



# Navigating Sustainability: Exploring the Strategic Shift towards Environmental Friendliness in the European Passenger Airline Industry

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## **Abstract**

The European passenger airline industry has been under scrutiny for its environmental impact and is under increasing pressure to adopt sustainable practices. This thesis investigates the industry's strategic transformation by focusing on how airlines are incorporating sustainability into their strategies to enhance environmental friendliness. The research objective is to understand this integration, uncover its driving forces, and identify the challenges airlines face, assessing the dynamics and feasibility of their efforts. A research approach that combines the analysis of airline sustainability publications with expert interviews with seven airline representatives and six key stakeholders is adopted. The findings suggest that airlines are gradually integrating sustainability into their strategies by refining governance, adjusting strategic frameworks, engaging in collaborative efforts, and employing a combination of decarbonization measures, including Sustainable Aviation Fuel (SAF), fleet renewal, operational efficiency measures, and carbon offsetting. External factors, such as regulatory and competitive pressure, economic incentives, and stakeholder expectations, as well as internal expectations from leadership and employees, are driving forces behind this transformation. However, efforts face significant barriers; challenges include knowledge management, legal compliance, technology accessibility, financial constraints, communication, and managerial capacity. Continuous innovation, collaboration, and commitment to sustainability are essential for the industry's decarbonization and future, which seems uncertain at this point. This thesis underscores the importance of holistic integration of sustainability and the complexity of driving forces and barriers faced in the context of the European passenger airline industry.

**Title:** Navigating Sustainability: Exploring the Strategic Shift Towards Environmental Friendliness in the European Passenger Airline Industry

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**Keywords:** Sustainability, Sustainability Integration, Sustainability Transformation, Environmental Friendliness, Airline Industry, Airline Strategy

## **Resumo**

A indústria de companhias aéreas europeias tem sido amplamente examinada devido ao seu impacto ambiental e enfrenta crescente pressão para adotar práticas sustentáveis. Esta dissertação investiga a transformação estratégica da indústria, focando em como as companhias aéreas estão incorporando a sustentabilidade em suas estratégias para promover a sustentabilidade ambiental. O objetivo da pesquisa é entender essa integração, revelar suas forças motrizes e identificar os desafios enfrentados pelas companhias aéreas, avaliando a dinâmica e a viabilidade de seus esforços. Adota-se uma abordagem que combina a análise de publicações sobre sustentabilidade das companhias aéreas com entrevistas com representantes de companhias aéreas e partes interessadas. Os resultados sugerem que as companhias aéreas estão gradualmente integrando a sustentabilidade em suas estratégias ao refinando a governança, ajustando os quadros estratégicos, engajar-se em esforços colaborativos e empregar uma combinação de medidas de descarbonização, incluindo SAF, renovação de frota, medidas de eficiência operacional e compensação de carbono. Fatores externos, como pressão regulatória e competitiva, incentivos econômicos e expectativas das partes interessadas, bem como expectativas internas de liderança e funcionários, são forças motrizes por trás dessa transformação. No entanto, os esforços enfrentam barreiras significativas, incluindo gestão do conhecimento, conformidade legal, acessibilidade tecnológica, restrições financeiras, comunicação e capacidade de gestão. Inovação contínua, colaboração e empenho são essenciais para a descarbonização e o futuro da indústria, que parece incerto no momento. Esta dissertação sublinha a importância da integração holística da sustentabilidade e a complexidade das forças motrizes e barreiras enfrentadas no contexto da indústria de companhias aéreas europeias.

**Título:** Navegar na sustentabilidade: Explorando a Mudança Estratégica em Direção à Sustentabilidade Ambiental na Indústria de Companhias Aéreas Europeias de Passageiros

**Autor:** Lena Dehen

**Palavras-chave:** Sustentabilidade, Integração da Sustentabilidade, Transformação da Sustentabilidade, Sustentabilidade Ambiental, Indústria de Companhias Aéreas, Estratégia de Companhias Aéreas

# Table of Contents

- Abstract.....I**
- Resumo ..... II**
- List of Abbreviations ..... V**
- List of Figures ..... VI**
- List of Table..... VII**
- 1. Introduction..... 1**
- 2. Literature Review ..... 3**
  - 2.1. Fundamentals of Sustainability Integration..... 4
    - 2.1.1. Definition and Theories of Corporate Sustainability ..... 4
    - 2.1.2. Relevance and Drivers of Sustainability Integration ..... 6
    - 2.1.3. Approaches to Sustainability Integration ..... 8
    - 2.1.4. Benefits and Challenges of Sustainability Integration ..... 10
  - 2.2. Fundamentals of Sustainability in Aviation..... 13
    - 2.2.1. Environmental Impact of Growing Air Travel ..... 13
    - 2.2.2. Approaches to Aviation Decarbonization..... 14
    - 2.2.3. Sustainable Aviation Technologies and Measures..... 15
      - 2.2.3.1. *Modern Aircraft Technology*..... 16
      - 2.2.3.2. *Alternative Propulsion*..... 16
      - 2.2.3.3. *Sustainable Aviation Fuel (SAF)*..... 18
      - 2.2.3.4. *Operational Efficiency*..... 19
      - 2.2.3.5. *Carbon Offsetting* ..... 20
    - 2.2.4. Stakeholder Impact in Airline Sustainability ..... 20
- 3. Methodology ..... 22**
  - 3.1. Sustainability Publications Analysis ..... 23
    - 3.1.1. Airline Sample Selection..... 23
    - 3.1.2. Source Selection Criteria..... 24
    - 3.1.3. Data Analysis Process ..... 25
  - 3.2. Qualitative Expert Interviews..... 26
    - 3.2.1. Participant Selection..... 26
    - 3.2.2. Interview Design and Process ..... 27
    - 3.2.3. Interview Data Analysis ..... 29
- 4. Results: Sustainability Publications Analysis..... 30**
  - 4.1. Size in Passenger Numbers ..... 30
  - 4.2. Sustainability Governance..... 31
  - 4.3. Environmental Impact of Selected Airlines..... 32
    - 4.3.1. Definition of Carbon Intensity ..... 32
    - 4.3.2. Current Carbon Intensity, Trends, and Targets ..... 33
  - 4.4. Key Pillars of Sustainability Strategies ..... 35

4.4.1. Fleet Renewal.....	36
4.4.2. Sustainable Aviation Fuel.....	38
4.4.3. Operational Efficiency .....	40
4.4.4. Carbon Offsets .....	41
<b>5. Results: Expert Interviews.....</b>	<b>41</b>
5.1. Strategic Approaches to Sustainability.....	42
5.1.1. Prioritization of Sustainability .....	42
5.1.2. Sustainability Goals .....	43
5.1.3. Strategic Planning .....	44
5.1.4. Sustainability Governance .....	44
5.1.5. Collaboration.....	45
5.1.6. Measures .....	46
5.2. Driving Forces .....	48
5.2.1. Legal Pressure and Policy Support .....	48
5.2.2. Competitive Pressure .....	48
5.2.3. Economic Incentives .....	49
5.2.4. Stakeholder Expectations .....	49
5.3. Challenges .....	51
5.3.1. Knowledge Management .....	51
5.3.2. Legal Compliance .....	52
5.3.3. Technology Accessibility .....	52
5.3.4. Financial Constraints.....	53
5.3.5. Communication and Transparency.....	53
5.3.6. Managerial Capacity .....	54
5.4. Future Outlook .....	54
<b>6. Discussion .....</b>	<b>56</b>
6.1. Strategic Sustainability Integration in Airlines.....	57
6.2. Driving Forces of Airline Sustainability.....	62
6.3. Challenges of Sustainability Integration in Airlines.....	65
6.4. Future Outlook and Summary of Findings.....	69
<b>7. Conclusion .....</b>	<b>71</b>
7.1. Managerial Implications.....	72
7.2. Limitations and Future Research.....	73
<b>References .....</b>	<b>VIII</b>
<b>Appendices .....</b>	<b>XX</b>

## List of Abbreviations

ATAG	Air Transport Action Group
CO <sub>2</sub>	Carbon Dioxide
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSR	Corporate Social Responsibility
CSV	Creating Shared Value
ESG	Environmental, Social, and Governance
EU ETS	European Union Emissions Trading System
g CO <sub>2</sub> /pkm	Grams of CO <sub>2</sub> per Passenger Kilometer
g CO <sub>2</sub> /RPK	Grams of CO <sub>2</sub> per Revenue Passenger Kilometers
g CO <sub>2</sub> /RTK	Grams of CO <sub>2</sub> per Revenue Ton Kilometers
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IAG	International Airlines Group
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
KPI	Key Performance Indicator
LCC	Low-Cost Carrier
NEO	New Engine Option
SAF	Sustainable Aviation Fuel
SESAR	Single European Sky ATM Research and Development SESAR
UK ETS	United Kingdom Emissions Trading Scheme

**List of Figures**

**Figure 1:** Integrating Corporate Sustainability into Strategic Management ..... 9

**Figure 2:** Trend of Publications on Aviation Sustainability (2000-2023) ..... 13

**Figure 3:** Breakdown of Contributions to Net Zero (IATA)..... 15

**Figure 4:** ReFuelEU SAF Blending Mandate ..... 19

**Figure 5:** Passenger Numbers and Growth of European Airlines (2022-2023) ..... 31

**Figure 6:** Carbon Intensity of Selected Airlines (2023) ..... 33

**Figure 7:** Carbon Intensity of Selected Airlines (2019-2023)..... 34

**Figure 8:** Fleet Size Development of Selected Airlines (2019-2023) ..... 36

**Figure 9:** Average Fleet Age of Selected Airlines (2023)..... 37

**Figure 10:** Order Books of Selected Airlines (2023)..... 38

**Figure 11:** Findings: Integration of Sustainability into Airline Strategy ..... 71

**List of Table**

**Table 1:** Benefits of Integrating Sustainability into Strategy ..... 12

**Table 2:** Challenges of Integrating Sustainability into Strategy ..... 12

**Table 3:** Current Sustainability Policy Landscape in Aviation ..... 22

**Table 4:** Airline Sample Selection ..... 24

**Table 5:** Interview Participants Selection ..... 27

**Table 6:** Carbon Intensity Reduction Targets of Selected Airlines ..... 34

**Table 7:** Key Sustainability Strategy Pillars of Selected Airlines ..... 35

**Table 8:** Airline Representatives Sentiments Towards Net Zero ..... 56

## 1. Introduction

The global impacts of climate change and pollution are profound and far-reaching, underscoring the urgent need of addressing the causes. Largely driven by the use of fossil fuels, climate change can lead to severe environmental and societal repercussions. (United Nations, n.d.).

In light of the global environmental crisis, action is needed across all sectors, particularly those with substantial carbon footprints. As the world is confronted with challenges caused by climate change and ecological degradation, the aviation industry has become the subject of intense scrutiny. The European Commission (n.d.-b) identifies the industry as “one of the fastest-growing sources of greenhouse gas emissions”, driven by increasing demand for air travel. This demand is expected to double by 2040 (IATA, 2023d) and surpass 10 billion annual passengers by 2050 (IATA, 2023h). Projections indicate that this growth could increase GHG emissions by over 300% by mid-century compared to 2005 (Reuter & Hyde, 2021). Consequently, the airline industry finds itself at the intersection of industrial progress and ecological responsibility, where pursuing environmental sustainability is no longer optional.

The movement towards sustainable aviation is driven by increasing environmental concerns among stakeholders, including the public, governments, and investors. Public concern is evident in movements such as flight shaming (Dichter et al., 2020). Governments are also taking action; for example Norway plans the electrification of all domestic flights by 2040 (Dichter et al., 2020; Nordic Network for Electric Aviation (NEA), 2023). Investors are increasingly aware of the environmental risks associated with the industry, leading to an increased prevalence of climate-related financial disclosures (Dichter et al., 2020). In response to these developments, the airline industry is committed to reshaping its sustainability landscape, recognizing its role in global emissions and responsibility for mitigation. A key initiative in this transformation is the commitment to achieving net zero flying by 2050, as outlined by the International Air Transport Association (IATA) (2021).

Technological advancements, such as the development of Sustainable Aviation Fuel (SAF), operational efficiency improvements, and the exploration of electric airplanes, are being leveraged to reduce the environmental impact of air travel (Afonso et al., 2023; Esqué et al., 2023; Sanjeev, 2021; The Economist, 2023). SAF, for instance, offers a lower-carbon alternative to conventional jet fuels, while advancements in operational efficiency and electric aviation technologies present opportunities to reduce the overall environmental footprint

(IATA, 2023e; Sanjeev, 2021). These innovations are crucial for the industry's transformation (IATA, 2023b).

Driven by a range of factors, such as legal pressure and market demand, the strategic integration of sustainability into corporate management has transformed from a peripheral concern to a central element of business strategy (Berns et al., 2009; Engert et al., 2016; Peters & Simaens, 2020; Porter & Kramer, 2007). Although this integration is complex, it can serve as a source of competitive advantage in the long term (Hagmann et al., 2015; Teh & Corbitt, 2015). Previous research suggests that the strategic integration of sustainability involves reshaping business models and strategies to align with a sustainable future, making environmental stewardship a cornerstone of business success and innovation (Baumgartner, 2014; Engert et al., 2016; Hart, 1997; Hoffman, 2018). Therefore, the journey towards sustainability goes beyond compliance and corporate social responsibility. It positions sustainability as a catalyst for innovation, competitive advantage, and long-term business success (Baumgartner, 2014; Engert et al., 2016; Lozano, 2012). This shift is crucial for balancing profitability with ecological and social responsibilities. However, this integration is complex and often hindered by various challenges (Lubin & Esty, 2010; Sharma et al., 1999; Teh & Corbitt, 2015), such as the prioritization of sustainability objectives without a solid implementation plan (Santamarta et al., 2022). Sustainability practices must be strategically integrated within the unique characteristics of an industry, such as aviation's highly regulated, competitive, and evolving landscape (Dichter et al., 2020; Esqué et al., 2023).

As integration, driving forces, and challenges faced can take unique forms based on industry context, this thesis will explore the following research questions:

- (1) How are European passenger airlines integrating sustainability into business strategy on their path towards environmental friendliness?*
- (2) What are the driving forces behind the integration of sustainability into airlines' business strategy?*
- (3) What are challenges associated with the integration of sustainability into airlines' business strategy?*

This research is significant as it can provide valuable insights and implications for embedding sustainability into business strategy, particularly within the airline industry. It explores the underlying drivers of accelerated sustainability efforts as well as the challenges posed by the industry's environmental impact and dynamic nature. By addressing these complexities, this

thesis contributes to the wider discourse on integrating sustainability into strategy and creating a sustainable future for the airline industry. This is particularly relevant as the airline industry seeks to balance growth with environmental responsibility.

It should be noted that this thesis focuses specifically on the environmental dimension of sustainability. Throughout this paper, the term 'sustainability' refers to environmental rather than social or economic sustainability. For feasibility reasons, the scope is limited to European passenger airlines. This allows for more accurate examination and comparison of airlines operating in the same geographical market.

In order to address the research questions and examine the strategic shift towards environmental friendliness in the European airline industry, this thesis begins with a review of existing research. The literature review of management and strategy-related research outlines the importance of integrating sustainability into strategy in modern business environments. Besides, the literature review of aviation-specific information on sustainability strategy and methods provides a more profound background of developments in the industry. This is followed by exploring strategic adjustments European passenger airlines are making towards incorporating sustainability into their strategies. This includes the analysis of industry company reports and sustainability publications as well as interviews with airline representatives and industry stakeholders. The thesis outlines the methodology applied during the two-phase research before exploring the results. Finally, the thesis discusses the findings, answers the research question, and formulates a conclusion. It also includes managerial implications derived from the research, limitations of the research, and suggestions for further research.

## **2. Literature Review**

The literature review of this thesis serves a dual purpose: it provides an understanding of the role, integration, and effects of sustainability within strategy and offers a specific exploration of sustainability issues within the airline industry.

The first part of the literature review explores sustainability in the context of corporate strategy, forming the foundation of this thesis. This aims to understand the strategic importance of sustainability in the corporate context and the considerations that companies face amid increasing environmental and societal pressures. The review examines previous research, including theoretical frameworks and models, highlighting a shift in perspective towards sustainability and its importance for corporate strategies.

The second part of the literature review focuses on aviation sustainability issues, providing an in-depth look at the airline industry as it moves towards sustainability. It covers topics such as aviation's environmental impact, technological innovations, and industry-specific sustainability strategies and measures. This highlights the current state of sustainable aviation practices and explores innovations, expectations, and developments shaping the industry's future. This focus is essential for an initial understanding of the strategic and technological intricacies of aviation sustainability.

Together, the two components represent a comprehensive basis for this thesis, offering context for understanding the broader strategic shift towards sustainability in general management and within the airline industry. This approach ensures the research is well-informed, relevant, and rooted in existing academic and industry-specific knowledge.

## **2.1. Fundamentals of Sustainability Integration**

As companies across various sectors confront environmental, social, and economic challenges, the role of sustainability in strategy and success has become a highly discussed topic among scholars (see Dyllick and Hockerts, 2002; Lozano, 2012; Rafi, 2022).

### **2.1.1. Definition and Theories of Corporate Sustainability**

In the modern business environment, sustainability has become crucial for companies seeking to maintain relevance and competitiveness (Porter & Kramer, 2007; Rafi, 2022). The concept of sustainability in a business setting is frequently termed *corporate sustainability*, encompassing a wide array of definitions that often emphasize different facets of sustainability in the corporate context (Linnenluecke & Griffiths, 2010). However, there is no consensus among scholars on a single, definitive interpretation, resulting in a certain level of ambiguity surrounding the concept (Meuer et al., 2020).

Corporate sustainability can be defined in accordance with the widely recognized principle of sustainability proposed by the World Commission of Environment and Development (WCED) (1987), which is about meeting “the needs of the present without compromising the ability of future generations to meet their own needs” (p. 16). In this context, Dyllick and Hockerts (2002) define corporate sustainability as a company’s ability to meet the needs of current stakeholders while ensuring the needs future stakeholders’. Lozano (2012) defines corporate sustainability as proactive efforts by companies to balance economic, environmental, and social factors, considering present and future impacts on the business and stakeholders. In other words, corporate sustainability entails simultaneously pursuing economic prosperity and

environmental and social responsibility (Dyllick & Hockerts, 2002). This is consistent with Elkington's (1998) concept of the triple bottom line, which he equates with corporate sustainability and defines as an organization's effort to balance social, economic, and environmental objectives.

Over time, scholars have developed frameworks and theories around corporate sustainability. One widely acknowledged theory is the mentioned 'triple bottom line' introduced by Elkington (1998), which serves as the foundation for numerous definitions of corporate sustainability (see Lozano, 2012). The triple bottom line evaluates corporate performance against three distinct dimensions: social, environmental, and economic. By considering the societal impact of activities, this framework goes beyond economic viability and considers the impact a company has on the society in which it operates. The need for environmentally sustainable practices aims to reduce environmental harm caused by a company's activities and positively contribute to the environment's well-being. (Elkington, 1998).

Freeman's (1984) Stakeholder Theory has also transformed how organizations view and enact their environmental responsibilities. The theory's core lies in the belief that businesses have ethical obligations beyond generating profits for shareholders.

It suggests that organizations are responsible for contributing positively to society and mitigating adverse environmental impacts. According to Freeman, organizations that adopt a stakeholder-focused approach are more likely to engage in sustainable practices as they recognize the interconnectedness of their operations with society and the environment. This is based on the idea that long-term business success is intertwined with the well-being of the society and environment in which an organization operates.

Porter and Kramer's (2011) concept of Creating Shared Value (CSV) has also emerged as transformative. The concept challenges the traditional business view and assumes that economic and social value creation are complementary. They argue that companies can gain a competitive advantage by addressing social problems intersecting with their business. According to Porter and Kramer, this holistic approach aligns business success with social progress and integrates economic and societal needs into a unified business strategy.

These theories have transformed how companies view responsibilities, by completing pure business intentions with broader environmental and social value creation (see Elkington, 1998; Freeman, 1984; Porter & Kramer, 2011).

### **2.1.2. Relevance and Drivers of Sustainability Integration**

Over the past decades, industrial development has caused a transformation which, despite generating wealth, concurrently causes environmental degradation (Shrivastava, 1995b). This duality underscores the urgency of integrating sustainability into strategy, balancing economic growth with environmental responsibility (Shrivastava, 1995b). According to Hoffman (2018), this incorporation of sustainability into strategic management is not a temporary trend but rather a fundamental shift essential for sustainable development. This is driven by market forces and an increasing awareness of environmental challenges (Hoffman, 2018), acknowledging that companies' substantial resources, technological capabilities, and global influence are essential for realizing sustainability objectives (Hart, 1997). As important actors in the economy, companies must actively support and engage in sustainability efforts, as societal efforts alone are insufficient (Bansal, 2002). Thus, companies should not merely be passive responders to external sustainability agendas but should actively participate in change (Bansal, 2002; Hart, 1997; Hoffman, 2018). Through their strategic position, they hold the power to drive significant transformation, leveraging capabilities and influence, often surpassing those of many nation-states (Hoffman, 2018). This places companies in a strategic position to initiate substantial changes beyond their organizational borders (Shrivastava, 1995b). Therefore, responsibility and power go beyond the traditional business focus, placing companies at the forefront of a global movement towards a more sustainable and resilient future (Bansal, 2002; Hart, 1997; Hoffman, 2018; Shrivastava, 1995b).

Consequently, there is an increasing expectation for holistic sustainability integration into corporate strategy (Porter & Kramer, 2007), coming from multitude of factors in companies' environment (Engert et al., 2016). Pressure and requirements enforced by internal and external stakeholders often take the decision of integration away, making it a necessity for long-term success and resilience (Berns et al., 2009; Davis et al., 2020).

*Externally*, a range of pressures and expectations affect companies in their sustainability efforts. For example, investors increasingly consider sustainability when assessing companies and their performance and value a strong integration of sustainability within companies' strategies (Thun et al., 2024). Sustainability disclosures and ESG scores provide investors with insights into risks and opportunities associated with companies' sustainability practices, having become a tool for assessing alignment with broader societal goals (Li et al., 2021; Rafi, 2022). Increased customer awareness can cause a shift in their consumption behavior, compelling companies to adopt sustainable practices to maintain and grow their market share (Peters &

Simaens, 2020). Effectively integrating sustainability is said to increase trust and the relationship with the different stakeholders (Lozano, 2015).

Legal pressure and imposed standards can effectively guide companies in their sustainability efforts (Davis et al., 2020). A study by Berns et al. (2009) found that government legislation has the biggest impact on sustainability measures in companies. Compliance with regulations ensures that companies operate within legal frameworks, avoiding potential fines and penalties (Peters & Simaens, 2020; Schaltegger, 2011). Especially in high-polluting industries organizations are often subject to significant legislative scrutiny (Engert et al., 2016). Moreover, legally requiring companies to report on sustainability issues can motivate the integration of sustainability practices as it increases transparency (Lozano, 2015). Adopting sustainability is not just about meeting the expectations of those stakeholders; it also helps to enhance reputation and increase trust (Davis et al., 2020; Lozano, 2015).

*Internally*, the culture and leadership of organizations are influential drivers in the integration process. Generally, leaders play a decisive role in organizational change; it is indispensable for them to support the transformation for it to be successful (Kotter, 1995). Engagement and prioritization of sustainability by leadership can encourage the entire organization to align operations and objectives with sustainable practices (Davis et al., 2020; Eweje, 2011). Proactive leadership can hence foster sustainability in companies (Lozano, 2015). In addition, companies that approach sustainability as a strategic opportunity can realize economic and financial benefits, including cost reductions, increased efficiency, and improved stakeholder relations (Davis et al., 2020; Engert et al., 2016; Peters & Simaens, 2020). Moreover, companies frequently employ innovative practices for sustainable technologies, which can facilitate the emergence of new business opportunities and markets (Engert et al., 2016). In this context, companies that effectively integrate sustainability into their strategies often gain a competitive advantage, using compliance and innovation to outperform less proactive competitors (Peters & Simaens, 2020).

Previous research examines various such drivers providing a comprehensive overview (Davis et al., 2020; Engert et al., 2016; Lozano, 2015; Peters & Simaens, 2020; Thun et al., 2024), of which a lot are tied to benefits related to sustainability integration, which will be explored later in this section. It can be assumed that the exact driving forces are largely influenced by the industry context (see Lozano, 2015; Peters & Simaens, 2020), which necessitates an individual examination in the context of the airline industry.

### **2.1.3. Approaches to Sustainability Integration**

Prompted by the driving forces, the growing importance of integrating sustainability practices requires a holistic transformation of companies (Rafi, 2022). Shrivastava (1995b) argues that environmental sustainability must be integrated into the core principles of a company, suggesting that it should be a fundamental element of business. Teh and Corbitt (2015) likewise emphasize the integration of sustainability strategies within the overall business framework rather than their isolation in separate units. Santamarta et al. (2022) suggest that for effective integration the entire value chain must be involved in the efforts. According to Engert et al. (2016) and Rafi (2022), holistically integrating sustainability into strategy and throughout the organization involves the consideration of sustainability in overall strategic planning. This aligns with Baumgartner and Korhonen's (2010) perspective that treating sustainability as part of strategy requires the alignment of individual activities and actors, ensuring coherence and preventing conflicting efforts. Teh and Corbitt (2015) further propose that by effectively managing resources and aligning sustainability with core business objectives, environmental goals can be achieved without compromising economic performance. Baumgartner (2014) explains that strategic adoption of sustainability beyond an ethical obligation can leverage competitive advantages, as advocating for environmental efficiency promotes innovations that simultaneously provide financial benefits.

Lozano (2020) explains that effective integration of sustainability into strategy requires a balanced combination of various tools and initiatives. He suggests that while individual tools have distinct advantages, their synergy creates a more holistic and impactful approach, addressing multiple dimensions and stakeholder needs. This aligns with Baumgartner and Korhonen (2010), who emphasize using multiple tools in parallel as complements, rather than seeking a single best tool. They argue that this approach helps navigate the complexities and achieve more comprehensive and effective outcomes.

While companies may possess considerable knowledge, power, and resources that can facilitate change, the journey towards comprehensive and authentic sustainability is complex (Hoffman, 2018; Shrivastava, 1995b). The roles of companies, governments, and consumers are intertwined in collectively addressing environmental challenges and promoting sustainable practices (Shrivastava, 1995b). This is because they act as important drivers and determinants (see Engert et al., 2016), interconnecting corporate innovations, supportive government policies, and responsible consumer behaviors (Dichter et al., 2020). To achieve resilient and sustainable development, efforts must extend throughout the organization, and internal

processes must be harmonized with external environmental and social impacts as part of a holistic approach (McPhee, 2014). Communicating sustainability efforts with the company’s internal and external environment is important to create transparency around the integration (Engert et al., 2016).

Engert et al. (2016) developed a model that summarizes factors and influences at play when integrating corporate sustainability into strategic management based on a comprehensive literature review (see Figure 1). The model shows how organizational influences – the underlying internal and external circumstances of a company – influence the approach to and integration of sustainability into the broader business strategy. The internal and external drivers, as discussed before, indicate the motivations for integrating sustainability. The supporting and hindering factors suggest that integrating sustainability involves managing the organization's facilitating and obstructive elements. The model demonstrates that integrating sustainability into corporate strategy is a complex and multifaceted process that depends on the environment of the organization. This indicates that sustainability integration requires a holistic approach balancing internal and external elements and depends on the context in which the organization is embedded.

**Figure 1: Integrating Corporate Sustainability into Strategic Management**



*Note. Adapted from “Exploring the integration of corporate sustainability into strategic management: A literature review.” by Engert, S., Rauter, R., & Baumgartner, R. J., 2016, Journal of Cleaner Production, 112, p. 2838 (https://doi.org/10.1016/j.jclepro.2015.08.031).*

#### **2.1.4. Benefits and Challenges of Sustainability Integration**

The evolution towards prioritizing sustainability represents a transformation in how companies operate and define success (Shrivastava, 1995b; Westley & Vredenburg, 1996). Sustainability is becoming essential to long-term competitiveness, necessitating operational alterations (Lubin & Esty, 2010). As previously outlined, scholars have identified the complexities of integrating sustainability into strategy (see Lubin & Esty, 2010; Sharma et al., 1999; Teh & Corbitt, 2015). This section will examine the challenges and benefits associated with the integration. Table 1 and Table 2 summarize the key findings.

*Benefits* of integrating sustainability into strategy can come in different forms. Already back in 1997, Hart identified the necessity of sustainable strategies, both from an ecological and an economic standpoint. His work acknowledges a growing trend of companies embracing environmental responsibility as they recognize that pollution reduction and profit enhancement can be achieved simultaneously. Teh and Corbitt (2015) also emphasize the importance of sustainability management in enhancing a company's long-term profitability, growth, and competitiveness. Cantele and Zardini (2018) similarly found that sustainability practices can enhance competitive advantages through better corporate reputation, customer satisfaction, and organizational commitment. Other scholars confirm reputational and relational advantages (Davis et al., 2020; Engert et al., 2016; Peters & Simaens, 2020; Shrivastava, 1995b). Kwarteng et al. (2016) also showed that economic and social sustainability improves corporate image and performance.

Shrivastava (1995a) also addresses the pivotal role of environmental technologies in enabling corporations to gain competitive advantages. He demonstrated that adopting green technologies benefits environmental sustainability and constitutes a strategic asset in enhancing a firm's competitive advantage. This includes improvements in production efficiency and public image, collectively contributing to a company's long-term success and market position (Shrivastava, 1995a). Other scholars agree that sustainability stimulates innovation across various business aspects and areas, such as the business model, marketing, manufacturing, and technology (Engert et al., 2016; McPhee, 2014; Peters & Simaens, 2020). Tangible strategic benefits can also be achieved through sustainable innovation, such as cost reduction through efficiencies, enhanced product designs, entry into new markets, or capturing first-mover advantages (Davis et al., 2020; Engert et al., 2016; Peters & Simaens, 2020; Shrivastava, 1995b).

Benefits such as enhanced innovation capabilities, reputational gains, and increased operational efficiency not only serve as valuable byproducts but also act as primary drivers for the adoption of sustainability practices (Davis et al., 2020; Engert et al., 2016; Peters & Simaens, 2020). However, Cantele and Zardini (2018) and Kwarteng et al. (2016) both found that in cases they studied, environmental practices had no significant effect, highlighting context-specific impacts of sustainability practices.

**Challenges** frequently occur in the integration of sustainability into strategy, potentially putting a shadow over the benefits. While the transition to integrating environmental and social dimensions is increasingly recognized by companies and leaders (Elkington, 1998; Estes, 2009; Lozano, 2012; Rafi, 2022; Sharma et al., 1999), the implementation is not always straightforward (Hoffman, 2018). While, long-term integration of sustainability can bring a range of benefits, the process of establishing a sustainability strategy can be challenging and uncertain (Engert et al., 2016).

Challenges can already occur before sustainability is effectively integrated; companies pursuing sustainability can struggle with establishing a clear roadmap (Santamarta et al., 2022), encountering various hurdles (Rafi, 2022). Selecting and developing a corporate sustainability strategy can initially increase risk for a company (Engert et al., 2016). The ambiguity in defining corporate sustainability can complicate decision-making (Meuer et al., 2020) and the growing number of sustainability tools and instruments can cause confusion (Baumgartner & Korhonen, 2010). Companies might struggle to identify which instruments to adopt and which business aspects to prioritize in a sustainability transformation (Baumgartner & Korhonen, 2010; Santamarta et al., 2022), as they often lack the information needed to make informed decisions (Berns et al., 2009). Moreover, large-scale transformations require strategic resource allocation across the company, necessitating short- and long-term funding strategies (Santamarta et al., 2022). Specifically, the early phases of incorporating sustainability may need a significant financial investment due to the expenses of technology, licensing, advertising, and marketing, as well as the hiring of professionals (Engert et al., 2016). Compliance with developing legal requirements also poses a key challenge, as it can complicate operations and efforts (Peters & Simaens, 2020).

Common issues in the establishment and realization also include limited commitment from the board (Rafi, 2022), often due to managers prioritizing economic performance over sustainability integration (Engert et al., 2016). Sustainability teams lacking the authority to execute projects, or a shortage of skilled personnel can also hinder effective integration (Rafi,

2022). The complexity of sustainability transformations requires robust mechanisms, including empowering leaders, engaging employees, and ensuring certainty of execution (Santamarta et al., 2022). To reduce the complexity around the integration of sustainability, companies should communicate their efforts transparently (Engert et al., 2016).

