-private partnership that aims to accelerate the development of innovative, environmentally friendly aviation technologies. Projects under Clean Sky include the development of more efficient aircraft engines, lightweight materials, and advanced aerodynamics, all of which contribute to reduced fuel consumption and emissions (Lohmann & Pereira, 2020).

Another notable example is the FAA's Continuous Lower Energy, Emissions, and Noise program in the United States. The CLEEN program partners with airlines, manufacturers, and research institutions to develop and implement technologies that improve aircraft fuel efficiency, reduce emissions, and decrease noise pollution (Zhang et al., 2020). The aviation industry can leverage technological advancements through initiatives like these to achieve significant environmental improvements.

7.3. Policy and Industry Collaboration

Collaborative efforts between airlines, governments, and non-governmental organizations are necessary to intensify sustainability in the aviation industry. These partnerships facilitate developing and implementing policies and initiatives that drive environmental and social responsibility.

An example of policy and industry collaboration is CORSIA, which ICAO established. CORSIA aims to cap CO2 emissions from international aviation at 2020 levels, requiring airlines to offset emissions exceeding this baseline by investing in carbon reduction projects. This initiative highlights the cooperative efforts of governments, airlines, and environmental organizations to address the aviation industry's impact on climate change (Scheelhaase & Maertens, 2020).

The European Union Emissions Trading System (EU ETS) is another example of effective collaboration. The EU ETS caps the total amount of greenhouse gases covered sectors, including aviation, can emit. Airlines operating within the EU must hold sufficient allowances to cover their emissions, with the cap being reduced over time to drive emission reductions. This system encourages airlines to adopt more efficient technologies and practices, fostering a competitive yet sustainable industry environment (Bayer & Aklin, 2020).

In addition to regulatory frameworks, industry collaborations have led to the establishment of initiatives such as the Sustainable Aviation Fuel Users Group (SAFUG). SAFUG is a coalition of airlines committed to accelerating the development and commercialization of sustainable aviation fuels. Members of SAFUG, including major airlines like Lufthansa, Qantas, and Cathay Pacific, work together to share best practices, invest in SAF production facilities, and advocate for supportive policies. This collaborative approach helps overcome the challenges of adopting SAFs, such as supply chain limitations and cost barriers (Hari et al., 2014).

Public-private partnerships also play a vital role in advancing sustainability. The Clean Sky Joint Undertaking in Europe is a prime example of bringing together the European Commission and the aviation industry to co-fund research and innovation projects to reduce aviation's environmental impact. Projects under Clean Sky have led to the development of more efficient engines, lighter materials, and improved aerodynamics, all of which contribute to lower fuel consumption and emissions (Pecora, 2021).

Furthermore, collaborations with NGOs and environmental organizations are vital for achieving sustainability goals. NGOs provide valuable expertise, advocacy, and public accountability, helping to ensure that industry practices align with broader environmental and social objectives. For example, the IATA and the Air Transport Action Group (ATAG) partnership has led to the development of the Aviation Environmental Roadmap, which outlines the industry’s commitments to reducing emissions, improving fuel efficiency, and enhancing sustainability reporting (Mousavi & Bossink, 2020).

To summarize, technological innovations and policy collaborations are vital drivers of sustainability in the aviation industry. The development and adoption of electric aircraft, advanced biofuels, and other cutting-edge technologies, coupled with collaborative efforts between airlines, governments, and NGOs, are essential for achieving long-term environmental and social goals. By embracing innovation and partnership, the aviation industry can navigate sustainability challenges and contribute to a more sustainable future for air travel.

8. Methodology

Although substantial research exists on Corporate Environmental and Social Responsibility within the aviation industry, there is still a need for further investigation regarding the latest gaps focusing on greenwashing in Europe. Identifying gaps in current literature is essential for a comprehensive understanding of CER and for developing a path toward more effective, sustainable strategies. This section primarily evaluates greenwashing and addresses critical gaps, such as sustainability practices, measuring and reporting environmental impacts, the evolving role of technology and innovation, and stakeholder engagement.

One notable gap in the literature concerns how airlines integrate sustainability practices throughout their operations and whether their reports exhibit signs of greenwashing. Existing literature often highlights specific initiatives, such as fleet renewal and adopting SAFs. Research is needed on how these practices are incorporated into strategies of airlines' overall business (Afonso et al., 2023). A deeper understanding of these integrations is essential for assessing the authenticity of airlines' environmental claims.

Accurate measurement and reporting of environmental impacts are critical for evaluating the effectiveness of CER initiatives (Dragomir, 2018). Although technological advancements, such as fuel-efficient aircraft and SAFs, are widely researched, more must be done to explore the broader innovation ecosystem supporting sustainability in aviation (Kim et al., 2019). This gap needs to be addressed to fully understand how emerging technologies contribute to long-term environmental goals in the sector.

Greenwashing, or the practice of making misleading claims about a company's environmental performance, remains a significant issue in aviation. Despite increased awareness, research on the prevalence of greenwashing, methods for detecting it, and its impact on stakeholder trust are still limited. Understanding this issue is crucial for enhancing transparency and credibility within the industry (Neureiter et al., 2024).

The next section of this thesis will examine these intersections, providing deeper insights into CER and greenwashing in the aviation sector.

9. Methodological approach

The present thesis is an empirical explorative study in which research is to be carried out to investigate which correlations can be drawn regarding Corporate Environmental Responsibility in the aviation industry. More precisely, greenwashing will be addressed. After extensive literature research in both German and English language, the current state of research will be presented. In this course, numerous library holdings and information available online from books and articles were studied. According to Döring, this study takes an inductive approach, as is usual for qualitative content analysis, as there is no need to collect data from investigators, and one can concentrate more on the data analysis itself (Döring, 2023).

This interpretative evaluation of documents is based on a rather inductive systematic process of coding because the material is segmented into small units of analysis, and the individual text passages are then assigned codes or categories that attribute meanings to the respective text passage. However, it should be noted that some aspects that would be relevant to the research may not be available (Döring, 2023). This methodology was chosen for its ability to provide an in-depth understanding of the selected airlines' sustainability practices and initiatives, focusing on qualitative insights and quantitative data extracted from their sustainability reports.

Qualitative content analysis aims to determine the meaning of documents based on a research problem utilizing data-driven step-by-step coding (Döring, 2023). An investigation was carried out using nine sustainability reports, whereby one company was excluded due to insufficient information from Europe's commonly known airline companies to gain an overview of the effects of greenwashing in the aviation industry. The authors freely chose the companies and combined financially stronger companies known as full-service carriers with well-known low-cost airlines on the market. The final decision includes the following companies: AirBaltic, SAS, Iberia, TAP Air Portugal, Air France-KLM, Lufthansa Group, Wizz Air, and Ryanair. For this purpose, studies were conducted according to familiarity with and relevance to the European market. Due to the lack of a basis for specialist literature regarding this topic in the European Union, the theoretical foundations need to be substantiated and expanded.

The qualitative approach is particularly suitable for inductive studies, as this way, a comprehensive and detailed analysis of the information published is possible, and at the same time, space is created for unexpected information due to comparison and thorough checking of reports. This way, the research questions relating to the report facts can be examined from various perspectives and analyzed (Döring, 2023). To enable the investigation, the reports were first accessed online and downloaded. Reports from the past two financial years were considered to ensure the material and topic were current. After looking through both years, the documents from one year were examined more closely and consulted for investigation.

More precisely, it is a genuine document analysis that draws on existing documents generated independently of the research process. These are documenting whose meanings will be reconstructed primarily through an interpretative-qualitative data analysis. In addition to other data collection methods, document analysis, as in this thesis, represents a further independent group of methods for obtaining and evaluating empirical data. In a genuine document analysis, existing documents are produced entirely independently of the research process. At this point, it must be said that the papers found differ in a way that research activities do not influence them, which is why it is also called a non-reactive method (Döring, 2023).

Summarizing qualitative content analysis aims to reduce extensive qualitative documents or data material step by step inductively to manifest main contents. It corresponds to the conventional qualitative content analysis (Hsieh & Shannon, 2005). This is done in four steps.

First is paraphrasing, where content-carrying text passages are identified, and each is reformulated into a short form (paraphrase). The second would be a generalization of the level of abstraction. The paraphrases are all brought to the same, previously defined level of abstraction. The third step describes the first reduction, where the relevant paraphrases are selected by deleting paraphrases that have the same meaning or are unimportant. In the fourth step, there is a second reduction. This means the remaining paraphrases are bundled and integrated on a case-by-case basis, resulting in new and more complex paraphrases that summarize the main content of the case (Döring, 2023).

10. Brief Company Profiles

AirBaltic Corporation AS, commonly known as airBaltic, is the flag carrier of Latvia and operates as a hybrid airline, combining the principles of traditional and low-cost carriers. Founded in 1995, the airline has grown significantly, establishing itself as a leading carrier in the Baltic region (airBaltic, n.d.). AirBaltic's sustainability initiatives are critical to its corporate strategy, reflecting its commitment to reducing environmental impact and promoting sustainable aviation. AirBaltic's sustainability strategy is built around several key pillars: fleet modernization, sustainable aviation fuel adoption, CO2 emissions reduction, waste management, and stakeholder engagement (airBaltic, n.d.). Moreover, they focus on improving ground operations by enriching the ground fleet with electric cars. These initiatives are documented in their sustainability reports, providing a comprehensive overview of their environmental performance and future goals. The company's top management monitors them and fully implements the strategy.

Scandinavian Airlines System (**SAS**) is the flag carrier of Denmark, Norway, and Sweden and is one of the largest airlines in the Nordic countries (SAS, n.d.). Established in 1946, SAS has a long history of innovation and commitment to sustainable aviation. The airline's sustainability initiatives are central to its corporate strategy, emphasizing reducing environmental impact through various measures, including fleet renewal, adopting sustainable aviation fuels, and comprehensive stakeholder engagement. SAS's sustainability strategy focuses on net-zero CO2 emissions by 2050 (SAS, n.d.). This ambitious goal is supported by several key initiatives, such as investing in new, fuel-efficient aircraft, increasing the use of SAFs, optimizing flight operations, and engaging stakeholders to promote sustainability (SAS, n.d.).

Finnair, Finland's flag carrier and largest airline, was established in 1923 and has grown to become one of the world's oldest operating airlines (Finnair, n.d.). During preparation, the decision was made to leave these reports out and not process them because they presented information inadequately. Including these reports would not provide enough insightful information and could distort the results.

Iberia, Spain's flag carrier, has been a significant player in the aviation industry for 95 years. Known for its commitment to sustainability, Iberia integrates environmental responsibility into its operations. The airline's sustainability initiatives focus on reducing carbon emissions, enhancing fuel efficiency, improving waste management, and engaging stakeholders in ecological stewardship (Iberia, n.d.).

TAP Air Portugal (TAP), Portugal's flag carrier, was founded in 1945 and has since become a leading airline in Europe (TAP, n.d.). Known for its extensive network connecting Europe, Africa, and the Americas, TAP Air Portugal has made sustainability a core part of its corporate strategy. TAP’s approach to sustainability is based on a holistic management model, integrating environmental, social, and financial resilience considerations across its value chain. The airline's sustainability initiatives focus on reducing carbon emissions, enhancing fuel efficiency, adopting sustainable aviation fuels, and engaging stakeholders (TAP, n.d.). Moreover, an integral part of their strategy is the efficient management of resources and the reduction, recycling, reuse, and upcycling of materials and items (TAP, n.d.).

Air France-KLM, formed by the merger of KLM Royal Dutch Airlines and Air France in 2004, is one of the world's largest airline groups (KLM, n.d.). Known for its extensive global network, the group is also recognized for its commitment to sustainability. Air France-KLM's sustainability strategy focuses on reducing carbon emissions, improving fuel efficiency, and engaging in innovative environmental initiatives to promote sustainable aviation (KLM, n.d.). KLM advanced its sustainability goals through fleet renewal, investment in sustainable aviation fuels, operational improvements, and partnerships within the industry.

The **Lufthansa Group** is one of the world's leading airline groups, including several European airlines such as Lufthansa, SWISS, Austrian Airlines, Brussels Airlines, and Eurowings (Lufthansa Group, n.d.). In 2023, the Lufthansa Group flew over 123 million guests, reflecting a solid recovery and high demand for air travel. The group aims to sustainably connect people, cultures, and economies, striving to lead the aviation industry in customer friendliness and environmental responsibility (Lufthansa Group, n.d.). The Group continually strengthens its ecological efforts, supports social initiatives, and treats employees, markets, and value chain partners somewhat accountable (Lufthansa Group, n.d.).

Wizz Air, the fastest-growing ultra-low-cost carrier in Europe, connects 194 destinations across 50 countries (Wizz Air, n.d.). Renowned for its low fares and sustainability efforts, Wizz Air aims to provide affordable and environmentally responsible air travel. The company is listed on the London Stock Exchange under the ticker WIZZ and is committed to lowering its carbon footprint while maintaining rapid growth and expansion (Wizz Air, n.d.). The airline strives to be the greenest choice for air travel by continuously decreasing its environmental footprint (Wizz Air, n.d.). They aim to achieve this goal by investing in fleet renewal and SAFs, increasing operational efficiency, and modernizing air traffic management. Wizz Air’s sustainability governance is led by its Board of Directors and internal governance structure. Oversight is provided by the CEO, Board Chairman, and the Sustainability and Culture

Committee, which monitors and guides the execution of the sustainability strategy and critical projects (Wizz Air, n.d.).

Ryanair, Europe’s largest low-cost airline, operates a fleet of over 500 aircraft and serves more than 225 million passengers annually (Ryanair, n.d.). Ryanair is well known for its aggressive cost-cutting measures and high efficiency, allowing it to become a dominant player in European aviation. The airline has set ambitious sustainability goals to achieve net-zero emissions by 2050 and is committed to reducing its environmental impact (Ryanair, n.d.). An integral part of their sustainability strategy is fleet renewal, improvement of ground operations, fair partnerships across the value chain, adoption of SAFs, and reform of air traffic management (Ryanair, n.d.).

11. Data Preparation and Evaluation

The following section will show how the data from the reports was processed and analyzed. The analysis aims to distinguish between substantive actions and potential greenwashing, providing a comprehensive understanding of the current state of CER in the aviation industry.

11.1. Data Preparation

A significant task in processing qualitative data concerns the creation of structured data sets from the often extensive and heterogeneous qualitative raw data material (LeCompte, 2000). After thoroughly selecting and downloading the necessary data, these were saved in a separate folder, named according to company and date, and separated from each other to avoid confusion regarding the year of publication or company. The appropriate program was also selected and procured in advance during data preparation. In the case of this study, the MAXQDA program was chosen, into which the processed data was imported. The MAXQDA file thus contained all sections of the relevant sustainability reports.

11.2. Data evaluation

The qualitative content analysis is carried out according to Mayring's process model. This consists of several steps presented, explained, and illustrated schematically using a figure. Qualitative content analysis proceeds strictly rule-based rather than creating free interpretations. It follows a procedural model compiled for the respective analysis and is based on the primary forms of content analysis. By breaking down the individual, previously defined interpretation steps of the analysis to such an extent that they are intersubjectively verifiable, they can be presented as a scientific method (Mayring, 2015).

Qualitative content analysis, according to Mayring, consists of the following steps.

Defining the research question and objectives

The process starts with clearly defining the research question or objective. This helps to focus on the analysis, guides the process, and ensures that the subsequent steps are aligned with the research goals (Mayring, 2015).

Selection of Material and Content for Analysis

This step involves Identifying and selecting the textual material to be analyzed. This work includes the companies' sustainability reports chosen for 2023.

Formulating categories and developing a coding frame

Establishing categories that reflect the research question and the material's content is fundamental. Categories can be deductively derived from theoretical frameworks (top-down approach). This means the categories are defined before examining the data because they are based on pre-existing theories or concepts. When the data forms categories during the coding process, this is called inductive coding (bottom-up approach). By creating sub-categories and definitions within the main categories, it is possible to capture more specific aspects of the data. One should provide clear definitions and coding rules for each category and subcategory to ensure consistency (Mayring, 2015).

Data Preparation

When preparing data, it is essential to ensure that all data required for the coding process has been uploaded and processed. The documents must be scanned, uploaded, and saved securely with the appropriate subject line (Mayring, 2015).

Initial Reading and Familiarization

This step is essential to getting an overall sense of the chosen data. It helps to understand the context and identify initial themes or patterns (Mayring, 2015). Each report was reviewed to understand its structure, key themes, and content. This initial review helped the researchers familiarize themselves with the layout and identify relevant sections for detailed analysis.

Coding Data

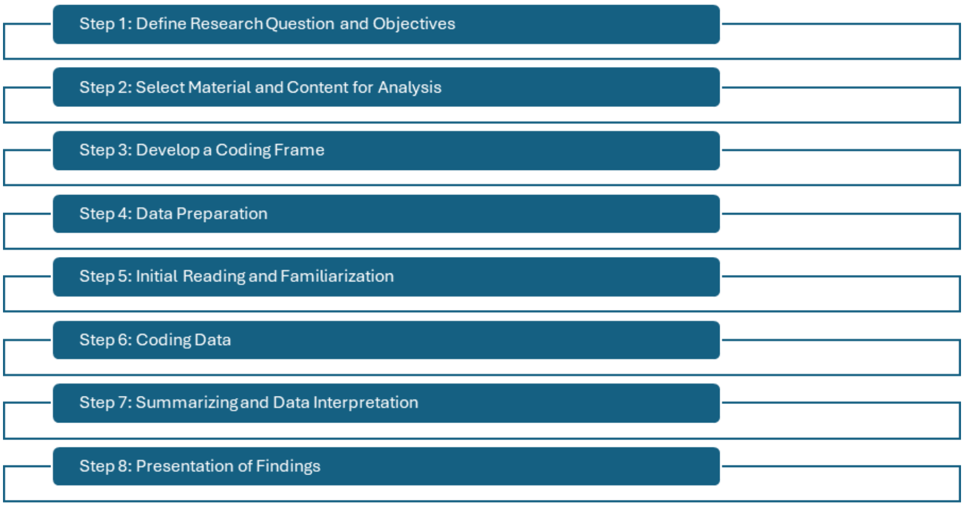
This step involves reviewing the text and assigning material segments to the appropriate categories and sub-categories. This step includes highlighting relevant passages and labeling them according to the predefined categories. This step can be divided into three parts. First, the data is divided into the most minor possible parts and checked for differences and similarities. These parts are then assigned initial codes. Categories and subcategories are formed based on the correlations after the first coding. The categories are then reviewed and refined so that they form a structure. This may involve multiple iterations to ensure the categories accurately capture the data and answer the research question. As coding progresses, some codes are refined, merged, or split to better capture the nuances of the data. The coding framework is iteratively updated to reflect the evolving understanding of the data (Mayring, 2015).

Summarizing Data

The next step would be to summarize the findings by analyzing the coded segments' frequency and patterns. This helps to identify key themes and insights from the data. The step of summarizing goes hand in hand with interpreting what has been found. The extracted data has to be cross-checked against the original reports to ensure accuracy and consistency. Any discrepancies must be resolved through careful re-examination of the source documents. Additional information, such as explanations of specific initiatives and their outcomes, must be noted to provide context and depth to the analysis. Through interpreting the results, a context for the research question is derived. This involves discussing the implications of the findings and how they relate to existing knowledge or theory. The presentation of the data comprises the final step of this schema. This can also be divided into three minor vital points. The themes must be depicted by describing the main themes and sub-themes. With the usage of quotes from the data, findings will be supported. Finally, the findings relate to the initial research question and theoretical framework (Mayring, 2015). Figure 1 shows the process in eight steps, which are worked through one after the other.

Figure 1

Structuring Technique According to Mayring (2015)



Note: Data adapted from Qualitative content analysis: Theoretical foundation, basic procedures, and software solution, by Mayring, 2015.

11.3. Structuring procedure

The analysis follows the guidelines of the structuring technique, according to Mayring, that aims to filter out a specific structure from the existing material. Further, this structure is applied to the material as a category system and systematically extracts all components addressed by the categories (Mayring, 2015). The process is divided into three steps. Defining the categories precisely defines which text components from the reports belong to a specific category (Mayring, 2015). The next step is to choose anchor examples that portray concrete examples that should be a part of a category (Mayring, 2015). Lastly, in case of a demarcation

problem between categories, coding rules are established to provide clear affiliation (Mayring, 2015). Categories were determined by an inductive method.
Before the final analysis, the categories were tested on the selected data, and adjustments were made if necessary. This way, reading and assessing the material are split into two steps. Firstly, all information in the categories addressed is designated with category numbers or underlined by different colors in the text (Mayring 2015). Finally, all relevant data is filtered out, summarized, and prepared for further analysis (Mayring, 2015).

11.4. Quality criteria in Mayring's qualitative content analysis

Even though qualitative research is pervasive due to methodological procedures and some authors believe that a clear definition of the quality criteria cannot be formulated, the so-called quality criteria of objectivity, reliability, and validity are used in content analysis in a modified and expanded form.

Objectivity ensures that the analysis is unbiased and replicable by others. This is achieved by clearly documenting the research process, using independent codes to verify the coding consistency, and providing examples and detailed descriptions of categories. Furthermore, objectivity, in this sense, means confirmability, which the authors' transparency and impartiality can guarantee (Kuckartz, 2016).

Reliability is based on the consistency of the coding process and the results' stability over time (Mayring 2022). It must be ensured that in the event of a repeated process, the results will remain the same. A study is reliable and auditable if comparable results are achieved when the data material is reprocessed. Reliability is also established by ensuring consistency in coding across different analysts. This is referred to as inter-coder reliability (Kuckartz, 2016).

Validity as a criterion is further subdivided into internal and external. Internal validity means the credibility and reliability of the study, while external validity covers the aspect of transferability (Kuckartz, 2016). Validity represents the extent to which the analysis accurately captures the data's meaning and context. According to Kuckartz, qualitative research also pays attention to internal and external study quality, which includes reliability, rule-guardedness, and intersubjective comprehensibility. This is the basis for external study quality, which refers to transferability and generalizability (Kuckartz, 2016.
By adhering to these quality criteria, researchers can enhance the rigor and credibility of their qualitative content analysis, ensuring that the findings are robust, reliable, and meaningful. Mayring's approach emphasizes the importance of systematic and transparent methods, making qualitative analysis more rigorous and reproducible.

11.5. Selection of Material - Data Source

For analysis, the sustainability and annual reports of nine selected companies are retrieved from their websites, covering primarily the year 2023 or, in case the report of 2023 is not available, the year 2022. Reports are usually enriched with images, graphics, subtitles, and additional explanations where necessary. The reports were downloaded from the companies' websites and organized into a structured database for easy access and reference during the analysis.

While annual reports cover several fields, such as financial performance, risk management, and similar, along with sustainability conduct, sustainability reports focus solely on a company's sustainability segment. Only the sustainability sections of the annual reports were considered, while others were excluded from the analysis.

For some companies, the annual report also includes the sustainability report and is listed as such in the table for accuracy. If the company has listed a sustainability and yearly report, it is also titled as such and still needs to be changed. Nevertheless, each report includes the sustainability section necessary for the research. These 2023 reports provide comprehensive information on the airlines' environmental initiatives, performance metrics, and future goals. The data collection process ensures that the most recent and relevant information is included in the analysis.

12. Presentation of the Data

The results of the applied method will be presented and interpreted in the following section. Table 1 lists the individual documents and the number of codes, simplifying and summarizing the processed material.

Table 1

Document List from MAXQDA

DOCUMENTS	
Codes in total	**705**
airBaltic 2023	130
Iberia 2022	82
KLM AirFrance 2023	59
Lufthansa Group 2023	83
TAP 2023	57
Wizz Air 2023	109
Ryanair 2023	81
SAS	72

A list of the produced codes is shown in Figure 2 before the individual categories are discussed in more detail. These were divided into categories and named accordingly. Fields marked with (x) in the table are not described as categories for reasons of scope. Nevertheless, they were marked as relevant in the reports as a code. The order of the codes does not match the order in the document, as this was irrelevant to the elaboration. The list merely serves as an overview of the number of categories and codes that have been created.

Figure 2

Code List from MAXQDA

Liste der Codes	Häufigkeit
Codesystem	705
waste handling	0
waste (x)	8
mixed packaging (x)	5
fresh food waste	9
waste management	22
recycling	13
participation interests of companies	0
Influence of external organizations	51
Collaborations (x)	2
Sustainable Development Goals (SGDs)	12
ESG reporting	15
Fly Net Zero	24
aspects of consumption	0
energy efficiency	12
fuel consumption (x)	35
fleet efficiency	20
fuel emission (x)	4
Nox (x)	15
emissions	0
non CO2 emissions (x)	4
carbon emissions (x)	51
CO2 emissions	74
greenhouse gases (x)	14
CO2 reduction	20
hub-related implications	0
ground operations	25
electric car fleet	11
energy consumption	4
companies presence	0
fines (x)	4
changes to 2022	23
future implications	13
collaborations (x)	4
Fleet (x)	1
internal sustainability strategies (x)	14
sustainability concerns	20
fleet management	0
flight efficiency (x)	11
fleet decision	14
fleet renewal	37
noise pollution	18
Sustainable Aviation Fuels	0
SAF usage	4
SAF barriers (x)	5
Agreements and Collaborations	3
SAF	84

12.1. Waste Handling

This category contains three categories, which are explained individually based on the companies. In general, the companies define waste as being generated in the aircraft, the offices, and other facilities the company is using. In the aircraft, there is galley and tank waste, with one hour of flying causing around 30 kg of waste (5 kg of galley waste and 25 kg of tank waste), or a total of 3,420 tons during FY23 (Wizz Air, 2023). Office waste for Wizz Air was 155 tons (Wizz Air, 2023). In comparison, airBaltic used 230.20 tons of household waste (2022: 213.9 tons) (airBaltic, 2023) while TAP mentions 2,310 tons (2022: 1,867 tons) as total waste (TAP, 2023) and Ryanair lists 1,073 tons (Ryanair, 2023) compared to KLM's 10,118 tons in 2023 (KLM, 2023). These numbers are to be compared with caution due to the size of the companies.

12.1.1. Fresh Food Waste

Food waste remains a significant issue in the aviation industry, so it is worth mentioning in this elaboration. Due to hygiene regulations that mandate the disposal of all unused food from flights, airBaltic counteracts by promoting the preordering of meals, allowing passengers to purchase their desired food for consumption during the flight in advance. In addition, they implemented the sale of unsold fresh food at a discount one hour before a flight's arrival at the home base (airBaltic, 2023). That this is an essential way for the future also shows Iberia using a similar system on short and medium-haul flights, whereby customers can choose their menu in advance up to eight hours before their flight, so they managed to achieve a 30% reduction in inflight waste. Another positive effect is that no unnecessary weight is loaded onto the aircraft (Iberia, 2022). Likewise, TAP has expanded the meal pre-ordering service to business class on all routes. Adjusting the quantity of products makes it possible to reduce food waste. Through this initiative, it is also possible to reduce weight on board, reduce fuel consumption and CO2 emissions. Meal orders can be placed in advance, between 30 days and 24 hours before flight departure (TAP, 2023).

To conclude this section, KLM confirms that food and food waste is highly regulated, just like everything else in the airline industry. Out of safety concerns, the EU demands that all waste from non-EU destinations be incinerated, even though KLM can and wants to recycle it. So, concerns for food safety clash with the need for environmental safety (KLM, 2023). TAP sets the priority of minimizing waste. However, their numbers show the opposite since the total garbage almost doubled compared to 2022.

12.1.2. Waste Management

The companies agree that waste management is integral to a sustainable future, so they continue to expand their actions in offices and onboard. Nevertheless, waste management in aviation is a multifaceted process due to the diverse sources and locations from which waste originates. Moreover, in aviation, waste management is subject to specific regulations, such as the Waste Management Law, Procedures for Accounting Waste and Waste Shipments, Rules on the Classification of Waste and the Characteristics that Make Waste Hazardous, and several other national and European regulations. It must comply with established waste handling, storage, transport, and disposal requirements. Flight operations also contribute to this complexity, encompassing tangible waste and items categorized as unwanted or unusable products. Therefore, it is vital to monitor and track generated waste, analyze waste streams, and ensure the proper removal of waste by licensed contractors in compliance with relevant regulatory requirements. AirBaltic's report shows that the amount of waste grew over the years, and the percentage of waste handling was negative. Mixed packaging waste grew from 42.33 tons in FY22 to 49.52 tons in FY23 (airBaltic, 2023). Iberia confirms all the information previously mentioned by writing that another of the environmental challenges facing aviation is the management of waste generated during flight and on the ground. In 2016, Iberia launched the Zero Cabin Waste project to create a sustainable management model for waste generated on board to recycle 80% of the generated waste (Iberia, 2022).

Nevertheless, their in-flight waste grew from 2,663 tons in FY22 to 3,923 tons in FY23. KLM admits they produce many flows from catering, maintenance, fleet, and buildings. All waste flows require good stewardship. Therefore, KLM Group aims to cut its non-hazardous, nonseparated waste to half its 2011 level of 12,980 tons to a maximum of 6,490 tons in 2030 (KLM, 2023). Furthermore, TAP signed 2023 the IATA declaration requesting an update to the regulations regarding international catering waste. In the current regulatory context, waste from the European Union is allowed to be processed and recycled. In contrast, waste generated on flights outside the EU must be incinerated or sent to a landfill (TAP, 2023). However, even Wizz Air confirms that there is still a need for action here by writing that they implemented an in-flight recycling trial program in cooperation with Budapest Airport to understand how they can get better results in collecting on-board waste to support circularity. The Company has been analyzing the trial results concerning passenger awareness and is looking to expand the trial to other bases in the network, currently assessing the feasibility and relevant resources (Wizz Air, 2023). On the other hand, SAS describes waste disposal across offices, ground services, and technical maintenance as rigorously monitored and categorized into sorted, unsorted, and hazardous waste. They support their statement by offering readers a small figure, shown in Table 2 (SAS, 2023).

Table 2

Quantity of Waste Types

	Unit	FY23	FY22	Base FY10
Sorted waste	tons	1.146	1.204	-
Unsorted waste	tons	176	113	815
Hazardous waste	tons	71	121	302

Note: Data adapted from SAS Annual and Sustainability Report FY 2023 (p.35), by SAS, 2023. Local PDF document

12.1.3. Recycling

The reports clearly show that recycling is gaining importance. According to airBaltic, it is a way of moving towards more sustainable actions. In 2023, the Group expanded its waste management in offices and onboard by implementing a new recycling system for plastic, paper, metal, glass, and household waste sorting by introducing designated collection points throughout the Company's offices. The new recycling system helped divert recyclables from general waste and reduced the amount of non-sorted waste by 9% per employee (airBaltic, 2023).

