Towards Greener Skies: Customer Perspectives on Sustainable Aviation Fuels (SAF) in the European Market

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Abstract

Title: Towards Greener Skies: Customer Perspectives on Sustainable Aviation Fuels (SAF) in the European Market

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Global aviation significantly contributes to climate change, representing about 2.5% of global emissions. Sustainable Aviation Fuels (SAF) offer a promising alternative, emitting up to 80% less CO_2 than conventional jet fuel. However, SAF prices are expected to surpass fossil kerosene prices, leading to cost increases for passengers.

This thesis studies how the introduction of SAF influences key customer behavior factors within the aviation industry in the European market and whether incentives can effectively encourage greater adoption.

A qualitative content analysis using Gioia's methodology was conducted based on 15 semi-structured interviews with aviation industry experts, and key findings were derived. Utilizing the insights gathered from the expert interviews, a survey was carried out among the general public with 261 participants.

The expert interviews confirm the extant literature regarding the significance of SAF and the need for new strategies to effectively engage customers during market ramp-up. The survey results demonstrate that key factors positively influence willingness to pay (WTP) for SAF. Factors include environmental awareness, consideration of environmental impacts when booking, previous compensation measures, frequency of flying, gender, and age (linked to income). Incentives can further increase WTP for SAF, most notably for seats with extra legroom and proportionally, most on short-haul flights.

The results identify crucial elements for achieving more carbon-neutral flying with SAF from the customer's perspective. They illustrate how incentives can create a win-win scenario, benefiting both airlines and customers.

Keywords: Aviation, Flying, Sustainability, Future, Sustainable Aviation Fuels, Awareness, Willingness to pay, Incentives

Sumário

Título: Rumo a céus mais verdes: Perspetivas dos clientes sobre Combustíveis de Aviação Sustentáveis (SAF) no mercado europeu

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A aviação global contribui significativamente para a mudança climática, representando cerca de 2,5% das emissões globais. Os Combustíveis de Aviação Sustentáveis (SAF) oferecem uma alternativa promissora, emitindo até 80% menos CO_2 do que o combustível de aviação convencional. No entanto, espera-se que os preços do SAF superem os preços do querosene fóssil, levando a aumentos de custos para os passageiros.

Esta tese estuda como a introdução do SAF influencia os principais fatores de comportamento do cliente na indústria da aviação no mercado europeu e se os incentivos podem efetivamente encorajar uma adoção maior.

Uma análise de conteúdo qualitativa usando a metodologia de Gioia foi conduzida com base em 15 entrevistas semiestruturadas com especialistas da indústria da aviação, e foram derivadas descobertas-chave. Utilizando os insights coletados nas entrevistas com especialistas, foi realizada uma pesquisa com o público em geral, com 261 participantes.

As entrevistas com especialistas confirmam a literatura existente sobre a importância do SAF e a necessidade de novas estratégias para engajar efetivamente os clientes durante a introdução no mercado. Os resultados da pesquisa demonstram que fatores como sensibilidade ambiental, consideração dos impactos ambientais na reserva, medidas de compensação anteriores, frequência de voos, sexo e idade (associada ao rendimento) influenciam positivamente a disponibilidade para pagar pelo SAF.

Os resultados identificam elementos cruciais para alcançar um voo mais neutro em carbono com SAF do ponto de vista do cliente. Eles ilustram como os incentivos podem criar um cenário vantajoso para ambos, beneficiando tanto as companhias aéreas quanto os clientes.

Palavras-chave: Aviação, Voar, Sustentabilidade, Futuro, Combustíveis sustentáveis para a aviação, Sensibilização, Disposição para pagar, Incentivos

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Abbreviations

AtJ	Alcohol-to-Jet
CO_2	Carbon Dioxide
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
EU ETS	European Union Emissions Trading System
HEFA	Hydrogenated Esters and Fatty Acids
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LCJF	Low Carbon Jet Fuels
NO_x	Nitrogen Oxide
PtL	Power-to-Liquid
SAF	Sustainable Aviation Fuels
SD	Standard deviation
TRL	Technology Readiness Level
WTP	Willingness to pay

1 Introduction

A 2023 IPCC report states that the Earth has warmed by 1.1 degrees Celsius since pre-industrial times. With the current measures, a mean global warming of 3.2°C by the year 2100 is projected. To achieve the 1.5-degree target set in the Paris Agreement, global emissions must be nearly halved by 2030 compared to 2019 (IPCC, 2023).

The impact of global aviation on climate is considerable, with one-third of radiative forcing attributed to CO_2 and two-thirds primarily to nitrogen oxides (NOx) and water vapor in contrail cirrus clouds (Klöwer et al., 2021). In 2022, aviation emissions comprised roughly 2.5% of global emissions. In the European Union, aviation contributed 5.2% to CO_2 emissions in 2019, placing it second within the transportation sector at 18.3%, just behind road transport (EASA, 2022). Long-haul flights (>4000km) are particularly significant in this context. While comprising only 6% of all European flights in 2019, they were responsible for 48% of all CO_2 emissions from aviation (Eurocontrol, 2021).

Various approaches exist to reduce emissions in aviation. In addition to advancements and optimizations in aircraft design (weight, aerodynamics, etc.), using more sustainable fuels is crucial. Sustainable Aviation Fuels (SAF) offer a more sustainable alternative to kerosene, reducing both CO_2 and non-CO_2 effects (Dr. Hepperle, 2023). Compared to conventional jet fuel, SAF produces up to 80 % less CO_2 emissions over its life cycle already today (IATA, 2023b). However, IATA forecasts that SAF will be utilized in only 0.53% of all flights in 2024 (IATA, 2023c). Hindrances to wider adoption include the substantial costs of new technologies and production methods (Shahriar & Khanal, 2022).

It is assumed that SAF prices will surpass those of fossil kerosene in the foreseeable future, which will also be noticeable to customers (Gerhards, 2023; IATA, 2023a). Starting in 2025, the European Union will introduce a mandatory minimum quota of 2% for the use of SAF, increasing to 70% by 2050 (European Parliament, 2023a).

This thesis examines the changes in customer behavior concerning introducing SAF in more detail. While previous studies have offered initial insights on the topic, this thesis aims to explore key customer behavioral factors for SAF in more detail through semi-structured expert interviews and a survey. Primarily focused is the analysis of the willingness to pay (WTP). Furthermore, a study is conducted on whether airline incentives can increase WTP for SAF and their influence on fostering long-term customer loyalty.

This leads to the following research question:

How does integrating Sustainable Aviation Fuels (SAF) within the European aviation industry influence key customer behavior factors, and what role do incentives play in encouraging greater adoption?

This inquiry aims to provide airlines with insights into the evolving preferences of their future clients, enabling them to adjust their strategies accordingly.

2 Theoretical Discussion

This literature review provides an overview of sustainable aviation focusing on Sustainable Aviation Fuels (SAF), including of production processes, the current landscape and regulations, and projected future price developments. Additionally, the current state of research regarding the impact of SAF on customer behavior is described.

2.1 Sustainable Aviation

The aviation industry faces the challenge of reducing its environmental impact and adopting more sustainable practices. A crucial aspect of this is reducing greenhouse gas emissions, which are significant for climate change. The ICAO Assembly embraced a shared long-term goal for international aviation, setting its sights on achieving net-zero carbon emissions by 2050 (ICAO, 2022). To achieve this, a combination of various measures will be necessary (Eurocontrol, 2022). Novel technologies such as electric propulsion, alternative fuels, and enhanced aircraft designs must be developed (World Economic Forum, 2022). Additionally, more efficient flight routes, optimized aircraft maintenance, and promoting environmentally friendly operational procedures are essential approaches that require further research (Lai et al., 2022).

According to all scenarios of the Eurocontrol Aviation Outlook 2050, the share of long-haul flights will increase, responsible for around 53% of aviation's CO_2 emissions by 2050. Over this time, developing any substitute, such as hydrogen or battery-electric technologies, will remain challenging, especially for long-haul flying (Eurocontrol, 2022). Denis Huet, Head of Aviation Intelligence, states: "There might be some hybrid electric aircraft by 2050 but not many if you consider the time to develop these aircraft and certify them. In any case, they will not be operating on long-haul routes by that date." (Huet, 2022) Therefore, it is assumed that using SAF is the most promising way of reducing CO_2 emissions from air travel in the foreseeable future (Eurocontrol, 2022).

2.2 Carbon Offsetting

In addition to CO_2 reduction, there is another category: CO_2 offsetting (Thess, 2021).

Carbon offsetting in the aviation industry, including initiatives like CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) and the EU ETS (European Union

Emissions Trading System), aim to mitigate the environmental impact of air travel by funding projects that reduce greenhouse gas emissions elsewhere. CORSIA, as the first global carbon offsetting scheme for aviation, requires airlines to offset their emissions above a certain baseline by purchasing carbon credits from approved projects. Similarly, the EU ETS mandates airlines operating within the European Economic Area to acquire emission allowances or face penalties for exceeding their allocated limit (ICAO, 2019).

While these schemes provide mechanisms for airlines to address their carbon footprint, they also pose risks. Supporters argue that CO_2 compensation is an efficient market-based tool for climate protection, whereas critics emphasize the lack of verifiability and label CO_2 compensation as indulgence trading. According to the latter, compensation measures do not reduce the CO_2 emissions of aviation but rather shift emission reduction to other sectors of the economy. Therefore, the reliance on offsetting may divert attention from more sustainable measures such as technological advancements or modal shifts (Thess, 2021). Balancing the effectiveness of carbon offsetting with the need for broader emissions reduction strategies remains challenging for the aviation industry. The following section explains how SAFs can contribute to reducing emissions.

2.3 Sustainable Aviation Fuels

From a technical standpoint, Sustainable Aviation Fuels (SAF) encompass all aviation fuels manufactured without using fossil feedstocks such as conventional kerosene. Moreover, SAFs adhere to sustainability standards established by the International Civil Aviation Organization (ICAO). To qualify, SAFs undergo a stringent certification process, proving their physical and chemical properties closely mirror those of fossil jet fuel. They must also demonstrate safe blending capabilities. Consequently, SAF can be seamlessly integrated into the existing global fleet without necessitating fuel delivery infrastructure or aircraft modifications (EASA, 2022).

2.3.1 Production Processes

Seven SAF production techniques are approved as of January 2022. Furthermore, two 5% blending limit procedures have been approved for co-processing renewable feedstock in oil refineries. A Technology Readiness Level (TRL) can be used to define the technological maturity of each industrial pathway. One stands for basic ideas, while nine means that an actual system has been proven in an operational environment. Working groups are examining options

for using 100% SAF in aircraft engines by 2030 through blending different SAF or adjusting raw materials and production processes. The aviation industry is already conducting research and test flights to assess the impact of 100% SAF on emissions and performance, with promising initial results (EASA, 2022).

Production pathway	**Feedstocks**	**Blending limit**	**TRL (1-9)**
Biomass Gasification + Fischer-Tropsch (Gas+FT)	Energy crops, lignocellulosic biomass, solid waste	50%	7-8
Biomass Gasification + Fischer-Tropsch with Aromatics	Energy crops, lignocellulosic biomass, solid waste	50%	6-7
Hydroprocessed Esters and Fatty Acids (HEFA)	Vegetable and animal fat	50%	8-9
HEFA from algae	Microalgae oils	10%	5
Direct Sugars to Hydrocarbons (DSHC)	Conventional sugars, lignocellulosic sugars	10%	7-8 or 5 (lignocellulosic)
Alcohols to Jet (AtJ)	Sugar, starch crops, lignocellulosic biomass	50%	7-8
Catalytic Hydrothermolysis Jet (CHJ)	Vegetable and animal fat	50%	6
FOG Co-processing	Fats, oils, and greases	5%	-
FT Co-processing	Fischer-Tropsch bi-ocrude	5%	-

Table 1: Drop-in SAF-approved pathways (EASA, 2022)

The most widely adopted method for producing SAF is the Hydrogenated Esters and Fatty Acids (HEFA) process. This process involves refining vegetable and animal fats, such as used cooking oil, and then removing oxygen through hydrodeoxygenation. Subsequently, hydrocarbons are cracked and isomerized to the appropriate chain length (EASA, 2022).

Other less prevalent methods for producing SAF include the Alcohol-to-Jet (AtJ) process, which converts biomass into ethanol and eventually into fuel, and the Fischer-Tropsch synthesis, involving the hydrogenation of carbon monoxide (Van Dyk & Saddler, 2021).

The most environmentally friendly pathway for SAF production is through Power-to-Liquid (PtL) processes, where liquid fuels are produced using (green) electricity via hydrogen electrolysis. However, these processes are still in the developmental stage and are not yet widely utilized for kerosene production on an industrial scale (Van Dyk & Saddler, 2021).

2.3.2 Current Landscape and Regulations

The SAF business is still in its infancy from the perspectives of production capacity and demand, with EU supply accounting for less than 0.05% of global jet fuel consumption in 2020. By 2030, more businesses are set to enter the SAF market, potentially boosting Europe's capacity to 2.3 million tons. The primary sources are expected to be AtJ and HEFA fuels, derived mainly from cooking oils, animal fats, and waste oils. Forecasting beyond 2030 remains challenging due to limited disclosures by fuel companies (EASA, 2022). According to EU regulation, fuel suppliers must ensure that EU airports receive a minimum share of SAF: 2% by 2025, 6% by 2030, 34% by 2040, 42% by 2045, and 70% by 2050. For synthetic fuels produced from captured CO_2 emissions using electricity, there is a quota of 1.2% starting in 2030, which will be raised to 35% by 2050 (European Parliament, 2023b).

Year of start	2025	2030	2035	2040	2045	2050
SAF share	2%	6%	20%	34%	42%	70%
Thereof synthetic fuels	0%	1.2%	5%	10%	15%	35%

Table 2: EU SAF mandates (European Parliament, 2023a)

The goal of the ReFuelEU Aviation Regulation is to ensure equal conditions for all actors within the EU by establishing standardized regulations on the uptake and supply of SAF. Specifically, the regulation aims to prevent divergent requirements that could exacerbate refueling practices and distort competition among aircraft operators (Council of the European Union, 2023). European airlines state that non-EU airlines operating at their hubs outside the EU are not subject to SAF quotas. This allows them to offer flights at lower prices and potentially divert

significant traffic from European hubs. As a result, emissions could not be reduced; instead, they could be shifted elsewhere (Airlines for Europe, 2023). However, based on the literature, this risk might not be as significant as some stakeholders perceive. For instance, a study conducted by Oxera in May 2022 on behalf of the airport association ACI-Europe suggests that EU hubs could experience a loss of 4% of transfer passengers by 2030 and 9% by 2050 as they opt for flights to non-EU hubs with lower charges. Despite a slight carbon leakage resulting from increased emissions on routes to non-EU airports, Oxera concludes that the EU's package of measures still leads to an overall reduction in emissions (Oxera, 2022). A study by SEO and NLR reaches a similar conclusion, estimating a carbon leakage risk of 1% of 2035 baseline emissions (SEO & NLR, 2022).

An EU label will be introduced in 2025 to inform airline customers about the use of sustainable fuels. It will provide information on the CO_2 footprint and CO_2 efficiency per kilometer. Fines will be imposed if airlines, airports, or fuel manufacturers violate the blending requirement for SAF. This will fill a new fund to invest in sustainable aviation fuels, innovative propulsion technologies, and research into new engines (European Parliament, 2023b).

Renewable hydrogen is also slated to be part of the sustainable fuel mix. EU airports must assist aircraft operators in accessing SAF by providing hydrogen refueling and electric charging infrastructure (Soone, 2023). Meeting the demand will necessitate significantly expanding SAF manufacturing facilities and renewable energy resources.

2.3.3 Price Development

Scott Kirby, CEO of United Airlines, conveyed to the Financial Times, “There's no sustainable aviation fuel that is cost competitive yet with traditional jet fuel” (Bushey et al., 2021).

The costs of SAF vary depending on the production method. According to IATA, the average price per ton of SAF in 2022 was $2400, roughly 2.5 times higher than conventional aviation kerosene (IATA, 2023a). The European Aviation Safety Agency (EASA) states that it is challenging to forecast accurately how SAF prices will change over time. Long-term trends should see a decline in the cost of producing SAF, made possible by economies of scale and technological advances (EASA, 2022). However, for the foreseeable future, spanning the next 10 to 15 years, it is reasonable to expect that the prices for SAF will exceed those of fossil kerosene. This holds even when factoring in potential carbon dioxide taxes on fossil fuels, which are anticipated to elevate prices further (Gerhards, 2023).

Therefore, accurately assessing the transformation estimate hinges on understanding how non-fossil fuels' costs evolve compared to fossil fuels, considering the internationalization costs associated with greenhouse gases (CENA Hessen - Kompetenzzentrum Klima- und Lärmschutz im Luftverkehr, 2021).

2.4 Strategic Management Concepts

Strategic management refers to the process of formulating, implementing, and evaluating long-term goals and strategies that assist an organization in achieving its mission and enhancing its competitiveness (David & David, 2022). This discipline encompasses a variety of concepts, theories, and approaches that aid organizations in effectively utilizing their resources, identifying opportunities, and addressing challenges (Barney, 1991).

Strategic management is critical for addressing current challenges in the aviation industry, such as reducing greenhouse gas emissions and introducing sustainable technologies (Baum & Auerbach, 2017). For instance, adopting SAF necessitates careful strategic planning to promote the transition to environmentally friendly fuels while ensuring the profitability and competitiveness of airlines.

2.4.1 Public goods – Free riding

In public discourse on environmental awareness, the recurring topic of a disparity between environmental consciousness and behavior inevitably arises. This phenomenon refers to the common finding in empirical studies that while individuals exhibit a high level of environmental consciousness, their actions often fail to align with it. Despite societal beliefs acknowledging growth limits and advocating for resource conservation, conspicuous consumption patterns persist. Empirical social research identifies a significant discrepancy between attitudes and actions, indicating that more positive attitudes toward environmental protection do not necessarily translate into more environmentally sustainable behaviors (Csutora, 2012). The question arises as to what the underlying reasons for this disparity are.

Concerning the utilization of the environment, the following applies:

1. Non-excludability: Environmental goods are accessible to all, with no exclusionary barriers to consumption (Kaul et al., 1999; Samuelson, 1954; Uitto, 2016).

2. Non-rivalry: Multiple individuals can utilize environmental goods simultaneously, precluding rivalry over their use (Kaul et al., 1999; Uitto, 2016).

Economists classify goods meeting these criteria as public goods. The crux of the issue with environmental goods lies in the reluctance of individuals to pay for them, as they can enjoy the benefits without incurring a cost. This behavior is commonly referred to as free riding (Stiglitz, 1999). Due to economic or political considerations, the state is called upon to overcome this market failure and to provide public goods or to create legal regulations for dealing with them (Pasour Jr, 1981). Formerly freely accessible goods may transition into economic goods if their availability is constrained, such as due to ecological degradation (European Environment Agency, 2018).

2.4.2 Airline Pricing

The airline industry is known for its advanced use of complex pricing strategies. Today, ticket prices for the same flight can fluctuate wildly and often change dynamically, even for seats close to one another (Etzioni et al., 2003; Narangajavana et al., 2014). It is not uncommon for the price of a single flight to change up to seven times in one day (Etzioni et al., 2003). While customers aim to find the cheapest tickets, airlines maximize their revenue and profits. However, mismatches between seat availability and passenger demand often result in customers paying more or airlines losing potential revenue. Airlines have sophisticated tools to manage their pricing strategies, but customers are also becoming more savvy, using various online tools to compare prices from different airlines (Li et al., 2014). Moreover, competition among airlines makes determining the optimal pricing challenging for everyone involved (Abdella et al., 2021).

2.4.3 Price Differentiation

Performance-based price differentiation is a strategic pricing approach that fosters a win-win scenario. Enhancements in products and services deliver more excellent customer value alongside higher supplier profitability (Shapiro, 2002).

This type of price differentiation is based on the premise that customers are willing to pay more for additional services or features. A classic example of this is the differentiated pricing of airline tickets. Airlines offer various fare options that differ in services, such as flexibility in changing flights, seat selection, meals on board, baggage allowance, etc. Customers can choose between fares depending on their preferred services and how much they will pay. Companies

can increase customers' WTP through performance-based price differentiation by providing additional incentives matching their needs and preferences (Botimer, 1994).

2.5 Customer Behavior

As the world's population is growing and getting wealthier, especially in developing countries, the demand for air travel is anticipated to double by 2040 compared to 2019, demonstrating a steady average annual growth rate of 3.4%. Accordingly, passenger numbers are expected to grow from around 4 billion in 2019 to just over 8 billion by 2040 (IATA, 2023a). This makes it all the more important to apply social science methods to understand human behavior regarding sustainable energy use and associated climate change. For example, Wüstenhagen et al., 2007 highlight the need to generate substantial public support for new energy solutions, as ignoring the social context of sustainable energy technologies can slow their development and adoption in broader markets (Kelly et al., 2019; Pasqualetti, 2011). Compared to other sustainable energy options (such as wind and solar), less attention has been paid to studying the social acceptance of low-carbon fuels in the transport sector, such as road and aviation (Chin et al., 2014; Kumar & Sinha, 2022).