**Table 1: Benefits of Integrating Sustainability into Strategy**

Category	Benefit	Description
<b>Financial Benefits</b>	<i>Cost Reduction</i>	Ecological sustainability can lead to cost advantages through increased efficiencies (Davis et al., 2020; Peters & Simaens, 2020; Shrivastava, 1995b)
	<i>Profit Enhancement</i>	Sustainability strategies can be economically prudent and enhance profit (Hart, 1997)
<b>Market Benefits</b>	<i>Market Access</i>	Access to ‘green’ markets and first mover advantages through early adoption (Shrivastava, 1995b)
	<i>Product Differentiation</i>	Better product designs and stronger public image (Shrivastava, 1995a)
<b>Competitive Benefits</b>	<i>Enhanced Competitiveness</i>	Environmental and social responsibility are important for long term-term competitiveness (Lubin & Esty, 2010; Porter & Kramer, 2007; Teh & Corbitt, 2015; Westley & Vredenburg, 1996)
<b>Reputation Benefits</b>	<i>Corporate Image</i>	Sustainability positively impacts corporate image and reputation (Cantele & Zardini, 2018; Kwarteng et al., 2016; Shrivastava, 1995b, 1995a)
	<i>Organizational Commitment</i>	Sustainability practices can enhance organizational commitment (Cantele & Zardini, 2018)
<b>Innovation Benefits</b>	<i>Innovation Stimulation</i>	Sustainability efforts can stimulate innovation, enabling actionable changes (Engert et al., 2016; McPhee, 2014; Peters & Simaens, 2020)

**Table 2: Challenges of Integrating Sustainability into Strategy**

Category	Challenge	Description
<b>Leadership and Governance</b>	<i>Commitment and Accountability</i>	Leaders and members must be committed and held accountable (Rafi, 2022)
<b>Resource Management</b>	<i>Strategic Resource Allocation</i>	Resources and appropriate funding must be planned and allocated (Engert et al., 2016; Santamarta et al., 2022)
	<i>Skilled Personnel</i>	Sufficient skilled personnel to execute sustainability projects must be available (Rafi, 2022)
	<i>Information Availability</i>	Knowledge and information on sustainability must be available (Berns et al., 2009)
<b>Operational Challenges</b>	<i>Authority of Sustainability Teams</i>	Sustainability teams lacking authority to execute projects (Rafi, 2022)
	<i>Implementation Difficulty</i>	Implementation difficulties due to complexity in decision-making processes (Meuer et al., 2020)
	<i>Legal Compliance</i>	Compliance with legal requirements can complicate operations (Peters & Simaens, 2020)

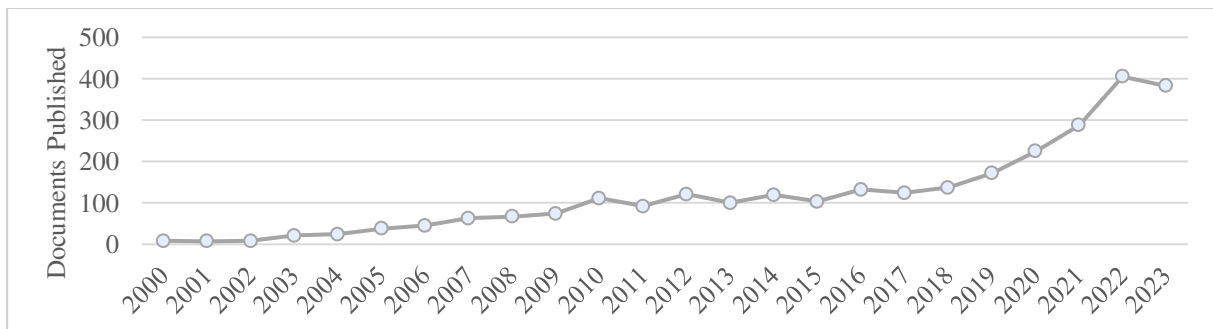
<b>Strategic Challenges</b>	<i>Prioritization</i>	Difficulties in identifying priorities in business aspects (Santamarta et al., 2022)
	<i>Comprehensive Approach</i>	Necessity of a comprehensive approach over isolated initiatives (Santamarta et al., 2022)
	<i>Definition Clarity</i>	Ambiguity in defining corporate sustainability (Meuer et al., 2020)
	<i>Instrument Management</i>	Choice of optimal tools and instruments in a fast-developing environment (Baumgartner & Korhonen, 2010)

## 2.2. Fundamentals of Sustainability in Aviation

Integrating sustainability into business strategy largely depends on specific business and industry contexts (Cantele & Zardini, 2018; Kwarteng et al., 2016; Peters & Simaens, 2020). In the aviation industry, characterized by high pollution levels and intense competition, sustainability takes on a unique form (Hagmann et al., 2015; Kim et al., 2020), making it significant to explore this phenomenon in the European passenger airline industry.

Over the past decades, research on aviation sustainability has increased (see Figure 2), reflecting growing awareness of the industry's environmental impact and the ongoing transformation (see Afonso et al., 2023; Chapman, 2007; Hagmann et al., 2015). The following section will review the current status of sustainability in aviation, providing an overview of the strategies and measures airlines are adopting, considering the industry's specific characteristics.

**Figure 2:** Trend of Publications on Aviation Sustainability (2000-2023)



*Note.* This figure shows the documents published by year on the topic of sustainability in the context of aviation. Adapted from Scopus, 2024. Documents for "aviation OR airline" AND "sustainability" OR "climate AND change" OR "environmental AND friendliness"

### 2.2.1. Environmental Impact of Growing Air Travel

Although air travel is pivotal for global connectivity and economic development, its environmental impacts are primarily uncontrolled (Perryman et al., 2022). The international aviation industry accounts for 2%–4% of global CO<sub>2</sub> emissions, a proportion much larger than its contribution to world GDP (The Economist, 2023). This proportion is estimated to rise to

22% by 2050 (Cames et al., 2015). Except for diesel combustion engine cars, this makes aviation the most polluting form of transportation (Chapman, 2007).

Consequently, awareness of the need for action is rising (Afonso et al., 2023; Chapman, 2007; Hagmann et al., 2015). Yet, the airline industry faces significant challenges on its journey towards achieving net zero emissions (The Economist, 2023), primarily due to rising passenger numbers and the complexities of decarbonizing air travel (The Economist, 2023). Projections indicate a compound annual growth rate of 3.1% between 2019 and 2050 in the global aviation industry (ATAG, 2021). Already in 2024, passenger numbers are expected to return to pre-COVID levels of 4 billion (IATA, 2022), with further projections suggesting that the number could exceed 10 billion annually by 2050 (IATA, 2023h). This surge in air travel could result in approximately 22 trillion kilometers flown by passengers annually by mid-century (ATAG, 2021), generating up to 2,000 million tons of CO<sub>2</sub> each year (ATAG, 2021). The growth in the industry is accompanied by a substantial increase in the global fleet, as highlighted by Boeing's (2023) estimate of a rise to more than 48,500 aircraft by 2040, effectively doubling the number from 2023. Increasing aircraft numbers bring about consequences, such as reduced fuel efficiency, increased GHG emissions, and airport expansion (Chapman, 2007).

### **2.2.2. Approaches to Aviation Decarbonization**

As air travel is projected to increase continuously and current operational standards lack sustainability, the necessity for solutions is paramount (Afonso et al., 2023; Cames et al., 2015; Chapman, 2007). Unlike other industries, where sustainability involves straightforward measures like switching to renewable energy sources or adopting green manufacturing processes, the airline industry faces a more complex scenario (Afonso et al., 2023). To approach this challenge, the industry has committed to reaching net zero emissions by 2050 (IATA, 2023h).

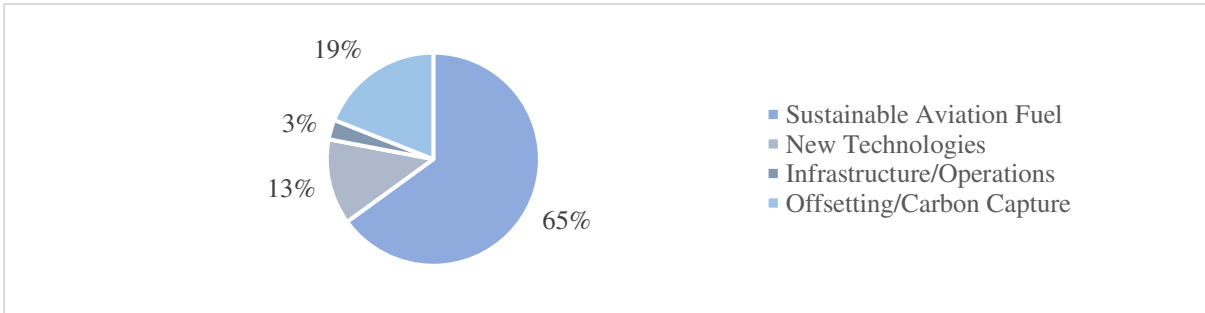
IATA plays a vital role in the industry's sustainability efforts through its commitment to achieve net zero carbon emissions by 2050 (IATA, 2023h). In 2021, member airlines collectively committed to the goal, aligning with the broader global targets set by the Paris Agreement (IATA, 2023h). International governments further endorsed this goal by adopting a Long Term Aspirational Goal (LTAG) for decarbonizing the aviation sector in 2022 (IATA, 2023h). To progress toward this target, IATA has established a carbon reduction strategy centered around four key pillars: SAF, infrastructure and operational efficiencies, new technologies, and carbon offsetting initiatives (IATA, 2023h). As shown in Figure 3 (IATA, 2023h), SAF is expected to

make up the largest part of the efforts, followed by new technologies and offsetting and carbon capture initiatives. The smallest portion is attributed to infrastructure and operation improvements.

Investment in these strategies is crucial, as reaching net zero with current aircraft fleets and technologies is deemed impossible (The Economist, 2023). According to the Mission Possible Partnership (2022), reaching the target requires doubling historical fuel-efficiency gains, introducing aircraft powered by novel technologies by the mid-2030s, and rapidly adopting sustainable fuels. Those efforts to decarbonize aviation are estimated to cost the global airline industry about \$5 trillion in investments until 2050 (IATA, 2023c).

The following section will provide an overview of the current status and advancements in tools and instruments that shape the future of sustainability in aviation. These developments are crucial for integrating sustainability into airline strategies.

**Figure 3:** Breakdown of Contributions to Net Zero (IATA)



*Note.* This figure shows the proportional contributions of different measures to achieving net zero by 2050. Adapted from “Net zero carbon 2050 resolution,” by IATA, 2023h (<https://www.iata.org/en/iata-repository/pressroom/fact-sheets/fact-sheet---iata-net-zero-resolution/>).

### 2.2.3. Sustainable Aviation Technologies and Measures

As seen in IATA's proposed decarbonization pathway, reaching net zero requires a multifaceted approach for aviation (IATA, 2023h). Proposed strategies mostly encompass fleet-renewal strategies, securing SAF supplies, optimizing flight and ground operations, and offsetting residual emissions (Afonso et al., 2023; Danicourt et al., 2023; Will et al., 2016).

Skepticism often arises regarding the maturity of these developments, as essential technology for substantially improving sustainability in aviation is not expected to be fully developed in the foreseeable future (The Economist, 2023). Compared to other industries that can more easily transition to renewable energies, the aviation sector faces significant challenges in identifying an energy storage solution that equals fossil fuel efficiency and energy density (Afonso et al., 2023).

In the pursuit of decarbonization of aviation, it is imperative to ensure transparency and adaptability across different measures while distinguishing between short-term and long-term initiatives (Esqué et al., 2023). Longer-term developments like the creation of batteries for powering larger electric aircraft might not be feasible in the foreseeable future (The Economist, 2023), necessitating more immediate actions to counteract the damage coupled with the growth of the industry (Chapman, 2007).

#### *2.2.3.1. Modern Aircraft Technology*

With this background, designing for sustainability is becoming a central focus for new aircraft and engines (Will et al., 2016), addressing concerns like climate change, resource depletion, waste, and noise (Afonso et al., 2023). As many airlines invest in fleet renewal, a significant portion of current aircraft will be replaced by next-generation models in the coming decade (Esqué et al., 2023). In 2023, the average fleet age in Europe was 11.5 years, closely matching the global average of 11.6 years (IATA, 2023g).

Modernizing fleets serves multiple purposes: modern aircraft enhance operational efficiency, helping meet global passenger demand, while reducing carbon emissions and operational costs (IATA, 2023g). According to IATA (2020), replacing an aircraft with a new model can yield an average fuel efficiency gain of 15-20%. Airbus (2022) claims that their newer models, such as the A330neo, can reduce CO<sub>2</sub> emissions per seat by up to 25% through fuel savings. Since fuel is a significant airline cost, increased fuel efficiency means financial savings (IATA, 2023g; World Economic Forum (WEF), 2024). However, the high acquisition costs of new aircraft can be a barrier for airlines (IATA, 2023g).

#### *2.2.3.2. Alternative Propulsion*

In addition to traditional fleet renewal, new propulsion systems are emerging, offering potential alternatives.

**Hydrogen Aircraft** are an approach to achieving decarbonized aviation and are often named a promising alternative to traditional aircraft (Adler & Martins, 2023; ICAO, 2022). Mid- and short-haul flights with hydrogen technology are expected to be feasible in the near future and could be upscaled to long-haul flights by mid-century (IATA, 2023a). Hydrogen can be an energy source in two forms: hydrogen combustion and hydrogen fuel cells (IATA, 2023a). Hydrogen combustion involves burning hydrogen in engines similar to conventional jet engines (IATA, 2023a; ICAO, 2022). The primary exhaust from burning hydrogen is water vapor and nitrogen oxides, making it an alternative that emits no CO<sub>2</sub> (ICAO, 2022). The second method,

hydrogen fuel cells, converts hydrogen directly into electrical energy through a chemical process, which powers the aircraft's electric motors (IATA, 2023a; ICAO, 2022). This approach eliminates direct emissions from the aircraft (ICAO, 2022).

Although hydrogen technology for aircraft is feasible and offers a promising path to net zero emissions, it poses considerable challenges that must be overcome (Adler & Martins, 2023; IATA, 2023a; ICAO, 2022). These include the development of lightweight liquid hydrogen tanks, integrating these tanks into aircraft, and further developing fuel cells to improve their performance, durability, and weight efficiency (Adler & Martins, 2023). Besides technological innovation, the transition to hydrogen aircraft requires infrastructure and energy systems investment to ensure the availability of low-cost green hydrogen (Adler & Martins, 2023).

*Electric Aircraft* are also gaining support to decarbonize aviation, reduce noise, and potentially offer cheaper travel (Future Agenda, 2020; Schäfer et al., 2018). For example, Norway aims to have all its domestic flights powered by electricity by 2040 (Future Agenda, 2020). Moreover, the market has witnessed the emergence of numerous start-ups working the development of electric airplane technologies (Crownhart, 2022).

There are three main types of electric propulsion systems: fully electric, turboelectric, and hybrid electric, each with distinct characteristics and potential for achieving reduced emissions, enhancing energy efficiency, or minimizing noise (Sahoo et al., 2020). Fully electric systems rely entirely on electrical power from batteries or similar sources (Sahoo et al., 2020), eliminating direct combustion emissions (Schäfer et al., 2018). Turboelectric systems use fuel to generate electrical power for propulsion (Sahoo et al., 2020). Hybrid electric systems combine multiple energy sources, such as traditional fuel, with battery power (Sahoo et al., 2020). Despite generating combustion emissions, hybrid electric aircraft can temporarily reduce or eliminate emissions (Schäfer et al., 2018).

Accordingly, electric propulsion can lessen aviation's environmental impact by reducing CO<sub>2</sub> emissions and noise pollution (Schäfer et al., 2018). Besides, higher efficiency compared to combustion engines can reduce maintenance and fuel costs (Schäfer et al., 2018). The possibility of using diverse energy sources also represents a more sustainable and resilient energy supply for aviation (Schäfer et al., 2018). However, current efforts are primarily concentrated on developing smaller aircraft designed for short to medium-distance flights since the technology required to electrify long-haul flights has not advanced to a point where it appears achievable (Danicourt et al., 2023; Sahoo et al., 2020; Schäfer et al., 2018). The present

level of technology falls behind in meeting energy density requirements and poses environmental concerns regarding battery production (Afonso et al., 2023). An adequate charging infrastructure and regulatory frameworks are also needed to facilitate the widespread adoption of electric aircraft (Mukhopadhyaya & Graver, 2022; Nordic Network for Electric Aviation (NEA), 2023). Accordingly, despite ongoing advancements, electric propulsion has not yet achieved the technological maturity required for commercial aviation (Schäfer et al., 2018).

#### 2.2.3.3. Sustainable Aviation Fuel (SAF)

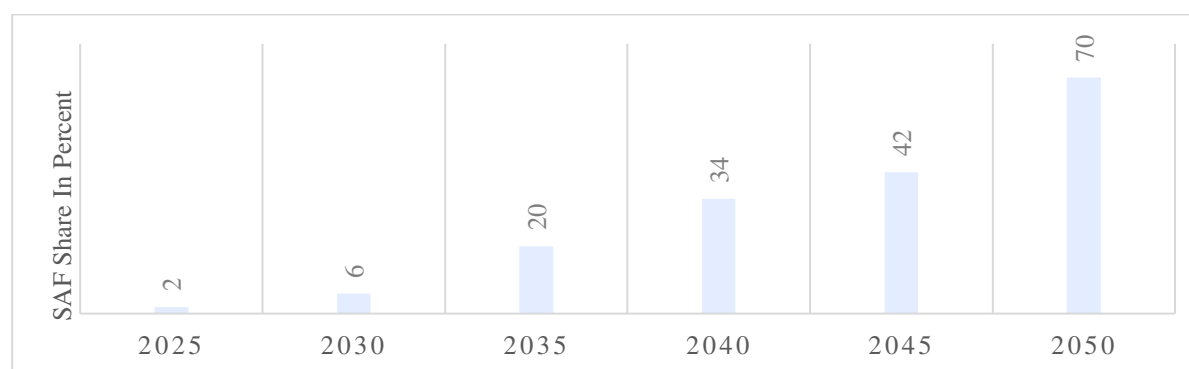
Sustainable Aviation Fuel (SAF) is “*a sustainable, non-conventional, alternative to fossil-based jet fuel*” (European Union Aviation Safety Agency (EASA) & European Environment Agency (EEA), 2023, p. 69). The combustion of SAF generates CO<sub>2</sub> emissions comparable to those of conventional jet fuel; however, its production incorporates CO<sub>2</sub> absorption (Dichter et al., 2020), enabling an 80% reduction of carbon emissions over its lifecycle compared to traditional jet fuel (IATA, 2023e). The Air Transport Action Group (ATAG) (2023) suggests that further advancements could enable SAF to even achieve a 100% reduction. This makes it a crucial mitigation option for emissions in the medium term (Malina et al., 2022). IATA (2023e) underscores the importance of SAF in achieving net zero emissions by 2050, estimating that it could account for around 65% of the needed emission reduction.

However, the alternative fuel’s current impact is limited by its nascent stage of development and a range of economic factors (IATA, 2023d). To boost figures, the European Commission has implemented a blending mandate called RefuelEU to increase SAF usage gradually (EASA & EEA, 2023). As illustrated in Figure 4, the strategy mandates a minimum SAF blend of 2% by 2025, rising progressively to 70% by 2050 (EASA & EEA, 2023; European Parliament, 2023). Projections suggest that around 2.3 million tons of SAF will be needed to meet these targets by 2030 (EASA & EEA, 2023). In 2022, the SAF supply constituted only under 0.05% of the total aviation fuel use in the EU (EASA & EEA, 2023). By 2023, global SAF production reached 0.5 million tons and is expected to triple in 2024, accounting for 0.53% of the total required fuel in aviation (IATA, 2023f). Forecasts predict a compound annual growth rate of 42.39% in SAF’s global market size until 2032 (Precedence Research, 2023).

The scale-up needed for a broad implementation of the fuel requires investing up to \$1.45 trillion until 2050 (ATAG, 2021), along with establishing approximately 5000-7000 new facilities (IATA, 2023b). Besides, SAF costs are higher than conventional jet fuel, implying that airlines' fuel spending is unlikely to reduce (IATA, 2023d). Typically, fuel constitutes one of the

largest portions of airlines operating expenses (up to 30%), and is subject to substantial fluctuations in price (IATA, 2023d). Fuel price volatility could be mitigated with SAF, which offers greater production flexibility as it can be produced from both biological and non-biological sources (ATAG, 2023; EASA & EEA, 2023; IATA, 2023; Malina et al., 2022). Additionally, SAF is considered a "drop-in fuel" as its properties closely match conventional jet fuel, meaning it can be blended and used without necessitating modifications to aircraft or engines (ATAG, 2023).

**Figure 4:** ReFuelEU SAF Blending Mandate



*Note.* Own representation based on "Fit for 55: Parliament and Council reach deal on greener aviation fuels" by European Parliament, 2023 (<https://www.europarl.europa.eu/news/en/press-room/20230424IPR82023/fit-for-55-parliament-and-council-reach-deal-on-greener-aviation-fuels>)

#### 2.2.3.4. Operational Efficiency

Optimizing operations can positively influence aviation efficiency while reducing the environmental damage it causes (Afonso et al., 2023), often providing potential for immediate implementation and low or negative financial expenditures (Esqué et al., 2023).

Operational efficiency strategies include measures like optimization of flight planning and scheduling, minimizing fuel use, electrifying ground operations, or improving air traffic management (ATM) (Afonso et al., 2023; Lohawala & Wen, 2024), ranging from low-cost, fuel saving initiatives to complex strategies needing broader cooperation (Esqué et al., 2023). Afonso et al. (2023) explore different changes airlines can make to their operations to increase sustainability, including flight scheduling optimization or flying in a V formation, which can reduce drag and fuel consumption. Air-to-air refueling or making additional stops for refueling on long-haul flights can reduce fuel consumption by lowering flight weight (Afonso et al., 2023). Efficient flight planning and trajectory optimization also enhance fuel usage (Afonso et al., 2023). Improving ATM can reduce emissions by up to 10% through direct routes (Directorate-General for Mobility and Transport, 2020). Additionally, optimizing ground operations, such as adopting all-electric processes and partnering with eco-friendly airports,

further enhances aviation efficiency and reduces environmental impact (Afonso et al., 2023; Lohawala & Wen, 2024; Will et al., 2016).

#### 2.2.3.5. *Carbon Offsetting*

Carbon offsetting involves balancing CO<sub>2</sub> emissions by investing in projects that mitigate emissions in other areas, such as renewable energy or reforestation (Dichter et al., 2020). In essence, emissions can be compensated by buying carbon credits and investing in projects that promote sustainable development and add social, environmental, or economic value (Danicourt et al., 2023; IATA, 2024). This concept is foundational to the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), a global initiative aimed at neutralizing the increase in CO<sub>2</sub> emissions from international civil air travel through carbon offsetting practices (IATA, 2024).

However, the long-term effectiveness and ethical considerations of carbon offsetting are debated, with concerns about potential greenwashing and diminished focus on direct emission reductions (Dichter et al., 2020). This stems from difficulties in proving actual emission reductions, permanence issues, potential emissions displacement, and possible harm to local communities (Lohawala & Wen, 2024).

#### 2.2.4. **Stakeholder Impact in Airline Sustainability**

Various airline industry stakeholder groups are increasingly paying attention to environmental issues (Dichter et al., 2020).

*Investors* are increasingly requesting disclosure of climate-related information as they consider the aviation industry's environmental risks to make more informed decisions (Dichter et al., 2020; Taşoğlu et al., 2024). A study by Taşoğlu et al. (2024) found a noticeable increase in the inclusion of sustainability statements in airlines' annual reports, with 9% of report pages in 2022 dedicated to sustainability topics, including social, environmental, and economic issues. With the developing regulatory environment and the introduction of directives such as the Corporate Sustainability Reporting Directive (CSRD), sustainability reporting and climate-related financial disclosures are becoming mandatory and increasingly standardized (Dichter et al., 2020; European Commission, 2024).

*Market demand* is also vital to consider; understanding customer choices is just as important as adopting innovative technologies (Lohawala & Wen, 2024). While demand for air travel is high and consistently growing (IATA, 2023h), the market is also increasingly concerned about the environmental harm caused (Dichter et al., 2020). Research by Haggmann et al. (2015) revealed

that nearly half of passengers are open to paying a premium for more environmentally friendly flights, suggesting that airlines could gain a competitive edge by enhancing and effectively communicating sustainability initiatives. A study by OAG found that 56% of travelers would consider switching to a more environmentally friendly option (OAG, 2020). Younger generations, in particular, are paying increasing attention to the environmental impact of air travel (Dichter et al., 2020). Esqué et al. (2023) propose that airlines should focus on identifying and prioritizing actions that can have the most significant impact at present, concurrently developing long-term future-proof measures. This aligns with the understanding that airline customer loyalty can be positively affected when airlines are seen as actively engaging in environmental efforts (Kim et al., 2020).

*Legal pressure and policy factors* can play an essential role in adopting sustainable practices in the European passenger airline industry. Authorities and regulatory bodies are in a crucial position to guide the industry towards achieving net zero emissions, especially concerning innovations such as SAF and eco-friendly aircraft technologies (Danicourt et al., 2023). Policy can also lessen the financial burden related to decarbonization for airline (Esqué et al., 2023).

To fully enable decarbonization, a range of policy tools will be required; with some already in place, others must still be established (World Economic Forum (WEF), 2023). Policies can be divided into market-based, mandate-based, and incentive-based (WEF, 2023). Market-based approaches use market mechanisms such as Cap-and-Trade Systems to reach sustainability goals (WEF, 2023). They create incentives for airlines and can increase the demand and, therefore, development of more fuel-efficient technologies (Lohawala & Wen, 2024). Mandate-based approaches, such as direct regulations, involve enforced legal requirements that must be adhered to (WEF, 2023). Incentive-based approaches, such as subsidies, work with rewards or penalties for specific behavior, offsetting the high cost related to sustainable alternatives (Lohawala & Wen, 2024; WEF, 2023).

Table 3 (WEF, 2023) provides an overview of current key policies impacting airlines and guiding the implementation and availability of decarbonization measures.

**Table 3: Current Sustainability Policy Landscape in Aviation**

Enabler	Policy type	Policy instruments	Key examples	Impact
Technology	Market-based	Carbon pricing	EU-Emission Trading Scheme (ETS) (European Commission, n.d.-a)	Incentivizes emission reductions through additional costs (European Commission, n.d.-b)
		Emissions cap	CORSIA (IATA, 2024)	Stabilizes emissions by requiring airlines to offset excess emissions (IATA, 2024)
	Mandate-based	Performance standards and certification		Reduction of emissions (World Economic Forum (WEF), 2023)
		Direct taxation	Energy Taxation Directive: Fit for 55 (proposed) (European Commission, 2021)	Increase taxation of jet fuel to incentivize SAF-usage (European Commission, 2021)
Infrastructure	Mandate-based	Direct regulation	Alternative Fuel Infrastructure Regulation (AFIR) (European Council, 2023a)	Mandates the installation of alternative fuels infrastructure (European Council, 2023a)
Demand	Mandate-based	Fuel standards	ReFuelEU Aviation: SAF blending mandate (European Council, 2023b)	Mandates the increase of SAF-usage (European Council, 2023b)
Capital	Incentive-based	Direct funding	Clean Aviation Joint Undertaking (Clean Aviation, n.d.)	Works on innovative technologies as public-private partnership (Clean Aviation, n.d.).

*Note. Adapted from “Net-Zero Industry Tracker” by World Economic Forum (WEF), 2023, p. 30f ([https://www3.weforum.org/docs/WEF\\_Net\\_Zero\\_Tracker\\_2023\\_REPORT.pdf](https://www3.weforum.org/docs/WEF_Net_Zero_Tracker_2023_REPORT.pdf)). Additional sources: European Commission, n.d.-a; European Commission, n.d.-b; IATA, 2024; World Economic Forum (WEF), 2023; European Commission, 2021; European Council, 2023a; European Council, 2023b; Clean Aviation, n.d.*

### 3. Methodology

The literature review shows that sustainability integration varies depending on the company's context and industry. As aviation undergoes a significant transformation, this thesis explores sustainability integration in the context of European passenger airlines using a comprehensive research approach.

The methodology of this thesis is designed to provide an assessment and analysis of the strategic changes and adjustments European passenger airlines are making to integrate sustainability into their strategies. An exploratory approach is adopted to investigate the topic in its entirety and uncover the dynamics of sustainability integration into airlines' strategies. Exploratory research allows to explore a topic to varying depths and clarify understanding of a specific problem area

(Saka et al., 2023). This facilitates a productive examination and explanation of specific segments of reality (Reiter, 2017).

This chapter outlines the methods employed to collect and analyze data from the combined research approach, including airline sustainability publications and expert interviews. The combination of research elements is designed to provide a comprehensive understanding of the manner in which European passenger airlines embed sustainability into their strategies. By using a mixed approach, the thesis thoroughly explores the complexities of sustainability integration, offering insights that are both broad in scope and detailed and context specific.

The initial phase involved examining publicly accessible data on the sustainability strategies of selected European passenger airlines. This analysis predominantly focused on sustainability and annual reports, aiming to understand current sustainability efforts within the industry and the role of sustainability within the strategic frameworks. The primary research phase entailed conducting qualitative interviews. This approach was selected to inductively explore how airlines integrate sustainability into strategy, identify the driving forces of those efforts, and understand challenges encountered, thereby assessing the feasibility of sustainability endeavors.

### **3.1. Sustainability Publications Analysis**

The sustainability publications review aimed to provide a comprehensive overview of the nature of sustainability efforts in the European passenger airline industry, serving as foundation of the research. The following section will explain how the airline sample and sources were selected, what data types were included, and how information was analyzed.

#### **3.1.1. Airline Sample Selection**

To ensure focused and relevant research, airlines were selected carefully based on three main criteria:

- (1) *Geographic Location*: The location of the headquarters of the airlines or airline groups, limited to Europe.
- (2) *Size*: The size of airlines, as determined by passenger numbers.
- (3) *Availability and Reliability of Sustainability Information*: The accessibility and depth of publicly reported sustainability data.

Ten airlines were selected based on these criteria. The list of airlines and airline groups included in the dataset is included below in Table 4. A more comprehensive version of the table listing all airline subsidiaries of the selected airline groups can be found in Appendix A.

It is important to mention that even though the initial selection based on geographic location and size included Aeroflot, the airline was excluded from further analysis. This is because the availability of detailed and current sustainability information is limited; hence, criteria (3) was not fulfilled. The ongoing geopolitical conflict involving Russia has led to economic sanctions and airspace restrictions, altering operations for Russian airlines and affecting data availability and reliability (IATA Economics, 2022). Consequently, the analysis included the Norwegian Air Shuttle, ranked as the 11th largest European passenger airline by passenger numbers. The dataset accordingly consists of airline groups and airlines based across Europe, representing a broad spectrum of the European passenger airline industry.

**Table 4:** Airline Sample Selection

Airline (Group)	Headquarter	Size (in million pax, in 2023)
Ryanair Group	Ireland	182
Lufthansa Group	Germany	123
International Airlines Group (IAG)	UK	116
Air France-KLM Group	France & Netherlands	94
Turkish Airlines	Turkey	83
easyJet	UK	83
Wizz Air Group	Hungary	60
Aeroflot Group	Russia	47
Pegasus Airlines	Turkey	32
SAS Scandinavian Airlines	Sweden	24
Norwegian Air Shuttle	Norway	21

*Note.* This table lists the selected airlines and their respective headquarters and passenger numbers in 2023. Own representation based on publicly reported data by the airlines: Aeroflot Group, 2024; Air France-KLM Group, 2024b; easyJet plc, 2024; Foster, 2024; International Airlines Group (IAG), 2024; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024a; Pegasus Airlines, 2023a; Ryanair, n.d.-b; SAS, 2024a; Turkish Airlines, 2024b.

**3.1.2. Source Selection Criteria**

To ensure data quality, the sources were selected based on the following criteria:

- (1) *Relevance:* Sources must be recent (if possible, not overhauled) and directly related to sustainability efforts within the European passenger airline industry.
- (2) *Credibility:* Sources were mainly selected directly from the studied airlines, reputable industry organizations, and disclosure systems.
- (3) *Comprehensiveness:* Sources that offer comprehensive and detailed information were prioritized.

The analysis was based on existing data, primarily on the most recent sustainability and annual reports from the selected airlines, focusing on information on environmental sustainability. For

airlines with dedicated sustainability reports, those were used; alternatively, the sustainability sections of annual reports. Due to the varying scope and depth of these reports, additional documents such as traffic data, regulatory filings, and press releases were consulted as needed after the initial analysis. These sources, mostly from 2022 and 2023, provided detailed insights into airlines' sustainability strategies, regulatory frameworks, and industry standards. Specific metrics, like carbon intensity and fleet size, were examined over a longer period to identify trends and offer an overview of progress.

According to the limitations of the thesis, the focus was on environmental aspects of sustainability, limiting the initial collection of sources on sustainability issues to the following areas:

- (1) *Emission Data*: Information on greenhouse gas emissions, reduction targets, and progress towards these targets.
- (2) *Sustainability Initiatives*: Data on specific initiatives undertaken by airlines to enhance sustainability, such as carbon offset programs, and management incentives.
- (3) *Technological Advancements*: Information on new technologies and innovations aimed at reducing the environmental impact on aviation, such as fleet renewal.

### **3.1.3. Data Analysis Process**

The data collection process involved several steps to ensure reliability and validity. Initially, sources were systematically identified and listed, focusing on information published by the studied airlines. Document analysis, such as organizational reports or press releases, is a frequently used tool in combination with other research methods to create a supplementary knowledge base (Bowen, 2009). It can involve content and thematic elements as material is first reviewed superficially, then thoroughly, and finally interpreted using categories (Bowen, 2009).

Likewise, the analysis involved a step-by-step examination and categorization of the relevant documents and involved different research elements. The primary analysis focused on the latest sustainability or annual reports of the airline sample. As a first step, a comprehensive systematic review of the content of sustainability and annual reports was conducted to break down the strategies. This was inspired by Mayring's (2000, 2014) content analysis method (see Appendix B) to determine frequently occurring tools and strategies, involving the identification of relevant data points and categories. The categories were largely based on key pillars of the strategies that emerged during the review and were also guided by the previous literature review.

After that, the documents were again reviewed closely, and qualitative and quantitative data were collected with the intention of comparison. Microsoft Excel was used to extract, organize, and classify the data into categories. Categories and categorized data were frequently reviewed to ensure consistency and reliability. A list of the categories can be found in Appendix C. To compare metrics and efforts of different airlines, specific additional publications were later reviewed to extract targeted information, complementing the initial data collection.

After gathering the data, a detailed analysis was conducted to identify common themes, strategies, and goals related to sustainability. This involved a category-by-category review to provide an initial overview of sustainability efforts, identify trends, and highlight similarities and differences in strategies. Qualitative information was interpreted and compared, while quantitative data, such as carbon intensity, were gathered in tables and compared over time and between airlines. To ensure a structured analysis, individual categories were analyzed in separate spreadsheets. Areas such as emission reduction, adoption of sustainable aviation fuel (SAF), and fleet renewal were partly assessed over a longer time frame, comparing the performance of different airlines based on reported quantitative data. Accordingly, the analysis incorporated both qualitative and quantitative data, using descriptive summaries, graphs, and tables for visual representation. During this phase, additional publications, such as older reports, traffic data, regulatory filings, and press releases, were reviewed to fill gaps or expand existing information. While all categories were considered, not all are listed separately in the results section; some served as a basis or were excluded later.

To ensure data quality, accuracy, and reliability, a validation process was carried out. During data comparison, information was cross-checked and validated with first-hand sources whenever possible. This was particularly important in the case of potential outliers or inconsistencies.

## **3.2. Qualitative Expert Interviews**

The second and main research part involved interviewing experts in the European passenger airline industry. The rationale for using interviews as a research method was to obtain detailed, nuanced information that cannot be captured through sustainability publications alone. The interviews allowed for a deeper and potentially more honest exploration of the topic.