Iberia differs from waste generated on domestic and intra-European flights and generated on international flights. For domestic and intra-European flights, waste is sorted into two categories: recyclable (plastic and aluminum packaging, paper, tetra bricks) and non-recyclable (organic matter, security seals, napkins, etc.). For international flights, the solution depends on the destination. Iberia generated 3,923 tons of cabin waste in 2022, 43% of which was subsequently recycled (Iberia, 2022).

TAP is committed to identifying and implementing initiatives that allow the reduction of consumption and reuse of materials, ensuring, whenever possible, recycling. As part of the onboard plastic reduction project implemented at TAP since 2018, the Company has been looking for solutions that allow for the gradual replacement of single-use plastics with recyclable materials. In 2023, TAP took an essential step by introducing reusable and recyclable tableware in economy class on long-haul flights. Made from 25% recycled material, the new reusable tableware highlights TAP's ongoing commitment to innovation and sustainability. TAP claims to have 292 products on board (meal complements, amenity kits, hygiene, and disinfection products, non-consumable materials, gear), of which 43% are recovered for new flights (whenever closed and not made available to passengers), 27% are rotatable, and 30% are disposable. As a highlight, they state a Sustainable Development Commitment to recycle 100% of flights arriving in the Lisbon hub by 2023 (TAP, 2023).

In comparison, SAS initiated a comprehensive furniture recycling program to repurpose and recycle furniture across its facilities. This initiative seeks to extend furniture's lifespan and minimize waste in alignment with circular economy principles. By recycling and refurbishing its furniture, SAS reduces the need for new resource-intensive production and lowers its environmental footprint (SAS, 2023).

12.2. Participation Interest of Companies

This section describes projects and plans that influence companies under external factors. Statements can differ between mandatory and voluntary participation. This category contains four subcategories, which are presented below.

12.2.1. Influence of External Organizations

The following statements show that the influence of external organizations is essential for all the mentioned companies. For example, airBaltic has aligned itself with the sustainability goals set by organizations such as ICAO, IATA, and Airlines for Europe. According to airBaltic, collaborating within the aviation industry to achieve carbon neutrality is crucial. At the IATA World Sustainability Symposium in October 2023, airBaltic signed an agreement to contribute data to the IATA CO2 connect emissions calculator. The EU ETS directive was revised to broaden its scope to include non-CO2 emission reporting and modifications to emission accounting and support mechanisms starting in 2025. The ReFuel Aviation Regulation was adopted, mandating the compulsory use of SAFs from 2025 and assigning tasks to the EASA to develop a labeling scheme for airlines. In 2024, the approval of the Green Claims Directive is expected to minimize any greenwashing risks. In addition to engaging in national-level activities, airBaltic supports and participates in international initiatives such as the EASA Environmental Label Program and IATA CO2 Calculation tool, whereby the tool prevents inaccurate calculations of the carbon footprint of air travel while allowing the calculation of passenger carbon footprint with an industry-approved methodology (IATA, n.d.). The Environmental Label Program aims to provide consumers with clear, accurate, and standardized information about the environmental performance of flights (EASA, 2024).

Furthermore, the Group follows the governing regulations and annually reports the number of produced emissions as directed under the schemes of the EU ETS [...] and the CORSIA (airBaltic, 2023). In other reports, like Iberia, similar facts were found: Within the framework of the United Nations 2030 Agenda, Iberia carries out its activities within a framework of responsibility and transparency, caring for the environment, and actively collaborating in the social sphere. Through this emissions system, the EU has set an emissions cap or ceiling for the aviation sector using 2004-2006 as a reference period. The EU-ETS system applies today and until 2023 on all domestic flights and all flights between airports in the European Economic Area (EEA) (Iberia, 2022). In 2023, KLM participated in the second SkyTeam Sustainable Flight Challenge. This yearly event aims to catalyze sustainable aviation by organizing a sustainability competition between airlines (KLM, 2023).

The Lufthansa Group also reports according to the SASB Report and has been a signatory of the TCFD since 2020. There, the company also provides a detailed description of its carbon footprint in the context of its Carbon Disclosure Project rating and, in its annual Communication on Progress, reports on its sustainable corporate governance following the ten principles of the UN Global Compact (Lufthansa Group, 2023).

To optimize the control of relevant environmental aspects of its activity through a structured and planned approach to ecological management, TAP was established as a strategic objective for implementing and certifying the IATA IEnvA program next year. This voluntary certification, based on the ISO 14001:2015 standard and adapted to the aviation sector by IATA, presupposes the implementation of environmental policies and procedures that will improve the Company's ecological performance towards a more sustainable operation (TAP, 2023). ISO 14001 is an internationally recognized standard that provides a framework for organizations to design and implement an environmental management system (ISO 14001:2015, n.d.).
To help drive change in the industry, Wizz Air joined the European Commission’s Alliance for Zero Emission Aviation and the Renewable and Low-Carbon Fuels Value Chain Industrial Alliance and is engaging with key stakeholders in Wizz Air entities, including in the UK [...]. Throughout the year, Wizz Air has been recognized as the most sustainable low-cost airline [...]. Wizz Air joined AZEA in September 2022, a voluntary initiative launched by the European Commission to pave the way for next-generation sustainable aircraft. Furthermore, the company joined the World Economic Forum’s Target True Zero coalition (Wizz Air, 2023).

Ryanair is active in highlighting the climate-negative impacts of the European Commission's proposal to continue the unjustified exemption of long-haul flights from EU ETS beyond 2026. Continuing with the limited scope of the ETS [...] means that over 50% of European aviation emissions - generated by just 6% of flights (long-haul) - need to be accounted for or paid for under the scheme. Together with the environment NGO Transport & Environment, Ryanair continues to promote the extension of the EU ETS to all flights departing from an EEA airport (Ryanair, 2023).

SAS claims that it is fully prepared to meet the emissions reporting requirements. Moreover, it is a member of the ELISE project, which aims to build expertise and drive rapid technological innovation in aviation. The project unites industry and technology stakeholders to advance electric aviation in Sweden (SAS, 2023).

12.2.2. Sustainable Development Goals

The processed reports of the selected companies also reveal how widespread and increasingly important the SDGs are. While a sustainable development strategy was found in airBaltic's report, more information or disclosure of compliance with the SDGs is needed. The report only provides information on benchmarks, such as implementing the best processes considering all sustainability components and commitments (airBaltic, 2023). More details on exact figures or facts need to be provided in this section. For example, Iberia states that in this complex context, humanity is faced with immense challenges of global scope that force us to rethink all systems and where history and past experiences can no longer be used as reference. These include economic, environmental, and social challenges, as well as technological and political or governance issues, which are graphically summarized in the 2030 Agenda for Sustainable Development Goals wheel and have the climate crisis as a common denominator. Within the United Nations 2030 Agenda framework, Iberia carries out its activities within a framework of responsibility and transparency, caring for the environment, and actively collaborating in the social sphere, focusing on the following Sustainable Development Goals. Iberia writes that they are working on SDGs 3,5,8,9,10,11,12,13, and 17 (Iberia, 2022). Wizz Air shows similar participation by following SDGs: 3,4,5,7,8,9,10,12,13, and 17 (Wizz Air, 2023). The Lufthansa Group illustrated its involvement in Table 3, demonstrating the SDGs.

Table 3

SDGs supported by the Lufthansa Group

SDGs supported by the Lufthansa Group

SDG 03	Good Health and Well-Being
SDG 04	Quality Education
SDG 07	Affordable and Clean Engergy
SDG 08	Decent Work and Economic
SDG 09	Industry, Innovation and Infrastructe
SDG 10	Reduced Inequalities
SDG 12	Responsible Consumption and Production
SDG 13	Climate Action
SDG 16	Peace, Justice and Strong Institutions
SDG 17	Partnerships for the Goals

Note: Data adapted from Lufthansa Fact Sheet 2023 (p. 5), by Lufthansa Group, 2023. Local PDF document.

TAP recognizes in the SDGs the action plan for the implementation and operationalization of the 2030 Agenda, a collective agreement and a global ambition to preserve the planet and improve the lives of all citizens of the world, combating inequalities, stimulating economic growth, promoting access to better health and education, while combating climate change and preserving ecosystems. In this sense, TAP values and seeks to actively contribute to the seventeen SDGs, with a particular focus on the following (7, 8, 12, 13, 17): Renewable and Accessible Energy, Climate Action, Sustainable Production and Consumption, Decent Work and Economic Growth, and Partnerships for the Implementation of the Objectives, identified as the most relevant and material for the business, considering both the positive impact of its activity as well as the awareness of the adverse effects that the Company has the responsibility to mitigate (TAP, 2023). SAS can positively impact eight sustainable development goals (5,8,9,11,12,13,16,17) as they aim for leadership in sustainable aviation. Their core focus is mitigating their climate impact, enhancing resource efficiency, and creating an attractive workplace (SAS, 2023).

12.2.3. ESG Rating

Companies increasingly internalize this reporting method as ESG reporting gains a vital role. For example, in airBaltic, the entire Top Management team is responsible for the company's Environmental, Social, and Governance values and principles. They want to remain a constructive and proactive social partner to national governmental organizations in achieving national ESG goals (airBaltic, 2023). KLM has been working actively on enhancing its ESG performance. According to S&P Global Ratings in Table 4, the group achieved an ESG score of 64 out of 100, reflecting significant progress in environmental, social, and governance dimensions. KLM's ESG Risk Rating, provided by Sustainalytics, evaluates its exposure to and management of industry-specific ESG risks and was rated 24.2 and therefore has a medium risk.

Table 4

ESG rating KLM

Agency	Score in 2023	Explanatory Notes
Sustainalytics	24.2	Scoring/Ranking: Sustainalytics use a 100 – 0 scale, with lower score being better.
S&P Global	64/100	Scoring/Ranking: S&P use 0 – 100 scale, with higher score being better.
CDP Climate Change CDP Water Security	B F	Scoring/Ranking: CDP use a F – A scale.

Note: Data adapted from CDP (n.d.), Sustainalytics (n.d.), and S&P Global (n.d.). Retrieved from https://www.cdp.net/en/scores, https://www.sustainalytics.com/esg-ratings, and https://www.spglobal.com/esg/solutions/esg-scores-data

The Lufthansa Group explains that a company's ESG performance is externally rated based on numerous criteria, which provide information on its values, risk management, non-financial targets, and the measures it adopts. The rating mainly draws on publicly available data and information (Lufthansa Group, 2023). The Lufthansa Group stands out as the only company to hold ESG ratings from such a wide array of agencies, surpassing its peers in the number and diversity of evaluations received, as can be seen in Table 5.

Table 5

Performance of Lufthansa Group in ESG ratings

Performance in ESG Ratings as of Dec 31, 2023

Agency	Score Type	Latest Score	Year	Explanatory Notes
MSCI	ESG Score	AA	2023	Confirmation of AA Level and sector leadership. Best Scoring in "Carbon Emissions", "Corporate Governance" and "Corporate Behavior"
Sustainalytics	Risk Score	28.3 (medium)	2023	Medium ESG risk rating due to high CO_2 relevance. Strong management on essential ESG aspects.
ISS ESG	ESG Score	C+ (Prime Status)	2023	Remaining a top-three "Industry Leader" in aviation, excelling in "Climate Protection", "Labor Standards", and "Transport Safety" and "Stakeholder Responsibility".
Moody's ESG-Solutions	ESG Score	47/100	2023	Above Sector Average performance (41). Best scores in "Environmental strategy", "Non-Discrimination and Diversity Audit" and "Internal Controls and Executive Remuneration"
FTSE Russell	ESG Score	3.4/5	2023	Above Industry Average (2.4). Lufthansa has been part of FTSE4Good Index Series since 2001. Top ratings in "Climate Change" and "Corporate Governance" categories.
S&P Global	ESG Score	47/100	2023	Above Average (35) among peer airlines. Maximum scores in "CSR Reporting Assurance", "CEO remuneration", "Climate Risk Management", "Codes of Conduct", and "Workplace Health/Safety Program"
CDP	Climate Change	A- (Leadership Level)	2023	Above Sector Average (B). Top scores in "Transparent and Credible Disclosure of Climate-Related Emissions", "Reduction Measures", and "Climate Risks and Opportunities".
ecovadis	Supply Chain Sustainability Assessment	65/100 (Silver Status)	2022/2023	op 9% of all evaluated companies in the passenger air transport industry. Strong performance in categories "Environment" and "Labor and Human Rights".

Note: Data adapted from Lufthansa Fact Sheet 2023 (p. 7), by Lufthansa Group, 2023. Local PDF document.

Moreover, TAP agrees that in recent years, investors have increasingly integrated ESG factors into investment strategies, and they have begun to demand updates and transparent disclosures of their performance in these aspects from companies. At the same time, customers are increasingly interested in obtaining information about companies' ESG strategies. Sustainability indices are crucial instruments that quantify a company's sustainable performance, mainly through identifying opportunities and managing ESG risks (TAP, 2023). Intending to have a recognized external assessment and independent diagnosis of its ESG practices, performance, and risks, in 2023, TAP voluntarily assessed to measure its exposure to material ESG risks specific to the sector. TAP obtains a score of 24.4 (medium risk). Therefore, TAP is considered the 2nd best Airline in Europe and 6th globally among the airlines analyzed in this rating (TAP, 2023).

Ryanair's commitment to ESG is reflected in its strong performance on vital external indices/rankings. It advertises its performance as 23.4 out of 100.0, whereby a lower score is seen as better. Table 6 demonstrates Ryanair's performance while stating to be Europe's No.

1 rated Airline as by March 23, 2023. They are further members of the Sustainable Co Future Forum, Transition Pathway for Tourism and Jet Zero (Ryanair, 2023).

Table 6

ESG ratings Ryanair

Agency	Score in 2023	Score in 2022	Explanatory Notes
Sustainalytics	23.4	23.8	Scoring/Ranking: Sustainalytics use a 100 – 0 scale, with lower score being better.
MSCI	BBB	B	Scoring/Ranking: MSCI use a CCC – AAA scale.
S&P Global	44	21	Scoring/Ranking: S&P use 0 – 100 scale, with higher score being better.
CDP	B	B	Scoring/Ranking: CDP use a F – A scale.

Note: Data adapted from Ryanair annual report 2023 (p. 7), by Ryanair, 2023. Local PDF document.

A critical risk to Wizz Air is connected to climate change, and environmental regulation compliance will affect ESG. To counteract that, Wizz Air is focused on strengthening its internal and board-level sustainability governance with frequent reviews and updates of reporting requirements, which are also enabled by training and employing expert sustainability consultants. All reporting and environmental compliance matters have ownership assigned to the responsible function, which then reports on the applicable risks and mitigation actions to the Corporate and ESG Officer and the Sustainability Council (Wizz Air, 2023). Wizz Air has a Sustainalytics ESG Risk Score of 27.7 as can be seen in Table 7, placing it slightly ahead of the Lufthansa Group but behind Ryanair in terms of managing environmental, social, and governance risks.

Table 7

ESG rating Wizz Air

Agency	Score in 2023	Explanatory Notes
Sustainalytics	27.7	Scoring/Ranking: Sustainalytics use a 100 – 0 scale, with lower score being better.
S&P Global	43/100	Scoring/Ranking: S&P use 0 – 100 scale, with higher score being better.
CDP Climate Change CDP Water Security	B F	Scoring/Ranking: CDP use a F – A scale.

Note: Data adapted from CDP (n.d.), Sustainalytics (n.d.), and S&P Global (n.d.). Retrieved from https://www.cdp.net/en/scores, https://www.sustainalytics.com/esg-ratings, and https://www.spglobal.com/esg/solutions/esg-scores-data

12.2.4. Fly Net Zero

As the goal to fly net zero is mentioned in almost all reports, it is a crucial subcategory to add. The International Air Transport Association, representing 290 airlines (83% of all aircraft participating in air traffic), including airBaltic, has committed to achieving net zero carbon emissions by 2050, establishing the Fly Net Zero by 2050 strategy for the entire aviation industry and governments. The strategy comprises new technologies, operations efficiency, increased use of sustainable aviation fuel, carbon offsetting, and carbon capture measures. AirBaltic is following the roadmap by following principles: reduce aircraft energy use, increase the use of SAFs, and reduce the Airline's carbon footprint by re-capturing all produced CO2, which could not be avoided in any other manner (airBaltic, 2023).

Iberia highlights the net zero goal throughout their report, mentioning that a vital development must continue to advance and be accompanied by other measures to achieve the International Airlines Group's (IAG's) goal of zero net emissions by 2050 with the greatest decarbonization effort technology allows. Aware of this immense challenge, in 2019, the IAG group launched its sustainability strategy FLIGHTPATH NET ZERO 2050, thus aligning with the targets set to limit global warming to 1.5°C. Furthermore, in 2022, the CO2LABORA program was launched, calling on customers to collaborate in the fight against climate change by offering the possibility of flying with net zero emissions (Iberia, 2022).

Next, KLM states that they also launched the Zero Emission Aviation program to explore electric, hydrogen, or hybrid propulsion systems for the next generation of sustainable aircraft (KLM, 2023). The Lufthansa Group affirms that they aim to be carbon-neutral by 2050, to halve the net CO2 emissions of flight operations from their 2019 levels by 2030. Their commitment to sustainability is also rated positively by several independent rating organizations (Lufthansa Group, 2023). TAP is committed to ensuring compliance with IATA's resolution to achieve zero carbon emissions by 2050, which will only be possible with the involvement of all stakeholders (TAP, 2023).

In Wizz Air's report, there are most of the statements on the achievement of Fly Net Zero goals, among others, that they joined the European Commission's Alliance for Zero Emission Aviation and the Renewable and Low-Carbon Fuels Value Chain Industrial Alliance and are engaging with key stakeholders in Wizz Air entities. The company is confident that investing in the most modern and fuel-efficient aircraft and engine technology will continuously reduce passengers' carbon footprint generated by flying and deliver the targeted CO2 intensity decrease by 2030 and beyond. Wizz Air UK provides business insight to the UK government to support the mission of reaching net zero in the aviation sector by 2050. The Company is a member of the delivery groups of the UK government's main advisory body on sustainable aviation, the Jet Zero Council. The Zero Emissions Flight delivery group focuses on accelerating zero-emissions aircraft design, manufacturing, infrastructure, and commercial operation (Wizz Air, 2023).

Ryanair's strategy to achieve net-zero carbon emissions by 2050 demonstrates the contributions of various measures towards the reduction of CO2 emissions over time, shown as percentages. The improvement in technology (32%) represents advancements in aviation technology, such as more fuel-efficient aircraft and engines. 34% highlights the increasing role of SAF. Air Traffic Reform (10%) indicates efforts to optimize air traffic management, reducing unnecessary fuel consumption through improved flight paths and operations. Ryanair's plans to offset emissions through carbon capture, afforestation, or similar initiatives amount to 24%. The CO2 pax/km should decrease from 69 g in 2030 to 50 g in 2050, reflecting overall progress. The Group has additionally set near-term carbon intensity targets (FY26 and FY31) to ensure progress towards the absolute net zero goal is on track (Ryanair, 2023).

SAS intends to contribute to a long-term sustainable society and supports the IATA ambition of net zero carbon emissions from commercial flights by 2050 (SAS, 2023).

12.3. Emissions

Omitted emissions cover a large area of sustainability reports, so it is essential to list them as separate items and divide them into subcategories. Two subcategories explain this topic. More subcategories were selected for this topic than were implemented, as seen in the code list at the beginning of this section. However, they were combined into two subcategories to avoid duplication and are presented below.

12.3.1. CO2 Emissions

Even though airBaltic has a long-term vision called Destination 2050, which focuses on reaching net zero CO2 emissions from all flights departing from the EU, UK, and the European Free Trade Association, its primary climate and environmental impact arose from 177,789 tons of fuel consumption, which results in 560,035 CO2 emissions.

They admit that aviation’s primary negative impact on the environment is its CO2 emissions from fuel and energy use. Table 5 shows omitted CO2 emissions in comparison between 2021 and 2023 (airBaltic, 2023).

Table 8

Omitted CO2 emissions from airBaltic in a year-on-year comparison

	2023	2022	2021
Jet Fuel, kg	2 127 357	1 825 383	955 448
Jet Fuel, kg	92 538	79402	41561
CO2 saved, kg	6 701 175	5 749 956	3 009 661
Per Flight, kg	58.36	53.46	41.4
Per Flight, GJ	2.54	2.33	1.8
CO2 saved per Flight, kg	184	168	130

Note: Data adapted from airBaltic sustainability report 2023 (p.37), by airBaltic, 2023. Local PDF document.

Table 8 shows that airBaltic has decreased its direct energy consumption, saving 58.36 kg of jet fuel per flight. This was possible through reduced flaps take-off, landing, and/or single-engine taxiing. The Airline continued to increase its growth by operating 18% more flights than in 2022 while achieving a reduction in CO2 emissions by 5.3% (0.089 kg vs. 0.094 kg) (airBaltic, 2023).

Likewise, Iberia focuses on reducing CO2 emissions in all businesses […] because CO2 emissions from air transport currently represent between 2% and 3% of total global emissions, so it is an activity that continues to grow. Since 2013, Iberia has added 48 new aircraft to its fleet, the latest aircraft that reduces fuel consumption and CO2 emissions by up to 35%. According to the report prepared by the independent aviation consultancy IBA, which monitors more than 65,000 aircraft and 35 million flights annually, Iberia is the second airline that significantly reduces CO2 emissions on long-haul flights (Iberia, 2022).

Table 9

Emissions by KLM

CO2 Emission – Scope 1 (ktons CO2 eq)

Aviation Fuel (in ktons CO2)	CO2 savings from SAF (in ktons CO2)	Ground Operations (in ktons CO2)
10.109	179	23.9
9.041	87	30.1
+ 11.8 %	+ 105.7 %	- 20.6 %

Note: Data adapted from KLM-Air France annual report 2023 (p.60), by KLM-Air France, 2023. Local PDF document.

Table 9 represents the numbers of KLMs emissions. They describe a growth of 11.8% in CO2 emissions from fuel consumption and an increase of 105.7% in CO2 savings through SAF usage. In addition, KLM will replace the full freighter Boeing 747-400 with new Airbus A350F freighters, which are expected to emit 40% less CO2. By including the freighters, approximately 12% of the 30% CO2 intensity target for 2030 will be reached by fleet renewal. To counteract the rise of CO2 emissions, airBaltic teamed up with KLM to address and discuss aviation challenges and explore more sustainable flying methods. SAFs have substantial decarbonization potential but need more widespread awareness among the public (airBaltic, 2023). KLM primarily aims to counteract CO2 emissions using SAFs and an efficient and modern fleet (KLM, 2023). Figures show that the Lufthansa Group saved 43,628 tons of fossil CO2 by using sustainable aviation fuel in 2023 and offsetting CO2 emissions through high-quality climate protection projects by 420 thousand tons by customers. The figure below shows the absolute comparison to KLMs numbers.

The Lufthansa Group aims to be carbon-neutral by 2050, and they want to halve the net CO2 emissions of their flight operations from 2019 levels by 2030 - the measures taken by the Lufthansa Group, such as modernization of the fleet towards fuel-efficient aircraft. Greenhouse gas emissions in the supply chain can also be reduced using sustainable alternative fuels (Lufthansa Group, 2023). The absolute emissions regarding CO2 emissions for the Lufthansa Group are shown in Table 10. The table shows that absolute emissions have risen in all areas. This can be due to the increased air traffic compared to the previous year.

Table 10

Emissions by the Lufthansa Group

Absolute Emissions 2023 in tons

	Passengers	+ PY	Cargo	+ PY	Total	+ PY
CO2	21.646.482	+ 19.2 %	4.975.451	+ 3.8 %	26.621.932	+ 16 %
NOX	98.903	+ 20.6 %	26.227	+ 5.3 %	125.130	+ 17.1 %
CO	18.230	+ 13.1 %	3.182	- 1.5 %	21.411	+ 10.7 %
UHC	2.166	+ 10.5 %	268	- 1.6 %	2.434	+ 9.0 %

Note: Data adapted from Lufthansa Fact Sheet 2023 (p. 7), by Lufthansa Group, 2023. Local PDF document.

For TAP, decarbonization represents a significant challenge for more sustainable mobility, as the aviation sector is still highly dependent on fossil fuels, and the solutions and technologies focused on the energy transition are not globally available. The Company continues to work on concrete projects and initiatives that will have a positive and measurable impact on reducing its carbon footprint. In 2023, TAP's energy and environmental efficiency indicator improved by 0.6% compared to 2022 and 9.1% compared to 2019 (TAP, 2023). The voluntary carbon dioxide emissions offset program, available at TAP since 2009, is an example of how to tackle climate change. The program provides customers with options for supporting climate action worldwide by supporting certified projects to reduce CO2 emissions in other areas.

Table 11

Total Emissions TAP

5.439.746t CO2	**2.377t CO2**	**84 g/pkm**
Total CO2 emissions	Total CO2 emissions	CO2 emissions per passenger
Scope 1	Scope 2	

Note: Data adapted TAP annual report 2023 (p. 60), by TAP, 2023. Local PDF document.

Currently, TAP has one of the youngest fleets in Europe, equipped with the latest state-of-the-art engines, which allows it to achieve essential levels of efficiency. Aircraft cabins are made of lighter materials to reduce weight on board, enabling savings in fuel consumption and carbon dioxide emissions (TAP, 2023).

Emissions grew from 3,438,705 tons of carbon dioxide equivalent (tCO2e) in 2021 to 5,283,024 tCO2e in FY22 and 5,439,746 in FY23, which can be seen in Table 11. The higher traffic volume can explain the jump between FY21 and FY22, although Scope 1 emissions in FY23 have stayed the same. However, an increase can still be observed. Of note is the increase in Scope 2 emissions between FY21 and FY22 from 2,586 tCO2e to 2,628 tCO2e, but a drop between FY22 and FY23 to 2,377.

In FY22, Wizz Air observed an average decrease in the intensity of carbon emissions of 15.4% compared to the previous calendar year. This is the strongest CO2/RPK (carbon emitted per passenger kilometer) decrease they have measured and reported from one year to the next, and they will continue to improve to reach their ambitious intensity target by FY30, with the help of fleet renewal and fuel efficiency initiatives, and the use of SAF. At the end of FY23, Wizz Air surpassed its previous record, surpassing its FY22 CO2/RPK performance (55.2 g) and reaching 53.8 g by FY23. In FY23, Wizz Air had the lowest carbon emissions in the

industry, expressed in CO_2 per revenue passenger kilometer (RPK), as it operates the youngest fleet at the highest seat load factors.
Like the Lufthansa Group, Wizz Air started a voluntary CO_2 emission offset program in 2020 as part of its broader commitment to reducing emissions, enabling passengers to calculate their flight's environmental impact and providing choices to offset the carbon emissions of their travel [...]. Moreover, to conclude Wizz Air's effort, the European Commission proposed to end kerosene tax exemption for intra-EU flights over ten years. In case of the adoption of the proposal in its current form, the most polluting flights, namely intercontinental long-haul flights, will be excluded despite being the primary source of European CO_2 emissions – based on the Euro control Data Snapshot on CO_2 emissions and flight distance from February 2021 (Wizz Air, 2023).

As written by the Lufthansa Group and Wizz Air, Ryanair offers customers the opportunity to offset their emissions through the Ryanair Customer Offset Scheme. Carbon-conscious customers can fully offset their emissions when they fly. Ryanair describes lowering the Scope 2 emissions from 3,717 tons of carbon dioxide equivalent (CO_2e) to 2,372 CO_2e. At the same time, the notable rise of Scope 1 emissions can be marked with 14,266,186 CO_2e in FY23, while there were 9,193,324 CO_2e in FY22 (Ryanair, 2023). Some statements and figures shown in the SAS report are as follows: "In FY23, our absolute CO_2 emissions from aircraft operations increased by 27% compared to the previous year. This increase can be attributed to the return of traffic, which had been significantly reduced for almost three years due to the pandemic. Conversely, our CO_2 emissions per passenger kilometer decreased by 3% to 87.4 g (from 90), driven by a higher cabin factor following the return of traffic and our ongoing fleet renewal. The carbon emissions per available seat kilometer experienced a slight increase of 0.9% to 54.5 g (from 54) due to an increased load factor following traffic return." [...] In FY23, these offsets accounted for 1,097 million tons of CO_2 (365 of total fuel), equivalent to 38% of passenger-related CO_2 emissions (SAS, 2023).

12.3.2. CO_2 Emissions Reduction

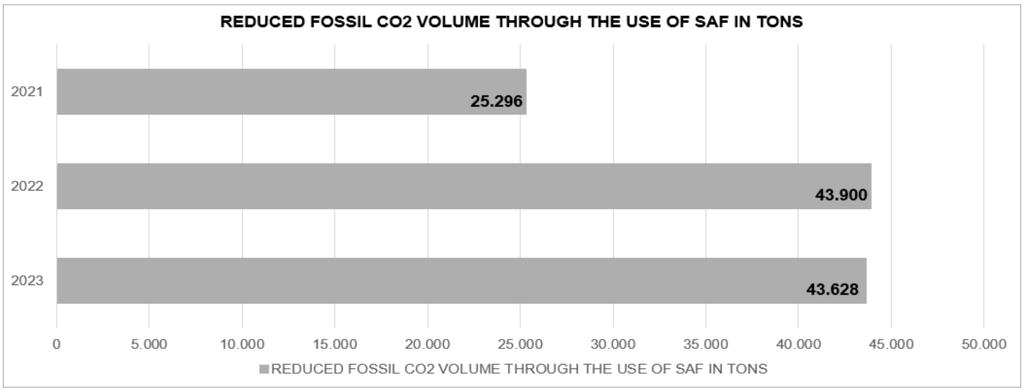
As shown in the previous chapter, CO_2 emissions are the airline's biggest challenge. Nevertheless, airBaltic continued to increase its growth by operating 18% more flights than in 2022, at the same time achieving a reduction in CO_2 emissions by 5.3% (0.089 kg vs. 0.094 kg) in the amount of carbon emissions released per passenger kilometer in 2023 as compared to 2022. By reducing fuel consumption, airlines can cut operational costs, potentially resulting in more affordable tickets for passengers. Additionally, the effort contributes to a decrease in CO_2 emissions released (airBaltic, 2023).

KLM also needs to take smaller emission-reducing steps across its value chain. To take these small steps, they focus on operational measures in the air and on the ground, reducing waste, increasing circularity, and collaborating with partners in the aviation industry. Together, these help KLM achieve 2-4% of its overall CO2 reduction target (KLM, 2023).