2.5.1 Willingness to Pay

According to the standard economic view, the WTP (or reservation price) is the maximum price a consumer is willing to pay for a certain quantity of a product or service (Wertenbroch & Skiera, 2002). At this price, it does not matter to the consumer whether he buys because the WTP reflects the product's inherent value in monetary terms. This means that the product and the money have the same value, so spending money on a product is equivalent to keeping the money (Schmidt & Bijmolt, 2020). Several studies have investigated the WTP for low-carbon jet fuels (LCJF).

Two empirical studies were conducted to explore individuals' attitudes towards sustainable air travel initiatives. Participants engaged with hypothetical scenarios involving the utilization of commercial aircraft engineered to diminish greenhouse gas emissions by varying degrees (ranging from 10% to 50% in 10% increments). Their WTP, an additional percentage (5%, 10%, or 15%) of the ticket price, was subsequently probed. The first study exclusively examined short-haul domestic flights, while the second study concentrated on international long-haul flights. Findings unveiled a positive correlation between the magnitude of greenhouse

gas reduction and participants' willingness to incur additional costs, underscoring a prevailing sentiment of support for eco-friendly endeavors within the aviation sector. When greenhouse gas emissions were significantly reduced, people were generally more willing to pay the higher ticket price. Nevertheless, this was only mildly noticeable at a 15% rise in ticket price, especially for long-haul flights. In addition, women tended to pay more for the extra ticket on average than males. However, this tendency was more noticeable for shorter domestic trips than longer flights (Rice et al., 2020).

Another study identified five key factors explaining WTP: social trust, attitude, perceived risks, level of education, and age. Social trust and positive attitude were positively correlated with WTP, while higher perceived risks led to decreased WTP. Higher education levels were associated with increased WTP, possibly due to increased social trust or decreased perceived risks. Furthermore, younger individuals were more likely to be willing to pay for LCJF, while gender did not emerge as a significant factor in WTP for LCJF, contrary to previous research (Xu et al., 2022).

Current figures reveal a disconnect between theoretical assumptions and actual customer spending on SAF. Only a tiny percentage of passengers are willing to pay a premium for SAF, and research has yet to fully explore the reasons for this discrepancy (Gerhards, 2023). This gap presents a significant challenge in predicting customer behavior. Therefore, this thesis aims to investigate passengers' WTP for SAF in detail, using practical examples from long-, medium-, and short-haul flights. Additionally, it examines how offering incentives when purchasing SAF can increase WTP based on the management theory of performance-based price differentiation. Understanding passengers' WTP for SAF enables airlines to optimize pricing and marketing strategies, accurately forecast demand, and enhance customer engagement. Ultimately, it can help airlines achieve sustainability goals and economic profitability.

2.5.2 Loyalty

A study conducted in 2022 revealed that environmental responsibility could confer advantages to airlines by fostering customer satisfaction, in addition to traditional determinants of customer loyalty such as brand perception and perceived value. Moreover, the investigation demonstrated that contented customers are more likely to re-engage with airline services and propagate positive word-of-mouth endorsements, thereby fortifying customer loyalty. This finding

underscores the correlation between an airline's perceived commitment to environmental concerns and the cultivation of customer loyalty (Baumeister et al., 2022).

Utilizing incentives rewards environmentally friendly behavior and has the potential to foster customer loyalty among those who choose to book flights with SAF (Santos & Delina, 2021). Preliminary suggestions include offering triple miles for every SAF booking, priority boarding privileges, complimentary baggage allowances, or a complimentary drink onboard (Gerhards, 2023). This thesis seeks to determine which incentives persuade passengers and how airlines can utilize them to foster long-term loyalty among passengers.

3 Methodology

The upcoming chapter outlines the methodology adopted in this research, which includes research design, primary data collection, and secondary data collection.

3.1 Research Design

Research methods commonly include quantitative, qualitative, or triangulation/ mixed methods (Mulisa, 2022). This research embraced triangulation as it allows for a comprehensive understanding of the outcomes, surpassing what any single approach could offer (Heale & Forbes, 2013).

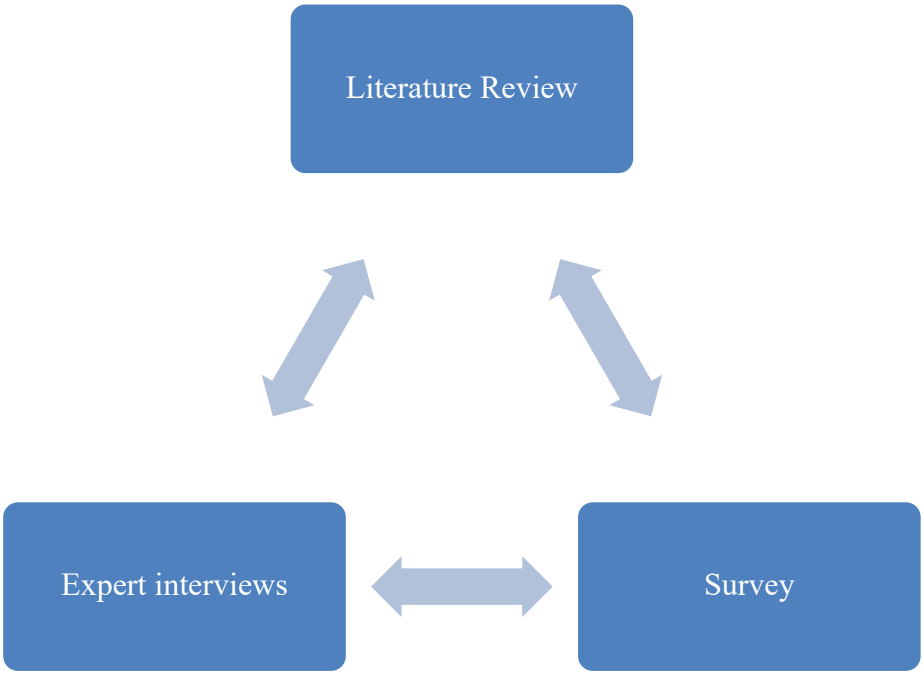

Figure 1: Triangulation approach

Integrating qualitative and quantitative methodologies enables the mitigation of inherent limitations within each method by juxtaposing findings from varied perspectives (Graham, 2005). Three outcomes may emerge: (1) convergence of results leading to consistent conclusions, (2) complementary results providing additional insights, and (3) divergent findings prompting deeper understanding. While triangulation is often praised for enriching research, its drawbacks must also be recognized. One concern is that it assumes data from different methods

can be easily compared and are equally important. Moreover, just because findings align does not always mean they are valid, as each dataset might have flaws (Heale & Forbes, 2013).

3.2 Data Collection

This section details the data collection methodologies utilized in this study. Primary data was gathered through expert interviews and a survey, while secondary data was obtained from a review of relevant literature.

3.2.1 Primary Data Collection - Expert interviews

Following Gioia's qualitative content analysis methodology, the study aimed to illuminate the impact of SAF introduction on key customer behavioral factors. This interpretive research anchors findings in interviewees' perspectives, correlating them with relevant theory (Gioia, 2021). Initially, data is structured into first-order concepts from transcripts, preserving the interviewees' language (Gioia, 2021; Gioia et al., 2013; Magnani & Gioia, 2023). These concepts are then categorized for comparison. Second-order analysis identifies emerging themes aligned with established theory (Gioia, 2021; Magnani & Gioia, 2023). Finally, themes are consolidated into dimensions to elucidate interdependencies and relationships (Gioia et al., 2013; Magnani & Gioia, 2023).

A comprehensive approach was adopted to achieve data saturation. Initially, a sample size of 10 interviews was conducted, ensuring diverse representation. A criterion for cessation was established: if, after ten interviews, no new insights emerged from three additional interviews, this was defined as the point of data saturation. This criterion was systematically tested after each subsequent interview, ensuring rigor and completeness (Francis et al., 2010). In parallel, to assemble a comprehensive panel of experts, outreach efforts targeted over 150 potential interviewees via email and LinkedIn. These efforts resulted in a wide range of perspectives and practical experiences being gathered, as detailed in *Table 3*. Various experts familiar with SAF were interviewed, including industry practitioners, researchers, developers, experts from non-governmental organizations, and consultants. After 15 interviews, data saturation was achieved following the procedure described.

Interviews were conducted using online video conferencing tools such as Microsoft Teams or Zoom, facilitating personalized interaction within a secure and efficient virtual environment,

transcending geographical barriers. Each interview, lasting between 30 and 60 minutes, allowed for a thorough exploration of the interviewee's perspectives and experiences. Furthermore, every interview was recorded and transcribed to ensure accuracy and completeness. All crucial quotes from the expert interviews can be found in *Appendix A, Table 16*. The full transcripts are available only upon request and with the prior consent of the respective expert for privacy reasons.

Interviews followed a guideline *(see Appendix A, Table 15)*, which included a standard set of questions covering the following topics: Introduction, participant information, background questions, understanding of Sustainable Aviation Fuels, impact on passenger behavior, airline strategies and adaption, challenges and opportunities, and future outlook, and closing. The interview guide mainly included open-ended, non-leading questions to enable in-depth analysis and encourage the interviewees to share their insights and ideas (Gioia et al., 2013). The elaborated guideline enables comparable responses and ensures that the investigative interviews aim toward answering the defined research question. Additionally, three questions were included on a Likert scale to compare significant opinions. The interview protocol was enhanced to include concepts and mechanisms that emerged throughout the interview series (Gioia et al., 2013).

List of interview partners:

#	Type of company	Role of interviewee	Years of experience	Country	Reason for choice of interviewee
1	Airline	Sustainability Manager	3+	Germany	Deep expertise in sustainability from an airline perspective
2	Airline	Sustainability Lead	10+	New Zealand	Experienced reputation, communications, CSR, and strategy leader
3	Airline	Sustainability Manager	3+	Sweden	Expertise in SAF from a Scandinavian airline
4	Airline	Vice President of SAF	10+	UK	Leading SAF expert in Europe

5	Airline	Director of Sustainability	15+	Spain	Aviation professional with more than 17 years of experience
6	Airline	Pilot and Fleet Manager	20+	Sweden	Pilot flying with SAF on daily basis
7	Fuel Supplier	Advisor Growth & SAF	10+	Austria	Focused on SAF, new airport entry evaluations, and contract negotiations with airlines
8	Fuel Supplier	Project Control Consultant	5+	Finland	Experienced project manager in the aviation fuel market
9	Fuel Supplier	Head of Renewable Aviation	10+	Europe	Long-time employee at one of the largest SAF producers
10	Airport Operator	Senior Vice President Infrastructure	20+	Germany	Experienced manager at one of the biggest European airports
11	Aircraft Manufacturer	European Sustainability Lead	5+	Belgium	Leading expert in European aviation regulatory
12	Research Organization	Project Manager SAF	5+	Germany	Expert in technology pathways of SAF
13	Aviation Initiative	Environmental NGO Representative	3+	Germany	Member of an initiative for aviation fuels from renewable energies
14	Consultancy	Senior Consultant Aviation	5+	Germany	Experienced consultant in aviation specialized on SAF with a focus in data science
15	Consultancy	Partner Aviation	20+	Germany	Long-standing aviation expert with experience from many clients around the globe

Table 3: Interview partners

3.2.2 Primary Data Collection - Survey

In addition to the expert interviews, a Qualtrics survey was conducted. In total, 261 people participated from May 5, 2024, to May 13, 2024. The survey was distributed through various online channels to ensure a representative sample of the entire population was asked.

Seven categories were included: current flight behavior, awareness of the impact of flying on the environment, introduction to SAF, willingness to pay for SAF, willingness to pay for SAF with incentives, customer loyalty, and demographics.

Drawing on the management theory of performance-based price differentiation, the survey investigated the extent to which additional incentives – identified through the literature review and expert interviews – can further increase the WTP for SAF. Previous studies have consistently shown meaningful results are achieved when it is possible to simulate an actual market purchase situation in the survey (Sugden, 1999). Therefore, WTP was assessed using slider questions, where participants could adjust their additional WTP for SAF for specific short-, medium-, and long-haul flight connections with a specified flight price.

Most other multiple-choice questions were answered on a 5-point Likert scale. An odd number of response options was chosen because it includes a neutral option in the middle, which participants can choose if they feel neutral about a topic (Leung, 2011).

Overall, it is essential to note that correlations alone do not yet provide proof of a causal relationship (Barrowman, 2014). Causality means that there is a clear cause-and-effect relationship between two variables. It exists if action A causes result B (Jesussek & Volk-Jesussek, 2024). This study does not examine transparent causal relationships. However, the correlations are checked for plausibility and compared with existing literature.

3.2.3 Secondary Data Collection

The secondary data for this study was curated from various reputable sources spanning esteemed academic journals, prominent research institutes, and respected entities such as NGOs, consultancies, and institutions like the World Economic Forum. In addition to scholarly literature, official websites, and resources from the European Parliament were extensively utilized to comprehend governmental initiatives and forthcoming policy guidelines. The literature review encompassed a diverse array of sources, including academic papers such as those authored by Barney (1991), Baum and Auerbach (2017), Baumeister et al. (2022).

Notably, a considerable number of A-grade sources were consulted to ensure the robustness and reliability of the findings. These sources collectively provided a comprehensive understanding of the subject matter, facilitating informed discussions on topics ranging from SAF to regulatory frameworks and consumer behavior in the aviation industry.

4 Analyses and Results

The thematic analysis reveals several key insights, considering all 15 expert interviews and 216 usable survey responses. Out of the initial 261 survey responses, 45 answers were not analyzed. This adjustment was necessary because 21 participants answered the test question incorrectly, and 24 still needed to complete the survey. The results' analysis is grounded in the dimensions aggregated from the expert interviews using the Gioia method. Critical insights from the expert interviews and the survey are subsequently presented and analyzed for each of the seven aggregated dimensions.

4.1 Significance of SAF

The experts unanimously highlighted the pivotal role of SAF in mitigating carbon emissions from air travel. Interviewee 11 stated: “Sustainable aviation fuels are sort of the star of the debate or the main lever actually that we have to decarbonize aviation.” Interviewee 12 explained that alternatives such as hydrogen airplanes are in development but will still need decades before they can be used on a large scale. A crucial advantage of SAF is that it can already be used in existing infrastructures and airplanes today. Interviewee 10 said: “The airplanes that are being built today are equipped with conventional engines. Such an airplane lasts 20 to 25 years. This means that everything being delivered today will have to fly with fuel unless it is expensively retrofitted. So, until 2050, this is the only way to make flying more carbon-neutral.” (Translated) Interviewee 9 underscored the direct emission reductions achieved through SAF compared to carbon offsetting methods, highlighting the tangible environmental benefits. He stated: “With SAF, you really have avoided emissions and don't have to hope that someone has saved a forest somewhere for carbon offsets, or that they won't chop it down or burn it down or do anything else.” (Translated) The following question, which was asked to all experts, further illustrated the importance of SAF.

How confident are you that SAF will be the primary driver for reducing CO_2 emissions in the aviation sector, rated on a scale from 1 to 7? (1 = No confidence at all, 7 = Utmost confidence)															
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**⌀**
1-7	3	6.5	5.5	7	7	7	/	6.5	6.5	6	7	7	6	5	5	**6.1**

Table 4: Expert opinions on the significance of SAF

The average response was 6.1 on a scale from 1 to 7, indicating that the experts were highly confident that SAF would be the primary driver for reducing CO2 emissions in the aviation sector. Although other important factors, such as higher operational efficiencies, were considered for reducing aviation emissions, the experts currently see SAF as the most crucial factor. This aligns with the forecast in the Aviation Outlook 2050 by Eurocontrol, 2022.

4.2 Production Technologies

The production technology significantly impacts the production costs and, more generally, the supply of SAF. Customer demand can only be met with an adequate supply of SAF. Therefore, sufficient availability of SAF is essential for considering the customer side and their WTP.

There was a consensus among the literature (e.g., European Aviation Environmental Report 2022 by EASA) and experts that a mix of technologies will be necessary to meet aviation's sustainability goals. Interviewee 11 emphasized: “The most important thing is that we keep sustainability criteria across all of them (production pathways) and that we have a pool where the market can choose respecting that sustainability criteria.” While the HEFA technology is predominantly used today, PtL is seen as a promising but cost-sensitive technology, with access to cheap green electricity identified as a crucial factor for its viability. Interviewee 9 noted: “It is relatively clear that PtL will be significantly more expensive than HEFA SAF.” (Translation) While PtL offers long-term sustainability benefits, concerns exist about its current cost competitiveness compared to biobased SAF. This cost challenge poses a barrier to voluntary adoption by airlines, highlighting the need for further cost-reduction efforts in PtL production. In the long term, experts anticipate a gradual shift towards synthetic fuels like PtL, driven by scalability and higher emission reduction potentials than traditional biofuels. This aligns with the European Parliament's quota for synthetic fuels, which must be at least 35% from 2050 onwards, making up half of all SAF used *(see Table 2)*.

The distinction between different production technologies will not be continued for the following considerations: awareness, WTP with or without additional incentives, and loyalty. The literature and experts provided an overview of the current state of technology. However, apart from briefly explaining what SAF is during the survey, the respondents should not get confused about the differences between various production technologies.

4.3 Awareness among passengers and the public

To better understand passenger behavior, especially the WTP for SAF, it is essential to consider the awareness of SAF among passengers.

The experts assumed a low awareness level of SAF among passengers and the general public. Interviewee 11 stated: “I have the impression many people never heard of SAF, especially the flying public.” All experts are asked to rate the awareness of SAF among passengers on a scale from 1 to 7, where 7 means “extremely aware”.

On a scale from 1 to 7, how aware do you think passengers are of SAF? (1 = Not at all aware, 7 = Extremely aware)																
#	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**⌀**
1-7	2	1	2.5	1.5	4	4	2	5	2	2.5	3	1.5	2	3	1.5	**2.5**
1-5	$1.\overline{6}$	1	2	$1.\overline{3}$	3	3	$1.\overline{6}$	$3.\overline{6}$	$1.\overline{6}$	2	$2.\overline{3}$	$1.\overline{3}$	$1.\overline{6}$	$2.\overline{3}$	$1.\overline{3}$	**2**

Table 5: Expert opinions on passenger awareness of SAF

The average response was 2.5 on a scale from 1 to 7. To best compare the experts' assessments with the survey responses, the experts' answers were converted to a 5-point Likert scale analogous to the survey. On a scale from 1 to 5, the average response from the experts was precisely 2.

The survey participants responded as follows:

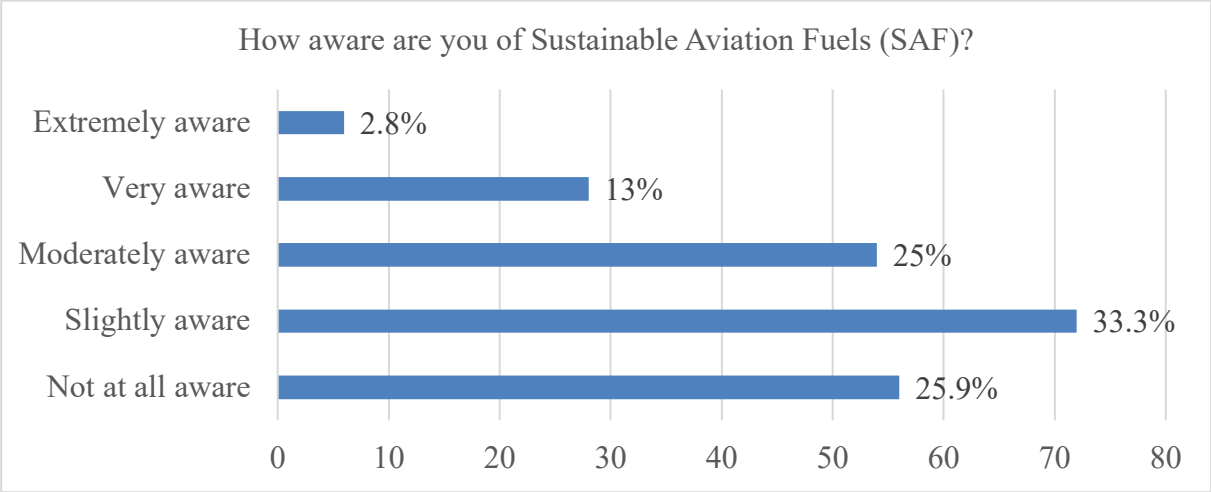

Figure 2: Awareness of SAF

This roughly aligned with the experts' results. The bar chart shows that merely 15.8% of respondents were highly or extremely aware of SAF. Just under 60% had a moderate or slight awareness of it. Over a quarter of respondents remained entirely unaware of SAF. The survey participants' average response was 2.3 on a scale of 1 to 5.

The literature (including Thess, 2021) highlights the risks associated with offsets and clarifies that communication mistakes were made. According to Interviewee 11, it will be a challenge to gain passengers' trust in SAF due to inaccurate statements in connection with offsets in the past: "People don't realize the huge benefits of SAF because we can go back to misleading claims made by offsets that led to not trusting these sorts of solutions."