### **3.2.1. Participant Selection**

The interview partners were selected based on different criteria and divided into two groups: airline representatives and industry stakeholders. This approach ensured data quality by

considering both the perspectives of airline sustainability representatives and industry stakeholders for a holistic view. Ten interviews were conducted with 13 interviewees. Table 5 provides an overview of the interviews, including interviewees’ identifiers, backgrounds, and interview dates. The following sections will introduce the two groups, starting with the airline sustainability representatives, followed by industry stakeholders.

The primary participant group consisted of airline sustainability representatives. Six interviews were conducted with seven experts. Interviewees were selected based on their employment in sustainability roles within passenger airlines, specifically those involved in developing and implementing sustainability initiatives and strategies. They represented either individual European airlines or airlines affiliated with European airline groups.

The second group consisted of industry stakeholders working strongly connected to airlines. Four interviews were conducted with six experts in sustainable aviation technologies (SAF, electric propulsion) or aviation-related businesses (airports, travel agencies). Participants were selected based on their expertise and relevance to the study's focus by providing insights into industry dynamics and stakeholders’ perceptions of aviation sustainability efforts.

To ensure confidentiality, no further details about the interviewees or their employers can be provided.

**Table 5:** Interview Participants Selection

Interview	Identifier	Background	Date
Airline Representative Interview 1	AR1	Airline Sustainability	April 2024
Airline Representative Interview 2	AR2	Airline Sustainability	April 2024
Airline Representative Interview 3	AR3	Airline Sustainability	April 2024
Airline Representative Interview 4	AR4.1 & AR4.2	Airline Sustainability	May 2024
Airline Representative Interview 5	AR5	Airline Sustainability	May 2024
Airline Representative Interview 6	AR6	Airline Sustainability	May 2024
Stakeholder Interview 1	SH1	Electric Propulsion	April 2024
Stakeholder Interview 2	SH2	SAF	May 2024
Stakeholder Interview 3	SH3.1 & SH3.2	Airport	May 2024
Stakeholder Interview 4	SH4.1 & SH4.2	Travel Agency	June 2024

**3.2.2. Interview Design and Process**

The interview questions were designed to align closely with the research objectives, which required gathering relevant and comprehensive information. The interviews were semi-structured, meaning the initial questions were predetermined but provided considerable

flexibility to follow up on responses (Mueller & Segal, 2015). This design provides a balance of guided inquiry and open-ended exploration, allowing for comprehensive data collection (see Mueller & Segal, 2015). The guiding questions for the interviews were dependent on the expertise area of the interviewee, meaning airline representative interviews were approached differently than industry stakeholder interviews.

The airline representative's guiding interview topics included *Sustainability Strategy and Long-Term Vision*, *Integration and Prioritization of Sustainability*, *Stakeholder Influence, Challenges*, and *Future Outlook*. For the stakeholder interviews, the guiding interview questions were adjusted to the area of profession and expertise. The airport and travel agency topics included *Sustainability Targets*, *Stakeholder Expectations and Requirements*, *Collaboration*, and *Future Outlook*. For experts in sustainable solutions for aviation, namely electric propulsion and SAF, the conversations were based on the guiding topics: *Background and Current State of the Technology*, *Implications for Airlines*, *Challenges in Adoption*, *Stakeholder Influence*, and *Future Outlook and Feasibility*.

The difference in guiding topics between groups aimed to tailor each interview to the unique background and expertise of the interviewee. This approach provided comprehensive insights into the various perspectives and complexities surrounding airline sustainability. The guiding questions related to the topics for the different interviewee groups can be found in Appendix D.

The interview process involved several steps to ensure thorough and systematic data collection. In the first place, participants were contacted, and interviews were scheduled at their convenience. Subsequently, the interviews were conducted in a semi-structured format, allowing to dive deeper into specific areas based on participants' responses and expertise. The interviews were conducted virtually via Microsoft Teams as a 45-minute to one-hour-long conversation. Interviews were recorded with the participants' consent to ensure accurate capture of their responses. The transcription of the interviews was done right after to ensure data integrity and facilitate the analysis. The transcripts were reviewed for accuracy and completeness and cleaned to remove irrelevant information and correct errors. All shared information was anonymized to guarantee data privacy in the thesis. Additionally, transcripts of the interviews with Airline Representatives 1 and 2 were translated from the original language verbatim into English.

### **3.2.3. Interview Data Analysis**

For analysis of the interviews an inductive coding process was adopted, allowing patterns and themes to emerge directly from the data. This approach was chosen to better take into account the unique dynamics of the industry and different perspectives. The analysis was based on the Qualitative Content Analysis method, according to Mayring (2000, 2014). As detailed in Appendix B, the method provides a structured approach to qualitative analysis, involving the inductive formulation and revision of categories based on qualitative data, with iterative reliability checks (Mayring, 2000, 2014).

Before coding, the interview transcripts were carefully read to familiarize with the content and identify potential codes and categories. Important information was highlighted during this phase. The software MAXDQA was used for the coding process, and Mayring's (2000, 2014) step model of inductive qualitative research was applied, as detailed in Appendix B. In the initial coding process, relevant words, phrases, and sentences were examined and assigned categories that emerged directly from the data. While the categories were developed using an inductive approach, the previous research through literature and reports, as well as relevance to the research question, were considered.

During the categorization process, the categories and coded segments were constantly reviewed and revised, leading to the emergence of new categories or the merging or subsumption of existing ones. Main categories with subcategories were created to ensure comprehensiveness and reliably capture all themes and aspects. Accordingly, the initial codes were grouped into broader categories based on content, relationships, and patterns identified during the process. Core categories were identified, and connections were established to develop a coherent narrative.

The interpretation of the analysis followed the category development process. Recurrent themes and patterns were identified across the interviews, providing insights into common strategies, drivers, and challenges related to sustainability. These themes were developed into insights that addressed the research questions. Additionally, the themes were interpreted in the context of the different stakeholder groups interviewed, beyond just the airlines, where possible. This approach facilitated an understanding of the various perspectives and priorities. Mayring's (2000, 2014) method is iterative. Accordingly, while drafting the findings and interpretations, categories were reviewed and, if needed, revised to ensure they addressed the research

objectives. Continuous review and refinement of categories and coded segments ensured the quality of the collected data.

Appendix E contains the codebook that emerged during the categorization development. Furthermore, Appendix F includes the coded segments of the interviews cited in the findings.

## **4. Results: Sustainability Publications Analysis**

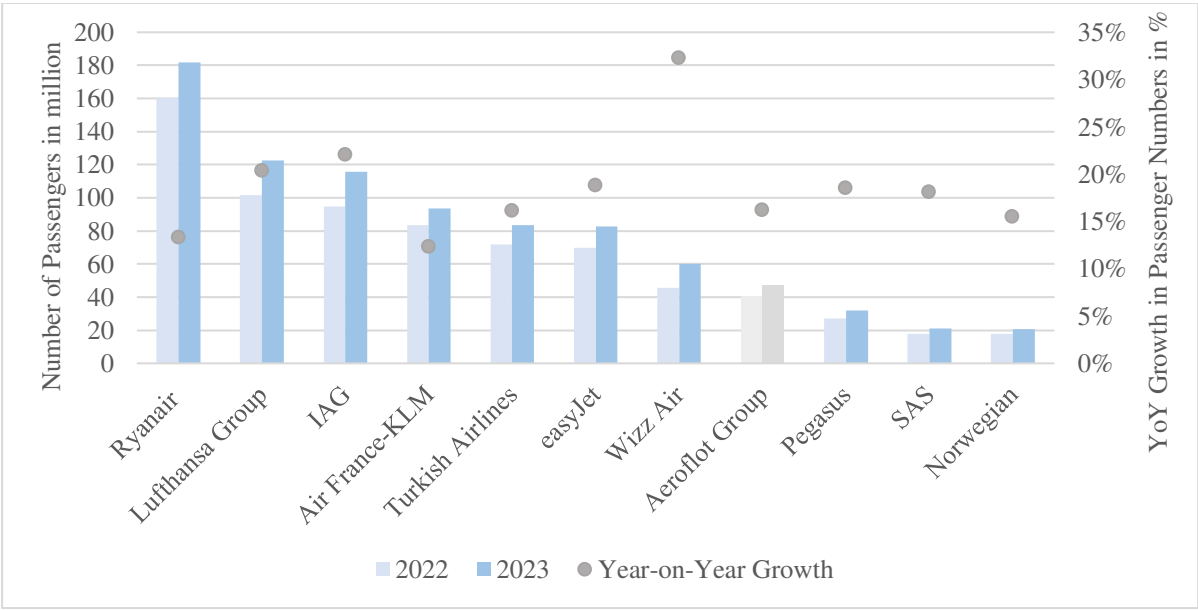
The ten airlines and airline groups included in the following exploration were selected based on geographic location, size, and availability of detailed sustainability information (see Section 3.1.1 and Table 4). The following presents the results of the analysis, aiming to provide a nuanced understanding of the airlines' sustainability initiatives.

### **4.1. Size in Passenger Numbers**

After the sample was narrowed to airlines in Europe, these were compared by size in terms of passenger numbers. The selected airlines can be found in the methodology section in Table 4. Figure 5 provides a graphic representation of the passenger numbers of the individual airlines.

It emerged that Ryanair has solidified its position as the leading European airline, carrying more passengers than any other regional airline (group) (CAPA, 2024). With a year-on-year growth of 13% between 2022 and 2023, Ryanair reached 182 million passengers in 2023 and is estimated to reach 300 million passengers annually by 2034 (CAPA, 2024; Ryanair Group, 2022, 2023b). 2023 results give Ryanair a significant lead over the Lufthansa Group, which ranked second in passenger numbers for 2023 and experienced a robust 20% year-on-year growth (Lufthansa Group, 2024a). Following these industry leaders, IAG, Air France-KLM, and Turkish Airlines also reported increased passenger numbers from 2022 to 2023 (Air France-KLM Group, 2023b, 2024a; IAG, 2022, 2023c; Turkish Airlines, 2024b). The other studied airlines, easyJet, Wizz Air, Pegasus, SAS, and Norwegian, also showed substantial growth during this period (easyJet plc, 2023a; Norwegian Air Shuttle, 2024a; Pegasus Airlines, 2024; SAS, 2024a; Wizz Air Holdings PLC, 2023a). Overall, the airlines experienced an average year-on-year growth of about 18%, with Wizz Air leading the growth at a rate of 32%. This collective growth underscores the ongoing growth and dynamism in the airline industry, supporting projections of continued high growth in the sector.

**Figure 5: Passenger Numbers and Growth of European Airlines (2022-2023)**



*Note. This figure shows the major European airlines based on passenger numbers in millions for 2022 and 2023, as well as the year-on-year growth in passenger numbers in percentage between the two years. Own representation based on Aeroflot Group, 2024; Air France-KLM Group, 2024b; easyJet plc, 2024; Foster, 2024; International Airlines Group (IAG), 2024; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024a; Pegasus Airlines, 2023a; Ryanair, n.d.-b; SAS, 2024a; Turkish Airlines, 2024b; Wizz Air Holdings PLC, 2023a.*

**4.2. Sustainability Governance**

A review of sustainability publications revealed that all of the airlines either publish dedicated sustainability reports or dedicate a section of their annual reports to sustainability. Other forms of disclosures are becoming increasingly important, such as the Carbon Disclosure Project (CDP) (CDP, n.d.), which has organizations consistently disclose sustainability information and rates them accordingly (CDP, n.d.). Due to the consistency in reporting, such disclosures enable efficient comparison. Hence, the airlines' responses were used to gather information on sustainability governance and organization.

The CDP responses indicate that the studied airlines incorporate environmental considerations at the highest governance levels, with most having dedicated board members or committees overseeing sustainability strategies. Moreover, executive remuneration is tied to environmental targets at all sampled airlines (except Norwegian). Wizz Air, for example, links executive remuneration to CO2 emissions targets. Other airlines also integrate sustainability into their incentive programs with management bonuses and variable pay linked to environmental performance and broader ESG targets. Norwegian, currently the exception without a sustainability-linked incentive structure, has such a system underway. (Air France-KLM Group, 2023a; Deutsche Lufthansa AG, 2023; easyJet plc, 2023b; IAG, 2023b; Norwegian Air Shuttle,

2023b; Pegasus Airlines, 2023b, 2023b; Ryanair Group, 2023c; SAS, 2023; Turkish Airlines, 2023b; Wizz Air Holdings PLC, 2023b).

Appendix G provides an overview of the sampled airlines' CDP scoring and their disclosed information on sustainability governance.

### **4.3. Environmental Impact of Selected Airlines**

Although carbon emissions are not the sole environmental harm caused by aircraft operations, they are the focal point of the industry's sustainability efforts. As the first airline group worldwide, IAG committed to net zero emissions by 2050 in 2019 (IAG, 2023c). Over time, and with the collective IATA agreement in 2021 (IATA, 2021), all sampled airlines have committed to that goal (Air France-KLM Group, 2024a; easyJet plc, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Wizz Air Holdings PLC, 2023a). Net zero aims to balance the emissions emitted by aviation through different measures (IATA, 2021). In the analysis, the carbon intensity was used as a benchmark for assessing the environmental impact of flight operations.

#### **4.3.1. Definition of Carbon Intensity**

In the discourse on the environmental performance of airlines, the terms 'carbon efficiency' and 'carbon intensity' often arise (e.g., Air France-KLM Group, 2023a; Lufthansa Group, 2024; Ryanair Group, 2023b). Both terms technically refer to the same concept: the amount of carbon dioxide emissions generated in relation to a certain unit of output, such as passengers or ton-kilometers traveled (see Air France-KLM Group, 2023a; Lufthansa Group, 2024; Ryanair Group, 2023b). For clarity and consistency, the term '*carbon intensity*' is used in this paper to encompass both terms. Three key performance indicators (KPIs) are:

- (1) *g CO<sub>2</sub>/RPK*: Grams of CO<sub>2</sub> emitted per Revenue Passenger Kilometer. Measures CO<sub>2</sub> emissions per kilometer traveled by paying passengers.
- (2) *g CO<sub>2</sub>/pkm (or g CO<sub>2</sub> pax/km)*: Grams of CO<sub>2</sub> emitted per Passenger Kilometer. Measures CO<sub>2</sub> emissions per kilometer traveled by any passenger.
- (3) *g CO<sub>2</sub>/RTK*: Grams of CO<sub>2</sub> emitted per Revenue Ton Kilometer. Measures CO<sub>2</sub> emissions per kilometer traveled by a ton of revenue-generating cargo.

*g CO<sub>2</sub>/RPK* and *g CO<sub>2</sub>/pkm* measure the CO<sub>2</sub> emissions per kilometer traveled by a passenger, but they differ in scope and are not interchangeable. Different airlines use different metrics, causing variations in reported figures. The sampled airlines' reported carbon intensities will be examined to analyze their environmental impact. However, a comprehensive comparison is not

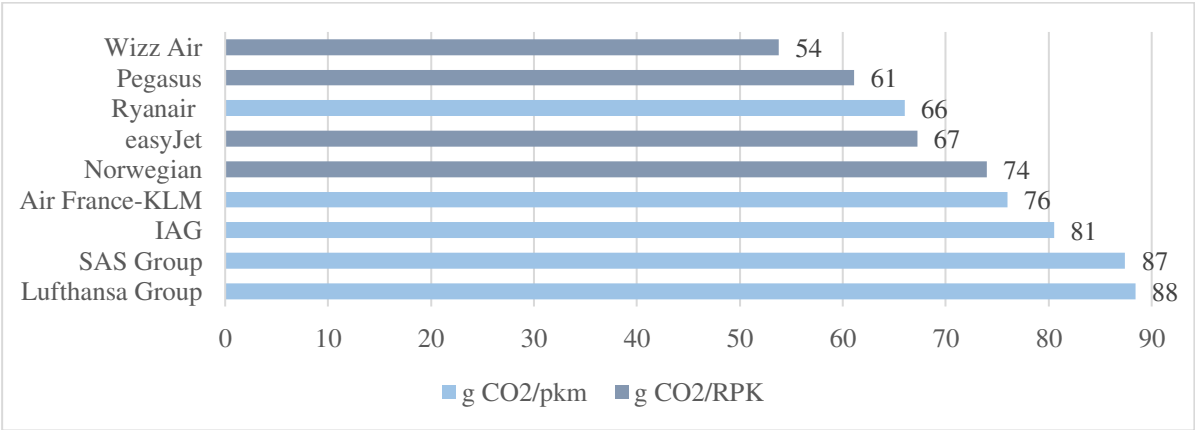
possible due to these differences. Some airlines also use g CO<sub>2</sub>/RTK, which includes revenue-generating cargo, providing insight into the overall efficiency of both passenger and cargo transportation. In the following, metrics will be marked accordingly.

*Note: Turkish Airlines is not included because they did not disclose their carbon intensity.*

**4.3.2. Current Carbon Intensity, Trends, and Targets**

The data collected illustrates a spectrum of carbon intensity across the airlines studied, highlighting variations in their environmental impact. In 2023, as illustrated in Figure 6, there is a clear range in carbon intensity among the airlines. Wizz Air, Pegasus, easyJet, and Norwegian reported their carbon intensity in g CO<sub>2</sub>/RPK, while the remaining sample reported it in g CO<sub>2</sub>/pkm. Measured in g CO<sub>2</sub>/RPK, Wizz Air leads with the lowest carbon intensity, followed by Pegasus, easyJet, and Norwegian. Measured in g CO<sub>2</sub>/pkm, Ryanair leads with the lowest carbon intensity and SAS and Lufthansa Group reported the highest.

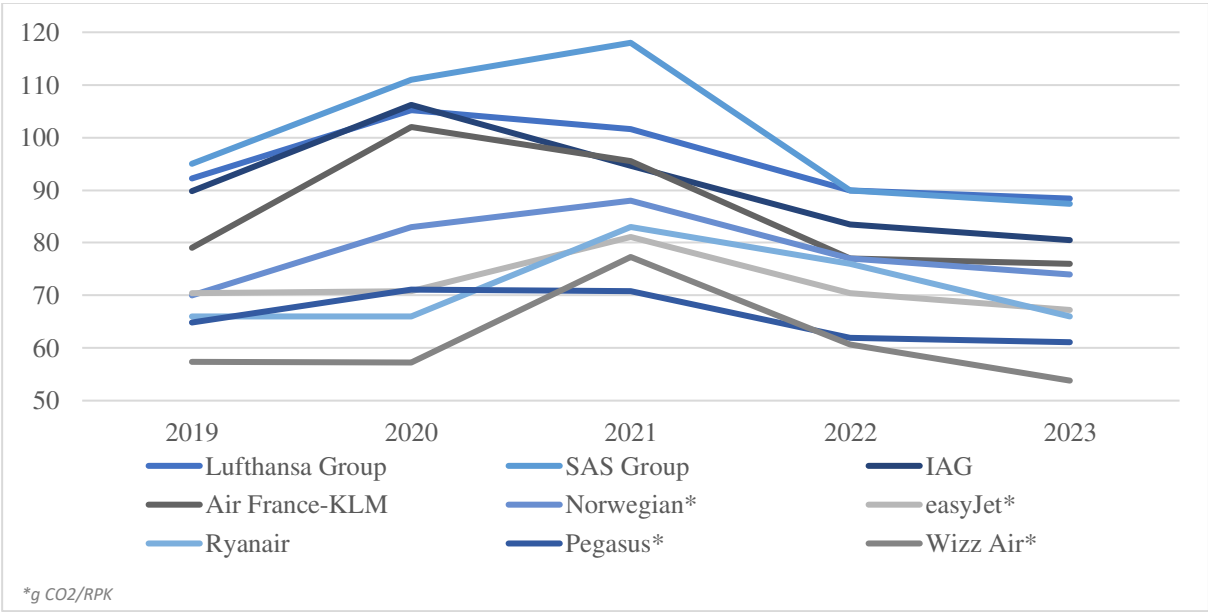
**Figure 6:** Carbon Intensity of Selected Airlines (2023)



*Note. Own representation based on Air France-KLM Group, 2024a; easyJet plc, 2023; IAG, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Wizz Air Holdings PLC, 2023a*

Figure 7 presents historical data on carbon intensity from 2019 to 2023, illustrating the progression and highlighting the impact of industry-wide factors. The baseline year, 2019, represents normal operational conditions, whereas 2020 reflects the disruptions caused by the COVID-19 pandemic. The pandemic's reduced flight schedules and lower passenger numbers resulted in increased carbon intensity. As the industry began to recover, airlines readjusted their operations, leading to varied recovery rates. By 2022, the trend stabilized, with many airlines approaching or surpassing their pre-pandemic carbon intensity levels. Despite the initial setbacks during the pandemic, the overall trend demonstrates a reduction in carbon intensity. Despite Norwegian, all airlines in the sample reduced their carbon intensity to or below pre-pandemic levels.

**Figure 7: Carbon Intensity of Selected Airlines (2019-2023)**



Note. This figure demonstrates the development of carbon intensity in g CO2/RPK and g CO2/pkm of the selected airlines between 2019-2023. Airlines using the measure g CO2/RPK are labeled. Own representation based on Air France-KLM Group, 2024a; easyJet plc, 2023; IAG, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Wizz Air Holdings PLC, 2023a

To further reduce carbon intensity and reach net zero emissions by 2050, the airlines in the sample have set specific reduction targets. For example, Norwegian aims for a 45% reduction in carbon intensity by 2030 (base year 2010), which corresponds to carbon intensity of ~53g CO2/RPK (Norwegian Air Shuttle, 2023a). Similarly, the other airlines have outlined specific reduction goals. An overview of targets set by the studied airlines can be found in Table 6.

**Table 6: Carbon Intensity Reduction Targets of Selected Airlines**

Airline	Reduction Target	Baseline Year	Target Year	Measurement Unit	Additional Targets
Ryanair	25%	2023	2031	g CO2/PK	50g CO2/RPK by 2031
Lufthansa Group	31%	2019	2030	g CO2/RTK	
IAG	27%	2019	2030	g CO2/PK	39% reduction by 2035 83% reduction by 2050
Air France-KLM	30%	2019	2030	g CO2/RTK	
easyJet	35%	2019	2035	g CO2/RTK	78% reduction by 2050
Wizz Air	25%	2020	2030	g CO2/RPK	
Pegasus	20%	2019	2030	g CO2/RPK	
SAS	35-40%	2019	2035	g CO2/PK	
Norwegian	45%	2010	2030	g CO2/RPK	53g CO2/RPK by 2030

Note. Own representation based on Air France-KLM Group, 2024a; easyJet plc, 2023; IAG, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Wizz Air Holdings PLC, 2023a

The data likely also reflects an association between airlines' business models and carbon intensity figures. Low-cost carriers (LCCs) tend to operate with higher operational efficiencies

through higher seat density, uniform fleet composition and point-to-point routing (Aviation Outlook, 2023), which can contribute to lower carbon intensity. This is supported by the data on carbon intensity displayed in Figure 6 and Figure 7, where LCCs such as Ryanair and Wizz Air demonstrate lower carbon intensity. However, these assumptions require further investigation to account for the complexity of airline operations and sustainability strategies.

#### 4.4. Key Pillars of Sustainability Strategies

The airlines share common approaches to sustainability based on several key pillars (See Table 7). These generally include fleet renewal, SAF usage, operational efficiency improvements and carbon offsetting initiatives. While the first three were named by all airlines, only half of the airlines cited carbon offsetting as a key strategy. However, this does not mean that these airlines are not implementing it at all. Besides the main pillars, individual airlines are focusing on additional key practices. Mostly, the airlines have outlined comprehensive roadmaps, specifying the actions necessary to achieve their sustainability targets. As covering all initiatives and measures in detail is beyond the scope of this thesis, the focus of the following section is on the most common ones, namely fleet renewal, SAF, operational efficiency, and carbon offsetting.

**Table 7: Key Sustainability Strategy Pillars of Selected Airlines**

	Fleet Renewal	SAF	Operational Efficiency	Carbon Offsetting	Other Pillars
<b>Ryanair</b>	•	•	•	•	Air Traffic Reform
<b>Lufthansa Group</b>	•	•	•	•	Intermodality
<b>IAG</b>	•	•	•	•	Carbon Removals
<b>Air France-KLM</b>	•	•	•		Intermodality
<b>Turkish Airlines</b>	•	•	•	•	Renewable Energy
<b>easyJet</b>	•	•	•		Airspace Modernization
<b>Wizz Air</b>	•	•	•		Carbon Removals, Air Traffic Modernization, Zero Emission Technology
<b>Pegasus</b>	•	•	•	•	
<b>SAS</b>	•	•	•		Air Traffic Control Collaboration, Innovative Technologies
<b>Norwegian</b>	•	•	•		Waste Resource Management

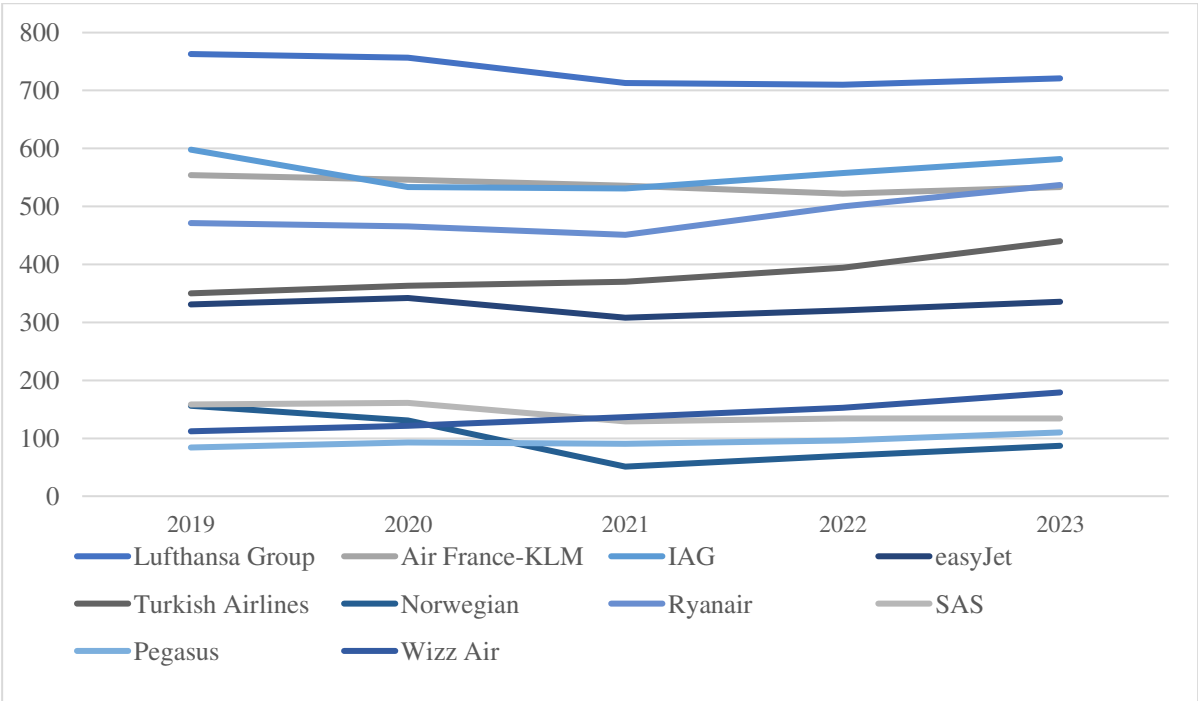
*Note. Own representation based on Air France-KLM Group, 2024a; easyJet plc, 2023; IAG, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Turkish Airlines, 2023; Wizz Air Holdings PLC, 2023a*

**4.4.1. Fleet Renewal**

According to Norwegian (2023a), investing in modern aircraft is the primary way airlines enhance their carbon intensity. Fleet renewal through adopting new-generation aircraft enables increased fuel efficiency and reduced emissions (Deutsche Lufthansa AG, 2023). An analysis of fleet development underscores the pattern of investments in modern, fuel-efficient aircraft among the sample.

As Figure 8 shows, between 2019 and 2023, Wizz Air exhibited the most substantial growth with a nearly 60% increase, while Pegasus and Turkish Airlines also saw notable growth of around 31% and 26%, respectively. Ryanair experienced a moderate fleet expansion of around 14%, while easyJet maintained a relatively stable fleet size. Conversely, IAG, Air France-KLM, and Lufthansa Group saw slight reductions, comparing 2023 fleet size with 2019. SAS and Norwegian faced significant decreases. Substantial growth by some carriers contrasts with reductions by others, reflecting varied approaches to fleet management and market adaptation. For example, fleet size decreased during the pandemic, suggesting a downsizing as a response to market disruptions.

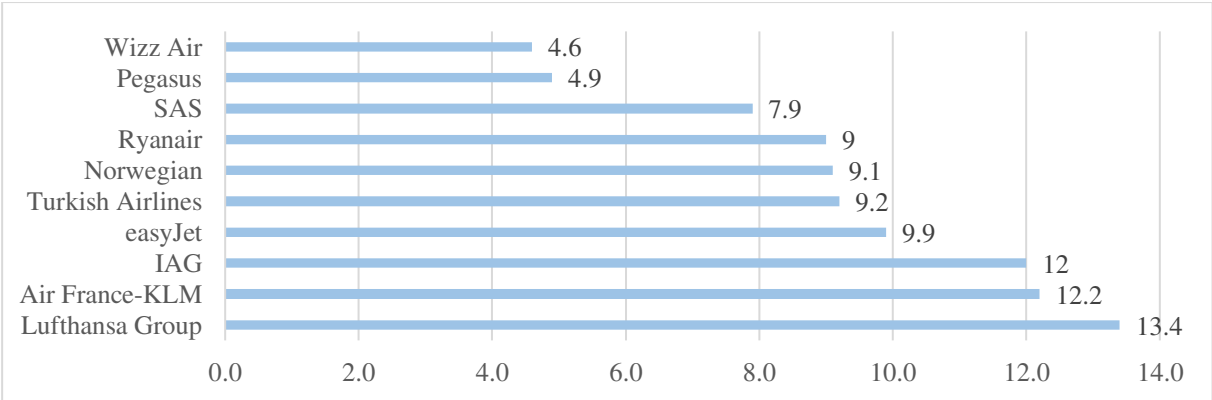
**Figure 8:** Fleet Size Development of Selected Airlines (2019-2023)



*Note.* Own representation based on Air France-KLM Group, 2020, 2021, 2022, 2023a, 2024b; easyJet plc, 2020, 2021, 2023; International Airlines Group (IAG), 2023b, 2023a; Lufthansa Group, 2021, 2022, 2024a; Norwegian Air Shuttle, 2020a, 2021, 2022, 2023, 2024; Pegasus Airlines, 2021, 2022a, 2023, 2024; Ryanair Group, 2019, 2020, 2021, 2022, 2023b; SAS, 2024a; Turkish Airlines, 2023, 2024a; Wizz Air Holdings PLC, 2020, 2022, 2023a.

The average fleet age of the airlines in the samples, as displayed in Figure 9, indicates a gradual renewal process, maintaining relatively young fleets. In 2023, Lufthansa Group, for instance, retired 18 less efficient aircraft and added 29 more modern and efficient aircraft to their fleet (Lufthansa Group, 2024b). Ryanair prioritizes having a young fleet and ordered 300 new aircraft (Boeing 737 MAX 10), up to 50% of which are meant to replace older models (Ryanair Group, 2023b). As shown in Figure 9, Wizz Air has the youngest fleet in the sample, with an average age of 4.6 years (Wizz Air Holdings PLC, 2023a). According to Wizz Air's 2023 Annual Report, they currently operate the youngest fleet in Europe and plan to reach an average fleet age of 3.1 years by 2030 through extensive fleet renewal and expansion plans (Wizz Air Holdings PLC, 2023a).

**Figure 9:** Average Fleet Age of Selected Airlines (2023)



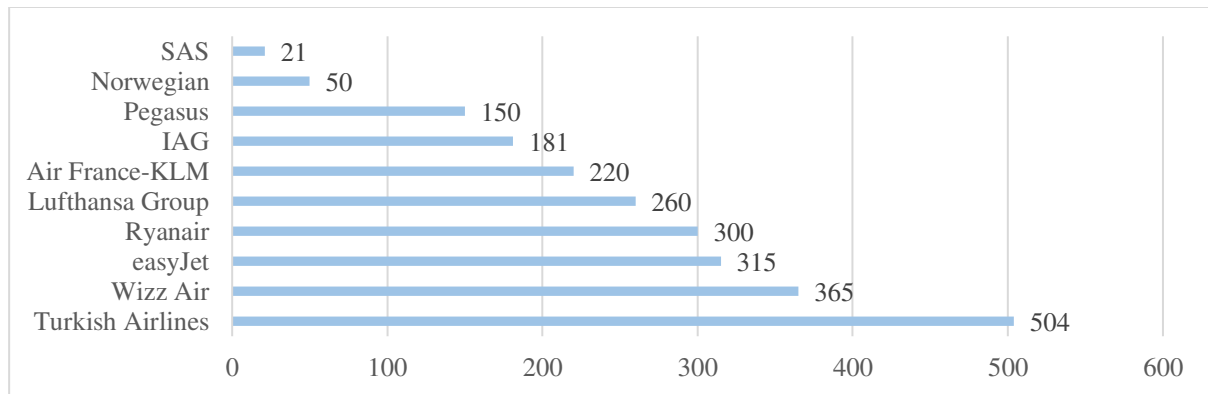
*Note. This figure presents the average fleet age of the selected airlines in year as of 2023. Own representation based on data from public sources: Air France-KLM Group, 2024a; easyJet plc, 2023; IAG, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Wizz Air Holdings PLC, 2023a.*

The airlines’ order books provide a forward-looking perspective. Most airlines have a significant number of aircraft on order, as illustrated in Figure 10. A breakdown of the airlines’ order books reveals a focus on modern, fuel-efficient aircraft. The Airbus NEO models (neo = new engine option), known for their improved aerodynamics and advanced engine technology, play an essential role in the fleets of several of the airlines such as easyJet, Wizz Air, and Turkish Airlines (easyJet plc, 2023a; Turkish Airlines, 2023a; Wizz Air Holdings PLC, 2023a). These aircraft are estimated to save around 15-20% fuel compared to their predecessors (Airbus, 2022). For instance, Wizz Air, as of end of F23, held a backlog order of 365 A321neo and A321XLR, making it one of the largest Airbus customers globally (Wizz Air Holdings PLC, 2023a).