The Lufthansa Group has joined the Science Based Targets initiative (SBTi) and follows a clearly defined CO2 reduction path. Lufthansa Group's target to achieve a 30.6% reduction in CO2 intensity in 2030 compared to 2019 was successfully validated in 2022 by SBTi as the first European airline group and the second worldwide. Efficiency in flight operations is measured as follows: Twenty-five thousand tons of CO2 reduction and around eight thousand tons of kerosene reduction through 67 fuel-saving projects underway across the Group, such as AeroSHARK (Lufthansa Group, 2023). Lufthansa's decrease in carbon emissions is also related to increased efficiency in flight operations and is reached by tools like intelligent route planning, modern approach procedures, and the latest technologies. The reduced consumption of fossil fuel is visible in Figure 3.

Figure 3

Reduced CO2 Emissions through SAF usage

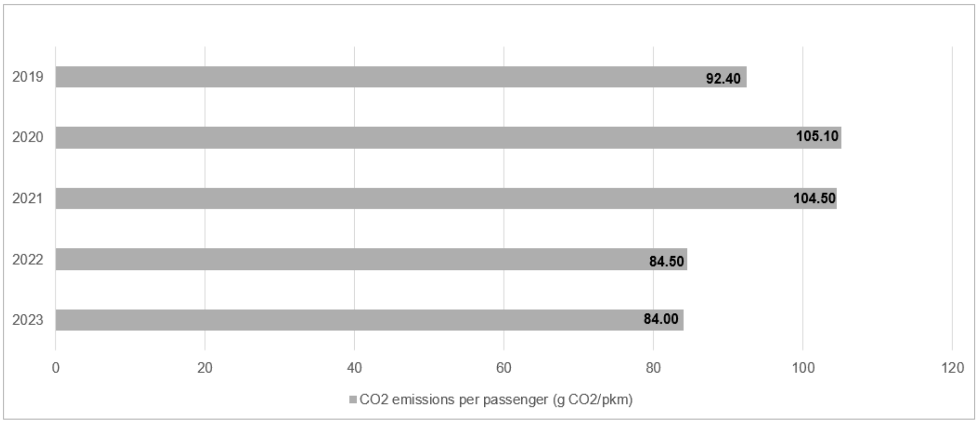


Note: Data adapted from Lufthansa Fact Sheet 2023 (p. 15), by Lufthansa Group, 2023. Local PDF document.

The TAP report also clearly shows that they want to reduce the CO2/pkm by 20% by 2030. In addition, in 2023, TAP continued the Aircraft Weight Reduction project, which aims to identify and implement initiatives that allow reducing the weight transported on board its aircraft through the replacement and/or removal of items unrelated to its certification. Overall, the measures identified within the scope of this project have the potential to reduce annual consumption by around 1,700 tons of fuel, thus avoiding the emission of approximately 5,350 tons of CO2 (TAP, 2023). Moreover, as Figure 4 shows, the company significantly reduced its CO2 emission per passenger compared to the pre-pandemic value in 2019.

Figure 4

CO2 Emissions TAP



Note: Data adapted TAP annual report 2023 (p. 61), by TAP, 2023. Local PDF document.

Wizz Air is fully committed to reducing its carbon emissions intensity in line with its target. They claim to be operating one of the youngest, most efficient fleets in Europe that reduces fuel consumption and CO2 emissions by as much as 20% – meaning Wizz Air currently has the lowest CO2 emissions per passenger kilometer in Europe (Wizz Air, 2023). SAS works proactively to reduce its greenhouse gas emissions by focusing on reducing emissions from its aircraft operations and, therefore, follows Goal 13 of the SDGs (SAS, 2023).

12.4. Fleet Management

One key factor in achieving sustainable aviation is aircraft in operation, making fleet management a crucial area of focus. Like many other industries, significant effort is dedicated to developing new aircraft that are more efficient in every aspect compared to previous generations. Airlines make a great effort to modernize their fleets by investing in the latest aircraft and phasing out older models. However, the need for more detailed data in reports makes it difficult to fully assess the current fleet composition as of the end of 2023. This section is divided into two subcategories.

Lufthansa Group currently operates the largest fleet, which is understandable given the number of daughter companies. The fleet comprises 721 aircraft, of which only 141 are newer generations (30 A220, 55 A320neo, 25 A32neo, and five Boeing 787) (Lufthansa Group, 2023).

As of December 2023, the SAS fleet consisted of 134 aircraft, 15 long-haul aircraft, 88 short-haul aircraft, and 31 aircraft operated by regional production partners, out of which 29 were A320neo, three A321neo, and four A350 (SAS, 2023).

AirBaltic's single-type fleet comprised 46 A220 at the year-end 2023, the aircraft that is now the most efficient commercial aircraft in the world with a transparent declaration of the life-cycle environmental impact, helping to reduce CO2 and NOx emissions by 25% and 50%, respectively and half as large noise footprint in comparison to the previous generation aircraft and industry standards (airBaltic, 2023). The decision to switch to a single fleet of Airbus A220-300, the most environment-friendly aircraft, has significantly shaped the sustainability roadmap in recent years (airBaltic, 2023). For training purposes, the Group uses one of the most modern aircraft types in the aviation industry, eight single-engine Diamond DA-40NG (New Generation) and one dual-engine Diamond 42-VI (Improved Speed).

At the end of the year, Iberia's fleet included 61 A320neo and 22 A350 (Iberia 2022). They go one step further and make decisions regarding the fleet within flight operations to make them more efficient. These initiatives include measures related to the reduction of aircraft weight, such as lighter seats and trolleys, the elimination of the on-board newspapers for a digital press, the Electronic Flight Bag, more efficient maintenance of aircraft and engines, or the use of new tools that use accurate time information to improve the flight plan, like more efficient altitude level, redefinition of alternative airports or more efficient maneuvers at airports (Iberia, 2022).

In 2023, the TAP fleet comprised 98 aircraft, 54% of which were the latest efficiency product — the Airbus neo generation, as illustrated in Table 12.

Table 12

TAP Fleet

TAP NEO FLEET				
	A330-900neo	A321-200LR	A321-200neo	A320-200neo
Number of aircraft	19	13	10	11
Avg. Fleet age (years)	4.6	2.8	4.9	3.8
TAP FLEET				
	A330-200	A321-200	A320-200	A319-100
Number of aircraft	3	3	15	5
Avg. Fleet age (years)	15.9	21.5	18	23.1
TAP EXPRESS				
			Embraer 195	Embraer 190
Number of aircraft			7	12
Avg. Fleet age (years)			12.7	12.7

Note: Data adapted TAP annual report 2023 (p. 63), by TAP, 2023. Local PDF document.

The KLM Air France group had 551 airplanes, of which 443 were active. These consisted of 177 long-haul, six cargo, and 260 short-haul aircraft.

Since its first flight in 2004, Wizz Air has continuously operated the Airbus A320 and A 321 family of aircraft and is currently operating the largest Airbus A321neo fleet among airlines (Wizz Air, 2023). By the end of 2023, the share of the latest neo-technology aircraft has stretched to 49.3%. The Airbus A321neo, which WIZZ introduced into the fleet in 2019, is the most efficient single-aisle aircraft with the lowest fuel consumption per seat kilometer in its category. It produces almost 50% less noise and burns 10% less fuel in comparison to the previous A321 aircraft (A321ceo), powered by two Pratt & Whitney geared turbofan engines, and features the broadest single-aisle cabin with 239 seats in a single-class configuration, what provides more flexibility, fuel efficiency, and lower operating costs. The engines and Airbus' fuel-saving Sharklet wingtip devices can enable fuel improvements of 20% per seat.

As of March 2023, Ryanair had 98 of its fleet's youngest-generation Boeing 737-8200S, the so-called "Gamechanger" aircraft. These aircraft are equipped with the latest technology, CFM-Leap 1B engines that are 16% more fuel efficient, reduce noise by 40%, and have 4% more seats than the previous generation (Ryanair, 2023).

12.4.1. Fleet Renewal

As a principal part of fleet renewal, the SAS plans to accelerate the retirement of older, less-efficient aircraft. In FY23, the company welcomed eight A320neo and five E195 airplanes, which phased out and rejected twelve aircraft, including two Airbus 350, one A320neo, five Boeing 737, and four Airbus a321. Out of 80 ordered Airbus 320neo, as of October 21, 2023, they had taken delivery of 62, and six out of eight A350 aircraft ordered in total. Finally, in the 140-200 seat category, they intend to operate a uniform fleet once all A320 aircraft are delivered (SAS, 2023).

Since 2013, Iberia has added 48 new aircraft to its fleet, including seven A350-900, six A320neo, and several A321neo. This latest generation significantly reduces fuel consumption and CO2 emissions, while the engines' combustion on the neo models is 50% smaller. In 2022, the company invested in five new aircraft (three A320neo and two A350-900) that enlarged its more sustainable fleet (Iberia, 2022).

KLM is also investing in more modern, high-performance aircraft with significantly lower environmental impact. As a result of this strategy, between early 2021 and the end of 2023, KLM welcomed 18 out of 25 new Embraer 195-E2 aircraft, emitting approximately 30% less CO2 per passenger-kilometer than the Embraer 190 that they replaced. Also, seven A350-900s and 16 A220-300 enriched the company's fleet. In 2023, they ordered a few Airbus A350s for the future long-haul sector and will renew the cargo fleet by replacing the entire Boeing 747-400 freighter with new Airbus A350F freighters (KLM, 2023).

In 2023, airBaltic expanded its uniform fleet by adding seven Airbus A220-300 aircraft and successfully concluded the re-delivery process of Bombardier Q400 NextGen turboprop aircraft, which is characterized by lower fuel consumption and, thus, lower CO2 emissions (Aircraft Commerce, 2009). Behind the scenes, they are working progressively to enrich their fleet further, so in Q4 2023, they converted 30 purchase options into orders and bought 20 new purchase rights of Airbus A220-300. To secure the capacity and deliveries in 2025 and 2026, they have signed two letters of intention with lessors related to aircraft deliveries in these two years (airBaltic, 2023).

Lufthansa Group invested in 29 new aircraft in 2023, including Airbus A320neos, A321neos, A350-900s and Boeing 787-9s. Since 2019, the Group has more than doubled the latest technology in its fleet to 20%, consisting of as many as 141 aircraft now. A total of 18 older aircraft have retired as part of modernization. In December 2023, the Group ordered 80 additional Boeing 737 MAX and Airbus A220-300 short- and medium-haul and signed 120 purchase options. Together with previous orders, the order book now comprises around 260 latest-generation aircraft. Moreover, the existing aircraft that will not be replaced soon is being modernized with innovative technologies like fuel-saving AeroSHARK technology that saves nearly five million kerosene annually (Lufthansa Group, 2023). As shown in Table 13, the group has as many as 253 firm orders for airplanes, with delivery expected between 2024 and2032, with 161 additional options.

Table 13

Lufthansa Group Fleet Orders

Lufthansa Group Fleet Orders (as of Dec 31,2023)

	Firm orders	Deliveries	Options
Long-haul fleet			
Airbus 350	42	2024 to 2031	
Boeing 787	34	2024 to 2028	13
Boeing 777	20	2024 to 2028	24
Boeing 777F	8	2024 to 2030	
Short-haul fleet			
Airbus A220	40	2026 to 2031	24
Airbus A320neo	46	2024 to 2028	40
Airbus A321neo	23	2024 to 2028	
Boeing 737	40	2027 to 2032	60
Total aircraft	**253**	**2024 to 2032**	**161**

Note: Data adapted from Lufthansa Fact Sheet 2023 (p. 9), by Lufthansa Group, 2023. Local PDF document.

Currently, TAP is implementing a forceful aircraft modernization program that foresees eliminating older and less efficient aircraft and gradually replacing them with aircraft with better energetic and environmental performance. In 2023, they received two new Airbus 321LR and phased out three planes that operated within the regional sector (TAP, 2023).

Wizz Air has continuously added new Airbus A321neo aircraft to its fleet, replacing older aircraft. In November 2021, the company signed an agreement with Airbus to purchase 102 Airbus A321 aircraft, comprising 75 Airbus A321neo and 27 Airbus A321XLR aircraft, with delivery expected between 2025 and 2027. Airbus has also granted Wizz Air 75 A321neo purchase rights for deliveries in 2028 and 2029, the completion of which must be approved by shareholders. Wizz Air was also the first aircraft operator in the fleet since every plane was delivered to the company brand new by Airbus. Moreover, Wizz Air may be a champion for replacing leased aircraft since they are typically relatively young, between eight and twelve years old, when the company returns them to the aircraft lessors (Wizz Air, 2023).

Ryanair is renewing its fleet by acquiring the Boeing 737-8200 and 737-MAX-10 aircraft, and it took delivery of a further 37 Boeing 737-8200 “Gamechanger” in 2023. In May, the airline signed an agreement with Boeing for 210 new Boeing 737-8200 aircraft from FY22 to FY25 and 300 new Boeing 737-MAX-10 aircraft from FY27 to FY34. The Boeing 737-MAX-10s are highly fuel efficient, the latest technology aircraft that offer 21% more seats, burn 20% less fuel and are 50% quieter than previous generation Boeing 737-800NGs (Ryanair, 2023).

12.4.2. Fleet Age

The age of an aircraft has a direct impact on its sustainability result. While younger planes are already built according to modern standards with a significantly reduced ecological footprint, older ones often require more maintenance and contain parts that are less efficient than the same ones for the newer generations.

The leader in the category of fleet age is certainly airBaltic, which was recognized by the web-based service provider ch-aviation as the winner of Europe’s Second Youngest Aircraft Fleet Award 2023, with an average fleet age of 3.8 years (airBaltic, 2023). Wizz Air is successfully refuting prejudices about LCC by operating one of the youngest fleets in the world – among airlines with more than 100 aircraft in their fleet, with an average age being 4.6 years, the company's average lease length being around ten years (Wizz Air, 2023). Additionally, the company aims to further reduce its aircraft lifetime to 3.1 years by 2027, underpinning its continued commitment to sustainability. Table 14 demonstrates the airline’s strategy to gradually achieve an average age fleet of 3.1 years until 2030 (Wizz Air, 2023).

Table 14

Wizz Air Fleet Age Plan

Fleet plan	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30
Avg. Fleet age	5.4	5.4	5.04	4.6	4.0	3.5	3.3	3.1	3.3	3.8	3.1
Avg. Seat count	201	205	213	219	226	231	234	235	236	237	237
Share of neo AC	7 %	20 %	36 %	49 %	64 %	76 %	87 %	94 %	99 %	100 %	100 %

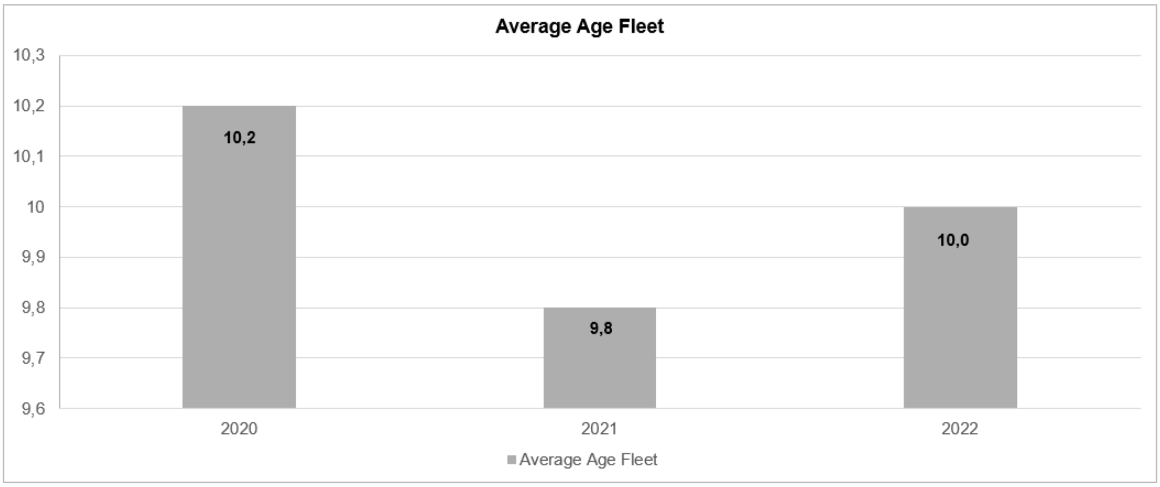
Note: Data adapted from Wizz Air annual report and accounts 2023 (p.24), by Wizz Air, 2023. Local PDF document.

Other airlines operate slightly older airplanes on average; thus, Ryanair's fleet was eight years old, and SAS´s was 8.6 years old as of December 2023.

In 2023, TAP´s fleet comprised 98 aircraft with an average age of 9.6 years. However, their neo fleet is one of the most recent fleets in Europe. TAP's neo fleet is also one of the youngest in Europe, generally aged 3.9 years (TAP, 2023).

Figure 5

Iberia Fleet Age



Note: Data adapted from Iberia annual report 2022 (p.3), by Iberia, 2022. Local PDF document.

Iberia's fleet is less modern, with an average age of ten years, slightly improved compared to 2020 but decreased to 2021, as summarized in Figure 5 (Iberia, 2022).

KLM Air France's general fleet age is 12.1 years, corresponding to 12.6 years for the long-haul fleet, 12.8 years for the medium-haul fleet, 20.8 years for the cargo fleet, and 9.5 years for the regional fleet (KLM, 2023).

The Lufthansa Group represents the most outdated fleet, with its airplanes flying the skies for 13.4 years on average (Statista, 2024).

12.5. Aspects of Efficient Consumption

Along with aircraft renewal, many other measures can be incorporated to improve overall flight efficiency. AirBaltic considers ongoing initiatives to enhance flight efficiency imperative and is trying to achieve this goal by collaborating daily with Maintenance, Dispatch, and Ground Operations teams. They are conducting Required Navigation Performance with Authorization Required approaches, resulting in more efficient arrival routing and notable reductions in noise and CO2 emissions (airBaltic, 2023). Next, they decrease aerodynamic drag by executing Reduced flap take-off and Landing procedures, which provide fuel savings compared to traditional full-flap landings and increased flap take-offs for a matching distance. They are also utilizing an Electronic Flight Bag (EFB) iPad solution, which, by replacing paper-based materials, lessens aircraft weight and reduces the distance flown per sector through initiatives such as Take-off in Direction of Flight, thereby decreasing general fuel consumption and CO2 emissions (airBaltic, 2023) What is more, a Single Engine Taxi-In policy at large airports with extended taxi times is a must, which involves shutting down one engine shortly after landing and taxiing to the parking stand using only one engine.

In 2023, TAP continued the Aircraft Weight Reduction project, which aims to identify and implement initiatives that allow reducing the weight transported on board its aircraft through the replacement and/or removal of items unrelated to its certification. Through this project, it was possible to implement 15 initiatives, including updating the trolleys used in the operation (replacing older ones with more modern, lighter ones) and reviewing catering boarding plans. Overall, the measures identified within the scope of this project have the potential to reduce annual consumption by around 1,700 tons of fuel, thus avoiding the emission of approximately 5,350 tons of CO2 (TAP, 2023).

Ryanair agreed with Aviation Partners Boeing to retrofit its 409 previous-generation Boeing 737-800NG fleet with split scimitar winglet technology. This upgrade will improve the airplane´s fuel consumption by up to 1.5% (Ryanair, 2023).

Like airBaltic, Iberia is also implementing single-engine taxiing at airports where taxiing time on both departures and arrivals allows for one of the engines of the aircraft to be switched off to reduce the emission of particulate pollutants and noise impact on the ground (Iberia 2022). Furthermore, they are limiting the use of APU (Auxiliary Power Unit) by connecting aircraft to the airport power grid, significantly reducing the noise impact and the emission of pollutants. Another measure that reduces noise pollution is coordination with air traffic controllers, which enables more efficient take-offs and landings, such as continuous ascents and descents. Iberia is committed to decreasing aircraft weight, one of the variables with the most significant impact on flight efficiency. They accomplish this by installing lighter seats, loading lighter trolleys, adjusting drinking water on flights, eliminating newspapers on board, and replacing flight plans with the EFB (Iberia, 2022).

SAS focuses on the correct aircraft size for a specific route since its extensive network of destinations and routes catering to varying passenger volumes necessitates an aircraft fleet of different sizes and ranges. Thanks to their regional production partners, they can adjust the schedule and aircraft sizes to match demand, particularly on routes with lower passenger numbers. This allows them to optimize fuel consumption and emissions per seat-kilometer (SAS, 2023).

Wizz Air joins other airlines with various initiatives that enhance flight efficiency. Wizz Air constantly measures and monitors fuel-related flight data, which is recorded by the aircraft itself and then used to create tail-specific performance models, which are then compared to the book-level performance. This helps increase the accuracy of the operational flight plan. The on-board flight management system uses idle factors to estimate the top of descent more accurately, which can help reduce the need to apply engine thrust or use speed brakes during descent. Instead of using the fixed weight of passengers and luggage to calculate flight operation plans, they introduced a machine-learning model trained with actual data over two years [...]. In addition, reduced take-off configurations have a significant fuel saving potential of around 10–15 kg of fuel per take-off due to decreased induced drag, meaning that a lower thrust setting is required. Moreover, when it is operationally feasible (runway length, aircraft weight, runway contamination), they use the idle reverse thrust on landing, reducing fuel consumption on the ground.

Like many other airlines, Wizz Air's pilots turn one engine off during taxi-in at the airport and after the required cooling period. Thanks to switching to aircraft weight instead of using fixed values when calculating final reserve fuel, Wizz Air managed to save around 100-200 kg of fuel that was needlessly used on top of the necessary amount of fuel (including safety precautions).

Like Ryanair, Wizz Air buys new planes with Sharklets and installs them on their older aircraft. They plan to have 100% of the fleet equipped with sharklets by 2024. Sharklets can reduce fuel burn by around 2% and reduce CO2 emissions by 800 tons/year/plane.

Finally, thanks to EFB, pilots make more accurate fuel planning decisions based on instantly updated data generated closer to the scheduled departure time. The new system is helping reduce fuel consumption due to more precise flight planning and weight reduction. This enables the use of more up-to-date weather forecasts, more accurate aircraft weights, and more optimal alternate airports and routes (Wizz Air, 2023).

12.5.1. Noise Pollution

Most companies mentioned noise levels significantly impacting air traffic, whereas airBaltic and Iberia aim to reduce air and noise pollution (airBaltic, 2023). For instance, Iberia tries to limit the use of APU. By connecting aircraft to the airport power grid, the noise impact of airport operations and the emission of pollutants are significantly reduced (Iberia, 2022). In comparison, Iberia and KLM have 100% compliance with ICAO noise chapters 4 & 14, whereas Wizz Air's 77% of the aircraft are compliant. To be more precise: The number of aircraft in the fleet meeting the ICAO Chapter four noise emissions standard is at 100%, and meeting the Chapter 14 emissions standard is at 77% currently (only the 41 A321ceo aircraft do not meet the Chapter 14 noise emissions standard) with a projection to get to 100% during 2029.

Wizz Air's fleet renewal program will deliver substantial noise reduction benefits yearly. The A321neo provides an almost 50% reduction in noise footprint versus the previous A321 aircraft (A321ceo) (Wizz Air, 2023).

Ryanair and SAS compared their FY23 as follows: 100% of Ryanair aircraft complied with the ICAO 10-decibel criterion. The introduction of over 120 new Boeing 737-8200s ahead of peak summer 2023 will maintain this high standard with operational noise emissions reductions of up to 40% compared to the Boeing 737-800NG, and the retrofit of the Boeing 737-800NGs with Scimitar winglets will also reduce take-off noise by approximately 6.5% (Ryanair, 2023). In FY23, there was a decrease in noise emissions during take-off (-2.2%) and a substantial reduction of 26.3% compared to 2010. This improvement is primarily due to introducing quieter and more modern aircraft (SAS, 2023).

12.5.2. Fuel Consumption

Since enormous quantities of fuel represent a large part of the company's environmental impact, it is essential to include this separately. This statement supports the following points in the reports.

The primary climate and environmental implications for the airBaltic Group arose from 177,789 tons of fuel consumption that resulted in 560,035 CO2 emissions. To reduce the adverse effects of its fuel consumption, airBaltic focuses on several mitigation actions: making continuous flight operation efficiency improvements that lead to reduced fuel consumption, using SAFs, switching to an electric ground vehicle fleet, and compensating for CO2 emissions. Further improvements would require a further increase in the cabin load factor and a gradual increase in the use of sustainable aviation fuels. By reducing fuel consumption, airlines can cut operational costs, potentially resulting in more affordable tickets for passengers. Additionally, the effort contributes to a decrease in CO2 emissions released (airBaltic, 2023).

Fuel efficiency initiatives can also be seen at Iberia. They monitor fuel consumption optimization throughout the flight annually, from airport operations like taxiing or using APUs to the entire flight phase, including the take-off and approach phases (Iberia, 2022).

The Lufthansa Group compared past decades: "While transport performance increased by 354% between 1991 and 2023, fuel consumption increased by only 170%. Specific fuel consumption in 1991 was still 446 g/tkm (grams of fuel per ton-kilometer transported); in the pre-crisis year 2019, this figure was already only 276 g/tkm, and in the 2023 reporting year, it was just 265 g/tkm. This corresponds to an efficiency increase of 41% compared to the base year 1991 (Lufthansa Group, 2023).

Currently, TAP has one of the youngest fleets in Europe, equipped with the latest state-of-the-art engines, which allows it to achieve essential levels of efficiency. Aircraft cabins are made of lighter materials to reduce weight on board, enabling savings in fuel consumption and carbon dioxide emissions (TAP, 2023).

To sum it up, Ryanair plans until FY31 their emission intensity target to jet-fuel usage with 25% reduction (Ryanair, 2023) compared to SAS`s continuous deliveries of more efficient aircraft, with 15–30% lower fuel consumption than the aircraft they replace (SAS, 2023).

12.6. Sustainable Aviation Fuels

Sustainable Aviation Fuels is the umbrella term for all sustainably produced aviation fuels (Lufthansa Group, 2023). They are made from renewable raw materials (Iberia, 2022) and are considered alternatives to fossil fuels as they can reduce greenhouse emissions by up to 80% (TAP, 2023). They can be divided into biofuels, which are obtained from biomass, and electro fuels, better known as e-fuels (power-to-liquid or power-to-jet-fuels) that are of non-biological origin, more precisely carbon-neutral synthetic fuels produced using renewable electrical energy through the synthesis of hydrogen or alcohols, amongst other raw materials (Iberia, 2022). In producing biofuels, diverse raw materials, such as cooking oils, vegetable oils, and municipal solid waste, can be used (TAP, 2023). E-fuels are produced using CO2 captured from the air, water, clever chemistry, and vast amounts of renewable energy (KLM, 2023).

Furthermore, to be considered sustainable, fuels must meet specific sustainability criteria determined in the Renewable Energy Directive (EU) 2018/2001/EU (RED II Directive) on the promotion and use of energy from renewable sources, which guarantees the fuel has a renewable origin and that its production does not compete with food production, nor does require deforestation practices or the high consumption of freshwater (Iberia, 2022).

The new European Union regulation, ReFuelEU Aviation, will come into force in 2025 and requires at least 2% SAFs on all flights in the EU, with a gradual increase to 70% by 2050 (European Commission, n.d.).

Lufthansa claims that SAFs are essential to the energy transition in aviation and that the key to making flying more climate-friendly is to increase the use of sustainable fuels. At the same time, airBaltic is sure that SAFs will play an essential role in ensuring the future of aviation, which is why they tend to increase their SAFs usage in 2024. SAS goes further and strictly uses SAFs, which satisfy long-term sustainability criteria, have no competition with food production or access to potable water, have minimal impact on biodiversity, and have efficient land utilization (SAS, 2023).

Likewise, Wizz Air thinks that alternative fuels are an essential part of decarbonizing the industry based on their established SAFs strategy, which includes securing off-take agreements with suppliers for the future (Wizz Air, 2023). The company is working with stakeholders to qualify a SAFs supply chain in line with the Ultra Low-Cost Carrier principles while meeting International Sustainability and Carbon Certification, Round Table on Sustainable Biomaterials, and EU Renewable Energy Directive II criteria on feedstock (Wizz Air, 2023).

SAF comes with various advantages, the main environmental being the size of its carbon footprint, which can be up to 80% or even 90% lower than conventional fuels. In addition, most of these fuels are less contaminated with impurities, further reducing the direct environmental impact of each flight. To use SAFs, airlines do not need to adapt or modify the supply infrastructure or the aircraft engines since SAFs have the same physical and chemical properties as conventional aviation fuel, meaning they can be applied without delay (Iberia, 2022).

On the other hand, the aviation industry has a long way to go before SAFs become standard, as various barriers must be overcome.
First and foremost, the certification process for SAFs can take several years and requires high and costly investments (Ryanair, 2023). What is more, even when it does acquire certification, aviation cannot look forward to an imminent increase in availability since it must compete for a limited feedstock base with other modes of transport, such as road and marine transport, whose decarbonization is also partially based on usage of SAFs (Ryanair, 2023).
SAF is being commercially produced today only in limited volumes and meets only a small percentage of the aviation industry's needs. The pricing is strongly uncompetitive, which encouraged Ryanair to call for a reduction of the price gap between jet kerosene and SAFs since currently, the cost of SAFs, depending on the feedstock and country of uplift, can be up to four times the price of ordinary jet kerosene (Ryanair, 2023). In addition, KLM claims that pricing is only the tip of the iceberg and is worried that supply issues will not be solved in the foreseeable future because there are only a handful of production plants in the world. Construction of new ones can last many years (Air France-KLM, 2023). Moreover, Ryanair speaks of a risk that through prohibitive pricing or lack of availability, companies will not be able to meet mandated SAFs blending requirements (Ryanair, 2023).

SAFs can also be produced using palm oil or crops that feed animals and people, raising another rather moral issue: deforestation and using food and feed-based crops in production. Another problem is represented by regulations still in their infancy (Air France-KLM, 2023). Also, according to KLM, there needs to be more regulation related to how using SAF in pure form can impact engines.

Finally, contrary to common opinion, SAFs emit the same volumes of CO_2 in the air as kerosene but avoid significant emissions during their total life cycle compared to fossil fuels (Air France-KLM, 2023).

12.6.1. SAFs Usage

As explained above, SAFs are only available in limited quantities within the aviation industry. Still, their expansion is expected in 2025, with a mandatory 2% blend introduced by the European Commission (airBaltic, 2023). Airlines have tried to increase their SAF utilization, but this is only partially possible due to many obstacles. The SAFs usage of several companies will be described below, while the usage of others is not available in reports.

AirBaltic has significantly improved, consuming 7,615 tons of SAFs in 2023, compared to 6,184 tons in 2022. This saved 6,701 tons of CO_2, equal to 1.2% of the Group's total jet fuel emissions (AirBaltic, 2023).

