JYVÄSKYLÄ STUDIES IN BUSINESS AND ECONOMICS
178

Stefan Baumeister

An Eco-label for the Airline Industry – Instrument for Behavioral Change?

JYVÄSKYLÄN YLIOPISTO

JYVÄSKYLÄ STUDIES IN BUSINESS AND ECONOMICS 178

Stefan Baumeister

An Eco-label for the Airline Industry – Instrument for Behavioral Change?

Esitetään Jyväskylän yliopiston kauppakorkeakoulun suostumuksella
julkisesti tarkastettavaksi yliopiston Agora-rakennuksen Lea Pulkkisen salissa
kesäkuun 12. päivänä 2017 kello 12.

Academic dissertation to be publicly discussed, by permission of
the Jyväskylä University School of Business and Economics,
in building Agora, Lea Pulkkinen hall, on June 12, 2017 at 12 o'clock noon.

UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2017

An Eco-label for the Airline Industry – Instrument for Behavioral Change?

JYVÄSKYLÄ STUDIES IN BUSINESS AND ECONOMICS 178

Stefan Baumeister

An Eco-label for the Airline Industry – Instrument for Behavioral Change?

UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2017

Editors
Tuomo Takala
Jyväskylä University School of Business and Economics
Pekka Olsbo, Ville Korkiakangas
Publishing Unit, University Library of Jyväskylä

Cover photo by Stefan Baumeister.

Permanent link to this publication: http://urn.fi/URN:ISBN:978-951-39-7081-9

URN:ISBN:978-951-39-7081-9
ISBN 978-951-39-7081-9 (PDF)

ISBN 978-951-39-7080-2 (nid.)
ISSN 1457-1986

Jyväskylä University Printing House, Jyväskylä 2017

ABSTRACT

Baumeister, Stefan Christoff
An Eco-label for the Airline Industry - Instrument for Behavioral Change?
Jyväskylä: University of Jyväskylä, 2017, 111 p.
(Jyväskylä Studies in Business and Economics
ISSN 1457-1986; 178)
ISBN 978-951-39-7080-2 (nid.)
ISBN 978-951-39-7081-9 (PDF)

Climate change is the biggest challenge humanity has ever faced and there is no doubt that human activities are the main cause. One activity that has received much attention in this discussion is air transportation. Although its contribution is still moderate, this industry is growing at a very fast rate and with that its impact on climate change. In order to enjoy its social and economic benefits also in the future and to avoid regulatory restrictions, the industry's contribution needs to be kept in check. Various mitigation strategies exist such as technological, market-based, operational, regulatory and behavioral changes. This dissertation focuses on behavioral change. One instrument leading towards behavioral change is the eco-label.

This dissertation presents and examines the idea of introducing an eco-label for the airline industry. It has the following two objectives: 1) to study prerequisites essential for the use of an eco-label in the airline industry and 2) to study the potential outcome an airline eco-label could have on the behavior of air passengers aiming at the mitigation of climate change.

This dissertation is based on four articles and follows a mixed-method approach. It utilizes data from two surveys (N=148, N=554), 12 industry expert interviews and flight and fuel data from secondary sources.

The results showed that it is difficult for air passengers to identify green flight options. However, air passengers actively selecting greener flight options can make a real difference as it was found that there are tremendous differences in the environmental performances of individual flights. An eco-label could promote behavioral change as it helps air passengers to easier identify greener flights. The results showed that an airline eco-label had influenced the booking decision of air passengers and led to behavioral change. Air passengers changing behavior would also demand the airline industry to improve its environmental performance. This could also lead to more environmental competition within the industry.

Based on the findings a clear recommendation can be given to the airline industry to implement an industry wide eco-label. An eco-label would lead to behavioral change among air passengers which in turn would mean less emissions and a reduced impact of air transportation on climate change.

Keywords: eco-label, behavioral change, air passengers, airline industry, climate change

Author's address Stefan Baumeister
Mattilanniemi 2
FI-40100 Jyväskylä
stefan.c.baumeister@jyu.fi

Supervisor Prof. Hanna-Leena Pesonen
School of Business and Economics
University of Jyväskylä
Jyväskylä, Finland

Reviewers Prof. Lassi Linnanen
School of Energy Systems
Lappeenranta University of Technology
Lappeenranta, Finland

Dr. Andreas Wittmer
Institute for Public Services and Tourism
University of St. Gallen
St. Gallen, Switzerland

Opponent Prof. Lassi Linnanen

ACKNOWLEDGEMENTS

First of all, I would like to thank my supervisor, Professor Hanna-Leena Pesonen, for all the guidance and advice as well as for always being there for me when I needed support or help in completing this project. Secondly, I would like to thank my second supervisor, Senior Researcher Tiina Onkila, who has been a great source of inspiration when it comes to actually doing research and an excellent co-author. Further, I would also extend my gratitude to Professor Magali Delmas at the University of California, Los Angeles (UCLA) and Professor Sybille Schwarz from the University of Applied Science Offenburg for their valuable contribution to this work. I also thank my opponent Professor Lassi Linnanen and my external reviewer Dr. Andreas Wittmer for their valuable comments in the final stages of writing this dissertation.

For all the personal and scientific support I would like to thank all my fellow Ph.D. candidates Salvatore Ruggiero, Sari Hämälainen, Kukka-Maria Ulvila, Kristiina Joensuu, Taneli Vaskelainen and Bhavesh Sarna as well as my dear colleagues at UCLA Institute of the Environment and Sustainability. Also would I like to express my warmest gratitude to the University of Jyväskylä, School of Business and Economics for providing me with the facilities, training and generous funding during all these years. Further I would like to thank the Fulbright program for giving me the opportunity to spend one year as a Graduate Visiting Researcher at UCLA. In addition to that, I would like to thank TEKES, Työsuojelurahasto and Liikesivistysrahasto for their financial support. Also would I like to thank Finnair Oyj, as one of the cooperation partners in the WINCSR project, for supporting me with my data collection.

Nevertheless, I would have never chosen this path without my parents and my brother who have taught me the importance of protecting our environment since my early childhood. Thank you for your ongoing support during all these years. Further, my gratitude goes to my relatives in Finland who have so often provided me with a home whenever I needed it. Last but not least I would also like to thank all those inspiring and wonderful people I have spent significant time with during this journey and who have made the past five years so memorable: Suvi Mäkelä, Gintas Silinskas, Xin Xing, Guillaume Bernard, Antonina Shevchuk, Daniela Wachter, Anson Lam, Peerapong Ping, Mikko Karhunen, Demi Smoloktou, Cecile Fountain, Andrew Mambo, Vesa Kaakkuriniemi, Jussi Rumbin, all the volunteers of the local Greenpeace Jyväskylä Group as well as all the guys from Kortepohja Sauna.