Interviewee 5 suggested the following actions to increase awareness: "Increasing awareness through various channels like social media, in-flight announcements, and educational campaigns can help bridge the gap between passenger intent and action." This is also evident in the literature. Filimonau et al. examined public attitudes towards biofuels in aviation. They found that while the general potential of biofuels for carbon reduction was recognized, awareness of their use in air travel is low. Additionally, there is a limited understanding of the challenges in adopting biofuel technology in aviation but a strong desire for more information to address this knowledge gap (Filimonau et al., 2018).

4.4 Willingness to Pay

A central theme emerges in the discourse surrounding SAF: passengers' WTP for sustainable air travel. This topic is pivotal as it reflects customer behavior and the potential success of SAF integration within the aviation industry.

From the experts' point of view, only a tiny portion of the population will be willing to pay more for SAF. According to Interviewee 14, people strongly focus on the price: "That is the biggest factor in aviation, that flights are still mainly booked based on price." (Translated) Furthermore, Interviewee 3 stated: "I think the majority still think it's expensive to fly and then they don't want to pay extra money on top of that because it is also nothing that they see or can kind of show off maybe. So it's like money that just disappears, and they don't get any benefit. I mean, people are only human; they want something." Another reason for a low WTP could be that the population may not see themselves as primarily responsible for paying for SAF, but

instead the companies and the politicians, according to Interviewee 3: “They're probably thinking: why should we fix this and not the politicians or the companies.”

Even though most experts agreed with existing literature that the WTP for SAF is low, some were already observing an upward trend. Interviewee 5 mentioned: “Passengers are increasingly willing to pay more for flights that use SAF, as evidenced by the voluntary contributions already being made in our booking process. On average, passengers are willing to contribute around 2% premium towards SAF voluntary purchases.”

Experts were hesitant about the exact extent of passengers' WTP for SAF. Many could not provide a precise percentage. The average among all six experts who provided a percentage was 7.5%.

Question	⌀
What percentage do you estimate customers would be willing to pay more for SAF?	7.5%

Table 6: Willingness to pay for SAF

Interviewee 7 noted that passengers may be more accepting of cost increases if they perceive them as reasonable. This suggests that if passengers understand the rationale behind SAF costs and believe them to be justified, they may be more willing to absorb them. The price increase can be designed differently: “Price increase will depend on the airline's decision if they want to make more specific flights more expensive or if they're going to distribute the cost impact among all their passengers. So, it will really depend a lot, but definitely it will make more expensive to fly” (Interviewee 11). Crucial is also the relative price increase. Interviewee 9 stated: “That's really the question, are people more willing, let's say, to pay an extra 20 euros when the flight already costs 500 euros or when the flight only costs 120 euros? Because then it naturally looks like you're significantly raising the price. I don't know exactly how that works for most people.” (Translated)

Before analyzing the WTP for SAF based on the survey results, the following table shows that over 90% of respondents have never compensated their flights with SAF.

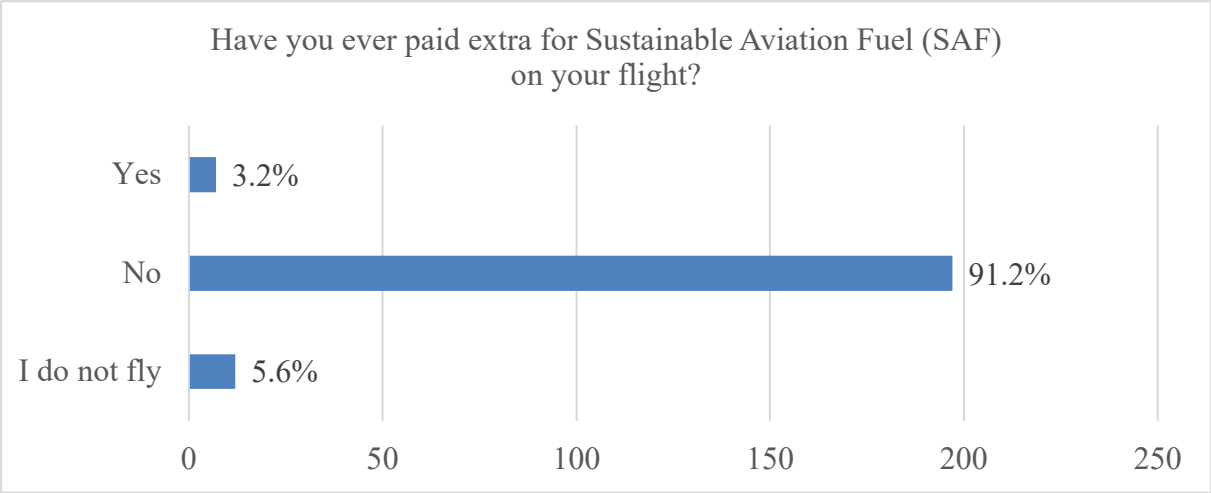

Figure 3: Compensation via SAF

It would have been valuable to conduct a more detailed examination of the respondents who previously paid a premium for SAF. However, since this group only accounts for 3.2% of respondents (7 individuals), the sample size needs to be bigger to draw significant insights. Therefore, the entire group of respondents was continued to be considered, bearing in mind that most have yet to gain practical experience compensating for their flights with SAF. One possible reason for this could be a need for more awareness of SAF.

To analyze the WTP for SAF as realistically as possible, it was surveyed for an exemplary long-haul, medium-haul, and short-haul flight. The departure and arrival airports, the flight price, and the cost for 100% CO_2 compensation with SAF were provided for each flight. The selection of flights was based on popular flight routes and average flight prices on these routes. The surcharge for 100% CO_2 compensation with SAF was calculated through the "Compensaid" platform (Compensaid, 2024).

1. Long-haul flight: Paris (CDG) to Los Angeles (LAX), flight price: 700€, surcharge for 100% SAF: 413€
2. Medium-haul flight: Berlin (BER) to Lisbon (LIS), flight price: 200€, surcharge for 100% SAF: 122€
3. Short-haul flight: Barcelona (BCN) to Madrid (MAD), flight price: 40€, surcharge for 100% SAF: 48€

The following table shows the mean as a percentage of the flight price and the standard deviation (SD) to provide an overview of the stated WTP in the survey. The percentage of SAF corresponding to this WTP is indicated in parentheses below the mean. Additional analyses,

including the median, 25% and 75% quantiles, and the 95% confidence interval of the mean, can be found in *Appendix B, Table 18*.

Descriptive statistics WTP:

		Long-haul	Medium-haul	Short-haul
		WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)
All (N = 216)	Mean	15.3% (25.9%)	26.1% (42.8%)	66.9% (55.7%)
	SD	14.1%	21.1%	55.2%
Male (N = 113)	Mean	14% (23.7%)	23.9% (39.2%)	60.1% (50.1%)
	SD	14.2%	20%	54.3%
Female (N = 102)	Mean	16.8% (28.5%)	28.7% (47%)	74.3% (61.9%)
	SD	13.8%	22.2%	55.7%

Table 7: Descriptive statistics WTP (Extract)

The table reveals that the average percentage WTP for SAF was lowest on the long-haul flight, at 15.3% of the total price. This translates to approximately 107€ for the long-haul flight priced at 700€. Conversely, on the medium-haul flight priced at 200€, the average WTP for SAF was higher at 26.1%, equating to roughly 52€. A significant increase in the percentage of WTP for SAF was observed on the short-haul flight, which accounts for nearly 70% of the flight price, approximately 27€ for the specified 40€ flight. This addresses the question raised by Interviewee 9. The WTP in this survey is significantly higher in percentage terms for cheaper/ short-haul flights.

For the long-haul flight, the average WTP for SAF at 15.3% already corresponds to an SAF share of nearly 26%. According to current EU regulatory guidelines, this quota will not become mandatory until after 2035. On the short-haul flight, the SAF share is even close to 70%, despite a significant increase in the standard deviation. This indicates that there is already a high

average WTP for SAF today, significantly exceeding the EU quotas expected in the coming years.

As with Rice et al.'s study from the literature review, this survey identified a difference between men and women regarding WTP for SAF. On average, men had a slightly lower WTP for SAF. Also, similarly to the findings in the literature, the percentage difference in WTP between men and women is most significant on short-haul flights (men: 60.1%; women: 74.3%). When calculating the Spearman rank correlation, the significant correlation between gender and WTP confirmed a weak association on short-haul flights ($r_s = 0.15$; $p = 0.025$; $N = 215$). However, there was no significant correlation for the medium- and long-haul flight. The Spearman rank correlation is the non-parametric counterpart to the Pearson correlation, providing a reliable measure of connections for ordinal data.

Furthermore, the correlations between the WTP for the three flights were examined:

	Spearman's correlation (r_s)/ p-value	Long-haul WTP for SAF	Medium-haul WTP for SAF	Short-haul WTP for SAF
Long-haul WTP for SAF	r_s	1	0.9	0.62
	p		<0.001	<0.001
Medium-haul WTP for SAF	r_s	0.9	1	0.75
	p	<0.001		<0.001
Short-haul WTP for SAF	r_s	0.62	0.75	1
	p	<0.001	<0.001	

Table 8: Correlations between WTP for SAF

There was a high or very high, positive, and statistically significant correlation between WTP for SAF across all three flight types: long-haul and medium-haul ($r_s = 0.9$; $p < 0.001$; $N = 216$), medium-haul and short-haul ($r_s = 0.75$; $p < 0.001$; $N = 216$), and long-haul and short-haul ($r_s = 0.62$; $p < 0.001$; $N = 216$) (Kuckartz et al., 2013).

This showed that individuals with a high WTP for SAF maintain this willingness relatively high regardless of short-, medium-, or long-haul flights. However, it made sense to continue

considering short-, medium-, and long-haul flights separately. There can indeed be significant differences in how the respective WTP is determined.

Spearman's rank correlation coefficient (r_s) was calculated for all survey variables that could be contextually related to the WTP for SAF to investigate which additional variables might influence it. A table with all correlation coefficients can be found in *Appendix B, Table 19*.

The results revealed interesting relationships between the WTP for SAF and environmental attitudes and previous compensation behavior through offsets, age, and income. No correlation was found for all other survey variables.

Spearman's correlation showed a moderate positive relationship between the importance placed on emissions when booking a flight and respondents' WTP for SAF (Long-haul: $r_s = 0.46$; Medium-haul: $r_s = 0.48$; Short-haul: $r_s = 0.39$; $p < 0.001$; $N = 175$). This indicates that the more importance respondents place on emissions, the higher their WTP for SAF across all flight types. This supports the idea that passengers considering emissions are willing to pay more for SAF.

Awareness of climate-damaging air travel emissions showed a slight but significant positive correlation with WTP for SAF, indicating that while awareness has some influence, it does not solely explain WTP for SAF.

Additionally, there was a moderate positive correlation between the frequency of opting for CO_2 compensation and WTP for SAF (Long-haul: $r_s = 0.43$; Medium-haul: $r_s = 0.44$; Short-haul: $r_s = 0.45$; $p < 0.001$; $N = 194$). This showed that respondents who frequently use offsets are generally more willing to pay for SAF than those who use offsets less often. Conversely, it is also interesting to note that, on average, people who have rarely used offsets were less willing to pay for SAF. This aligned with Interviewee 11's assumption that offsets, regardless of the reason for not using them, can also be an obstacle to WTP for SAF.

There was a low correlation between age and WTP for SAF on long-haul ($r_s = 0.22$; $p = 0.001$; $N = 216$) and medium-haul flights ($r_s = 0.21$; $p = 0.002$; $N = 216$). Older respondents tend to have higher incomes, confirmed by a moderately positive correlation between age and income ($r_s = 0.49$; $p < 0.001$; $N = 198$). This is contrary to the study by Xu et al., which found a positive correlation between younger respondents and the WTP for LCJF, which includes SAF.

For long-haul flights, a significant but low correlation existed between income and WTP for SAF ($r_s = 0.18$; $p = 0.013$; $N = 216$), showing that higher income correlates with higher WTP for SAF.

In contrast to the study by Xu et al., there was no significant correlation between the level of education and WTP for SAF.

4.5 Incentives and Loyalty

The interviewees shed light on various opportunities and challenges when offering incentives in connection with SAF.

Interviewee 10 highlighted that incentives must provide tangible benefits to resonate with customers, emphasizing the importance of perceived value. Interviewee 7 suggested that from the perspective of a fuel supplier, creative and visible incentives such as priority seating, free check-in for luggage, free snacks for short-haul flights, or a seat with more legroom could drive customer engagement. Interviewee 15 saw the topic critically and noted: “Everything is overlapping. Every new incentive idea cannibalizes the airline's product variety, landscape, and differentiation opportunities on the flight, where the airline currently makes money.” (Translated) Interviewee 9 raised concerns about inadvertently incentivizing more flying through rewards, emphasizing the need for thoughtful incentives that do not counteract environmental efforts. Finding the right balance between environmental impact and commercial viability remains a crucial challenge for the industry.

Several incentives were queried in the survey to gain more precise insights into the WTP for specific incentives if they were included in the payment for SAF. For selecting incentives, both literature and suggestions from expert interviews were utilized. To avoid overwhelming the respondents, the selection was limited to five incentives on the long-haul flight. On the medium and short-haul flights, there were two additional incentives each. These were a free drink and a free snack. These incentives are typically already included on a long-haul flight. The incentives will be examined separately for long-haul, medium-haul, and short-haul flights to identify possible differences in the correlations.

4.5.1 Incentives Long-haul

The following table illustrates the mean and SD of the additional WTP for SAF on a long-haul flight when the following incentives were included. The percentage of SAF corresponding to this WTP is indicated in parentheses below the mean. Additional analyses, including the median, standard deviation, 25% and 75% quantiles, and the 95% confidence interval of the mean, can be found in *Appendix B, Table 20*.

Descriptive statistics incentives long-haul (N = 216):

	Double air miles WTP (SAF share)	Priority Boarding WTP (SAF share)	Free (extra) piece of luggage WTP (SAF share)	Seat with more legroom WTP (SAF share)	Complimentary lounge access WTP (SAF share)
Mean	2.4% (4%)	1.7% (2.9%)	3.1% (5.3%)	**4.2%** **(7.1%)**	2.8% (4.7%)
SD	3.9%	2.4%	3.1%	4.4%	3.9%

Table 9: Descriptive statistics incentives long-haul (Extract)

The average WTP for SAF among the respondents would increase by 4.2% if a seat with extra legroom were included. This corresponds to a SAF share of 7.1%, according to Compensaid (Compensaid, 2024). The second-largest increase in the average WTP for SAF would be 3.1% if a free extra piece of luggage were included. The other three incentives – complimentary lounge access, double air miles, and priority boarding – showed slightly lower average increases in WTP for SAF at 2.8%, 2.4%, and 1.7%, respectively.

Only minor differences were observed regarding gender. For all incentives except free lounge access, women had a slightly higher WTP for SAF than men, while for complimentary lounge access, it is the opposite.

Correlations were calculated to investigate whether there were correlations between various survey variables and the additional WTP for SAF with incentives *(see Appendix B, Table 21)*. Spearman's rank correlation was used again, as most of the survey variables were measured on a Likert scale and are, therefore, ordinal rather than metric.

There appeared to be only small significant correlations r_s <0.3 (Kuckartz et al., 2013). Thus, no survey variables could adequately explain the influence of additional WTP for SAF when the mentioned extras are included. The formation of individual WTP for SAF with extras appears to be more complex. Nevertheless, a few interesting observations can be made.

The correlations between the influence of WTP without incentives and WTP with incentives were examined. It turned out that respondents who had a high WTP for SAF on a long-haul flight without extras tended to have a higher WTP if the extras priority boarding or a seat with more legroom were included (both: $r_s = 0.23$; $p<0.001$; $N = 216$).

Furthermore, it is interesting that if double air miles ($r_s = -0.15$; $p = 0.002$; $N = 216$) or priority boarding ($r_s = -0.17$; $p = 0.014$; $N = 216$) were included, people who were less aware of the climate-damaging emissions of air travel, on average, had a higher WTP compared to those who were very aware of it. This showed the potential that incentives can have for people who have not yet engaged much with the environmental impacts of air travel. The difficulty related to environmental attitudes and awareness of emissions is that offering passengers personalized incentives is practically challenging because this information is unknown to airlines.

Many extras correlated significantly with age and income. The older the respondent, the higher the average WTP for SAF when double air miles ($r_s = 0.15$; $p = 0.026$; $N = 216$) or priority boarding ($r_s = 0.19$; $p = 0.005$; $N = 216$) were included. The correlation was reversed for a free (extra) piece of luggage and complimentary lounge access. The younger the respondent, the higher the average WTP for SAF when a free (extra) piece of luggage ($r_s = -0.24$; $p <0.001$; $N = 216$) or complimentary lounge access ($r_s = -0.15$; $p = 0.032$; $N = 216$) were included.

There were positive significant correlations between income and the WTP for SAF with the incentives of double air miles ($r_s = 0.15$; $p = 0.037$; $N = 198$), priority boarding ($r_s = 0.15$; $p = 0.034$; $N = 198$), and a seat with more legroom ($r_s = 0.17$; $p = 0.019$; $N = 198$). However, a negative correlation existed with a free (extra) piece of luggage ($r_s = -0.2$; $p = 0.005$; $N = 198$).

Focusing on individuals who fly more frequently is crucial regarding the overall environmental impact. Frequent flyers have a more significant cumulative effect on emissions and are thus a more critical target for SAF initiatives. Their WTP for SAF is much more relevant in practice than the WTP of individuals who fly rarely. Below, an attempt was made to construct a regression model that can provide better insights into this group, allowing airlines to tailor their

strategies more effectively and maximize the adoption of SAF among passengers who travel the most.

Regression (N = 194):

To conduct a linear regression, four assumptions must be met. First, there has to be a linear relationship between the dependent and independent variables. Second, the residuals should be normally distributed. Thanks to the central limit theorem, a violation of this assumption is not problematic for large samples (N > 30) (Kwak & Kim, 2017). Third, there should be no autocorrelation of the error term. The Durbin-Watson test yielded a p-value of 0.909, indicating no autocorrelation. Finally, the variance of the residuals must be constant, meaning no heteroscedasticity should be present. This assumption was also satisfied.

Model summary

R	R^2	Adjusted R^2	Std. Error of the Estimate
0.27	0.07	0.05	92.15

Table 10: Regression model summary

ANOVA

Model	df	F	p
Regression	4	3.74	0.006

Table 11: Regression ANOVA

With an R^2 of 0.07, the regression model indicated that the variables “Every now and then (5-10 times)”, “Rarely (1-4 times)”, “Frequently (11-24 times)”, and “Very frequently (more than 24 times)” to the question of how often one flew in 2023 explained 7% of the variance in the WTP for SAF on a long-haul flight. The model had a standard estimation error of 92.15 for predicting the variable WTP for SAF on a long-haul flight. An ANOVA was conducted to test whether this value significantly differed from zero. Based on the sample, the effect differed significantly from zero, $F = 3.74$, $p = 0.006$, $R^2 = 0.07$.

Coefficients

	Non-standardized coefficient		Standardized coefficient		
Model	B	Standard error	β	t	p
(Constant)	135.7 (19.4%)	18.1 (2.5%)		7.51	<0.001
Rarely (1-4 times)	-11.1 (1.6%)	21.1 (3%)	-0.06	-0.53	0.599
Every now and then (5-10 times)	-63.5 (-9.1%)	21.8 (3.1%)	-0.31	-2.92	0.004
Frequently (11-24 times)	-48.8 (-7%)	24.7 (3.5%)	-0.19	-1.98	0.05
Very frequently (more than 24 times)	-12.5 (-1.8%)	39.2 (5.6%)	-0.02	-0.32	0.751

Table 12: Regression Coefficients

After conducting the linear regression, it was found that the WTP for SAF among respondents who flew “Every now and then” (5-10 times) in 2023 decreased by an average of 63.5€ compared to respondents who indicated they “Never” (0 times) flew in the past year, ceteris paribus. This effect was significant, as demonstrated by the t-test (t (4) = -2.92; p = 0.004).

Similarly, for respondents who flew “Frequently” (11-24 times) in 2023, the WTP for SAF decreased by an average of 48.8€ compared to respondents who “Never” (0 times) flew in the past year ceteris paribus. This effect was also significant, as demonstrated by the t-test (t (4) = -1.98; p = 0.05).

Principle non-flyers were filtered out of the dataset to eliminate the effect of including non-flyers whose WTP for SAF would never apply in practice (N = 194). The results showed that, on average, respondents who flew more frequently had a noticeably lower WTP for SAF than those who had never flown in the past year.

When filtering the dataset for respondents who flew at least five times in 2023, the average WTP for SAF among these respondents only differed slightly if the following incentives were included: 2.6% with double miles, 1.7% with priority boarding, 3.1% with a free (extra) piece of luggage, 4.1% with a seat with more legroom, and 2.9% with complimentary lounge access.