KLM has been a true SAF pioneer. In 2011, it operated the world's first flight containing SAFs. In 2023, the Air France—KLM group incorporated 17% of the world's SAF supply and voluntarily blended 1.2% SAFs, putting them at the industry's high end (Air France-KLM, 2023).

SAS successfully nearly doubled its utilization of SAF in 2023, primarily through the blend-in mandate in Norway and the reduction mandate in Sweden, with the support of customers dedicated to purchasing SAFs to make their fight fossil-free. They consumed 6,049 tons of SAFs (3,083 in 2022), the enhanced quality of which resulted in an average CO_2 reduction of 92% in 2023 (SAS, 2023).

Using SAFs, the Lufthansa Group reduced emissions that impact the climate by 43,628 tons in 2023, of which 39,195 tons were accounted for by direct savings in the combustion of SAFs (Lufthansa Group, 2023). Nonetheless, the total reduction from using SAFs remained almost identical to the previous year.

12.6.2. Agreements and Collaborations

Airlines are participating in many projects and investments to accelerate SAF production and obtain larger or at least required quantities.

But, at the same time, KLM is aware of the long way it still must go to reach its targets. Engineering and Maintenance worked with engine manufacturer CFM International and Neste, the world's largest SAFs producer, to test an engine using 100% SAFs. This helps KLM to understand how engines handle this type of fuel. By the end of 2023, KLM's usage stood at 1.2%. This percentage may seem low, but it puts KLM at the high end of the industry. The company also has strict criteria for using only SAFs that emit at least 75% less CO_2 than conventional fuel over the life cycle.

SAS initiated the ALIGHT project with Copenhagen Airport and the German Center for Aeronautics and Space Travel. During this project, one A320neo aircraft was flown four times daily for two consecutive weeks, utilizing a 30% blend of SAFs to measure local air quality. The results demonstrated that SAFs reduce particles and improve local air quality (SAS, 2023).

In April 2023, the company also introduced two new types of ticket: Go Smart Bio and Plus Pro Bio tickets. Passengers can purchase tickets with approximately 50% biofuel content, effectively lowering the CO_2 emissions associated with their SAS flight (SAS, 2023). SAS also consistently requests SAF quotes from all jet-fuel tenders to demonstrate a willingness to purchase biofuel when it meets sustainability criteria and competitiveness.

AirBaltic thinks that it is essential to raise awareness about SAFs among passengers, which is why, in May 2023, it offered them the opportunity to additionally buy SAFs ancillary products, meaning adding 1 kg of SAFs for economy class and 1.5 kg of SAFs for business class passengers (airBaltic, 2023). This resulted in 9,318 passengers, representing 0.21% of all bookings, adding SAFs to the flight throughout the summer of 2023 (airBaltic, 2023). Additionally, the airline continuously cooperates with industry partners and fuel providers to promote and accelerate the commercialization of SAFs, discusses the challenges that aviation faces, and explores more sustainable ways of flying, teamed with KLM.

Lufthansa Group works with research institutions and industry partners to drive the development of sustainable fuels and help speed up their production. The Group has joined the First Movers Coalition of the World Economic Forum, which aims to use at least 5% SAFs in 2030, with an emissions advantage of at least 85% compared to fossil fuel. Positively, this overcomes the statutory obligations since this 5% refers to the total fuel requirements of the Lufthansa Group (not just fuel taken on board in Europe as stated in the initiative), and the emissions advantage of SAFs required in the EU is 65% (Lufthansa Group, 2023).

From February 2023, Lufthansa Group will offer Economy Green and Business Green fares to its customers, which are supposed to reduce 20% of individual (additional) flight-related CO_2 emissions by using SAFs and offset the remaining 80% of CO_2 (Lufthansa Group, 2023).

KLM has set an ambitious goal of 10% of its global fuel consumption being SAFs by 2030, beyond the EU's mandated 6% for kerosene used on intra-European flights.
This is supposed to help to achieve 8% of KLM's overall CO_2 intensity reduction target in 2030. Together with Air France, they voluntarily add a SAFs surcharge of 1% to tickets for all flights from Schiphol Airport, which is used to buy and blend more SAFs. Now, they also offer customers the option to purchase extra SAFs voluntarily. In 2022, KLM established the corporate SAFs program, which currently participates in 130 businesses and the Dutch government, while a Cargo SAFs program is being used by large shippers and freight forwarders (KLM, 2023).

On the 10th of May 2023, Wizz Air took off from Budapest for the first time with a 37% blend of SAFs produced of cooking oil and animal fat by Finnish company Neste. Through this project, Wizz Air aims to support broader efforts in the aviation industry to reduce lifecycle CO_2 emissions and to prepare the supply system at Budapest Airport ahead of the SAFs blending mandate, which starts in 2025. Moreover, in 2022, they completed the first demonstration flight using 4.5 tons of SAFs, or 30% out of 100%.
Wizz Air is committed to complying with regulatory requirements related to SAFs, overcoming barriers, and upgrading the overall situation. In recognition of the numerous obstacles to SAFs, Wizz Air has closely followed the negotiations between the Council of the European Union on the Fit for 55 climate package and the European Parliament and has also advocated with stakeholders to improve current markets and policies. They stand up for SAFs flexibility mechanisms that would help airlines to meet the SAFs blending mandates when operating in regions with limited (or zero) possibilities to purchase SAFs at a favorable price, e.g., Central and Eastern Europe (CEE) and parts of the European periphery. This system should enable the purchase of requested quantities of SAFs even if they are unavailable at the airport from which they depart. The company is working on long-term SAFs supply contracts with prices below the market level that are supposed to provide enough SAFs to meet blending requirements from 2025 onwards.
Wizz Air signed a Memorandum of Understanding (MoU) with OMV for the supply of SAFs between 2023 and 2030, allowing Wizz Air to acquire up to 185,000 metric tons of SAFs from OMV. Moreover, Wizz Air has another MoU with Neste for SAFs purchases across its route network. Neste's SAFs are produced from 100% sustainably sourced renewable waste and residue raw materials and reduce greenhouse emissions by up to 80% over the fuel's life cycle compared to conventional fuel. Finally, another Mou, with Cepsa, will enable sufficient supply of the airline's route network in Spain as of 2025.
They announced a £ 5 million investment in Firefly, a biofuel company. This is Wizz Air's first equity investment in SAF research and development, and it will help them achieve the

American Society for Testing and Materials qualification. This investment will provide up to 525,000 tons of SAFs for the airline's UK operation from 2028 to 2043.

Wizz Air has strongly advocated the new ReFuelEU Aviation legislation introduced in April 2023. This legislation obligates fuel suppliers to provide airlines with gradually increasing amounts of SAFs to progressively increase their SAF intake (Wizz Air, 2023).

The IAG, whose member Iberia is committed to using SAFs on 10% of its flights by 2030 and investing $ 865 million in SAFs over the next 20 years, the figure is constantly rising. Iberia has a collaboration agreement with Repsol and Cepsa, the leading producers of SAFs in Spain, whose SAFs were used on many flights recently. They also have a SAFs supply agreement with Gevo that will enable that from 2028, flights departing from an airport in the State of California will operate with 45% SAFs. In 2021, IAG signed an agreement with Velocys to purchase 220,000 tons of SAFs in ten years starting in 2026, which will be used by Iberia, British Airways, and Aer Lingus. The technology used in this project will trap CO2 during the manufacturing process, thus permanently removing it from the atmosphere (Iberia, 2022).

Ryanair relies on SAFs to achieve 34% of its 2050 net zero target. Like other companies, it also seeks ways to overcome SAF barriers. In 2023, it signed a MoU to supply 675,000 mt of SAFs to its key European locations.

By expanding the SAF partnerships with Neste (Schiphol), OMV (Austria, Germany, and CEE), Shell (in London and Dublin) and announcing a multi-year MoU with Repsol to supply Ryanair bases in Spain, a significant step forward was made towards the 2030 goal of powering 12.5% of flights with SAFs.

Ryanair is actively cooperating with the European Commission, national governments, the Fueling Flight Project, and fuel suppliers to encourage government support for investment in SAFs, incentivize its use, and support introducing policies promoting sustainable fuels. The Group welcomes the SAFs blending mandates and has encouraged decision-makers to ensure that only genuinely sustainable SAFs will be distributed in the EU (Ryanair, 2023).

TAP has started working on an SAFs action plan, through which it hopes to sign Offtake Agreements and MoUs. They maintained their association with CoLAB BIOREF (Laboratório Colaborativo para as Biorefineries). They continued the partnership in the Move2LowC project, participating in two sub-projects where it shared its operational and regulatory experience in the aeronautical industry, which include refining autotrophic microalgae into bio-jet fuel – PPS1 and the production of biomass by fermentation for refining into bio-jet fuel – PPS2. This project was completed in 2023, and it was impossible to achieve the objective of producing enough bio-jet fuel to carry out tests on the engine bench. However, it proved to be an essential forum for sharing knowledge and innovation, allowing the creation of new future partnerships at both national and European levels.

12.7. Hub-Related Factors

Another often-forgotten critical part of the aviation industry is ground operations, which must be considered when evaluating an airline's sustainability results. This includes buildings, vehicles, and others.

AirBaltic, as part of process optimization, introduced educational training to its employees to mitigate greenhouse gas emissions arising from the energy consumption of its buildings. Additionally, the group strictly designs all new buildings to meet or exceed the 'excellent' energy efficiency standard to manage energy consumption and reduce costs effectively. Most of the Group's offices and buildings are heated by natural gas and diesel fuel (airBaltic, 2023). In 2023, the combined CO2 emissions from electricity and heating energy consumption were 315.87 tCO2 and 663.03 tCO2, respectively. For the owned real estate and ground vehicles, the Group has implemented the ISO 50001 energy management system and has been performing an internal energy audit following it, a management review, as well as an independent external energy audit. The latter has concluded that the company's energy management system has been deemed effective and complies with the standard (airBaltic, 2023). However, in Table 15, all indirect energy consumption comes from non-renewable resources, with no progress in 2023 toward renewable resources. Moreover, consumption has almost doubled compared to 2020.

Table 15

airBaltic Energy Consumption

All renewable key figures are 0

	2023	**2022**	**2021**	**2020**
Indirect Energy Consumption	non-renewable	non-renewable	non-renewable	non-renewable
Facility Electricity, MWh	2 897.93	1 711.61	1 507.13	1 249.22
Facility Electricity, GJ	10 432.55	6 161.78	5 425.66	4 497.20
Facility heat, MWh	3 349.30	2 129.83	2 469.71	2 161.00
Facility heat, GJ	12 057.48	7 667.39	8 890.95	7 779.61
Total, GJ	**22 490.03**	**13 829.16**	**14 316.61**	**12 271.81**

Note: Data adapted from airBaltic sustainability report 2023 (p.38), by airBaltic, 2023. Local PDF document

In 2023, the Lufthansa Group expanded waste management in offices and onboard to move towards more sustainable actions. They implemented a new recycling system that helped divert recyclables from general waste and reduced the amount of non-sorted waste by 9% per employee. The Lufthansa Group sets itself a goal to become carbon-neutral in its mobility on the ground in its home markets by 2030 (Lufthansa Group, 2023).

SAS employs and promotes vehicles with lower environmental impact for maintenance and ground-related services. At their main base, all vehicles are leased, and their fuel consumption is constantly monitored. The Cargo department tracks the CO2 output of their sub-contracted ground trucking operations, and any spillages are handled according to established procedures. The company recognizes the importance of mitigating the environmental impact of de-icing glycol runoff, but even though they have implemented advanced glycol capture and treatment systems, the usage of Glycol that is employed for aircraft de-icing increased to 2,729 thousand liters in 2023 (SAS, 2023).

TAP also agrees that it is essential to create modern, energy-efficient environments and workspaces for its employees across its extensive infrastructure on the ground. They seek to optimize workspaces to reduce energy consumption and increase productivity. Currently, TAP Campus facilities are covered by an Energy Rationalization Agreement for the period 2020-2027, approved by the Direção Geral de Energia e Geologia (General Directorate of Energy and Geology), which was based on an energy audit carried out by the facilities in 2020 (TAP, 2023). Moreover, like AirBaltic, TAP has also introduced educational environmental training for its workers.

Emissions reduction and the airports they operate from have net zero-related decarbonization targets, proving their commitment to sustainable airport operations, emissions reduction, and working towards carbon neutrality. In addition, in collaboration with Rentalcars.com and Green Motion, Wizz Air offers a 10% cashback reward for choosing an electric or hybrid vehicle (Wizz Air, 2023).

“Over 70% of our flights are to airports that have set a net zero goal. We engage with our airport partners to ensure future aviation infrastructure demands will be met. More and more airports that Ryanair flies to are increasing their use of electric ground handling with 40% of the diesel ground handling equipment” (Ryanair, 2023).

12.7.1. Electric Car Fleet

In 2021, AirBaltic gradually switched its ground vehicle fleet to electric cars. In 2023, the electric car fleet was expanded by six new vehicles, reaching 29 and reducing 58 tons of CO2 emissions compared to the previous year. Additionally, four charging stations (18 in 2022) were installed in the apron and technical areas, totaling 29.

However, a portion of the Group's ground fleet still consists of gasoline and diesel vehicles, whose CO_2 emission factors were 74 tCO_2 /TJ for diesel and 71.18 tCO_2 /TJ for gasoline vehicles. In 2023, the Company also started tracking the electricity emissions from electric cars (airBaltic, 2023).

Out of commitment to reducing its global Scope 1 emission and as part of an investment plan that enhances saving the planet and the employees, TAP started a program to renew the Maintenance and Engineering operational fleet in 2023 to replace combustion vehicles with electric vehicles gradually. This transition is expected to allow TAP savings of around 5,000 liters annually. In addition to this initiative, TAP began installing an electric vehicle charging network in its facilities in Lisbon, allowing the charging for both employees' and visitors' vehicles (TAP, 2023).

Since 2015, 80% of Iberia's ground equipment has been renewed, and 40% of this has been converted to electric power, allowing for a very significant reduction in emissions and fossil fuel consumption. In addition, two projects are being developed further to support the reduction of fuel consumption and atmospheric emissions: the catalytic converter (cleaner combustion) and telemetry (geolocation of the fleet to improve its efficiency) (Iberia, 2022).

KLM's strategy is to reach zero emissions on the ground, so it is electrifying ground equipment at Schiphol Airport. In 2023, 99 electric vehicles were delivered to KLM, including 14 push-back trucks, 13 ground power units, eight water service trucks, and two toilet service trucks. KLM also began testing an Iron Flow Battery, which can supply electricity to smaller ground power units (KLM, 2023).

Ryanair aims to entirely electrify ground vehicles by 2050. In 2023, their handling partners increased the usage of electric vehicles during the turnaround (Ryanair, 2023).

12.7.2. Energy Consumption

From 2019, all electrical energy consumed at Iberia-owned facilities will come from 100% renewable sources, reducing the environmental impact resulting from the use of this energy as well the emission of greenhouse gases, such as CO_2, to zero, contributing to the goals of decarbonization and improvements in air quality.

In December 2022, together with Getting Greener, Iberia started up the largest rooftop self-consumption plant amongst the Spanish Stock Exchange Ibex 35 companies or groups, intending to generate 80 million kilowatt hours, or 2.7 million kWh per year, which is equivalent to the consumption of 800 homes and means 32,000 tons less of CO_2 during the lifetime of the project (Iberia, 2022).

In 2023, TAP began constructing a new lounge for TAP and Star Alliance passengers in the non-Schengen area of Lisbon Airport under sustainability and energy efficiency priorities. Furthermore, Light Emitting Diode luminaires were used, and a centralized intelligent system called the Digital Addressable Lighting Interface was implemented, enabling individualized control of lighting, thus resulting in greater energy efficiency and significantly reducing energy consumption. Moreover, the centralized energy technical management system was implemented to achieve a more efficient operation of the facilities with the lowest possible energy consumption and maintenance effort. It finally replaced lighting in different operational spaces with LED luminaires (more than 900) and 70 old skylights in 2023, allowing energy savings of 25% compared to luminaires (TAP, 2023).

Ryanair follows the goal of using 100% renewable energy by 2050. Speaking of 2023, certified green electricity was used in their Dublin buildings and hangars in Seville, Stansted, and Vienna (Ryanair, 2023).

12.8. Companies' Presence

This category explains the individual positions of the companies regarding retrospective changes and plans. Three sub-categories were used for this purpose.

12.8.1. Changes to 2022

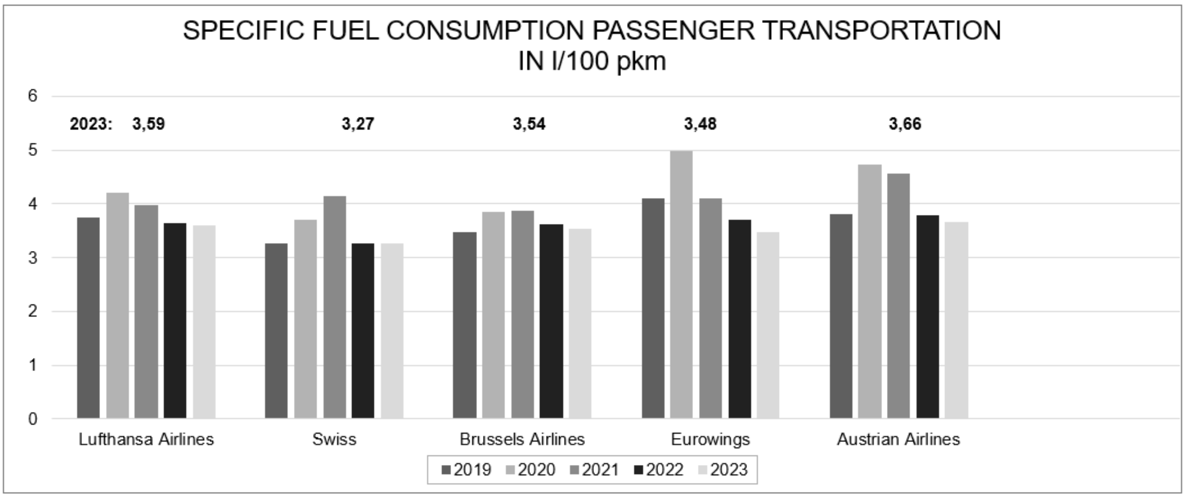
This subcategory addresses all topics relating to changes to FY22. This does not imply a specific topic area but only explicitly mentions improvements or modifications to the previous year that were brought to light.

Companies are searching for changes and improvements in each segment in which they operate. One example would be the proactive waste sorting initiatives in all airBaltic offices, which have proved successful. In 2023, 49.52 tons of mixed packaging waste were efficiently managed, a considerable amount compared to the 42.33 tons of mixed packaging waste handed over for recycling in 2022 (airBaltic, 2023).

In 2022, KLM launched its new strategy, and in 2023, it began embedding it in the organization, with dedicated people and formalized networks in every division. In 2022, KLM and Air France have already set their targets based on the SBTi. A Climate Action Plan that describes how KLM plans to reach these targets was launched. For the most part, KLM already has a concrete plan to reduce its emissions (KLM, 2023).

Figure 6

Fuel Consumption of individual subsidiaries



Note: Data adapted from Lufthansa Fact Sheet 2023 (p. 12), by Lufthansa Group, 2023. Local PDF document.

Figure 6 shows the fuel consumption of Lufthansa Group subsidiaries from 2019 until 2023 (Lufthansa Group, 2023). The improvements in the subsidiaries are evident here, and the report's discussion section critically examines them.

In 2023, TAP consolidated its strategy around the material topics identified in 2022. This exercise was carried out through an extensive analysis of the market, starting from benchmarking TAP's main peers in the aviation sector to the most recent trends in sustainability. Then, the company followed references with information on Environmental, Social, and Governance materiality for the industry from Standard & Poor's GLOBAL, the SASB for aviation, and the 2022 Sustainability Yearbook, among other references of good sector practices (TAP, 2023).

Ryanair illustrated its changes from the previous year through two short illustrations. The following key points can be summarized: In FY22, they established an absolute Scope 2 emissions reduction target of 35% by 2030 and an absolute non-fuel Scope 3 emissions reduction target of 50% by 2030 (Ryanair, 2023).

12.8.2. Future Implications

As mentioned, the most critical future implications for the companies will be summarized. AirBaltic is committed to minimizing the environmental impact as much as possible to reach carbon neutrality by 2050 (airBaltic, 2023).

Iberia claims to have ambitious goals ahead for the entire IAG group set out in the 2050 roadmap: to continue with efficiency until they hit at least a 10% improvement by 2025 compared to 2019. Iberia is committed to sustainability, so in 2022, it recovered its pre-pandemic efficiency levels and achieved 9% improvements compared to 2019 and 17% compared to 2013 (Iberia, 2022).

As part of its small steps, in 2023, improvements were made to the IT systems. These enable a joint train and aircraft boarding pass and better signage at Schiphol Airport. KLM wishes to expand the Air-Rail network to more European destinations (KLM, 2023).

The Lufthansa Group also looks for alternative transport to hubs: The expansion and interconnection of air, rail, and bus services make it possible to reduce the number of short-haul flights and offer alternative modes of travel (Lufthansa Group, 2023).

TAP summarized their milestones in Table 16, which shows the company's SDGs. It shows that the target for using SAF should be over 0.5% by 2030, and that more information needs to be provided about recycling after flights to Lisbon (TAP, 2023).

Table 16

TAP Sustainable Development Commitment

Sustainable Development Commitmment

	2024	2025	2030
	Obtain IATA environmental certification	Obtain ESG qualification for TAP suppliers and third parties	- 75 % of the TAP fleet to be new generation - Fly with 10 % SAF - Reduce in 20 % the CO2/pkm emissions (baseline 2019) - Recycle 100 % on flights with arrival at the Lisbon hub
Status in 2023	In Progress	In Progress	- 55 % of fleet is new generation - < 0.5 % SAF - 84g CO2/pkm - Not available
SDG	12	8	7,12, 13

Note: Data adapted TAP annual report 2023 (p. 21), by TAP, 2023. Local PDF document

In FY22, Ryanair published its Pathway to Net Zero, a detailed plan for reducing emissions. This pathway forms a vital pillar of the ongoing Group's strategy. Emission reductions will come from technological and operational improvements, SAFs, the Single European Sky initiative, and carbon offsetting (Ryanair, 2023).

By 2025, SAS wants to lower total CO2 emissions compared with 2005 by 25%. Until 2030, they aim to improve the following topics: Sustainable aviation fuel, noise reduction, sustainable materials in SAS' customer offering, and recycling where possible. By 2050, they want net zero carbon emissions, which aligns with IATA's updated ambition. In FY22, SAS committed to aligning with the Science-Based Targets initiative, offering a clearly defined pathway for emissions reduction in line with the goals of the Paris Agreement. For SAS, this commitment translates into a target of reducing our average carbon intensity by approximately 35-40% between 2019 and 2035. SAS and Airbus entered a MoU in 2019 to expedite the development of a 100-seat aircraft with technology enabling full-electric, hybrid, or hydrogen propulsion in the 2030s (SAS, 2023).

12.8.3. Sustainability Concerns

To this end, Iberia's sustainability strategy is defined in four fundamental pillars, which include environmental and social initiatives to accelerate the ecological transition of activities fairly and inclusively. In this regard, the first pillar includes initiatives to decarbonize and improve waste management; the second provides measures to achieve a more sustainable and personalized travel experience for customers; the third consists of training and awareness-raising projects for Iberia employees on sustainability; and the fourth includes initiatives that highlight the contribution of aviation activities to the well-being of society. Iberia continues improving its services and products to give customers more sustainable travel experience. The main actions developed in the last year have to do with the reduction of plastics, the recycling or the reuse of the materials used, the reduction of waste and weight on board the aircraft, or the development of the CO2 calculator, allowing customers to calculate the carbon footprint of their trip (Iberia, 2022).

KLM believes it can make a game-changing difference by investing in a new fleet, using SAF, and stimulating the emergence of zero-emission aviation. KLM is fully committed to making air travel more sustainable but must change the industry before achieving its sustainability targets. That is why KLM works with businesses, researchers, knowledge institutions, and policymakers on changing regulations, getting parties to invest in facilities, and ensuring a level playing field for EU and non-EU airlines (KLM, 2023).

Following Lufthansa Group's mission statement to connect people, cultures, and economies sustainably, they make every effort to minimize the environmental impact of flying and to use resources and every drop of kerosene as efficiently as possible. Their declared goal is to lead the way in transforming their industry, and they have set ambitious targets to do so by claiming, "We aim to be carbon-neutral by 2050, and we want to halve the net CO2 emissions of our flight operations from their 2019 levels by 2030. Our commitment to sustainability at the Lufthansa Group is also rated positively by several independent rating organizations" (Lufthansa Group, 2023).

TAP assumes sustainability as a strategic pillar of transversal action to its business, operational performance, and competitive position in the market, incorporating the focus on responsible, ethical, and resilient management into its business processes. In redefining its vision for the future, TAP identified five essential pillars of strategic action, where the Planet assumes one of the prominent positions. 2023 will be marked as a year of deep and interdisciplinary reflection across the different areas of the Company to define a robust medium-term strategy aligned with relevant material topics where the environment plays an essential role (TAP, 2023).

Wizz Air is dedicated to this subject area with a manifesto: "We launched Wizz Air with the strong belief that air travel should not be a privilege. We will create a world of opportunity for all through affordable travel […] Crucial business models and design decisions, from pricing to seat density, make sure we fly with high load factors. We've never even considered business class seats, a hub-and-spoke model, or substituting train rides below four hours for flights. Instead, we've focused on flying with the youngest, most efficient fleet and the most modern engines possible to consume less fuel. This delivers the industry's lowest CO2 emissions per passenger kilometer, beating legacy carriers and low-cost airlines operating similarly to us. A plane will never be greener than a train or an electric vehicle. But we are and will be the greenest choice of flying. Because when it comes to a crucial issue like sustainability, we believe in the facts of today, not the promises of the future […] Our sustainability strategy is integrated with the Company's vision and plan to achieve WIZZ500 by 2030 and, as such, we have set 15 objectives to deliver on Wizz Air's sustainability ambition" (Wizz Air, 2023).

Ryanair has developed a comprehensive Climate Transition Plan encompassing their approach to reducing carbon emissions through fleet renewal and new technologies, promoting the scaling and use of sustainable aviation fuels, and prioritizing climate change across business. Using FY23 as the base year, the Group targets a reduction in CO2 intensity of 25% by the end of FY31, from a previous target of a 10% reduction. Additionally, the Group is introducing a new near-term efficiency target to reduce CO2 per pax/km [...] FY26 (Ryanair, 2023).

Lastly, SAS acknowledges its responsibility to minimize its environmental footprint. "We focus on reducing our climate and environmental impact through various initiatives. Our primary areas of environmental concern include aircraft fuel efficiency, resource utilization, and waste reduction. We aim to decrease carbon emissions, optimize resource use, and promote biodiversity conservation […] The transition to more sustainable air travel is an existential topic for SAS, and we believe that sustainable development means continuous improvements in all relevant areas of sustainability. We have a well-defined process for continuously reviewing relevant sustainability topics. The process involves engaging with internal and external stakeholders based on international guidelines such as the GRI, the UN Global Compact, the UN SDGs, global trends, the media, stakeholder dialogues, and our assessments of risks and opportunities" (SAS, 2023).

13. Discussion of the Data

This section of the thesis critically reflects on the data found and presented in the previous part. For this purpose, the categories will be discussed individually, while the subcategories will not be examined separately again.

13.1. Waste Handling

With a critical look at the issue of waste management, there have been improvements and changes in waste separation processes, which are increasingly being implemented. However, it must be emphasized that the quantities of waste within companies, whether recyclable or non-recyclable, are enormous. Even if options such as pre-ordering or discounts for fresh products are offered before the end of the flight, the amount of food and its equipment is still higher than what can ultimately be used. Many passengers, for example, have yet to become familiar with pre-ordering. Therefore, emphasis must be put on this in the reports concerning the actual process on board. Especially on long flights where food and drinks are included, a lot of them are thrown away and not recycled at the end.

In these sections of the reports, the terms “can” and “will” were frequently used, but it was unclear how much is in the process of change and improvement. The quantities of plastic, sometimes neglected in the reports but occurring in everyday life, should also not be ignored. For example, drinks are served in plastic, or most products are still packaged in plastic.

Changes are apparent and recognizable in ground operations. This is because it is easier to separate waste from the ground and dispose of it accordingly. Inside the aircraft, this is probably not treated as a priority for reasons of space and time. The future goals are a positive development in which all waste, whether on board or the ground, will be separated and increasingly recycled in the coming years. The concepts of pre-ordering and throwing away fresh food will be continuously improved, resulting in less waste.

Based on the data presented, it is evident that the amount of waste at airlines like airBaltic and Iberia has even increased compared to the reference year 2022. The graphic provided by the company SAS also shows that, although the amount of waste decreased between 2022 and 2023, the amount of mixed, non-separated waste increased, which cannot be viewed positively.

In summary, efforts are being made to improve, and the issue of waste separation will be addressed. The reports clearly show the importance of this issue, even though signs of greenwashing, as explained above, can be substantiated.

The promotion of significant waste reductions is portrayed much more favorably than what the actual figures and behind-the-scenes realities can support.

13.2. The Participation Interest of Companies

A positive aspect for all the companies analyzed is that they have yet to suspend cooperation with or under the influence of external partnerships. Even though some view the benchmarks set by these organizations as the maximum performance, which could undoubtedly be exceeded, the goals remain clear. All companies state that they comply with the rules and regulations of well-known organizations such as IATA. Furthermore, they all claim to have set targets for the year 2050 and want to meet them.

However, the environmental impact calculators for each passenger mentioned in the reports should be viewed critically. Numerous reports on the internet demonstrate the greenwashing involved in such practices. The European Commission published a warning regarding greenwashing, where companies present consumers with a “calculator” for the CO2 emissions of a specific flight without providing sufficient scientific proof on whether such calculation is reliable and without information on the elements used for such calculation (European Commission, 2024).

The following points from the article are repeatedly evident in the reports and could thus be substantiated and confirmed. Greenwashing is especially noticeable when using terms like "green," "sustainable," or "responsible." The term Sustainable Aviation Fuel is also frequently used. However, its current and near-future use is significantly limited, and the environmental impact and production costs are substantial. The article also confirms that most sections of the sustainability reports discuss the path to achieving net-zero greenhouse gas emissions. However, it should be noted that this is a plan, with the steps to reach that goal needing to be clearly outlined, and the specific components of how to get there need to be presented with concrete numbers and facts.