Jyväskylä 15.05.2017
Stefan Baumeister

CONTENTS

1 INTRODUCTION

"I think that once people understand the great risk that climate change poses, they will naturally want to choose products and services that cause little or no emissions of greenhouse gases, which means 'low-carbon consumption.' This will apply across the board, including electricity, heating, transport and food." Nicholas Stern

1.1 The investigated topic

Climate change is the biggest challenge humanity has ever faced (McKinnon, 2012). Although still heavily debated, there is clear scientific proof that climate change is mainly caused by human activities through the release of greenhouse gas emissions. More than 97% of all climate scientists support this thesis (NASA, 2016). Since the Rio Earth Summit in 1992 and the latest Climate Change Conference in Paris in 2015 the consensus on the pressing need to address issues related to human activities causing climate change more seriously has increased. The agreement negotiated during the Climate Change Conference in Paris set an ambitious target of capping global warming at 2 degrees Celsius above preindustrial levels. Nevertheless, still things are changing very slowly and we are currently far from real improvements.

In terms of human activities contributing to climate change, electricity and heat production, with a share of 42% of the worldwide CO2 emissions, are the highest, followed by transportation with 23% and industrial production which accounts for 19% (IEA, 2015). Although road transportation is the major contributor to the total CO_2 emissions of the transportation sector (IEA, 2015), aviation has received the most attention in the public debate on climate change impacts of human's mobility which is due to the high energy intensity of air transportation. Nevertheless, aviation consumes only 11% of all transport energy used and accounted for about 12% of the CO_2 emissions of the entire transport sector (IEA, 2009). However, while the share of CO_2 emissions is still

moderate it is assumed that the warming effects of air transportation might be much higher due to other greenhouse gases such as NO_X, CH_4 and H2O as well as the differential effects of emissions on different altitudes (IEA, 2009). Though, the real impacts of non-CO_2 emissions are still not clearly identified and heavily debated within science (Preston, Lee & Hooper, 2012).

Nevertheless, aviation in its current form cannot be regarded as sustainable (Forsyth, 2011). Based on all three dimensions of sustainability (environmental, social and economic) "a sustainable air transport system would have a negligible environmental footprint while satisfying the transportation needs of a globally connected society and providing adequate returns on investment to attract and retain investors, employees, and the supporting value chain" (Sgouridis, Bonnefoy & Hansman, 2011). However, according to Walker and Cook (2009) the concept of sustainable aviation is still in its infancy. Coles, Fenclova and Dinan (2011) further claim that research on aviation's CSR activities are still on an early stage. When looking closer at environmental sustainability, the main focus of this dissertation, Forsyth (2011) found that the two pressing issues regarding the aviation industry are its high dependency on fossil fuels and its contributions to climate change. The dependency on fossil fuel could be overcome by the use of fuel that comes from renewable resources such as biofuels. Nevertheless, the current availability of biofuels is still limited. It is just until recently that the first airport, Oslo Gardermoen, has started to offer biofuels through its normal supply mechanisms (Moores, 2016). Besides that there are more concerns regarding the use of aviation biofuels such as safety (Walker & Cook, 2009) as well as that biofuels might compete with food production (Koh & Ghazoul, 2008). However, the major drawback is that aviation biofuels won't help reduce aviation's impact on climate change. In some cases the impacts of burning biofuels might even be higher than those of fossil fuels (Forsyth, 2011). While finding new sources of renewable energies will remain a future technological challenge, this dissertation will focus on the mitigation of climate change impacts caused by air transportation based on current technology.

Aviation can be divided into passenger and freight transportation as well as military flights. This dissertation will exclusively focus on passenger transportation which according to Gössling, Haglund, Kallgren, Revahl and Hultman (2009) has the largest share in the overall emissions created by aviation. Aviation currently accounts for about 2.5% of the worldwide CO_2 emissions (Lee, Fahey, Forster, Newton, Wit, Lim, Owen & Sausen, 2009). Although this doesn't sound alarming yet, the industry is growing at a very fast rate. In the past the industry saw average growth rates of about 5% annually, doubling its size every 20 years, while at the same time not been facing any restrictions on its emissions growth at all (Cohen & Higham, 2011; Dubois & Ceron, 2006). Between 1991 and 2003 alone, aviation's carbon dioxide emissions grew by 87% (Rothengatter, 2010). Also in recent years the aviation industry's growth has continued. Between 2003 and 2013 the industry grew at an even higher rate of 6.2% on average and a further increase in growth is according to the International Civil Aviation Organization (ICAO, 2016a) expected. Based on the pre-

dicted growth also carbon dioxide emissions will increase. Owen, Lee and Lim (2010) predicted a growth in carbon emissions by a factor of 2.0-3.6 between 2000 and 2050 while Macintosh and Wallace (2009) are expecting an increase of CO_2 emissions by 110% between 2005 and 2025. Aviation shows hereby the classic signs of a rebound effect, based on Jevon's Paradox (Sorrell, 2009), where increasing efficiency has been outperformed by its tremendous growth.

Despite its growing environmental impacts, air transport has become an essential part of our everyday life. It brings people to business, products to their markets, tourists to their holiday destinations, and it unites families and friends all over the planet. Air transport has made the global village a reality. Because of its importance for social welfare and mobility, Adler and Gellman (2012) call for more pro-active strategies in order to ensure further growth to be sustainable, otherwise there might be the regulatory risk of a reduction of air travel which certainly would harm our society and economy. Although the aviation industry cannot be regarded as a sustainable system, it is an important driver for economic development and social welfare (Janic, 2004). The aviation industry provides social and economic benefits in form of leisure and business travel, job creation and by sharing knowledge and experiences (Cowper-Smith & de Grosbois, 2011). Our globalized economic system, as we know it today, would not exist without air transportation. Restricting air travel would certainly mean to give up huge benefits for the society and our global economy.

The commercial transportation of passengers is usually carried out by airlines. Currently there are 260 major airlines, carrying 83% of the world's air traffic (IATA, 2016), which together form the airline industry as such. Within the airline industry the market is typically segmented into business and leisure (Doganis, 2002). This dissertation focuses exclusively on leisure travelers as in many cases business travelers are unable to select their destinations, airlines or flights and can therefore take influence on the mitigation of the environmental impacts of their flights. The terms air passengers or passenger refer in this dissertation to paying individuals that are using commercial aircrafts operated by airlines as a mode of transportation, hereafter refereed to air transportation, to reach their destination for other purposes than work.

