

Contributing to the vision of net-zero aviation emissions in 2050 through change in consumption behaviour

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Abstract

Aviation plays a crucial role for economic development and social welfare, but at the same time significantly contributes to climate change. Therefore, the industry has to mitigate its environmental impact. Literature has discussed five mitigation strategies: technological, market-based, operational, regulatory and consumption behaviour. While changes in consumption behaviour is regarded as having the greatest mitigation potential, it also received far less attention in literature. The purpose of this study is to investigate the potential of consumption behaviour change as an instrument to mitigate the environmental impact of aviation that could contribute to the vision of net-zero aviation in 2050. The study is conducted in the form of a literature review. The research shows that an instrument is needed to stimulate people to make a more sustainable choice to mitigate aviation's environmental impact. The task of the aviation industry is to provide the resources that are required to ensure that this instrument will be successful.

Introduction

By 2050, aviation threatens to become the single largest source of carbon dioxide emissions due to rapidly increasing demand. Although passenger air travel currently only accounts for about 2-3% of global carbon emissions, this is largely generated by the fraction of the world population that flies regularly (Graver, Rutherford, & Zheng, 2020). High-income countries were responsible for 62% of carbon emissions emitted in 2018 (Graver, Rutherford, & Zheng, 2020) with demand rising by 5.9% globally (ICAO, 2019). Several studies suggest that by 2050 aviation will account for about one quarter of all global emissions (Pidock & Yeo, 2016). Technological improvements and alternative fuels, such as biofuel have some potential (Prussi, O'Connell, & Lonza, 2019), yet studies show that these improvements will not be enough to reduce emissions in the context of such pronounced growth in demand (Prussi, O'Connell, & Lonza, 2019; Pavlenko, 2018; Graver, Rutherford, & Zheng, 2020; Kousoulidou & Lonza, 2016).

According to Daley (2010), the environmental impact of air travel can be reduced through five changes: technological, market-based, operational, regulatory as well as in consumption behaviour. Even though both Davison, Littleford and Ryley (2014) and Gössling et al. (2007) see consumption behaviour as the greatest potential for mitigating the climate change impact of aviation, it has, as a measure received far less attention in the literature than others. Consumption behaviour in this context has to be understood as altering consumption in order to reduce environmental impacts, exploring the historical and social context of air travel consumption. Although this certainly could be achieved through the reduction of flights, the social and economic impacts of air transportation should be accounted for. The purpose of this study is to investigate the potential of consumption behaviour change as an instrument to mitigate the environmental impact of aviation that could contribute to the vision of net-zero aviation in 2050. The study has the following structure. First, the reason why people fly or not will be described. Second, the characteristics of passenger groups will be discussed. The final section focuses on what is needed to change the passenger's behaviour based on the information from the previous sections.

Why do people fly or not?

To understand how to change the consumption behaviour of passengers, it is important to understand why people fly in the first place. This section focuses on the reasons why people do or do not fly and what the factors are that influence those reasons.

The reasons why people fly is affected by a several forces. Morphet & Bottini (2014) found the following factors that affect the propensity to fly:

- ❖ **Demographic changes:** A growing population simply raises the number of people that potentially will fly. Also, a growing middle class boosts the propensity because of a higher income.
- ❖ **Market maturity:** A growing economy does not increase the propensity to fly indefinitely. There is a point where the demand does not go up and the supply matches that demand.
- ❖ **Crises:** Crises such as 9/11 or the 2008 economic crisis decreased the demand for air travel. However, after such a crisis a strong catching-up pattern was seen. This can therefore be expected after COVID as well.
- ❖ **Geographical features:** The propensity to fly is bigger in remote and isolated countries such as islands, and countries with limited land transport and large distances between population centres. These countries reach market maturity later than non-isolated countries as well.
- ❖ **Competition:** The rise of new business models such as LCC's made air travel more affordable increasing the propensity.
- ❖ **Airport hub status:** Countries with a big hub airport which generates more connectivity than necessary for those countries, such as Singapore or the UAE, have a higher propensity to fly.

The main reason however is the GDP of a country (Airbus, 2021). Historic trends show that the growth of flights follows the growth of GDP (Eurocontrol, 2018). And that the trips per capita increase when the GDP per capita increases. When people have enough personal income to afford flying, they will do so. A healthy economic situation in a country means growth in business, and therefore the need for more business flights, as well (Morphet & Bottini, 2014). The relation between GDP per Capita and the Air Trips per Capita is are shown in Figure 1. It clearly shows that with a higher GDP per capita, the trips per capita increase.