Almost all companies list the 13th goal of climate action in their report, which can be classified as positive. On the other hand, not every report lists clean energy as a focus and SDG goal. Some of the goals also do not concern greenwashing and CER in the direct sense and are more focused on topics such as gender equality (SDG 5) (United Nations, 2015). If one looks at the bias towards LCCs in this area, it is visible that Ryanair, for example, has a better ESG rating than the Lufthansa Group. According to Sustainalytics, both companies have a medium risk rating, with the Lufthansa Group's rating at 28.3 and Ryanair's at 23.4. It must be considered that all companies are rated at medium risk, which means an overall score of 20-29.99 points. The enterprise values have a medium risk of impacts driven by ESG factors (Karoui & Zerter, 2023).

13.3. Fleet Management

Fleet management is undoubtedly one of the most essential factors in enabling sustainable aviation. Still, it is evident that, despite the efforts and will, the entire fleet renewal process has been prolonged at most examined companies. This can be attributed to several factors. First, constructing an airplane is a long process, and the existing manufacturers simply need more capacity to deliver the ordered airplanes in the desired period. Sometimes, they are limited by government authorities to a certain quantity monthly, as is currently the case with the new Boeing MAX program, which is limited to 38 per month. Still, Boeing needs to reach this level (Al Root, 2024). MAX has a backlog of around 4,800 aircraft (State: April 2024), and it is estimated that, at this rate, it will take about 20 years to fulfill it (Al Root, 2024). Second, airplanes are costly investments, and airlines often need more financial resources to acquire new aircraft quickly (Tusa, 2024). As a result, one might get the impression, after reviewing reports, that while airlines recognize the need to retire aging aircraft, this process is either delayed or avoided. For instance, Iberia's report needs to address fleet renewal in more detail, and Air France - KLM only briefly mentions the phasing out of cargo planes.

Additionally, Iberia's acquisition of fewer than 20 new Airbus models over nine years since 2013 hardly reflects rapid fleet growth. Similarly, after reviewing Air France - KLM's report, the detailed composition of its fleet still needs to be discovered. Furthermore, these two companies have some of the oldest fleets among the examined airlines, highlighting their limited investment in fleet renewal.

Unfortunately, the modernization of Lufthansa's fleet is progressing slowly. In 2023, only 20% of the airline's aircraft were considered the latest models, and with new deliveries being spread across multiple subsidiaries, the pace of renewal could be better. Furthermore, nearly half of the current aircraft orders are options, which may result in something other than actual purchases. Given this situation, Lufthansa's goal of rapidly renewing its fleet seems far from being achieved, and it may take years, if not decades, before most of the fleet is fully modernized.

On the other hand, SAS demonstrates a solid commitment to fleet renewal and provides an excellent example of efficiently balancing aircraft retirement and the introduction of newer models. AirBaltic aggressively pursues its fleet renewal strategy and responds swiftly to market changes.

On the other hand, even though TAP maintains a modern fleet, the fleet modernization must be accelerated to align with the strategy.

Wizz Air, known as the largest operator of neo-technology aircraft, has made significant investments in fleet modernization, significantly increasing the share of neo-technology aircraft, which aligns with their renewal strategy. Moreover, their current fleet age is low, and the presented age plan for the upcoming year promises a well-structured and young fleet. Ryanair's current fleet composition, as of September 2024, reveals that in March 2023, only one-fifth of its aircraft featured the latest technologies, indicating room for improvement in modernization efforts.

13.4. Emissions

CO_2 emissions remain a crucial topic in aviation, and we have witnessed that air traffic intensity has recovered after the pandemic. This means more frequent flights with higher occupancy of cabins and seats. The best example is airBaltic, which, by applying alternative methods such as a taxi with one running engine, managed to reduce CO_2 emissions despite a more significant number of passengers. Iberia joins as the company that managed to reduce emissions the most in 2022. However, companies rely heavily on using SAFs and fleet modernization to reduce CO_2 emissions, such as KLM, which focuses on replacing four-engine B747 with new A350 freighters. Still, it will take many more years for most old aircraft to be replaced by new ones and become the standard.
Moreover, allowing passengers to buy additional SAFs, lowering CO_2 emissions can be ensured. Still, practice shows that this is a very uncontrolled initiative and that there are many indications of greenwashing. TAP claims to have one of the youngest fleets in Europe, reducing CO_2 impact, but this is an indicator of greenwashing since the youngest fleets in Europe are between three and four years old, as seen in airBaltic's example. It has been shown that various take-off and landing configurations lead to savings in emissions and fuel, but there is a lack of precise information on the frequency of use and regulations on when and how such use is made. Benefits can be seen at the companies that operate very young fleets, such as Wizz Air, which had the lowest carbon emissions in the industry expressed in CO_2 per revenue passenger kilometer as it operates the youngest fleet at the highest seat load factors.

Furthermore, voluntary internal projects, such as AirSHARK at Lufthansa group, proved to be a good starting point for the pathway to carbon neutrality since this project helped to reduce CO_2 output in the whole group. Likewise, TAP's initiative to make planes lighter helped them reduce the CO_2 impact compared to 2019. Opposite to airBaltic, a negative trend can be observed at SAS, which failed to handle the traffic increase efficiently and has significantly increased its overall carbon emission. Most companies intend to be carbon neutral by 2050, but few are showing a promising picture.

In addition, it must be noted that misleading information in the calculations of emissions consumption does not enlighten the reader of the Ryanair report. While they show a steady decrease in Scope 1-3 emissions, one table calculates the intensity of these emissions to be 0.0. This contradicts other data showing that consumption decreased by 35% by 2030 but amounted to 2.372 metric tons of carbon dioxide equivalent in FY23.

13.5. Aspects of Consumption

Reports show that without single engine taxiing (SET) emissions and fuel consumption would be 50% higher (Stettler et al., 2018). The benefits are demonstrated, such as fewer engines running means less noise pollution, which benefits airports near residential areas. Operating just one engine reduces fuel consumption, saving vast amounts, especially at large airports where taxi distances can be significant. Suppose one takes a closer look at this subject area. In that case, it is also noticeable that larger wide-body aircraft like the Boeing 777 or Airbus A350, commonly used by the Lufthansa Group for long-range flights, also use this technique. Still, it’s less frequent because of their size and power demands during taxiing (Kameníková et al., 2022).

However, it should be noted that more precise information needs to be provided about how often and when SET is used. Some airlines may use it consistently, while others may adopt it only in certain conditions, such as during low traffic or on long taxiways.

A positive aspect to be seen in the graph from airBaltic is the consumption of kg per flight, which has increased by 4.9 kg, but the CO2 savings have increased by 16 kg per flight. Wizz Air's savings of 100-200 kg are also considerable, but this must also be considered in terms of actual fuel consumption in kilograms per flight. This weight is only a tiny part of the fuel consumed. The introduction of lighter trolleys, seats, and loading plans for the individual companies are listed, as seen with Ryanair and Iberia. Still, there need to be more precise details about when and to what extent these will be implemented.

It is essential to highlight that each company is aware of the environmental impact caused by their enormous fuel consumption. Ideas and actions are in place to save as much fuel as possible, thus increasing efficiency. For instance, the Lufthansa Group achieved an efficiency increase of 41% compared to the base year 1991, where Greenwashing couldn't be identified. The same applies to noise regulations. This may be due to the homogeneous framework set by the ICAO, which companies adhere to, eliminating the need for greenwashing.

Ryanair mentions that they have started retrofitting their previous aircraft models, but more information is needed on how many have been done. From other sources, it was only possible to find that the first one was retrofitted in January 2023, indicating a sign of hiding information and greenwashing (Hardiman, 2023).

13.6. Sustainable Aviation Fuels

Sustainable Aviation Fuels are emerging as a vital solution to help decarbonize the aviation industry, reducing its environmental footprint and dependence on fossil fuels. The sector hopes they will be the key to the future of sustainable air travel.

Reports highlight some of the SAFs' environmental benefits, such as reduced lifecycle greenhouse gas emissions by up to 80%, less contamination by impurities, and no requirement of changes to existing aviation infrastructure, as they are chemically like conventional jet fuel. This allows for immediate adoption without modifications to aircraft or fuel supply systems.

Moreover, SAFs align with stringent sustainability criteria and regulations that ensure their production does not lead to deforestation, excessive freshwater use, or competition with food production. These safeguards ensure that SAF production remains environmentally sustainable in the long term.

On the other hand, despite the various benefits of SAFs, several barriers still need to be overcome before they can be widely adopted. One of the biggest challenges is cost. SAFs are currently up to four times more expensive than conventional jet fuel, making them economically uncompetitive. Some airlines like Ryanair have called for reducing the price gap to make SAFs more viable.

Additionally, SAF production is limited, with only a few commercial plants operating globally. Building new plants is time-consuming and expensive, making it difficult to scale up production to meet industry demands. SAFs also face competition for raw materials from other transportation sectors like road and marine transport, limiting availability.

Certification and regulatory issues present further obstacles. The SAF certification process is lengthy and costly, and current regulations are still evolving.

The production of SAFs raises some ethical and moral questions, mainly involving palm oil, food crops, or animal fat, which could ring a bell at the organizations for animal protection. The potential for deforestation and diversifying food resources for fuel production are significant concerns, prompting calls for stricter sustainability standards and better regulation.

Furthermore, while SAFs reduce lifecycle emissions compared to fossil fuels, they still emit the same amount of CO2 during flight as conventional kerosene. For this reason, a question arises as to whether the sacrifice for SAF production is too great. The emissions reductions come primarily from how SAFs are produced and the renewable nature of their feedstocks. Still, their impact on overall atmospheric carbon levels remains a topic of debate.

Regulations and mandates within the European Union predict a gradual growth in the mandatory usage of SAFs. Still, airlines know that fulfilling them will be significantly complicated, given the abovementioned obstacles.

SAFs hold significant promises for reducing the aviation industry's carbon footprint, with the potential to cut greenhouse gas emissions by up to 80%. However, challenges such as high production costs, limited availability, and regulatory hurdles must be overcome before SAFs become the industry standard. As research and investment continue, SAFs will likely play a critical role in making air travel more sustainable, but their widespread adoption will take time.
Speaking of current SAF usage, several airlines have already made meaningful strides in incorporating SAFs into their operations, though usage rates remain relatively low overall. There is the upcoming mandate of 2%, but it still needs to be determined what difference it will make when 98% remains conventional fuel. For instance, airBaltic made notable progress in 2023 by consuming 7,615 tons of SAFs, an increase from 6,184 tons in 2022. Despite these improvements, airBaltic’s use of SAFs still represents a small fraction of its overall fuel consumption, reflecting the broader industry’s struggle to scale up SAF usage significantly.
KLM has positioned itself as a leader in SAF adoption, having pioneered the world’s first flight using SAF in 2011. In 2023, the Air France-KLM group accounted for 17% of the global SAF supply and voluntarily blended 1.2% of SAFs into its fuel. Although this percentage is higher than many other airlines, it highlights the gap between current SAF usage and the industry’s long-term decarbonization goals.
Even though the Lufthansa Group managed to reduce CO2 emissions by blending SAFs, the total reduction in emissions from SAFs usage remained roughly the same as in 2022, signaling a plateau in growth for Lufthansa’s SAFs program and greenwashing possibility. This underscores the difficulties in scaling SAF adoption despite growing awareness and commitment to sustainability.
Given the barriers explained above, the airlines invest a lot of effort and financial means in projects, investments, initiatives, and discussions to improve the overall SAFs situation. One of the critical areas where airlines have made progress is collaborative testing and research. KLM, a frontrunner in SAF adoption, has worked with engine manufacturer CFM International and Neste, the world’s largest SAF producer, to test engines running on 100% SAFs, which helped them understand how engines perform with this type of fuel and obtain an essential piece of information that had been lacking for years before the testing. Some airlines have introduced the option to purchase SAFs and ancillary products, which has positively influenced the adoption of SAFs. However, as already explained, there are rumors and accusations that these initiatives lack evidence of reliability. Moreover, airlines claim to be using this additional revenue to buy and blend more SAFs, but this raises the question of whether they manage to buy more SAFs even with the seemingly covered costs, given the current massive shortage on the market.
The SAFs area still needs regulatory advocacy and flexibility mechanisms. In recognition of these challenges surrounding SAF production, several airlines have actively engaged

policymakers to advocate for more flexible regulations. Wizz Air has been closely following the Fit for 55 climate package negotiations and has advocated flexibility mechanisms to help airlines meet SAF mandates in regions where SAFs are not readily available. These mechanisms allow airlines to purchase SAFs from locations with better supply and pricing conditions, ensuring compliance with EU regulations while avoiding prohibitive costs.

A positive trend can be observed at several airlines that have signed memoranda of understanding and long-term offtake agreements with SAF producers and suppliers to secure long-term SAF supply and manage costs. Still, concerns need to be addressed whether the agreed quantities will be sufficient to meet the demands and regulatory requirements and make a change. Nevertheless, these long-term agreements are essential for helping airlines meet the SAFs blending mandates that will take effect in 2025 and beyond.

13.7. Hub-Related Factors

Hub-related operations again show relatively slow progress toward sustainability, i.e., the first point is the heating of buildings, where airBaltic admits that it uses natural gas and diesel fuel, which cannot be considered green. At the same time, other companies do not provide information. airBaltic introduced standard ISO 50001 for owned real estate and ground vehicles, the implementation of which is checked by internal management, as well as by external organizations, but the report only mentions the internal one that reached a positive result, which as the experience teaches us, can be easily manipulated. At the same time, no words describe the outcome of external control.

SAS claims to be handling fuel spills according to established procedures but does not provide any data on the quantity of spillage. Moreover, the advanced glycol capture system has yet to help due to increased usage.

Only two companies, airBaltic and TAP, discussed introducing environmental education training for their employees, which shows that there is much room for improvement in the aviation industry.

Wizz Air and Ryanair rely on the fact that more than half of the airports they fly to are committed to sustainability, but more data is needed on how and to what extent.

There is a lot of talk about the electrification of vehicles used for airport operations. However, for some, it remained at the level of a story, like Ryanair, which talks about its plan to be ground operation neutral by 2050. Still, for the last year, there is only information that 40% of the ground equipment was electrified, and that is only in Spain, and Ryanair flies in as many as 37 countries (Ryanair, n.d.). For example, there must be more information about their home country, Ireland. Although some companies have renewed their vehicles in the past few years, it is noticeable that many still use combustion vehicles. AirBaltic also started measuring the emissions of its electric cars, which leads us to conclude that even such vehicles are not wholly neutral for the planet and pollution. A positive trend can be seen within airBaltic and TAP, which have started to install chargers for electric vehicles at their main airports in Riga and Lisbon. Also, KLM received as many as 99 new electric vehicles last year and started testing a new type of battery for smaller vehicles.

Regarding overall energy consumption, a positive example can be seen at Iberia, which uses 100% energy that comes from 100% renewable sources. Furthermore, Iberia and TAP invested in more modern lounges, systems, or plants that aim to significantly reduce their energy consumption, enabling TAP to use 25% less energy than the previous year. On the other hand, Ryanair, as part of its goal to be climate neutral by 2050, mentions that it has used certified green energy in its specific ground locations but needs to provide data on how much, which still needs to be clarified and leaves suspicion for greenwashing.

13.8. Companies' Presence

To critically examine the significant aspects of the changes compared to the previous year, airBaltic highlights in its report the successful recycling of 49.52 tons of mixed waste, representing an increase of 7.19 tons compared to the prior year. On the one hand, KLM's report presents only concrete plans without any specific data or defined changes that have been documented. The same applies to Ryanair, which has set targets for the future that it aims to achieve. On the other hand, the Lufthansa Group provides a detailed chart showing the individual fuel consumption of each subsidiary. Here, improvements are observed in each of the subsidiaries, except for Swiss, where consumption has remained unchanged. The most significant change of 0.23 liters per passenger-kilometer (l/pkm) is seen at Eurowings, followed by 0.12 l/pkm at Austrian Airlines. TAP reports on an extensive market analysis they have conducted to implement improvements for the coming years. However, more precise information about actual changes could not be derived from the report.
The plans of the individual companies cannot be critically assessed in concrete terms from the current perspective. As has been evident, companies like KLM write extensively about the goals and plans they aim to achieve or adhere to. However, it remains to be seen how much of this will be realized. Some goals may seem overly ambitious, such as achieving complete carbon neutrality by 2050, as this requires far more extensive and concrete plans than currently exist. At the same time, improvements are anticipated regarding topics mentioned by Iberia, such as reducing plastic. However, the mention of future calculators for air travel raises concerns that could point to greenwashing. The most important thing is that companies continue to work on themselves and move in a less environmentally harmful direction, where

possible. However, claims about a complete transition to SAFs remain questionable, as visible in KLMs report.

Significant parallels regarding prospects also call into question the reliability of the individual statements. Within the same industry, the goals do not differ significantly; however, companies pursue practically the same objectives, merely described in different terms. Ultimately, how much of this will be realized is already questionable at the formulation stage.

14. Conclusion

The objective of this study was to conduct a substantive analysis of sustainability reports by deconstructing them into their thematic components and subsequently comparing them among similar operating airlines from European airports. The results provide a comprehensive overview of the communication of sustainable engagement in the year 2023.
Additionally, trends in the civil aviation sector become apparent. Through thoroughly examining and processing relevant literature, the qualitative investigation was initially embedded into the subject matter and the current state of research. In addition to defining terms and providing an industry introduction, the intentions and backgrounds of CSR and CER were outlined. For the subsequent empirical investigation, sustainability reports from 2023 or 2022 in the case of Iberia from a sample of eight internationally operating airlines were analyzed. The selection of companies was based on recognition factors and the number of operations conducted from the Vienna, Austria location. The reports were coded and evaluated using Mayring's qualitative content analysis methodology concerning four research questions. The composition and the relationship of the thematic areas to each other were examined based on the three dimensions of the Triple Bottom Line and the hierarchical dimensions according to Caroll's pyramid. The evaluation highlights a focus on ecological aspects among European airlines. The topics relating to social and economic components were deliberately only considered in the background here, as this would go beyond the scope of this thesis. Additionally, the statements in the sustainability reports were analyzed in terms of their time horizon. In particular, the proportion of communicated plans and future intentions per airline was determined.

After presenting and critically analyzing the study's results in the previous chapter, the findings are summarized in this conclusion, which addresses the research questions. The conclusion seeks to comprehensively answer the research questions and present detailed findings from the data outlined in the preceding sections and provided by the companies in the reports. Furthermore, this section will detect signs of greenwashing and highlight the positive examples that align with CER and CSR principles and a company's strategy.

Research Question 1: How do examined airlines' environmental responsibility strategies and actions align with CER and CSR theoretical frameworks and principles?

CSR and CER standards require that companies' strategies have primarily positive intentions, with a significant appreciation of the need for profit for the company to survive. Also, they consider it very important that actions and initiatives are in harmony with nature and the population, that they do not endanger them, and that they are trying to reduce their negative impact on the planet as much as possible. Reports of the companies examined thoroughly cover this section and explain the strategies, actions, and initiatives. All companies have created and described their environmental sustainability strategies according to their responsibility to the planet and people. However, to begin with, top management, airBaltic and Wizz Air are the only airlines that claim that their fight for the planet starts from the very top of the company and that they have even established a sustainability board or sustainability committee that regularly monitor development and progress in this field. As explained in the theoretical part; to prevent greenwashing and to successfully progress on the path to sustainability, the very head people of the company must be engaged. Unfortunately, all other companies describe a company-level strategy without clearly explaining how it will be carried out and monitored.

Nevertheless, other actions companies take in pursuit of sustainability mostly align with the principles of CER and CSR. Thus, they have ambitious strategies for fleet renewal, which coincide with the principle of implementing new technologies.

Moreover, this step will further reduce carbon footprint since new-generation aircraft are designed to be more CO2 effective. SAS, TAP, and airBaltic include active interaction with stakeholders in their strategy. As described before, part of the plan is waste management and improving the efficiency of their operations to reduce their environmental impact, such as making an aircraft lighter or one-engine taxiing.

Furthermore, operations on the ground are a large part of the strategy, where partners, suppliers, and other participants of value chain management are involved, working together in the direction of sustainability. Sustainable aviation fuels are an inseparable part of the future of aviation, including these companies, which have signed many agreements and collaborations to ensure their supply in the upcoming years. Wizz Air went one step further and invested in a production plant.

However, the companies' action plans must sufficiently promote sustainability and care for nature. Furthermore, airplane maintenance should be mentioned in the reports; thus, it remains to be discovered. Although aircraft maintenance is of the utmost importance for the sustainability strategy, it is disregarded in all reports.

In conclusion, based on the CER theoretical framework, all companies align their strategies with these principles to varying degrees. While companies like AirBaltic fully integrate CER into their approach, others implement it only partially, like Ryanair.

Research Question 2: To what extent do airlines comply with environmental standards and rules?

After carefully examining the sustainability reports, it can be confirmed that each company adheres to international and national requirements, as they would not otherwise be allowed to carry out operations at European airports. However, these vary in terms of selection. Following the Triple Bottom Line theory, several companies implement the environmental dimension into their business operations and implicit CSR activities.
At this point, it is essential to note that all three dimensions—economic, ecological, and social—are addressed multiple times, with various issues being thoroughly dealt with. For instance, noise regulations, customer orientation, and operational efficiency are not overlooked. Analyzing Caroll's pyramid, one can observe that every company maintains financial stability, encompassing the economic factor. The next level of legal responsibilities is also fulfilled by addressing frameworks such as the EU Emissions Trading System and the Carbon Offsetting and Reduction Scheme for International Aviation. From an ethical standpoint, companies are constantly working on operating businesses in the interests of consumers while combining economic strategies and goals.
In contrast, European labor standards ensure the well-being of their employees. Additionally, many companies engage at the philanthropic level by participating in various additional projects. Examples include Iberia's partnership with different NGOs to support humanitarian causes or the Lufthansa Groups Help Alliance, which supports numerous social projects worldwide.

European Airspace has a comprehensive regulatory framework aimed at reducing environmental impact. The cap-and-trade EU ETS system, CORSIA, or the European Green Deal are vital regulations. All airlines are required to report their CO2 emissions accurately and comply with emissions caps due to participating in the EU ETS. AirBaltic or Ryanair use this information in their reports. Other companies like SAS in the ELISE project or the Lufthansa Group with their Carbon Disclosure Project mention their voluntary participation.

For instance, companies like airBaltic participate in the IATA CO2 emissions calculator to ensure accurate emissions calculations. In contrast, Wizz Air uses its calculation tool, as stated in its sustainability report, which could facilitate greenwashing since no external organization has verified this tool. The Green Claims Directive, as also reported by airBaltic, aims to minimize the risks of greenwashing. None of the other companies has this proven information in their reports.

According to Iberia, SAS, airBaltic, KLM, Wizz Air, and Ryanair, they comply with the EU ETS for all domestic flights and all flights between airports in the European Economic Area. However, more information needs to be provided about their compliance with flights outside this area, which could suggest greenwashing, as they do not disclose the standards they adhere to or whether they follow any at all. TAP and the Lufthansa Group did not mention their statement towards the EU ETS, while both are voluntarily complying with the ISO 14001, reporting about ESG frameworks, complying with the 17 SDGs, and being part of the Sustainability Accounting Standards Board. Together with Ryanair, they are the only ones reporting on SASB. Additionally, Ryanair contributes to several standards, except the SDGs and KLM, which also does not mention any of the 17 SDGs in their report. Like the other LCC, Wizz Air keeps all information about ISO 14001 secret within their environmental management system.

Compared to other companies, TAP is the only company that does not provide information about participating in CORSIA but is writing about Fly Net Zero. In this context, it is noteworthy that all companies, except for both low-cost carriers, comply with ICAO's Fly Net Zero regulations. However, it is striking that only Ryanair and Wizz Air have developed company-based strategies to achieve these targets, which only follow international requirements. This indicates greenwashing, as their targets have not undergone external validation. To emphasize this, the reports also show that both companies use their own calculators to compute emissions consumption.

As seen with KLM's participation in the SkyTeam Sustainable Flight Challenge, inadequate information must clarify their standards or what has been achieved. Information about sole participation does not reveal any signs of genuine environmental actions. In addition, KLM's sustainability report does not include information about the GRI, while all other companies explicitly highlight the global reporting initiative.

Research Question 3: To what extent do airlines effectively distinguish between genuine environmental stewardship and superficial marketing tactics?

From a marketing perspective, the aviation industry frequently employs green colors, imagery of trees, and terms such as "green" and "eco-friendly." Such practices can serve as indicators of greenwashing. For example, on the website and within the sustainability report of Wizz Air, the slogan “Fly the greenest” can be observed along with many trees. They confirm their statements within the sustainability report with the “greenest ideas” accompanied by pictograms and pictures of trees and meadows. TAP's planes are painted in three colors: red, light green, and dark green, but only dark green colors dominate their report, while Ryanair uses green color only in the section dedicated to the environment. AirBaltic also uses green colors on its planes and posts pictures of green areas and employees in front of trees throughout the report. These tactics can create a false impression of a solid commitment to the green world and the environment.

Similar indications can also be seen within the Lufthansa Group's report. For example, an Eurowings aircraft is depicted beneath various trees and slightly shaded in green. Nature-inspired pictograms can also be found that promote "green fares," among other things. This leads directly to greenwashing, as it also states that 3% of customers have already paid for green prices when purchasing on websites. On the one hand, the segment of customers here is reduced to those who buy their tickets on the official website; customers via third-party providers are deliberately not mentioned here and, therefore, do not count as a total quantity. On the other hand, if the figure was increased to include all customers, the percentage of 3% would probably be much smaller. Therefore, 97% who do not pay for the Green Fare are not emphasized here either, which still makes up most of the total.

TAP and airBaltic both include improvement of waste management in their sustainability strategy, but the total amount of waste generated increased compared to the previous year. Furthermore, TAP claims to have introduced measures such as allowing passengers to order their meals upfront to help reduce waste; from 2021 onwards, their waste has constantly increased, and in 2023, it has almost doubled compared to 2021. Similarly, although airBaltic has introduced additional discounts on unused food, in-flight waste has risen in recent years; for example, 41% of food loaded on the plane is not consumed. Moreover, the amount of hazardous waste has doubled since 2020. Other companies, such as Ryanair and KLM, don't provide reference quantities, and whether their waste quantity has increased or decreased cannot be concluded. However, it can be observed that KLM has generated the highest amount of as much as 10,118 tons, and they admit that their waste management system has many shortcomings. Iberia explains that with the help of special initiatives, such as pre-flight meal ordering, they managed to reduce food waste by 30%, which is a positive example. However, the total in-flight waste more than doubled compared to 2020 and increased by more than 1,000 tons compared to 2021.

Moreover, the company does not disclose the exact amount of total waste for 2022. The Lufthansa Group mentions waste management as one of its core principles in materiality assessment but does not provide any data on this topic. In their whole report, there is just one single sentence stating that waste management is a material sustainability aspect within the Group.

The Lufthansa Group further claims to have reduced their CO_2 emissions and fuel consumption thanks to investing in fleet renewal, but even though they have many ordered planes, only 20% of their fleet consists of the latest and more efficient aircraft. This means that 80% or around 575 airplanes from the Lufthansa Group still fly regularly but less efficiently. This is supported by the group having the oldest planes of all the companies examined. SAS does not disclose its entire fleet structure; the only information available is that 29 of the 134 aircraft are new generation. This is evidenced by their aircraft having an average age of 8.6 years.

Similarly, KLM provides information on its fleet composition but needs more details on fleet modernization, apart from noting the addition of new aircraft between 2021 and 2023. However, the relatively high average fleet age of 12.1 years only partially supports their claims of active investment in fleet renewal and modernization. TAP, Iberia, and Ryanair also emphasize their commitment to fleet renewal, but their fleet's average age contradicts this. Although more than half of their aircraft are newer generations, the question remains about how old their older planes are, as TAP's fleet averages 9.6 years. Despite recent deliveries of the MAX series, Ryanair maintains an average fleet age of eight years, suggesting continued reliance on older models. Likewise, Iberia, which added nearly 50 new aircraft in the last 10 years, still has an average fleet age of 10 years, indicating slow progress in reducing fleet age. Furthermore, many airlines mention investments in new, efficient aircraft as part of their fleet renewal strategy but need specific timelines for when older models will be phased out. For instance, KLM and Ryanair highlight orders for new planes but don't clarify how quickly these will replace older, less efficient aircraft.

Airlines with younger fleets, such as Wizz Air and airBaltic, heavily promote this as a sustainability marker, suggesting a direct correlation between fleet age and environmental impact. However, a younger fleet doesn't necessarily equate to sustainability without consideration of operational practices, overall emissions, and fleet utilization.

Although KLM claims to be a pioneer in blending SAF, even a voluntary increase in blended volume did not help them reduce their total carbon emissions, which increased by 12.52% in 2023 compared to 2022. Likewise, Lufthansa Group performed 14% more flights than in 2022. Yet, their CO_2 footprint was 16% larger compared to 2024, concluding that saving CO_2 due to using SAF did not improve the company's overall carbon emissions.

For SAF to effectively contribute to long-term CO_2 emissions reduction, it must foster greater confidence regarding its viability as a primary solution in aviation decarbonization. This entails scaling production sustainably and demonstrating clear, measurable impacts on carbon reduction. To inspire such confidence, stakeholders in the aviation industry—including policymakers, fuel producers, and airlines—must provide transparent data on SAF's lifecycle emissions, ensure consistent quality standards, and commit to significant investments in research and infrastructure that support SAF scaling. As KLM admitted in its report, this fuel emits the same amount of CO2 as ordinary kerosene, as shown in the cases of Lufthansa and KLM, where the increased blending of SAF had not contributed to reducing pollution. Although companies invest in ensuring safe quantities for the future, such as Wizz Air, which invested in a production plant, total guarantees do not exist. Another conflict is the lack of strategy for distributing the supplied quantity among the fleet or companies, as in the case of IAG (Iberia), where SAF will be divided among three companies.

The airlines need a clear, comprehensive strategy for integrating SAF effectively across their network. They either reference the whole network or just a specific part of flights from only certain airports, like Iberia's plans to use 45% of the SAF from flights from California. However, this represents only a tiny portion of their overall operations, and their SAF strategy for the remainder of their flights still needs to be defined.

There are no precise estimates of the environmental benefits the upcoming 2% SAF mandate will provide, given that 98% of fuel will still be conventional. SAF faces challenges related to production conflicts, particularly with food resources, leading the aviation industry to shift its focus from SAF to alternative technologies already in development. According to the European Union Aviation Safety Agency, hydrogen will significantly influence aviation's decarbonization in the coming years.

According to current research, hydrogen is far more CO2 efficient than SAFs and is part of the EU sustainability strategy (European Union Aviation Safety Agency, n.d.). Airlines should have included hydrogen in their reports as part of their decarbonization strategy. Instead, they primarily focus on approaches that need a clear path to meet long-term decarbonization goals.