This illustrated that although respondents who flew at least five times in 2023 had a significantly lower WTP for SAF without extras, they were willing to pay about the identical additional amounts for SAF if incentives were included. Airlines could, therefore, examine closely, based on this result, which incentives surpass the costs to offer them. With these incentives, the airline could encourage frequent flyers to pay more for SAF without incurring a financial disadvantage and, simultaneously, can significantly reduce its emissions.

4.5.2 Incentives Medium-haul

The following table illustrates the mean and SD of the additional WTP for SAF on a medium-haul flight when the following incentives were included. The percentage of SAF corresponding to this WTP is indicated in parentheses below the mean. *Appendix B, Table 22* provides additional analyses, including the median, standard deviation, 25% and 75% quantiles, and the 95% confidence interval of the mean.

Descriptive statistics incentives medium-haul (N = 216):

	Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Free drink	Free snack	Complimentary lounge access
	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)
Mean	4.9% (8.1%)	4.1% (6.7%)	6.9% (11.3%)	**8.5%** (13.9%)	3.6% (6%)	3.9% (6.4%)	6.1% (10%)
SD	7.7%	6.8%	7.6%	11.1%	6.2%	6.3%	9.4%

Table 13: Descriptive statistics incentives medium-haul (Extract)

Similar relationships were observed as in the case of long-haul flights, with the difference that the WTP now appeared significantly higher as a percentage of the flight price (approximately twice as high) but approximately 40% lower in absolute terms due to a flight price over 70% lower.

Appendix B, Table 23 highlights all significant correlations between other survey variables and the additional WTP for SAF on a medium-haul flight in bold. Compared to long-haul flights, even fewer substantial relationships could be established here. If significant, the correlations were primarily low (Kuckartz et al., 2013).

The correlations between the influence of WTP without incentives and WTP with incentives were examined. Respondents with a high WTP for SAF on a medium-haul flight without extras tended to have a higher WTP for all extras.

Moreover, the data indicated that, on average, for individuals who were less aware of aviation's climate-damaging emissions, the additional WTP for SAF with incentives was slightly lower than for those who were more aware of the climate-damaging emissions. This applies for the incentives double air miles (r_s = -0.18; p = 0.009; N = 216), priority boarding (r_s = -0.2; p = 0.003; N = 216), seat with more legroom (r_s = -0.15; p = 0.03; N = 216), and free snack (r_s = -0.14; p = 0.036; N = 216). This aligned with one of the objectives of providing additional incentives. Individuals who already place high importance on emissions tend to have a higher baseline WTP for SAF without any incentives. For those who do not prioritize emissions when flying, included incentives offer a way to increase their WTP for a more environmentally friendly alternative.

Concerning age, there were differences between medium-haul and long-haul flights. There was no significant positive correlation with double air miles or priority boarding. However, similar to long-haul flights, there was a moderate negative correlation with a free (extra) piece of luggage (r_s = -0.31; p <0.001; N = 216). Thus, younger respondents also had a higher average WTP for SAF than older respondents when a free extra piece of luggage was included. Since age and income correlated among the respondents, the average income was also lower for those with a higher WTP for SAF when a free (extra) piece of luggage was included (r_s = -0.17; p = 0.014; N = 198).

4.5.3 Incentives Short-haul

The following table illustrates the mean and SD of the additional WTP for SAF on a short-haul flight when the following incentives were included. The percentage of SAF corresponding to this WTP is indicated in parentheses below the mean. *Appendix B, Table 24* provides additional analyses, including the median, standard deviation, 25% and 75% quantiles, and the 95% confidence interval of the mean.

Descriptive statistics incentives short-haul (N = 216):

	Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Free drink	Free snack	Complimentary lounge access
	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)	WTP (SAF share)
Mean	9.1% (7.6%)	9.2% (7.7%)	15.9% (13.3%)	**17.1%** (14.2%)	8.8% (7.3%)	8.9% (7.4%)	11.5% (9.6%)
SD	20.1%	18.8%	21.9%	24.9%	17%	16.7%	21%

Table 14: Descriptive statistics incentives short-haul (Extract)

Similar relationships were observed with the long- and medium-haul flight, with the difference that the WTP for the short-haul flight was significantly higher as a percentage of the flight price (approximately twice as high). However, compared to the medium-haul flight it was about 60% lower in absolute terms due to an 80% lower flight price.

For short-haul flights, there were few significant correlations between the additional survey questions and the WTP for SAF with included incentives *(see Appendix B, Table 25)*.

The correlations between the influence of WTP without incentives and WTP with incentives were examined. Respondents with a high WTP for SAF on a short-haul flight without extras tended to have a higher WTP for all extras except complimentary lounge access. In contrast to long- and medium-haul flights, this study found no significant correlations between WTP for SAF with incentives and environmental attitudes on short-haul flights.

Again, a free (extra) piece of luggage negatively correlated with age (r_s = -0.25; p <0.001; N = 216). However, in contrast to the long- and medium-haul flight income did not show a significant correlation with the short-haul flight. This was likely due to the relatively low costs of short-haul flights, which are affordable for almost everyone. Here, the additional consideration of the individual's financial leeway helped. The correlation remained negative (r_s = -0.19; p = 0.005; N = 216). Respondents with less financial leeway had a higher average WTP for SAF with an included free (extra) piece of luggage than those with greater financial leeway.

4.5.4 Further Incentives

In addition to the incentives identified through the literature review and expert interviews, the survey also asked respondents to suggest other incentives that would increase their WTP for SAF if included in the price.

Some survey participants addressed skepticism about SAF's effectiveness. Providing credible assurance of using SAF through transparency and certification would reassure them. Others strongly desired enhanced travel comfort and convenience, such as upgrades, free seat selection, priority security, faster lanes, and free Wi-Fi. Participants also noted that flexibility in booking and financial incentives like discounts and loyalty points would motivate them to support SAF. Additionally, integrating free or discounted public transportation to and from the airport was highlighted as a way to enhance the sustainability of the travel experience for environmentally conscious travelers.

The results indicated a general willingness among passengers to pay more for SAF if additional incentives are offered. These incentives span various stages of the customer experience, beginning with flexible cancellation options before the flight, eco-friendly transportation to the airport via train or public transit, a more comfortable and expedited process at security and boarding, an enhanced onboard experience, and loyalty benefits after the flight.

4.5.5 Loyalty

In terms of loyalty, one notable approach is SAS Scandinavian Airlines' introduction of Green Fares, offering customers the option to purchase biofuel blocks to offset their flights. Interviewee 3 elaborated on SAS's conscious traveler program, aiming to educate and incentivize eco-conscious travel behaviors. Corporate sustainability programs are also offered, highlighting the collaboration between airlines and companies to reduce emissions. However,

Interviewee 4 pointed out voluntary sustainability programs' complexities and potential pitfalls, emphasizing the difficulty of aligning profit motives with environmental benefits. Moreover, the challenges of integrating sustainability programs into booking flows without cannibalizing other revenue streams illustrate the delicate balance airlines must strike.

Following the study by Santos & Delina, the survey results confirmed that offering incentives would increase most passengers' loyalty to a specific airline, as illustrated in the following diagram.

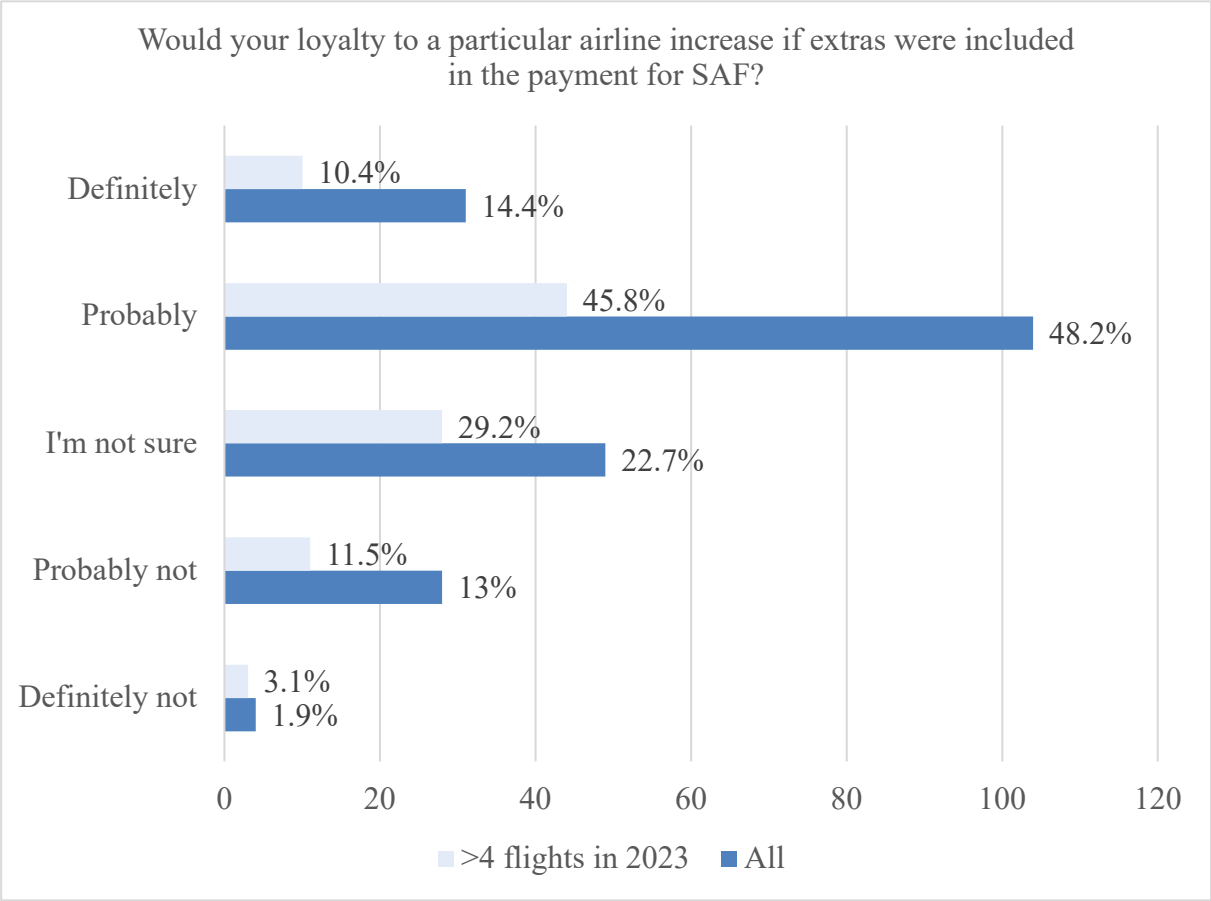

Figure 4: Loyalty

Since loyalty to a particular airline is more relevant for frequent flyers, the responses from those who flew more than four times in 2023 were analyzed separately. A slightly higher percentage of this group were unsure whether their loyalty would increase, but the results are comparable overall.

4.6 Regulatory Requirements

The experts discussed various aspects of SAF and related policies. They highlighted the importance of global cooperation in environmental protection and the need for supportive policies for airlines, particularly in promoting SAF usage. Challenges such as certification of aircraft and fuel supply logistics were mentioned, along with concerns about fluctuating market prices due to mandates. Additionally, the role of organizations like the "Science Based Targets Initiative (SBTI)" in setting voluntary, higher sustainability goals was emphasized. Overall, there was a consensus on the necessity of international collaboration and transparent regulatory frameworks to advance the adoption of SAF in aviation.

The introduction of SAF mandates will change the current situation starting in 2025. Airlines must use a minimum percentage of SAF on their flights. How they achieve this is up to the airlines. One possibility is to add the additional costs incurred from using SAF to the ticket price for each passenger. Alternatively, the airline could continue relying on voluntary SAF payments, with or without incentives.

There are already airlines that currently charge every passenger a fixed percentage to cover the additional costs of using SAF, as Interviewee 1 mentioned: "For example, Air France already has a quota of 1% in France and, as far as I know, passes this on to the passenger. It is possible that the passenger will bear this cost directly. Alternatively, the airline will bear the cost and correspondingly make less revenue." (Translated)

Assuming an airline decides to pass on the additional costs to passengers automatically, the survey found that this would result in a very ambiguous WTP voluntarily beyond the mandatory quota.

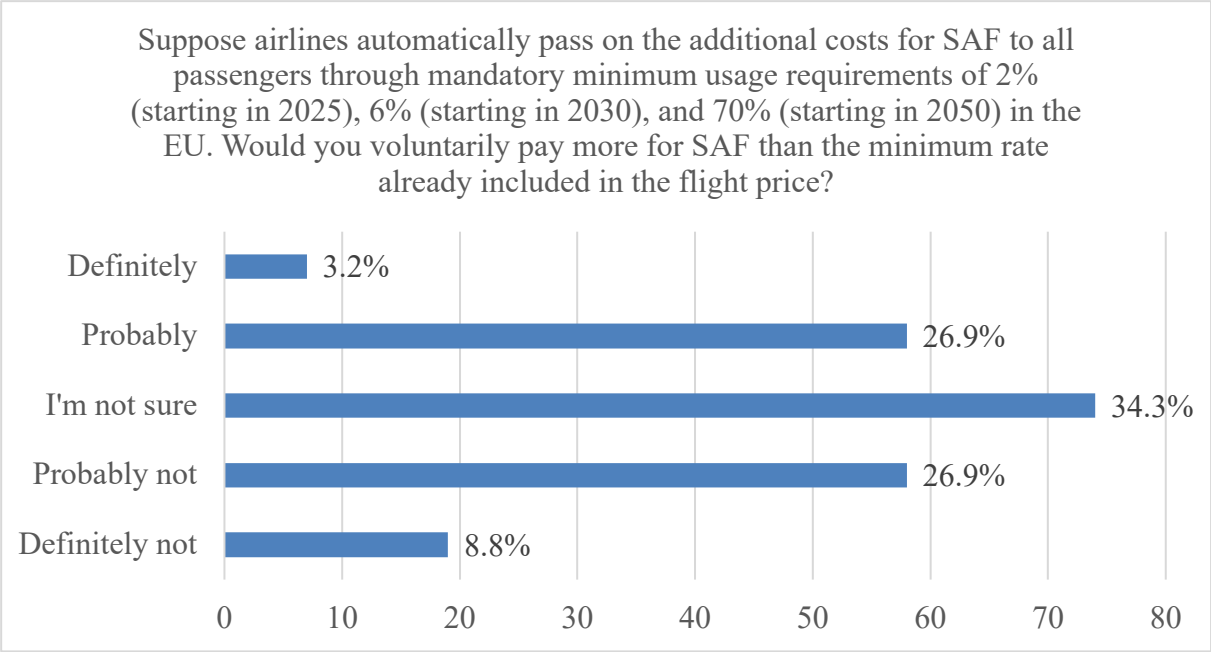

Figure 5: Impact on WTP when introducing mandates

Opinions were divided. Some respondents were willing to voluntarily pay more for SAF despite mandates, while most were unsure. Some respondents were not willing to pay more voluntarily for SAF.

Interviewee 2 expressed concern about potential elitism from the increased costs of SAF. He questioned whether higher prices might create a scenario where air travel becomes accessible only to the wealthy, worsening socioeconomic disparities. This apprehension highlighted the importance of carefully considering how SAF integration may affect accessibility and equity within the aviation sector.

The survey also addressed the concern that air travel is becoming increasingly elitist due to additional costs. Therefore, participants were asked about their perceptions regarding changes in their frequency of flying.

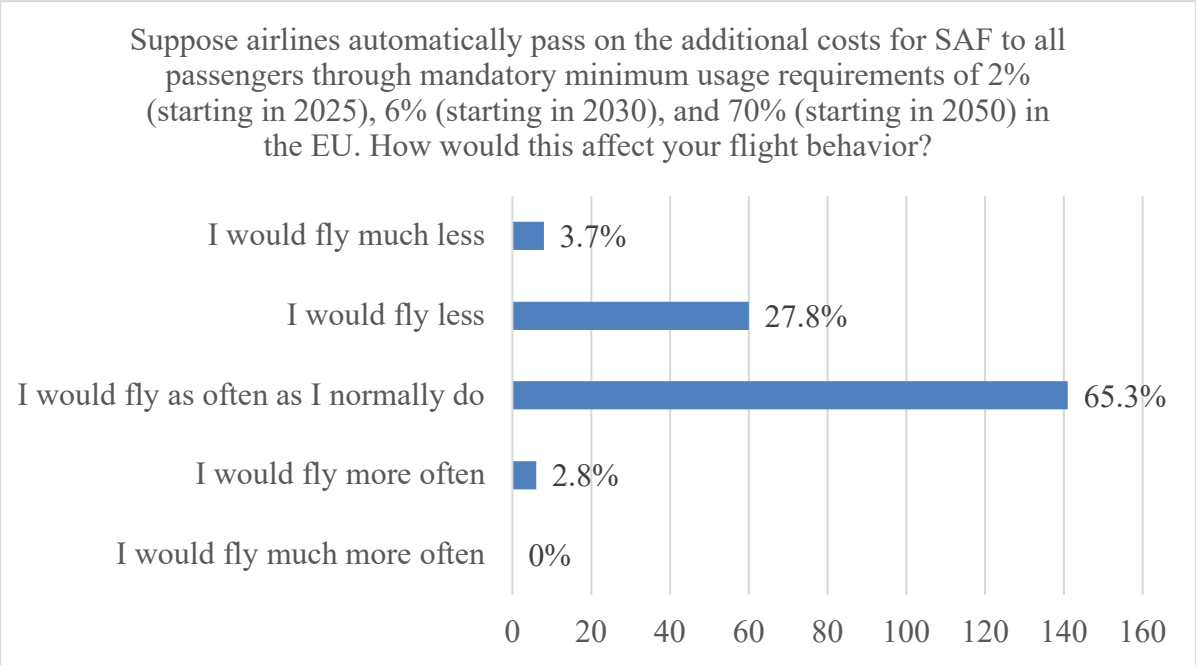

Figure 6: Impact on flight behavior with the introduction of mandates

Approximately two-thirds of the respondents said they would continue to fly as often as before. Nearly 28% will fly less frequently. The correlation was examined to analyze whether flying less frequently correlates with income. Consequently, individuals with lower incomes would potentially be most affected by the increased costs of flying and may reduce their frequency of flying. However, this was not reflected in the survey. The frequency of flying after introducing mandates and income were not significantly correlated ($r_s = -0.02$; $p = 0.77$; $N = 198$). Similarly, the frequency of flying after introducing the mandates and the extent to which your financial means influence your decision when booking a flight did not significantly correlate ($r_s = -0.04$; $p = 0.605$; $N = 216$).

4.7 SAF Strategy

As depicted in the literature, including the works of Baum & Auerbach, strategic management is a significant cornerstone before the implementation of SAF. Interviewees emphasized the competitive landscape, cost considerations, and regulatory pressures shaping airlines' strategies. Many airlines are still in the early stages and are currently in the strategic planning phase. Interviewee 14 recommended that airlines should consider building their own SAF capacities at this point. This involves, at the very least, participating in projects such as refineries for SAF,

as there is currently limited market availability. Like fuel hedging, strategic fuel procurement will mitigate market fluctuations influenced by regulatory changes and airline demand.

Moreover, integrating SAF initiatives into the customer experience, particularly flight booking, is essential. Leveraging distribution channels like online travel portals to sell SAF alongside flights aligns customer choice with sustainability goals. Cross-departmental collaboration is pivotal in SAF adoption. Airlines could involve procurement, investor relations, product design, sustainability, and customer engagement. This interdisciplinary approach ensures comprehensive consideration of SAF integration from scientific, financial, and customer-centric perspectives.

5 General Discussion

The overview of the research findings allows for a final step in summarizing the key insights regarding their added value for theory and practice. The study's limiting factors and recommendations for further research are mentioned. Additionally, it provides a focused perspective on the identified research gap and allows for a targeted response to the underlying research question.

5.1 Main Conclusions

This study has elucidated the importance of Sustainable Aviation Fuels (SAF) for the decarbonization and future sustainability of aviation. According to the literature and experts, SAF, potentially reducing CO_2 emissions by up to 80%, represents the most significant lever currently available.

However, widespread adoption of SAF faces challenges due to limited availability and higher production costs than conventional kerosene. Biofuel production requires specific biological residues, while synthetic fuels demand substantial renewable energy.

From 2025, the European Union will mandate the market ramp-up of SAF through compulsory quotas. This will provide long-term planning security for SAF producers and oblige all SAF distributors to adhere to these quotas, compelling airlines to address SAF strategically. A critical aspect of this strategy is managing the higher costs associated with SAF. Airlines will likely pass these additional costs to passengers to meet the quotas. Therefore, understanding passengers' WTP for SAF is crucial.

Previous studies indicate a higher WTP than observed in practice, suggesting a gap between theoretical and practical WTP for SAF. Existing literature and experts point to the absence of incentive structures for purchasing SAF as a potential customer deterrent. However, there are no detailed studies on specific incentives and their impact on WTP for SAF. To address this research gap, this study has focused on the research question: “How does integrating Sustainable Aviation Fuels (SAF) within the European aviation industry influence key customer behavior factors, and what role do incentives play in encouraging greater adoption?”