Since its beginning the airline industry has undergone considerable changes. While air transportation was initially reserved for the rich exclusively, it has turned into a transportation mode for the masses. Since the de-regulation of air transport markets in Europe, North America and Australia and the advent of low-cost carriers, competition has increased which resulted in a significant decrease of air fares (Baumeister, 2010). Air travel has become part of our lifestyle and a good we consume at an increasingly faster rate, with ever falling air fares and more and more destinations which we visit more frequently. In the first world the idea of taking several foreign holidays per year, including long-haul flights, has almost become normality (Shaw & Thomas, 2006). Hares, Dickinson and Wilkes (2010) speak hereby of hyper-mobility which is characterized by increasing length of holidays as well as more frequent short holidays, get a ways and weekend breaks. According to Gössling and Peeters (2007) a combi-

nation of higher incomes and more leisure time as well as decreasing air fares (compared to other transportation modes) have made more shorter but frequent trips to more distant locations a routine. Thereby it is often forgotten that emissions produced by a single long-haul flight can easily exceed an individual's annual emission's allowance (Gössling et al., 2009). While air travel opens up new opportunities for tourism and leisure, it heavily contributes to climate change. It is estimated that for a vacation including air transportation, 60% to 95% of the impacts on climate change are caused by the flight itself (Gössling & Peeters, 2007; Peeters & Schouten, 2006).

According to an article in the New York Times, air travel is considered the biggest individual climate sin (Rosenthal, 2013). Nevertheless, it seems as if the general public still lives under the impression that individual behavioral change is irrelevant to mitigate climate change and this misconception seems to be especially strong in the context of flying (Gössling & Peeters, 2007). Even though several studies found that consumers do identify air traveling as a cause of climate change (Bonini & Oppenheim, 2008; Brouwer, Brander & van Beukering, 2008) studies also revealed that there is little willingness to cut back on flying or to sacrifice vacations for the environment's sake (Cohen & Higham, 2011; Lassen, 2010). For many, such changes would be considered a restriction of the personal freedom to travel (Becken, 2007). As Rosenthal (2010) argues, air passengers are caught in a "flying dilemma" where one's individual self-concept as an environmentally responsible consumer conflicts with the environmental impacts of frequent air travel. Ironically, it is the middle-class that is the most environmentally aware (Alibeli & Johnson, 2009) but also the group who flies the most (Randles & Mander, 2009). Though some consumers might act in environmentally conscious ways in everyday situations (e.g. by using public transport, recycling or going paperless), transferring these values to their flying behavior is considered to be difficult (Barr, Shaw, Coles & Prillwitz, 2010). Both Barr et al. (2010) and Miller, Rathouse, Scarles, Holmes and Tribe (2010) found little willingness among air passengers to change their behavior. Actually as Gössling et al. (2009) found only one third of air passengers see themselves as being responsible for the environmental impacts caused by their flying. Davison, Littleford and Ryley (2014) clearly see a value-action gap when it comes to consumers' knowledge about the environmental impacts of air travel and their actual behavior. The low awareness among air passengers towards the environmental impacts of flying might be explained by the fact that the immediate impacts are not visible compared to some other harmful environmental behavior such as littering Gössling and Hall (2005). Gössling and Peeters (2007) see the reason for the low awareness of air passengers, at least partially, in the fact that the aviation industry is actively trying to play down the impacts. On the other hand numerous examples can be found for how the industry has actively been addressing its environmental impacts (Chapman, 2007; Wittmer & Wegelin, 2012). Among those initiatives are: operating a modern fleet, offering direct flights, high load factors, reduced take-off trust, using electric vehicles for ground services, using biofuels, making aircrafts lighter or offering carbon off-

set (Hagmann, Semeijn & Vellenga, 2015; Mayer, Ryley & Gillingwater, 2012). As Wittmer and Wegelin (2012) found, environmental initiatives by airlines are certainly appealing to air passengers however their study also unrevealed that passengers are not always fully aware of all the environmental efforts taken by airlines. Airline's environmental initiatives are normally not visible to the average air passenger (Hagmann et al., 2015).

Nevertheless, it has also been found that at least some air passengers want to take responsibility for their air travel consumption in form of compensating their carbon emissions produced during the flight. Brouwer et al. (2008) for example could show that the motivation among air passengers to pay for carbon offset comes not from existing values such as giving to good causes or charity but from the primarily motive to take responsibility by paying for one's contribution to climate change. The motivation was hereby more explained by a moral obligation paired with concerns about our environment and future generations. This concern might even increase in the future, especially when the environmental impacts further grow and negative outcomes of climate change become more visible (Sgouridis et al., 2011). Further van Birgelen, Semeijn and Behrens (2011) found that environmentally friendly behavior practiced in other areas (e.g. recycling) had as well strongly influenced air passenger's willingness to mitigate their climate impacts on flying with the help of carbon offset.

Nevertheless, while carbon offset might help to compensate for some of the climate damage caused by air traveling, its effectiveness has been questioned by various authors (e.g. Araghi, Kroesen, Molin & van Wee, 2014; Eijgelaar & de Kinderen, 2014; Walker & Cook, 2009; Wittmer & Wegelin, 2012) but I will elaborate more on this issue in chapter 2.1.4. Another weak point of carbon offset is that it won't necessarily motivate airlines to improve their environmental performances as long as they can "outsource" the problem to carbon offset providers and leave the responsibility by the air passenger to compensate their "own" emissions. In terms of responsibility for mitigating aviation's impact on climate change, Gössling et al. (2009) found that airlines actually expect passengers' being more active in reducing emissions while at the same time air passengers see the responsibility in the hands of the industry. In addition to that Lynes and Dredge (2006) found that the industry hasn't perceived much pressure from the passengers to increase its environmental performance so far. More pressure from air passengers would not necessarily be a bad thing for the industry. Although the mitigation of environmental impacts will bear some costs on airlines, Forsyth (2011) not necessarily sees only disadvantages for the industry's economic situation in that. Mayer et al. (2012) further argue that this bears the potential for airlines to focus more on building a green image which in return could attract more customers.