Some airlines have introduced the voluntary blending of SAF against a small surcharge. For instance, KLM offers this on all flights from Schiphol, claiming a 1.2% SAF blend. However, it remains unclear what the 1.2% figure is relative to—whether it pertains to total fuel use or another measure.

While many airlines claim reductions in CO2 emissions, like the Lufthansa Group, KLM, and TAP, the data often needs more clarity or needs to include critical details. For instance, references to "emissions savings" or "efficiency improvements" appear without consistent data on overall emission increases due to rising flights or other factors. This creates a biased perception, as minor efficiency improvements are highlighted over total emission increases.

Furthermore, it becomes evident that companies reveal more information about ambitious long-term goals than and prove present actions. Most airlines, such as the Lufthansa Group, airBaltic, or Ryanair, emphasize long-term targets such as net zero by 2050 without detailing concrete, short-term actions that reliably lead to such outcomes.
Moreover, they often use offset programs as a substitute for reduction, such as the Lufthansa Group's 420,000 tons offset or Ryanair's Customer Offset Scheme, which gives the impression of environmental responsibility but does not represent an actual reduction in aviation CO2 emissions. AirBaltic describes the future as continuing to execute mandatory offsetting, but their statements, like "compensating for CO2 emissions," lack specificity, as offsetting can vary significantly in quality and effectiveness. Without clear information on offset programs or their impact, offsetting is a substitute for direct emissions reduction, potentially overstating environmental progress. Offset programs can detract from efforts to decrease emissions genuinely.
Moreover, they compare minor improvements against a growing baseline; Airlines like airBaltic, KLM, SAS, the Lufthansa Group, and Wizz Air emphasize reductions in emissions per flight or per passenger kilometer, yet the absolute emissions have increased or remained high due to overall growth in flights. In the case of Iberia, they highlight the reduction of CO2 emission per passenger per kilometer in 2022 compared to 2020. Yet, their total CO2 footprint doubled in Scope 1 and flight operations in the same period. Similarly happened at Ryanair, where CO2 emissions per passenger per kilometer slightly decreased compared to the previous year, but the total Scope 1 emissions substantially increased. This makes the data appear favorable while failing to address the fundamental issue of growing overall emissions in the sector. In addition, the focus is being put on minor operational adjustments in place of systematic change, such as the description of "reduced flap take-offs" or "single-engine taxiing," like airBaltic, appear to be minor operational adjustments that, while beneficial, have minimal impact on the industry's significant carbon footprint. Relying on minor optimizations instead of substantial investments in technology or infrastructure gives an illusion of progress. While airlines like the Lufthansa Group acknowledge the role of their supply chain, there's limited evidence of concrete steps being taken to address Scope 3 emissions, which are often substantial. This oversight suggests that more significant and impactful areas of responsibility may be downplayed or ignored.

Companies like airBaltic and the Lufthansa Group have emphasized improvements in fuel efficiency over the decades, such as the increase in the efficiency of the Lufthansa Group by 41% since 1991. With this calculation, they state the overall rise of transport performance of 354%, while fuel consumption has risen only 170%. Looking closer at this, they lowered emissions from 446 g/tkm in 1991 to 265 g/tkm in 2023. Similarly to CO2 emissions, companies again focus on future goals rather than present actions. Ryanair's intention to reduce emissions by 25% by 2030 without concrete short-term actions is an example of making ambitious long-term promises that may not hold the same level of accountability as immediate measures.

Similarly, other airlines reference plans without detailing steps to achieve these goals shortly. Many of the actions described, such as "switching to an electric ground vehicle fleet" and "lighter aircraft cabins," are beneficial but incremental improvements rather than systematic changes needed to significantly reduce overall emissions. Focusing on these actions can create a sense of progress while failing to address the primary source of emissions—the fuel used for flight operations.

Moreover, as mentioned and explained, reliance on SAFs without industry-scale application does not reliably support airlines' commitment to a greener future. SAF is currently produced in limited quantities and is not yet scalable across the aviation sector. Companies may create an inflated impression of its impact by emphasizing SAF usage without discussing its availability constraints or limits.

The following example shows a positive expansion of sustainable rules and regulations. The Lufthansa Group is an innovative pioneer that goes beyond environmental standards and regulations. SWISS is the first passenger airline worldwide to use the new AeroSHARK surface technology. Through this technology, they further reduce their CO_2 emissions and fuel consumption. This change was implemented on all twelve Boeing 777-300ERs in 2022 (SWISS, 2022), and in 2024, it will also be the turn of four of Austrian Airlines' long-haul aircraft. This is a remarkable change towards a sustainability strategy. However, it must also be said that, according to the management of Austrian Airlines, the Boeing 777 fleet has reached its final years (Austrian Airlines, 2024). This raises the question of how long it will take until all aircraft have been equipped with the skin and how long they will be in operation if it has already been announced in 2024 that they will soon no longer be in use.

According to the Swiss, this innovation leads to fuel savings of around 1.1%. This corresponds to more than 4,800 tons of fuel and up to 15,200 tons of CO_2 (SWISS, 2022). However, 98.9% of the fuel is still consumed commonly, and enormous quantities are used for just a single long-haul flight. This could indicate greenwashing because this is a minor improvement to overall fuel consumption.

AirBaltic highlights employee training and building energy standards to reduce building emissions. However, these efforts are slight compared to emissions from aviation fuel, the most significant part of an airline's environmental footprint.

AirBaltic's mention of ISO 50001 certification for owned real estate and ground vehicles and energy audits is presented as proof of sustainability. However, the data shows a reliance on non-renewable resources, with energy consumption nearly doubling since 2020. Certifications show compliance with specific standards, but they don't directly equate to significant reductions in environmental impact when renewable energy use has not increased.

Lufthansa aims for ground carbon neutrality by 2030, while Ryanair targets electrification of ground vehicles by 2050. According to the sustainability report, Ryanair wants to achieve 100% complete electrification by 2030. However, as they do not have a specific hub and only operate via various European centers, reviewing where they would like to participate in the electrification process is possible. Neither concrete measures nor locations for this implementation are mentioned. These goals could be more specific and distant, often needing interim targets or steps that hold the companies accountable in the short term.

Ryanair and Wizz Air highlight that they operate flights from airports with net-zero targets. However, the airports' goals do not directly reflect the airlines' efforts to reduce their flight-related emissions, creating an association that may overstate their commitment. Furthermore, these companies do not specify the number of airports or the specific destinations that have set decarbonization or sustainability targets. This lack of clarity makes it difficult to determine the true extent of their commitment or compliance with this strategy.

Although programs to recycle, use electric ground vehicles, and manage de-icing fluids are positive, focusing on them could imply that these actions are more impactful than they really are. For example, SAS's increase in glycol usage highlights the limited effect of capturing systems on emissions overall.

Ryanair's goal of using 100% renewable energy by 2050 is a distant, vague commitment with no immediate or interim targets for reducing aviation emissions, representing the bulk of their environmental footprint. Long-term goals often give an impression of commitment while allowing the company to delay substantial emissions cuts.

Iberia's claim of 32,000 tons of CO_2 avoided over the lifespan of its rooftop solar project may sound substantial, but it's a fraction of the emissions generated by flights. This focus on localized projects with impressive statistics can overstate the project's significance relative to the airline's broader impact on the environment.

Research Question 4: How do the differing business models of Low-Cost Carriers and Full-Service Airlines affect their sustainability strategies, and what are the implications for environmental and social performance?

LCCs mostly use one type of aircraft from one manufacturer, allowing them to quickly and easily adapt to new generations of the same models since the staff does not require extensive training. In Ryanair's case, it is evident that they only use Boeing aircraft, except for flights operated by Lauda, which uses Airbus. Moreover, acquiring more significant quantities of aircraft from one producer usually allows for a discount, thus reducing the financial expenditure of the investor. This gives them the advantage of implementing new technology aircraft more rapidly and in larger quantities than FSAs, reducing their environmental impact faster. Moreover, their models are typically smaller and short haul, without included baggage, forcing passengers to avoid unnecessary loads and making the airplane lighter. LCCs have no business or first-class seats, so they can maximize capacity utilization and use that as their sustainability asset. Their minimum turnaround times significantly shape their business model, partly because they only need a little time for catering reloading as they have minimized their in-flight services.

LCCs primarily focus on short- to medium-haul routes and generally operate with standardized fleets, often sourced from a single aircraft manufacturer, as previously mentioned. This strategy enables LCCs to maintain younger, more fuel-efficient fleets, reducing maintenance complexities and operational costs through standardized parts and streamlined training. In contrast, traditional carriers like the Lufthansa Group manage diverse fleets that include older long-haul aircraft, some of which are only replaced gradually.

For instance, Austrian Airlines, a member of the Lufthansa Group, operates Boeing 777 models that are now considered to be aged by industry standards, with the youngest being around 14 years old. This variation in fleet renewal rates among traditional carriers often results in a mix of older and newer aircraft, affecting fuel efficiency and overall emissions profiles compared to LCCs, which prioritize the latest, single-type aircraft to maximize cost and energy efficiencies.

Moreover, FSAs often exceed regulatory requirements, driven by broader stakeholder expectations and CSR commitments to influence external appearance.

Almost all airlines commit to adopting tailored approaches, like Iberia, KLM, SAS, airBaltic, Wizz Air, Ryanair, or the Lufthansa Group, which use the EU ETS and CORSIA to show their emissions and their actual impact on the environment. At the same time, none of this could be found in TAP’s report. Within this differentiation, no distinction between LCCs and FSAs can be identified. At the same time, it should be noted that Ryanair, for example, uses its calculators to determine emissions per passenger and does not rely on verified international guidelines.

Furthermore, looking at the hubs of individual companies makes it easier for FSAs to improve sustainability on the ground. The Lufthansa Group, for example, has its bases in Munich, Frankfurt, or Vienna and can implement targeted changes there. Ryanair has fixed stations but operates from various airports and does not have a dominant hub. To what extent they make changes at such centers remains to be seen.

14.1. External Sources

NGOs are actively challenging greenwashing in the aviation industry through legal actions, public awareness campaigns, and advocacy for policy reforms. Various NGOs and industrial bodies, such as the IATA, have addressed the issue of greenwashing in the airline industry. IATA has a clear position regarding airlines' true intentions regarding sustainability, so it does not hesitate to accuse European policymakers of superficially addressing aviation emissions without delivering substantial environmental benefits. The IATA Director General Willie Walsh emphasized the need for genuine solutions over symbolic actions and marketing tactics.

In this regard, there has been a ban on misleading ads on Google highlighting airlines' sustainability efforts from airlines like KLM-Air France, Ryanair, or the Lufthansa Group (Garcia, 2023). Measures like the IATA CO2 Connect, distributed by ATPCO, provide precise carbon emissions data for flights. The platform uses fuel burn metrics and operational data from 150 airlines where emission insights are offered to be compared.

Collaborations like this aim to set industry-wide reliable carbon standards. The focus is to ensure that data is clear and actionable for consumers and the travel industry. Moreover, it is not to be disregarded that even IATA targets a fly net-zero goal by 2050 without precise measurements to determine if this goal is even reachable, with this not being the only similar goal to several airlines (IATA, n.d.).

In July 2024, organizations like ClientEarth and Reclame Fossielvrij, both environmental charities, cautioned 71 airlines operating out of Schiphol Airport to adhere to legal standards (Business & Human Rights Resource Centre, 2024). They filed a lawsuit because the report misleadingly suggests that flying does not worsen the climate crisis. They claim that current technology cannot fully decarbonize air travel and that such claims are misleading. There are ongoing discussions and articles about airlines claiming that flights are becoming sustainable. However, according to the opinions of several NGOs, these claims are deceptive.

Stay Grounded, another NGO has published fact sheets and reports highlighting greenwashing in the aviation industry. The reports cover topics like efficiency, net zero, and carbon offsets, aiming to educate the public and pressure airlines to change their practices and become more transparent (Stay Grounded, n.d.).

While some NGOs have collaborated with airlines to promote sustainability, disagreements over some approaches have led to tensions. For instance, in November 2024, the NGOs Ecodes and Transport and Environment withdrew from Spain's Air Transport Sustainability Alliance, accusing it of favoring biofuels over more sustainable alternatives, which they claimed to be greenwashing (Medina, 2024).

Campaign groups like Subvertisers International and Brandalism have initiated actions against deceptive airline advertisements to expose and challenge false eco-friendly claims. They see the problem in ads for more air and plane travel without illuminating the consequences and adverse effects. That is why they took over their advertisements above those of the airlines in cities like Paris, Berlin, or London to describe airlines' environmental impact (Subvertisers International, 2024).

The Aviation Environment Federation advocates for the mandatory disclosure of emissions information at the point of sale, enabling consumers to make informed choices. They suggest that flight marketing should include emissions information, like health warnings on tobacco products, to raise awareness and encourage responsible decision-making. They tackle serious topics in their articles where they face airlines' most sensitive fields, like achieving carbon neutrality in airports, which does not lead to carrying neutrality in flights or finding environmental projects at companies like Ryanair that are ineffective in reducing emissions. One example would be a reforestation project from Ryanair in Ireland, leading to controversial results (AEF, 2022).

14.2. Theoretical Implications

This study's findings make several significant contributions to current literature, particularly in the context of the aviation industry.

First, it provides empirical insights into how airlines' environmental sustainability strategies align with established CSR and CER principles. This expands the understanding of how these theoretical frameworks manifest in the aviation industry and gives critical insights into greenwashing in CSR. Then, it reinforces the importance of top management involvement in sustainability strategies, as emphasized in CSR and CER frameworks; it highlights a practical distinction between companies that embrace CSR/CER as part of their core strategy (e.g., AirBaltic) and those that only superficially address sustainability (e.g., Ryanair, Wizz Air), which contributes to the large body of CSR research on how companies may mislead stakeholders.

Furthermore, the research provides a detailed analysis of the airlines' compliance with environmental regulations and how it fits within the CSR and CER frameworks. It strengthens the importance of regulatory compliance as part of CSR's legal and ethical dimensions, showing that adherence to regulations is essential but should not be the sole criterion for assessing a company's environmental responsibility. The literature often questions companies' ability to transparently measure and report their environmental impact. This study contributes to the CSR literature on measurement and reporting by illustrating how airlines selectively present data on carbon emissions, fleet composition, and waste management, often without providing a comprehensive or consistent picture of their environmental impact.

The research also addresses the moral aspect of CSR, as airlines aim to operate to align with legal requirements and broader societal goals, such as emissions reductions. Moreover, it expands on applying the Triple Bottom Line theory in the airline industry, showing how companies simultaneously address economic, environmental, and social issues.

The paper also highlights gaps in SDG alignment, particularly with low-cost carriers like Ryanair and Wizz Air, providing a basis for future research on how the aviation sector can better integrate the SDGs into its business practices and advances the discussion on the quality and transparency of CSR and CER reporting, particularly in the context of the airline industry.

In summary, these findings contribute to CSR literature by providing detailed insights into the gap between environmental marketing and genuine sustainability practices in the airline industry. They also highlight the complexity of measuring CSR impact, the risk of greenwashing, the need for better reporting and transparency, and the importance of systemic change to achieve meaningful environmental goals. This research advances CSR theory by offering empirical evidence of how airlines navigate their ecological responsibilities through legitimate actions and superficial marketing. It adds depth to the ongoing discussions around greenwashing, accountability, and sustainable business practices in high-impact industries.

14.3. Practical Implications

The insights gained from this study may be of assistance to airlines in the process of improving their CSR and CER strategies and results. Airlines can enhance their sustainability strategies, improve transparency, and build more authentic relationships with stakeholders by addressing the discrepancies between their environmental claims and actual practices. This can be

achieved by providing precise, verifiable data on key ecological metrics such as total emissions or waste quantities and adopting third-party verification for sustainability claims to increase credibility and prevent accusations of greenwashing. Moreover, this study highlights the importance of regular updates on progress toward short-term and long-term sustainability goals. Airlines should go beyond vague promises and include specific, actionable steps, timelines, and performance metrics in their reports.
This study's empirical findings provide a new understanding of the difference between symbolic actions and substantive changes that impact environmental outcomes. It recommends focusing on the latter. For instance, to improve the fleet modernization process, clear timelines for fleet upgrades and specific data on the environmental benefits of these changes should be more transparent.

This research has shown that technologies that aviation currently relies on for a greener future are not promising enough. This should encourage companies to explore breakthrough technologies for decarbonization, such as hydrogen-powered aircraft or more effective SAFs.

The study highlights a mismatch between waste management claims and actual waste increases and raises awareness of better waste management measures that airlines should adopt.

Furthermore, while airlines often set ambitious long-term sustainability goals (e.g., net zero by 2050), the study results show that these goals are typically vague, and stakeholders may view them skeptically. Accordingly, the airlines should set clear and actionable short-term targets that provide milestones along the path to long-term goals.

Lastly, the paper repeatedly emphasizes that superficial marketing tactics do not contribute to a company's positive image. This can be a lesson for abandoning such practices in the future.

In conclusion, these findings offer airlines a roadmap to improve their CSR and CER practices by encouraging them to focus on transparency, accountability, and meaningful action. To avoid accusations of greenwashing and build credibility, airlines must back up their environmental claims with clear, data-driven evidence of progress, focus on direct emission reductions, and adopt scalable, long-term solutions to sustainability challenges. By aligning their actions with their words, airlines can build stronger, more authentic CSR strategies that contribute to their long-term success and the global sustainability agenda.

14.4. Limitations

The following limitations of the research must be considered in this study. Given the available data, it is not possible to determine the exact extent of greenwashing in Europe. This would require further comparisons with other reports, external sources, and potentially internal company documents that are not publicly accessible. To address this challenge, the study focuses on analyzing corporate communications. Additionally, the empirical investigation was conducted by only two individuals. Since the coding process in the qualitative analysis allows for some interpretative flexibility, there is a risk of bias. To mitigate this, a coding guide was implemented as a rule-based framework, and an iterative process was followed to verify the category assignments repeatedly. Efforts were also made to ensure transparency in crucial decision-making processes throughout the study. For a more comprehensive understanding of airline sustainability efforts and greenwashing in 2023, evaluating additional sustainability reports in this industry is necessary. A comparison with airlines from other continents would provide even deeper insights; however, this would exceed the scope of this master's thesis. Furthermore, due to the dynamic nature of the field and ongoing developments, the generalizability of the core findings to future periods is limited, as new sustainability reports for this year may already present updated information.

An explicit limitation of this report is that the results are only from the year 2023. Previous years' results would not be comparable due to the impact of the COVID-19 pandemic. Using 2019 as a reference year was considered, but it was beyond the scope of this thesis, as sustainability reports are extensive and detailed. Nonetheless, some reports have made comparisons with the pre-pandemic period, and it is notable that the results in 2022 nearly reached pre-pandemic levels.

14.5. Research Prospects

Corporate environmental and social responsibility is a highly relevant and continually evolving issue. The overview of themes addressed within the airline’s CER activities framework offers numerous starting points for further research. In the context of reporting, one potential goal could be establishing a unified standard with extensive requirements specifically for airlines, adapting goals and requirements annually. This would enhance the comparability of data across organizations and nations. The topic of CER and CSR also serves as a starting point for studies employing various research designs. Utilizing the case study methodology, researchers could accompany companies over an extended period during their development and restructuring processes toward more sustainable business practices. The analysis can be conducted from various perspectives, such as change management, rebranding, or changes

in organizational structure. This approach can illuminate individual success factors as well as challenges.
Furthermore, a quantitative analysis in the form of a survey, building on the results of this work, could examine the extent to which the public perceives airlines' sustainable engagement as authentic. Moreover, a qualitative approach with in-depth interviews could reveal information not given in sustainability reports or other published literature. One significant obstacle is identifying the appropriate contact persons and questioning them in a manner that elicits the necessary information. This may prove challenging, as individuals might be reluctant to disclose details on such sensitive issues.

Given the dynamic nature of the shift towards more excellent corporate sustainability and environmental responsibility, new points of departure for further research are continuously emerging. Questions for further research could include: How do consumers perceive the environmental claims made by airlines, and how does this influence their purchasing decisions? What role does transparency in environmental reporting play in shaping consumer trust and loyalty? What methodologies can be developed to detect greenwashing practices in the aviation sector and quantify them? What additional regulations or policies could be implemented to ensure greater accountability and transparency? How do CSR and CER strategies in the aviation industry compare to those in other high-impact sectors, such as shipping or automotive? What can be learned from case studies of airlines that have successfully implemented robust CSR and CER programs? How does corporate governance influence the implementation and effectiveness of CSR and CER initiatives in the aviation industry?

After 2025 and 2030, it will be critically important to evaluate, among other aspects, whether the targets established for individual companies were achieved, whether new ambitious targets were set, and what the consequences were for failing to meet them.

15. References

Abrantes, I., Ferreira, A. F., Silva, A., & Costa, M. (2021). Sustainable aviation fuels and imminent technologies-CO2 emissions evolution towards 2050. Journal of Cleaner Production, 313, 127937.

Afonso, F., Sohst, M., Diogo, C. M., Rodrigues, S. S., Ferreira, A., Ribeiro, I., Marques, R., Rego, F. F., Sohouli, A., Portugal-Pereira, J., Policarpo, H., Soares, B., Ferreira, B., Fernandes, E. C., Lau, F., & Suleman, A. (2023). Strategies towards a more sustainable aviation: A systematic review. Progress in Aerospace Sciences, 137, 100878. https://doi.org/10.1016/j.paerosci.2022.100878

Aggarwal, P., & Kadyan, A. (2014). Greenwashing: The darker side of CSR. Indian Journal of Applied Research, 4(3), 61-66.

airBaltic. (n.d.). Company history. airBaltic. https://company.airbaltic.com/en/company-history

airBaltic. (2023). Sustainability report 2023. https://www.airbaltic.com/sustainability-report-2023

Aji, H. M., & Sutikno, B. (2015). The extended consequence of greenwashing: Perceived consumer skepticism. International Journal of Business and Information, 10(4), 433.

Alamdari, F., & Fagan, S. (2005). Impact of the adherence to the original low-cost model on the profitability of low-cost airlines. Transport Reviews, 25(3), 377–392. https://doi.org/10.1080/01441640500038748

Alameeri, A., Ajmal, M. M., Hussain, M., & Helo, P. T. (2017). Sustainability practices in the aviation sector: a study of UAE-based airlines. International Journal of Sustainable Society, 9(2), 119. https://doi.org/10.1504/ijssoc.2017.086818

Albert, C., Brillinger, M., Guerrero, P., Gottwald, S., Henze, J., Schmidt, S., Ott, E., & Schröter, B. (2020). Planning nature-based solutions: Principles, steps, and insights. Ambio, 50(8), 1446–1461. https://doi.org/10.1007/s13280-020-01365-1

Alderighi, M., Cento, A., Nijkamp, P., & Rietveld, P. (2012). Competition in the European aviation market: the entry of low-cost airlines. Journal of Transport Geography, 24, 223–233. https://doi.org/10.1016/j.jtrangeo.2012.02.008

Atallah, S., Hotle, S. L., & Mumbower, S. (2018). The evolution of low-cost Carrier operational strategies pre-and post-recession. Journal of Air Transport Management, 73, 87-94.

Austrian Airlines. (2024). Fin-tastic news: Austrian Airlines takes off with sharkskin. Austrian Airlines. https://www.austrianairlines.ag/en/2024/08/19/fin-tastic-news-austrian-airlines-takes-off-with-sharkskin/

Aviation Environment Federation (AEF). (2022, October 28). The truth about flying: Greenwashing in the aviation industry. Retrieved December 20, 2024, from https://www.aef.org.uk/2022/10/28/the-truth-about-flying-greenwashing-in-the-aviation-industry/

Avogadro, N., & Redondi, R. (2024). Demystifying electric aircraft's role in aviation decarbonization: Are first-generation electric aircraft cost-effective? Transportation Research Part D Transport and Environment, 130, 104191. https://doi.org/10.1016/j.trd.2024.104191

Awan, U., Kanwal, N., & Bhutta, M. K. S. (2020). A Literature Analysis of Definitions for a Circular Economy. In Ecoproduction (pp. 19–34). https://doi.org/10.1007/978-3-642-33857-1_2

Baden, D. (2016). A reconstruction of Carroll's pyramid of corporate social responsibility for the 21st century. International Journal of Corporate Social Responsibility, 1(1). https://doi.org/10.1186/s40991-016-0008-2

Bakker, C. A., Wever, R., Teoh, C., & De Clercq, S. (2010). Designing cradle-to-cradle products: a reality check. International Journal of Sustainable Engineering, 3(1), 2-8.

Balzarova, M. A., & Castka, P. (2008). Underlying mechanisms in the maintenance of ISO 14001 environmental management system. Journal of Cleaner Production, 16(18), 1949-1957.

Bauer, P. (2024b, April 2). Boeing 707 | Description, Background, History, & Facts. Encyclopedia Britannica. https://www.britannica.com/technology/Boeing-707.

Baur, N., & Blasius, J. (Eds.). (2019). Handbuch Methoden der empirischen Sozialforschung. Springer.

Bayer, P., & Aklin, M. (2020). The European Union emissions trading system reduced CO2 emissions despite low prices. Proceedings of the National Academy of Sciences, 117(16), 8804-8812.

BBC ON THIS DAY | 2 | 1952: Comet inaugurates the jet age. (n.d.). http://news.bbc.co.uk/onthisday/hi/dates/stories/may/2/newsid_2480000/2480339.stm

Bîrgovan, A. L., Vatca, S. D., Bacali, L., Szilagyi, A., Lakatos, E. S., Cioca, L. I., & Ciobanu, G. (2022). Enabling the circular economy transition in organizations: a moderated mediation model. International journal of environmental research and public health, 19(2), 677.

Blišťanová, M., & Tirpáková, M. (2021). A Brief Overview of Implemented Management System Standards in Aviation. Quality-Access to Success, 22(185).

Bouwer, J., Krishnan, V., Saxon, S., & Tufft, C. (2022, March 31). Taking stock of the pandemic's impact on Global Aviation. McKinsey & Company. https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/taking-stock-of-the-pandemics-impact-on-global-aviation

Bowen, H. R. (2013). Social responsibilities of the businessman. University of Iowa Press.

Brem, A., Cusack, D. Ó., Adrita, M. M., O'Sullivan, D. T., & Bruton, K. (2020). How do companies certified to ISO 50001 and ISO 14001 perform in LEED and BREEAM assessments?. Energy efficiency, 13, 751-766.

Brown, J. A., & Forster, W. R. (2012). CSR and Stakeholder Theory: A Tale of Adam Smith. Journal of Business Ethics, 112(2), 301–312. https://doi.org/10.1007/s10551-012-1251-4.

Brown, J. A., Clark, C., & Buono, A. F. (2016). The United Nations Global Compact: Engaging Implicit and Explicit CSR for Global Governance. Journal of Business Ethics, 147(4), 721–734. https://doi.org/10.1007/s10551-016-3382-5

Brundtland, G. H. (1985). World commission on environment and development. Environmental policy and law, 14(1), 26-30.

Bureau, A. T. (2020). Effects of novel coronavirus (COVID-19) on civil aviation: economic impact analysis. International Civil Aviation Organization (ICAO), Montréal, Canada, 178.

Business & Human Rights Resource Centre. (2024, July 18). Environmental groups have warned 71 airlines over potential greenwashing. https://www.business-humanrights.org/en/latest-news/environmental-groups-have-warned-71-airlines-over-potential-greenwashing/

Caiado, R. G. G., De Freitas Dias, R., Mattos, L. V., Quelhas, O. L. G., & Filho, W. L. (2017). Towards sustainable development through the perspective of eco-efficiency - A systematic literature review. Journal of Cleaner Production, 165, 890–904. https://doi.org/10.1016/j.jclepro.2017.07.166

Carbon Credits. (2024, October 17). Clear skies ahead: EU takes action against 20 airlines for greenwashing claims. https://carboncredits.com/clear-skies-ahead-eu-takes-action-against-20-airlines-for-greenwashing-claims-arlines-carbon-offsets/

Carroll, A. B. (1999). Corporate social responsibility: Evolution of a definitional construct. Business & Society, 38(3), 268-295.

Carroll, A. B. (2016). Carroll's pyramid of CSR: taking another look. International Journal of Corporate Social Responsibility, 1(1). https://doi.org/10.1186/s40991-016-0004-6

Carroll, A. B. (2021). Corporate social responsibility: Perspectives on the CSR construct's development and future. Business & Society, 60(6), 1258-1278.

Chan, R. Y. K., Lai, J. W. M., & Kim, N. (2022). Strategic motives and performance implications of proactive versus reactive environmental strategies in corporate sustainable development. Business Strategy and the Environment, 31(5), 2127–2142. https://doi.org/10.1002/bse.3011

Chen, C. S., Yu, C. C., & Hu, J. S. (2018). Constructing performance measurement indicators to suggested corporate environmental responsibility framework. Technological Forecasting and Social Change, 135, 33-43.

CMS, (2023). United Arab Emirates - Sustainability claims and greenwashing, Available at: https://cms.law/en/int/publication/cms-green-globe/uae

Cochran, P. L. (2007). The evolution of corporate social responsibility. Business horizons, 50(6), 449-454.

Coles, T., Dinan, C., & Fenclova, E. (2009). Corporate social responsibility: issues for future development in the low-fares airlines sector. Centre for Sport, Leisure and Tourism Research, University of Exeter.

Commercial aviation at Mid-Century. (2021, November 18). National Air and Space Museum. https://airandspace.si.edu/explore/stories/commercial-aviation-mid-century

Covington & Burling LLP. (2024, May 3). Coordinated EU-wide crackdown on airline greenwashing. https://www.cov.com/en/news-and-insights/insights/2024/05/coordinated-eu-wide-crackdown-on-airline-greenwashing

Cowper-Smith, A., & De Grosbois, D. (2011). The adoption of corporate social responsibility practices in the airline industry. Journal of Sustainable Tourism, 19(1), 59–77. https://doi.org/10.1080/09669582.2010.498918

Crane, A., & Matten, D. (Eds.). (2016). The Oxford handbook of corporate social responsibility. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198752780.001.0001

Crifo, P. (2014). The Economics of Corporate Environmental Responsibility. International Review of Environmental and Resource Economics, 7(3–4), 279–297. https://doi.org/10.1561/101.00000063

Crouch, T. D., Bilstein, . Roger E. and Boyne. Walter James (2024, April 9). history of flight. Encyclopedia Britannica. https://www.britannica.com/technology/history-of-flight

Dahmani, N., Belhadi, A., Benhida, K., Elfezazi, S., Touriki, F. E., & Azougagh, Y. (2021). Integrating lean design and eco-design to improve product design: From literature review to an operational framework. Energy & Environment, 33(1), 189–219. https://doi.org/10.1177/0958305x21993481

Dalamagkidis, K., Valavanis, K. P., Piegl, L. A., Dalamagkidis, K., Valavanis, K. P., & Piegl, L. A. (2012). Aviation history and unmanned flight. On Integrating Unmanned Aircraft Systems into the National Airspace System: Issues, Challenges, Operational Restrictions, Certification, and Recommendations, 11-42.