A triangulation approach was employed to address the research question. This involved drawing on existing methods from the literature, interviewing experts from airlines, fuel producers,

airports, aircraft manufacturers, research institutes, associations, and consultancies, and conducting a survey among the general population.

While previous studies assessed WTP directly as a percentage without further distinctions, this study developed a more detailed and differentiated picture of WTP for SAF. Specifically, WTP for SAF was assessed in absolute terms for specific long-, medium-, and short-haul flights.

To answer the research question, the findings revealed significant variation in customers' WTP for SAF based on flight price and distance. For long-haul flights, the average WTP for SAF was about 15% of the flight price, while for short-haul flights, it was nearly 70%. This exceeded the experts' forecasts and the results of previous studies, especially for short-haul flights, and underscored the need to differentiate between flight types. The current WTP for SAF may already exceed future EU quotas.

Key factors positively influencing WTP included environmental awareness, consideration of environmental impacts when booking, previous compensation measures, gender, and age (linked to income). Moreover, frequent flying negatively impacted WTP.

Incentives like extra legroom seats, additional luggage, and complimentary lounge access notably increased WTP for SAF. However, the financial viability of these incentives varied. The additional WTP for SAF in percentage was more substantial for short-haul flights (9.1% – 17.1%) than for long-haul flights (1.7% – 4.2%), while the absolute WTP for SAF with incentives on long-haul flights was higher. Therefore, it is financially most attractive for airlines to offer incentives that are roughly equally costly regardless of the flight distance on long-haul flights (such as Priority Boarding and Complimentary Lounge Access) and to focus on incentives that are proportional to the flight price on medium and short-haul flights (such as double air miles, free luggage, and seats with more legroom).

For long-haul flights and frequent flyers, incentives are especially relevant. Regarding the literature, long-haul flights contribute significantly to CO_2 emissions. While frequent flyers typically had a lower base WTP for SAF, their WTP increased substantially with included incentives, making this strategy particularly effective for this group.

5.2 Limitations

A key limitation of this work is that only a limited sample of N = 261 was surveyed in this study. While this provides initial insights into correlations, further verification is necessary.

Another limitation of the survey is that, even with specific flight examples, it cannot be ruled out that the stated WTP with and without incentives does not correspond to the actual WTP in practice. During the survey, an attempt was made to help respondents best imagine the booking situation by presenting concrete flights with specific departure and arrival airports and a concrete flight price. Participants did not have to specify a percentage for SAF but had to provide an absolute WTP for SAF in euros.

Furthermore, although the survey was distributed as widely as possible, most responses came from Germany and Austria. For this reason, the results of this work can only be partially generalized to the entire European Union. Meaningful results are available only for the German-speaking region.

Additionally, one more question in the survey would have been beneficial. If respondents had been asked why they had never paid for SAF, it would have been possible to analyze more precisely whether this was due to a lack of awareness or a deliberate decision.

5.3 Future Research

Several connections to this work could yield exciting insights. The topic of SAF with incentive structures is still a very new field that offers various opportunities for further exploration.

The expert interviews and the survey revealed that there is still a certain level of mistrust about SAF. Gathering deeper insights into this mistrust and developing measures to prevent it best would be an exciting topic. Investigating whether this mistrust is related to passengers comparing SAF to offsetting would be particularly valuable.

Moreover, conducting a conjoint analysis or, even better, a behavioral experiment to observe and analyze the WTP for SAF and the effectiveness of specific incentives in more detail would be interesting. In this context, it could also be examined whether the way SAF is displayed and advertised on the airlines' homepages significantly impacts the WTP.

One expert suggested that the WTP might be higher on-site at the airport or in the airplane than during the flight booking, where there is a stronger focus on the price. This could be better determined through an experiment conducted on-site at the airport or within an airplane during a flight.

There are many ideas about the exact incentives that could be offered. However, it would be worthwhile to analyze which incentives for SAF are most likely to cover costs and not cannibalize the existing product portfolio.

It can be assumed that incentives alone will not suffice. Flying has changed significantly over the past decades, becoming a mode of transportation for an increasingly broad population. The fact that flights are often the cheapest travel option is difficult to justify in light of the environmental impact. Establishing a more conscious approach to flying is crucial in achieving climate goals. It could, therefore, also be analyzed whether there could be alternative, more sustainable business models for airlines that are still profitable. The analogy to the electricity market (conventional vs. green energy) demonstrates that a strategy of establishing a foothold with a more sustainable, albeit more expensive, product can succeed, even if it offers limited direct added value to customers.

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Appendix A: Semi-structured Interviews

A.1 Interview Questionnaire

Introduction	Hello, my name is Yannic Opphard, and I'm currently pursuing my master's degree in management with a specialization in Strategy, Entrepreneurship, and Impact at Católica Lisbon School of Business & Economics. My thesis focuses on examining the introduction of Sustainable Aviation Fuels (SAF) into the aviation industry and how it may influence passenger behavior. The interview lasts approximately 30 minutes. I have carefully prepared various questions that I would like to ask you shortly. Your insights and perspectives are highly valued, and I encourage you to share them openly and freely. All information shared during the interview will be treated confidentially and used exclusively for my academic work. Thank you in advance for your participation.
Data privacy	For data privacy reasons, I would like to clarify the following two points in advance: • Firstly, I would like to confirm whether you consent to the mention of your position and your company within the context of my work. This information will be used to provide context and background for the readers. Your name will not be mentioned. • Secondly, for evaluation and accuracy purposes, I plan to record the audio of our conversation. Any recordings made will be used solely for the purpose of transcribing our conversation. After the transcription is completed, I will promptly delete them. Please let me know if you are comfortable with this arrangement.
Participant Information	At the beginning of the interview, I'd like to briefly learn a bit more about you and your professional background. Perhaps you could take 1-2 minutes to introduce yourself.
	How long have you been working in the aviation industry, and what are the main responsibilities in your current position?
Background Questions	What interesting projects or research have you been involved in related to sustainable aviation?
	How do you perceive the current state of sustainability efforts in the aviation industry?
Understanding of Sustainable Aviation Fuels (SAF)	Then I'd like to discuss Sustainable Aviation Fuels (SAF). In your view, what impact do these fuels have on the aviation industry?
	How confident are you that SAF will be the primary driver for reducing CO_2 emissions in the aviation sector, rated on a scale from 1 to 7? (1=No confidence at all, 7=Utmost confidence). Please explain your choice.
	What, in your opinion, are the key advantages and disadvantages of SAF in terms of production and use?
	Which SAF production technology do you consider most relevant in the long term? Hydro-processed Esters and Fatty Acids (HEFA), Alcohols to Jet (AtJ), Power to Liquid (PtL), etc.
Impact on Passenger Behavior	On a scale from 1 to 7, how aware do you think passengers are of SAF? (1=Not aware at all, 7=Fully aware). Please explain your choice.
	On a scale from 1 to 7, do you believe passengers would be willing to pay more for flights if they knew SAF was being used? (1=Strongly disagree, 7=Strongly agree). Please explain your choice.
	What percentage do you estimate customers would be willing to pay more? Please explain your choice.

	What might explain why passengers' express willingness to pay more for SAF flights in surveys but don't follow through in practice? (Say/do gap)
	What incentives are currently being offered and what additional incentives should be introduced to encourage customers to book their flights with SAF?
	What other changes in passenger behavior might be observed due to the introduction of SAF?
Airline Strategies and Adaptation	How do you think airlines could effectively implement the introduction of SAF and address the needs of environmentally conscious passengers?
	Which departments are involved in strategy development?
Challenges and Opportunities	What do you see as the main challenges and opportunities associated with integrating Sustainable Aviation Fuels (SAF) into the aviation industry, particularly in terms of passenger engagement?
	How might regulatory, technological, or market factors impact the adoption of SAF and its implications for passenger behavior?
Future Outlook	Looking ahead, what are your predictions for the future adoption of SAF in the aviation industry and its potential long-term effects on passenger behavior?
	Are there any emerging trends or developments that you believe will significantly shape the relationship between SAF adoption and passenger preferences in the coming years?
Closing	Thank you for the interview and your time. Would you be interested in receiving the findings of my master thesis once it's completed?
	Do you have any final thoughts or recommendations for further research on the topic of Sustainable Aviation Fuels (SAF) and its impact on passenger behavior?

Table 15: Interview Questionnaire

A.2 Gioia Methodology

#	**First-order concepts (direct quotations)**	**Second-Order Themes**	**Aggregated Dimensions**
1	Interviewee 11: “And we see that debates when we discuss about sustainable aviation fuels the term sustainable can mean different things here in Europe to what it might mean in Southeast Asia, the Americas, or China for instance.”	Definition and conceptualization of sustainability	Significance of SAF
2	Interviewee 5: “In conclusion, investing in SAF is essential for sustainable aviation, requiring collective efforts from authorities, airlines, and passengers to drive meaningful change. Collaborative action and ongoing research are essential to realize the full potential of SAF in reducing carbon emissions and promoting a more efficient, net-zero, and sustainable future for air travel.”	Importance of SAF for decarbonizing aviation	
3	Interviewee 11: “Sustainable aviation fuels are sort of the star of the debate or the main lever actually that we have to decarbonize aviation.”		
4	Interviewee 10: „Also die Flugzeuge, die heute gebaut werden, die werden ja gebaut mit herkömmlichen Triebwerken. So ein Flugzeug hält ja 20, 25 Jahre. Das heißt, alles das, was heute noch ausgeliefert wird, wird mit einem Treibstoff fliegen müssen, es sei denn, man rüstet teuer um. Das heißt also, bis 2050 ist das die einzige Möglichkeit, um das Fliegen CO_2-neutraler zu machen.“		
5	Interviewee 14: „SAF sind im Moment das wichtigste Mittel, um tatsächlich Emissionen im Flug zu reduzieren. Vielleicht zusammen mit dem Thema Operational Efficiency, also zum Beispiel Flottenerneuerung, effizienterer Flugbetrieb, alles was dazu gehört.“		
6	Interviewee 9: „Bei SAF hat man wirklich eben Emissionen vermieden und muss nicht irgendwie hoffen, dass irgendwer irgendwo einen Wald für Carbon-Offsets gerettet hat, auch diesen wirklich nicht abhackt oder niederbrennt oder sonst was mit macht.“		
7	Interviewee 2: “The biggest opportunity is that the future of aviation has to have much lower carbon. We will lose our social license as an industry if we are not actively trying to decarbonize and really showing proper signs of that, not just fluffing around the edges, really having people want to see our carbon going down. And I think that is the biggest opportunity.”	Opportunities	
8	Interviewee 9: „Natürlich kommt es jetzt auch darauf an, tatsächlich den Worten dann Taten folgen zu lassen. Und ich glaube, das ist, das ist, das ist an manchen Stellen noch deutlich ausbaufähig und auch nötig, dass tatsächlich dann, um auch nur irgendwo andersweise Richtung Net Zero bei 2050 zu kommen.“	Challenges	

9	Interviewee 5: “The aviation industry faces significant challenges in its journey towards sustainability, but there's a notable commitment to achieving net-zero emissions by 2050. Major players, including airlines and regulatory bodies like the European Union, are actively investing in sustainable initiatives to drive progress in this direction.”		
10	Interviewee 4: “The challenge is do they have the financial resources and the personnel resources to get it done, and do they have the capacities in their own home countries, whether that's kind of sustainable fuel or other kind of capabilities, things like push from regulations or civil society or their own customer base to spur them forward.”		
11	Interviewee 5: “The challenge of SAF, nowadays, is that the supply is very scarce, and it can be 3-5 times more expensive than traditional jet fuel.”		
12	Interviewee 1: „Die größten Herausforderungen sind Preis und Scalability im Zusammenspiel. Und Wettbewerbsfähigkeit, denn die Frage ist auch: was macht der Rest der Welt.“		
13	Interviewee 2: “One of the challenges that we have in New Zealand is nobody is talking about this except for in New Zealand, there's no pressure from customers, there's no pressure from industry. We are the only airline, basically we are the national carrier.”		
14	Interviewee 2: ”The biggest challenge is how to pay for that and how do we help explain that to investors? How do we help explain that to staff? How do we help explain that to customers? We are 51% owned by the government. They expect a return. How do we help explain that the future of aviation is potentially more expensive? How do we do we keep in a country like New Zealand, how do we keep our tourism and trade connected at a reasonable cost? I think how do we get passengers to help us pay for that? That's the really crunchy side of it, I think.”		
15	Interviewee 4: “And for me, I think a lot of the challenge with SAF from a customer standpoint and an awareness standpoint is that it's designed to look the same or it's designed to perform the same, and it's designed to be out of sight from customers. So how we make that more visible, how we make something that's today invisible to customers intentionally and make that something that customers are aware of is a very difficult challenge that no one's figured out the full answer on.”		
16	Interviewee 14: Risiken: „Aufbaurisiko und das Kapitalrisiko, was damit einhergeht und regulatorisches Risiko. Das sind für mich die größten Faktoren.“	Risks	
17	Interviewee 12: „Genau, zwangsläufig kommt man natürlich auch dahin, dass man sich mit den biogenen Kraftstoffen auseinandersetzt. Gerade in den ganzen Konferenzen sieht man auch, dass es extrem wichtig ist, weil es eben die Möglichkeit bietet, jetzt den Markthochlauf zu ermöglichen, dass man schon erste Prozente einmischt in die fossilen Kerosin-Gemische, aber auf lange Sicht ist dann eigentlich in allen Studien klar, es muss einfach Power to Liquid geben, dass man eben aus Sonnen- und Windenergie über Wasserstoff dann Kerosin herstellt, einfach weil die Biomasse nicht ausreicht. Und Kerosin ist auch nicht der einzige Interessent an der Biomasse, sondern auch die Kunststoffindustrie und verschiedene andere Produzenten, dadurch, dass es noch das mit einfachste Verfahren ist, um heutige Energieträger zu ersetzen.“	Production technologies	Production technologies
18	Interviewee 12: „Es wird immer eine Mischung aus verschiedenen Technologien geben.“		

19	Interviewee 11: “Power to liquid, it's a very good solution, but it's also very dependent on having access to cheap green electricity… In Europe we will see an uptake of power to liquid because the sub mandates of ReFuel require suppliers to do that.”		
20	Interviewee 11: “The most important thing is that we keep sustainability criteria across all of them (production pathways) and that we have a pool where the market can choose respecting that sustainability criteria.”		
21	Interviewee 4: “I mean all production technologies are relevant. I suppose in the end though, what matters is kind of what's the most marginal technology and where does incremental production come from? So in the long run that's power to liquid because everything else will maximize out and reach limits at some point in time. So really, it's how well can we scale power to liquid? How well can we get that price down or that cost down? It's important to distinguish between cost and price.”		
22	Interviewee 9: „Es ist relativ klar, dass PtL deutlich teurer als HEFA SAF, sein wird. Zumindest auf absehbare Zeit. Und das werden die Fluglinien schwierig freiwillig stemmen, wenn sie eben zum halben oder einem Drittel von dem Preis eben Biomasse-basierte SAF erwerben können. Und das ist einfach die Realität. Also realistische Kosteneinschätzungen bei PtL, SAF gehen so ab 5.000 Euro pro Tonne los, also 54 pro Liter oder so. Aber wahrscheinlich eher tendenziell noch ein bisschen darüber. Und da wird es auch schwierig, sich das dann von Passagieren tatsächlich bezahlen zu lassen, weil dann geht es doch deutlich ins Geld.“		
23	Interviewee 9: „HEFA ist im Prinzip schon so für diese Dekade sowieso, aber auch auf absehbare Zeit schon noch eine sehr wichtige Technologie. Und es geht halt darum, dann eben andere Quellen für die Fettsäuren zu finden, die wir da als Rohmaterial nehmen, eben nachhaltig angebaute Ölsaaten, so als Zwischenfrucht zwischen der eigentlichen Sojabohnen oder Mais Rotation. Sogenannte Cover Crops oder Intermediate Crops heißen sie, glaube ich, in der Regulatorik. Und genau dann mit ganz klaren Vorgaben, unter welchen Umständen die wirklich dann auch als solche gelten. Und da ist eben die Tatsache, dass es keinen zusätzlichen Landverbrauch antreibt, ganz essentiell, um eben nicht nur einfach nur ein anderes, nicht nur Pflanzenöl zu sein, sondern wirklich das nachhaltige Zwischenfrucht-Pflanzenöl zu sein.“		
24	Interviewee 14: „Ich glaube tatsächlich, mittelfristig werden wir von der Menge her immer noch sehr stark auf Advanced Biofuels setzen müssen. Das heißt also, das, was man als Second- und Third-Generation Biofuels bezeichnet, zum Beispiel Thema hier Altfetteinsatz, Pflanzenreste etc. Hoffentlich auch zum Beispiel das Thema Ligno-fluide Treibstoffe und langfristig wird es wahrscheinlich dann auch eben auf diese synthetischen, rein synthetischen Kraftstoffe Power-to-X gehen, weil die möglicherweise langfristig sogar günstiger herzustellen sind und weil sie besser skalierbar sind und weil sie eben nochmal ein höheres Reduktionspotenzial haben.“		
25	Interviewee 7: „Im Moment ist das HEFA-Verfahren jenes, das am meisten entwickelt ist und bereit ist für die Umsetzung. Die Herausforderung, als Fuel Supplier, ist Power to Liquid (genannt: PtL). Von PtL gibt es aktuell im europäischen Markt keine produzierenden Anlagen, die eine Mengenverfügbarkeit in größeren Mengen aufweisen.“		
26	Interviewee 13: „Ein Großteil des SAFs wird auch langfristig noch biobasiert bleiben. Allerdings wird PtL immer mehr eine Rolle spielen.“		

27	Interviewee 7: „Aber die Erwartungshaltung ist nicht, dass Flugkraftstoff von einem Tag auf den anderen von fossilen Ressourcen auf 100% biogenen Treibstoff umgestellt werden kann. Entwicklung passiert Schritt für Schritt und gerade im Flugverkehr ist Sicherheit an oberster Stelle. Das hat zur Folge, dass Prozesse, um nachhaltige Treibstoffe zuzulassen Jahre an Evaluierungen mit sich bringen und somit längere Zeit benötigen um von internationalen Gremien zugelassen zu werden.“	Supply	Regulatory requirements
28	Interviewee 9: „Wir sind im Prinzip nächstes Jahr in der Lage, nun mit unseren Anlagen den Bedarf zu decken, den Refuel EU zusammen mit dem Mandat im Vereinigten Königreich, was gestern auch noch mal bestätigt wurde, dass das also nach wie vor on track ist, um für nächstes Jahr dann tatsächlich verabschiedet zu werden.“		
29	Interviewee 11: “My reflection with offsets, for instance, which I think only 3% of people pay extra for offsets. I think there are two factors for that. I think one is because people lost trust on offsets and also because people like to think of solutions that have an impact and therefore everybody should do the same.”	Offsets	
30	Interviewee 13: „Also Offsetting kann man so und so sehen, ist erstmal besser als nichts. Aber es wäre natürlich schon klüger, die Emissionen einfach komplett zu vermeiden oder sie vorher halt der Atmosphäre zu entziehen, wie es bei SAF halt einfach der Fall ist.“		
31	Interviewee 2: “And I think even if you look at offsetting and the carbon credit programs that we have now, I mean ours sits roughly at about 3% of customers buy carbon credits, which is roughly about similar to most US airlines and definitely Australia. So I think we are going to have an uphill battle, and I think the questions that we will need to really think about as an airline are, do we just embed this in the cost? Do we be transparent about it? Do we give people options? It's all really going to be up for grabs. One of the things we do know currently, which is probably quite maybe different certainly for Europe, is that there is no understanding here of Scope three emissions.”		
32	Interviewee 14: „Ja, schwierige Frage tatsächlich. Also ich glaube schon, dass das das Potenzial hat, das Thema zu verdrängen. Also wenn es eine Option gibt, günstiger das Ganze auszugleichen, ist das tatsächlich in der echten Zukunft oder zumindest die Zertifikate von SAF reduziert, die gekauft werden. Ich denke aber auch, dass sich das von selber ein bisschen ergeben wird, weil in Zukunft einfach diese Kompensation mit Zertifikaten zunehmend auch unattraktiver wird für die Airlines, was einfach die Regulatorik angeht. Also das Thema Kompensation ist in allen Standards, die mit dem Thema Nachhaltigkeit zu tun haben, gerade auch in der EU-Gesetzgebung, die es dazu gibt, die ESS etc. langfristig keine Option mehr. Das heißt, dadurch, dass es für die Airlines eben auch keinen positiven Effekt mehr hat, werden sie es wahrscheinlich längerfristig nicht mehr unbedingt anbieten.“		
33	Interviewee 14: „Bei der Lufthansa Group sind wir inzwischen insgesamt bei einer Kompensationsquote von vier bis fünf Prozent. Und ungefähr bei einem Prozent, ein bis zwei Prozent, die über Sustainable Aviation Fuels kompensiert werden. Also das heißt, vier bis fünf Prozent aller Passagiere kompensieren überhaupt auch mit Zertifikaten. Und insgesamt von den Passagieren ein Prozent, etwas über ein Prozent, gehen dann auf eine Kompensation, zumindest teilweise mit SAF. Was auch noch ein bisschen reinzählt, ist tatsächlich, das B2B-Geschäft, gerade im Frachtmarkt, da ist die Quote auch ein Ticken höher, was die Kompensation angeht, weil da eben viele, insbesondere Paketversender inzwischen, auch Rahmenverträge haben, die sowas mit inkludieren.“		