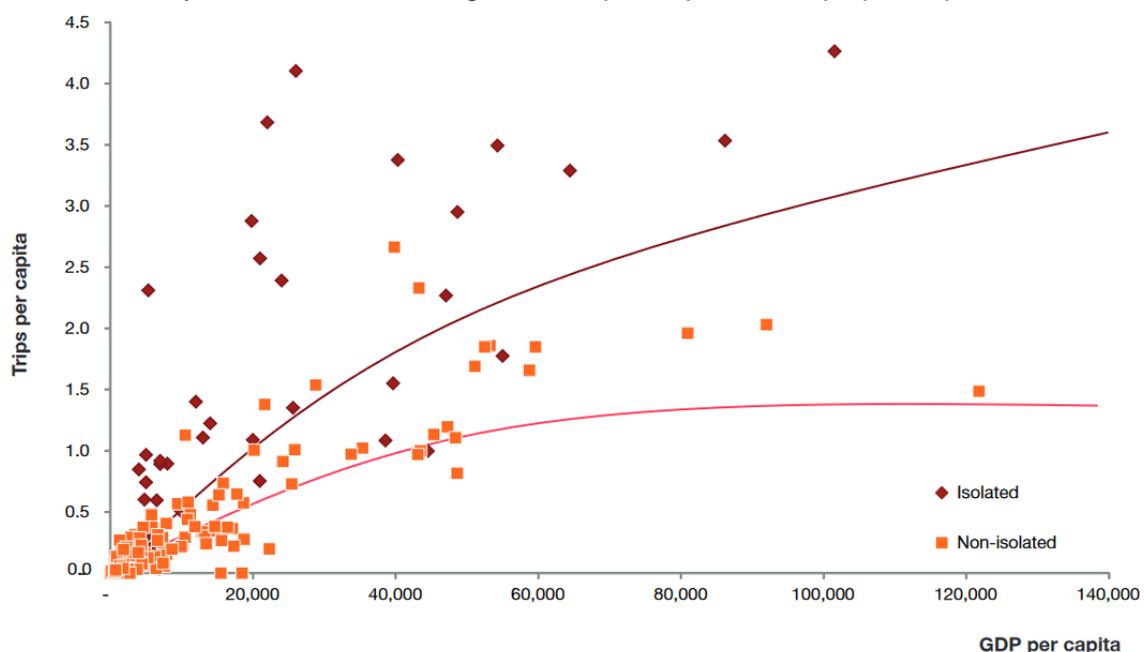


Figure 1: Relationship between air trips per capita and GDP, 2013 (Morphet & Bottini, 2014)

Eurocontrol (2018) predicted that the worldwide GDP will grow until at least 2040. And Airbus (2021) predicted that the middle class will have grown 1.5 times in 2040. Both expecting the demand for air travel to continue to grow the coming decades.

Before the 2000's, the aviation industry was socially unequal, but the rise of the low-cost carriers, continuing social normalisation of aviation, and growing dispersion of global networks have all contributed to a decrease in inequality (Büchs & Mattioli, 2021). Whilst the overall social inequality in aviation has decreased, the inequality between the highest and the lowest classes has remained high. As only 17.5% of the lowest income decile (lowest 10%) fly at least once a year. Compared to the 71.6% of the highest income decile (highest 10%), this is still a big gap. Similar inequalities arise in the trip rates of different social groups, 0.35 trips per year for the lowest income decile and 2.54 trips per year for the highest income decile (LCF, 2018), which is supported by figure 1.

When those factors (GDP etc.), as previously explained, are stimulating people to fly, most of them fly for leisure as can be seen in figure 2, 3 and 4. Vacation was the reason for 78% of the most recent flights of people in the Netherlands. 13% was for visiting friends and relatives (VFR) and 7% for business (Zijlstra & Huibregtse, 2018). In a study of 29 international students 40% of the flights taken by those students was for vacation, 26% for VFR, 25% was for school or work. The remaining 9% was for other reasons (Gossling, Hann, Higham, Cohen, & Hopkins, 2019). And in 2019 71% of the flights in the US was for personal reasons and 29% for business (Airlines for America, 2021).