However, in terms of mitigating the environmental impacts of aviation, the role of the consumer hasn't received much attention in literature so far (Dickinson, Robbins & Lumsdon, 2010). I have therefore decided to focus on the consumer's role in this mitigation process. In this dissertation I intend to investigate how aviation's impacts on climate change can be mitigated through a

market driven approach. Bearing in mind the social and economic importance of air transportation the aim of this dissertation is not to recommend to cut back on flying. Instead I want to raise the question whether there is a possibility to mitigate the environmental impacts by the way in which we fly? As Miyoshi and Mason (2009) found, there is a difference between the environmental performances of individual airlines. Based on that I argue that, choosing the right flight could help us reduce the environmental impacts of our flying behavior. However, this required a change in behavior. One approach to encourage behavioral change is the use of environmental labels (Delmas & Lessem, 2015; Sammer & Wüstenhagen, 2006). Although many initiatives exist so far to make the transportation sector more sustainable, only a few have focuses on the idea of eco-labelling (Anderson, Mastrangelo, Chase, Kestenbaum & Kolodinsky, 2013). Eco-labels are tools that provide buyers with information on the environmental impacts of products (Bratt, Hallstedt, Robert, Broman & Oldmark, 2011; Buckley, 2002), allowing them to compare different products based on their environmental performance. Eco-labels can help change consumption patterns by stimulating more sustainable purchases, and at the same time they can also motivate producers or service providers to raise their environmental standards (Gallastegui, 2002). According to Anderson et al. (2013) the transportation sector presents an optimal market for the utilization of an eco-label, not only because of its significant environmental impacts, which are even predicted to grow in the future, but also due to the variety of choices of transportation providers. While eco-labels have proven successful in many markets and can these days be found among many products, they haven't received much attention so far in the aviation industry. Eco-labels function as a driver of behavioral change and that is the reason I decided to study their use in the aviation industry.

This dissertation presents and examines the idea of introducing an eco-label for the airline industry, which so far hasn't received much attention in the literature. Previous studies by Gössling et al. (2009), Hagmann et al. (2015) as well as Lynes and Dredge (2006) have outlined the importance of making flights environmentally comparable by using environmental indicators. Further, Gössling et al. (2009) found evidence for air passengers' interest in integrating environmental information into their booking decision once the information would become available. This was also confirmed by Araghi et al. (2014) who studied passenger's preference towards an airline eco-efficiency index, proving through a stated choice experiment that such an index had influenced passengers' airline choice. Finally the latest study by Gössling and Buckley (2016) clearly supports the use of eco-labels in air transportation as an instrument for air passengers to enable them choosing greener alternatives. Nevertheless, none of the above mentioned studies discussed the idea of using eco-labels in the airline industry more in-depth. This dissertation instead answers the questions why the airline industry does need an own eco-label and how such an eco-label could lead to behavioral change among air passengers with the aim of mitigating aviation's impacts on climate change.

1.2 Aim and research task of the study

The overall aim of this dissertation is to study whether an eco-label in the airline industry could lead to behavioral change among air passengers with the overall goal of mitigating environmental impacts of air transportation. Nevertheless, the study doesn't aim at developing an entire eco-label scheme for the aviation industry nor does it focus on any other environmental impacts than carbon dioxide emissions release from commercially operated passenger aircrafts. In order to fulfill the aim of the study two research objectives were set. The first objective is to study prerequisites essential for the use of an eco-label in the airline industry. Here the purpose is to clearly show the need for as well as importance of an airline eco-label. This first step is necessary in order to justify the idea as such and to gain more understanding before studying the potential outcome of an airline eco-label. The second objective then is to study the potential outcome an airline eco-label could have on the behavior of air passengers aiming at the mitigation of climate change. To achieve these objectives four empirical studies (article I-IV) had been conducted. The first and the third article focus on the first objective while the second and fourth article answer questions related to the second objective. Article I deals with the question whether airline's pro-environmental initiatives are actually visible to air passengers while article III focuses more on the aspect of whether there is a difference in the environmental performance of individual flights in terms of carbon dioxide emissions. While article I is more underlining the need for an airline eco-label due to the low visibility of airline's pro-environmental initiatives, article III is clearly showing the importance of using eco-labels in the airline industry in order to mitigate carbon dioxide emissions causing climate change. Article II addresses the question how an airline eco-label should been developed in order to function as a driver for behavioral change among air passengers. Article IV is finally analyzing whether an airline eco-label would affect the booking decisions of air passengers by studying their booking behavior under the presence of an eco-label, showing the real impact an airline eco-label might have towards passenger's behavioral change. Below an overview of all four research questions is provided:

RQ1:	Are airline's pro-environmental initiatives actually visible to air passengers?
RQ2:	How should an airline eco-label been developed to function as a driver for behavioral change?
RQ3:	Are there differences in the environmental performance of individual flights?
RQ4:	Would an airline eco-label affect the booking decisions of air passengers?

1.3 Eco-labels in the airline industry

Since the introduction of the first aircraft eco-labeling scheme by British low-cost carrier Flybe (2016a) in June 2007, many discussions have arisen among various groups of airline stakeholders regarding the need and importance of such a labeling scheme. The eco-label presented by Flybe (see also figure 1) provides simple information on the environmental performance of aircrafts used within the Flybe fleet in form of an energy label, similar to the one known from white goods. The eco-label rates the local environmental impacts (noise, take-off and landing emissions, and air quality), the environmental impacts of the journey (fuel consumption and CO_2 emissions per seat) as well as the passenger environment (minimum leg room and number of seats per aircraft).

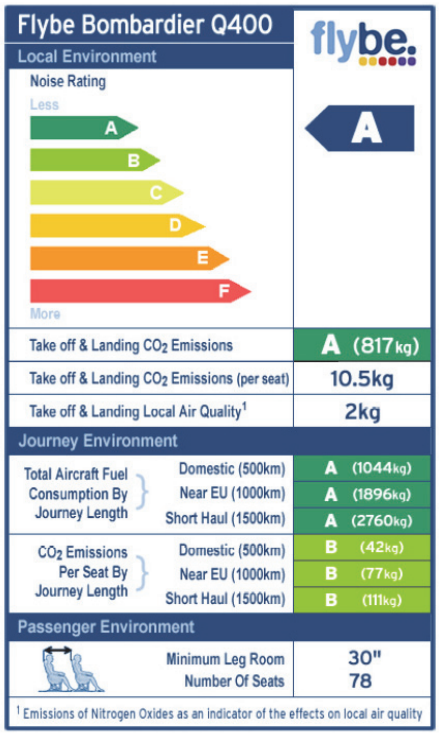


FIGURE 1 Flybe's eco-labelling scheme (Flybe, 2016b)

Flybe has integrated this eco-labelling scheme into its online booking site and has placed the label on its aircrafts as well. The methodology of the scheme is openly available and allows any airline to calculate the environmental impacts of their individual aircrafts in order to produce their own eco-label. However, so far not many airlines have followed this example. Only Thomas Cook (2015) has adopted the Flybe scheme and uses the same eco-label on the fuselage of their UK based fleet.

Based on the Flybe idea, the findings from the Stern Review and after hearings with representatives from the International Air Transport Association (IATA), British Airways, Virgin Atlantic, and EasyJet, the UK House of Commons Treasury Committee (2008) recommended that the airline industry join forces in developing a common eco-label scheme for the industry. The committee proposed that such a scheme should independently rate the environmental impacts of each flight and the information should become available for passengers at the point of purchase. While such a scheme would help passengers to make more environmentally-conscious choices, they argued, it would also encourage airlines to improve their environmental performance, which in turn could lead to more environmental competition. The airline representatives at the committee hearing agreed to commit to establishing such a scheme. However, since then no further steps have been taken by airlines in order to develop such a scheme, which perhaps might be explained by the outbreak of the financial crises that also started in 2008.