34	Interviewee 9: „Wobei der Markt für Leute, die eben freiwillig was kaufen, im Moment auch noch sehr klein ist. Und dann denke ich mir andererseits, diese Leute werden vielleicht auch weiterhin trotzdem dann Wert drauflegen. Und vor allem, wenn sie wissen, dass das jetzt sechs Prozent ist und ich bezahle noch mal für zehn oder 20 Prozent extra, dann habe ich ja noch einen größeren Effekt.“	Market	
35	Interviewee 7: „Aktuell basiert der Markt auf freiwilliger Abnahme. Das bedeutet, nachdem es im Jahr 2024 noch keine Verpflichtung gibt, sind die Mengen, die am europäischen Markt nachgefragt werden, überschaubar. 2025 wird sich dieses Bild – mit der Einführung von Mandaten – ändern.“		
36	Interviewee 11: “Keep the market open by two ways: 1. Allowing all sort of pathways that meet the society criteria to move across the globe. 2. To have a well functional and trustworthy book and claim system especially in the first years to keep costs down and environmental impact down and not needing to transport so much SAF around.”	Regulatory	
37	Interviewee 1: “ Ich würde mir aus Airlinesicht manchmal mehr Unterstützung wünschen, auch aus politischer Sicht.“		
38	Interviewee 6: “We have a reduction obligation in Sweden regarding JET A1 fuel to a minimum of 3.5% SAF. That figure is not something we control; it’s handled by fuel companies. And since they can mixture up to 50% and it’s same specification on the fuel we don’t know. Additional to that SAF we add in average around 2%. So average on our flights is around 5.5-6% SAF. But since we have over 38000 flights a year it’s between 3.5% and 50% on each flight, large span between min and max. SAF is bought in large quantities on single occasions, that’s the reason to the span. For example, one of our customers by all their SAF fuel once a year and that is just mixed in to the other fuel in the storage tanks.”		
39	Interviewee 6: “We were the first airline on a commercial flight flying with 100% SAF on both engines. And the issue to get that flight accepted was huge. The biggest blocker was actually getting the fuel into the airport.”		
40	Interviewee 6: “The aircraft needs to be certified. It's all the rubber parts that can be sensitive to biofuel that needs to be correct and able to cope with stuff. But otherwise for the pilots, it's just flying.”		
41	Interviewee 15: „Umweltschutz ist keine nationale Angelegenheit, es ist eine internationale. Und die Luftqualität macht an der Grenze keinen Halt. Und wenn ich CO_2 einspare und fünf andere pusten es raus, haben wir netto immer noch einen Verlust.“	Regulatory/ Level playing field	
42	Interviewee 9: „Insofern, klar, macht es schon Unterschied. Und aus meiner Sicht und ich denke, Firmensicht, ist die Antwort darauf klar, dass wir global eben sehen müssen, dass ähnliche SAF-Mandate etabliert werden. Gerade in so wichtigen Locations wie eben Middle East.“		
43	Interviewee 4: “The quotes for power to liquid seem reasonable to me. There's going to be different figures region by region as well that come into play. So there's a lot of figures that do get shown around, but it's also important to really think about things on that kind of regional basis.”	Mandates	
44	Interviewee 4: “Well, I think there's going to be a lot of market shifts that happen next year because of the mandates. My personal view is the market is going to be short of SAF and the price of every bit is going to be enormously higher because of those mandates. So, what those prices look like for, let's say a voluntary purchase would go up quite considerably as well.”		

45	Interviewee 9: „Die Quote für nächstes Jahr ist okay, aber das dann auf zwei Prozent zu lassen bis 2029 und dann erst hochzugehen, das ergibt irgendwie keinen Sinn. Und das haben wir auch als Firma, ich glaube, viele andere Vertreter auch ganz klar gemacht.“		
46	Interviewee 9: „Die Quoten an sich schon sehr ambitioniert. Das gibt es doch so in der Welt sonst nirgendwo. Ich meine, die EU ist im Prinzip, die einzige Region, die tatsächlich so ein langfristiges Ziel auch gesteckt hat. Im Straßenverkehr haben wir sowas bisher noch nicht gesehen.“		
47	Interviewee 7: „Die EU gibt Vorgaben für ihre Mitgliedsstaaten, die in der ReFuelEU Aviation Regulative geregelt sind. Diese stellt eine gleiche Zielsetzung (SAF-Mandate) für Mitgliedsstaaten dar. Mitgliedsstaaten können in einigen Belangen wie z.B. Pönalen aber strenger agieren. Bedeutet: Man kann innerhalb der EU sicherstellen, dass ein Minimum gewährleistet ist. Aber andere Länder können natürlich darüber hinaus Akzente setzen, wie z.B. Incentivierungen geben, um mehr Aktivität anzukurbeln.“		
48	Interviewee 7: „Die Verpflichtung für nachhaltigen Flugzeugtreibstoff, die sich aus der ReFuelEU ergibt, liegt beim Fuel Supplier, nicht bei den Airlines. Das heißt, die Verpflichtung trifft in diesem Fall uns als Erzeuger und Bereitsteller.“		
49	Interviewee 1: „Also die 2% sind realistisch, die jetzt eingeführt werden. Zumindest was die Verfügbarkeit angeht.“		
50	Interviewee 11: “I mean the world can change a lot in 30 years, but I'm pretty positive that we will achieve those production levels mainly because we already have companies claiming that with what they produce, they can supply the European market by that 2% next year already.”		
51	Interviewee 1: „Quoten stellen einen Wettbewerbsnachteil für europäische Airlines dar. Hier würde ich mir wünschen, dass es gleichzeitig zu solchen Quoten auch politisch Unterstützung gibt, zum Beispiel durch Förderinstrumente, um den Markt an Sustainable Aviation Fuels anzukurbeln.“		
52	Interviewee 7: „Im Speziellen möchte ich hier auf SBTI verweisen. Die Abkürzung steht für Science Based Targets. SBTI steht für eine Freiwilligkeit, Emissionsreduktionen zu erzielen, die über die Vorgaben der ReFuelEU Aviation hinausgehen. Die Zielsetzung betrifft das Jahr 2030. Im konkreten Fall bedeutet das, dass Airlines, die sich zu SBTI committen, bestreben 10% statt 6% nachhaltigen Flugzeugtreibstoff im Jahr 2030 beizumengen.“		
53	Interviewee 3: “We need the help from passengers basically to have this bridge of SAF now and then hopefully increase the SAF volume. And I think we are only human, so I think it's very difficult to make the general people pay for it. It's easier to get the companies on board, but the awareness, I think it's quite low actually.”	Role of passengers and the public in the acceptance and promotion of SAF	
54	Interviewee 2: “Well, it's very depressing working in sustainability for an airline because air travel is growing and it's incredibly difficult to decarbonize, incredibly difficult. I think also in New Zealand we have a slightly different challenges as well in that geographically miles away from anywhere, we are a heavy tourist destination. And also we are a trading nation, so people all around the world buy our beef, dairy, wine, et cetera. So vegetables, seafood, et cetera. So air travel is critical to our country. And so I think at Air New Zealand, I personally believe we take it incredibly seriously because I think we really,		

	really understand the responsibility that we have for the future of our country more generally. However, I think every single airline is struggling and I think they're finding it really hard to be honest about that, and I don't think customers have got any idea how difficult it is."		
55	Interviewee 14: „Wir sind noch in einer sehr explorativen Phase. Also ich glaube, wenn man das mit dem Thema, sagen wir mal zum Beispiel mit dem Thema E-Autos oder generell alternative Antriebe bei Autos vergleicht, stehen wir da, wo wir ungefähr vor zehn Jahren standen."		Raising awareness among passengers and the public
56	Interviewee 4: "I think the awareness of SAF is still quite low. I mean, I think it also depends on if we take developed countries, if we look Europe, north America, let's say. But then also we have to think, well, who's interested in the problem of people who are interested and care about decarbonization? Maybe it's say, a three or a four of people. If we're saying the entire kind of customer base, it's still probably down at a one or a two."	Awareness	
57	Interviewee 5: "Increasing awareness through various channels like social media, in-flight announcements, and educational campaigns can help bridge the gap between passenger intent and action."		
58	Interviewee 11: "I have the impression many people never heard of SAF, especially the flying public, and then there is a trust issue. People don't realize the huge benefits of SAF because we can go back to misleading claims made by offsets that led to not trusting these sorts of solutions."		
59	Interviewee 14: „Ja, also ich glaube, man kann einerseits überhaupt mal das Wissen zu dem Thema erhöhen. Also es wird natürlich über direkte Buchungs-Channels teilweise schon gepusht. Es ist aber was, was, glaube ich, noch nicht so einer breiten Öffentlichkeit bekannt ist."		
60	Interviewee 9: „Die Kosten werden weitergegeben. Da gibt es, meiner Meinung nach, keine zwei Meinungen. Da haben wir als Fuel Supplier auch gar keine Margenreserven, um groß die Kosten abzufedern."	Price	Willingness to pay
61	Interviewee 9: „Wenn wir uns angucken, was das eigentlich für Extrakosten, sind, die dazu kommen? Also wenn man jetzt mal konservativ ansetzt, also einen sehr hohen Wert für SAF 2000 Euro teurer als eine Tonne Fossiles Jet Fuel, ist das auf einer Strecke von Amsterdam nach Helsinki so bei zwei Prozent, dann sind es weniger als zwei Euro Extrakosten, die diese zwei Prozent Beimischung eigentlich erzeugen müsste, je nachdem, wie die Ölfirmen dann versuchen, da auch die Preisgestaltung zu machen."		
62	Interviewee 3: "We are not planning on increase the ticket price, but I always a bit careful when I say that because, but that's not the plan."		
63	Interviewee 2: "As the cost goes up, then does flying become more elite? Do we go back to the days where it costs you so much to fly that only rich people did it? It's really, there's some really big issues to think about."		
64	Interviewee 7: „Das gute Gewissen hört auf, wenn man für eine vierköpfige Familie einen Flug bucht. Da spielen Kosten eine Rolle. Der Kunde möchte für den Preis, den er bezahlt etwas zurückbekommen. Das gute Gefühl allein, nachhaltig zu fliegen,		

	wird in den meisten Fällen nicht ausreichen. Da muss man sich überlegen welche Serviceleistung man den Passagieren anbieten kann.“		
65	Interviewee 1: „Also zum Beispiel, die Air France hat ja schon eine Quote von 1% in Frankreich und reicht das soweit ich weiß durch an den Passagier. Es kann schon sein, dass der Passagier das dann direkt mitträgt. Alternativ wird die Airline es tragen und entsprechend weniger Umsätze machen.“		
66	Interviewee 11: “Price increase will depend on the airline's decision if they want to make more specific flights more expensive or if they're going to distribute the cost impact among all their passengers. So, it will really depend a lot, but definitely it will make more expensive to fly.”		
67	Interviewee 7: „Wir vernehmen aktuell das Feedback vom Markt, dass der Anteil der Passagiere, die auf die SAF Möglichkeit klicken, gering ist. Das hängt mit den damit verbundenen Kosten zusammen und dem Fehlen einer Serviceleistung, wenn man gewillt ist, dies auf sich zu nehmen. Man muss sich daher überlegen, wie man den Schritt zu SAF für den Passagier motivieren kann. Die andere Möglichkeit ist es, eine Verpflichtung einzuführen. Dann werden Kosten über alle Flüge verteilt, an alle Passagiere gleichermaßen.“	WTP/ Price	
68	Interviewee 3: “I think the majority still think it's expensive to fly and then they don't want to pay extra money on top of that because it is also nothing that they see or can kind of show off maybe. So it's like money that just disappears and they don't get any benefit. I mean, people are only human; they want something.”	WTP	
69	Interviewee 14: „Das ist ganz klar der größte Faktor beim Thema Luftfahrt, dass Flüge immer noch hauptsächlich nach dem Preis gebucht werden.“		
70	Interviewee 9: „Das ist wirklich die Frage, sind die Leute eher bereit, sagen wir mal, 20 Euro extra zu zahlen, wenn der Flug schon 500 Euro kostet oder wenn der Flug nur 120 Euro kostet? Weil es dann natürlich relativ irgendwie so aussieht, als würde man den Preis deutlich in die Höhe treiben. Da weiß ich nicht, wie genau das bei den meisten Menschen funktioniert.“		
71	Interviewee 3: “They're probably thinking: why should we fix this and not the politicians or the companies.”		
72	Interviewee 5: “Passengers are increasingly willing to pay more for flights that use SAF, as evidenced by the voluntary contributions already being made in our booking process. This willingness to support sustainable initiatives indicates a growing awareness and commitment among passengers. Currently, more than 200k users have contributed to voluntary SAF purchases since the launch of the initiative, meaning that there is a clear incentive by the passengers to contribute to this alternative.”		
73	Interviewee 5: “On average, passengers are willing to contribute around 2% premium towards SAF voluntary purchases, showcasing a modest willingness to support sustainable aviation practices in terms of expenditure. This is based in the current premium offered to the customers that are contributing to supply SAF on the day of operation with Vueling.”		

74	Interviewee 5: “The gap between survey responses and actual contributions may stem from a lack of awareness about how passengers can support SAF initiatives. Bridging this gap requires ongoing education and communication efforts, which I am convinced we will be able to accomplish in the long term.”		
75	Interviewee 1: „Es gibt ja ein Say-Do-Gap, das findet man auch in Umfragen: sechs von zehn Passagieren sagen, sie würden für Nachhaltigkeit mehr zahlen. Tatsächlich kompensiert dann nur einer von den zehn. Ich glaube, das Potenzial ist, diesen Anteil zu erhöhen, mit mehr Awareness und mehr Anreizen. Es gibt auch schon Airlines, die ein grünes Vorteilsprogramm umsetzen.“		
76	Interviewee 1: „Verschiedene Airlines bieten bereits grüne Tarife an. Ich glaube, da kann man nur seine Erfahrungen machen. Was am besten wäre, das ist nicht so einfach zu beantworten und jeder muss seine Erfahrungen machen und dann wird man sehen, wie sich das weiterentwickelt.“	Incentives	Incentives and Loyalty
77	Interviewee 3: “SAS has created a model where travelers can purchase 20-minute blocks of biofuel per flight. Prices are set at 10 USD/10 EUR/100 SEK/100 NOK/70 DKK per block of biofuel. On a 60-minute flight, one 20-minute block of biofuel will correspond to a third of the average fuel consumption per passenger of an average flight. For example, to buy biofuel for a ticket on a 60-minute flight, a traveler would have to purchase three blocks to cover the full flight time. You can also choose one of our ticket types, Go Smart Bio or Plus Pro Bio. The ticket includes the cost of approx. 50% biofuel, which is calculated on an average journey, corresponding to approx. 60 min on Swedish or Norwegian domestic, 60 min within Scandinavia, 35 min on Danish domestic or 1h 30 min on European flights. The amount of biofuel a traveler buys will not necessarily be used on the actual flight the traveler has bought a ticket for, but it will be used to replace fossil fuel to the equivalent amount in SAS’ operations.”		
78	Interviewee 3: “We have around 1200 conscious traveler at the moment. It's a program where basically the customer takes 10 steps. So, one is to watch a video about biofuel, what it is, and that it can reduce the customer's emissions. So, it's a video five minutes. I mean that's not a benefit as such. And then they can buy these tickets, Go Smart Bio or Plus Pro Bio. And they also get some discounts in our Euro bonus shop. But we had to be very careful there because we only have a few products that you can use for your home to reduce water, et cetera. Because I mean, we don't want to encourage shopping at the same time. And they get an invitation to an exclusive event, which will be in this autumn, I think, where there'll be some speakers, et cetera, and they get a conscious traveler baggage tag, which is electronic.”		
79	Interviewee 3: “Yeah, first we have this CSP, it's called Corporate Sustainability program. But then we have companies who joined this program, and they partner with us basically. And so we work together with them to reduce their emission and it's a way for them to reduce their scope three indirect emissions from the business trips. But then we have for the general public “conscious traveler” but we have also, we have launched two tickets. One is called “Go Smart” and one is called “Plus Pro Ticket”. So then a traveler can choose these tickets, which means that they buy approximately 50% of it is biofuel to lower their own emissions. Basically. It's not used maybe on that flight that they are flying on, but within the year.”		
80	Interviewee 4: “The minute someone in the media finds out, Hey, you pocketed some profit on this environmental thing that's supposed to be a benefit, a public benefit, well then you get in public trouble for that. So there's almost no way to win on a		

	voluntary program, customer facing program. And I think if you look as well at corporate facing programs, those have had way more success in terms of the benefit they've achieved."		
81	Interviewee 4: "To me, the biggest challenge with voluntary programs is really a few things. I've been part of offset programs back in 2008 was when I first got involved in them. So I've seen a lot of things in them. To me the biggest challenge on them is where is that offer presented to the customer? In marketing, they'll often talk about the three Ps. There's product, price, and place. And place is really important here in terms of putting it in the booking flow. And that certainly drives the highest uptake because it then can be presented as part of an ancillary, along with other interesting items. Maybe you can add some incentives around it, and it's easier to find. Of course, everyone has to see it. I mean, that's how in offset programs, Qantas in Virgin Australia had 10% uptake rates, which were the highest in the world forever. But the problem to that is, do you get some displacement of other profitable ancillaries? So it was one airline several years ago who took their offset program and moved it from independent to booking path. They had an enormous increase in offset transactions. They saw a corresponding decrease in terms of other ancillaries, which were profit generators for the company. And so their CFO called, or their chief commercial officer or someone called them a week later and said, you have to pull this. This is costing us profit. And so that it ended. And I think one of the other problems with that placement, even if you, let's say you put it well after the transaction has completed, well, the customer just spent a lot of time trying to figure out how to get the lowest possible cost, and now you want to add something, it is the wrong place. You need to do it at a point in time when a customer is spending a lot of money. To me, that kind of time is when they're at the airport, they're spending a lot of money on the cost to get there. They're spending money kind of in the airport doing whatever shopping or a meal. That to me is a very good time to do it as opposed to a time of booking when they're in a cost conservation mode."		
82	Interviewee 4: "I guess the other one I would point to that I've seen from a customer engagement standpoint that's quite interesting has been that Delta has kind of gift rewards for customers when they reach certain status levels and one of the upper status levels. One of the gifts you can get is they will buy a certain amount of SAF and fund it on your behalf. So that can be quite curious. I don't know what the uptake is on that, but also an interesting model, let's say."		
83	Interviewee 4: "I've studied some of those kinds of propositions before. The economics are very tough. I mean, giving additional miles or points has historically always been a good way to get customers to adopt new behaviors. I have seen some interesting work in it though. I mean Qantas, I'll give some examples kind of pre covid, actually, maybe first, but pre Covid, Qantas and SAS, both. I don't think these were SAF examples, but these were, let's say, offset examples and they were quite interesting because they had very clearly targeted customer bases with it. So SAS was very much like 18 to 24 or something like that year olds, they would buy the offset for a free flight, and it was certainly related to flight shaming, but then Qantas was very much, Hey, if you're a member of our frequent flyer program, we'll offset it for you. And both of those were interesting to me, partially in terms of their structure, but also if you looked at that period of time, both of them had rivals, Virgin Australia and Norwegian that were in a lot of financial pain. And so to me, this was also a very strategic element to go and put even a little bit more pressure on their competitors and differentiate themselves in a way that they believed would create value for themselves and win some share ultimately from their arch rivals. I don't know how well it worked, but I suspected probably had some decent success in those objectives these days. I think there's other interesting examples. I mean,		