The analysis indicates that airlines are investing high financial sums in fleet renewal and expansion. Ryanair, for instance, has announced a \$62 billion investment towards greener

aircraft (Ryanair, n.d.-a). Lufthansa Group plans to invest €15.8 billion from 2023 to 2030 and estimates a potential financial impact of this opportunity to be €612 million by 2030, based on fuel and carbon intensity improvements (Deutsche Lufthansa AG, 2023).

**Figure 10: Order Books of Selected Airlines (2023)**



*Note. This figure presents the size of the order books of the selected airlines in number of aircrafts as of 2023. Own representation based on data from public sources: Airbus, 2024; Air France-KLM Group, 2024a; easyJet plc, 2023; IAG, 2023; Lufthansa Group, 2024a; Norwegian Air Shuttle, 2024; Pegasus Airlines, 2024; Ryanair Group, 2023b; SAS, 2024; Wizz Air Holdings PLC, 2023a.*

#### 4.4.2. Sustainable Aviation Fuel

The adoption of SAF represents another key pillar in the airlines' sustainability strategies. The adoption of SAF represents another key pillar in the airlines' sustainability strategies. All airlines are actively incorporating SAF into their operations, setting future targets, and forming diverse partnerships to advance the development of the alternative fuel. Due to differences in reporting, exact comparison is difficult, which is why the following section adopts a descriptive approach. Appendix H provides a summary of current SAF use, SAF use targets, SAF partnerships examples.

**SAF Use** is implemented or planned by all sampled airlines. In 2023, Air France-KLM used the most SAF worldwide for the second consecutive year, consuming 80,000 tons, constituting 1% of fuel (Air France-KLM Group, 2023c). This comes after KLM, subsidiary of Air France-KLM, was the first airline to use SAF on a commercial flight in 2011 (Air France-KLM Group, 2024b). In 2022, the Lufthansa Group's fuel usage included about 0.2% of SAF, which translates to 13,000 tons (Lufthansa Group, n.d.), leading to the avoidance of 43,900 tons of carbon emissions from fossil fuels (Lufthansa Group, 2023). In 2023, the usage decreased to 0,15% (Lufthansa Group, 2024b). IAG consumed 53,000 tons of SAF in 2023, representing 0.66% of fuel use (IAG, 2023c). From April 2023, Ryanair began powering all its flights from Amsterdam Airport Schiphol with a 40% SAF blend (Ryanair Group, 2023a). Wizz Air and

easyJet have also started testing and adopting SAF blends in its operations (easyJet plc, 2023a; Wizz Air Holdings PLC, 2023a). Similarly, Turkish Airlines introduced the regular use of SAF on several European routes (Turkish Airlines, 2023a), and Pegasus performed its first SAF-powered flight in Turkey in 2022 (Pegasus Airlines, 2022b). SAS reported 6,049 tons of SAF in 2023 (SAS, 2024a), whereas Norwegian used 1,759 tons in its 2023 operations, making up 0.3% of total fuel usage (Norwegian Air Shuttle, 2023a).

**SAF Use Targets** have been set by almost all airlines. To increase SAF usage in the coming years, the airlines have set up specific plans including targets. IAG, as the first European airline group to commit to a specific target for SAF usage, aims for 10% SAF usage by 2030, investing nearly \$865 million (IAG, 2023c). The airline plans to consume one million tons of SAF annually by 2030 and, as of 2023, has already invested \$1 billion, covering 86% of future commitments (IAG, 2021, 2022, 2023c). Ryanair targets 12.5% SAF usage by 2030, contributing 34% towards its net zero emissions goal by 2050 (Ryanair Group, 2023a). Air France-KLM and Wizz Air aim for at least 10% usage by 2030 (Air France-KLM Group, 2024a; Wizz Air Holdings PLC, 2023a). Norwegian aims for a 16-28% SAF blend by 2030, expecting an 11-20% improvement in carbon efficiency (Norwegian Air Shuttle, 2020b). SAS plans to use an amount of SAF equivalent to its domestic production by 2030, averaging about 18% of its fuel (SAS, 2024a). EasyJet invests in SAF development and supply, anticipating large-scale adoption to meet regulatory mandates (easyJet plc, 2023a). Lufthansa Group, Turkish Airlines, and Pegasus has not published concrete targets for 2030. However, it can be assumed they will adhere to at least the regulatory mandates for SAF use of 6% under the EU blending mandate (see Figure 4).

**SAF Partnerships** are increasingly formed by airlines to ensure the availability and development of SAF. The partnerships mainly include supply agreements, production investments and research and development. To secure a supply of SAF, airlines are entering partnerships with major suppliers like Neste, OMV, Repsol, and Shell to ensure a steady supply of SAF (Ryanair Group, 2023a). To contribute to the development of SAF, airlines are investing in innovative production methods, such as IAG's partnership with LanzaJet Freedom Pines Fuels project (IAG, 2022), to build the world's first alcohol-to-jet plant or Norwegian's partnership with Norsk e-Fuel to build the first large-scale e-fuel production facility worldwide (Norwegian Air Shuttle, 2024b). Moreover, airlines are participating in projects and networks to advance SAF technology, such as SAS's involvement in the IATA/ATAG biofuel network (SAS, 2024a). Air France-KLM names themselves a "leader in research and development of

Sustainable Aviation Fuel” (p. 282), engaging in several initiatives that drive SAF development and use (Air France-KLM Group, 2024b). Others are setting up own research initiatives, such as Ryanair’s Sustainable Aviation Research Centre at Trinity College Dublin (Ryanair Group, 2023a). Lufthansa Group has set up a CleanTech Hub for research and development of climate-related technologies, including alternative fuels (Lufthansa Group, 2024a).

#### **4.4.3. Operational Efficiency**

The analysis shows that airlines adopt a wide range of operational efficiency approach. The complexity and diversity of these measures make comprehensive coverage beyond the scope of this thesis. The following section will provide an overview of common operational efficiency measures adopted by the airlines.

Airlines are working on modernizing their existing fleet and operations to increase efficiency and reduce fuel usage. These measures are crucial for reducing an airline's carbon footprint and achieving cost efficiency in a highly competitive industry (Norwegian Air Shuttle, 2023a). For instance, they invest in advanced aerodynamics, such as winglets, to reduce drag and improve fuel efficiency (Lufthansa Group, 2023; Ryanair Group, 2023a). Flight and ground operations are adjusted to save energy, using measures like single-engine taxiing and electric ground handling equipment (Air France-KLM Group, 2023b; easyJet plc, 2023a; IAG, 2023c; Lufthansa Group, 2023; Ryanair Group, 2023a). For instance, Lufthansa Group set a CO<sub>2</sub>-neutral mobility ground operations goal for 2030, aiming to increase efficiency and replace vehicles with alternatives (Lufthansa Group, 2024a). Air France-KLM has set a similar goal for its main hubs and has already electrified 64% of its ground equipment there by 2023 (Air France-KLM Group, 2024b).

Ensuring higher flight occupancy and opting for direct routes significantly reduce fuel use and emissions (Norwegian Air Shuttle, 2023a). Detailed performance analyses and route optimization techniques can increase efficiency of operations (Air France-KLM Group, 2023b). Technology and innovation, such as artificial intelligence and predictive analytics, can further streamline operations (easyJet plc, 2023a). For optimized flight planning, the Single European Sky ATM Research and Development (SESAR) program is supported by airlines, which are engaging in an ATM reform (e.g., Air France-KLM Group, 2024b; Lufthansa Group, 2024a). Reducing aircraft weight by removing unnecessary equipment and using lighter materials also improves fuel efficiency (Air France-KLM Group, 2023b).

#### **4.4.4. Carbon Offsets**

All sampled airlines have implemented carbon offsetting schemes. The airlines are based in countries participating in the CORSIA scheme, requiring compliance. Additionally, they fall under the EU ETS, which applies to flights within the European Economic Area and flights that go to Switzerland and the United Kingdom (Air France-KLM Group, 2024b). Some airlines are also subject to UK ETS and other regional policies (e.g., Pegasus Airlines, 2024).

Moreover, all airlines engage in voluntary customer offsets (e.g., Lufthansa Group, 2023; Pegasus Airlines, 2024; Ryanair Group, 2023a). While some have long offered carbon offsetting, like SAS since 2006, others began recently, such as Turkish Airlines in 2022 and Wizz Air in 2020 (SAS, 2024a; Turkish Airlines, 2023a; Wizz Air Holdings PLC, 2023a). Notably, in 2019, easyJet became the first airline worldwide to offset all flight-related carbon emissions, but switched to voluntary customer offsetting at the beginning of 2023 (easyJet plc, 2023a). In addition to customer flight offsetting, some airlines offset the carbon emissions of flights for their staff (e.g., Lufthansa Group, 2023; SAS, 2024a). Under specific conditions, SAS also offsets some tickets for customers (EuroBonus members and youth travel tariffs) (SAS, 2024a).

Some airlines have introduced specific fares for customers to offset their carbon emissions. Lufthansa Group introduced “Green fares”; the first airline fare designed to offset flight-related carbon emissions (Lufthansa Group, 2024b). The fare aims to reduce 100% of CO<sub>2</sub> emissions through (1) SAF, covering 20% of the emissions reduction, and (2) Climate Protection Projects, offsetting the remaining 80% by investing in European climate projects. Since its launch, over 850,000 customers have purchased the fare, offsetting over 65,000 tons of CO<sub>2</sub> (Lufthansa Group, 2024b). Other airlines are following suit, such as Turkish Airlines, which announced a “Green Class” initiative that combines biofuel with environmentally friendly products (Turkish Airlines, 2023a).

## **5. Results: Expert Interviews**

After reviewing the European passenger airline industry's sustainability initiatives and plans through sustainability publication analysis, the next section presents the interview findings. These aim to provide a deeper understanding of the realities behind the publicly disclosed information, revealing actual dynamics of the shift of airline strategies towards environmental friendliness.

The findings from the interviews are explored topic by topic, focusing on how sustainability is integrated into airline strategy, the driving forces behind this integration, the challenges faced, as well as a future outlook. The structure of the results is based on the research questions and the themes emerged during the analysis (see Appendix E).

*Note: Interview references can be found in Appendix F.*

## **5.1. Strategic Approaches to Sustainability**

*“Only since a couple of years, sustainability is really part of the central strategy”* (AR4, 2), one airline representative remarked, summing up an evolving approach to sustainability within the industry. Another explained: *“We had some goals in the past, but I don’t think it was a strategy”* (AR5, 6). Interviews showed that initially, sustainability was often managed separately from core business plans in airlines but is increasingly embedded into a central strategic framework (AR2, 1; AR4, 2; AR5, 6). Airline representatives indicate that they have been developing and refining their strategic approach to sustainability during the past few years (AR2, 1; AR3, 24; AR4, 2; AR5, 4, AR6, 32). The integration process involves making sustainability a core component of overall strategic management instead of side initiatives. For instance, one airline representative reported that they are now steering towards sustainability ambitions on an annual basis and integrating these ambitions with other strategic initiatives (AR4, 2).

Despite advances, several representatives noted that their sustainability strategies remain in a state of development (e.g., AR5, 2, 4; AR 6, 32). Continuous efforts are being made to enhance technological capabilities and improve investment decisions related to sustainability (AR6, 32).

### **5.1.1. Prioritization of Sustainability**

Airline representatives expressed that the shift towards a holistic integration of sustainability is accompanied by a corresponding mindset shift, with growing recognition and awareness for the topic (AR3, 10; AR5, 20). One airline representative explained that in their organization, *“They saw sustainability as one department, but now they are starting to look at sustainability as a priority within the company”* (AR5, 20). Raising employee awareness about individual and collective impact is crucial, as is creating a culture of sustainability where everyone is engaged and committed (AR1, 10; AR2, 5; AR3, 10; AR5, 4). Interviews highlighted the need for an open-minded, flexible approach, including willingness to adapt as new information and technologies emerge (AR3, 16; SH2, 49).

However, the interviews also showed that airlines face dual objectives: growing while committing to sustainability (AR5, 40; AR6, 8), requiring to find a balance between the two (AR2, 17; AR6, 8). All airline representatives acknowledged that complete prioritization of sustainability is still a work in progress. While sustainability is becoming more embedded in their decision-making processes (AR2, 1; AR3, 12; AR5, 20), it must still be fully integrated into all aspects of strategic decisions (AR1, 10; AR4.2, 24; AR5, 14). One airline representative explained: "... sustainability is now part of the strategy, but is it fully embedded in all decision-making or let's say the top of minds of the policy or decision makers within our company? No." (AR4.2, 24). The interviews showed that it remains challenging to prioritize long-term sustainability targets on par with more immediate business priorities (AR1, 10; AR2, 17; AR4.2, 24). One interviewee noted that they often disagree from an environmental standpoint, but leadership prioritizes competitive advantage and customer satisfaction (AR 1, 10). One airline representative explained that this might be due to the nature of airline business operations; "... it will be immensely difficult for an airline to somehow prioritize the topic as high as it is with many other topics." (AR2, 17).

### **5.1.2. Sustainability Goals**

Airline representatives highlighted taking a goal-oriented approach towards environmental friendliness. Long-term goals, like achieving net zero carbon emissions by 2050, guide sustainability efforts (AR3, 2; AR6, 6; SH2, 4), while short- and medium-term targets to ensure continuous progress (e.g., AR1, 2). For example, goals for 2025 to 2030 include lowering carbon emissions, increasing SAF usage, and improving waste management (AR6, 6). Interim goals ensure continuous improvement and keep airlines on track. Depending on resources, airlines may prefer to focus on concrete, short-term actions they can control, rather than speculative long-term goals (AR2, 21, 23).

Developing sustainability goals requires thorough strategic planning and the establishment of key performance indicators (KPIs) to track progress (AR5, 4.2, 32). The airline representatives emphasized the importance of setting clear, achievable goals based on comprehensive research and data (AR1, 2; AR2, 23; AR5, 32). In large airline groups, strategic goals are usually aligned across the organization, leveraging collective efforts for goal achievement and ensuring a coherent approach (AR1, 2; AR4.2, 9; AR6, 6). However, one airline representative highlighted that group dependency can potentially lead to unethical behavior, whereby the poor performance of some is offset by the high performance of others (AR1, 2).

Airline representatives also acknowledged that achieving sustainability is a dynamic process (e.g., AR3, 16; AR6, 32). Goals and strategies are continually evaluated and adjusted. As stated by one airline representative, “I would say we're not there yet, but I think we at least managed to set the basis there, and for now, it's also working towards how it would evolve in the future” (AR4.1, 2).

### **5.1.3. Strategic Planning**

For alignment with overall business goals and economic viability, airlines need to integrate sustainability into strategic planning efforts, as one airline representative explained they must identify “where the journey is going and how you can bundle all the topics together into a corporate strategy ...” (AR2, 1). The establishment of long-term commitments and roadmaps, as discussed above, is critical and includes modeling and budgeting the targets and how to get there (AR2, 21; AR3, 6; AR4.1, 12; AR5, 4; AR6, 18). Holistically integrating sustainability makes it part of overall strategic planning, ensuring it is regularly evaluated and adjusted based on new insights and advancements (AR4.1, 2; AR6, 32). Collaboration is crucial in this monitoring and adjustment procedure (AR1, 10; AR2, 30). Regular updates and aggregating information across organizational divisions help monitor and stay on track with targets and ensure that sustainability considerations are incorporated in planning (AR2, 19; AR4.1, 12). By making sustainability part of decision-making, the environmental impact of various projects and initiatives is taken into account (AR2, 19; AR4.1, 12; AR5, 20).

### **5.1.4. Sustainability Governance**

The interviews revealed that prioritization in strategic planning and decision-making is closely linked sustainability governance. One airline representative explained, “given the importance of the sustainability topic, we are connected and reporting directly to a board member to have a big impact on the company” (AR5, 46). While some airlines have established governance structures (e.g., AR6, 10), others are still developing and refining theirs (e.g., AR2, 1; AR5, 2). Most airlines have centralized sustainability teams that report to senior leaders, ensuring consistency, alignment, and strategic importance across the organization (AR3, 26; AR5, 46; AR6, 10).

The results indicate that sustainability encompasses topics from emissions to social and governance aspects, necessitating input and action from various departments (AR3, 42; AR6, 10). Governance structures often include departmental and cross-functional teams, ensuring integration at all organizational levels (AR2, 1; AR4.2, 13; AR5, 16, AR6, 16). Some airlines

assign sustainability responsibilities to departments, while others encourage collaboration through open communication channels without designating specific individuals (AR2, 1, 20; AR3, 26; AR4.1, 12, 13; AR5, 14, 16; AR6, 6). Multi-layered governance models, with central sustainability committees and working groups, are typical and include representatives from various business functions (AR4.1, 12, 13; AR6, 6). In airline groups, this structure enables a coordinated group-level approach while providing individual companies with some autonomy (e.g., AR6, 6). Thus, centralized governance offers overall direction, but departments and subsidiaries can have flexibility (AR4.2, 13; AR6, 10). Airlines with limited sustainability teams might rely on coordinated efforts and parent companies (AR2, 5).

### **5.1.5. Collaboration**

Governance structure and internal and external collaboration are intertwined in sustainability efforts.

*Internal Collaboration* involves centralized networks and steering groups, that allow various parts of the organization to contribute, ensuring a holistic approach (e.g., AR6, 10). Airline representatives noted that effective sustainability governance requires involvement of various operational areas, financial departments, and other units (e.g., AR5, 4; AR6, 18). Leveraging specific technical expertise and local knowledge can benefit sustainability efforts, ensuring complex initiatives are managed effectively (AR1, 28; AR2, 21). As one interviewee stated, “It's sustainability, it belongs in everybody's job.” (AR3, 46). Coordination across the organization or group facilitates the scaling and sharing of initiatives, resources, and expertise (AR2, 11; AR6, 14). Additionally, open communication channels facilitate decision-making and adjustments, keeping sustainability efforts cohesive and on track (AR4.1, 12; AR5, 48; AR6, 18).

*External Collaboration* includes partnerships with suppliers, technology companies, airports, infrastructure providers, and consultancy firms. Airlines are working with suppliers and technology companies to advance sustainability initiatives and secure resources (e.g., AR2, 7; AR6, 6). Interviewees emphasized that close cooperation between industry stakeholders and airlines is essential for implementing and scaling new technologies like electric aircraft and SAF (SH1, 10; SH2, 31; SH3.1, 40; SH3.2, 111; SH4.1, 29). Additionally, consultancy firms provide specialized expertise for sustainability projects (AR1, 30, 32).

### 5.1.6. Measures

*“But the reality is that we still all agree that there's no single solution, there's no silver bullet here” - AR6, 26*

Airlines are adopting various measures to achieve sustainability, leveraging a combination of technologies and initiatives to reduce emissions (AR6, 26; SH1, 24). While quick fixes like fuel replacement are considered, the focus is shifting towards long-term approaches to decouple passenger growth from emissions and achieve net zero emissions through a multi-channel strategy (AR2, 13; AR6, 6; SH1, 24). This involves investing in new technologies and diverse measures (AR2, 13; AR5, 26; AR6, 6; SH1, 24).

**SAF** is critical in the short- and medium-term due to its immediate benefits and possible application within current operational frameworks (AR3, 2; AR6, 20). One stakeholder noted, “... SAF is going to do the heavy lifting” in decarbonization efforts (SH2, 4). As a result, many airlines heavily invest in SAF as a key component of their decarbonization strategies (AR6, 6; SH4.1, 31).

However, SAF is recognized as intermediate solution, not a panacea: “... it's not going to be the future. This is an intermediate solution which will help, but it's not everything yet” (AR5, 26). One airline representative raised concerns about airlines relying on SAF as an easy and fast route to decarbonization due to its immediate applicability (AR1, 22). Other airline representatives expressed concerns about relying on SAF due to its high cost and current production limitations (AR2, 9; AR5, 26; AR6, 26). A range of challenges to SAF implementation were mentioned during the interviews which will be discussed in more detail in a later section.

**Fleet Renewal** also emerged as critical, with one stakeholder remarking that airlines are “competing on who has the newest fleet” (SH4.1, 15). This ambition is evident, with one airline representative noting that their aircrafts' average age is nine years despite a potential lifespan of up to 25 years (AR3, 4). Another mentioned a large order of new aircraft arriving in the next five years and dedicated teams for fleet renewal (AR6, 6, 20). Next to environmental advantages, maintaining a young and modern fleet offers advantages such as reduced fuel costs and lower capital expenditure, making it financially viable (AR3, 4; AR4.1, 32; AR6, 20). However, as with SAF, concerns persist regarding financial constraints, making fleet renewal not feasible for all airlines (AR1, 2, 18).

**Carbon Offsets** are expected to address residual emissions that cannot be resolved through other measures (AR1, 18; AR2, 29; AR3, 2; AR6, 6; SH2, 4). They are viewed as provisional solutions with the long-term focus being the direct reduction of emissions through enhanced technologies (AR2, 28, 30). Economic incentives and regulatory frameworks, such as the EU ETS and CORSIA, also drive carbon offsets (AR6, 26). Offering voluntary carbon offset options during bookings is a measure a lot of airlines take, but customer uptake is low, around 2-3% for one airline (AR3, 36). A study conducted by another airline revealed that 45% of customers who do not purchase offsets do so due to skepticism about the effectiveness of offsets or the airline's reliability (AR1, 14). The reliability and transparency of offset projects can be challenging to guarantee (AR6, 26).

**Operational Efficiency** measures are crucial as well, especially for airlines with restricted resources (AR1, 2, 4). Some airlines use advanced tools for precise fuel calculations and dynamic route adjustments based on real-time weather data, optimizing fuel usage and enabling more efficient flight routes (AR1, 10; AR6, 28). Operational changes like continuous descent approaches and single-engine taxiing are being adopted to reduce fuel consumption during flight phases (AR3, 4). Others are looking into reducing aircraft weight by minimizing unnecessary cabin equipment and installing lighter components (AR2, 7, 9). Other measures are renewable energy sources at airports, using electric ground support equipment, and testing innovations like drag-reducing surface technology on aircraft exteriors (AR1, 2; AR6, 28).

**Other measures** named by interviewees included improved air traffic management, carbon capture and utilization technologies, sustainability-tied management incentives, or waste reduction (AR3, 2, 12; AR6, 6). Moreover, investments in emerging technologies, such as hydrogen and electric aircraft, are ongoing (AR6, 6; SH1, 2). An expert in electric propulsion highlighted that advancements in electric motors are making electric aircraft increasingly viable, particularly for short distances (SH1, 2, 14, 44). He also emphasized reduced maintenance costs and lower operational expenses (SH1, 2, 14, 44). However, airline representatives and other stakeholders were skeptical about the near-term feasibility of electric aircraft due to battery technology limitations, lack of infrastructure, and safety concerns (AR3, 16; AR5, 22). Due to these constraints, long-haul flights powered by electric engines are considered unlikely in the near future (AR2, 31; SH2, 4). One airline representative explained, "You hear people talking about electric planes that's not feasible. Even from a safety perspective that's not feasible. Let alone from a physics perspective" (AR3, 12). Despite these concerns, some interviewees admitted that adoption on short regional routes where transportation is

challenging due to geographic circumstances could become an option (AR1, 42; AR5, 28; AR6, 6; SH4.1, 35).

## **5.2. Driving Forces**

*“We have different things that make us do this sustainability strategy” (AR5, 8).*

The interviews indicate that various underlying forces drive the transformation.

### **5.2.1. Legal Pressure and Policy Support**

One airline representative stated: “It’s not so much that the management says, ‘Okay, sustainability is incredibly important to us’, but rather that the management is afraid of politics” (AR1, 22), suggesting that regulatory pressure drives sustainability rather than intrinsic commitments. Another interviewee echoed this sentiment: “On the one hand, it is always a bit of a question of what can be done that is good, but first and foremost meets the regulatory requirements.” (AR2, 25).

Despite the pressure associated with upcoming policies, it is recognized that without it, meaningful change is unlikely to happen at the required pace (AR1, 10, 22). The interviews show that the emerging regulatory environment forces airlines to alter their strategies to comply and avoid penalties. Penalties for non-compliance or increased operational costs create a financial incentive for airlines to adhere to the policies (AR1, 10, AR3, 32). The European Union’s ETS introduced carbon pricing to aviation, prompting airlines to prioritize decarbonization efforts (AR6, 8). The Corporate Sustainability Reporting Directive (CSRD) mandates integrating sustainability impacts into financial reports (AR3, 32; AR4.1, 6). Global agreements like the Paris Agreement and CORSIA set ambitious targets for a unified approach to sustainability (AR6, 26). Regional initiatives like RefuelEU further drive European sustainability efforts (SH2, 4, 39).

Policy support, such as incentivizing SAF production and usage, making it more economically viable and competitive with fossil fuels, is important as well (SH2, 14). The immediate costs of compliance must be balanced with the long-term benefits; investing in SAF or green technology early on can be a proactive approach to mitigating future regulatory costs (AR3, 6; AR6, 26).

### **5.2.2. Competitive Pressure**

The findings indicate that airlines are influenced by their competitors' sustainability efforts. As one airline representative noted, “... that will always be the biggest driver. Competitiveness, what are the others doing, how do we compare” (AR1, 22). Another interviewee explained that

the competition between airlines is “... the best driver to move in the right direction” (SH4.1, 31).

Competition manifests in different ways – airlines compete to announce ambitious targets, invest in new and fuel-efficient aircraft fleets, and promote initiatives and certifications (AR1, 14; AR5, 10; AR6, 6; SH4.1, 15). Airlines constantly benchmark themselves against each other to monitor and compare strategies (AR1, 22; AR2, 7, 11; AR5, 4, 24, 30; AR6, 28; SH4.1, 13). Sustainability ratings and regulatory reporting requirements further drive competitive dynamics (AR5, 42). By one airline introducing new sustainability goals and initiatives, others are prompted to improve their practices in response (SH4.1, 13). This is necessary to stay on top of developments, avoid negative publicity and maintain their market reputation (e.g., AR1, 18). As highlighted by one airline representative, “No airline wants to pollute more than another. ... When the time comes, it's going to be a race” (AR5, 24).

Accordingly, the desire to outcompete competitors motivates airlines to improve their sustainability performance (AR2, 25; AR5, 10). As explained by one airline representative, “Because if we've certainly decarbonized ... we would certainly want to make that a competitive gain over other airlines who either are behind or are doing so more costly, having to pass that cost on to their consumers” (AR6, 28).

### **5.2.3. Economic Incentives**

Economic incentives and disincentives encourage airlines to adopt environmentally friendly practices. As explained before, policy requirements can be used to steer airlines towards sustainable solutions (SH2, 19). For instance, carbon pricing can incentivize airlines to invest in sustainable solutions to reduce emissions, as the cost of emissions can outweigh the initial investment (AR3, 6; AR6, 28). Investing in new technologies and operational efficiencies can be financially beneficial by reducing costs. Electric aircraft are expected to be more profitable than fossil-fueled ones due to lower fuel and maintenance costs (SH1, 6, 14). Replacing older, less fuel-efficient aircraft with newer models reduces fuel costs alongside carbon emissions (AR1, 14; AR2, 1; AR3, 4, 10, 32; AR4.1, 32).

### **5.2.4. Stakeholder Expectations**

Various other internal and external stakeholder expectations influence airlines' strategy and sustainability efforts.

*External stakeholders* have increasing expectations and demands regarding sustainability performance and strategy (AR3, 8; AR4.1, 19; AR5, 8, 12).

*Investors* pressure airlines to take decarbonization more seriously, requiring airlines to demonstrate commitment to sustainability, especially given the industry's slow pace of change and high associated costs (AR2, 15; AR3, 38; AR4.1, 21; AR6, 20). Airlines must demonstrate and transparently report concrete measures to reduce their environmental impact (AR2, 15). Reasons for increased investor interest can be regulatory pressures but also the appeal of sustainable investments (AR3, 32). One airline representative explained that pressure comes from sustainability-focused investors and shareholders (AR4.1, 21). Investors are also crucial in developing technologies like SAF production and demand assurance due to the risks associated (S2, 14, 35).

*Customers*, with increasing sustainability awareness, are said to prefer airlines that demonstrate a commitment to sustainability over less sustainable ones (AR2, 25; AR4.1, 19; AR5, 10, 42; SH4.1, 19). Younger generations, in particular, are increasingly concerned about environmental issues and prefer travel options that align with their values (AR2, 24; AR5, 42; SH4.2, 19). Airlines that fail to prioritize sustainability risk being perceived as less credible or trustworthy (AR1, 38). At the same time, airline representatives observe that many customers are indifferent to sustainability (AR3, 34). According to one stakeholder, business customers increasingly prioritize sustainability, while leisure travelers tend to prioritize cost over sustainability (SH4.1, 6, 45). This causes a noticeable gap between what customers claim to value and their actual behavior; "... what we see at this moment in time is that customers do say a lot of things, what they think is important, but in their behavior, we don't really see them acting" (AR4.1, 19). This discrepancy might stem from customers deflecting responsibility, thinking their infrequent flights are not significant contributors to the problem (AR2, 26; AR6, 24). Additionally, issues of trust and validity towards airlines can arise, "... those who take the issue seriously don't take us seriously and we annoy those who don't care about the issue" (AR1, 14).

*Other external stakeholders* connected with or affected by airline operations also demonstrate interest in sustainability. For instance, NGOs review sustainability reporting to ensure validity (AR5, 32). Airports maintain close communication with airlines, sharing a mutual interest in sustainability measures, reporting, and coordinating sustainability-technology infrastructure (SH3.1, 40, 46; SH3.2, 87, 105). Travel agencies, acting as intermediaries between airlines and customers, can also raise sustainability demands, challenging airlines to enhance and disclose their efforts (SH4.1, 13, 17). Some stakeholders', such as tour operators, Scope 3 emissions are also affected by airlines, leading to increased interest in decarbonization (AR2, 13, 27).

*Internal stakeholders* of the airlines also play an essential role in driving sustainability efforts forward.

*Leadership*, or parent companies in the case of airline groups, often set the overall strategy and targets, which subsidiaries must align with and contribute to while having some flexibility in implementation (AR1, 18; AR2, 5; AR4.2, 9; AR6, 6, 14). Leadership is in the position to establish and impact sustainability measures across the organization (AR5, 46, 32). One interviewee explained that they received a detailed reduction path from the group, specifying demanded reductions, and highlighted significant consequences for not meeting targets (AR1, 2, 18).

*Employees* should be engaged in the airlines' sustainability efforts according to interviewees. Involving them in sustainability topics helps identify organizational priorities (AR5, 4). Increased internal communication and sustainability education can moreover enhance employee engagement and understanding (AR2, 15; AR3, 10). One airline representative explained that employees who perceive their company as committed to sustainability might also be more likely to identify with the company and remain loyal (AR1, 38).

### **5.3. Challenges**

*"It's one thing to set a target. It's another thing to sort of identify how we're going to do it"* (SH2, 4).

Interviewees highlighted the complexity of the transformation, noting a high number of variables to manage and describing the journey ahead as "really difficult" (AR4.1, 6, 28). Overcoming challenges is essential for survival; one airline representative stated, "We still need to make sure we save our own skins, at least to the extent that we stay in business" (AR1, 26). The industry's dynamic nature and growth trajectory contribute to these difficulties (AR4.2, 27). One airline representative noted that "... unless there is a very big technical breakthrough or a giant mind switch, it will probably be very hard" (AR4.2, 27).

#### **5.3.1. Knowledge Management**

Challenges revolving around knowledge and current expertise on sustainability measures and alternative technologies were frequently named during the interview. Many interviewees acknowledged the complexity and breadth of the information required. One stakeholder noted the overwhelming amount of information, making it difficult to know where to start (SH2, 31), while another emphasized the need to build shared knowledge around new technologies (SH1,

52). The rapid evolution of climate science and technology requires continuous learning and adaptation to ensure current knowledge remains relevant and goals are achievable (AR1, 24; AR5, 32, 40).

One airline representative noted that in their respective airline group, "... it's not quite clear where you get this knowledge from" (AR1, 24). Finding and retaining sustainability experts can be challenging. While one airline representative notes that diverse skill sets are required (AR3, 42), another stresses the importance of specialized expertise in environmental issues to address sustainability effectively (AR1, 28). Additionally, educating staff about the importance of sustainability and its relevance to the aviation industry can be challenging but is deemed essential (AR2, 3).

### **5.3.2. Legal Compliance**

The evolving regulatory landscape was described as complex and difficult to navigate in the interviews. One airline representative highlighted the challenge of complying with new regulations and balancing them with operations: "We are all facing new regulation, and I think that's going to be very challenging to comply with all of them" (AR5, 40). Airlines must manage progress while publicly disclosing plans, adding to the operational burden (AR6, 28)

Legal hurdles can also impede the adoption of technologies as stringent certification processes can slow innovation, requiring new technologies to meet standards before deployment (SH1, 2). Regulations can hinder the use of technologies, such as AI designed to enhance sustainability, limiting their broader application (SH3.2, 125). Additionally, the widespread implementation of SAF is heavily dependent on policy support. Although ambitious mandates for SAF usage exist, they fall short of replacing fossil fuels entirely (AR2, 31; AR6, 6). One airline representative explained that even with the SAF EU Blending Mandate, "you are not at 100% SAF, but at 70%. So that means if I still burn 30% kerosene, I still have emissions at the end of the day" (AR2, 31). The carbon market presents its own set of challenges as policymakers must establish mechanisms to ensure project accountability and protect airlines from being unfairly blamed (AR6, 28).

### **5.3.3. Technology Accessibility**

While achieving net zero emissions with current technologies and fleet is perceived as challenging, the widespread availability of sustainable solutions is also a significant concern (AR5, 22). The primary obstacles identified by the interviewees are the development,

implementation, and scalability of new technologies and the infrastructure required to support them.

For example, electric aircraft face readiness and feasibility issues. Interviewees noted that current battery technology is inadequate for large-scale, long-haul flights, citing safety and physics concerns (AR3, 12, 16; SH4.1, 35). Hydrogen energy also presents hurdles, including safety concerns and infrastructure needs (SH2, 4; SH3.1, 48). Airports must adapt to support these new technologies, requiring significant investment and coordination (SH3.1, 40, 46). The scalability of SAF production is constrained by challenging production processes and high investment costs (AR1, 18; AR5, 22, 40). Besides, accurate calculation tools for emission reduction paths are scarce. Reported CO<sub>2</sub> emissions often rely on predictions rather than actual data, making it difficult to accurately track and reduce emissions (AR1, 20; SH2, 10). Moreover, airlines use different methods to calculate KPIs, which complicates comparison (SH2, 10).