Aside from these efforts, three more players who have developed an airline eco-label have emerged. The first is the Dutch-based online travel agent CheapTickets.nl, which integrated an energy label called eco value into its flight booking site in 2008 (Ohlden, 2008). This energy label rated all flight options and displayed them according to their environmental impacts on a scale from A to E by taking the flight distance and amount of stopovers into account. This gave the users of CheapTickets.nl the chance to easily compare and choose different flight options according to price, departure/arrival times and airline as well as by environmental aspects. As the company indicated on its website, there were even plans to integrate aircraft type and other factors into the calculations. However, in the meantime, the eco value has been removed from the booking site and is no longer used by CheapTickets.nl (2016).

Similarly to CheapTickets.nl another online distributor, UK-based Direct Flights, could be identified that had integrated a so called carbon rating scheme into its booking system (Gössling & Buckley, 2016). Compared to CheapTickets.nl Direct Flights used a much more sophisticated method to evaluate individual flights environmentally. They utilized instead aircraft fuel consumption data, fuel to emissions conversion values and the actual fleet data of individual airlines to calculate each aircraft's overall emissions footprint. To determine the individual carbon footprint of individual passengers they divided then the aircraft's overall emissions by the amount of seats commonly provided by the aircraft type in question (PR Newswire, 2011). Even though Direct Flight's results are still based on many assumptions and on average data, the information provided to the air passenger certainly can be regarded as relevant for decision making. Unfortunately the carbon rating is no longer used in the search engine of Direct Flights (2016).

Finally, the according to Hagmann et al. (2015) currently best available data source for comparing the environmental friendliness of airlines comes from Atmosfair, a German-based climate protection organization and aviation carbon offset provider. Since 2011, Atmosfair (2015a) has annually released the

so-called Atmosfair Airline Index, which ranks and compares almost 200 airlines according to their environmental efficiency. The results are presented in an energy-label–like rating which ranges from A to G, as also displayed in figure 2. Passenger load factors and the aircraft type used by the airline have the strongest impact on the calculations, but seat and cargo capacity as well as the engines installed on the aircraft are also taken into account.

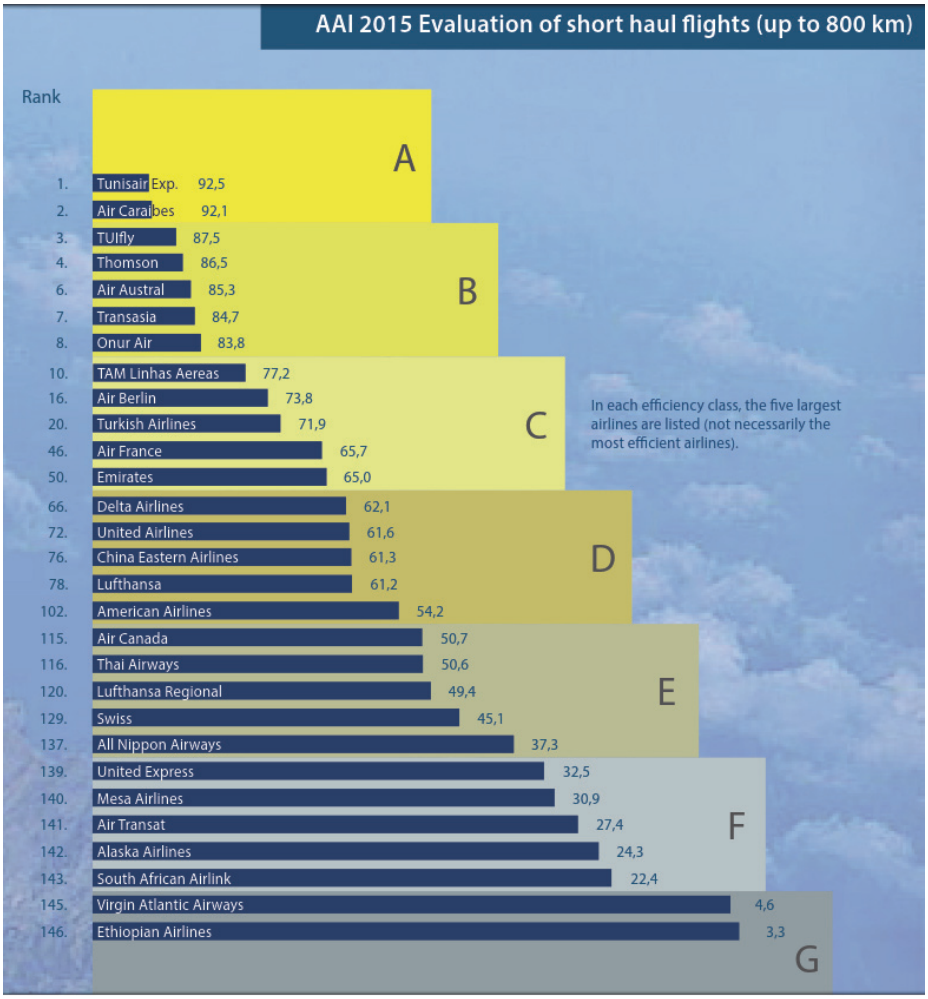


FIGURE 2 Atmosfair Airline Index (Atmosfair, 2015a)

Even though the importance of an airline eco-label scheme has been understood and several attempts have been made by various industry players to develop such a label, no industry-wide standard exists so far. Still today air passengers are not able to make environmentally conscious decisions because they are not able to compare different flight options, at the time of booking, in terms of environmental impacts.

1.4 The research process and summary of the articles

The origins of this dissertation go back to my Master's Thesis which provided also the data for my first article. Each study in this research has eased the way for the next as my understanding of the idea of using an eco-label in the airline industry has grown constantly. Nevertheless, my interest in doing research in this particular industry goes even back further as the starting point can clearly be seen in my Diploma Thesis which I completed in 2009 at the University of Applied Science in Offenburg, Germany. My Diploma Thesis focused on the strategic positing choices of airlines under the circumstance of deregulation of the aviation industry (Baumeister, 2010). While this first research study helped me to understand which are the driving forces of competition in this particular industry it also helped me to formulate the research question for my Master's Thesis which I wrote two years later (Baumeister, 2011). By then I had integrated my personal interest in environmental protection and the fight against climate change into my study curriculum by completing the Master's Degree Programme in Corporate Environmental Management at the University of Jyväskylä. During my Master's studies I had become familiar with the concept of eco-competitiveness and integrated that into the research question of my Master's Thesis. The study was conducted in close cooperation with Finnish flag carrier Finnair and focused on the question how Finnair could gain competitive advantage based on their outstanding environmental responsibility work. The findings of this first study stressed the need for an instrument that could help airlines, like Finnair, to better communicate their environmental efforts. At the same time it also found that air passengers would need such an instrument as they are not able to change behavior as long as differences in the environmental performance of airlines are not visible to them. While considering ideas for further research based on my Master's Thesis, I came across Flybe's eco-labelling scheme and the idea of using an environmental indicator within the airline industry, in form of an eco-label, was born. This idea laid the ground for my doctoral dissertation as well as for my second article.