	Alaska Airlines has something where you can go and if you buy SAF, it can count as elements towards your status renewal for the subsequent year."		
84	Interviewee 9: „Ja, das ist ein bisschen so ein zweischneidiges Schwert. Was für Anreize setzt man dann? Treibt es die Leute nur dazu, noch mehr zu fliegen? Dann ist netto fürs Klima dann nichts gewonnen, wenn man einfach nur Anreize fürs Mehrfliegen gibt."		
85	Interviewee 9: „Ich denke, irgendwie so gewisse Anreize zu schaffen, ist sicherlich nicht verkehrt. Das ist nicht nur allein, dass das grüne Gewissen sein muss, was da zur Entscheidungsfindung beiträgt, sondern dass man irgendwie noch ein bisschen was zusätzlich bekommt als Kunde. Und natürlich idealerweise kostet es die Airline nicht zusätzlich, wie zum Beispiel Priority Boarding, das ist ja kein richtiger Kostenfaktor. Genau, so Dinge, denke ich, sind da ganz, ganz interessant."		
86	Interviewee 15: „Priority Boarding für alle, die Sustainable Aviation Fuels machen, okay. Dann stehen vorne diejenigen, die Dienstreisen machen, weil die sowieso die Dinger kaufen und die haben dann gleichzeitig den Status und sonst irgendwas. Und dann die drei Leute, die das noch dazukaufen, die können auch Geld für einen Priority Pass ausgeben. Das ist ja alles überlagernd. Das heißt, alles, was an Produktidee reinkommt, kannibalisiert die eigene Produktvielfalt und Landschaft und Differenzierungsmöglichkeit auf dem Flug, wo die Airline im Moment Geld mit verdient."		
87	Interviewee 2: "So some customers who are environmentally minded are going to want to be rewarded in a way that's right for them. Other customers, we have a lot of customers who are mostly interested in status and points and free valet parking and all of these things. And maybe that's how we're going to have to get them to onboard. I don't know. The thing that's tricky is we don't want to reward it with more flying, so we can't give people frequent flyer points or anything. It doesn't make sense."		
88	Interviewee 7: „Ich repräsentiere hier den Fuel Supplier aber ich denke, es ist wichtig, dem Kunden eine Serviceleistung anzubieten für das SAF, das er zukauft. SAF ist nicht sichtbar für den Kunden, aber man kann versuchen, es sichtbar zu machen indem man den Kauf mit einer „direkt sichtbaren" Leistung belohnt wie z.B. Priority boarding, free check-in für Gepäck (wo man bei low-cost Airlines bezahlt), einen Sandwich / free snacks bei Kurzstreckenflügen, Sitzplätze mit mehr Beinfreiheit, die speziell für Passagiere reserviert sind, die sich für die SAF Option entschieden haben. Kleine Akzente, könnten hier bereits einen Unterschied machen. Aber es muss sichtbar sein, auch für andere."		
89	Interviewee 10: „Ja, also ich glaube, da kann man schon einiges tun, auch als Airline, um halt Anreize zu schaffen. Nur rein zu sagen, klickt das an, zahl mehr Geld. Sieht man ja an den Zahlen, das bringt es ja nicht. Das führt nicht zum Erfolg. Also der Mensch will wohl immer irgendeine Gegenleistung haben, die er auch sieht, die er auch anfassen kann."		
90	Interviewee 13: „Allerdings darf man natürlich die Bevölkerung oder die Leute auch nicht überfrachten. Das Thema SAF ist natürlich irgendwo auch in gewisser Weise Nerdwissen."		
91	Interviewee 4: "But engagement, if this is a measure of success, did the customer learn about what we're doing for the environment and the values and what we're undertaking, then there's a lot of value. Hard to quantify value, but to me that's where the real value of these kinds of programs lies is not the direct benefit, but the brand enhancement and brand value that it imparts."	Incentives/ Brand enhancement	

92	Interviewee 7: „Es ist schon ein Wettbewerb. Immer mehr Unternehmen beginnen in SAF-Projekte zu investieren. Produkt ist am Markt verfügbar. Airlines sind gezwungen ihre Kosten sehr eng im Auge zu behalten. Auch wenn es Wettbewerb gibt, sind die Kosten von SAF immer noch deutlich höher als jene von fossilen Flugtreibstoff. Solange der nachhaltige Treibstoff freiwillig ist, wird eine Airline gut analysieren, ob es tragbar ist, diese Kosten auf sich zu nehmen bzw. ob der Endkunde bereit ist, dafür Mehrkosten zu bezahlen.“	Competition	
93	Interviewee 14: „Ja, also es ist nicht mehr vollständig freiwillig. Das einzige, was mir jetzt gerade konkret einfällt, ist bei der Lufthansa-Gruppe, aber auch bei manchen anderen Airlines gibt es gewisse Pflichtstrecken. Bei der Lufthansa-Gruppe ist das bei der Swiss der Fall, von Zürich nach Genf. Da werden tatsächlich nur noch diese sogenannten Green Fares angeboten. Das heißt, da muss eine Quote von 20 Prozent SAF-Kompensation dazu gebucht werden. Ich kann mir sehr stark vorstellen, dass das insbesondere auf den Strecken, wo das auch immer wieder eine politische Dimension hat, also gerade auf Kurzstrecken, innerdeutschen Strecken, also Inlandsstrecken generell, dass das da stärker noch kommt. Aber es wird auch sehr stark natürlich mit der Konkurrenzsituation zusammenhängen, weil man muss auch ganz klar sagen, auf den Strecken, wo das bisher diskutiert wird, ist in der Regel die Konkurrenz geringer, zumindest durch andere Airlines.“	Strategy/ Competition	SAF Strategy
94	Interviewee 7: „Wir gehen selbstverständlich aktiv in Verhandlung mit den Airlines, möchten dabei unterstützen, Nachhaltigkeitsziele zu erreichen. Aber auch Firmen sind auf der Suche ihre (Scope 3) Emissionsreduktions-Zielsetzungen zu erreichen und auch hier kann SAF eine Möglichkeit sein. Die CO2 Emissionen von Firmenkunden sind jene die sich aus dem Flugverkehr (Business travels) ergeben und jene aus der Logistik (CO2 Emissionen, die aus der Logistikkette kommen). Auch auf diese Kundengruppe gehen wir aktiv zu und bieten Lösungen an.	Strategy	
95	Interviewee 1: „Es gibt ganz viele Ideen, die wir gerade evaluieren. Ich kann noch nicht sagen, was es dabei werden wird. Das sind alles Ideen, die wir haben und es bringt nichts, wenn wir etwas implementieren, was nachher kostentechnisch ein Nullsummenspiel ist.“		
96	Interviewee 14: „Also der Grundsatz ist, ich würde schon einer Airline empfehlen, an der Stelle möglichst im Moment auch eigene Kapazitäten aufzubauen. Also mindestens mal sich selber auch an Projekten, an Raffinerien zum Beispiel für SAF zu beteiligen, weil man einfach sieht, dass im Moment die Marktverfügbarkeit extrem gering ist und es einfach eine gewisse Anschubfinanzierung auch für die Anbieter braucht, die im Moment auf diesen Markt gehen wollen. Das wäre schon mal das Erste. Ich würde das natürlich sehr eng verzahnen mit dem Thema Fueleinkauf. Also gerade im Fueleinkauf haben es ja die Airlines geschafft, über die letzten Jahre und Jahrzehnte sehr effiziente Strukturen aufzubauen was zum Beispiel das Thema Fuel Hedging angeht, also zur richtigen Zeit langfristige Fuelbestellungen machen zu können, damit man ein bisschen das Preisrisiko reduzieren kann. Ich glaube, eine ähnliche Form wird es in Zukunft auch beim Thema SAF geben, bei dem, was man auf dem Markt einkauft, weil sich da auch durchaus Schwankungen ergeben werden. Nicht so sehr aus den Rohstoffpreisen. Klar, der Strompreis zum Beispiel spielt da auch eine Rolle. Aber ich glaube auch in erster Linie aufgrund der Frage, wie sich die Regulatorik und die einzelne Nachfrage der Airlines da entwickelt. Genau. Und ansonsten würde ich das auch sehr stark in das Thema der Customer Experience, also der Flugbuchung insbesondere, mit einbeziehen. Wir haben ja jetzt Möglichkeiten, zum Beispiel dieses Thema wie New Distribution Capabilities, also eine neue Form von Vertrieb über Drittanbieter wie Online-Reiseportale etc., dass man als Airline auch Zusatzleistungen mitverkauft. Und ich glaube, es wäre		

	eben auch extrem wichtig, bei dem Aufbau von SAF-Kapazitäten das da mitzusteuern damit die Personen, die eben sich entscheiden, SAF zuzukaufen zu ihrem Flug, damit das auch einhergeht mit der Einkaufsstrategie von denen, die dieses SAF einkaufen oder eben die Kapazitäten selber aufbauen.“		
97	Interviewee 2: “So we have a lot of different departments involved, actually, which has been great because you learn a lot. But we have everything from our procurement. We have a couple of procurement people who are involved. We have our investor relations team involved because we are one of only, I think seven investment grade airlines in the world. So what we are talking to investors about for the future is really important, and SAF is a critical part of that. We have our product design people involved, we have our sustainability nerds involved as well. All the scientists, we've got a couple of, I guess more like behavioral and customer touchpoint people involved. And I think all of those people just will they come and go as the project starts. So over the last year in particular, it's been very much focused around the science and the procurement and the procurement pathway. Now it's morphing into we've got that side underway. Now it's morphing into how do we pay for it? How do we get customers to be engaged, et cetera.”		

Table 16: Expert Interviews Gioia Methodology

Appendix B: Survey

B.1 Survey Questions

#	Question type	Question
Info 1	Multiple choice	Dear participant, My name is Yannic Opphard, and I am studying Management at Católica Lisbon School of Business and Economics. Currently, I am conducting research for my master's thesis on the topic of "sustainable flying". Please mark the answer or multiple answers that apply to you. The duration of this survey is approximately 10 minutes. For the success of the survey, it is important that you complete the questionnaire in full and do not skip any of the questions. All data will be treated strictly confidentially and cannot be attributed to your person. If you have any questions or comments, feel free to send an email to: s-yopphard@ucp.pt Thank you for your participation.
Q1	Multiple choice	How often did you fly in 2023? • Never (0 times) • Rarely (1-4 times) • Every now and then (5-10 times) • Frequently (11-24 times) • Very frequently (more than 24 times)
Q2	Multiple choice	Do you mainly fly short-haul (up to 1500 km), medium-haul (1500 to 4000 km) or long-haul (more than 4000 km)? • Mainly short-haul • Mainly medium-haul • Mainly long-haul • Balanced
Q3	Multiple choice	Do you fly for leisure or business? • Much more often for leisure • More often for leisure • Balanced • More often for business • Much more often for business
Q4	Matrix table	How important are the following criteria to you when booking a flight? Statements: • Q4_1: Price • Q4_2: Direct flight/ Number of layovers • Q4_3: Airline • Q4_4: Departure time • Q4_5: Emissions Scale points: • Very Important • Important • Neutral • Not important • Not important at all

		• No opinion
Q5	Multiple choice	How aware are you of the climate-damaging emissions of air travel compared to other modes of transportation? • Extremely aware • Very aware • Moderately aware • Slightly aware • Not at all aware • I don't believe that air travel causes harmful emissions to the climate
Q6	Multiple choice	Do you consider the sustainability practices of the respective airline when booking your flight? • Always • Often • Sometimes • Rarely • Never • I do not fly
Q7	Multiple choice	How often do you opt for CO_2 compensation for your flight? • Very frequently • Frequently • Every now and then • Rarely • Never • I do not fly • I am not familiar with CO_2 compensation
Q8	Multiple choice	How aware are you of Sustainable Aviation Fuels (SAF)? • Extremely aware • Very aware • Moderately aware • Slightly aware • Not at all aware
Info 2	Text	For your reference: Sustainable Aviation Fuels (SAF) are non-fossil fuels derived from biological sources (bio-kerosene) or synthetically (e.g., E-Fuel). Their sustainable origin enables them to achieve emission reductions of up to 80% compared to conventional kerosene. However, they are currently 2 to 5 times more expensive than conventional kerosene, depending on the production method.
Q9	Multiple choice	Have you ever paid extra for Sustainable Aviation Fuel (SAF) on your flight? • Yes • No • I do not fly
Q10	Multiple choice	Please consider only your personal flight bookings for this question: To what extent do your financial means influence your decision when booking a flight? • Not at all - I have a large financial flexibility • Minimally - I have some financial flexibility • Somewhat - I have some financial flexibility • Strongly - I have very limited financial flexibility • Very strongly - I currently have no financial flexibility

Q11	Slider	Please indicate how much extra you would be willing to pay for Sustainable Aviation Fuels (SAF) on these flights, in euros: Q11_1: Paris (CDG) to Los Angeles (LAX) Flight price: 700€ Surcharge for 100% reduction of CO_2 emissions through SAF: 413€ Q11_2: Berlin (BER) to Lisbon (LIS) Flight price: 200€ Surcharge for 100% reduction of CO_2 emissions through SAF: 122€ Q11_3: Barcelona (BCN) to Madrid (MAD) Flight price: 40€ Surcharge for 100% reduction of CO_2 emissions through SAF: 48€
Q12	Slider	Imagine again, you book the long-haul flight just shown in economy class from: Paris (CDG) to Los Angeles (LAX) Flight price: 700€ Surcharge for 100% reduction of CO_2 emissions through SAF: 413€ How much extra would you be willing to pay for SAF compared to your previous answer if the following extras were included?
Q13	Slider	Imagine again, you book the medium-haul flight just shown in economy class from: Berlin (BER) to Lisbon (LIS) Flight price: 200€ Surcharge for 100% reduction of CO_2 emissions through SAF: 122€ How much extra would you be willing to pay for SAF compared to your previous answer if the following extras were included?
Q14	Slider	Imagine again, you book the short-haul flight just shown in economy class from: Barcelona (BCN) to Madrid (MAD) Flight price: 40€ Surcharge for 100% reduction of CO_2 emissions through SAF: 48€ How much extra would you be willing to pay for SAF compared to your previous answer if the following extras were included?
Q15	Text entry	What other included extras would increase your willingness to pay for SAF?
Q16	Multiple choice	Would your loyalty to a particular airline increase if extras were included in the payment for SAF? • Definitely • Probably • I'm not sure • Probably not • Definitely not
Q17	Multiple choice	Suppose airlines automatically pass on the additional costs for SAF to all passengers through mandatory minimum usage requirements of 2% (starting in 2025), 6% (starting in 2030), and 70% (starting in 2050) in the EU. How would this affect your flight behavior? • I would fly much less • I would fly less • I would fly as often as I normally do • I would fly more often • I would fly much more often

Q18	Multiple choice	Suppose airlines automatically pass on the additional costs for SAF to all passengers through mandatory minimum usage requirements of 2% (starting in 2025), 6% (starting in 2030), and 70% (starting in 2050) in the EU. Would you voluntarily pay more for SAF than the minimum rate already included in the flight price? • Definitely • Probably • I'm not sure • Probably not • Definitely not
Q19	Multiple choice	How old are you? • Under 18 • 18 - 24 years • 25 - 34 years • 35 - 44 years • 45 - 54 years • 55 - 64 years • 65 - 74 years • 75 - 84 years • 85 years or older
Q20	Multiple choice	To which gender do you identify? • Male • Female • Diverse • Prefer not to say
Q21	Drop down list	Where is your current primary residence located?
Q22	Multiple choice	How many people currently live in your household (including yourself)? • 1 • 2 • 3 • 4 • 5 • 6 or more
Q23	Multiple choice	What is the best way to describe your current employment status? • Pupil • Apprentice • Student • Employed/ Self-employed • Unemployed • Retired
Q24	Multiple choice	What is your highest level of education completed? • No formal education • High school diploma • Completed vocational training • Bachelor • Master/ Diploma • Doctor/ PhD
Q25	Multiple choice	What is your annual gross household income in euros? • 0 - 10,000 • 10,001 - 25,000

		• 25,001 - 50,000 • 50,001 - 75,000 • 75,001 - 100,000 • 100,001 - 200,000 • More than 200,000 • Prefer not to say

Table 17: Survey questions

B.2 Survey Statistics

Descriptive statistics WTP (N = 216):

	Long-haul	Medium-haul	Short-haul
	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)
Mean	15.3% (25.9%)	26.1% (42.8%)	66.9% (55.7%)
Median	11.9%	23.5%	52.5%
Standard deviation	14.1%	21.1%	55.2%
Min	0%	0%	0%
Max	64.4%	101%	300%
25% quartile	6%	10.5%	22.5%
75% quartile	21.3%	37%	112.5%
95% confidence interval of the mean	13.4% – 17.2%	23.3% – 29%	59.4% – 74.3%

Table 18: Descriptive statistics WTP

Correlations WTP (N = 216):

	Spearman's correlation (r_s)/ p-value	WTP SAF Long-haul	WTP SAF Medium-haul	WTP SAF Short-haul
Q1 How often did you fly in 2023?	r_s	**-0.16**	**-0.17**	**-0.15**
	p	**0.017**	**0.011**	**0.023**
Q3 (N = 175) Do you fly for leisure or business?	r_s	-0.03	-0.04	0.05
	p	0.689	0.629	0.489
Q4_1 How important is the price to you when booking a flight?	r_s	**-0.2**	**-0.18**	**-0.14**
	p	**0.003**	**0.008**	**0.044**
Q4_5 (N = 175) How important are emissions to you when booking a flight?	r_s	**0.46**	**0.48**	**0.39**
	p	**<0.001**	**<0.001**	**<0.001**
Q5 How aware are you of the climate-damaging emissions of air travel compared to other modes of transportation?	r_s	**0.15**	**0.14**	**0.22**
	p	**0.032**	**0.033**	**0.001**
Q6 (N = 200) Do you consider the sustainability practices of the respective airline when booking your flight?	r_s	**0.33**	**0.34**	**0.33**
	p	**<0.001**	**<0.001**	**<0.001**
Q7 (N = 194) How often do you opt for CO_2 compensation for your flight?	r_s	**0.43**	**0.44**	**0.45**
	p	**<0.001**	**<0.001**	**<0.001**
Q8 How aware are you of Sustainable Aviation Fuels (SAF)?	r_s	0.11	0.12	0.11
	p	0.098	0.081	0.093
Q10 To what extent do your financial means influence your decision when booking a flight?	r_s	**0.21**	**0.22**	0.08
	p	**0.002**	**0.001**	0.22
Q19 How old are you?	r_s	**0.22**	**0.21**	0.11
	p	**0.001**	**0.002**	0.119
Q24 What is your highest level of education completed?	r_s	0.04	0	0.02
	p	0.562	0.971	0.759
	r_s	**0.18**	0.11	0.02

	Spearman's correlation (r_s)/ p-value	WTP SAF Long-haul	WTP SAF Medium-haul	WTP SAF Short-haul
Q25 (N = 198) What is your annual gross household income in euros?	p	**0.013**	0.137	0.738

Table 19: Correlations WTP

Descriptive statistics long-haul (N = 216):

	Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Complimentary lounge access
	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)
Mean	2.4% (4%)	1.7% (2.9%)	3.1% (5.3%)	**4.2% (7.1%)**	2.8% (4.7%)
Median	0.9%	0.6%	2.9%	3.3%	1.9%
Standard deviation	3.9%	2.4%	3.1%	4.4%	3.9%
25% Quartile	0%	0%	0.0025%	1.4%	0%
75% Quartile	3.3%	2.9%	4.3%	5.7%	3.7%
95% confidence interval of the mean	1.9% – 2.9%	1.4% – 2%	2.7% – 3.5%	3.6% – 4.8%	2.3% – 3.3%

Table 20: Descriptive statistics incentives long-haul

Correlations incentives long-haul (N = 216):

		Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Complimentary lounge access
Q11_1	r_s	0.13	**0.23**	0.1	**0.23**	0.12
	p	0.051	**0.001**	0.158	**0.001**	0.079
Q1	r_s	**0.21**	0.03	0.04	0.04	**0.16**
	p	**0.002**	0.63	0.543	0.551	**0.018**
Q5	r_s	**-0.15**	**-0.17**	0.01	-0.08	-0.09
	p	**0.023**	**0.014**	0.892	0.244	0.21
Q6 (N = 200)	r_s	**0.16**	0.06	0.09	0.11	-0.01
	p	**0.025**	0.363	0.228	0.111	0.94
Q7 (N = 194)	r_s	0.14	0.11	0.1	0.12	0.1
	p	0.051	0.136	0.153	0.103	0.149
Q8	r_s	0.08	0	-0.01	-0.02	0.08
	p	0.232	0.951	0.923	0.748	0.263
Q10	r_s	0.11	**0.15**	**-0.25**	0.08	-0.05
	p	0.118	**0.033**	**<0.001**	0.266	0.492
Q19	r_s	**0.15**	**0.19**	**-0.24**	0.12	**-0.15**
	p	**0.026**	**0.005**	**<0.001**	0.089	**0.032**
Q25 (N = 198)	r_s	**0.15**	**0.15**	**-0.2**	**0.17**	0.07
	p	**0.037**	**0.034**	**0.005**	**0.019**	0.34

Table 21: Correlations incentives long-haul

Descriptive statistics incentives medium-haul (N = 216):

	Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Free drink	Free snack	Complimentary lounge access
	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)
Mean	4.9% (8.1%)	4.1% (6.7%)	6.9% (11.3%)	**8.5%** (13.9%)	3.6% (6%)	3.9% (6.4%)	6.1% (10%)
Median	1.5%	0.5%	5%	5%	2%	2.5%	3.3%
Standard deviation	7.7%	6.8%	7.6%	11.1%	6.2%	6.3%	9.4%
25% Quartile	0%	0%	0%	1.4%	0%	0%	0%
75% Quartile	7.5%	6.1%	10%	10%	5%	5%	8.5%
95% confidence interval of the mean	3.9% – 6%	3.2% – 5%	5.9% – 7.9%	7% – 10%	2.8% – 4.5%	3.1% – 4.8%	4.9% – 7.4%