#### **5.3.4. Financial Constraints**

Sustainability initiatives must be balanced with the need to remain profitable despite the high associated costs. As one airline representative noted, achieving sustainability requires “huge amounts of capital” (AR6, 26). SAF, for instance, is more expensive than conventional jet fuel and requires substantial capital investment to develop new facilities and technologies (SH2, 14; SH4.1, 31). Financial uncertainties and market fluctuations further complicate long-term planning (AR2, 21; AR6, 18). The significant upfront investment in sustainable technologies and infrastructure forces airlines to balance current economic viability with future sustainability goals (AR1, 4, 24; AR2, 11; AR6, 26; SH2, 23; SH3.2, 107). Airlines must decide whether to absorb costs or pass them on to customers, potentially making air travel less accessible (AR1, 4, 24; AR2, 11; SH2, 23).

For smaller or less profitable airlines, the financial burden is even more pronounced, making some sustainability measures financially unviable and risking survival (AR1, 2; AR6, 18; SH2, 31). One airline representative feared economic constraints might compel airlines to cease operations: “If this takes effect as it looks at the moment, the logical consequence will be that the [Airline Group 1] will have to close airlines” (AR1, 6).

#### **5.3.5. Communication and Transparency**

Communication challenges emerged as significantly impacting airlines' sustainability efforts.

*Internally*, aligning all stakeholders and maintaining brand identity while promoting group-wide sustainability initiatives can be challenging (AR6, 14). However, it is crucial to create

awareness and understanding of the importance of sustainability and its integration into daily operations throughout the organization (AR2, 3, 15). Moreover, one airline representative discussed the challenge of misalignment between targets pre-defined at group level and individual airline realities and available resources (AR1, 18).

*Externally*, airlines must provide accurate and comprehensive information about sustainability practices to increasingly demanding stakeholders (AR5, 8; SH4.1, 6). Communicating these responsibilities and initiatives without overstating achievements is crucial to avoid credibility issues and legal repercussions (AR1, 16; AR5, 2, 32; AR6, 28). Establishing clear and achievable goals helps maintain trustworthiness in the eyes of customers while avoiding accusations of greenwashing (AR1, 14; AR5, 32), which many airlines have been the subject of (AR1, 16; AR5, 2). The challenge lies in reporting extensive information in a way that does not mislead the public (AR6, 28). Airlines must assume responsibility for addressing sustainability issues while exercising caution to not overstate ambitions (AR1, 16). This might cause anxiety, leading airlines to remain silent on sustainability issues (AR1, 16, 38). One airline representative explained, "... at the moment, the management message is very clear: we'll hide for as long as we can" (AR1, 16).

### **5.3.6. Managerial Capacity**

Limited resources available to airlines can impede the establishment of large sustainability teams, especially in smaller airlines (AR3, 40; SH2, 31). This can make prioritizing and effectively implementing sustainability goals challenging due to a lack of specialized knowledge and human resources (AR1, 24, 28). Reliance on non-specialized personnel to lead sustainability initiatives is another issue. Some airlines assign sustainability roles to individuals with backgrounds in other fields like accounting, law, and marketing, potentially leading to a lack of strategic emphasis (AR1, 24, 26; AR2, 1; AR3, 40). One airline representative noted that the dynamics of sustainability teams vary significantly depending on the team's background and strategic location within the organization (AR1, 26). Moreover, internal resistance and a lack of strategic alignment can cause employees to perceive sustainability initiatives as an intrusion into their roles, causing implementation difficulties (AR5, 32).

## **5.4. Future Outlook**

*I don't think any business would want to say that its plan to 2050 is to reduce what it does. It will want to grow what it does and continue to sell more products or provide more services like we are in our sector but, of course, doing so in a sustainable way. (AR6, 8)*

The future outlook for aviation's sustainability is a complex mix of visions, hindering factors, and cautious optimism. Table 8 presents statements from the airline representatives to capture their sentiments on the future of the airline industry.

While ambitious targets are frequently presented, the reality can fall short due to the industry's slow pace of change and inherent difficulties (SH4.1, 27). With aviation's current 2% contribution to global emissions projected to rise, the urgency for transformation is apparent (SH2, 19). Airlines have difficulties to prioritize and balance sustainability against business priorities and growth (AR1,10; AR2, 17; AR4.2, 24; AR5, 14; AR6, 8). The interview proved it is difficult to predict whether the industry will meet its sustainability goals or need more time (AR3, 12; AR6, 32). Airline representatives explained that efforts will have to continue well past 2050 to address historical emissions and achieve genuine environmental friendliness (AR5, 2; AR6, 32).

**Technological Advancements** are seen as a critical component of this transformation among interviewees. Stakeholders express hope in emerging technologies such as artificial intelligence (AI) and electric aviation, anticipating their transformative impact. Rapid advancements in AI suggest new possibilities for operations and efficiencies (SH3.2, 117; SH4.1, 35; SH4.2, 33). Continuous investment and research in alternative propulsion systems and other innovations are essential to meet long-term sustainability goals (AR5, 22, 40). Despite efforts, the path to decarbonization is acknowledged as a long and challenging journey (AR2, 31). One airline representative explained “We have several initiatives within sustainability to help the environment, but it's very difficult to achieve net zero with our engines and if we don't stop to use fuel” (AR5, 22).

**Shifting Industry Dynamics** historically exist in the airline industry with environmental sustainability representing the latest developments (SH2, 39). Interviewees indicated that the industry is moving towards a more sustainability-focused model, with changes expected to develop further (AR3, 40; AR5, 32). Achieving net zero by 2050 will require broad industry-wide efforts, collaboration, and substantial financial investments (AR3, 52; AR6, 26, 32; SH1, 10; SH3.2, 113). The transition will be gradual, necessitating sustained effort and adaptation (AR3, 52). This can cause an evolution of business models and the potential emergence of new entrants to capture opportunities, such as electric aviation (AR5, 40; SH1, 6).

However, as Table 8 shows, uncertainty about the feasibility of net zero 2050 exists among interviewees. Airline representatives observed that the industry as a whole is still behind and

that many factors are beyond their control (AR3, 12; AR5, 2). Despite the uncertainty, there is a shared determination to make progress among the interviewees (AR1, 18; AR2, 31). One airline representative explained that “Since the sustainability topic is raising awareness within every person, I think this is going to be easier in the future” (AR5, 32). The interviewees anticipate that the future of the industry will be shaped by high financial investments, intensified regulation, and increased competition (AR1, 22; AR3, 52; AR4.1, 28). As airline representatives put it, “airlines are all in the same boat” (AR6, 28) when dealing with these challenges, and “it’s going to be a race” (AR5, 24).

**Table 8:** Airline Representatives Sentiments Towards Net Zero

#	Statement
1	<p>“It doesn't contribute to our credibility. Still acting as if it's totally awesome. ‘Yes, sure, by 2050 we have everything under control.’ We don't. It's that simple. We just have to say that honestly. No reason to give up, but maybe it's also time to stop fooling ourselves.” (AR1, 18)</p> <p>“I would like us to manage this in a socially fair way and I would like us as an industry to accept that this also means that we will become smaller, that we will shrink.” (AR1, 40)</p>
2	<p>“That is a very long, rocky, and challenging path, especially for air traffic, I believe. But I also believe there is no way around it. So, this is a topic that definitely needs to gain much more momentum in the coming years.” (AR2, 31)</p>
3	<p>“2050, it all depends what day of the week you find me. Some days I'm very optimistic and other days I'm not so optimistic. And the reason why that is the case, it's so much outside our control.” (AR3, 12)</p> <p>“It won't happen all of a sudden. It's going to be slow and it's going to take time. And it's going to take money.” (AR3, 52)</p>
4	<p>“But at this moment in time, not knowing if that will go through and whether or not other airlines will follow suit, I think it's hard.” (AR4.2, 27)</p>
5	<p>“The industry in overall is still behind.” (AR5, 2)</p>
6	<p>“The reality is that 2050 is not the end date. You know, even once we get to 2050 ... there'll be a roadmap either after 2075 or 2100.” (AR6, 32)</p> <p>“I think we have to just accept that airlines will need a little bit of slack and it's not that they can't get there, it's just they need a bit more time to do so.” (AR6, 32)</p>

**6. Discussion**

While the analysis of airline sustainability publications provides an overarching picture of the industry’s decarbonization efforts, tools, and instruments, the expert interviews provide more in-depth insights into organizational factors, driving forces, and challenges. This section will discuss these insights, relating them to existing literature to contextualize and derive implications, ultimately answering the research questions.

## 6.1. Strategic Sustainability Integration in Airlines

*The following section discusses the findings to answer the first research question, i.e. how airlines are integrating sustainability into their strategies to enhance environmental friendliness.*

Confirming IATA projections (2023h), the passenger numbers (see Figure 5) and aircraft order books (see Figure 10) of the major European airlines indicate continued growth and expansion ambitions. As previous research shows, companies are increasingly demanded to balance growth with taking on responsibility for environmental impact (Shrivastava, 1995b). In high-polluting industries like the airline industry the call for action is as high as ever (Afonso et al., 2023; Perryman et al., 2022; The Economist, 2023). This was reflected in the interviews, where airline representatives indicated that they need to find ways to reconcile economic goals with sustainability goals (AR5, 40; AR6, 8), aligning with Elkington's (1998) Triple Bottom Line concept, which emphasizes the need for businesses to achieve a balance among economic, environmental, and social performance.

The interview findings show that in order to achieve a future state where an airline can exist profitably while being sustainable, transformation is needed. According to previous research, sustainability must be integrated holistically into the overall business framework as a strategic choice (Baumgartner, 2014; Teh & Corbitt, 2015). The interviews show that this shift is happening in the airline industry. While airlines are at various stages of developing and refining their sustainability strategies, there is a tendency towards a more overarching integration (see Section 5.1). The recognition of the topic has increased, elevating its status from a peripheral issue to a central part of the strategic framework (see AR2, 1; AR4.1, 2; AR5, 6). Both, interviews and sustainability publications indicate a shift towards more structured and comprehensive approaches to sustainability involving several key measures (see Section 4.4 and 5.1).

*P1: Sustainability is becoming an integral part of the strategic framework, rather than a separate initiative or peripheral issue.*

**Prioritization** of sustainability is increasing in the airline industry, reflecting growing recognition and awareness of the issue (e.g., AR3, 10; AR5, 20). This is consistent with previous research showing that leaders and organizations increasingly recognize the value of integrating sustainability dimensions into strategy (Elkington, 1998; Estes, 2009; Lozano, 2012; Rafi, 2022; Sharma et al., 1999). While reports suggest that sustainability is strategically important

(see Section 4.4), interviews indicate that it is still a work in progress (see Section 5.1.1). Santamarta et al. (2022) noted the challenge of prioritizing business issues when integrating sustainability. Interviews indicated that sustainability influences decision-making, but often remains secondary to immediate business priorities, possibly due to a lack of leadership commitment (AR1, 10; AR2, 17; AR4.2, 24; AR5, 14), which can be a common problem, as explored by Rafi (2022).

*P2: Sustainability is gaining ground in airline strategies, although full prioritization and integration into decision-making are still evolving.*

**Goals** are set to create pathways for implementing sustainable practices, creating a goal-oriented approach towards sustainability (see Section 4.4). The pathways are often based on the industry-wide net zero ambition (e.g., AR3, 2; AR6, 6; IATA, 2023h; SH2, 4). Reports and interviews indicate that airlines are setting clear, measurable short-, medium-, and long-term goals to establish a comprehensive sustainability roadmap and integrate environmental friendliness into their daily operations (see Section 4.3.2 and 5.1.2). This structured approach ensures that sustainability efforts are measurable and aligned with overall business objectives (e.g., AR1, 2; AR2, 23; AR5, 32).

The development of comprehensive sustainability pathways fosters the incorporation of sustainability into strategic planning, which is crucial for effective integration (Engert et al., 2016; Rafi, 2022). This integration allows for regular evaluation and alignment with broader objectives (AR4.1, 2), with new insights and technological advancements prompting strategy adaptations (AR6, 32). Holistic integration is essential, as involving employees ensures that sustainability considerations are included at all levels and in day-to-day decision-making (e.g., AR5, 20). Empowering and engaging employees has been proven to be vital for successful integration (Santamarta et al., 2022).

*P3: Airlines are embedding sustainability into their core strategies by setting measurable targets and creating strategic pathways.*

**Governance Structures** specific to sustainability have emerged as a critical factor during the research. These can involve both centralized and decentralized approaches, depending on the organization. Interviews revealed a common approach where a centralized sustainability team coordinates with various departments and escalates issues to top management, who have decision-making power and can make a significant impact (AR3, 26; AR5, 46; AR6, 10). Reports confirm that airlines involve top management in sustainability issues and provide

sustainability-related management incentives (see Section 4.2), which can increase commitment. As literature explains, involving executives and top-down management of sustainability can improve integration throughout the organization (Davis et al., 2020; Eweje, 2011).

Literature's emphasis on holistic sustainability integration further suggests that sustainability must be embedded in all organizational functions and departments (Rafi, 2022). As the interviews showed, some airlines assign specific sustainability responsibilities to different departments, while others foster collaboration through open communication channels (AR1, 26; AR2, 1, 21; AR3, 26; AR4.1, 12; AR4.2, 13; AR5, 14, 16; AR6, 6). This ensures that sustainability is integrated into all organizational functions, facilitating knowledge sharing and company-wide collaboration.

*P4: Centralized teams coordinating with departments and leadership involvement support holistic sustainability integration in airlines.*

**Internal Collaboration** and well-structured governance frameworks are critical to effective sustainability within airlines. Establishing collaborative networks or steering groups can ensure broad participation across different departments and promote a holistic approach to sustainability (e.g., AR6, 10). Cross-functional involvement is essential to leverage technical expertise and local knowledge to effectively manage complex sustainability efforts (AR1, 28; AR2, 25). This highlights the importance of engaging individuals across the organization for effective integration, as supported by Santamarta et al. (2022).

**External collaboration** is equally significant, enabling airlines to leverage external expertise and participate in joint initiatives with shared resources. For instance, airlines collaborate with suppliers and technology companies to advance sustainability initiatives and secure necessary resources (e.g., AR2, 7; AR6, 6). Literature shows that the interconnected nature of industry roles makes collaboration with stakeholders essential (Dichter et al., 2020; Shrivastava, 1995b). The analysis of the report reveals the necessity of extensive collaborations with industry partners in order to build the infrastructure supporting airlines' sustainability strategies (see Section 4.4.2). This confirms Santamarta et al.'s (2022) proposition that collaborative efforts across the entire value chain are required.

*P5: External and internal collaboration are essential to achieve a holistic sustainability transformation.*

*Measures* for decarbonization form the cornerstones of sustainability integration in airlines. The literature review, along with report and interview findings, revealed that airlines are adopting a multi-faceted approach to sustainability (see Section 2.2.2, 4.4, & 5.1.6). The airline industry recognizes that no single solution can achieve net zero emissions; there is no “silver bullet” (AR6, 26; SH1, 24). This aligns with the literature, which suggests that combining several tools and initiatives instead of focusing on a single one can enhance the impact of sustainability approaches (Baumgartner & Korhonen, 2010; Lozano, 2012).

The measures taken by airlines demonstrate their commitment to fundamental changes in operations through research, the adoption of new technologies, increased efficiency, and the introduction of new products (see Section 4.4, & 5.1.6). This multi-faceted approach is evident in the steps they are taking to improve sustainability on multiple fronts. Consistent with previous literature, the implementation of innovative strategies for advancing clean technologies can facilitate the emergence of new opportunities (Engert et al., 2016). This highlights that besides the importance of organizational structures and commitment, actual practices, and technologies are driving sustainability forward.

*SAF* is identified as an essential short- to medium-term measure due to its immediate impact on emission reductions (see Section 2.2.3.3, 4.4.2, 5.1.6.) The industry, including all studied airlines in the sustainability publications analysis (see Section 4), confirmed that SAF is crucial for decarbonization (see Figure 3 & Table 7). The analysis of sustainability disclosures shows that airlines have set SAF adoption targets for the coming decades and are engaged in partnerships to ensure supply and development (see Section 4.4.2). Literature also supports SAF's potentially decisive role in medium-term decarbonization (Malina et al., 2022). However, interviews indicated challenges such as high costs and limited availability associated with the alternative fuel, making it more of an interim solution than a long-term one (AR1, 2; AR2, 9; AR5, 26; AR6, 26; SH1, 24). Industry associations like ATAG and IATA also confirm these challenges (ATAG, 2021; IATA, 2023d), underscoring the complexity of achieving decarbonization. The findings indicate that while SAF is crucial, its limitations require ongoing innovation and investments in alternatives.

*Fleet Renewal*, involving investments in newer, more fuel-efficient aircraft is a key measure for reducing operating costs and emissions, as highlighted in literature, reports, and interviews. Findings indicate that airlines are heavily investing in fleet renewal (see Section 4.4.1), expecting financial and environmental benefits from newer aircraft (AR3, 4; AR4.1, 32; AR6, 2; Deutsche Lufthansa AG, 2023). Literature and interviews agree that achieving net zero with

current fleets is impossible (AR5, 22; The Economist, 2023). However, interviews also revealed that the financial burden and logistical challenges of fleet renewal can be significant barriers for some airlines (e.g., AR1, 2). This underscores the conflict between the necessity and challenges of fleet renewal in the pursuit of sustainability.

*Operational Efficiency Measures*, such as advanced fuel management, optimized flight planning, and aircraft weight reduction, are crucial for immediate emission reductions. The findings indicate that airlines are adapting their operations to increase efficiency in several ways (see Section 4.4.3). Operational efficiency measures are particularly important for airlines with limited resources due to their low cost and ease of implementation (AR1, 2). Esqué et al. (2023) also noted that these measures can be quickly implemented and frequently entail minimal costs, which underscores the role of operational efficiency in achieving short-term sustainability goals, especially for resource-constrained airlines.

*Carbon Offsetting* is a common measure among airlines to address residual emissions (see Section 4.4.4 & 5.1.6). Many airlines, such as Lufthansa with its Green Fare, offer voluntary customer offsets either separately or included in a fare to promote environmentally conscious travel (see Section 4.4.4). Initiatives like this can enhance customer satisfaction and reputation as environmental concerns continue to grow (Davis et al., 2020; Peters & Simaens, 2020). However, issues with customer acceptance, reliability, and transparency limit its effectiveness, making it a temporary measure until more direct emissions reductions are achieved (AR1, 14; AR2, 29; AR3, 36). Literature also explains that long-term efficacy and ethical implications are frequently questioned (Dichter et al., 2020). Hence, while it can help address residual emissions, the effect and application of carbon offsets are limited.

*Alternative Propulsion*, particularly electric aircraft, shows promise for specific uses, but faces limitations due to current battery technology, infrastructure, and safety concerns (Danicourt et al., 2023; Mukhopadhyaya & Graver, 2022; Sahoo et al., 2020; SH2, 4). The alternative propulsion expert highlighted advancements in research, suggesting that new business models may emerge in the electric aircraft market (SH1, 2, 6, 14, 44). This is supported by the efforts of start-ups working on the technology (Crownhart, 2022). Additionally, some interviewees noted that electric propulsion could be a viable solution for shorter routes in specific geographical contexts (AR1, 42; AR5, 28; AR6, 6; SH4.1, 35), as exemplified by Norway's electrification ambitions (Future Agenda, 2020). Still, neither the reports nor the interviews identified electric aircraft as a key solution for the decarbonization of the European passenger airline industry (see Section 5.1.6). Literature supports the need for ongoing research and

development to make electric aircraft viable for commercial aviation (Mukhopadhaya & Graver, 2022; Schäfer et al., 2018).

*P6: Integrating sustainability requires a multifaceted approach that combines different tools and measures.*

Based on these findings, the research question ‘*How are European passenger airlines integrating sustainability into business strategy on their path towards environmental friendliness?*’ can be answered as follows:

European passenger airlines are integrating sustainability into their strategies by transforming it from a separate issue to a central component of business and operations. As the industry grows, airlines try to balance economic viability with environmental goals through a goal-oriented approach that sets short-, medium-, and long-term targets. To integrate sustainability in the organization, governance structures mostly centralize efforts within dedicated teams and foster internal collaboration across all functions. This ensures that sustainability is integral to strategic planning and decision-making. External collaborations provide essential expertise and resources, acknowledging that multiple measures are required to achieve net zero emissions. Key measures for decarbonization include the adoption of sustainable aviation fuel, fleet renewal, operational efficiency improvements, and carbon offsetting. This multi-faceted strategy reflects a comprehensive approach to sustainability, aiming to achieve net zero emissions by 2050.

## **6.2. Driving Forces of Airline Sustainability**

*The following section discusses the findings to answer the second research question, i.e. the driving forces behind the integration of sustainability into airline strategies.*

Previous research indicates that companies adopt sustainable practices due to a combination of external and internal forces (see Davis et al., 2020; Engert et al., 2016; Porter & Kramer, 2007; Schaltegger, 2011). Interviews reveal that, for airlines, the primary driving forces are legal and competitive pressure, economic incentives, and internal and external stakeholder expectations (see Section 5.2).

**Legal Pressure** emerges as the main driver of sustainability efforts in the airline industry, supporting Engert et al.'s (2016) assumption that strict regulations significantly influence sustainability in high-polluting sectors. The aviation policy landscape is rapidly evolving (see Table 3), with numerous policies compelling airlines to adopt sustainable practices in order to avoid penalties and ensure compliance (Danicourt et al., 2023; WEF, 2023). Interviews

confirmed that this evolving regulatory framework leads airlines to prioritize sustainability out of necessity rather than intrinsic motivation (e.g., AR1, 22; AR2, 25). Consequently, authorities and regulatory bodies play a crucial role in guiding the industry's sustainability efforts.

*P7: Legal pressure is a main driver of sustainability efforts in the airline industry.*

**Competitive Pressure** is intensifying as sustainability is becoming essential for long-term relevance and performance (see Hart, 1997; M. Porter & Kramer, 2007; Rafi, 2022; Teh & Corbitt, 2015). The sustainability publications show that airlines are publicly detailing their sustainability efforts, allowing easy comparison and revealing similar initiatives, such as 'green fares' (see Section 4.4.4) (Lufthansa Group, 2024b; Turkish Airlines, 2023a). Interviews confirm that airlines compete on sustainability, driving improvements in their practices (e.g., AR1, 22; AR5, 25).

Airlines benchmark against each other, set ambitious targets, and invest in sustainable technologies to maintain market position and attract environmentally conscious consumers (AR1, 22; AR2, 7, 11; AR5, 4, 24, 30; AR6, 26; SH4.1, 13). This is connected to a shift in consumer behavior, compelling organizations to adopt sustainable practices to stay competitive (Peters & Simaens, 2020). Interviews highlight that competitive dynamics foster innovation and improved sustainability performance, helping airlines gain a competitive advantage (AR2, 25; AR5, 10; AR6, 28). As literature suggests, adopting innovative sustainability practices can create new market opportunities, thereby enabling organizations to outperform their competitors (Engert et al., 2016; Peters & Simaens, 2020). This emphasizes the role of competitive pressure in driving sustainability efforts in the airline industry, promoting continuous improvement and innovation.

*P8: Competitive pressure is driving sustainability as it becomes critical to long-term relevance.*

**Economic Incentives** in form of cost savings drive airlines to adopt sustainable practices (e.g., AR3, 6; AR6, 26). Previous research shows that organizations viewing sustainability as a strategic opportunity can benefit economically through cost reductions and increased efficiency (Davis et al., 2020; Engert et al., 2016; Peters & Simaens, 2020). In aviation, fuel-saving technology offers economic incentives as fuel is a major cost component (see Section 2.2.3.4 and 4.4.3) (AR1, 10; AR2, 1; AR3, 4, 10, 32; AR4.1, 32). This encourages investments in fleet renewal (see Figure 9), as maintaining a young fleet reduces both climate impact and costs (Deutsche Lufthansa AG, 2023). Measures for operational efficiency also provide similar

economic benefits (Esqué et al., 2023). These economic incentives align sustainability efforts with cost-saving measures, making sustainability financially viable.

*P9: Economic incentives drive airlines to adopt sustainable practices by aligning sustainability with cost savings.*

**Stakeholder Groups** are increasingly interested in airline sustainability, as explored by Dichter et al. (2020). According to Freeman (1984), organizations that adopt a stakeholder-focused approach are more likely to implement sustainable practices.

*Externally*, growing investor awareness of aviation's environmental risks drives the need for mandatory, standardized climate-related financial disclosures and ESG scoring (see Dichter et al., 2020; Li et al., 2021; Rafi, 2022; European Commission, 2024). This compels airlines to prioritize transparency and adopt comprehensive sustainability practices to meet regulatory requirements and investor expectations (e.g., AR2, 15; AR3, 38; AR4.1, 21; AR6, 20). The analysis of sustainability disclosures shows that airlines are providing detailed sustainability-related information and engaging in sustainability ratings (see Section 4).

The market's growing concern over airlines' environmental impact (see Dichter et al., 2020) suggests that early engagement in sustainability can provide competitive advantages (McPhee, 2014; Shrivastava, 1995b; Teh & Corbitt, 2015). Customers, especially younger generations, increasingly prioritize sustainability (e.g., SH4.2, 19), with a study showing that 56% of travelers would switch to more eco-friendly options (OAG, 2020). This shift compels airlines to prioritize sustainability to attract and retain customers, creating a competitive race (e.g., AR5, 4). However, airline representatives noted a gap between customers' stated values and actual behavior (AR4.1, 19), as well as a tendency for customers to deflect responsibility (AR2, 27; AR6, 24). Accordingly, evolving customer preferences drive airlines to adopt sustainable practices, however, there are some discrepancies in customer behavior.

*Internal stakeholders*, such as parent companies and employees, also play a crucial role. As proposed by Davis et al. (2020) and Eweje (2011), when leadership prioritizes sustainability, it motivates the entire organization to align its operations with sustainable practices. The review of airlines' CDP responses revealed that sustainability issues are overseen by the board of directors and aligned with management incentives (see Section 4.2). Linking bonuses and salaries to sustainability-related targets and performance is likely to increase management's engagement in prioritizing sustainability, as managers often prioritize economic variables (Engert et al., 2022). By enhancing commitment in this way, managers might increasingly

promote sustainable practices throughout the organization (see Davis et al., 2020; Eweje, 2011). Interviews revealed that parent companies set overarching sustainability targets for their subsidiaries (AR1, 22; AR2, 5; AR4.1, 12; AR6, 6, 14), as reflected in sustainability reports where groups set goals for the entire organization (see Section 4.4). A strong commitment to sustainability can also enhance employee commitment and loyalty (e.g., AR1, 38; AR2, 15; AR3, 10). As discussed earlier, involving employees in these initiatives contributes to a holistic approach, integrating sustainability throughout the organization. As proposed by Baumgartner and Korhonen (2010), the alignment of individual actors and activities in vision and goals must be reached in order to ensure coherence and prevent conflicts. Accordingly, leadership plays an important role in ensuring sustainability is integrated throughout the organization.

*P10: Stakeholder interest drives airline sustainability, with internal targets and commitments complemented by external demands for comprehensive practices.*

Based on these insights, the second research question, ‘*What are the driving forces behind the integration of sustainability into airlines’ business strategy?*’ can be answered as follows: The integration of sustainability into airlines’ business strategies is driven by a combination of external pressures and internal motivations. Key driving forces include legal pressure, competitive dynamics, economic incentives, and stakeholder influences. Legal pressure, coming from an intensifying policy landscape, is a primary driver, compelling airlines to adhere to a range of environmental policies. Competitive pressure motivates airlines to enhance sustainability efforts to stay ahead in the market and potentially gain a competitive advantage. Economic incentives, such as cost savings from fuel efficiency, make sustainable practices financially attractive. Finally, stakeholder demands, including those from investors, consumers, and internal leadership, push airlines to adopt comprehensive sustainability measures. Collectively, these forces drive airlines towards sustainability in order to ensure compliance, competitiveness, cost savings, and stakeholder satisfaction.

### **6.3. Challenges of Sustainability Integration in Airlines**

*The following section discusses the findings to answer the third research question, i.e. the challenges airlines face in integrating sustainability into their strategies.*

The integration of sustainability into airline strategy is complex and influenced by various forces, as previously discussed. The process is fraught with challenges that must be addressed to achieve sustainability goals, confirming prior research highlighting its complexity and uncertainties (Hoffman, 2018; Engert et al., 2016; Rafi, 2022).

**Knowledge Management** can be challenging when it comes to a topic as complex as the decarbonization of aviation. While literature suggests that establishing clear roadmaps is difficult (Santamarta et al., 2022), the review of sustainability publications showed that airlines have developed comprehensive roadmaps with various targets and initiatives (see Table 7). However, interviews revealed doubts about the feasibility of these targets (see Section 5.4). Moreover, sustainability publications outline specific targets for carbon intensity reductions (see Section 4.3.2), but interviews revealed concerns about data accuracy and availability (see Section 5.3.3 & 5.3.4). The analysis of sustainability publications confirmed an interviewee's assertion that CO<sub>2</sub> data reported by airlines are not comparable due to the lack of a standard calculation method, resulting in varied approaches (SH2, 10). This challenge arose during the analysis as airlines used different, non-interchangeable metrics to report their carbon intensity, making comparison difficult (see Section 4.3.2).

Implementing sustainable practices is complicated by the vast amount of information and specialized expertise required (SH1, 52; SH2, 31). This supports Berns et al.'s (2009) claim that a lack of sustainability-related information is highly challenging. This situation underscores the need for ongoing research and collaboration to keep up with advancements in climate science, which was also named crucial in the interviews (AR1, 24; AR5, 32, 40). As the literature review indicates, the complexity of sustainability transformations remains a major challenge for organizations (Santamarta et al., 2022), emphasizing the need for continuous learning and expert involvement.

*P10: The complexity of sustainability transformations requires effective knowledge management, research, expertise, and collaboration.*

**Legal Compliance** can complicate sustainability efforts for airlines. The evolving legal landscape requires airlines to adapt and meet new standards (see Table 3). For instance, the EU Blending mandate sets clear guidelines for using SAF (see Figure 4). While regulations help integrate sustainability (Davis et al., 2020; Engert et al., 2016), interviews revealed that the stringent regulatory environment demands significant efforts, potentially slowing innovation and adding operational burdens (e.g., AR6, 28; SH3.2, 125). This aligns with research suggesting legal compliance can hinder progress due to its complexity (Peters & Simaens, 2020). Thus, while legal compliance provides essential guidance, it also introduces operational challenges and burdens.

*P11: Legal compliance can slow down sustainability efforts by complicating operational adjustments and potentially hindering innovation.*

**Technology Accessibility** is a considerable obstacle to adopting decarbonization technologies in the airline industry. Interviews and literature indicate that the industry's transformation will take longer due to its complexity and reliance on developing technologies (see Afonso et al., 2023; AR6, 32). For instance, as confirmed by interviews and previous literature, the production and scalability of SAF are constrained by high costs and insufficient infrastructure (see IATA, 2023d). While sustainability publications outline specific targets for SAF use (see Section 4.4.2), interviews revealed concerns about the availability (see Section 5.3.3 & 5.3.4). Similarly, alternative propulsion technologies like electric aircraft have not yet reached the required maturity (Schäfer et al., 2018), which was confirmed by interviewees (AR3, 12, 16; SH4.1, 35). Interviews highlighted that superior technology is often either unaffordable or not ready for implementation (AR3, 40). This underscores the need for ongoing innovation and investment in developing viable, cost-effective technologies to support the industry's decarbonization efforts. While many of the challenges align with findings in previous management literature, the challenge of technology accessibility and development to this extent seems unique to the airline industry. This supports Afonso et al.'s (2023) thesis that there is no straightforward solution to sustainability in aviation.

*P12: Technological hurdles are barriers to the adoption of decarbonization technologies in the airline industry, requiring continued innovation and investment.*

**Financial Constraints** significantly hinder sustainability efforts in the airline industry, often accompanying technological challenges. Sustainability publications show that some airlines are investing significantly in sustainability measures (see Section 4.4), such as IAG's \$1 billion investment in SAF or Ryanair's \$62 billion investment towards greener aircraft (IAG, 2021; Ryanair, n.d.-a). However, the interviews revealed that not all airlines can afford these investments, and accessibility to technology is limited (see Section 5.3.3 & 5.3.4). The high costs associated with sustainable technologies present major financial challenges, especially for smaller or less profitable airlines struggling to balance sustainability with financial viability (AR1, 2; AR6, 18; SH2, 31). This finding aligns with those of Santamarta et al. (2022) and Engert et al. (2016), which highlight resource allocation and funding as significant obstacles to sustainability transformations, particularly in the early stages when investment in, among other things, technology is required.

While achieving net zero carbon emissions with current fleets and technologies is deemed unfeasible (The Economist, 2023), interviews revealed that not all airlines have the financial resources required for fleet renewal and innovations (e.g., AR1, 2; AR2, 21), making decarbonization a significant challenge. Additionally, airlines face the challenge of balancing growth and sustainability, as these goals often conflict (see AR1, 40; AR5, 40; AR6, 8). As Chapman (2007) argues, technological advancements alone cannot sufficiently mitigate projected industry growth and will require further regulations. This underscores the need for financial planning and policy support to advance sustainability in the airline industry.

*P13: Financial constraints and the high cost of sustainable technologies can hinder sustainability efforts, particularly in balancing profitability with environmental goals.*

**Communication and Transparency** challenges can impede sustainability efforts internally and externally. Interviews revealed the necessity of educating employees on the importance of sustainability (AR1, 18; AR2, 3, 15; AR6, 14) and providing stakeholders with transparent and credible information (AR1, 16; AR5, 2, 32; AR6, 28). Greenwashing concerns frequently arise in discussions of airline sustainability (Dichter et al., 2020), complicating communication efforts and undermining trust (e.g., AR1, 14; AR5, 32). The potential for accusations of greenwashing compels airlines to balance transparency and credibility. As proposed by Engert et al. (2016), the implementation of a sustainability strategy may initially result in an increased risk for the organization. Some airlines may choose to avoid these risks by maintaining silence rather than engaging in communication (see AR1, 16, 38). However, Engert et al. (2016) also argue that the transparent communication of sustainability issues can enhance manageability and facilitate the achievement of targets.