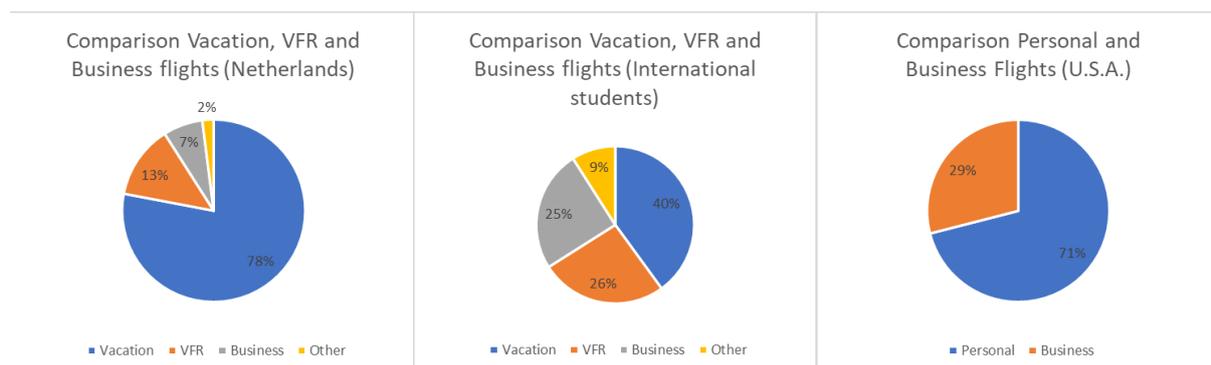


Figure 2: (Zijlstra & Huibregtse, 2018)

Figure 2: (Gossling, Hann, Higham, Cohen, & Hopkins, 2019)

Figure 3: (Airlines for America, 2021)

One reason people choose to fly, rather than take a different mode of transport, is because the world attracts people to do so constantly. For example, travel programs and books encouraging people to travel the world. These examples of travels do have a positive effect, because those gives relaxation, or contact with different cultures, or it is a status symbol (Berveling, 2019). Travel is at heart also an emotional, fundamentally human issue. Travelers can have personal needs and desires which they want to fulfil (2CV, 2015). The people that fly for business do so to attend meetings, conferences, check other locations of the company etc. In a small survey done amongst thirteen conservation scientists the reasons why they did fly was asked. The main reason was networking (Fox, et al., 2009).

There is also a small part of the population that stops flying or flies less because of environmental reasons. In 2015 only 4% of the people in the UK had environmental concerns as a reason for not flying (Civil Aviation Authority, 2015). However, it is a growing trend. The term 'flight shame' appeared around 2018 (Berveling, 2019). Wormbs and Soderberg (2021) held a survey among environmentally conscious people. They found that the respondents stopped flying after they gained more, or better understood, knowledge about the effects of flying. A second reason was if the respondents experienced the effects of climate change themselves, such as the record-breaking summer resulting in forest fires. The emotions the respondents felt during those experiences, or emotions from an indirect experience such as watching a documentary, were the third reason to stop flying. This resulted in a form of social awareness and social responsibility. This is supported by a similar study by Jacobsen, Akerman, Giusti, and Bhowmik (2020).

Other reasons were that they found flying not lining up with their already green morals, the future of their children, the opinion in the public debate or of their role models, their social group, shame, and the availability of alternatives such as taking the train or traveling more closely to home (Wormbs & Soderberg, 2021).

Despite the growing knowledge of the effects of flying on climate change the majority of people still fly. Even in a scenario where there is a 200% ticket tax and a \$1.000/ton CO2 tax, people will not reduce their flying behaviour in a way that will lead to enough CO2 reduction (Peeters, 2017). This points out that passengers will not easily start flying less, even when passengers are aware of the effects. For 'green consumers', this causes 'cognitive dissonance', which means that their (perceived) behaviour is different from their (perceived) thoughts about flying (McDonald, Oates, Thyne, Timmis, & Carlile, 2015).

Passengers use three strategies to mitigate their cognitive dissonance:

- People tend to constantly consider the same elements in their decision-making process, especially travel time and price (Higham, Cohen, & Cavaliere, 2013).
- People use reasons that they feel are beyond their control to justify their behaviour, such as work, events, special holidays and VFR (McDonald, Oates, Thyne, Timmis, & Carlile, 2015).
- People fly because other people fly too, due to the normalisation of flying by society (Higham, Cohen, & Cavaliere, 2013). This because going against your own norms is easier than going against those of society (McDonald, Oates, Thyne, Timmis, & Carlile, 2015). The conclusion of the study was that people rather try to justify their behaviour regarding their otherwise environmentally friendly attitude instead of changing their behaviour. And that it is more difficult to be out of line with the social norms regarding flying than one's own 'green' attitude (McDonald, Oates, Thyne, Timmis, & Carlile, 2015).