Dash 8 & Q Series specifications. (2009). AIRCRAFT COMMERCE, 63, 6–7. https://www.aircraft-commerce.com/wp-content/uploads/aircraft-commerce-docs/Aircraft%20guides/DASH%208%20&%20Q%20SERIES/ISSUE63_DASH8SPECS.pdf

Davison, L., Littleford, C., & Ryley, T. (2014). Air travel attitudes and behaviours: The development of environment-based segments. Journal of Air Transport Management, 36, 13–22. https://doi.org/10.1016/j.jairtraman.2013.12.007

Delbeke, J., Runge-Metzger, A., Slingenberg, Y., & Werksman, J. (2019). The Paris Agreement. In Routledge eBooks (pp. 24–45). https://doi.org/10.4324/9789276082569-2

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. California Management Review, 54(1), 64–87. https://doi.org/10.1525/cmr.2011.54.1.64

Delta's history: From dusting crops to connecting the world | Delta News Hub. (2024, May 22). Delta News Hub. https://news.delta.com/deltas-history-dusting-crops-connecting-world

Desai, B. (1993). The Bhopal gas leak disaster litigation: An overview. Asian Yearbook of International Law, Volume 3 (1993), 163-179.

DesJardins, J. Corporate Environmental Responsibility. Journal of Business Ethics 17, 825–838 (1998). https://doi.org/10.1023/A:1005719707880

de Freitas Netto, S. V., Sobral, M. F. F., Ribeiro, A. R. B., & Soares, G. R. D. L. (2020). Concepts and forms of greenwashing: A systematic review. Environmental Sciences Europe, 32, 1-12.

Deutsche Welle. (2024, March 20). Greenwashing: KLM ads were misleading, Dutch court says. https://www.dw.com/en/greenwashing-klm-ads-were-misleading-dutch-court-says/a-68621641

Dmytriyev, S. D., Freeman, R. E., & Hörisch, J. (2021). The relationship between stakeholder theory and corporate social responsibility: Differences, similarities, and implications for social issues in management. Journal of Management Studies, 58(6), 1441-1470.

Dobruszkes, F. (2006). An Analysis of European Low-cost Airlines and their Networks.

Döring, N. (2023). Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften. In Springer eBooks. https://doi.org/10.1007/978-3-662-64762-

Dovis, F., Ruotsalainen, L., Toledo-Moreo, R., Kassas, Z. Z. M., & Gikas, V. (n.d.). Recent Advancement on the Use of Global Navigation Satellite System-Based Positioning for Intelligent Transport Systems [Guest Editorial]. IEEE Intelligent Transportation Systems Magazine, 12(3), 6–9. https://doi.org/10.1109/mits.2020.2994923.

Dragomir, V. D. (2018). How do we measure corporate environmental performance? A critical review. *Journal of Cleaner Production*, *196*, 1124–1157. https://doi.org/10.1016/j.jclepro.2018.06.014

Dube, K. (2022). Emerging from the COVID-19 Pandemic: Aviation Recovery, Challenges and Opportunities. Aerospace, 10(1), 19. https://doi.org/10.3390/aerospace10010019

Dube, K., Nhamo, G., & Chikodzi, D. (2021). COVID-19 pandemic and prospects for recovery of the global aviation industry. Journal of Air Transport Management, 92, 102022.

Dwivedi, P. (2023). Navigating the Skies: An Overview of Aviation Law in India. International Journal for Multidisciplinary Research (IJFMR), 5(6).

Edelman, J. (2021). Reviving antitrust enforcement in the airline industry. Mich. L. Rev., 120, 125.

EARTHDAY.ORG. (2024, January 23). The history of Earth Day - Earth Day. Earth Day. https://www.earthday.org/history/

EASA to inform air passengers on the environmental impact of their flight | EASA. (2024, January 25). EASA. https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-inform-air-passengers-environmental-impact-their-flight#:~:text=The%20Environmental%20Labelling%20Scheme%20is,the%20environmental%20performance%20of%20flights.

EasyJet Airline Company Limited - Company profile, information, business description, history, background information on EasyJet Airline Company Limited. (n.d.). https://www.referenceforbusiness.com/history2/7/easyJet-Airline-Company-Limited.html.

Eccles, R. G., Ioannou, I., & Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. Management Science, 60(11), 2835–2857. https://doi.org/10.1287/mnsc.2014.1984

Ekins, P., & Zenghelis, D. (2021). The costs and benefits of environmental sustainability. Sustainability Science, 16(3), 949–965. https://doi.org/10.1007/s11625-021-00910-5.

Elliott, D. (n.d.). Covid-19: Challenging time ahead for aviation. Frontier Economics. https://www.frontier-economics.com/uk/en/news-and-insights/articles/article-i7261-covid-19-challenging-time-ahead-for-aviation/

Etchebehere, V. (2023). Climate change and aviation. In Edward Elgar Publishing eBooks (pp. 187–207). https://doi.org/10.4337/9781839103001.00015

European Commission. (2011). A renewed EU strategy 2011-14 for Corporate Social Responsibility. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52011DC0681

European Commission (2024). Commission and national consumer protection authorities start action against 20 airlines for misleading greenwashing practices. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_2322

European Commission. (n.d.). EU emissions trading system (EU ETS). European Union. https://climate.ec.europa.eu/policies/ets_en

European Commission. (2024, October 17). EU takes action to strengthen the aviation sector's sustainability and safety. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_2322

European Commission. (n.d.). RefuelEU aviation: Strengthening the EU's energy security and sustainability in aviation. https://transport.ec.europa.eu/transport-modes/air/environment/refueleu-aviation_en

European Parliament & Council of the European Union. (2002). Directive 2002/49/EC on the assessment and management of environmental noise. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32002L0049

European Parliament & Council of the European Union. (2022). Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Directive 2013/34/EU as regards the sustainability reporting of certain large undertakings and groups. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L2464

European Union. (2022). Directive 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Directive 2013/34/EU, Directive 2004/109/EC, Directive 2006/43/EC and Regulation (EU) No 537/2014, as regards corporate sustainability reporting. Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464

European Union Aviation Safety Agency (EASA) (n.d.) Hydrogen and its potential in aviation. https://www.easa.europa.eu/en/light/topics/hydrogen-and-its-potential-aviation

Feige, A., & Pforte, L. (2017). Sustainability certification in the aviation industry. In Springer eBooks (pp. 403–432). https://doi.org/10.1007/978-3-662-53065-8_17

Feinstein, N. (2013). Learning from past mistakes: future regulation to prevent greenwashing. BC Envtl. Aff. L. Rev., 40, 229.

Finnair. (n.d.). History. Finnair. https://company.finnair.com/en/about/history

Flachsland, C., Pahle, M., Burtraw, D., Edenhofer, O., Elkerbout, M., Fischer, C., ... & Zetterberg, L. (2020). How to avoid history repeating itself: the case for an EU Emissions Trading System (EU ETS) price floor revisited. Climate Policy, 20(1), 133-142.

Flightworx. (2023, November 2). The history and demise of the Boeing 747 - Flightworx. Flightworx. https://www.flightworx.aero/blog/history-and-demise-of-the-boeing-747/

Fornell, C., Morgeson III, F. V., Hult, G. T. M., & VanAmburg, D. (2020). The reign of the customer: Customer-centric approaches to improving satisfaction. Springer Nature.

Fox, S. J., & Martín-Domingo, L. (2020). EU Air Passengers' Rights Past, Present, and Future: In an Uncertain World (Regulation (EC) 261/2004: Evaluation and Case Study). J. Air L. & Com., 85, 271.

Freeman, R. E., & Dmytriyev, S. (2017). Corporate social responsibility and stakeholder theory: Learning from each other. Symphonya. Emerging Issues in Management, (1), 7-15.

Freeman, R. E. (2023). The Politics of Stakeholder Theory: Some future directions. In Issues in business ethics (pp. 119–132). https://doi.org/10.1007/978-3-031-04564-6_5

Freeman, R. E., & McVea, J. (2001). A stakeholder approach to strategic management. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.263511

Friedman, A. L., & Miles, S. (2002). Developing stakeholder theory. Journal of Management Studies, 39(1), 1–21. https://doi.org/10.1111/1467-6486.00280

Gangi, F., Mustilli, M., Daniele, L. M., & Coscia, M. (2022). The sustainable development of the aerospace industry: Drivers and impact of corporate environmental responsibility. Business Strategy and the Environment, 31(1), 218-235.

Garcia, M. (2023, December 13). As airlines face greenwashing accusations, Google and IATA crunch data. Forbes. https://www.forbes.com/sites/marisagarcia/2023/12/13/as-airlines-face-greenwashing-accusations-google-and-iata-crunch-data/

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2018). The circular economy – A new sustainability paradigm? Journal of Cleaner Production, 143, 757-768.

German Ecolabel Jury. (n.d.). EU Ecolabel. https://eu-ecolabel.de/

GHG Protocol Scope 2 guidance. (n.d.). https://ghgprotocol.org/sites/default/files/2023-03/Scope%202%20Guidance.pdf

Gittell, J. H., Nordenflycht, A. V., Kochan, T. A., Bamber, G. J., & McKersie, R. B. (2015). Labor Relations and Human Resource Management in the Airline Industry. The global airline industry, 21(2), 287.

Global Reporting Initiative. (2021). GRI Standards. https://www.globalreporting.org/standards/

Greenhouse Gas Protocol. (n.d.). https://ghgprotocol.org/sites/default/files/2022-12/FAQ.pdf

Goffetti, G., Böckin, D., Baumann, H., Tillman, A. M., & Zobel, T. (2022). Towards sustainable business models with a novel life cycle assessment method. Business Strategy and the Environment, 31(5), 2019-2035.

Goldstein, M. (2024, March 26). 110 years ago, the first commercial airline took off from Florida. Forbes. https://www.forbes.com/sites/michaelgoldstein/2024/03/21/110-years-ago-the-first-commercial-airline-took-off-from-florida/#:~:text=On%20January%201%2C%201914%2C%20a,and%20a%20single%20paying%20passenger.

Gonzalez-Garay, A., Heuberger-Austin, C., Fu, X., Klokkenburg, M., Zhang, D., Van Der Made, A., & Shah, N. (2022). Unravelling the potential of sustainable aviation fuels to decarbonise the aviation sector. Energy & Environmental Science, 15(8), 3291–3309. https://doi.org/10.1039/d1ee03437e

Gottlieb, R., Smith, M., & Roque, J. (1995). 'Greening or Greenwashing? The Evolution of Industry Decisionmaking. Reducing toxics: A new approach to policy and industrial decisionmaking, 170-208.

Gough, A. (2013). The emergence of environmental education research: A "history" of the field. In International handbook of research on environmental education (pp. 13-22). Routledge.

Green, E. G. (2024). PFAS, Planes, and Problems: PFAS Regulation in the Aerospace and Aviation Industries. Oklahoma Law Review, 76(2), 441.

Greenpeace, (2020). The biggest problem with carbon offsetting is that it doesn't really work. Available at: https://www.greenpeace.org.uk/news/the-biggest-problem-with-carbon-offsetting-is-that-it-doesnt-really-work/

Guan, H., Liu, H., & Saadé, R. G. (2022). Analysis of carbon emission reduction in international civil aviation through the lens of shared triple bottom line value creation. Sustainability, 14(14), 8513.

Guix, M., Ollé, C., & Font, X. (2022). Trustworthy or misleading communication of voluntary carbon offsets in the aviation industry. Tourism Management, 88, 104430.

Gupta, I., Mishra, N., & Tandon, D. (2020). Triple bottom line: Evidence from aviation sector. International Journal of Business Ethics and Governance, 71-80.

Gürçam, S. (2022). The neoliberal initiative of the aviation industry to fight the climate crisis: Greenwashing. International Journal of Environment and Geoinformatics, 9(3), 178-186.

Hajian, M., & Kashani, S. J. (2021). Evolution of the concept of sustainability. From Brundtland Report to sustainable development goals. In Sustainable resource management (pp. 1-24). Elsevier.

Halkos, G., & Nomikos, S. (2021). Corporate social responsibility: Trends in global reporting initiative standards. Economic Analysis and Policy, 69, 106-117.

Hamidu, A., Haron, M., & Amran, A. (2015). Corporate Social Responsibility: A review on definitions, core characteristics and theoretical perspectives. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2861506

Hanke, T., & Stark, W. (2009). Strategy development: Conceptual framework on corporate social responsibility. Journal of Business Ethics, 85, 507-516.

Hardiman, J., & Bodell, L. (2023, October 14). Larger than the flag carrier: How AirAsia dominated Malaysian aviation. Simple Flying. https://simpleflying.com/airasia-history/.

Hardiman, J. (2023, January 20). Ryanair performs its first Boeing 737-800 winglet retrofit. Simple Flying. https://simpleflying.com/ryanair-first-boeing-737-800-winglet-retrofit/

Hari, T. K., Yaakob, Z., & Binitha, N. N. (2014). Aviation biofuel from renewable resources: Routes, opportunities, and challenges. *Renewable and Sustainable Energy Reviews*, *42*, 1234–1244. https://doi.org/10.1016/j.rser.2014.10.095

He, P., & Sun, R. (2023). Trends and characteristics of incidents in China civil aviation: 1994–2020. Transportation research record, 2677(5), 420-431.

Helmold, M. (2023). Preisgestaltung. Preisgestaltung in der Luftfahrtindustrie„Industrie". In Springer eBooks (pp. 143–152). https://doi.org/10.1007/978-3-031-29773-1_13

Heyes, G., Hooper, P., Raje, F., Flindell, I., Dimitriu, D., Galatioto, F., Burtea, N. E., Ohlenforst, B., & Konovalova, O. (2021). The role of communication and engagement in airport noise management. Sustainability, 13(11), 6088. https://doi.org/10.3390/su13116088

Hiss, S. (2009). From implicit to explicit Corporate Social Responsibility: Institutional change as a fight for myths. Business Ethics Quarterly, 19(3), 433–451. https://doi.org/10.5840/beq200919324

History milestones - SAS. (n.d.). https://www.sasgroup.net/about-sas/sas-history/history-milestones/

Hoffmann, T. (2011). Unternehmerische Nachhaltigkeitsberichterstattung: eine Analyse des GRI-G3. 1-Berichtsrahmens (Vol. 30). BoD–Books on Demand.

Holtbrügge, D., & Dögl, C. (2012). How international is corporate environmental responsibility? A literature review. Journal of International Management, 18(2), 180–195. https://doi.org/10.1016/j.intman.2012.02.001

Hooper, P. D., & Greenall, A. (2005). Exploring the potential for environmental performance benchmarking in the airline sector. Benchmarking an International Journal, 12(2), 151–165. https://doi.org/10.1108/14635770510593095

Hsieh H-F, Shannon SE. Three Approaches to Qualitative Content Analysis. Qualitative Health Research. 2005;15(9):1277-1288. doi:10.1177/1049732305276687

Hsu, C. W., & Chiu, S. C. (2013). Economic benefits of LEED-certified buildings. In Sustainable Building 2013 (pp. 1-11). https://doi.org/10.1061/9780784413005.001

IATA. (n.d.). Sustainability. Retrieved December 15, 2024, from https://www.iata.org/en/programs/sustainability

IATA CO2 connects for airlines. (n.d.). https://www.iata.org/en/services/data/environment-sustainability/co2-connect/iata-co2-connect-for-airlines/

Iberia. (n.d.). Historical timeline. Iberia. https://grupo.iberia.com/about_us/historical_timeline

Iberia. (2022). Sustainability report 2022. https://grupo.iberia.com/en/about-us/sustainability-report-2022

Impact of COVID-19 on world Aviation industry, The: Challenges and opportunities. (n.d.). GoogleBooks. https://books.google.at/books?hl=de&lr=&id=ZwhqEAAAQBAJ&oi=fnd&pg=PR5&dq=covid+19+aviation+today&ots=tjr3iF22Pc&sig=BCM_vdWg8TkOveiTl2c9YFbJxTk&redir_esc=y#v=onepage&q=covid%2019%20aviation%20today&f=false

Incardona, R., & Poncibò, C. (2007). The average consumer, the unfair commercial practices directive, and the cognitive revolution. Journal of consumer policy, 30(1), 21-38.

International Air Transport Association. (2023). *Airport environmental sustainability policy*. https://www.iata.org/contentassets/d1d4d535bf1c4ba695f43e9beff8294f/airport-environmental-sustainability-policy.pdf

International Air Transport Association. (2024, April). Beginner’s guide to airline sustainability reporting. https://www.iata.org/contentassets/77ec9a8c8a864daaa00bdb7f5de02902/beginners-guide-to-airline-sustainability-reporting-april2024.pdf

International Civil Aviation Organization. (n.d.). History of ICAO. https://www.icao.int/about-icao/history/pages/default.aspx

International Organization for Standardization. (2015). ISO 14001:2015 - Environmental management systems - Requirements with guidance for use. https://www.iso.org/standard/60857.html

ISO 14001:2015. (n.d.). ISO. https://www.iso.org/standard/60857.html#:~:text=ISO%2014001%20is%20the%20internationally,continually%20improve%20their%20environmental%20performance.

John, I., Kwofie, E. M., & Ngadi, M. (2020). Two decades of eco-efficiency research: a bibliometric analysis. Environmental Sustainability, 3(2), 155–168. https://doi.org/10.1007/s42398-020-00105-1

Kameníková, I., Kameník, M., Capoušek, L., & Cejnar, I. J. (2022). Application of the single-engine taxi-out procedure for commercial transport, focusing on the Airbus A320 fleet. Transportation Research Procedia, 65, 126–132. https://doi.org/10.1016/j.trpro.2022.11.015

Karassin, O., & Bar-Haim, A. (2016). Multilevel corporate environmental responsibility. Journal of Environmental Management, 183, 110-120.

Karoui, A., & Zerter, L. (2023). ESG Risk Ratings: A 360° Review. In Sustainalytics.

Kim, H., Park, K., & Ryu, D. (2015). Corporate Environmental Responsibility: A Legal Origins Perspective. Journal of Business Ethics, 140(3), 381–402. https://doi.org/10.1007/s10551-015-2641-1

Kim, S., & Hwang, J. (2023). Airline CSR and Quality Attributes as Driving Forces of Passengers’ Brand Love: Comparing Full-Service Carriers with Low-Cost Carriers. Sustainability, 15(9), 7293. https://doi.org/10.3390/su15097293

Kim, Y., Lee, J., & Ahn, J. (2019). Innovation towards sustainable technologies: A socio-technical perspective on accelerating transition to aviation biofuel. Technological Forecasting and Social Change, 145, 317–329. https://doi.org/10.1016/j.techfore.2019.04.002

Kim, Y., Lee, S. S., & Roh, T. (2020). Taking another look at airline CSR, we will examine how required CSR and desired CSR affect customer loyalty in the airline industry. Sustainability, 12(10), 4281. https://doi.org/10.3390/su12104281

Kiracı, K., & Caliyurt, K. T. (2022). Corporate Governance, Sustainability, and Information Systems in the Aviation sector, Volume I. Springer.

Kito, M., Nagashima, F., Kagawa, S., & Nansai, K. (2020). Drivers of CO2 emissions in international aviation: the case of Japan. Environmental Research Letters, 15(10), 104036.

KLM. (n.d.). CO2 impact program. KLM. https://www.klm.at/information/legal/extra-options/co2-impact-programme

KLM. History of KLM. (n.d.). KLM. https://www.klm.nl/ en/information/corporate/history.

KLM. (2023). Sustainability report 2023. https://www.klm.com/sustainability-report-2023

Kuckartz, U. (2021). Qualitative Inhaltsanalyse: Methoden, Praxis, Umsetzung mit Software und künstlicher Intelligenz. Beltz Juventa.

Kuckartz, U. (2022). Einführung in die computergestützte Analyse qualitativer Daten (3., aktualisierte Auflage). Springer.

Kuo, T., Chen, H., & Meng, H. (2021). Do corporate social responsibility practices improve financial performance? A case study of airline companies. Journal of Cleaner Production, 310, 127380. https://doi.org/10.1016/j.jclepro.2021.127380

Kuo, T. C., Kremer, G. E. O., Phuong, N. T., & Hsu, C. (2016). Motivations and barriers for corporate social responsibility reporting: Evidence from the airline industry. Journal of Air Transport Management, 57, 184–195. https://doi.org/10.1016/j.jairtraman.2016.08.003

Kurpierz, J. R., & Smith, K. (2020). The greenwashing triangle: adapting tools from fraud to improve CSR reporting. Sustainability Accounting, Management and Policy Journal, 11(6), 1075-1093.

Lai, Y., Christley, E., Kulanovic, A., Teng, C., Björklund, A., Nordensvärd, J., Karakaya, E., & Urban, F. (2022). Analysing the opportunities and challenges for mitigating the climate impact of aviation: A narrative review. Renewable & Sustainable Energy Reviews, 156, 111972. https://doi.org/10.1016/j.rser.2021.111972

Laing, T., Sato, M., Grubb, M., & Comberti, C. (2014). The effects and side-effects of the EU emissions trading scheme. Wiley Interdisciplinary Reviews. Climate Change, 5(4), 509–519. https://doi.org/10.1002/wcc.283

Latapí, M., Jóhannsdóttir, L., & Davíðsdóttir, B. (2021). Evolution of Corporate Social Responsibility: A Historical Overview. In Springer eBooks (pp. 1–6). https://doi.org/10.1007/978-3-319-23514-1_1269-1

LeCompte, M. D. (2000). Analyzing Qualitative Data. Theory Into Practice, 39(3), 146–154. https://doi.org/10.1207/s15430421tip3903_5

Lee, S. S., Kim, Y., & Roh, T. (2019). Modified Pyramid of CSR for Corporate Image and Customer Loyalty: Focusing on the moderating role of the CSR experience. Sustainability, 11(17), 4745. https://doi.org/10.3390/su11174745

Lenzen, M., & Murray, J. (2010). Conceptualising environmental responsibility. Ecological Economics, 70(2), 261–270. https://doi.org/10.1016/j.ecolecon.2010.04.005

Lewis, M. J. (2023). History of Aircraft & Aviation – Introduction to Aerospace Flight Vehicles. Eagle Pubs. https://eaglepubs.erau.edu/introductiontoaerospaceflightvehicles/chapter/history-of-aircraft-and-aviation/.

Li, W., Cui, J., Gao, J., & Xiong, J. (2023). Corporate social responsibility in China's airline industry: A longitudinal content analysis of related reports. Journal of Air Transport Management, 111, 102420.

Lim, J., & Lee, H. C. (2020). Comparisons of service quality perceptions between full service carriers and low cost carriers in airline travel. Current issues in Tourism, 23(10), 1261-1276.

Lohmann, G., & Pereira, B. A. (2020). Air transport innovations: a perspective article. Tourism Review, 75(1), 95-101

Lomas, C. (2023, October 8). Wizz Air at 20 – a short history of Europe’s Ultra Low Cost Carrier. Flightradar24 Blog. https://www.flightradar24.com/blog/history-of-wizz-air/.

Lu, M. (2018). What Does CSR/CER Mean?. In Corporate Social and Environmental Responsibility (pp. 31-67). Brill Nijhoff.

Lu, M., & Faure, M. (2016). The regulation of corporate environmental responsibility. Market Integration: The EU Experience and Implications for Regulatory Reform in China, 239-265.

Lu, J., & Wang, C. (2018). Investigating the impacts of air travellers’ environmental knowledge on attitudes toward carbon offsetting and willingness to mitigate the environmental impacts of aviation. Transportation Research Part D Transport and Environment, 59, 96–107. https://doi.org/10.1016/j.trd.2017.12.024

Lufthansa Group. (n.d.). Health management and occupational safety. Lufthansa Group. https://www.lufthansagroup.com/en/responsibility/social-responsibility/health-management-and-occupational-safety.html

Lufthansa Group. (n.d.). History. Lufthansa Group. https://www.lufthansagroup.com/en/company/history.htm

Lufthansa Group. (2023). Sustainability report 2023. https://www.lufthansagroup.com/en/company/sustainability-report-2023.html

Lufthansa Innovation Hub. (n.d.). Project portfolio. Compensaid. https://compensaid.com/de/projects/portfolio

Madrakhimova, F. (2013). History of development of corporate social responsibility. Journal of Business and Economics, 4(6), 509-520.

Mamun, M. A., & Shaikh, J. M. (2018). Reinventing strategic corporate social responsibility. Journal of Economic & Management Perspectives, 12(2), 499-512.

Manetti, G., & Toccafondi, S. (2011). The role of stakeholders in sustainability reporting assurance. Journal of Business Ethics, 107(3), 363–377. https://doi.org/10.1007/s10551-011-1044-1

Martinez-Valencia, L., Garcia-Perez, M., & Wolcott, M. P. (2021). Supply chain configuration of sustainable aviation fuel: Review, challenges, and pathways for including environmental and social benefits. Renewable & Sustainable Energy Reviews, 152, 111680. https://doi.org/10.1016/j.rser.2021.111680.

Matten, D., & Moon, J. (2008). “Implicit” and “Explicit” CSR: A conceptual framework for a comparative understanding of corporate social responsibility. the Academy of Management Review, 33(2), 404–424. https://doi.org/10.5465/amr.2008.31193458

Matuszek, G. (2013). Marktmacht-Effekte der Zertifizierung. In Springer eBooks (pp. 93–106). https://doi.org/10.1007/978-3-658-02290-7_15

Maurice, L. Q., Lander, H., Edwards, T., & Harrison Iii, W. E. (2001). Advanced aviation fuels: a look ahead via a historical perspective. Fuel, 80(5), 747-756.

Mayring, P. (2015). Qualitative Inhaltsanalyse: Grundlagen und Techniken (2nd ed.). Beltz Juventa.

Mazıoğlu, V., & Güngör, H. (2024). An Examination of the Sustainability Activities of Global Airline Collaborations within the Scope of IATA's Sustainability Goals. Journal of Aviation, 8(3), 288-304.

McManners, P. J. (2015). Developing policy integrating sustainability: A case study into aviation. Environmental Science & Policy, 57, 86–92. https://doi.org/10.1016/j.envsci.2015.11.016

Meade, M. (n.d.). Big Oil's history of greenwashing. Green America. https://www.greenamerica.org/your-green-life/big-oils-history-greenwashing

Medina, M. Á. (2024, November 27). Las ONG abandonan la alianza de las aerolíneas y las acusan de ecopostureo con los biocombustibles. El País. https://elpais.com/clima-y-medio-ambiente/2024-11-27/las-ong-abandonan-la-alianza-de-las-aerolineas-y-las-acusan-de-ecopostureo-con-los-biocombustibles.html

Meehan, J., & Bryde, D. (2010). Sustainable procurement practice. Business Strategy and the Environment, 20(2), 94–106. https://doi.org/10.1002/bse.678

Melas, D., & Melasova, K. (2020). The early impact of COVID-19 pandemic on the aviation industry. Acta Avionica, 22(1), 38-44.

Menghwar, P. S., & Daood, A. (2021). Creating shared value: A systematic review, synthesis and integrative perspective. International Journal of Management Reviews, 23(4), 466–485. https://doi.org/10.1111/ijmr.12252

Miller, N., Spivey, J., & Florance, A. (2008). Does green pay off? Journal of Real Estate Portfolio Management, 14(4), 385 400. https://doi.org/10.1080/10835547.2008.12089822

Mitchell, L. D., & Ramey, W. D. (2010). Look How Green I am! An Individual-level Explanation for Greenwashing. Social Science Research Network. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID2409956_code2215950.pdf?abstractid=2409956&mirid=1

Modarress, B., Ansari, A., & Ansari, A. (2020). Environmental degradation and the implementation of the circular economy in commercial aviation. Sustainability the Journal of Record, 13(4), 178–184. https://doi.org/10.1089/sus.2020.0006

Moravcikova, K., Stefanikova, Ľ., & Rypakova, M. (2015). CSR reporting as an important tool of CSR communication. Procedia Economics and Finance, 26, 332–338. https://doi.org/10.1016/s2212-5671(15)00861-8

Moreno, L., Ramon, A., & Pedreño, A. (2015). The development of low-cost airlines and tourism as a competitiveness complementor: effects, evolution and strategies. Journal of Spatial and Organizational Dynamics, 3(4), 262-274.

Morris, B. F., & Loughlin, T. R. (2013). Overview of the Exxon Valdez oil spill. Marine mammals and the Exxon Valdez, 1.

Morrison, S., & Winston, C. (2010). The economic effects of airline deregulation. Brookings Institution Press.

Morrow, D., & Rondinelli, D. (2002). Adopting corporate environmental management systems: European Management Journal, 20(2), 159–171. https://doi.org/10.1016/s0263-2373(02)00026-9

Morsing, M., & Spence, L. J. (2019). Corporate social responsibility (CSR) communication and small and medium sized enterprises: The governmentality dilemma of explicit and implicit CSR communication. Human relations, 72(12), 1920-1947.

Moura-Leite, R. C., & Padgett, R. C. (2011). Historical background of corporate social responsibility. Social responsibility journal, 7(4), 528-539.

Mousavi, S., & Bossink, B. (2020). Corporate-NGO partnership for environmentally sustainable innovation. Environmental Innovation and Societal Transitions, 34, 80–95. https://doi.org/10.1016/j.eist.2019.12.005

Nature. (2024). Air-travel climate-change emissions detailed for nearly 200 nations. *Nature*. https://doi.org/10.1038/d41586-024-01148-8

Nemes, N., Scanlan, S. J., Smith, P., Smith, T., Aronczyk, M., Hill, S., Lewis, S. L., Montgomery, A. W., Tubiello, F. N., & Stabinsky, D. (2022). An integrated framework to assess greenwashing. Sustainability, 14(8), 4431. https://doi.org/10.3390/su14084431

Neureiter, A., Hirsch, M., Matthes, J., & Naderer, B. (2024). Sustainable Flying? The effects of greenwashed claims in airline advertising on perceived greenwashing, brand outcomes, and attitudes toward flying. *Environmental Communication*, 1–18. https://doi.org/10.1080/17524032.2024.2327060

Neureiter, A., & Matthes, J. (2023). Comparing the effects of greenwashing claims in environmental airline advertising: Perceived greenwashing, brand evaluation, and flight shame. International journal of advertising, 42(3), 461-487.