*P14: Effective communication of sustainability efforts can be challenging as transparency must be balanced with the risk of greenwashing.*

**Managerial Capacity** issues can hinder the sustainability efforts of airlines in different ways. Some airlines lack dedicated sustainability teams, relying instead on non-specialized personnel or small teams, which hinders effective implementation (see AR3, 40; SH2, 31). A shortage of skilled personnel, as Rafi (2022) noted, is a significant barrier echoed in interviews (e.g., AR1, 24, 26; AR2, 1; AR3, 40). Internal resistance and fear of negative publicity further slow progress (AR1, 16, 38). Despite the growing importance of sustainability, leadership does not always prioritize it over economic concerns by leadership (see AR1, 10; AR2, 17; AR4.2, 24). These findings support Rafi's (2022) propositions that common issues include a lack of board

commitment and limited authority for sustainability teams to execute projects independently. However, Teh and Corbitt (2015) found that aligning sustainability objectives with core business objectives can achieve both environmental and economic benefits. Baumgartner and Korhonen (2010) suggest that strategic integration requires a unified approach with everyone working towards the same goal, preventing conflicts or divergent efforts. These findings indicate that the neglect of sustainability objectives compared to business objectives by leadership, as reported by some airlines, can hinder effective implementation and undermine potential benefits.

*P15: Managerial capacity constraints, such as lack of expertise and authority, can hinder effective sustainability implementation.*

Based on these insights, the third research question ‘*What are challenges associated with the integration of sustainability into airlines’ business strategy?*’ can be answered by identifying several key challenges. The complexity of sustainability transformations requires extensive knowledge management, ongoing research, and specialized expertise. Evolving regulations create operational burdens and can hinder innovation, adding to the complexity of sustainability efforts. Technological hurdles, such as underdeveloped infrastructures, hinder progress and require continuous research and investment. Financial constraints make balancing sustainability initiatives with economic viability difficult. Effective communication is crucial but challenging, as airlines must balance transparency with the risk of greenwashing. Finally, managerial capacity, including insufficient expertise, small teams, and lack of board commitment, can hinder effective implementation.

#### **6.4. Future Outlook and Summary of Findings**

While the European passenger airline industry is committed to achieving net zero emissions by 2050 (see Section 2.2.2 and 4.4), the path to this goal is complex and challenging. The industry is projected to grow in the coming decades (ATAG, 2021), as confirmed by current passenger number trends (see Figure 5). Airline representatives confirmed growth ambitions and the difficulty of balancing them with environmental goals (AR2, 17; AR5, 40; AR6, 8). While airlines publish extensive sustainability plans (see Section 4), interviews revealed that they face various challenges, making the feasibility of targets uncertain (see Section 5.3). As Table 8 shows, airline representatives are highly uncertain about the feasibility of targets and the development of the industry. However, despite these challenges and doubts, there is a collective determination to progress, driven by the urgency of reducing emissions and the need for

sustained effort (see Section 2.2.2 & 5.4). Interviews and sustainability publications indicate that collective efforts across organizations and the industry and continued research and innovation are essential to overcome challenges and advance sustainability (see Section 4.4& 5.1.5), which is confirmed by literature (Dichter et al., 2020).

The findings provide an understanding of the dynamics behind the strategic shift, showing that integration elements, drivers, and challenges are highly interconnected in an airline's efforts to navigate sustainability. Figure 11 illustrates the interplay between these elements, drawing inspiration from Engert et al.'s (2016) depiction of issues in integrating corporate sustainability into strategic management (see Figure 1).

*Sustainability Integration* highlights the key elements identified for embedding sustainability into airline strategy. *Internal and External Driving Forces* represent the various pressures and influences driving airlines towards adopting sustainability practices. *Challenges* outline the hindering factors airlines may face in their sustainability journey. The graphic shows how these elements are interconnected.

Internal and external driving forces push airlines to embed sustainability into their strategies. The effectiveness of this integration can influence these drivers. For instance, a low level of integration might increase external pressures, while successful integration can reinforce and satisfy these drivers. Challenges can impede the integration of sustainability, and efforts to incorporate sustainability can impact the nature of these challenges. For example, a weak governance structure can lead to managerial capacity issues.

There is a dynamic interplay between drivers and challenges. Drivers can create challenges, and challenges can reinforce certain driving forces. For instance, legal pressures can lead to legal compliance challenges, while financial constraints and technology accessibility issues can drive policy support.

Overall, the process of integrating sustainability into airlines' strategies is complex, with a range of interrelated factors determining its success.

**Figure 11: Findings: Integration of Sustainability into Airline Strategy**



*Note. Own figure based on interview findings adapted from “Exploring the integration of corporate sustainability into strategic management: A literature review.” by Engert, S., Rauter, R., & Baumgartner, R. J., 2016, Journal of Cleaner Production, 112, p. 2838 (<https://doi.org/10.1016/j.jclepro.2015.08.031>)*

**7. Conclusion**

*Airlines are holistically integrating sustainability into business strategy, driven by external pressures, including legislation, competition, and market demands, alongside internal motivators and incentives. The effectiveness and feasibility of efforts remain uncertain due to the industry’s projected growth and managerial, financial, informational, communication, and technological barriers.*

The European passenger airline industry finds itself at a pivotal transition point, confronted with the challenge of pursuing growth while committing to sustainability. Integrating sustainability into core strategies and operations is now a necessity, demanding immediate action. This integration involves a holistic governance approach, adjusting strategic frameworks, engaging in collaborative efforts, and adopting a combination of measures and tools, including SAF, fleet renewal, operational efficiency, and carbon offsetting. A combination of legal and competitive pressure, economic incentives, investor expectations, consumer behavior, leadership commitment, and employee engagement primarily drives this process. Despite efforts, the path to net zero emissions is fraught with uncertainties and barriers. Airlines

must navigate challenges such as knowledge management, legal compliance, technology accessibility, communication and transparency, and managerial capacity.

Managing these challenges and balancing growth with environmental responsibility presents an unpredictable future for the airline industry, potentially altering market dynamics and business models. While an intrinsic commitment to sustainability is crucial, legal pressure and resulting market dynamics will play a decisive role in ensuring that airlines implement the necessary changes. Policy frameworks will be a driving force ensuring that sustainability becomes a lasting transformation rather than a passing trend. However, achieving net zero emissions requires immediate and decisive action by airlines and industry stakeholders and will have to continue beyond 2050. Resilience and success will depend on continuous innovation, collaboration, and an overarching commitment to sustainability. As airlines navigate the strategic shift towards environmental friendliness, they face a long and challenging road ahead.

### **7.1. Managerial Implications**

*The findings of the thesis provide implications for managers in airlines that are dealing with the integration of sustainability into strategy.*

Integrating sustainability into airline strategy and operations should not be just a regulatory requirement, but a strategic imperative. To navigate the complex shift, airlines must adopt a comprehensive and holistic approach. This involves transitioning from treating sustainability as a separate initiative to a central strategic factor and shared responsibility in the organization.

Leadership must drive efforts by incorporating sustainability into decision-making and strategic planning, ensuring it remains relevant to business priorities. For effective realization of sustainability, it should not compete against business objectives but be aligned with them. To create impact, building managerial capacity is crucial; sustainability managers need authority and expertise to oversee initiatives effectively. Centralized expertise should be combined with widespread participation and two-way communication across the organization, ensuring that sustainability is integrated into all areas and knowledge is shared.

While stakeholder expectations and other driving forces of the transformation can be accompanied by high pressure, they should be welcomed. Regulatory pressures should not be viewed as a burden but as an opportunity to drive uniform and long-term progress across the industry. Regulations and policy support can provide the necessary framework and financial assistance for airlines to invest in initiatives and technologies. Understanding market changes and actively participating in industry developments can allow airlines to leverage sustainability

for better positioning and competitiveness. As sustainability becomes a differentiator, it can open up new business opportunities, transforming challenges into opportunities for innovation and growth.

Investments in new technologies are likely unavoidable but can offer returns in form of operational efficiency and environmental impact. Airlines should adopt a multichannel approach, integrating a combination of measures and allocating sufficient resources towards these investments. Early investment costs can often be outweighed by later cost savings related to policies and operational efficiencies. While gaining a competitive edge is tempting, reaching sustainability in aviation should be viewed as a collective endeavor. Collaboration with other airlines, regulatory bodies, and stakeholders is vital for sharing knowledge, resources, and best practices. Industry-wide initiatives can drive collective progress and address shared challenges.

Overall, integrating sustainability into airline strategy and operations requires a comprehensive and strategic approach, substantial investment, and collaborative efforts across the industry. As challenges such as limited knowledge and availability of technology remain, efforts should be directed towards continuous research and innovation. While roadmaps target 2050 as overarching milestone, ongoing efforts will be necessary to counterbalance the growth of the airline industry. By treating sustainability as a strategic variable, airlines can mitigate their environmental impact while gaining a competitive advantage in a rapidly evolving market. As the market evolves, airlines should be prepared to adapt their strategies and business models to contribute to a more sustainable future of the industry.

## **7.2. Limitations and Future Research**

It is important to acknowledge the limitations of this thesis. Firstly, as the analysis showed, the airline industry is dynamic, highly regulated, and competitive, implying that the landscape of sustainability is constantly evolving. Fast-paced developments and complexities may exceed the scope of this research, potentially leading to gaps in capturing recent advancements or shifts in sustainability strategies. Secondly, the thesis focuses on European passenger airlines, which may limit the applicability of the findings to the global airline industry, as different regions operate under varying regulatory and market conditions. Furthermore, while data quality was ensured, the analysis may be limited by disparities in airline reporting and restricted access to proprietary data. Despite assurances of confidentiality, interviewees might not have been fully open about their efforts and progress due to concerns about greenwashing allegations.

Additionally, the scope of the interviews included stakeholder groups from different backgrounds, such as SAF and electric propulsion, who may be biased in certain respects. The analysis of sustainability publications of airlines also bears the risks of bias as companies are likely to present themselves positively in their own publications. Finally, as a business student, the depth of pre-existing knowledge of the specific operational intricacies of the airline industry is limited. This may affect the ability to fully grasp and interpret complex technical aspects of airline operations and sustainability practices.

Further research should explore the integration of sustainability into strategy in airlines across different geographical contexts, as the industry dynamics and policy landscapes, which are identified as key drivers, vary. Examining specific organizations such as governance, goal-setting, and strategic planning can provide deeper insights into sustainability integration. Additionally, comparing how different airline business models - such as full-service versus low-cost carriers or small individual airlines versus large airline groups - affect sustainability integration can enhance understanding of driving forces and challenges. Finally, it will be interesting to revisit the research questions over time to assess progress and examine the ongoing interplay between growth and decarbonization. This continuous evaluation will offer insights into the evolution of sustainability integration and related market dynamics in the industry.

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## **Appendices**

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**List of Appendices**

**Appendix A: Airline Sample..... XXII**

**Appendix B: Mayring Inductive Step Model.....XXIII**

**Appendix C: Report Analysis Categories.....XXIV**

**Appendix D: Guiding Interview Questions.....XXV**

Airline Representatives ..... XXV

Stakeholder Group 1: Airport and Travel Agency ..... XXV

Stakeholder Group 2: Sustainable Solutions for Aviation ..... XXV

**Appendix E: Qualitative Interview Analysis Codebook ..... XXVI**

**Appendix F: Coded Interview Segments..... XXVII**

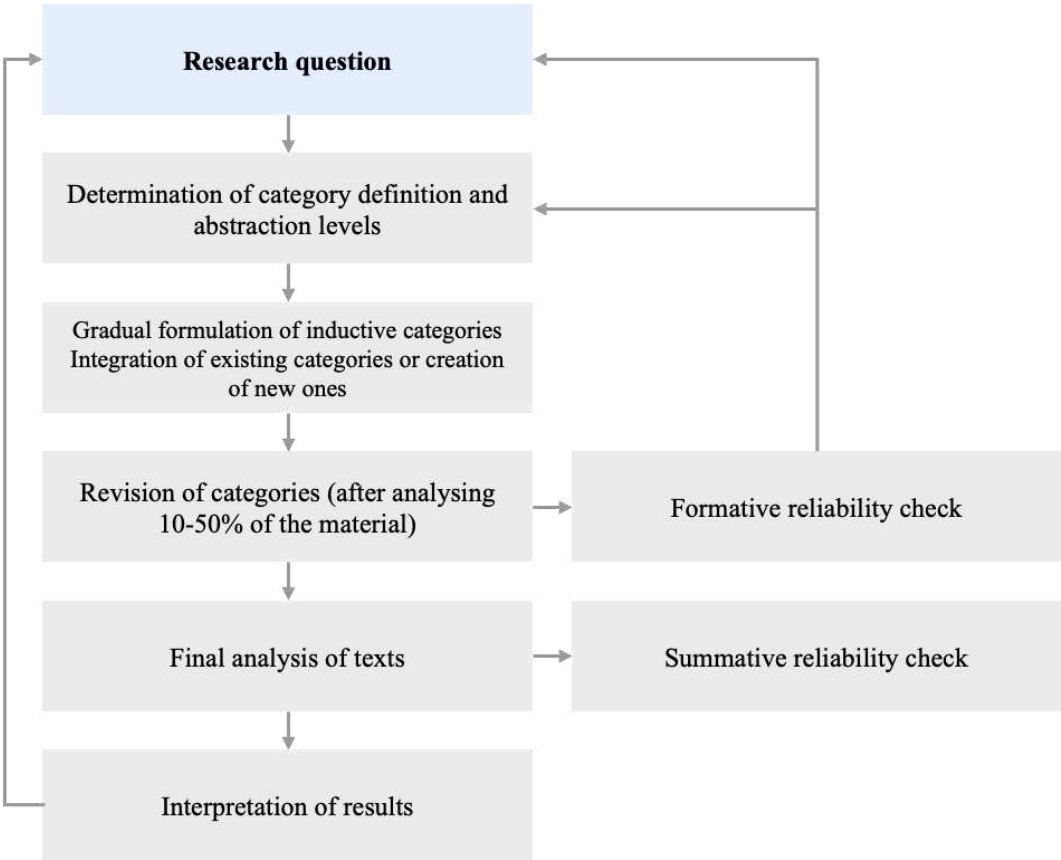
**Appendix G: Overview CDP Rating and Sustainability Governance .....L**

**Appendix H: Overview of SAF Use, Targets, and Partnerships ..... LI**

## Appendix A: Airline Sample

Airline	Headquarters	Passenger Airline Subsidiaries
<b>Ryanair Group</b>	Dublin, Ireland	Ryanair Ryanair UK Buzz, Lauda Malta Air
<b>Lufthansa Group</b>	Frankfurt, Germany	Lufthansa Airlines SWISS Austrian Airlines Eurowings Brussels Airlines Lufthansa CityLine Lufthansa City Airlines Edelweiss Air Discover Airlines SunExpress (joint venture with Turkish Airlines)
<b>International Airlines Group (IAG)</b>	London, UK	British Airways Iberia Vueling Aer Lingus LEVEL
<b>Air France-KLM Group</b>	Paris, France Amsterdam, Netherlands	Air France HOP! KLM KLM Cityhopper Martinair Transavia France Transavia Netherlands
<b>Turkish Airlines</b>	Istanbul, Turkey	Turkish Airlines SunExpress (joint venture with Lufthansa) Air Albania
<b>easyJet</b>	Luton, UK	easyJet UK easyJet Europe easyJet Switzerland
<b>Wizz Air Group</b>	Budapest, Hungary	Wizz Air Hungary Wizz Air UK Wizz Air Malta Wizz Air Abu Dhabi
<b>Aeroflot Group</b>	Moscow, Russia	Aeroflot - Russian Airlines Rossiya Airlines Pobeda
<b>Pegasus Airlines</b>	Istanbul, Turkey	Pegasus
<b>SAS Scandinavian Airlines</b>	Stockholm, Sweden	Scandinavian Airlines SAS Connect SAS Link
<b>Norwegian Air Shuttle</b>	Fornebu, Norway	Norwegian Air Shuttle ASA Norwegian Air Norway AS Norwegian Air Sweden AOC Norwegian Air Shuttle AOC Widerøe

# Appendix B: Mayring Inductive Step Model



*Note. Own representation adapted from Mayring, 2000, cited in "Qualitative Content Analysis" by Mayring, P., 2000, p. 4 (<https://doi.org/10.17169/fqs-1.2.1089>)*

## Appendix C: Report Analysis Categories

Category	Subcategory	Additional information	
<b>General Information</b>	Passenger Numbers		
	Fleet	Fleet Size Average Fleet Age Expansion Plans (Orderbook)	
<b>Carbon Emissions</b>	Carbon Intensity		
	Total Emissions	Scope 1 Scope 2 Scope 3	
	Emissions Reduction Targets		
<b>Key Sustainability Measures and Tools</b>	SAF	Current Usage Usage Targets Offtake Agreements Investments Partnerships	
	Fleet Renewal	Orderbook Investments	
	Carbon Offset	Types of Offset Programs Supported Projects	
	Operational Efficiency	Fuel Reduction Measures Fuel Reduction Achievements Ground Electrification Innovative Technologies Other	
	Other		
	<b>Technology and Innovation</b>	Investments and Participation in Projects	
	<b>Investments and Partnerships</b>	Own Research & Development Special Achievements	
<b>Governance</b>	Board-Level Oversight		
	Responsible Persons		
	Management Incentives		

## Appendix D: Guiding Interview Questions

### Airline Representatives

<b>Sustainability Strategy and Long-Term Vision</b>
What are currently the cornerstones and main targets of your sustainability strategy?
What internal changes or developments have been crucial in pursuing these sustainability targets?
Based on the current status, do you believe these targets are realistic?
<b>Integration and Prioritization of Sustainability</b>
How do you integrate sustainability goals into long-term strategic planning and how do these goals influence decision-making?
How do you prioritize sustainability initiatives compared to other strategic goals? Have there been changes in prioritization over time?
Who is primarily involved in the planning and implementation?
<b>Stakeholder Influence (Driving Forces)</b>
What factors are the drivers for these initiatives?
In what ways have stakeholder expectations influenced the evolution of your sustainability strategies?
How do you balance these expectations with operational realities and business objectives?
<b>Challenges</b>
What are the biggest challenges your airline faces in integrating and executing sustainability measures, if there are any?
<b>Future Outlook</b>
Looking ahead, how do you see the future of aviation and your airline develop in terms of sustainability? What major strategic changes do you expect?
Are there emerging technologies or practices you exploring to advance its sustainability further?

### Stakeholder Group 1: Airport and Travel Agency

<b>Sustainability Targets</b>
What role does sustainability play in your company?
Have you established your own sustainability goals?
Through your work with airlines, have you observed any significant changes in the sustainability strategies of airlines in recent years?
<b>Stakeholder Expectations and Requirements</b>
What sustainability-related expectations do you have from the airlines you work with?
What sustainability-related expectations do your stakeholders (e.g., clients, regulatory bodies, local communities) have from your company regarding aviation?
How do these expectations influence your collaboration with airlines?
<b>Collaboration</b>
Are there any specific joint initiatives or programs between your company and airlines aimed at sustainability?
Do you prioritize partnerships with airlines that demonstrate strong sustainability commitments?
Do you support airlines in their sustainability practices?
<b>Future Outlook</b>
What future technologies or innovations do you believe will have the most significant impact on the sustainability of aviation?
Looking ahead, what is your company's long-term vision for working with airlines to create a more sustainable aviation industry?

### Stakeholder Group 2: Sustainable Solutions for Aviation

<b>Background and Current State of the Technology</b>
Can you describe the current state of the technology in the aviation industry?
<b>Implications for Airlines</b>
From a strategic standpoint, how important is the adoption of the technology for airlines aiming to meet their sustainability goals?
How can airlines plan for the integration of the technology in their business?

Could you outline potential opportunities this transition may open up (e.g., environmental impact, cost savings)?

### Challenges in Adoption

What are the main challenges airlines might face when integrating the technology into their strategic planning and operations?

Which technical challenges are associated with the technology, if there are any?

Which economic challenges associated with the technology, if there are any?

### Stakeholder Influence

How do various stakeholders (governments, environmental groups, consumers) influence the development and adoption of the technology?

Looking ahead, what is your company's long-term vision for working with airlines to create a more sustainable aviation industry?

### Future Outlook and Feasibility

How do you see the role of the technology within the aviation industry developing in the future?

What advice would you give to European airlines that are currently considering integrating the technology into their operations?

## Appendix E: Qualitative Interview Analysis Codebook

Category	Subcategory	Additional information
<b>Strategy Integration</b>	Business Strategy Integration	
	Prioritization	
	Goals (Pathway)	
	Strategic Planning	
	Governance	
	Collaboration	<i>External Collaboration</i> <i>Internal Collaboration</i>
	Sustainability Measures and Tools	<i>SAF</i> <i>Fleet Renewal</i> <i>Carbon Offset</i> <i>Operational Efficiency</i> <i>Other</i>
<b>Driver</b>	Legal Pressure	
	Competitive Pressure	
	Economic Incentives	
	External Stakeholder	<i>Investor</i> <i>Customer</i> <i>Other</i>
	Internal Stakeholder	<i>Parent Company</i> <i>Employees</i>
<b>Challenges</b>	Communication and Transparency	
	Financial Constraints	
	Technology Accessibility	
	Legal Compliance	
	Knowledge Management	
	Managerial Capacity	
<b>Future Outlook</b>	General	
	Technology Outlook	
	Industry Changes	

## Appendix F: Coded Interview Segments

Int.	Pos.	Sub-category	Additional Information	Text Segment
<b>Category: Strategy Integration</b>				
<b>Description:</b> Factors that describe how sustainability gets integrated into the airlines' strategies.				
AR2	1	Business Strategy Integration		From a strategic point of view, of course, you also have to look a bit at where the journey is going and how you can bundle all the topics together into a corporate strategy, which didn't exist before.
AR4.12		Business Strategy Integration		Only since a couple of years, sustainability is really part of the central strategy, business strategy
AR4.12		Business Strategy Integration		During COVID, the company reframed its future strategy for the coming, say 10 years. And we really did our best to integrate sustainability as much as possible as a core component of this strategy. That means that before that we had a separate sustainability strategy, which was kind of hosted by the sustainability team, our team, but it was always next to all the other strategies, business plans that were there. So currently it's part of the central strategy, which means that on an annual basis, we also steer towards sustainability ambitions.
AR5	4	Business Strategy Integration		So, in the last year, we started the definition of our sustainability strategy that uses our material topics as a basis.
AR5	6	Business Strategy Integration		We had some goals in the past, but I don't think it was a strategy. It was just some generic goals that we have that we track every year to see if we are accomplished or not. But it was not a clear sustainability strategy. So, this is the first time.
AR3	24	Business Strategy Integration		Our sustainability strategy like it's been ... and I'm like as in we developed about two and a half years ago.
AR6	32	Business Strategy Integration		Right now, we're kind of still very much in development of the strategy and proving the technology and getting confidence in making the investment cases that we do today.
AR2	1	Governance		For us, this is a position that was created about two years ago at [Airline 2]. Because the topic of sustainability was dealt with a bit more in the departments
AR2	1	Governance		Our finance team, for example, has one or two colleagues who are familiar with the topic and then do what needs to be done.
AR2	1	Governance		To have someone who has a bit of an overview on the one hand and on the other hand also pulls the strings together
AR2	1	Governance		And yes, we saw the need to have someone who knows the company well and who can bring the topics together a bit and make sure that it fits in with the corporate strategy.
AR5	2	Governance		We are still defining our sustainability governance and what ... how we can manage it inside.
AR2	5	Governance		But the measures that we take, we can fall back on the parent companies if we need to. But we don't have to, let's put it that way.
AR6	6	Governance		We take strategic decisions on sustainability at group level and then disclose those and sort of operate those through not just our airline businesses, but also, we have non-airline businesses as well.
AR6	10	Governance		There's a lot of governance that we've now developed following the launch of this strategy in [Airline Group 6] and in the airlines as well and across the business, to be fair. So, we have a sustainability network ... across the group. More than 70 people across the whole company work on sustainability, covering both emissions but also social and governance issues as well. In [Airline Group 6], we have a team of roughly about seven or so, so about 10% of that team is based in [Airline Group 6]. And we have two governance strands that sit within [Airline Group 6]. So, we have one

		that focuses on sustainability as a whole. And we call that our sustainability governance kind of forum. ... We have monthly cadence calls with all the sustainability professionals, we have a steering group for decision making, and then we have a structure that moves through our finance, our CFO effectively into the board. At the same time, because of the role that SAF plays, we have a separate SAF governance mechanism at the moment.	
AR6	10	Governance	So, we have a whole similar parallel process, a kind of operational officials kind of group, steering group. And then we obviously have accountability into the board. ... Within the board itself, we have what's called a safety environment and corporate responsibility sub-board committee. And that is designed to effectively be privy to the most senior decisions and actually take action on sustainability across the group.
AR6	10	Governance	Individually, the operating companies as well have their own ... sort of team structures. They have their own organograms effectively to manage sustainability issues. They also have management committee sort of governance that allows them to take particular sensitive sustainability issues to their own management committee. And then from there, one operating company, they can still manage that issue with a degree of autonomy rather than have to bring absolutely everything through the [Airline Group 6] sort of central structure in the short term.
AR4.1	12	Governance	So, we have a sustainability team at [Airline Group 4 Airline A], [Airline 4] and [Airline Group 4], and we all have a little bit of a different focus I would say because [Airline Group 4] has also more legal obligations, but also investor relations, for example. And we have our customers for as other stakeholders well. [Airline Group 4] is more like the holding level so there is like different focus at some subjects
AR4.2	13	Governance	For almost all of our departments, we have what we call so-called sustainability leads. You could say that's a program manager who is almost solely responsible.
AR4.2	13	Governance	It's another piece of the puzzle in the governance to ensure that there's action because there's someone who's specifically responsible for translating those annual goals into action
AR5	14	Governance	We are also defining our sustainability governance and then there we will have some forums and some committees and some teams that will do this question in particular.
AR6	14	Governance	We're the kind of responsible group effectively for setting the strategy and obviously adhering to our investor appetite pressure and obviously our science-based validation of that roadmap. Effectively, the operating companies are ... partly accountable and have kind of consultation rights on how you deliver that strategy. ... In terms of helping us set that strategy and they own their share of the strategy, but they don't necessarily operate on their own basis.
AR5	16	Governance	I don't think that there is a sustainability person in each department. But we all have an open channel. We talk about the different the different topics.
AR2	21	Governance	We are not usually the implementing department, but we are the ones who develop the ideas and try to define the measures, which are then usually implemented by other departments.
AR1	26	Governance	I therefore believe that this it is the exception rather than the rule [to have sustainability] in the strategy department, but I hope that this will change in the future.
AR3	26	Governance	There's the director of sustainability, the deputy director of sustainability, and then myself that kind of look at it on a day-to-day basis
AR3	26	Governance	Every month we also have a sustainability committee that meet to discuss different projects. That brings together all the airlines and the flight Ops, ground Ops, engineering, all those kinds of things. That's how we're going to keep on top of it all.
AR3	42	Governance	Sustainability includes the social aspect into it as well like how many people have experience of climate change, biodiversity, water, employee diversity training, other HR things, supply chain management procurement, governance, legal secretaries. So, there's no expertise like if you're talking

			to somebody who's an expert, I'm not an expert in most of those things I've just listed.
AR5	46	Governance	The sustainability team already exists for a couple of years in our company. But now I think it has more impact because it's reporting directly to a board member. So, prior to this we were in another area. But now, given the importance of the sustainability topic, we are connected and reporting directly to a board member to have a big impact on the company.
AR6	6	Collaboration <i>External</i>	We have investments in a company called [Company A] in the [Country A] and in the [Country B]. ... And we obviously recently announced our commitment with the company who will produce powder liquid SAF second generation SAF and that will obviously provide us with a huge volume of really high quality, good LCA SAF out for the longer term.
AR2	7	Collaboration <i>External</i>	We worked with a company that does a 1.5-degree compatibility calculation.
SH1	10	Collaboration <i>External</i>	I think it needs to be in every airline's strategy to have collaboration projects with aircraft manufacturers, energy companies, destinations, airports, those sort of collaborative projects where you actually work towards a business deal, that's the sort of end goal of it, but the way there is really collaboration and to create this common knowledge and trust in each other that this is something that we want to do together, it's going to benefit the region, it's going to benefit the airlines, it's going to benefit the airports.
SH4.1	29	Collaboration <i>External</i>	We help them [airlines] a lot in seeing how it can be displayed. We also help them a lot in workshops and discussion to see is this something the customers want? Is this something that we hear is a demand in the market? To kind of help them, to guide them a little bit on the way. But we don't have any joint in that way that we sit together, and we work at a product. We basically have to distribute what they come up with because they need to do what they feel.
AR1	30	Collaboration <i>External</i>	I think in [Airline Group 1] it's not quite clear where you get this knowledge from. And then you buy it from [Consultancy A].
SH2	31	Collaboration <i>External</i>	What we do is a range of different sort of SAF readiness workshops and interactions with our member airlines.
AR1	32	Collaboration <i>External</i>	We have an external consultancy with us for the first time this year, but in [Airline Group 1] we are constantly, i.e. we regularly sit on calls and new people are involved from [Consultancy A], [Consultancy B], [Consultancy C], the usual suspects.
SH3.1	40	Collaboration <i>External</i>	We have very close communication and cooperation with the carriers or with those operating at the airport.
SH3.2	111	Collaboration <i>External</i>	Of course, it's a connection since we need to have the infrastructure and everything in order, but since we are not working closely together, it's not that easy ...
AR5	4	Collaboration <i>Internal</i>	So, I think we did three workshops and involved more than 50 people from all the companies. So, people from security, people from compliance, people from the customer, from human resources, et cetera. So, by inviting those people we were able to, within each material topic, to identify what was their perspective on sustainability, and then what they think should be the priority topics.
AR6	10	Collaboration <i>Internal</i>	We have a sustainability network, we call it, across the group. ... Not only do sustainability professionals kind of come and join particular calls. The idea of steering groups is so that we can bring in broader parts of the business. So that we can provide input into ... our business planning process, our strategic modelling, our financial accounting, our reporting structure. All of that covers sustainability within those groups
AR2	11	Collaboration <i>Internal</i>	[Airline Group A] launched this [Innovation] about a year or a year and a half ago, I think it was. This [Innovation] is designed to make the aircraft fly more efficiently. Of course, we are also in contact with the parent company and are trying to understand whether this could be a possibility for us in the future.