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Passenger Characteristics

Within aviation there are two commonly known passenger groups, leisure (Including VFR and vacation trips), and business (Dresner, 2006). Each passenger is different, but among passenger groups there exists a to be believed commonality in behaviour/characteristics.

One of the biggest differences between the passenger groups is the price they are willing to pay. Not only for the ticket, but also for flight amenities, such as the time of departure, duration of the flight, and in-flight services. For instance, vacation routes, commonly flown by leisure passengers have a greater mean price elasticity, compared to the mean for non-vacation routes, commonly flown by business passengers (Dresner, 2006). This shows that generally leisure passengers seek out lower airfares and are more restricted by the price of a ticket compared to a business passenger (for whom the ticket is often paid for by their employer) (Martínez-García, Ferrer-Rosell, & Coenders, 2012). If no inexpensive flights on their budget are available, they have a higher tendency not to fly. Except for the VFR portion of leisure travel. They will keep flying, even though their ticket price will increase. VFR passengers have different motives for their flight and are not always able to choose an alternative mode of transport (Backer, Leisch, & Dolnicar, 2017).

Business passengers put a higher value on non-stop flights compared to connecting flights and are willing to pay a premium fare for it. Leisure passengers on the other hand are more willing to trade lower airfares for longer and “inconvenient” travel connections (Warburg, Bhat, & Adler, 2006). They are even willing to spend an extra night at a destination to obtain a lower ticket price (Dresner, 2006). It is also stated that business passengers have a higher value of time compared to leisure passengers. They are less willing to drive longer distances for lower ticket prices and are more likely to trade in higher airfares for shorter travel times (Hess, Bierlaire, & Polak, 2005). Additionally, business travellers rate flight frequency and short airport access time higher than leisure travellers (Parrella, 2013). Therefore, airlines that operate for leisure markets tend to offer less frequencies than airlines operating in business markets (Dresner, 2006)

It is expected that the price of an airline ticket will increase, as passengers will have to pay for the effects of CO₂. As business passengers are more willing to pay for a premium price, it is expected that they will more likely be able to pay for the effects of sustainability as is the VFR portion of leisure travel. Besides business and VFR passengers, young people and women are more willing to pay more for a (more) sustainable flight, whilst older passengers are far less willing (Dichter, Henderson, Riedel, & Reifer, 2020) Rice, Ragbir, Rice, & Barcia, 2020).

Business passengers do not value ticket price as highly as leisure passengers do, they are willing to choose a shorter, direct flight, at a better departure time for a higher ticket price. Therefore, we believe that business passengers are more willing to pay a higher ticket price to contribute to net-zero aviation. Not all leisure passengers have this luxury and by increasing the ticket price significantly, not all leisure passengers will be able to fly in the future. The VFR segment of leisure travel will more likely be able to pay this increase in ticket price, because travel is a necessity for them, and there are not always alternative modes of transport available.

Change in consumption behaviour

As discussed before, passengers have many different reasons to fly. To achieve net-zero aviation, it is necessary to know how people can be encouraged to fly responsibly. To determine how this can be achieved, the DINAMO-model will be used in this section. DINAMO stands for “the Diagnostic INventory for the Assessment of willingness to change Among Managers in Organisations”. Originally, the DINAMO model (see figure 5) was developed by Erwin Metselaar and can be used to assess the willingness for change by managers and employees. However, it can also be used to investigate the readiness for change of people's behaviour and in this study the willingness to change among aviation passengers (Stoffers & Mordant-Dols, 2015) (Managementmodellen, 2021). The willingness to change is determined by “want to”, “have to” and “be able to”.