However, before outlining my second article I first attended an aviation industry conference on Eco-Aviation in Washington D.C. where I met representatives of major industry players of airlines (e.g. Lufthansa, ANA, South West, Alaska Airlines), airframe makers (e.g. Airbus, Boeing, Bombardier), engine providers (e.g. Rolls-Royce, Pratt & Whitney) as well as some regulatory agencies (e.g. United States Department of Transportation, Airlines for America). I wanted to discuss this idea first at the conference in order to receive some feedback from the industry but also to be able to formulate my actual research question. The actual data collection took then place as part of a TEKES funded project in which also Finnair was one of the industry partners. Finnair's industry contacts helped me to get in touch with suitable industry experts whom I could interview. Altogether I conducted 12 research interviews. Both conference attendants and the actual interviewees clearly identified a need for an airline

eco-label. While there was a lot of discussion why an eco-label would be needed, the industry experts provided me also with valuable insights on how an eco-label should be implemented. Nevertheless, the in-depth interviews left two questions open that couldn't be answered by the industry experts and those formed then the research questions for the remaining two articles. Some of the critical issues presented by the industry experts were that the eco-label should be flight specific and it should be an energy label. Using an energy label would mean that it not only indicates those flights which are environmentally superb but also the ones which are not performing that well. Although discussed by several industry experts, the question remained open whether the environmental performance of individual flights really differ that much that it would justify the use of an energy label. The third study therefore set out to investigate the environmental performance of individual flights and could provide clear empirical evidence that differences exist and that those differences are actually quite tremendous. Those differences further justified the use of an eco-label and its climate change mitigation potential of air passengers changing behavior by selecting those particular flights which are less polluting. While the third article further supported the idea of an eco-label in the airline industry, the fourth article tried to answer the essential question, whether an eco-label would actually affect the booking decision of air passengers and therefore lead to behavioral change? The third as well as the fourth study were conducted during my one year Fulbright research visit at the University of California, Los Angeles (UCLA), Institute of the Environment and Sustainability. Participants of the fourth study were recruited in the United States, altogether 554 air passengers took part. Using a stated choice experiment to simulate real booking choices showed that an eco-label certainly does affect the booking decision of air passengers. Also crucial issues for the success of an airline eco-label, presented by the industry experts in the second study, were tested and approved.

Besides my research visit at UCLA also my annual participation in ATRS's (Air Transport Research Society) World Conferences 2013-2015 as well as in the 2016 WCTR (World Conference on Transport Research), were all four studies had been presented, had shaped my understanding of the topic due to the valuable discussions and comments that I received from other researchers in the field. These had certainly led to further considerations and revisions of my research. Last but not least also presenting some of my results in the courses of our Master's Degree Programme had helped to develop my ideas further as the students, not familiar with the actual topic, had made some very useful comments. In this introductory essay I will summarize the results of the four studies and show how an airline eco-label could lead to behavioral change among air passengers. The following Table 1 gives an overview of all four articles.

TABLE 1 Summary of the research articles

Article	Focus of the study	Research material and analysis	Main findings and contributions
Baumeister, S. 2015. Environmental responsibility as a factor in gaining competitive advantage in the aviation industry. Journal of Geotechnical and Transportation Engineering 1 (2): 43-48.	Studying the visibility of airline's pro-environmental initiatives to the air passengers	Survey data from 148 air passengers which were statistically analyzed	Some airlines engage in pro-environmental initiatives. However, air passengers can currently not change behavior as environmental differences between airlines are not visible
Baumeister, S. & Onkila, T. 2017. An eco-label for the airline industry? Journal of Cleaner Production 142 (4): 1368-1376.	Exploring the potential idea of an airline eco-label and how it should be developed in order to function as a driver for air passengers changing behavior	Standardized open-ended interviews with 12 aviation industry experts which were thematically analyzed	Eco-labels can change air passenger's behavior by creating awareness and helping them to make better informed choices. This could lead to more competition between airlines as environmental performance becomes more visible to the air passenger
Baumeister, S. 2017. 'Each flight is different': Carbon emissions of selected flights in three geographical markets. Transportation Research Part D (2017).	Understanding the differences of environmental performance of individual flights	Fuel and flight data for 118 flights for which carbon dioxide emissions have been calculated	Individual flights differ tremendously in their environmental performance and airlines can influence this performance
Baumeister, S. & Hoffendahl, A. The effect of an eco-label on the booking decisions of air passengers. Under review in Journal of Air Transport Management.	Analyzing the effects of an airline eco-label on the booking decisions of air passengers	Survey data from 554 air passengers which were statistically analyzed	Eco-labels lead to behavioral change among air passengers and make air passengers avoid most polluting flights. Nevertheless, providing additional information is essential for eco-label's success

2 THEORETICAL FOUNDATIONS

2.1 Aviation and the environment

In this first subchapter of my theoretical foundations I will discuss the relation between aviation and the environment. I will first present aviation's environmental impacts and show five possible streams of solutions. After that, I will focus on behavioral change which is the solution discussed in this dissertation.

2.1.1 Aviation's environmental impacts and possible solutions

Air travelling is one of the most energy intensive forms of transportation with huge environmental impacts (Gössling, Peeters, Ceron, Dubois, Pattersson & Richardson, 2005). The major impacts are noise, local air pollution and greenhouse gas emissions (Green, 2003) from which the latter one having the most significant long-term impact, causing climate change (Forsyth, 2011). The main contributors to climate change produced by aircrafts are carbon dioxide (CO_2), nitrogen oxides (NO_X), water vapour (H_2O), emissions of soot particles, various sulphur oxides (SO_X), condensation trails and cirrus clouds (Daley, 2010). While the aviation industry accounts for about 2.5% of the total CO_2 emissions worldwide (Lee et al., 2009) it has been growing at a very fast rate of about 5% annually, doubling its size every 20 years (Cohen & Higham, 2011; Dubois & Ceron, 2006). For the future an even larger growth rate is predicted (Button, 2007; Gössling & Peeters, 2007). Past growth had also an impact on the emissions released by aircraft. For example, between 1991 and 2003, aviation's carbon dioxide emissions grew by 87% (Rothengatter, 2010).