AR4.1	12	Collaboration	<i>Internal</i>	We are only a central team in that sense with expertise on sustainability aiming to indeed embed sustainability in the organization we support them also with knowledge.
AR6	14	Collaboration	<i>Internal</i>	They do have the ability to set some of their own initiatives so they can work with us to set specific initiatives that are important to their own operations.
AR6	14	Collaboration	<i>Internal</i>	And in scenarios where that happens, what we do is we tend to find that that's actually a really successful measure, we might decide to look at, you know, sharing that understanding or that kind of experience with the other operating companies in the group. And of course, then benefiting from being able to roll that out on a larger scale across the group as a whole.
AR6	18	Collaboration	<i>Internal</i>	We have a strategy team who also report through our finance team and we kind of work collectively with or collaboratively with them.
AR1	28	Collaboration	<i>Internal</i>	In other words, he [colleague] comes from the technical side and can of course explain things in a completely different way. So, if I'm on a call with him and don't understand it, he can explain to me why the weight distribution makes more sense this way or that and what influence it has. That's fantastic.
AR3	46	Collaboration	<i>Internal</i>	It's sustainability, it belongs in everybody's job. It can't sit in just one person's job because if I win the lotto and leave tomorrow what happens? Whereas there's a gatekeeper approach with a lot of sustainability experts of kind of going oh if I don't do it that means it's not done right. And you're just like well no it's just done differently.
AR5	48	Collaboration	<i>Internal</i>	We report to the board member and so we have different information that can be passed through the board member to another department and the other way around, the other departments can pass this information to the board members to ours, so that helps us communicate within each other.
AR1	2	Goals		For us as part of [Airline Group 1], the [Airline Group 1] Group target is of course one that we also have a very significant influence on and, in the best case, help to achieve.
AR1	2	Goals		Of course, the fact that the Group target is counted against each other across the Group at the end gives us a bit of a chance, possibly if others overperform, that we can get away with underperformance without it happening anywhere. It is interpreted negatively. But that is explicitly not the aim.
AR1	2	Goals		Accordingly, these target corridors also apply to us for 2030 and 2050 and we have also decided that we will achieve them.
AR3	2	Goals		So, our real strategy is based, we call it a [Sustainability Strategy]. So, it's to get to net zero carbon emissions by 2050.
AR5	4	Goals		Then we wanted to define goals and KPIs. So, okay, we have now the topics, but what we want to achieve and are we going to measure?
SH2	4	Goals		So obviously 2021 was the big year where the International Air Transport Association in collaboration with its 300 odd member airlines, as well as the OEMs, the equipment manufacturers, the engine manufacturers, a lot of specialist consultants, they delivered the net zero 2050 goal.
AR6	6	Goals		We were one of the first airline groups to come up with a sustainability strategy and pledge to net zero emissions by 2050.
AR6	6	Goals		The short term again set by group level is very close to us now in 2025. We have two key targets in 2025 we're delivering. Specifically on the emission side we have a 10 reduction in our carbon supersede that, but it would be effectively representing a reduction of 11% on our 2019 level, which is where we set our baseline for our strategy
AR6	6	Goals		The other 2025 target I should say, which we can talk about maybe separately later, is on waste.
AR6	6	Goals		We have a 20% target to reduce our net CO2 compared to 2019 levels.
AR6	6	Goals		Obviously, the big one is getting to net zero.
AR4.1	12	Goals		I would say we're not there yet, but I think we at least managed to set the basis there and for now it's also working towards how it would evolve in the future

AR4.29	Goals	The big strategic goals are the same.
AR2 21	Goals	We probably wouldn't be able to set any reliable destinations because we would have to or want to refuel it in the [Country], largely because the planes take off from there.
AR2 23	Goals	And then we are simply of the opinion that if we set ourselves these goals and work out these targets, then we want to do so on the basis that we know we can meet them.
AR2 23	Goals	And because ...we are only a small team, we can't spend all our time thinking about ... what medium-term goals might be, but we simply try to implement them directly.
AR5 32	Goals	We need to do research first and try to have a clear goal that we know that we can maybe achieve. Maybe we are not 100% sure, but we always try to work to achieve that.
AR2 1	Prioritization	And then, about two years ago, people said, "Well, the topic is becoming more and more important" ... and, above all, a lot is developing.
AR6 8	Prioritization	I don't think any business would want to say that its plan to 2050 is to reduce what it does. It will want to grow what it does and continue to sell more product or provide more services like we are in our sector but of course, doing so in a sustainable way
AR1 10	Prioritization	We often have a situation where, from an ecological perspective, I have to say, "No, that's the wrong decision you're making right now". And the company has said, "We don't care at all, we're doing it because it has competitive advantages, because it looks better, because it goes down well with the customer". And then we still tend to follow the group's line. But that is also changing more and more within the group.
AR3 10	Prioritization	So maybe since I joined, we've been speaking about it much more getting kind of much more confident around what we do and all this.
AR3 12	Prioritization	Over the last few years, even just since I joined, noticed just so much more an infrastructure around the whole thing that has been built or been built further that will allow us to get there.
AR5 14	Prioritization	We will define how is sustainability integrated in their areas, how we should prioritize. So, I think it's not something we do now, but it's something that we are working on to do in the future.
AR3 16	Prioritization	We're willing to say we're willing to change our minds. So, if something changes tomorrow, absolutely, we'll be brilliant
AR2 17	Prioritization	And I think it will be immensely difficult for an airline to somehow prioritize the topic as high as it is with many other topics.
AR2 17	Prioritization	It will probably take a few more years before it has really climbed up the ladder a bit and has somehow become one of the top topics or top priorities. Because I don't think it's where it needs to be yet. So, I'm very sure.
AR5 20	Prioritization	They saw sustainability as one department, but now they are starting to look at sustainability as a priority within the company
AR5 20	Prioritization	So, every project they do, every supplier they choose, they want that autonomy. They do that without asking us first, "Okay, is this a more sustainable product?". No, they already are going to look for sustainable products.
AR5 20	Prioritization	So, I think the sustainability is raising awareness within the company, so the people are more aware of their impact, and I think that is going to be integrated in the daily activities of each one of them.
AR4.224	Prioritization	We are also in a transition as a company. So yes, sustainability is now part of the strategy, but is it fully embedded in all decision-making or let's say the top of minds of the policy or decision makers within our company? No.
AR5 40	Prioritization	At the same time, we don't want to stop having another sustainability initiatives. So, we need to have these two things at the same time.
SH2 49	Prioritization	We have to be open-minded to change.
AR4.12	Strategic Planning	So currently it's part of the central strategy, which means that on an annual basis, we also steer towards sustainability ambitions. And looking forward, there is a few strategic projects in which sustainability and especially the decarbonization part is a big component of that. So that's been chosen as

			one of the 10 strategic programs, so to say, which means that it's on a regular basis also being evaluated. What is our progress on our goals? What are the projects that we need to execute to reach the targets? What's the status of these projects? We do not only do that for CO2, for decarbonization, since this year we also have a quarterly review on all our sustainability, major sustainability ambitions
AR5	4	Strategic Planning	“Okay, now we have established this goal and this indicator, but what initiatives you would like to have within the company to accomplish them?”. So, they presented as a list with everything, and we hope to have it in the future.
AR3	6	Strategic Planning	It [decarbonization] is a challenge, undoubtedly, but it is something we have modelled out that allows us to do it.
AR1	10	Strategic Planning	Ideally, the process is that we agree across the industry or at least across the Group that a certain topic or a certain decision should now be prioritized because we have come to the conclusion together that, okay, this is the right thing to do, or this is what we should do.
AR4.1	12	Strategic Planning	By steering now on a quarterly basis regarding progress on our targets also progress on the projects we are not the ones that are executing most of the projects
AR4.1	12	Strategic Planning	We want to have updates, or we want to aggregate information from the whole organization and therefore we request updates from our divisions so to say. And we bring it together and we can steer, or we can say, or compile are we on track on our general targets for the company.
AR6	18	Strategic Planning	And what we do is effectively we model sustainability cost. ... What is the cost of each of those wedges between now and 2050 on an annual basis? How do they change over time? How does the, you know, how do we expect the price evolution of, you know, some of the market prices for our fuel or carbon might change and how will that impact what our exposure to carbon costs will be in the long term? ... We include obviously sustainability within that financial accounting process. And that gets audited as part of our annual audit. So, we are always kind of maintaining a view on sustainability costs, or the costs of our investments in SAF, or our costs of investment in carbon removals or new aircraft and how that will impact our overall cost base in the long term.
AR2	19	Strategic Planning	And simply take the idea of sustainability into account a little and assess the topic from a sustainability perspective. ... And if I, as the owner, know that the sustainability officer or the commissioner or whoever is in which department will look over this paper and will also have to give feedback on the extent to which it meets the sustainability goals, then of course I, as the owner, also have to think about it. I have to deal with the issue. So, I simply have to think about it: does it have an impact on sustainability? Will it possibly cause more CO2 emissions or less? Does it contribute to our long-term goal, yes or no?
AR5	20	Strategic Planning	So, every project they do, every supplier they choose, they want that autonomy. They do that without asking us first, “Okay, is this a more sustainable product?”. No, they already are going to look for sustainable products.
AR2	21	Strategic Planning	But we always try to set ourselves a few goals, at least for a year, and say that these are topics that we want to start this year, but we also want to complete them in the year.
AR2	31	Strategic Planning	So, I think you can kind of look at that in 20, 24, 25, the next five years and then you have a pretty good feeling for what is likely to happen in the next five years. But I believe that this really is an issue that you have to look at again and again at regular intervals in terms of development and also see what is realistic and where you can get to.
AR6	32	Strategic Planning	Even once we get to 2050 ... there'll be a roadmap either after 2075 or 2100.
AR3	2	Sustainability Measures & Tools	<i>Carbon Offset</i> And then the final pillar, and it's the one that is the most frustrating, but we do believe, even as we currently stand, we will need to use some form of carbon marking mechanism to reduce our emissions fully to zero, so

			currently we think about 24% would have to be either offset through a means of removals or other offsetting projects. But that's going to be our last that's going to be our last approach we're trying to solve everything else and then that's just going to be dealing with the drags of it.
SH2	4	Sustainability Measures & Tools	<i>Carbon Offset</i>
			There's also going to be a role for high quality carbon offsets for any residual emissions that we are not able to solve with these other measures that I've just described.
AR6	6	Sustainability Measures & Tools	<i>Carbon Offset</i>
			The pledge is that we will be only using carbon removals in 2050 to cover our residual footprint. ... And then of course, where there are any emissions that are still uncovered in our operations by 2050 that we would need to cover ourselves on a voluntary basis, we may look at the full suite of removal technologies available, both nature based and tech carbon capture
AR1	18	Sustainability Measures & Tools	<i>Carbon Offset</i>
			And we won't be the only ones who suddenly realize in 2030 or 2050, oh shit, that's now. Now I must have reached my target. And then, of course, there will be a run on CO2 certificates, on SAF. And that's fine. It's better than nothing.
AR6	26	Sustainability Measures & Tools	<i>Carbon Offset</i>
			With all the pressure that's obviously currently on the carbon market space and obviously the fact that the reality even under CORSIA, is that there will be projects that fall foul of delivering what their stated objectives were. I think we have to kind of accept that as the basis. But the point, the critical point for policymakers is to make sure that there are mechanisms in place that protect airlines from being maybe unfairly blamed for acquiring the incorrect asset, if that was to be the case. And to ensure that there's some sort of mechanism that allows you to address that problem in an efficient transparent we
AR2	29	Sustainability Measures & Tools	<i>Carbon Offset</i>
			I believe that this can be an interim solution if you say you have no other option at the moment, but you can still do something good by investing in such projects and pushing ahead with expansion or development. ... For example, in 2050 we should rather be at a point where we say, "Hey, we have products here with which we can avoid it" and should not pull our heads out of the noose by going into such projects, for example, and saying that we are now compensating for everything that is good.
AR2	31	Sustainability Measures & Tools	<i>Carbon Offset</i>
			And then, of course, to push a few technologies even further, such as carbon capture or direct air capture, which is one of the many projects currently in the pipeline or under development. I think a lot will certainly happen in the next five to ten years.
AR3	36	Sustainability Measures & Tools	<i>Carbon Offset</i>
			2-3% [of customers offset voluntarily]
AR1	14	Sustainability Measures & Tools	<i>Carbon Offset</i>
			We have 45 percent of respondents who say they do not buy a CO2 certificate because they either do not believe in the certificate itself or do not believe that we can deliver it reliably.
AR3	4	Sustainability Measures & Tools	<i>Fleet renewal</i>
			We tend to have a relatively young fleet. ... Our average age of our aircrafts is about nine years, even though the average lifespan of a [Airplane Model], which we fly, is up to 25 years
AR6	6	Sustainability Measures & Tools	<i>Fleet renewal</i>
			We obviously have a slightly larger number of aircraft that we're expecting over the next five years now. So, we're actually now looking closer to 170, 180 aircraft to 2028
SH4.1	15	Sustainability Measures & Tools	<i>Fleet renewal</i>
			You know, they're all competing on who has the newest fleet. That's what ...that's the big thing.
AR6	20	Sustainability Measures & Tools	<i>Fleet renewal</i>
			Across all the airlines we have a whole fleet team dedicated to that process of fleet renewal that's probably less directly focused on our sustainability. We're not retiring aircraft necessarily for sustainability reasons alone, but we are getting the added value from retiring 747s and putting in newer aircraft with far more fuel efficient, far higher for the efficiency associated.
AR4.1	32	Sustainability Measures & Tools	<i>Fleet renewal</i>
			So that means that new fleet is also just reducing your fuel costs, your fuel bill. So, it's a financial and sustainable, from a sustainability perspective, and return on investment that you have.

AR1	2	Sustainability Measures & Tools	<i>Operational Efficiency</i> But then the efficiency measure goes again for that. So, if I have green procedures or more efficient approaches, then they are just as efficient on the 350 as they would have been on the 330. The fleet benefits from this, regardless of the constellation. That's why this is such a big push at the moment.
AR1	2	Sustainability Measures & Tools	<i>Operational Efficiency</i> [drag-reducing surface technology] for the 330.
AR1	2	Sustainability Measures & Tools	<i>Operational Efficiency</i> We can implement these Ops efficiency measures now; we can start them today. That is somehow the safest way.
AR1	4	Sustainability Measures & Tools	<i>Operational Efficiency</i> That's why we focus on small measures that are relatively inexpensive to implement in-house, such as Ops-Efficiency
AR3	4	Sustainability Measures & Tools	<i>Operational Efficiency</i> There's a couple of operational changes that have been needed that have led to us performing so well already. ... So, we've introduced continuous descent approaches, when at all possible, we've introduced a single engine taxiing when at all possible.
AR1	6	Sustainability Measures & Tools	<i>Operational Efficiency</i> So basically, the most urgent thing for us now is this whole issue of route planning and adapted route planning. In other words, you no longer plan a route once before departure, refuel accordingly and then you're off. Instead, you adjust the route during the journey in response to changes in the weather or something similar in order to make the whole thing more efficient. ... Have Wi-Fi on board. This means that in order to retrieve weather data, for example in a high quality, high frequency, the aircraft needs contact with the ground that goes beyond Arcas. ... Planning another Alternate airport. ... And that means we have to take less fuel with us.
AR2	7	Sustainability Measures & Tools	<i>Operational Efficiency</i> And of course, to understand the topic of efficiencies, "Okay, what can be done". But of course, you're also a bit ... tied to development steps, i.e. to what extent such efficiencies are possible, i.e. of course making airplanes fly more easily, there are always possibilities here and there. Or measures that can be implemented. But then you are also limited. So, an aircraft will always carry a certain weight around with it. Or you can also make various modifications to an aircraft to make it fly more efficiently and consume less kerosene.
AR2	9	Sustainability Measures & Tools	<i>Operational Efficiency</i> So, we can make our aircraft easier to fly. As I said, there are various parts in the cabin, for example, that are transported on every flight but that we don't need on every flight.
AR6	28	Sustainability Measures & Tools	<i>Operational Efficiency</i> We can obviously do things, for example, [Airline Group 6 Airline A] can do things within [Terminal], where it obviously has a majority of control and it can use kind of, it can obviously improve how it operates by putting, you know, aircraft on stand with, you know, renewable generation, et cetera, supporting it, et cetera, flying more point to point, that kind of stuff. ... Look at fuel, we use fuel planning tools that allow us to plan fuel more efficiently
AR6	6	Sustainability Measures & Tools	Effectively, four key pillars that we monitor
SH1	24	Sustainability Measures & Tools	I think everybody's looking for that silver bullet, that one thing that will make them sustainable. I don't think that's going to be the case in the future. I think it's going to be ...a combination of different things. ... It's probably going to be electric aviation, it's going to be hydrogen, it's going to be sustainable aviation fuels. I think there's going to be a combination of those three things.
AR6	26	Sustainability Measures & Tools	But the reality is that we still all agree that there's no single solution, there's no single bullet here. ... You need a combination of impacts to help, but all of them need huge amounts of capital.
AR3	2	Sustainability Measures & Tools	<i>Other</i> Third pillar is something outside our control. Unfortunately, it's around air traffic management reform. So, if you look at the way the planes fly, they often are not the most fuel efficient or carbon environmentally friendly

			<p>routes. And due to a number of issues, different routes need to be changed. If this was formally enacted, actually, the single European skies, it could save up to about 10% of carbon emissions, which could be quite considerable. But unfortunately, that's outside our control, but we're actively engaged on that.</p>
SH1	2	Sustainability <i>Other</i> Measures & Tools	<p>A lot of advancements are being done on the electric motor side, piggybacking a lot on the automotive industry where electric motors have been developed for a long time now. ... Motors are becoming lighter, more powerful, and easier to certify.</p>
SH2	4	Sustainability <i>Other</i> Measures & Tools	<p>The implication there is you can't electrify or intend in the next 20 to 30, let alone 50 years for a long-haul liquid hydrogen aircraft, not just from an operational perspective, but even from the infrastructure perspective as well.</p>
AR6	6	Sustainability <i>Other</i> Measures & Tools	<p>It not only is the kind of core measurement for the group's kind of success in the short term, but we have more than seven and a half thousand managers me included who have a proportion of our bonus, our annual incentive made up for the board and obviously across senior management in the group and that applies both within [Airline Group 6] but also its operating companies as well</p>
AR6	6	Sustainability <i>Other</i> Measures & Tools	<p>And we have a waste reduction plan, and we obviously have a zero waste by, or we have a zero, we have a five by five effectively.</p>
AR6	6	Sustainability <i>Other</i> Measures & Tools	<p>There's obviously a role for hydrogen that comes into our modelling.</p>
AR6	6	Sustainability <i>Other</i> Measures & Tools	<p>We have investments in a company called [Company A] in the [Country A] and in the [Country B], who are looking to develop the ... they've already got the first kind of flying high hydrogen electric kind of things.</p>
AR6	6	Sustainability <i>Other</i> Measures & Tools	<p>So, we're putting obviously a lot of investment as well at this stage in terms of helping scale that up. And of course, continuing to engage with the main aircraft manufacturers the Airbuses and the Boeings who obviously have their own programs.</p>
AR3	12	Sustainability <i>Other</i> Measures & Tools	<p>But then the thing that personally, the thing that excites me the most is the ...what's known as RFMBOs ... it's effectively capturing the carbon and generating sustainable aviation fuel from it, the power to liquid. And that excites me because it's actually solving the problem. So, while it's not reducing tailpipe emissions it's reducing the life cycle emissions.</p>
SH1	14	Sustainability <i>Other</i> Measures & Tools	<p>You have to do a lot of maintenance per aircraft kilometer flown on a fossil fueled engine. But on the electric engine side, you basically don't have to do any maintenance at all. So that's also a huge benefit. Our aim is to reduce the operational costs or the total cost of ownership for an electric aircraft significantly.</p>
AR3	16	Sustainability <i>Other</i> Measures & Tools	<p>We want it to succeed, we just don't think it will. ... right now, the structures aren't there. ... One is the technology itself. So currently the weight of batteries and the amount of lithium and cobalt that's needed to carry them, it's very, very difficult to do and arguably impossible. ... The second challenge is the infrastructure at the airports. The increase of electrification, of everything, that's going to be a huge challenge in itself. ... It's the safety aspect of it.</p>
AR5	28	Sustainability <i>Other</i> Measures & Tools	<p>I see in other airlines; they already do some testing about hydrogen and electric airplanes</p>
AR2	31	Sustainability <i>Other</i> Measures & Tools	<p>And also, the topic of hydrogen or electrified flying, i.e. with batteries, we already know today that this is ...Yes, battery-powered is also very difficult, so it's more like cab transport in my mind. And hydrogen is possible, but not for longer distances. And you also have to be honest when you think about how complex the entire infrastructure behind kerosene distribution to various airports is. This entire infrastructure would still have to be built for hydrogen.</p>

SH4.1	35	Sustainability <i>Other</i> Measures & Tools	So, we are in that project of, you know, having an electrified airline between [City C] and [City D]. ... It's going to be different because it's going to be a very small aircraft. It's most likely going to fly on very, very short distances, on very small airports. And it's going to take a long, long time to.
AR1	42	Sustainability <i>Other</i> Measures & Tools	I think it will be an issue. But it will be more of an issue outside Europe. ... That's why I believe that this whole issue of electric flying will be incredibly important, especially for such short distances. But I could imagine that people in [country] will say, "Hey, we have alternatives that are cheaper and have infrastructure that already exists", a.k.a. the railroads, not always the yellow of the egg either, but they do exist and accordingly the push for this topic will be greater in other countries.
SH1	44	Sustainability <i>Other</i> Measures & Tools	I think the important thing to stress, though, is that we want to do something now. And we cannot wait for hydrogen to be mature enough. We cannot wait for sustainable aviation fuel to be up and fully running in production replacing all the ... .We need to do something now and we can do that with batteries yeah
AR3	2	Sustainability <i>SAF</i> Measures & Tools	Probably the most impactful in the short to medium term is sustainable aviation fuel. Like every airline, we think this is the thing that's going to really help us over the next 10 to 20 years
SH2	4	Sustainability <i>SAF</i> Measures & Tools	SAF is going to do the heavy lifting
AR6	6	Sustainability <i>SAF</i> Measures & Tools	Then you obviously have sustainable aviation fuels that will make up a fairly similar amount of CO2 reduction, around 70% of fuel we expect will be SAF in our operations by 2050. ...But for the majority of our short-term focus is largely on the SAF world and getting SAF scaled up. ...We moved through a billion dollars in our investment in SAF to date
AR2	9	Sustainability <i>SAF</i> Measures & Tools	And I would say that the big problem that the industry still has at the moment is availability. There is very little available for what is needed. And secondly, of course, it's the price. And of course, we took a look at this and tried to understand how prices will develop in the future.
AR1	18	Sustainability <i>SAF</i> Measures & Tools	And we won't be the only ones who suddenly realize in 2030 or 2050, oh shit, that's now. Now I must have reached my target. And then, of course, there will be a run on CO2 certificates, on SAF.
AR6	20	Sustainability <i>SAF</i> Measures & Tools	So, for SAF it's all about making the case that SAF is the only, currently, is the only solution that's available to us, that we have the opportunity to kind of actually decarbonize our scope one and scope three theoretically emissions profiles in in kind of in-house. You know, we can actually put that that fuel in our aircraft and get the immediate benefit alongside obviously renewing our fleet, operating more efficiently, that kind of stuff. ... So we're very, very supportive of SAF as the kind of core part of our decarbonization trajectory.
AR5	26	Sustainability <i>SAF</i> Measures & Tools	But I think that it's not going to be the future. This is an intermediate solution which will help, but it's not everything yet.
AR6	26	Sustainability <i>SAF</i> Measures & Tools	A SAF plant is roughly a billion-dollar investment and for some scale there's about 200,000 tons or so. Last year, we used about 50,000 tons of that. So, we used about a quarter of the global supply, which is, you know, obviously great in terms of showing our effort and our commitment to doing this. It shows how desperately inadequate that volume is.
SH4.1	31	Sustainability <i>SAF</i> Measures & Tools	So, I mean, with KLM Air-France now, you know, building their own SAF production in the Netherlands. You see Emirates investing billions of dollars in SAF to be able to fill their aircraft.
<b>Category: Driver</b>			
<b>Description:</b> Factors that drive the integration of sustainability into airlines' strategies.			
AR1	10	Economic Incentives	The second is cost. In other words, everything, which is why we are doing so well with fuel efficiency. It saves us money. Regardless of CO2. Every liter of fuel that we don't have to fill up is really grateful in our balance sheet at the end of the year.

AR2	1	Economic Incentives		The topics of sustainability and fuel efficiency, for example, are very closely linked. Because, of course, less fuel means lower costs, which in turn, of course, also drives the issue of sustainability forward a little.
AR3	4	Economic Incentives		Because they're more fuel efficient, so it saves the operational expenditure, but it also saves the CAPEX because as planes get older, they need more.
AR3	6	Economic Incentives		That's our carbon pricing mechanism effectively you know as in it will cost us this much, so let's invest it now to save the money in the long run. So, that's the kind of approach we're taking
AR3	10	Economic Incentives		Fuel is our biggest operational expense, so anything that can reduce fuel reduces our expenses. And so, if we, and it just so happens fuel and carbon go hand in hand. So, it just kind of was along those lines so like already we were by far and away of the major airlines and we were the most fuel efficient.
AR3	32	Economic Incentives		The biggest driver is cost because fuel, as I said, biggest cost. If we can reduce that.
AR4.1	32	Economic Incentives		So that means that new fleet is also just reducing your fuel costs, your fuel bill. So, it's a financial and sustainable, from a sustainability perspective, and return on investment that you have.
AR6	28	Economic Incentives		But I think in terms of where the benefits are, with all of the initiatives that we're putting in place, from our business point of view, there's positive NPV in everything that's on screen. So, with everything that we do, the investments we put into the fuels and the car removals, but also our new aircraft naturally trying to operate more efficiently
SH1	14	Economic Incentives		You have to do a lot of maintenance per aircraft kilometer flown on a fossil fueled engine. But on the electric engine side, you basically don't have to do any maintenance at all. So that's also a huge benefit. And those two factors are the ones that really saves you cost for electric aviation. So, our aim is to reduce the operational costs or the total cost of ownership for an electric aircraft significantly.
SH2	19	Economic Incentives		There is becoming financial disincentivizing to go into fossil fuels. The tax on jet fossil fuel, let alone any fossil fuel, is going to go up. So that gap between SAF and fossil will come down relative one way or the other because jet fuel will become more expensive. So that is going to make SAF increasingly more attractive, meaning more investment will go in it, meaning supply will go up, meaning the price ultimately comes down
AR1	34	Internal Stakeholder	<i>Employees</i>	And if I'm interested in it privately, but in my job, I have the feeling that it's not being taken seriously, then somehow a situation arises where I perhaps don't identify with my company at all. And in a situation where we are increasingly competing for jobs and the skilled workers that go with them ... we have to somehow see where we can stay, being able to honestly say that we are a sustainable company is of course also a reason for some people to keep a job with us. ... When they say, "Hey, they support me in working sustainably, that's important to me and I'll stay and remain loyal to the company". I think that's a great opportunity in other sectors, perhaps even more so than in our company. But I basically believe that if you appeal to the right people, it also gives them freedom of choice in their own day-to-day work, which in turn simply gives them a better feeling in their own job.
AR2	15	Internal Stakeholder	<i>Employees</i>	And then also to educate our colleagues a bit and explain why we think the topic is important and what's actually behind it. There are always a lot of questions, which is good at the end of the day, because you realize, "Okay, there's interest" and people try to understand where this hype about sustainability is coming from all of a sudden.
AR3	10	Internal Stakeholder	<i>Employees</i>	So maybe since I joined, we've been speaking about it much more getting kind of much more confident around what we do and all this.
AR1	2	Internal Stakeholder	<i>Parent company</i>	But of course, that leads you to say, okay, so either we perform here now, or we prepare ourselves for the fact that at some point in the hard cut you say, "Okay, the main thing is that the group achieves its goal, even if that means that airlines have to leave here". ... So here again the advantage of

				[Airline Group 1]. If they decide it's coming, good for us. If they say it will take another ten years, we're out of luck.
AR1	18	Internal Stakeholder	Parent company	I have to be honest and say that we received a very detailed reduction path from the Group, in which the Group calculated which reductions are planned for which airlines and in which areas.
AR2	5	Internal Stakeholder	Parent company	Of course, they also have an interest in us reducing our emissions as much as possible, which is to their advantage or an advantage for them. ... But the measures that we take, we can fall back on the parent companies if we need to. But we don't have to, let's put it that way. We are not currently being asked to do exactly the same as [Airline Group A] or [Airline Group B]. With some big issues, you should of course make sure that you coordinate with each other a bit and know what the other side is doing, so that there are no big surprises all of a sudden ...yes, they become public
AR4.29		Internal Stakeholder	Parent company	So, the big strategic goals are the same [throughout the group].
AR6	6	Internal Stakeholder	Parent company	Everybody within the group is effectively set by the strategy ... put together at group level
AR6	14	Internal Stakeholder	Parent company	That's much harder when you're in a group structure, when you need to effectively disclose what you're planning or what you'd like to do.
AR1	10	Legal Pressure		Simply because the legal situation, i.e. the legal landscape, is changing in such a way that we are also coming under increasing pressure. This year, for example, we are subject to the Energy Efficiency Act for the first time. This means that we have to set up an energy management system. We didn't have that before. And we wouldn't have done it if this law hadn't existed. But now, with the prospect of a €100 thousand procedural fine next year, it has suddenly moved to the top of the agenda. So, I think the safest way to bring about change at the moment is unfortunately still legal compulsion, as shitty as it is.
AR1	10	Legal Pressure		But the really big challenges, to be honest, nothing happens without economic or legal pressure.
AR1	22	Legal Pressure		"It's not so much that the management says, "Okay, sustainability is incredibly important to us", but rather that the management is afraid of politics. You have to be honest about that. ... If we continue to have a more green government ... that will mean that more laws will be passed. The transport sector will miss its targets, even if they soften them now. Sooner or later, the day will simply come when [Country] will have to justify why we are not meeting climate targets. And then the politicians will certainly not say, "Oh come on, we'll pay for it, it doesn't matter, we'll solve it for you". Instead, it will be handed down in some form or other.
AR1	22	Legal Pressure		I think this concern that the combination of public pressure and political willingness to make decisions to our disadvantage will lead to rules that we suddenly have to abide by. It's quite a driving force.
AR2	25	Legal Pressure		On the one hand, it is always a bit of a question of what can be done that is good, but first and foremost meets the regulatory requirements.
AR3	32	Legal Pressure		But also, regulation so ETS, those carbon ... the carbon is getting more expensive and CORSIA being introduced is going to add to an extra an extra volume to that. ... So, ETS obviously but also the corporate sustainability reporting directive requires us to kind of refine some of our approaches.
AR4.16		Legal Pressure		One and a half year ago, I think, we started working much more together with the finance department, parallel to the developments around European legislation. I'm not sure if you already heard of the CSRD. So European legislation that tells us to report on sustainability impacts next to financial impacts, actually. And what we did is really try to make this an integrated component in the finance organization, so that we can look at finance and at sustainability impacts at the same kind of level
AR6	8	Legal Pressure		So obviously the airlines in the group are all participants of emissions trading systems in the [Country A] and the EU, but obviously the EU's scheme introduced carbon pricing to aviation back in 2012. So effectively that was the kind of starting point really for thinking about decarbonization,

			because it was the first time obviously that a carbon price was being applied to aviation, of course. ...The Paris Agreement pressure and certainly some of the third-party pressure that obviously had built up to a point where we were able to create a model effectively starting to put together some of these component parts.
AR6	26	Legal Pressure	Obviously, the main thing with CORSIA is about ensuring that it works so making sure that there's a financial penalty that's implemented by each of the member states and adhered to and enforced
SH2	14	Legal Pressure	So, policy on both the supply side, incentivizing, as well as demand side, where you sort of, you know, are able to set the goalposts for regulated demand.
SH2	14	Legal Pressure	The producers themselves probably won't naturally go to SAF unless it's regulated on the goalposts.
AR6	26	Legal Pressure	We believe that we can obviously achieve what we've presented here, but it relies on a huge amount of policy support.
AR1	14	Competitive Pressure	I believe that the safest and strongest lever is definitely legislation or competition.
AR1	14	Competitive Pressure	So, the fact that [Competitor A] is now pushing its 2-liter plane in this way naturally also means that we somehow need an answer, because then the trade press suddenly says "So, what are you doing in terms of sustainability? [Competitor A] has now written this and that". And if we then say, "Nothing", we also look kind of stupid.
AR1	22	Competitive Pressure	And then, in this competition, make sure that we have the most attractive offer at the same time, of course. So that will always be the biggest driver. Competitiveness, what are the others doing, how do we compare? ... But I believe that it is precisely this competitiveness that will decide in which countries the airline industry will survive in the form we would like it to.
AR2	7	Competitive Pressure	So, what do we have for aviation in general? So, what is aviation working towards and what are other airlines also doing? These are the main drivers that can be used to reduce emissions
AR2	11	Competitive Pressure	These are the kind of considerations where you also look a bit, well, what are the others doing? Are there companies that offer innovations?
AR2	25	Competitive Pressure	And if many airlines in Europe in particular communicate about this and you then perhaps realize one airline or another doesn't do this, then in my opinion this could also have an influence on how the choice is ultimately made in the future. So, the customer then says, "I now have the option of traveling with three airlines and I know that two of them are more sustainable than the others". If that is a criterion for me, then I would probably choose the more sustainable option under certain circumstances.
AR5	4	Competitive Pressure	We established those material topics by comparing us to other airlines. So, we did a benchmark
AR5	10	Competitive Pressure	When I mention clients is that because sometimes the client thinks that the airline A is more sustainable and presents all these sustainable products and carbon offsets and you have the airline B that does nothing. I think the client is going to choose company A. So, I think the people are becoming aware of their impact on traveling. So, they always are going to choose the more sustainable company.
AR5	24	Competitive Pressure	Everybody wants to have it, okay? Because no airline wants to pollute more than another. So, I think when the time comes, it's going to be a race.
AR5	30	Competitive Pressure	We do a lot of benchmarking with other companies to see what they are doing, what we are not doing, to see things that we are doing, but they are not doing.
AR5	42	Competitive Pressure	And I think the regulation for the reporting and indicators is going to allow companies to compare each other to see who is more sustainable than other or who's investing more. Because at the end the client if he has two airlines to choose and he has one that is more sustainable is always going to choose the sustainable one.
AR6	6	Competitive Pressure	We were one of the first airline groups to come up with a sustainability strategy and pledge to net zero emissions by 2050.

AR6	28	Competitive Pressure		Because if we've certainly decarbonized and got, you know, to our net zero commitment, we would, you know, we would certainly want to make that a competitive gain over other airlines who either are behind or are doing so more costly, having to pass that cost on to their consumers
SH4.1	13	Competitive Pressure		I feel like mainly all the big ones, they are competing with each other all the time, who's best on sustainability, you know, who changed, passes the plastic, who changed, you know, everything.
SH4.1	13	Competitive Pressure		I think they're pushing each other all the time and they're better at doing that way.
SH4.1	13	Competitive Pressure		And as soon as, you know, KLM comes out with a new, you know, sustainability vision or goal, then Lufthansa, you know, they want to compete, and they do it even better. So, I think that is the best way of keeping the pressure is actually, you know, them fighting against each other being the best.
SH4.1	15	Competitive Pressure		You know, they're all competing on who has the newest fleet. That's what ... that's the big thing.
SH4.1	31	Competitive Pressure		The competition between them to be the best, is the best driver to move in the right direction, I think.
AR1	14	External Stakeholder	<i>Customer</i>	We notice in the surveys - we have this Passenger Satisfaction, the Net Promoter Score and a few other things are simply queried once a month as standard. And it has to be said that there is interest in the topic, but there are also major doubts about our credibility. So, if we look at it, we have 45 percent of respondents who say they don't buy a CO2 certificate because they either don't believe in the certificate itself or don't believe that we can deliver it reliably. ...That's a small part, but I think it shows very clearly that those who take the issue seriously don't take us seriously and those who don't care about the issue are annoyed by it. And it's difficult to figure out how best to deal with it. But I don't think we'll be spared that. We have to find out somehow.
AR1	38	External Stakeholder	<i>Customer</i>	... Regardless of the question of whether people rate climate change as we would, we can at least develop a standing in which we can perhaps say, "Hey, we're a credible partner" in a world of fake news and social media and deepfakes. And I have the feeling that this still means something to people, especially in [Country]. It's also just an imaginary construct, but you can use it. ...We actually want the guest to think of us, ideally as a travel companion, as someone they enjoy spending time with. And if we can package sustainability in such a way that this is exactly what it's all about, then I think it's something that gives us another opportunity to position ourselves differently in the market.
AR2	25	External Stakeholder	<i>Customer</i>	And I don't think we should underestimate the impact this issue of sustainability can have on society if we know that people are perhaps understanding and taking more account of the influence they actually have from year to year.
AR2	25	External Stakeholder	<i>Customer</i>	So, the customer then says, "I now have the option of traveling with three airlines and I know that two of them are more sustainable than the others". If that is a criterion for me, then I would probably choose the more sustainable option under certain circumstances.
AR2	27	External Stakeholder	<i>Customer</i>	I think it's one of those things in society that people always like to say, well, I fly once a year. I'm not the problem. So, business travelers who fly every week should think about whether they can fly less. And I don't think our customers have reached the point where they attach much, much importance to that. But I think you also have to differentiate a bit here. There are also customers who tend to look at the price and see the cheaper the better. And I take the cheapest offer and I don't really care where it ends up at the end of the day. And then, of course, there are the same customers who say they want to go on vacation to a Robinson Club, which are not known for being very inexpensive, but rather in a higher price segment. And with them, I can imagine that they would be more willing, for example, to ... adjust their choice or to say, for example, if I can do something good with 50 euros more, then it's worth the 50 euros to me, for example.