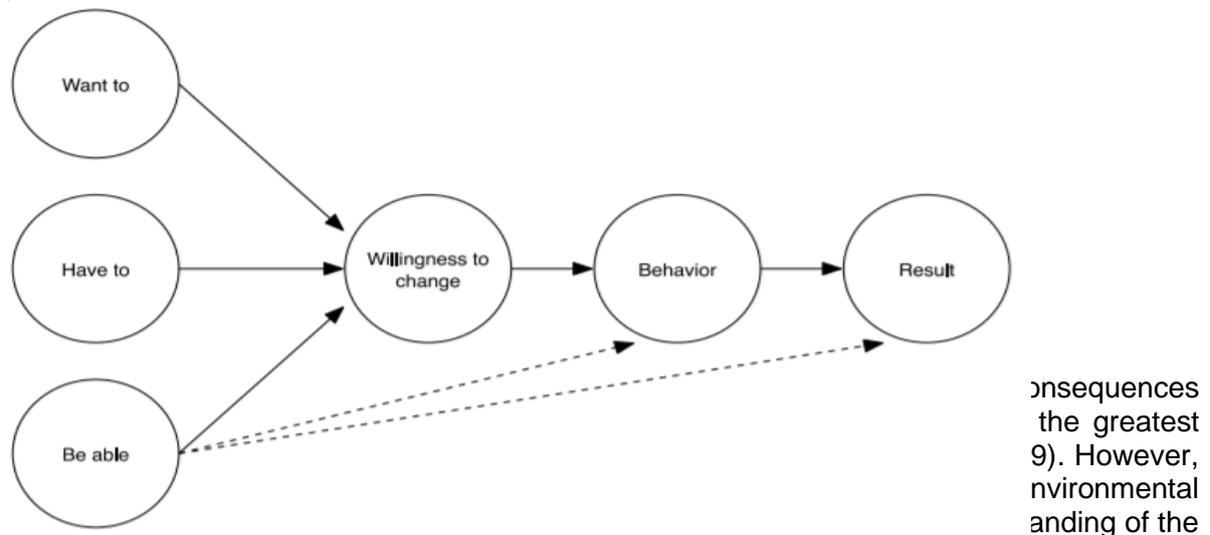


Figure 5: DINAMO Model (Stoffers & Mordant-Dols, 2015)

environmental impact of flying, but they do not change their flying behaviour (Brouwer, Brander, & Van Beukering, 2008). An example can be seen when looking at carbon off-setting. Research among Asian travellers indicated that passengers are unaware of the impact they have on climate change. These passengers are not willing to pay for carbon offsetting (Lu & Wang, 2018).

A survey by McKinsey (2020) shows that the youngest airline customers are the most concerned about climate change (n = 5,300). It showed that one third of the respondents want to change their behaviour because of their concerns on the impact of climate change. The passengers that were aware of the impact their flight has on climate change were also willing to pay more for a carbon-neutral aircraft. This example shows that passengers are willing to take measures, either by flying less or paying more, but only when they are aware of the consequences.

Airlines are trying to increase awareness of passengers to climate change by giving them the opportunity to invest in alternative fuel or carbon – offsetting. The aim of this measure is to give the passenger the feeling that he or she is taking action to reduce the impact on climate change (Becken & Pant, 2018).

Have to – necessity of flying

The influence on having to change will be determined by analysing both internal pressure or external necessity. Air travel is often justified as necessary, trips always have purpose and value. Though as discussed before, it is evident that people travel for reasons that include forced and voluntary movement. Motives to fly range from VFR to holiday or business. These motives have different degrees of 'urgency' and the 'necessity of flight' cannot be generalized (Gössling, Hanna, Higham, Cohen, & Hopkins, 2019).

Air travel is regularly presented as a social norm, specifically by airlines and other aviation related organisations. This fosters various discourses and mechanisms designed to strengthen the social norm of flying, for example the self-promotion through frequent flyer programs (Peeters, Gössling, & Becken, 2006). Moreover, large passenger numbers on global scale could be interpreted wrong. This could suggest that flying is ordinary and a mass activity (Peeters, Gössling, & Becken, 2006). It results in the misunderstanding of flying behaviour. Social norms are furthermore reinforced through advertisement, in which airlines motivate people to fly for shopping, relaxation or experience purposes. Frequent flyer programs often complement offers in an attempt to bind customer closely to airlines (DEFRA, 2009). The examples above show how air travel is supported by and framed within practices underlining the social desirability of flight and how it is maintained as a social norm. Moreover, there is notable absence of public discussion on the legitimacy of flight, the moral valence of different motives to travel by air, and individual responsibility (Ostrowski, O'Brien, & Gordon, 1993).

Able to – availability of information

The influence on being able to change will be discussed by exploring the availability and manageability of information. Self-effectiveness is one's confidence in their own ability to successfully influence their environment, such as completing a task or solving a problem. People are more likely to be "able to" perform a particular action if they feel that they have the ability to perform it successfully (Gössling, Hanna, Higham, Cohen, & Hopkins, 2019). By creating awareness of the problems the aviation industry is facing, the consumers might think twice before they book a flight. There are multiple solutions that could increase the feeling of influence among aviation consumers (Baumeister & Onkila, 2016).