As the industry itself is currently not facing any restrictions on its emissions growth, it is estimated that aviation's share of worldwide CO_2 emissions could increase by a factor between 2.0 and 3.6 until 2050 (Owen et al., 2010). The relative contribution of the sector might increase that strongly due to the expected improvements in emissions reductions achieved in other sectors (Sgouridis et al., 2011). Under these circumstances, there is a possible risk that

regulation might restrict air transportation's future growth, which would have a huge impact on the industry (Gössling, Broderick, Upham, Ceron, Dubois, Peeters & Strasdas, 2007). To avoid the possible risk of restrictions and to put aviation on a sustainable growth path, it needs to reduce its environmental impacts (Adler & Gellman, 2012). According to Daley (2010), the environmental impact of air travel can be reduced through technological changes, market-based changes, operational changes, regulatory changes as well as behavioral changes.

During the four decades following the 1950s technological improvements were able to compensate for the immense growth of the industry, keeping its overall impacts rather constant (Green, 2003; Penner, Lister, Griggs, Dokken & McFarland, 1999). However, by today the efficiency potentials are nearly exhausted as current technology has reached its maturity (Gössling & Peeters 2007). Current aircraft technology is kind of locked in as aircrafts have a very long life span and existing aircraft as well as airport infrastructure is very difficult to update (Forsyth, 2011). Extensive growth has also pushed the industry's infrastructure to its limits and congestions as a result has made the system even more inefficient (Janic, 2004). According to the Intergovernmental Panel on Climate Change (IPCC, 1999) the emissions produced through predicted growth cannot anymore be compensated by emissions reductions based on current technology. In order to achieve significant efficiency gains, which could match the predicted traffic growth, a totally new design of aircraft would be needed (Åkerman, 2005). Even though such aircraft would become available in the near future, the change of infrastructure needed would require decades in order to accommodate such airplanes at all major airports around the globe (Green, 2003).

While technology alone won't be able to solve the problem anymore the focus has in recent years turned to other solutions. Market-based changes such as taxes, charges, subsidies or emission trading present some set of new solutions (Daley, 2010). They are based on the cost of carbon which in return should reflect the cost of environmental damage caused by its release (Stern, 2007). One market-based approach that has receive a lot of attention in the past years is emission trading. So far however emission trading is only practiced within the EU. The big challenge of integrating aviation into a global emission trading scheme lies according to Scheelhaase and Grimme (2007) in the divergence of political interests.

A third solution to mitigate environmental impacts of aviation is seen in operational changes. Operational changes relate to the reduction of inefficiencies in the operation of aircrafts on the ground and in the air. These inefficiencies are mainly caused by air traffic management (ATM) systems and procedures resulting in congestion (Daily, 2010), requiring aircrafts to spend more time in the air or waiting on the ground with engines running. The IPCC (1999) found that improvements in ATM could reduce aviation's fuel consumption by 6 to 12%. However, this would require major changes in ATM and more collab-

oration (e.g. Single European Sky) between the currently quite fragment ATM systems (Button and Neiva, 2013).

A fourth solution is seen in regulatory changes. Regulatory changes have in the past mainly focused on the certification of engines and certification limits exposed on newly-manufactured engines (negotiated and agreed through the ICAO Committee on Aviation Environmental Protection - CAEP), with the aim to reduce emissions produced by aircrafts. Nevertheless, ICAO engine certification standards have only centered on NO_X emissions, ignoring the most significant pollutant of radiative forcing, CO_2 (Daily, 2010). However, in October 2016 the ICAO general assembly introduced with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) some ground-breaking regulatory changes in order to achieve carbon neutral growth beyond 2020. Although CO_2 emissions will finally be addressed with CORSIA, still the actual scheme, which is voluntary, won't start before 2021 and will only focus on future CO_2 emissions, neglecting the existing ones (ICAO, 2016b).

A fifth solution for mitigating environmental impacts of aviation, that has recently been more discussed, is behavioral change. Nevertheless, behavioral change as a mitigation strategy has not received that much attention in literature yet. Nonetheless, several authors have identified behavioral change as the measure with the greatest mitigation potential. Davison et al. (2014) argues that emissions reductions certainly rely on behavioral change while remaining measures such as technological changes are rather having a minor role. Gössling et al. (2007) came up with similar conclusions, in their opinion technological and behavioral changes are the two measures that are able to bring aviation back to a sustainable growth path. However, they clearly stated that behavioral change is playing the key role in this. As behavioral change has received less attention in literature but has been identified by several authors as playing a key role in mitigating the environmental impacts of aviation, this dissertation will therefore exclusively focus on behavioral change.

2.1.2 Behavioral change

The concept of behavioral change is applied in many fields such as health, education, international development, criminology or the mitigating environmental impacts, just to name a few of them. Very broadly speaking, behavioral change refers to any transformation or modification of human behavior. When looking closer at behavioral change from a perspective of human's impacts on the environment, behavioral change can be defined as: "Behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (Kollmuss & Agyeman, 2002). Similar to that, Steg, van den Berg and De Groot (2013) defined behavioral change in this context as: "The use of intervention techniques to create or enhance environmentally friendly behavior". Environmentally friendly behavior or pro-environmental behavior can hereby be understood as behavior that reduces the harm caused to the environment or in some cases even create benefits for the environment (Steg et al., 2013). However, in regard to air transportation, at least in its current form, it always causes

harm to the environment. We therefore have to understand environmentally friendly behavior in this context as using air transportation in a way that causes less harm to the environment. Air transportation certainly cannot bring any benefits to the environment as such.