AR3	34	External Stakeholder	<i>Customer</i>	They don't care. They don't care. Yeah, you hear also a lot of different opinions on that, if they care or not. But I mean, overall picture from most services, no.
AR4.1	19	External Stakeholder	<i>Customer</i>	The customer also has a kind of power because they are the ones choosing us or don't choose us.
AR4.1	19	External Stakeholder	<i>Customer</i>	For example, as a company but what we see at this moment in time is that customers do say a lot of things, what they think is important, but in their behavior, we don't really see them acting.
AR5	10	External Stakeholder	<i>Customer</i>	When I mention clients is that because sometimes the client thinks that the airline A is more sustainable and presents all these sustainable products and carbon offsets and you have the airline B that does nothing. I think the client is going to choose company A. So, I think the people are becoming aware of their impact on traveling. So, they always are going to choose the more sustainable company.
AR5	42	External Stakeholder	<i>Customer</i>	Because at the end the client if he has two airlines to choose and he has one that is more sustainable is always going to choose the sustainable one.
AR6	24	External Stakeholder	<i>Customer</i>	It's not really my problem if I'm just taking one fly a year.
SH4.1	6	External Stakeholder	<i>Customer</i>	But our customers, they demand this report. They need to deliver. They need to see what is their emissions. They need to show.
SH4.1	45	External Stakeholder	<i>Customer</i>	When it comes to leisure, your wallet is what counts the most. ... You won't see them buying biofuel fares. That's basically business because they want to write off their emissions. You don't really see that they prefer doing a direct flight, which is more expensive because it's less emissions than actually doing a stopover
SH4.2	19	External Stakeholder	<i>Customer</i>	I think more and more we will see that they will have responsibility for their companies have a more green travel. And if there are options, I think they will maybe choose to not travel, or maybe use train instead, or use an electric car, or you know, if they have a choice. And I also think that the younger generation is much more concerned than what we see from our customers
SH4.2	19	External Stakeholder	<i>Customer</i>	But I think in the future there will be more demand from the traveler to be able to choose green travel and have that be easy, so they don't need to do a lot of research to find out what's the greenest way to travel.
AR3	8	External Stakeholder		Our stakeholders are looking at it a lot more as well.
AR4.1	19	External Stakeholder		But we also base our opinion or advice on the external pressure and external developments. And that means that we also do stakeholder analysis and these kinds of things. But there are so many stakeholders in the field that have an opinion about aviation and sustainability.
AR5	8	External Stakeholder		Our stakeholders. So, investments, clients, but corporates, so another companies, our suppliers, banks. So, they also send us a lot of inquiries on our sustainability performance and having a sustainability strategy will help answering these questions
AR5	12	External Stakeholder		I just received some requests from external stakeholders like suppliers, clients, banks, and other entities. And they always ask us to fulfil some information about our sustainability strategy, initiatives, indicators.
AR2	15	External Stakeholder	<i>Investors</i>	But we are still working on our reports in order to meet the needs of the banks and partners, who regularly ask what measures you are taking, what you want to achieve in the future, have you set specific goals, including this topic of SBTI targets, for example.
AR3	32	External Stakeholder	<i>Investors</i>	And then there is stakeholder expectations. So, our investor community is very interested in this as well, because the regulation is probably driving them, but also just some of them are looking to respond to the sustainable investment trend
AR3	38	External Stakeholder	<i>Investors</i>	From an investor perspective, really what they're interested in is to show that we're taking it seriously. They appreciate, like in aviation, it takes quite a long time for things to change because of the sheer cost of things. And so, they want to understand kind of what our approach is, what our thinking is, you know, all that kind of thing. ... They were very much interested in

			"Are you actually taking this seriously?". So, there was a huge amount of work that we've done to show that we are taking it seriously, you know.
AR4.1 21	External Stakeholder	<i>Investors</i>	So, to an extent you are allowed as a company to yourself say what is a material topic and not. And that has been partly for us, it has been partly decided with by investors or on what's a material topic from an investment point of view.
AR4.1 21	External Stakeholder	<i>Investors</i>	There is a small part of our investors that are activate investors, now what do you call it, activist investors. So, they are allowed to like come from environmental groups they are allowed to also attend for example the annual ...How do you call that? ... shareholders meeting. But they have a minor, like from that perspective, they have a minor influence because they are a really small investor in our big company, so to say. ... The [Nationality A] state and the [Nationality B] state are big shareholders in our company, which means that they have a big say. So yeah, from that perspective, we also have to listen to some extent to what our shareholders are saying or wanting to see in our companies because they have a big investor share.
AR6 20	External Stakeholder	<i>Investors</i>	So, a lot of that comes back to where the investors ultimately want to see us trying to decarbonize, which needs to start with your own operations before you worry about everything else.
SH2 14	External Stakeholder	<i>Investors</i>	If you were a financier, project developer, you want to know that this product is still going to be around in 30, 40, 50 years' time. ... If we can give that long-term certainty, then that's very useful and then helps an institutional financier who goes, you know, I'm in charge of this particular fund or this particular portfolio of investment. If I'm going to be committing, name a figure, \$200 million, \$1 billion, who knows how much, to a particular set of projects or a particular product like SAF, I want to know that it's still going to be around and on the right side of history.
SH2 35	External Stakeholder	<i>Investors</i>	Institutional financiers are going to be critical. ... Financiers will have to take some risk on projects they may have not taken 10 years ago.
AR2 13	External Stakeholder	<i>Other</i>	Because we also work with a large number of tour operators on the EU side, for example. And the tour operators naturally also have an interest in understanding what the airlines are doing through their corporate sustainability strategy, because we are of course largely responsible for their Scope 3 emissions.
AR2 27	External Stakeholder	<i>Other</i>	We notice this on the tour operator side, i.e. with the tour operators we work with. But, as I said, they also have their own corporate goals and naturally have a vested interest in the airlines they work with being more sustainable or becoming more sustainable.
AR5 32	External Stakeholder	<i>Other</i>	We also have the clients and the NGOs, non-governmental organizations, always looking at our reports to verify if our information is true or not.
SH3.1 40	External Stakeholder	<i>Other</i>	we have, as you said, very close communication and cooperation with the carriers or with those operating at the airport
SH3.2 87	External Stakeholder	<i>Other</i>	It's not including our plan, but we set the requirements to everyone at the airport.
SH3.2 105	External Stakeholder	<i>Other</i>	But we have shown the results from the climate account and related it to the measures we are doing and the targets we have.
SH4.1 13	External Stakeholder	<i>Other</i>	The only thing we can do is raise it, constantly raise it in all the meetings. ... In every meeting that we're raising what are you doing in every presentation they always need to you know present their main focus and main vision for sustainability. We can't remember all the details but it's just always keeping it in the dialogue like that they keep the focus.
SH4.1 17	External Stakeholder	<i>Other</i>	We have to make sure that, you know, we have a great selection of all the airlines to offer them. But, of course, we challenge them. ... So, we do these kinds of choices, but we don't take anyone in or out according to it. We let the choice be the customers, but we try to give them good advice.
AR5 8			I think we have different things that make us do this strategy, sustainability strategy.

**Category: Challenges**

**Description:** Factors that are hindering airlines during sustainability integration efforts.

AR1	22		We still need to make sure we save our own skins, at least to the extent that we stay in business.
AR4.16			There's many, many variables to manage and many things we have to look.
AR4.128			It's going to be a really difficult journey.
AR4.227			But at this moment in time, not knowing if that will go through and whether or not other airlines will follow suit, I think it's a hard, tough cookie to get there. It's very hard.
AR4.227			That's also because what needs to be done and some of the trajectories that are out there to reach net zero almost all of them take into account that you need to do some kind of abatement aka fly less. Almost all of them have something in it about actually. Probably it's just looking at the growth trajectory of this business reaching net zero will be very, very hard so unless there is a very big technical breakthrough or a giant mind switch, it will probably be very hard. It's not impossible, but personally I think it's going to be very hard.
SH2	4		It's one thing to set a target. It's another thing to sort of identify how we're going to do it.
AR1	14	Communication and Transparency	That's a small part, but I think it shows very clearly that those who take the issue seriously don't take us seriously and those who don't care about the issue are annoyed by it. And it's difficult to figure out how best to deal with it. But I don't think we'll be spared that. We have to find out somehow.
AR1	16	Communication and Transparency	And we as an industry simply skipped that phase completely. We were part of the problem for a very long time and ignored the problem. And now we're pretending to be part of the solution. But we never picked up the guest in between and said, "Hey, we understand the problem. We are with you. This is a serious situation. And it can't be that you have to pay for all this. It can't be that we have to pay for all this. But we have to do something.
AR1	16	Communication and Transparency	We need ownership of this narrative, because otherwise it will continue to be driven by other people who either make money from it themselves or who simply don't want us and that can't be in our interest. So, we have to somehow get involved in this story. But the question is whether we want to. Because, of course, we haven't been in any court yet. That's an exception in [Airline Group 1] now. Most of the others already have. ... Apart from that, it's going very fast at the moment. And of course there's a lot of fear. If we make any kind of public statement, then we're out too. Then we're in the public eye. And then maybe this puppy protection and this flying under the radar and "Who is [Airline 1] anyway?", we won't have that anymore. And we would have to actively decide to do that. And at the moment, the management message is very clear: we'll hide for as long as we can.
AR1	18	Communication and Transparency	And then they expect us to achieve a 15% efficiency gain through the fleet. But we don't get any new aircraft. And then you call your colleagues in Fleet Planning and say, "Excuse me, I've got a problem with my understanding. How am I supposed to gain 15 percent efficiency through the fleet by 2030 with exactly the same fleet composition?" ... And then we get back, "Yes, we'll get back to you on that". 2030 is six years away. If we were to get a 350, if we were to get rid of our 330, they would have to tell us at some point. ... And it's the same with the efficiency measures. It says 10% profit through efficiency measures. So, I say, "Well, we've done the math, we can do 4. Where are the other 5? ...". You can't just draw a chart and then there's a great waterfall and in the end, it somehow makes sense, mathematically in the chart, but it doesn't translate.
AR1	38	Communication and Transparency	I don't think anyone dares to go there at the moment. That's my perception, also in the communication preparations we have with the company. It's very clear that they are very afraid of being taken to court, that there will be a harsh press article. And their own perception is that so far, it's all been totally unjustified, and we're constantly being hated by someone. But we haven't done anything. I think that's only half the truth. We've already made a real mess of things in one or two places, and we think I should have gone to the lawyer about that too.

AR2	3	Communication and Transparency	And that's where the story is a bit more difficult, because you first have to create a basic understanding of why you're talking about sustainability at all and why it's important and why it should be important for all of us and what the background is and so on. There was still a bit more educational work to be done.
AR2	5	Communication and Transparency	With some big issues, you should of course make sure that you coordinate with each other a bit and also know what the other side is doing so that there are no big surprises all of a sudden ... yes, they become public.
AR5	2	Communication and Transparency	It's an ongoing process because we are facing the [Greenwashing] claims.
AR5	8	Communication and Transparency	Our clients need to know what the company is doing in the sustainability, in the people, and the governance, and in the environmental aspects.
AR5	32	Communication and Transparency	I think the major difficulties in establishing very big challenges um when establishing a sustainability strategy is making sure that we are not saying something that's impossible. Because that's not a strategy. That is just saying things in the report that we know that we are never going to achieve.
AR5	32	Communication and Transparency	I think that's one of the major challenges, to establish our goals for the sustainability strategy, because we also have the clients and the NGOs, non-governmental organizations, always looking at our reports to verify if our information is true or not. So, we need to be very careful, and we don't want to lie to anybody.
AR5	42	Communication and Transparency	I think that that's really important for all the companies, to showcase what they are doing in sustainability.
AR6	14	Communication and Transparency	All of the airlines want to maintain brand identity. ... So obviously, there is a balancing act between trying to work on something that is for the benefit of the group and obviously working on something that is for the benefit of the individual.
AR6	28	Communication and Transparency	We're in a bit of a difficult state of play today in that we are being asked to report a massive amount of information around our progress and how we're actually planning to deliver on the roadmap that's on screen. But at the same time, making that a public statement brings risk that we're misleading the public that we're informing.
SH4.1	6	Communication and Transparency	But our customers, they demand this report. They need to deliver. They need to see what is their emissions. They need to show.
AR1	2	Financial Constraints	Preferably with measures that are not based on sustainable aviation fuel or CO2 certificates, because we simply realize that this is taking on forms that we would not survive in terms of costs.
AR1	2	Financial Constraints	If this takes effect as it looks at the moment, the logical consequence will be that the [Airline Group 1] will have to close airlines.
AR1	2	Financial Constraints	But it's not like other airlines, where we can say that we are explicitly relying on the 350, which is coming and the NEOs, and that will save us everything. Instead, we have to make sure that we somehow manage without this aircraft
AR1	4	Financial Constraints	So even now, [Airline Group 1] has, just as you say, decided to buy certain quantities every year and they have already contractually agreed to do so. We bear the costs for this. So, there is a distribution formula that also provides for a certain share of SAF for [Airline 1], which we have to pay to the group, whether we sell it or not, i.e. whether we sell it to the guest or not.
AR1	4	Financial Constraints	And we won't be spared that either, but it's not as if we say, okay, we're going to do something with [Energy Company] like [Airline Group 1 Airline B], for example, or we're going to do some kind of cooperation of our own, because we have the feeling that this is a price category that doesn't work for us.
AR1	24	Financial Constraints	But it is essential money, you simply have to say. Regardless of whether it's SAF or new aircraft, it has to be paid for somewhere. And then we can

			say, yes, we won't add that to the customer's ticket. But to be honest, we add everything to the ticket. Because the ticket is the only way we can get money to do what we do here. Even if it doesn't say afterwards that it's an SAF tax, the ticket is more expensive than it was before because we need that money somewhere. We're not putting it on there yet. Something has to happen, or something will happen.
AR2	11	Financial Constraints	To what extent this can of course be passed on to the customer, because to be honest it can never be borne solely by the airline. Sooner or later the customer will have to jump in too.
AR2	21	Financial Constraints	Issues such as how much SAF we want to fill up by 2030 or 40 or 50, for example, we are currently focusing even more on the mandates, because I think it's easy to be more ambitious. But I believe that the developments we are currently seeing in the production of SAF and also in the price trend make it difficult to set even higher targets.
	18	Financial Constraints	Sustainability cost is too hard to implement then of course it creates a very difficult business case to either implement that particular initiative or keep flying.
AR6	18	Financial Constraints	So, what is the cost of each of those wedges between now and 2050 on an annual basis? How do they change over time? How does the, you know, how do we expect the price evolution of, you know, some of the market prices for our fuel or carbon might change and how will that impact what our exposure to carbon costs will be in the long term?
AR6	26	Financial Constraints	It relies on a huge amount of upfront investment in capital, not just from us, but from broader investments, for broader investors, other airlines.
AR6	26	Financial Constraints	you need a combination of impacts to help, but all of them need huge amounts of capital.
SH2	14	Financial Constraints	If you're building a first of a kind greenfield new facility, this could be \$1 billion worth of capital expenditure that you need.
SH2	14	Financial Constraints	The unfortunate part with SAF is that it has to be further upgraded relative to, say, renewable diesel. And as a consequence, the process is a little bit more cost intensive. And so that sort of sets SAF a little bit back, where if it's just left to market forces, then producers won't naturally go down the SAF pathway
SH2	23	Financial Constraints	In the short term, they're going to have to face higher fuel bills. And as a result, the biggest challenge is do we absorb that? Do we pass some of that on to the customer? Do we try and sell the scope three of the SAF to some corporate customers?
SH3.2	107	Financial Constraints	It's the financial due to our projects. That's a huge impact that you need to have all the financial. You can't do a project if you cannot be sure that financial is okay and that can stop some of the development of course.
SH4.1	31	Financial Constraints	And they're doing all these measures at the same time as they need to make money. And we all know that, you know, sustainable or SAF is more expensive.
AR1	24	Knowledge Management	So, a lot of what we do today is basically based on climate research that was carried out in the 1980s and 1990s. And that's good. But things are already happening again in parallel, for example in the area of non-CO2, i.e. this whole issue of various cloud formation effects or NOX or whatever. We don't know that at all yet. It's possible that in ten years' time we'll be standing here saying, "Fuck, we did everything we did to the best of our knowledge, but our knowledge was simply outdated". So, it's possible that the climate impact of flying - and that's the rough framework at the moment - will be three to seven times higher than we previously assumed. But no one can tell us whether that is three or seven. And developing measures in between to counter this is really fishing in the dark.
AR1	28	Knowledge Management	Where are the ideas supposed to come from? The two of them only know what they've done in their previous jobs. What did they do? If not sales representative and legal counselling. Cool. But then please go, so with what expertise? "I read a book about it". Well, then everything is fine.
AR2	3	Knowledge Management	And that's where the story is a bit more difficult, because you first have to create a basic understanding of why you're talking about sustainability at

			all and why it's important and why it should be important for all of us and what the background is and so on.
AR3	42	Knowledge Management	It's very difficult to have a sustainability expert. And to be honest, I don't think there's such a thing. I don't think there is such a thing as a sustainability expert. Everybody has different skill sets
AR5	32	Knowledge Management	We need to do research first and try to have a clear goal that we know that we can maybe achieve.
AR5	40	Knowledge Management	So, I think that needs to be a priority for the tech companies. We need to have more research to try to change that.
SH1	52	Knowledge Management	We need to gain knowledge within this field.
SH2	31	Knowledge Management	Part of the challenge is there's so much information out there. It's almost like, where do you begin? Where do you look?
AR1	18	Technology Accessibility	"Yes, and then we buy SAF if necessary". From where? Well, all the studies I know about this say that SAF will be in short supply until 2030 or 2050. There will be more, and it will be cheaper and yes, all good. But there won't be nearly enough for us all to buy our way out of it. And we won't be the only ones who suddenly realize in 2030 or 2050, oh shit, that's now. Now I must have reached my goal. And then, of course, there will be a run on CO2 certificates, on SAF.
AR1	20	Technology Accessibility	But I am also confident that there will be answers in the next few years, because we are not the only ones. The entire industry has this problem. We have to report all the figures that we don't have. We all need databases that we have not yet maintained. This is now being carried out in quite a forced march. And when it is complete, I believe that this reporting will become more reliable and then these figures will also become more tangible.
AR3	12	Technology Accessibility	So, you hear people talking about electric planes that's not feasible. Even from a safety perspective that's not feasible. Let alone from a physics perspective
AR3	16	Technology Accessibility	One is the technology itself. So currently the weight of batteries and the amount of lithium and cobalt that's needed to carry them, it's very, very difficult to do and arguably impossible. ... The second challenge is the infrastructure at the airports. The increase of electrification, of everything, that's going to be a huge challenge in itself. ... It's the safety aspect of it.
AR5	22	Technology Accessibility	We have several initiatives within sustainability to help the environment, but it's very difficult to achieve net zero with our engines and if we don't stop to use fuel.
AR5	40	Technology Accessibility	The industry in overall is still behind. So, we are still very dependent on fossil fuels. So, we can have as many initiatives as we want to reduce the water consumption, the fuel consumption, the plastic usage. But at the end, we are always using fossil fuel. So, I think that needs to be a priority for the tech companies. We need to have more research to try to change that
SH2	4	Technology Accessibility	The implication there is you can't electrify or intend in the next 20 to 30, let alone 50 years for a long-haul liquid hydrogen aircraft, not just from an operational perspective, but even from the infrastructure perspective as well.
SH2	4	Technology Accessibility	The momentum is building, but there's also no shortage of challenges and getting sufficient amount of facilities up online in the first place.
SH2	10	Technology Accessibility	We can't just sort of turn aviation off for six months or however long just so we can completely redshift the nature of our infrastructure.
SH3.1	40	Technology Accessibility	But at the same time, we are cautious not to over invest into something that may be the technology of yesterday.
SH3.1	46	Technology Accessibility	The main difference will be electrification because that's a completely different animal. And you know the power supply into the airport is currently not sufficient for electrification in order to charge aircrafts. So, we are in discussions with authorities and with different power companies. But that's a rather massive job that has to be carried out. And that is totally out of our hands.
SH3.1	48	Technology Accessibility	When it comes to hydrogen, that will be really important to analyze what impact that would have on the infrastructure due to explosion, danger and

			so on. So, placement of where we are going to have this and so on, it needs to be looked at really closely. We're not going to put up that kind of structure next door to the terminal, that would be rather stupid. So, it has to be somewhat remote, because it's very explosive.
SH4.1	35	Technology Accessibility	It's going to take time. It's going to take a long time before you have more than 50 to 90 to 100 pax on board where you really can start to sell it for real.
AR2	31	Legal Compliance	And even with a mandate, as you can see in the EU, you are only, which is very ambitious, but at the end of the day you are not at 100 percent SAF, but at 70 percent. So that means if I still burn 30 percent kerosene, I still have emissions at the end of the day.
AR5	40	Legal Compliance	We are all are all facing new regulation and I think that's going to be very challenging to comply with all of them. ... That's one of the biggest challenges now for the sustainability teams is to keep the daily work and also try to comply with all these new regulations on all the different topics
AR6	6	Legal Compliance	the policy intensives that are around at this stage as to where there is SAF being produced versus where SAF can be claimed or used
AR6	28	Legal Compliance	We're in a bit of a difficult state of play today in that we are being asked to report a massive amount of information around our progress and how we're actually planning to deliver on the roadmap that's on screen. But at the same time, making that a public statement brings risk that we're misleading the public that we're informing.
SH1	2	Legal Compliance	You can't just take any motor and put it on an airplane and fly with it, but you have to have it certified for aviation.
SH3.2	125	Legal Compliance	But also, there are some regulations that is stopping us from using it. So, we could use it more in more areas. But also, some areas that we would like to use it, we can't because of the regulations.
AR1	24	Managerial Capacity	It needs trained resources. When I look at my colleagues at [Airline Group], you can see exactly which projects are managed by whom. Not because they are bad people, but because during the coronavirus pandemic they decided to somehow add six auditors, a lawyer and a communications expert to the people who now have to make decisions about sustainability. And then you sit there and say, "... There are reasons for studying this. There are reasons why there is atmospheric research. There are reasons why there are geoscientists. And you are neither one nor the other". And I think that's something we have to admit to ourselves.
AR1	26	Managerial Capacity	If sustainability is a marketing aspect, then it is not a strategic assessment. ... [Airline Group 1 Airline B], for example, now has eight people. They have a completely different dynamic than a colleague who is part of the marketing team at [Airline Group 1 Airline C]. Where you have to honestly say, "Well, if that's just marketing for you, then we haven't taken the problem seriously enough". Because as important as marketing is, it doesn't have the same relevance. So, I think that's the exception rather than the rule in the strategy department, but I hope that will change in the future.
AR1	28	Managerial Capacity	But I think, especially in a situation where you have very few jobs, if there isn't one person in these small teams who, like [Colleague] at [Airline Group Subsidiary C], really knows what they're talking about, then it's difficult. ... If you have one person or maybe two and it's, like I said, there's one case, one businessperson and one lawyer. ... Where are the ideas supposed to come from? The two of them only know what they've done in their previous jobs.
AR2	1	Managerial Capacity	But I've been with [Airline 2] a little longer ... and was previously in product management and revenue management. ... The topic of sustainability was quite new to me as far as air traffic is concerned, I have to say. It's a super diverse topic, but I hadn't really dealt with the topic of sustainability in aviation before.
AR3	40	Managerial Capacity	But on some of the other companies, just because of resources, they just don't have the headspace for it. Like a lot of companies don't have any dedicated ESG-person. Their ESG-person is the same as their finance person, is their same possibly, the same as their lawyer.

AR5	32	Managerial Capacity	It may be difficult because people can see within the company, “Oh, this person is trying to control my job to see if I’m doing my part to achieve that goal”.
SH2	31	Managerial Capacity	The truth of the matter is for a lot of these airlines, if you sort of forget the bigger 20 or 30 that exist around the world, a lot of them are smaller entities and a lot of them don’t have big widespread sustainability teams because they’re not large organizations.
<b>Category: Future Outlook</b>			
<b>Description: Projections for the future development of the industry with respect to sustainability.</b>			
AR1	18	General	It doesn't contribute to our credibility. Still acting as if it's totally awesome. ‘Yes, sure, by 2050 we have everything under control.’ We don't. It's that simple. We just have to say that honestly. No reason to give up, but maybe it's also time to stop fooling ourselves.
AR1	40	General	But I would like us to manage this in a socially fair way and I would like us as an industry to accept that this also means that we will become smaller, that we will shrink.
AR3	12	General	2050, it all depends what day of the week you find me. Some days I'm very optimistic and other days I'm not so optimistic. And the reason why that is the case, it's so much is outside our control.
AR3	12	General	Whether we get there by 2050 is the challenge. Whether we get there by 2060 or 2040. It could go either way. But there are things that are being mentioned that are ... that aren't feasible in the short term.
AR4.227		General	But at this moment in time, not knowing if that will go through and whether or not other airlines will follow suit, I think it's a hard, tough cookie to get there. It's very hard.
AR5	2	General	We are still in the very beginning.
AR6	32	General	The reality is that 2050 is not the end date. You know, even once we get to 2050 ... there'll be a roadmap either after 2075 or 2100. ... While the roadmap gets us to a particular point in time in 2050, it doesn't solve this problem of the problem we caused 15, 20, 35, 40 years previously. So, I think there's a huge amount to be said for continuing to certainly go beyond net zero when we get to that point in time. But I think I'm a bit of a realist and sitting in aviation, having worked in carbon markets before joining [Airline Group 6], you know, there'll be some other sectors that can do that far, far more quickly. You know, 2040, 2035, they can probably go net negative very, very quickly. I think we have to just accept that airlines will need a little bit of slack and it's not that they can't get there, it's just they need a bit more time to do so.
SH2	19	General	Aviation represents 2% of global emissions right now. Some people may go, well, you know, for what aviation delivers to the world, it's not an unreasonable amount. It's not really what the discussion we're having is, though, because the truth is, because we're hard to abate, like I was saying before, because so much of our mission is due to long and mid-haul flying where we don't have many alternatives. If we don't proactively change, that 2% becomes 10 to 15% in the next 20 years.
SH4.1	27	General	But, you know, it's a lot of visions. It's a lot of dreams. It's a lot of nice presentations. But what we see, unfortunately, is not that, you know, things take time and they're not able.
AR1	22	Industry Changes	But I believe that it is precisely this competitiveness that is now deciding in which countries the airline industry will survive in the form we would like it to.
AR1	40	Industry Changes	I would like us to manage this in a socially fair way and I would like us as an industry to accept that this also means that we will become smaller, that we will shrink
AR3	40	Industry Changes	I started working in this space 10 years ago and it wasn't on anybody's agenda. Like people would have thought you were tree-hugging, you know, if you brought up the environment. But in the last few years, it has changed so much in the corporate world. And I can only imagine it will get like that further down the supply chain as well

AR3	52	Industry Changes	I know there is definitely a shift happening. But ...whether it happens all of a sudden? No, it won't happen all of a sudden. It's going to be slow and it's going to take time. And it's going to take money. And because there's only a certain amount of resources, that will take time, you know. So, it will happen. I'm confident it will happen. But it's not going to happen tomorrow.
AR4.1	28	Industry Changes	But will the rest of the world then also be on the same line? Yeah, I can't control that. We can't control that.
AR5	24	Industry Changes	It's going to be a race.
AR5	32	Industry Changes	Since the sustainability topic is raising awareness within every person, I think this is going to be easier in the future.
AR6	26	Industry Changes	What you need is industry-wide traction.
AR6	28	Industry Changes	I think airlines are all in the same boat at the moment when it comes to that. That might change in the long-term. We hope it maybe does change kind of towards 2050.
SH1	6	Industry Changes	I think there's also an opportunity here for new airlines, smaller airlines, maybe even as a spin-off from the big airlines ... There is an opportunity there for new actors to move into the industry ... So maybe we won't see the big airlines as frontrunners here, but rather smaller airlines.
SH1	10	Industry Changes	this sort of like transformation of the industry into something else and that can only happen through collaboration so that needs to be an integral part of the strategy to have those sorts of collaborations that will pay off in a couple of years.
SH3.2	112	Industry Changes	I think it's [working together with airlines more closely] important. It's really important.
SH4.1	39	Industry Changes	I think travels will still be going on. ... It's just that we need to travel smarter, and we need to travel better. So that's how they're changing all this, because they see that demand ... of using airlines in the future is just going to continue to increase as new markets awakes.
AR2	31	Technology Outlook	But to be honest, aviation will not be able to manage without emissions in 2050 either. ... And then you can consider, to what extent can you use other technologies to achieve an effect, to get CO2 out of the atmosphere, which is simply still too much. That is a very long, rocky, and challenging path, especially for air traffic, I believe. But I also believe there is no way around it. So, this is a topic that definitely needs to gain much more momentum in the coming years ....
AR3	16	Technology Outlook	All these things can be overcome. But whether they can be overcome by 2040, I really struggle to say it. I really do struggle to say it.
AR5	22	Technology Outlook	Maybe in the future, when technology is more evolved, maybe we have electric airplanes, I don't know. But currently I don't think it's possible but maybe in 30, 40 years maybe it's one option.
AR5	40	Technology Outlook	The industry in overall is still behind. We are still very dependent on fossil fuels. We can have as many initiatives as we want to reduce the water consumption, the fuel consumption, the plastic usage. But at the end, we are always using fossil fuel. So, I think that needs to be a priority for the tech companies. We need to have more research to try to change that.
SH3.2	117	Technology Outlook	AI, artificial intelligence. Yeah, it will have a huge impact.
SH4.1	35	Technology Outlook	But I think whatever comes around, we'll have to adapt, and we'll have to make sure that we have access to it, if it is something that needs to be given to the market. And if the corporate wants it, then they have to make sure that it's available where we make our booking.
SH4.2	33	Technology Outlook	But I also think that AI I think there's like more things happens really fast and there are possibilities that we can't really think of now that a year from now will be available to us. But I think we're watching and we're following. But I think it's really important and I think it's something that will be one of the most important things we do in the future.

*Note: Quotes from AR1 and AR2 have been translated from the original language verbatim into English.*

## Appendix G: Overview CDP Rating and Sustainability Governance

The CDP assigns scores ranging from "A" to "D-" according to the comprehensiveness of the response, the management and understanding of environmental risks, and the advancement of environmental stewardship (CDP, n.d.).

Airline	Score 2023	Board-Level Oversight	Management Incentives
<b>Lufthansa Group</b>	A-	Group Executive Board, Supervisory Board, CFO, CSO	15% of annual bonus and multi-year variable remuneration tied to sustainability targets
<b>Ryanair</b>	A-	Board Committee, Audit Committee, CSO, CEO	Variable pay tied to ESG performance
<b>IAG</b>	A-	Board Committee, SECR Committee, Remuneration Committee, CEO, CSO	Climate-related remuneration for senior executives
<b>easyJet</b>	A-	Board-level Committee, CEO, CFO, COO	CEO and CFO monetary reward and bonus tied to sustainability
<b>Pegasus Air</b>	A-	CEO, Board of Directors	Bonus tied to climate and sustainability targets
<b>France-KLM</b>	B	Board Chair, CEO, CSO, Sustainable Development and Compliance Committee, Audit Committee, Remuneration Committee	CEO: Monetary reward, Shares CSO & Sustainability Manager : Monetary Reward, Salary Increase Business Unit Manager: Monetary Reward, Bonus
<b>Turkish Airlines</b>	B	CEO	CEO: Monetary reward, bonus Employees: Bonus payments within sustainability framework
<b>Wizz Air</b>	B	Board-level Committee, Board Chair, CEO, Board Level Audit and Risk Committee	Remuneration of officers tied to emissions targets
<b>Norwegian</b>	B	Board Chair	<i>Implementation planned</i>
<b>SAS</b>	D	Board Chair, CEO, CSO	Rewards and annual salary review tied to sustainability and ESG criteria

Note: Own representation based on Air France-KLM Group, 2023a; Deutsche Lufthansa AG, 2023; easyJet plc, 2023b; IAG, 2023b; Norwegian Air Shuttle, 2023b; Pegasus Airlines, 2023b, 2023b; Ryanair Group, 2023c; SAS, 2023; Turkish Airlines, 2023b; Wizz Air Holdings PLC, 2023b

## Appendix H: Overview of SAF Use, Targets, and Partnerships

Airline	SAF Use	SAF Target (2030)	SAF Partnerships (Examples)	Sources
<b>Ryanair</b>	Began powering all flights from Schiphol Airport with 40% SAF blend	12.5%	Partnerships with Neste, OMV, Repsol, Shell to enhance SAF supply chain	(Ryanair Group, 2023a)
<b>IAG</b>	2023: 53,000 tons (0.66% of fuel use)	10%	Investment in SAF production; partners with LanzaJet Freedom Pines Fuels, Phillips 66, Neste, aemetis, LanzaTech, Gevo, Velocys, LanzaJet/NovaPangaea	(IAG, 2021, 2022, 2023c)
<b>EasyJet</b>	Started implementation	Meet regulatory demands	Five-year SAF supply agreement with Q8 Aviation (2022).	(easyJet plc, 2023a)
<b>Lufthansa Group</b>	0.15% of fuel	<i>Not announced</i>	Research in SAF; partnerships with OMV, Neste, HCS Group	(Cousins, 2023; Lufthansa Group, 2024b; Lufthansa, n.d.)
<b>Air France-KLM</b>	2023: 80,000 tons (1% of fuel use)	10%	Global SAF agreements with Engie, EDF, Elyse Energy, TotalEnergies, OMV, Raven, Groupe International SAF; investment in SkyNRG and DG Fuels	(Air France-KLM Group, 2023c)
<b>Norwegian</b>	2023: 1,759 tons (0.3% of fuel use)	16-28%	Partnership with Norsk e-Fuel for first large-scale e-fuel production	(Norwegian Air Shuttle, 2024b)
<b>Wizz Air</b>	Started implementation	10%	Partnerships with Mabanaf/P2X Europe, OMV, Neste, Cespa; targeting start dates between 2023 and 2026	(Wizz Air Holdings PLC, 2023a)
<b>Turkish Airlines</b>	Introduced regular use on several European routes	<i>Not announced</i>	Signed Global SAF Declaration; sources SAF from Neste; seeks diverse partnerships for collaboration	(Turkish Airlines, 2023a)
<b>Pegasus</b>	First SAF-powered flight in 2022	<i>Not announced</i>	Partnership with Petrol Ofisi for fuel from Neste	(Pegasus Airlines, 2022b)
<b>SAS</b>	2023: 6,049 tons	~18%	Participation in IATA/ATAG biofuel network, SAFUG, NISA, RISE, Fossil Free Aviation 2045, Klimapartnerskabet; collaborations with Shell, Vattenfall, LanzaTech; partnership with Inter Terminals for SAF infrastructure	(SAS, 2021, 2024b)