Table 22: Descriptive statistics incentives medium-haul

Correlations incentives medium-haul (N = 216):

		Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Free drink	Free snack	Complimentary lounge access
Q11_2	r_s	**0.2**	**0.26**	**0.15**	**0.25**	**0.22**	**0.2**	**0.14**
	p	**0.003**	**<0.001**	**0.025**	**<0.001**	**0.001**	**0.003**	**0.039**
Q1	r_s	**0.22**	0.12	0.05	0.08	0.07	0.1	**0.19**
	p	**0.001**	0.084	0.501	0.231	0.286	0.163	**0.005**
Q5	r_s	**-0.18**	**-0.2**	0.05	**-0.15**	-0.07	**-0.14**	-0.13
	p	**0.009**	**0.003**	0.464	**0.03**	0.334	**0.036**	0.058
Q6 (N = 200)	r_s	0.09	0.01	0.1	0.09	0.06	0.04	-0.02
	p	0.182	0.915	0.151	0.197	0.413	0.55	0.74
Q7 (N = 194)	r_s	0.12	0.07	**0.19**	0.09	**0.15**	0.11	0.05
	p	0.086	0.338	**0.008**	0.218	**0.036**	0.122	0.497
Q8	r_s	0.06	-0.01	0	-0.03	0	-0.04	0.04
	p	0.36	0.876	0.989	0.614	0.976	0.572	0.565
Q10	r_s	0.12	**0.13**	**-0.2**	0.11	0.11	0.08	0.02
	p	0.074	**0.05**	**0.003**	0.12	0.099	0.242	0.817
Q19	r_s	0.1	0.11	**-0.31**	0.13	0.04	0.02	-0.11
	p	0.145	0.112	**<0.001**	0.059	0.554	0.744	0.115
Q25 (N = 198)	r_s	**0.17**	**0.14**	**-0.17**	0.09	0.09	0.09	0.06
	p	**0.014**	**0.047**	**0.014**	0.189	0.223	0.212	0.38

Table 23: Correlations incentives medium-haul

Descriptive statistics incentives short-haul (N = 216):

	Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Free drink	Free snack	Complimentary lounge access
	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)	WTP for SAF (SAF share)
Mean	9.1% (7.6%)	9.2% (7.7%)	15.9% (13.3%)	**17.1%** (14.2%)	8.8% (7.3%)	8.9% (7.4%)	11.5% (9.6%)
Median	0%	0%	10%	11.3%	2.5%	2.5%	2.5%
Standard deviation	20.1%	18.8%	21.9%	24.9%	17%	16.7%	21%
25% Quartile	0%	0%	0%	0%	0%	0%	0%
75% Quartile	10%	12.5%	25%	22.5%	12.5%	12.5%	12.5%
95% confidence interval of the mean	6.4% – 11.8%	6.7% – 11.7%	13% – 18.9%	13.7% – 20.4%	6.5% – 11.1%	6.6% – 11.1%	8.7% – 14.3%

Table 24: Descriptive statistics incentives short-haul

Correlations incentives short-haul (N = 216):

		Double air miles	Priority Boarding	Free (extra) piece of luggage	Seat with more legroom	Free drink	Free snack	Complimentary lounge access
Q11_3	r_s	**0.17**	**0.21**	**0.22**	**0.18**	**0.25**	**0.22**	**0.17**
	p	**0.013**	**0.002**	**0.001**	**0.01**	**<0.001**	**0.001**	**0.014**
Q1	r_s	**0.18**	0.1	0.06	0.02	0.05	0.05	**0.16**
	p	**0.007**	0.163	0.399	0.716	0.456	0.508	**0.022**
Q5	r_s	-0.12	-0.13	0.01	-0.09	-0.05	-0.05	-0.1
	p	0.077	0.053	0.882	0.186	0.478	0.491	0.14
Q6 (N = 200)	r_s	0.11	0.04	0	-0.03	0.04	0.04	-0.03
	p	0.116	0.603	0.995	0.655	0.577	0.557	0.691
Q7 (N = 194)	r_s	0.1	0.03	0.08	0.03	0.1	0.1	0.03
	p	0.181	0.694	0.254	0.631	0.166	0.176	0.669
Q8	r_s	0	-0.06	-0.04	-0.09	-0.05	-0.04	0.04
	p	0.979	0.383	0.523	0.176	0.453	0.576	0.516
Q10	r_s	0.06	0.04	**-0.19**	0.02	0.03	0.01	0.01
	p	0.352	0.603	**0.005**	0.776	0.669	0.891	0.927
Q19	r_s	0.06	0.05	**-0.24**	-0.03	-0.06	-0.09	-0.07
	p	0.4	0.462	**<0.001**	0.683	0.403	0.18	0.3
Q25 (N = 198)	r_s	0.1	0.08	-0.13	-0.04	-0.03	-0.04	0.08
	p	0.177	0.239	0.064	0.554	0.726	0.584	0.244

Table 25: Correlations incentives short-haul

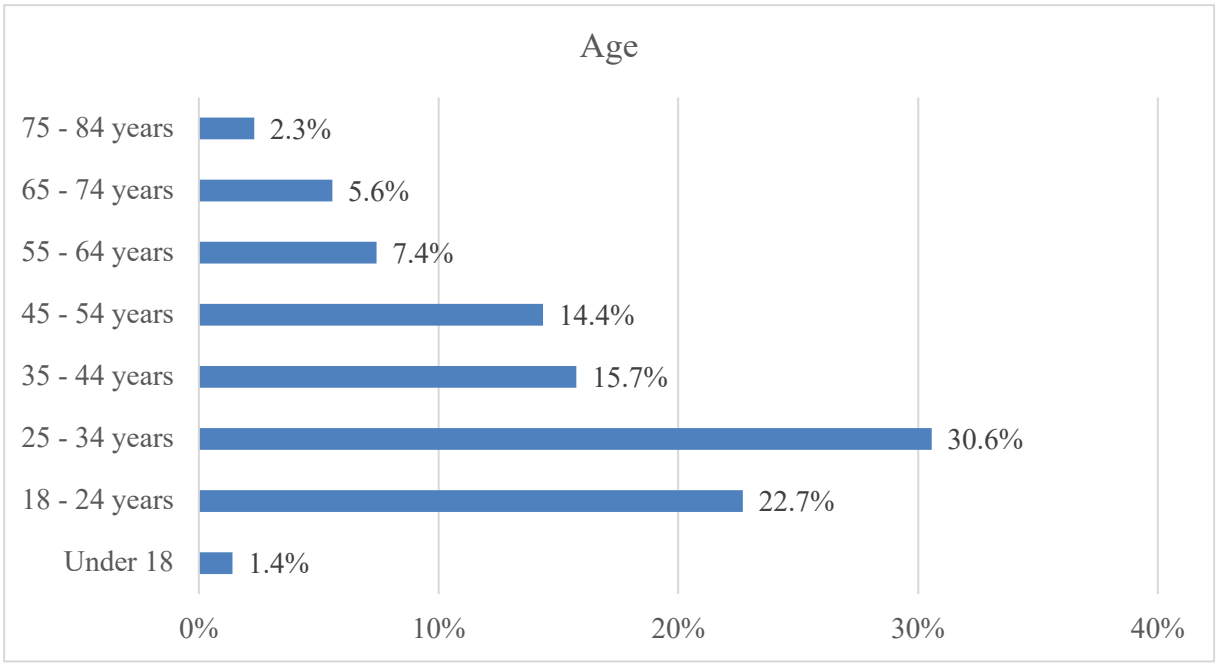

Figure 5: Age

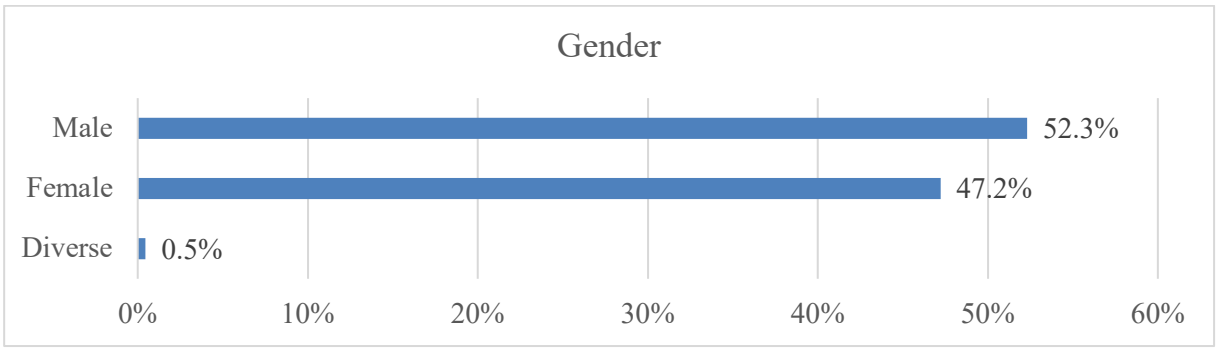

Figure 6: Gender

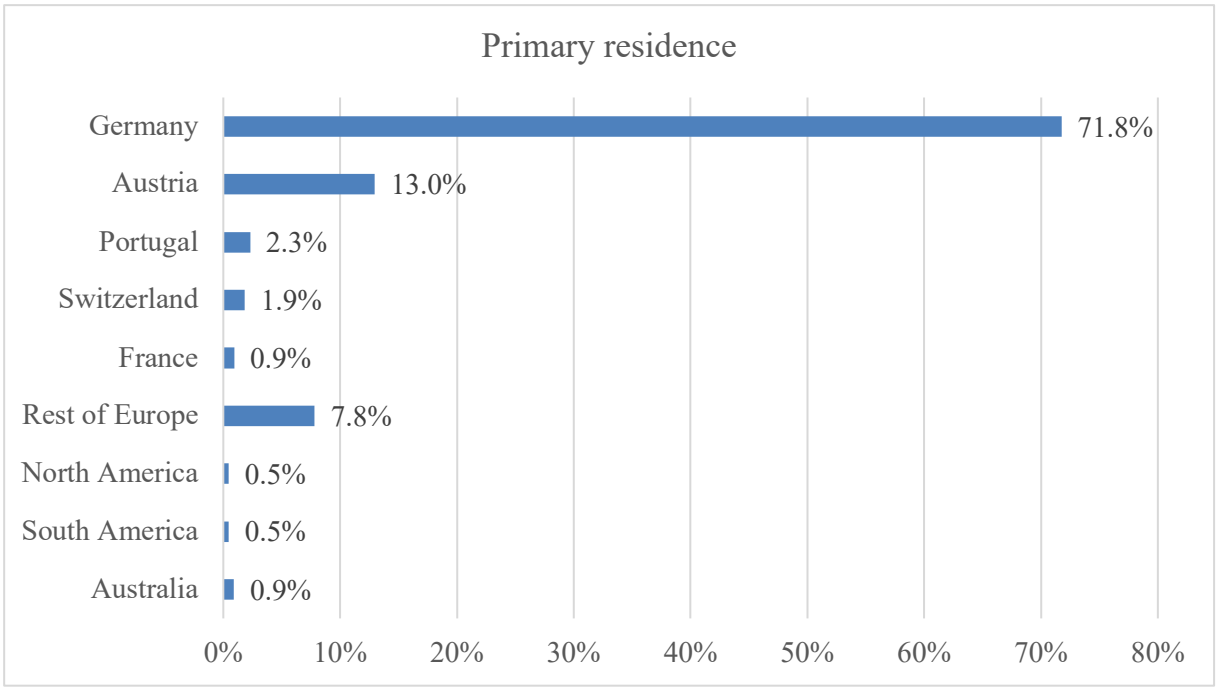

Figure 7: Primary residence

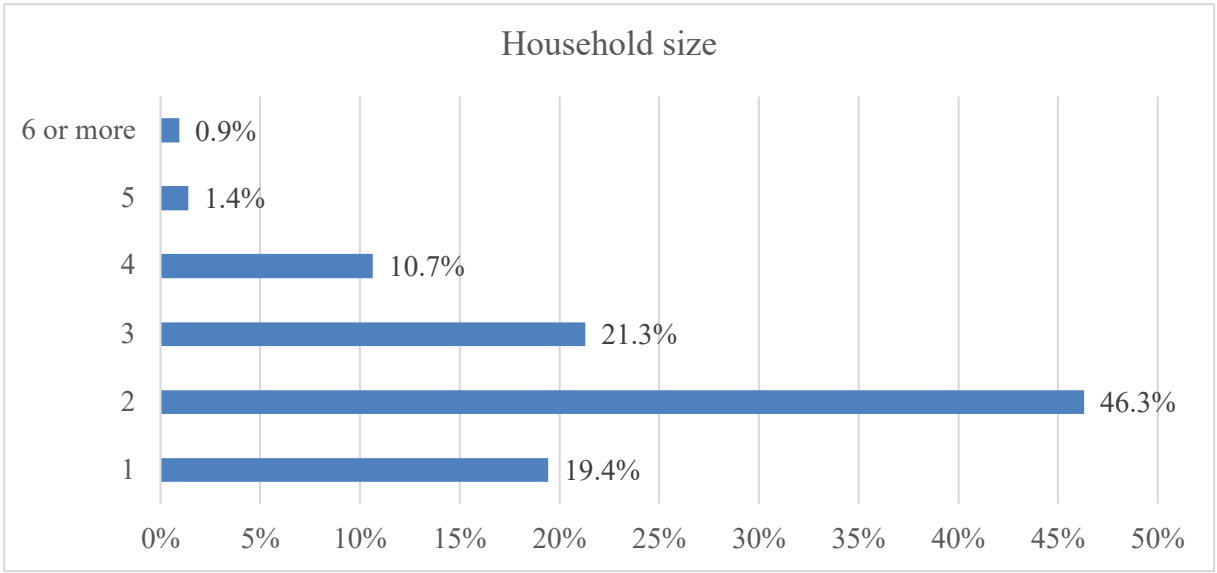

Figure 8: Household size

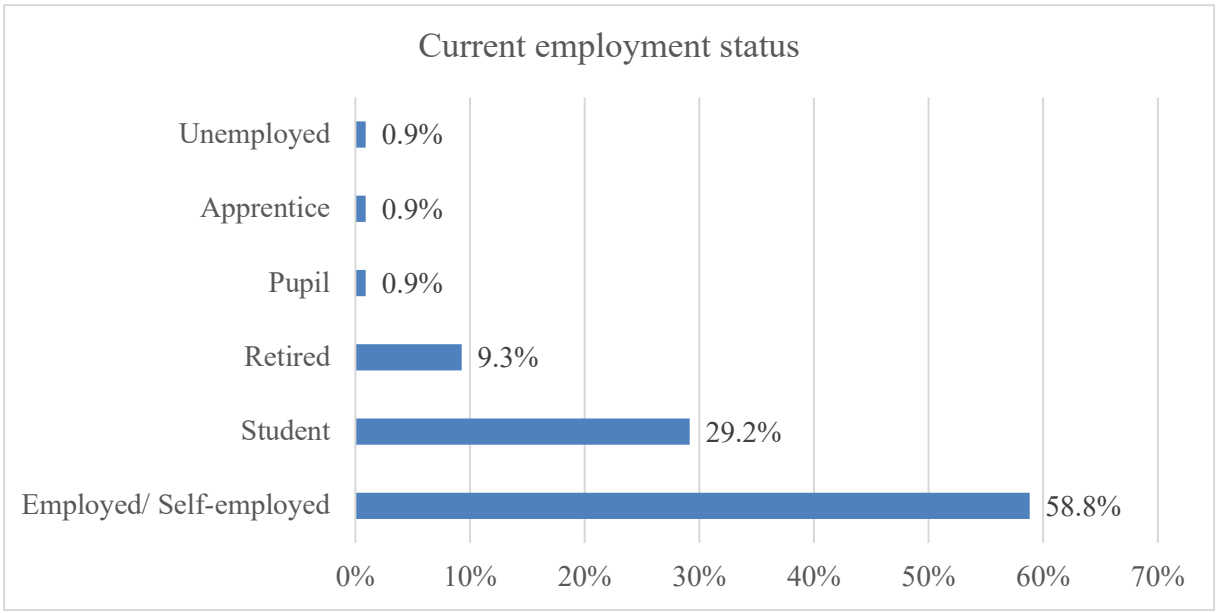

Figure 9: Current employment status

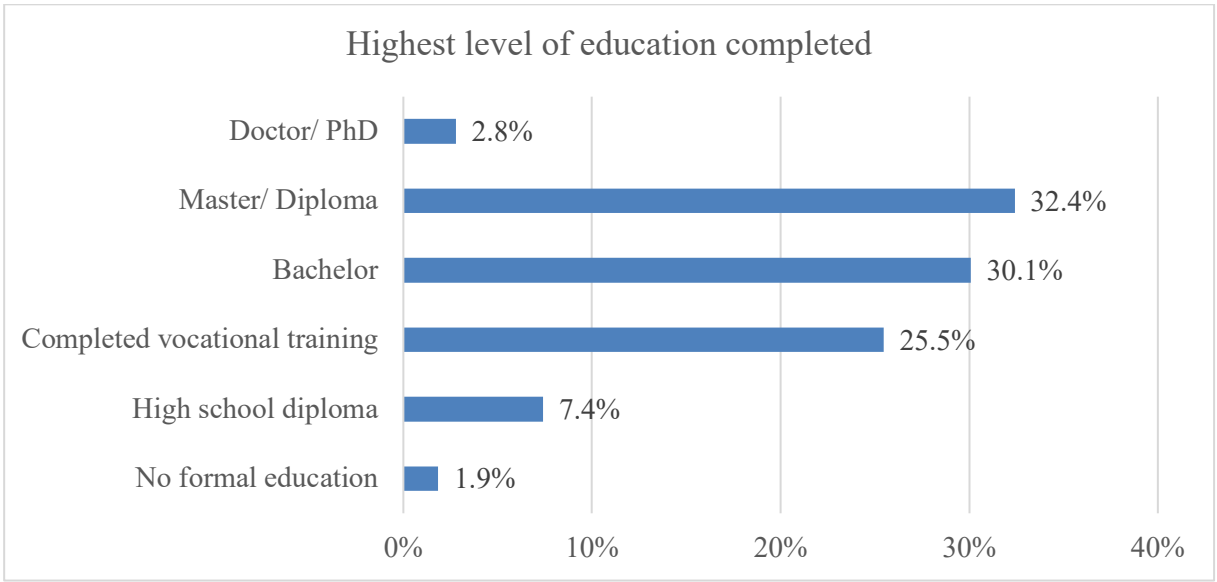

Figure 10: Highest level of education completed

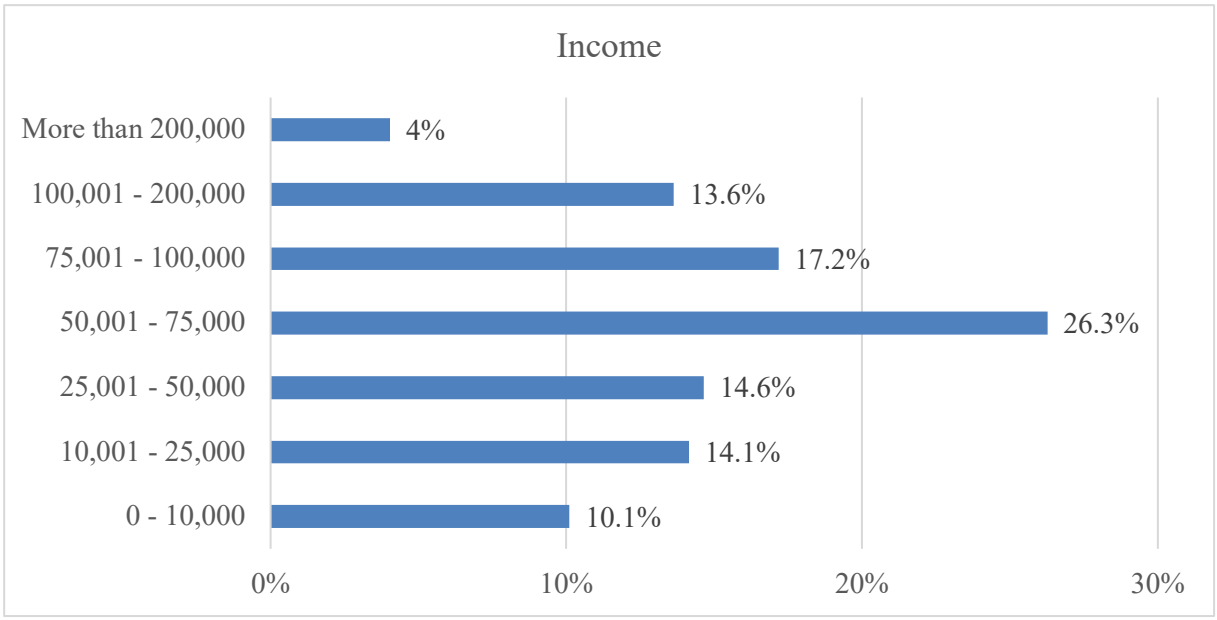

Figure 11: Income