Ngo, T., Le, T., Ullah, S., & Trinh, H. H. (2022). Climate risk disclosures and global sustainability initiatives: A conceptual analysis and agenda for future research. Business Strategy and the Environment, 32(6), 3705–3720. https://doi.org/10.1002/bse.3323

Ngo et all ersetzen durch: Task Force on Climate-related Financial Disclosures. (2021). TCFD implementing guidance: The use of scenario analysis in disclosure of climate-related risks and opportunities. https://assets.bbhub.io/company/sites/60/2021/07/2021-TCFD-Implementing_Guidance.pdf

Nhamo, G., Dube, K., Chikodzi, D., Nhamo, G., Dube, K., & Chikodzi, D. (2020). COVID-19 and implications for the aviation sector: A global perspective. Counting the cost of COVID-19 on the global tourism industry, 89-107.

Nielsen, A. E., & Thomsen, C. (2007). Reporting CSR – what and how to say it? Corporate Communications, 12(1), 25–40. https://doi.org/10.1108/13563280710723732

Nisanci, D. A. (2021). FSB task force on climate-related financial disclosures. In World Scientific Encyclopedia of Climate Change: Case Studies of Climate Risk, Action, and Opportunity Volume 3 (pp. 3-8).

Nordhaug, S. (2017). The role of third party assurance of sustainability reports : Incentives and Challenges. DIVA. https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1105370&dswid=-795

Nygaard, A. (2023). Is sustainable certification's ability to combat greenwashing trustworthy? Frontiers in Sustainability, 4. https://doi.org/10.3389/frsus.2023.1188069

Olanipekun, A. O., Omotayo, T., & Saka, N. (2021). Review of the use of corporate social responsibility (CSR) tools. Sustainable Production and Consumption, 27, 425-435.

Oreskes, N., & Supran, G. (2023, December 7). The forgotten oil ads that told us climate change was nothing. The Guardian. https://www.theguardian.com/environment/2021/nov/18/the-forgotten-oil-ads-that-told-us-climate-change-was-nothing

Orikpete, O. F., Dennis, N. M., Kikanme, K. N., & Ewim, D. R. E. (2024). Advancing noise management in aviation: Strategic approaches for preventing noise-induced hearing loss. Journal of Environmental Management, 363, 121413. https://doi.org/10.1016/j.jenvman.2024.121413

Oven-Krockhaus, I. Z., & Albers, C. (2023). Dynamisches Pricing bei Fluggesellschaften und Wahrnehmung der Preisfairness bei Flugreisenden. In Springer eBooks (pp. 317–334). https://doi.org/10.1007/978-3-658-38210-0_19

Parguel, B. & Johnson, G. (2021). Beyond greenwashing: Addressing 'the great illusion' of green advertising. Revue de l'organisation responsable, 16, 59-66. https://www.cairn.info/revue--2021-2-page-59.htm.Formularende

Parmar, B. L., Freeman, R. E., Harrison, J. S., Wicks, A. C., Purnell, L., & De Colle, S. (2010). Stakeholder Theory: The state of the art. the Academy of Management Annals, 4(1), 403–445. https://doi.org/10.5465/19416520.2010.495581

Pecora, R. (2021). Morphing wing flaps for large civil aircraft: Evolution of a smart technology across the Clean Sky program. Chinese Journal of Aeronautics, 34(7), 13-28.

Pendse, M. K., Nerlekar, V. S., & Darda, P. (2023). A comprehensive look at Greenwashing from 1996 to 2021: a bibliometric analysis. Journal of Indian Business Research, 15(1), 157-186.

Pérez, A. (2015). Corporate reputation and CSR reporting to stakeholders. Corporate Communications, 20(1), 11–29. https://doi.org/10.1108/ccij-01-2014-0003

Peters, L., & Peters, L. (2024, February 16). 40 years of Ryanair – a brief history. AeroTime. https://www.aerotime.aero/articles/40-year-ryanair-history

Petrescu, R. V., Aversa, R., Akash, B., Bucinell, R., Corchado, J., Apicella, A., & Petrescu, F. I. (2017). History of aviation-a short review. Journal of Aircraft and Spacecraft Technology, 1(1).

Pires, S., Sénéchal, O., Loures, E., & Jimenez, J. (2016). An approach to the prioritization of sustainable maintenance drivers in the TBL framework. IFAC-PapersOnLine, 49(28), 150–155. https://doi.org/10.1016/j.ifacol.2016.11.026

Pirson, M., & Malhotra, D. K. (2008). Unconventional Insights for managing Stakeholder Trust. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1088111

Pizzi, S., Principale, S., & De Nuccio, E. (2023). Material sustainability information and reporting standards. Exploring the differences between GRI and SASB. Meditari Accountancy Research, 31(6), 1654-1674.

Phillips, E. D. (2006). Corporate social responsibility in aviation. Journal of Air Transportation, Volume 11, No. 1.

Pokhrel, D. (2024, March 18). From Wright Brothers to Jet Age: Evolution of Aviation History. Avio Space. https://aviospace.org/from-wright-brothers-to-jet-age-evolution-of-aviation-history/

Politico, (2020). Ryanair slapped down over ‘misleading’ green claims, Available at: https://www.politico.eu/article/ryanair-slapped-down-over-misleading-green-claims/

Porter, M. E., & Kramer, M. R. (2015). Shared Value – Die Brücke von Corporate Social Responsibility zu Corporate Strategy. In Springer eBooks (pp. 145–160). https://doi.org/10.1007/978-3-662-43483-3_10

Ramón-Rodríguez, A. B., Moreno-Izquierdo, L., & Perles-Ribes, J. F. (2011). Growth and internationalisation strategies in the airline industry. Journal of Air Transport Management, 17(2), 110-115.

Ringham, K., & Miles, S. (2018). The boundary of corporate social responsibility reporting: the case of the airline industry. Journal of Sustainable Tourism, 26(7), 1043–1062. https://doi.org/10.1080/09669582.2017.1423317

Rizzi, P., Rizzi, C., & Tettamanti, M. (2022). The impact of covid-19 on world aviation industry: Challenges and opportunities. World Scientific.

Root, A. (2024). Boeing Max production is at a crawl. It would take 20 years to fill the backlog at this rate. https://www.barrons.com/articles/boeing-max-production-backlog-4e3cb4a1

Rozenberg, R., Šebeščáková, I., & Szabo, S. (2014). Comparison of FSC and LCC and Their Market Share in Aviation. International Review of Aerospace engineering, 7(5). http://dx.doi.org/10.15866/irease.v7i5.4439.

Rubel, R. C. (2010). The US Navy’s Transition to Jets. Naval War College Review, 63(2), 49-60.

Ruiz-Blanco, S., Romero, S., & Fernandez-Feijoo, B. (2022). Green, blue or black, but washing–What company characteristics determine greenwashing?. Environment, Development and Sustainability, 24(3), 4024-4045.

Ryanair. (n.d.). Our network. Ryanair. https://corporate.ryanair.com/about-us/our-network/

Ryanair. (2018). Ryanair unveils 2018 Always Getting Better plan, including 5-year plan to eliminate plastics. Ryanair. https://corporate.ryanair.com/news/ryanair-unveils-2018-always-getting-better-plan-including-5-year-plan-to-eliminate-plastics/

Ryanair. (2023). Sustainability report 2023. https://www.ryanair.com/sustainability-report-2023

Saleh, Y. A. B. (2022). Using the Concept of Precedence as an Approach to Explain the Logical Interaction and Interrelationships among Corporate Social Responsibilities: Battal's CSR Train VS. Carroll′ s CSR Pyramid. Universal Journal of Business and Management, 1-37.

Santos-Reyes, D., & Lawlor-Wright, T. (2001). A design for the environment methodology to support an environmental management system. Integrated Manufacturing Systems, 12(5), 323–332. https://doi.org/10.1108/eum0000000005710

Sarker, M. A. R., Hossan, C. G., & Zaman, L. (2012). Sustainability and growth of low cost airlines: an industry analysis in global perspective. American Journal of Business and Management, 1(3), 162-171.

SAS Group. (n.d.). History milestones. SAS Group. https://www.sasgroup.net/about-sas/sas-history/history-milestones/

SAS. (2023). Sustainability report 2023. https://www.sasgroup.net/sustainability-report-2023

Scheelhaase, J., & Maertens, S. (2020). How to improve the global ‘carbon offsetting and reduction scheme for international aviation’(CORSIA)?. Transportation Research Procedia, 51, 108-117.

Schmidt, B. Verbraucherschutzorganisationen klagen gegen “Greenwashing” von Fluggesellschaften. (n.d.). BRF Nachrichten. https://brf.be/national/1731668/#:~:text=Auch%20Ryanair%20und%20Brussels%20Airlines,%22%20oder%20%C3%BCbersetzt%20%22Gr%C3%BCnwaschen%22

Schneider, A. (2015). Reifegradmodell CSR – eine Begriffsklärung und -abgrenzung. In Springer eBooks (pp. 21–42). https://doi.org/10.1007/978-3-662-43483-3_2

Scholz, D. (2020). Aviation Ethics–Growth, Gain, Greed, and Guilt. In Deutscher Luft-und Raumfahrtkongress 2020. Deutsche Gesellschaft für Luft-und Raumfahrt-Lilienthal-Oberth eV.

Schwab, A., Thomas, A., Bennett, J., Robertson, E., & Cary, S. (2021). Electrification of aircraft: challenges, barriers, and potential impacts. https://doi.org/10.2172/1827628

Schwartz, M. S., & Carroll, A. B. (2003). Corporate social responsibility: A three-domain approach. Business Ethics Quarterly, 13(4), 503-530.

Seber, G., Malina, R., Pearlson, M. N., Olcay, H., Hileman, J. I., & Barrett, S. R. (2014). Environmental and economic assessment of producing hydroprocessed jet and diesel fuel from waste oils and tallow. Biomass and Bioenergy, 67, 108–118. https://doi.org/10.1016/j.biombioe.2014.04.024

Seneca ESG. (2023, June 15). Comparing ESG reporting frameworks: GRI vs. TCFD. https://senecaesg.com/insights/comparing-esg-reporting-frameworks-gri-vs-tcfd/

Sengur, F. K., & Altuntas, O. (2023). Taking Off for Net-Zero Aviation: Sustainability Policies and Collaborative Industry Actions. In Achieving Net Zero (Vol. 20, pp. 233-250). Emerald Publishing Limited.

Shahrin, R., Quoquab, F., Jamil, R., Mahadi, N., Mohammad, J., Salam, Z., & Hussin, N. (2017). Green “eco-label” or “greenwashing”? Building awareness about environmental claims of marketers. Advanced Science Letters, 23(4), 3205-3208.

Shahriar, M. F., & Khanal, A. (2022). The current techno-economic, environmental, policy status and perspectives of sustainable aviation fuel (SAF). Fuel, 325, 124905.

Shang, Y., Song, M., & Zhao, X. (2022). The development of China's Circular Economy: From the perspective of environmental regulation. Waste Management, 149, 186–198. https://doi.org/10.1016/j.wasman.2022.05.027

Shanks, B. A. (2017). EPA's Endangerment Finding for Aircraft Emissions: How Should the Airline Industry Respond. Air & Space Law., 30, 19.

Sindhi, S., & Kumar, N. (2012). Corporate environmental responsibility – transitional and evolving. Management of Environmental Quality, 23(6), 640–657. https://doi.org/10.1108/14777831211262927

Spaeth, A. (n.d.). Nach 56 Jahren: Produktionsende der Boeing 747. MTU AEROREPORT. https://aeroreport.de/de/aviation/nach-56-jahren-produktionsende-der-boeing-747.

Slavova, I., & Ivanova, V. (2019). Corporate environmental responsibility within the circular economy context: Opportunities for development and sustainability. Economic Alternatives, 2, 184-204.

Smyth, A., Christodoulou, G., Dennis, N., Al-Azzawi, M., & Campbell, J. (2012). Is air transport a necessity for social inclusion and economic development? Journal of Air Transport Management, 22, 53–59. https://doi.org/10.1016/j.jairtraman.2012.01.009

Southwest Corporate Fact Sheet. (n.d.). Southwest Airlines Newsroom. https://swamedia.com/pages/corporate-fact-sheet#:~:text=History%3A,the%20billion%2Ddollar%20revenue%20mark.

Statista. (2024, June 27). Average age of aircraft operated by Lufthansa Group's passenger airlines in 2023. https://www.statista.com/statistics/147

Stay Grounded. (n.d.). Greenwashing. Retrieved December 20, 2024, from https://stay-grounded.org/greenwashing/

Stenstrom, J. (2009). Effects of LCC entry on pricing in aviation. In The Airline Industry (pp. 77-94). Physica-Verlag HD. https://doi.org/10.1007/978-3-7908-2088-1_5

Stettler, M. E. J., Koudis, G. S., Hu, S. J., Majumdar, A., & Ochieng, W. Y. (2018). The impact of single-engine taxiing on aircraft fuel consumption and pollutant emissions. The Aeronautical Journal, 122(1258), 1967–1984. https://doi.org/10.1017/aer.2018.117

Stoop, M. A. (2024, July 19). CSRD Reporting: Mandatory reporting on corporate sustainability. Human in Progress. https://humaninprogress.com/csrd-reporting/

Streimikiene, D., Lasickaite, K., Skare, M., Kyriakopoulos, G., Dapkus, R., & Duc, P. A. (2020). The impact of Corporate Social Responsibility on Corporate Image: Evidence of budget airlines in Europe. Corporate Social-responsibility and Environmental Management, 28(2), 925–935. https://doi.org/10.1002/csr.2099

Subvertisers International. (2024, May). Week of action on airline advertising. Retrieved December 15, 2024, from https://subvertisers-international.net/2024/05/week-of-action-on-airline-advertising/

Sun, Z., & Zhang, W. (2019). Do government regulations prevent greenwashing? An evolutionary game analysis of heterogeneous enterprises. Journal of Cleaner Production, 231, 1489-1502.

SWISS. (2022). SWISS adopts new AeroSHARK riblet film technology to further reduce its flights' carbon emissions. SWISS Newsmarket. Retrieved [date accessed], from https://swiss.newsmarket.com/german/press-releases/swiss-adopts-new-aeroshark-riblet-film-technology-to-further-reduce-its-flights--carbon-emissions/s/105eec50-03fe-44c4-8911-c3fdb9db004b

TAP Air Portugal. (n.d.). Timeline. TAP Air Portugal. https://www.tapairportugal.com/en/our-history/timeline

Terceiro, M. (2008). When green wash won't wash: avoiding misleading environmental claims. Law Society Journal: The Official Journal of the Law Society of New South Wales, 46(10), 50–54. https://search.informit.org/doi/10.3316/ielapa.200812816

The Greenhouse Gas Protocol. (n.d.-b). https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

Tokoro, N. (2007). Stakeholders and Corporate Social Responsibility (CSR): A new perspective on the structure of relationships. Asian Business & Management, 6(2), 143–162. https://doi.org/10.1057/palgrave.abm.9200218

Toniolo, S., Tosato, R. C., Gambaro, F., & Ren, J. (2020). Life cycle thinking tools: Life cycle assessment, life cycle costing and social life cycle assessment. In Elsevier eBooks (pp. 39–56). https://doi.org/10.1016/b978-0-12-818355-7.00003-8

Torenbeek, E., & Wittenberg, H. (2009). Flight Physics: Essentials of Aeronautical Disciplines and Technology, with Historical Notes. Springer Science & Business Media.

Tritton, D. J. (1977). Physical Fluid Dynamics. Springer Netherlands.

Trivedi, S., Negi, S., & Tiwari, S. (2024). Business sustainability in aviation industry in post-COVID era through information technology and triple bottom line perspective. International Journal of Sustainable Aviation, 10(1).

Tukker, A. (2000). Life cycle assessment as a tool in environmental impact assessment. Environmental Impact Assessment Review, 20(4), 435–456. https://doi.org/10.1016/s0195-9255(99)00045-1

Tusa, S (2024). Opinion: The industry must make developing a new aircraft affordable. Aviation Week Network. https://aviationweek.com/aerospace/aircraft-propulsion/opinion-industry-must-make-developing-new-aircraft-affordable

United Nations. (2015). Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

United Nations. (2015). The 17 goals. United Nations. https://sdgs.un.org/goals

Upadhaya, B., Munir, R., Blount, Y., & Su, S. (2018). Diffusion of corporate social responsibility in the airline industry. International Journal of Operations & Production Management, 38(4), 1020-1040.

Upham, P. (2000). An assessment of The Natural Step theory of sustainability. Journal of Cleaner Production, 8(6), 445–454. https://doi.org/10.1016/s0959-6526(00)00012-3.

U.S. Department of Transportation. (n.d.). Aviation consumer protection. https://www.transportation.gov/airconsumer

Varma, T. M. (2021). Responsible leadership and reputation management during a crisis: The cases of Delta and United Airlines. Journal of Business Ethics, 173, 29-45.

Vázquez, J. L., & Lanero, A. (2021). Consumer transition to a green economy: The role of third-party certified eco-labels. SHS Web of Conferences, 120, 02002. https://doi.org/10.1051/shsconf/202112002002

Verma, M., & Bharti, U. (2023). Combating greenwashing tactics and embracing the economic success of sustainability. Veethika: An International Interdisciplinary Research Journal, 9(3), 6–12. https://doi.org/10.48001/veethika.2023.09.03.002

Waheed, A., & Zhang, Q. (2022). Effect of CSR and ethical practices on sustainable competitive performance: A case of emerging markets from stakeholder theory perspective. Journal of Business Ethics, 175(4), 837-855.

Wang, H. (2016). Systematic analysis of corporate environmental responsibility: Elements, structure, function, and principles. Chinese Journal of Population Resources and Environment, 14(2), 96-104.

Watson, B. (2016, August 22). The troubling evolution of corporate greenwashing. The Guardian. https://www.theguardian.com/sustainable-business/2016/aug/20/greenwashing-environmentalism-lies-companies

Weaver, G. R., Treviño, L. K., & Cochran, P. L. (2012). Corporate Ethics Practices in the mid-1990s: An Empirical Study of the Fortune 1000. In Springer eBooks (pp. 625–640). https://doi.org/10.1007/978-94-007-4126-3_31

Weerasinghe, S., & Ahangama, S. (2018, December). Predictive maintenance and performance optimisation in aircrafts using data analytics. In 2018 3rd International Conference on Information Technology Research (ICITR) (pp. 1-8). IEEE.

Wizz Air. (n.d.). About Wizz. Wizz Air. https://wizzair.com/en-gb/information-and-services/about-us/about-wizz

Wizz Air. (2023). Sustainability report 2023. https://wizzair.com/en-gb/information-and-services/sustainability-report-2023

Wongleedee, K. (2017). Customer satisfaction in the airlines industry: comparison between low-cost and full service airlines. Актуальні проблеми економіки, (1), 218-222.

World Business Council for Sustainable Development. (2000). Corporate social responsibility: Making good business sense. https://www.wbcsd.org/Programs/People/Social-Impact/Corporate-Social-Responsibility

Wright Brothers first flight - NASA. (n.d.). NASA. https://www.nasa.gov/image-article/wright-brothers-first-flight/

Yadav, M., Singh, N. K., Sahoo, R. C., & Mohanty, U. K. (2020). Role of corporate Social Responsibility (CSR) and Corporate Environmental Responsibility (CER) in achieving sustainability goals. In CRC Press eBooks (pp. 173–186). https://doi.org/10.1201/9781003011255-14

Yuan, Y., Lu, L. Y., Tian, G., & Yu, Y. (2020). Business strategy and corporate social responsibility. Journal of Business Ethics, 162, 359-377.

Zaharia, R. M., & Zaharia, R. (2021). Triple bottom line. The Palgrave Handbook of Corporate Social Responsibility, 75-101.

Zein, T., & Zein, S. (2020). A legal perspective on Corporate Social Responsibility (CSR). BAU Journal-Creative Sustainable Development, 1(2), 1.

Zhang, L., Butler, T. L., & Yang, B. (2020). Recent trends, opportunities and challenges of sustainable aviation fuel. Green energy to sustainability: strategies for global industries, 85-110.

Zieba, M., & Johansson, E. (2022). Sustainability reporting in the airline industry: Current literature and future research avenues. Transportation Research Part D: Transport and Environment, 102, 103133.

Appendix

A - Coding Manual

Category 1: Waste Handling

Definition: Waste handling refers to separating, utilizing, and recycling different types of waste.

Anchor example: In aviation, waste management is subject to specific regulations [...] and must comply with established requirements for waste handling, storage, transport, and disposal (airBaltic, 2023).

- **Subcategory 1: fresh food waste**

Definition: This refers to the waste resulting from the disposal of fresh food.

Anchor example: Adjusting the quantity of products boarded on TAP planes can reduce food waste and improve resource management (TAP, 2023).

- **Subcategory 2: waste management**

Definition: This describes the management and disposal of waste within the company.

Anchor example: We continuously work to enhance the recycling of onboard waste despite the challenges posed by varying national regulations governing waste management (SAS, 2023).

- **Subcategory 3: Recycling**

Definition: Recycling means separating, recovering, and reusing certain types of waste. For example, by separating plastic, paper, or glass, materials can be reused, and no new materials need to be procured. The purpose of waste separation is to reuse the waste.

Anchor example: Additionally, onboard waste is now being sorted on all European flights, and the process for collecting plastic and cardboard cups has been improved. The catering teams recycle glass, cans, aluminum lids, paper, cooling material, PET plastic bottles, and other forms of plastic (KLM, 2023).

Category 2: Participation interest of companies

Definition: This defines participation in or compliance with specific requirements of external organizations.

Anchor example: The Company complies with all applicable laws and regulations in every country it operates in and participates in all mandatory consultations where applicable (Wizz Air, 2023).

- **Subcategory 1: Influence of External Organizations**

Definition: Companies are influenced by external organizations and take their guidelines and specifications as their standards.

Anchor example: The Company has aligned itself with the sustainability goals set by organizations such as the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA), and Airlines for Europe (A4E) […] (airBaltic, 2023).

- **Subcategory 2: Sustainable Development Goals**

Definition: The SDGs, drawn up by the United Nations, cover essential ecological, economic, and social aspects for a more sustainable world by 2030.

Anchor example: […] Lufthansa Group concentrates on the SDGs where, based on its business model, it can reduce its negative impact and increase its positive effect (Lufthansa Group, 2023).

- **Subcategory 3: ESG rating**

Definition: The ESG rating assesses a company's environmental, economic, and social aspects on a scale of 1 to 100.

Anchor example: Ryanair's commitment to ESG is reflected in our strong performance on vital external indices/rankings. […] Ryanair Group […] determination to ensure that we deliver our ambitious ESG targets (Ryanair, 2023).

- **Subcategory 4: Fly Net Zero**

Definition: Fly Net Zero aims to achieve zero emissions by 2050 through technological advances and innovative ideas such as SAFs.

Anchor example: To meet this challenge, aviation must transform itself, moving away from fossil fuels and towards new energy sources and technologies that will allow us to fly with net zero emissions by 2050 (Iberia, 2022).

Category 3: Emissions

Definition: This section explains environmentally harmful emissions, such as CO2. Burning fossil fuels releases gases or pollutants into the atmosphere, contributing to climate change.

Anchor example: […] emissions from air transport currently represent between 2 % and 3%

of total global emissions. It is an activity that continues to grow […] (Iberia, 2022).

- **Subcategory 1: CO2 Emissions**

Definition: This refers to the release of carbon dioxide gas into the atmosphere, which contributes to climate change and global warming.

Anchor example: Aviation's primary negative impact on the climate is its CO2 emissions from fuel and energy use, which are viewed from three perspectives […] (airBaltic, 2023).

- **Subcategory 2: CO2 emissions reduction**

Definition: Efforts and strategies implemented to decrease the amount of carbon dioxide released into the atmosphere.

Anchor example: Also, essential savings are expected in fuel consumption and a reduction in carbon dioxide emissions [...] (TAP, 2023).

Category 4: Fleet Management

Definition: The process of efficiently managing the current aircraft of a commercial airline, which increases operation efficiency and revenue but decreases environmental impact.

Anchor Example: The fleet is one of the fundamental pillars of TAP's value chain, and the Company is continuously investing in innovative initiatives and technologies to improve operational efficiency and reduce carbon dioxide emissions (TAP, 2023).

- **Subcategory 1: Fleet renewal**

Definition: Modernizing the fleet through investments in new aircraft and retirement of old ones.

Anchor Example: Throughout the year, we welcomed eight A320neo and five E195 aircraft while phased out and rejected twelve older aircraft, including two Airbus 350, one A320neo, five Boeing 737s, and four Airbus 321 (SAS, 2023).

- **Subcategory 2: Fleet Age**

Definition: The average age of an airline's entire fleet is calculated by dividing the total number of years of operation of all planes in the fleet by the number of planes.

Anchor Example: The average age of our entire aircraft fleet stood at 8.6 years at year-end (SAS, 2023).

Category 5: Aspects of Efficient Consumption

Definition: Information on efficient consumption of, for example, fuel or savings in areas such as aircraft weight. Specific processes are defined to improve flight efficiency. **Anchor example:** Improving aircraft fuel efficiency and optimizing passenger and cargo capacity reduces fuel consumption and operational costs (SAS, 2023).

- **Subcategory 1: Noise pollution**

Definition: Noise pollution means excessive noise in the environment, generated by noise at airports, among other things.

Anchor example: Due to the impact of noise pollution on society and its importance to our communities and policymakers, we are focused on continuously reducing the noise in our fleet (Wizz Air, 2023).

- **Subcategory 2: Fuel consumption**

Definition: Average quantity of fuel an airline uses to perform flight operations along with techniques for fuel savings.

Anchor Example: Eight thousand tons of kerosene are being reduced through 67 fuel-saving projects across the Group, such as AeroSHARK (Lufthansa, 2023).

Category 6: Sustainable Aviation Fuels

Definition: Sustainably produced fuels using renewable or waste-based resources, designed to replace conventional fossil-based fuels with aim to reduce environmental impact.

Anchor Example: Unlike conventional fuels, SAF is produced without relying on non-renewable natural resources. These fuels use diverse raw materials, such as used cooking oils (UCO), vegetable oils, and municipal solid waste […] (TAP, 2023).

- **Subcategory 1: SAF Usage**

Definition: Adoption and implementation of SAFs by airlines during ordinary operations.

Anchor Example: In 2023, following the latest industry and regulatory requirements, airBaltic continued to increase its use of SAF to 71.372 kg [...] (airBaltic, 2023).

- **Subcategory 2: Agreements and Collaborations**

Definition: Strategic partnerships, contracts, and MoUs between airlines, fuel suppliers, governments, research institutions, and other stakeholders related to SAFs supply and production.

Anchor Example: Since we published our 2022 Sustainability Report, Ryanair has signed MoUs to supply up to 675.000 mt of SAF [...] (Ryanair, 2023).

Category 7: Hub-Related Implications

Definition: All pre-flight operations performed on the ground at relevant airports necessary to successfully execute a flight.

Anchor Example: TAP recognizes the importance of creating modern, energy-efficient environments and workspaces for its employees across its extensive infrastructure, which includes corporate offices, support buildings, warehouses, hangars, and maintenance workshops (TAP, 2023).

- **Subcategory 1: Electric car fleet**

Definition: A vehicle powered by electricity, utilizing an electric motor rather than a traditional internal combustion engine.

Anchor Example: The Group has a fleet of 29 electric vehicles, which are used for technical, ground operations, management, and administration purposes (airBaltic, 2023).

- **Subcategory 2: Energy consumption**

Definition: Overall electrical energy usage by ground facilities at the relevant airports.

Anchor Example: As Iberia consumes 100 % renewable electricity, […] it is estimated that in 2022, the emission of 13.274 t CO2 was avoided (Iberia, 2022).

Category 8: Companies' Presence

Definition: Defines the presence of companies vis-à-vis the public in general. **Anchor example:** SAS collaborates with customers, authorities, suppliers, airports, and other stakeholders […]. We engage in dialogues with employees, partners, experts, NGOs, organizations, and researchers […] (SAS, 2023).

- **Subcategory 1: Changes to 2022**

Definition: All explicitly described changes from the previous year are explained.

Anchor example: Lufthansa Group's target to achieve a 30.6 % reduction in CO2 intensity in 2030 compared to 2019 was successfully validated in 2022 by SBTi as the first European airline group and the second worldwide (Lufthansa Group, 2023).

- **Subcategory 2: Future Implications**

Definition: This refers to all plans and prospects for the coming years.

Anchor example: Environmental goals 2030: Sustainable aviation fuel equivalent to SAS' domestic production […], 50 % noise reduction compared with 2010, 100 % sustainable materials in SAS' customer offering, and 100 % recycling where possible (SAS, 2023).

- **Subcategory 3: Sustainability Concerns**

Definition: Defines long-term viability of environmental, social, and economic aspects with a focus on sustainable resource use, eco-system preservation, and overall well-being.

Anchor example: To this end, Iberia's sustainability strategy is defined in four fundamental pillars, which include environmental and social initiatives. The goal is to accelerate the ecological transition of activities moderately and inclusively (Iberia, 2022).

B- Examination material with the number of coding units assigned

Liste der Dokumente

Liste der Dokumente	#
Dokumente	705
AirBaltic 2023	130
Finnair 2023	32
Iberia 2022	82
KLM AirFrance 2023	59
Lufthansa Group 2023	83
TAP 2023	57
WizzAir 2023	109
Ryanair 2023	81
SAS 2023	72

C - Code system from MAXQDA with the number of coding units assigned

Liste der Codes	Häufigkeit
Code system	705
waste handling	0
waste (x)	8
mixed packaging (x)	5
fresh food waste	9
waste management	22
recycling	13
participation interests of companies	0
Influence of external organizations	51
Collaborations (x)	2
Sustainable Development Goals (SDGs)	12
ESG reporting	15
Fly Net Zero	24
aspects of consumption	0

energy efficiency	12
fuel consumption (x)	35
fleet efficiency	20
fuel emission (x)	4
Nox (x)	15

emissions	0
non CO2 emissions (x)	4
carbon emissions (x)	51
CO2 emissions	74
greenhouse gases (x)	14
CO2 reduction	20
hub-related implications	0
ground operations	25
electric car fleet	11
energy consumption	4
companies presence	0
fines (x)	4
changes to 2022	23

future implications	13
collaborations (x)	4
Fleet (x)	1
internal sustainability strategies (x)	14
sustainability concerns	20
fleet management	0
flight efficiency (x)	11
fleet decision	14
fleet renewal	37

noise pollution	18
Sustainable Aviation Fuels	0
SAF usage	4
SAF barriers (x)	5
Agreements and Collaborations	3
SAF	84