By the use of environmental labels the feeling of influence among passengers can be increased (Anderson, Mastrangelo, Chase, Kestenbaum, & Kolodinsky, 2013). These eco-labels are tools that provide the buyer with information on the environmental impact of their booked flights (see figure 6). This allows them to compare different products based on their environmental performance with an increased feeling of influence as well (Bratt, Hallstedt, Robert, Broman, & Oldmark, 2011). Eco-labels can help change consumption patterns by stimulating more sustainable purchases. They can also motivate airlines to raise their environmental standards (Gallestegui, 2002). A study conducted by Hagmann et al. (2015) have outlined the importance of making flights environmentally comparable by using fitting indicators. According to the study, air travellers are interested in integrated environmental information into their booking decisions once this information is available for them (Hagmann, Semeijn, & Vellenga, 2015). In a study executed by Araghi et al. (2014) it is confirmed that eco-labels have an influence on air travellers decisions to choose for a more sustainable option (Araghi, Kroesen, Molin, & van Wee, 2014).

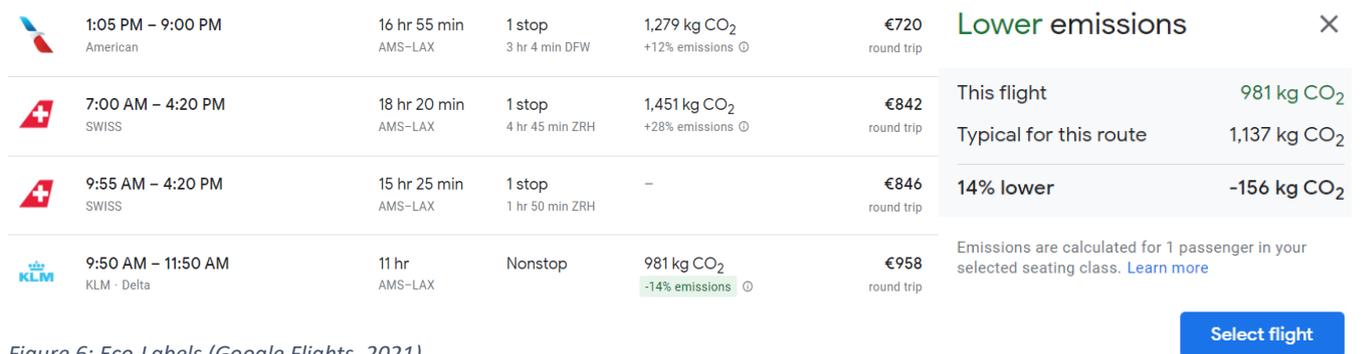


Figure 6: Eco-Labels (Google Flights, 2021)

Conclusion

This study set out to investigate the potential of consumption behaviour change as an instrument to mitigate the environmental impact of aviation, contributing to the vision of net-zero aviation in 2050. It identified concrete actions the aviation industry could perform to mitigate its impact; enhance awareness on the environmental consequences of flying to increase transparency and limit the promotion of flying as a social norm. Although passengers are aware of the negative effects of flying, this is not reflected in their consumption. Passengers experience cognitive dissonance, justifying their consumption sooner than changing it.

However, gaining knowledge about the environmental impact of flying or experiencing direct or indirect effects of climate change has caused part of the population to stop flying. Frequent flying is differentiated by social class, wealthier people and those in higher social classes are more likely to fly. Besides social class, the type of travel plays a role. It is expected that business and visiting friends and relatives (VFR) passengers are more likely to pay for an increase in ticket price should this be imposed to reduce carbon emissions. Though, this does not necessarily reduce demand. Leisure travellers on the other hand are more price sensitive. An increase in ticket price is likely to have a drop in demand as a result. This reduces emissions should airlines decide to bring down their air traffic movements.

Reducing consumption further could be achieved by making it easier for passengers to identify the consequences of flying through sharing information on the environmental impact of flying (e.g., kilograms of CO₂ per flight). The purpose of this is to ensure that awareness of the consequences is raised to a higher level than it is currently. Additionally, the promotion of flying as a social norm (e.g., through advertisements) should be reduced to limit the number of flight movements associated with certain activities (e.g., city trips).

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