Behavioral change in this context can be understood as a form of mitigating environmental impacts caused by human activities. Such environmental impacts are according to Stern (2000) a by-product of human's desire for status, power, security, enjoyment, maintenance of family and tradition as well as mobility. In recent years these environmental impacts have become more visible and a connection between these human activities and the impacts has been established. It has been understood that a change in behavior is needed and that these human activities have to be altered in a way that the impact on the environment is becoming less (Stern, 2000). Hillman (2004) emphasized that humans have to change their behavior if they want to be able to tackle the problem of climate change. Brewer and Stern (2005) see hereby a great potential for major improvements in reducing environmental impacts from individuals and households changing their consumption behavior in areas such as housing, energy, water, food, waste and transportation. In the U.S. for example households alone account for almost half of the carbon emissions (Cutter, Mitchell, Hill, Harrington, Katkins, Muraco, DeHart, Reynolds & Shudak, 2002). This whole discussion has led some consumers to adapt towards a more sustainable lifestyle by changing their behavior (Degenhardt, 2002). According to Kollmuss and Agyeman (2002) many different models exist in literature explaining why consumers would adapt towards a more sustainable lifestyle. Based on their own findings the three main factors for such a lifestyle change are internal factors (awareness, knowledge, values, attitudes, motivation, emotions, responsibilities and priorities), external factors (cultural, social, economic and institutional) as well as demographic factors. The UK Department for Environment, Food & Rural Affairs (DEFRA) has in its Sustainable Lifestyle Framework identified seven consumer categories based on their willingness to act in a sustainable manner which are the positive greens, concerned consumers, waste watchers, cautious participants, sideline supporters, stalled starters and honestly disengaged. The consumers belonging to the first two categories, positive greens and concerned consumers, showed hereby the highest willingness to act. They accounted together for about 32% of the entire UK population (DEFRA, 2011). Based on this classification the amount of consumers that are willing to adapt their lifestyle by changing their behavior can play an important role in mitigating environmental impacts and climate change causes by human activities. This has of course also an effect on companies and service providers that offer products which are affected by the change in behavior as they have to adapt and change behavior by providing more green offerings as demanded by the market (Dauvergne & Lister, 2010; Nicholls & Opal, 2005; Wüstenhagen & Bilharz, 2006).

Nevertheless, not all consumers have yet adopted their lifestyle and changed their behavior for the benefit of reducing their environmental impacts. How to motivate consumers to change behavior in this context has been studied

by environmental psychologists for the past four decades and they have since come up with various intervention techniques (Steg et al., 2013). According to Steg and Vlek (2009), there are two different streams of intervention techniques to motivate behavioral change: structural strategies and information strategies. While structural interventions aim at changing the conditions under which behavioral decisions are made (e.g. financial incentives, availability of goods), information strategies try to alter knowledge, perceptions, norms, attitudes and awareness which are assumed leading to changes in the behavior (Steg et al., 2013). As this study is focusing on behavioral change thought he use of eco-labels, this dissertation can be clearly positioned under the intervention technique of information strategies by utilizing information provision as one possible instrument. Anderson et al. (2013) see hereby eco-labels as one approach to encourage behavioral change by providing information to consumers.

2.1.3 Pro-environmental initiatives in the aviation industry

In recent years airlines have begun to address environmental issues more seriously. Some of the operators have hereby gone beyond compliance (Lynes & Dredge, 2006). By reviewing the CSR reports of 14 leading airlines, Cowper-Smith and de Grosbois (2011) could identify seven broader areas where airlines had engaged in pro-environmental initiatives performing concrete environmental actions. The most common activity hereby was the reduction of emissions both in terms of climate change and local air pollution. These reductions were mainly achieved through the reduced use of fuel by employing newer and more fuel-efficient aircrafts, weight reductions on existing aircrafts, the installation of winglets, optimized operational procedures and engine washing. Although these measures require investments, they result in savings, not only in terms of emissions but also costs (Mayer et al., 2012). While these emissions reductions require first of all technological changes in terms of the development of new technology, it is in the end on the airlines to apply these new technologies which again requires pro-environmental initiatives compared to continuing with the old technology. Regarding the fleet renewal it should be noted that the earlier retirement of aircraft does not necessarily expose any additional impacts as, based on a life cycle assessment conducted by Howe, Kolios and Brennan (2013), 99.9% of the environmental impacts of an aircraft stem from its actual use phase. Annual technological efficiency gains of about 1% certainly justify the earlier replacement of equipment before the end of its life-span (Egelhofer, Marizy & Cros, 2007; Sgouridis et al., 2011). Further on, operational efficiency improvements such as using a continuous descent approach, reduced take-off thrust or single engine taxiing could lead to further emissions reduction. In addition, Local air pollution could be reduced through latest engine technology and the use of electrically powered ground equipment such as vehicles and power units.

The second common initiative Cowper-Smith and de Grosbois (2011) identified was noise reduction. This was mainly achieved through the introduction of quieter aircraft and the alteration of operational procedures such as the

continuous descent approach. The third most commonly practiced activity was the reduction of waste e.g. through recycling onboard waste, in offices but also of aircraft parts. Further waste was reduced by introducing electronic boarding passes. Followed by waste reduction was the reduction of energy and water consumed by the airlines. Energy was mainly saved in offices by using LED light bulbs, reduced air-conditioning and heating as well as by the switch to renewable energy sources. Energy could also be saved in maintenance and training facilities. The use of water was mainly reduced by using rainwater/greywater for equipment washing and better calculation of water needed on board of aircrafts. Another focus was on the reduction of water pollution through the reduced discharge from maintenance facilities. Another area airlines focused on was biodiversity. Among those were to ensure ecological integrity through e.g. the use of environmentally friendly refrigerants, the use of FSC certified paper or alternative de-icing substances. Besides that airlines also reported the sponsorship of various activities to support biodiversity such as oil spill relief activities, programs to avoid deforestation or academic research. Finally Cowper-Smith and de Grosbois (2011) found a list of further initiatives that didn't fit under any broader area, those included obtaining environmental management system (EMS) certification such as ISO 14001, sponsorship of environmental organizations or the development of environmental indices.

When looking closer at the reasons why some airlines engage in pro-environmental initiatives Lynes and Dredge (2006) could identify various reasons. Among those are first of all financial cost-benefits which they describe as both, money saved and money earned, as the use of cleaner production methods such as operating more fuel-efficient aircraft, not only means less production costs but also a better corporate image. Secondly, they named regulatory settings which contain both a good relationship with regulatory bodies as well as the possibility to influence policy making towards tighter environmental regulations which would also mean competitive advantage for a forerunner. Hagmann et al. (2015) see hereby a great potential for airlines to gain competitive advantage through environmental differentiation. The third reason for engaging in voluntary environmental initiatives was seen in practicing good corporate citizenship. Some airlines want to demonstrate that they care about the environment and respond to the increasing concern among the public. At the same time there was also the idea of creating a demand for flights offered by airlines that engage in voluntary environmental initiatives, which so far hasn't existed (Lynes & Dredge, 2006). Nevertheless, Mayer et al. (2012) also think that it would not be advisable for an airline to exclusively focus on the green market segment as this segment is still quite small. Instead airlines should understand environmental friendliness more as an add-on to their core product which is the transportation of air passenger from point A to B through the air. The fourth reason discussed by Lynes and Dredge (2006) was airline image in form of positive image in the marketplace, among suppliers and in the eyes of regulatory bodies. A better image can bring market benefits but also strengthen an airline's position in negotiations. As Wittmer and Wegelin (2012) found, positive envi-

ronmental image can help an airline to improve its overall image. Finally Lynes and Dredge (2006) named pressure from industry stakeholders as the fifth motivator for airline's voluntary environmental initiatives. Here they not only discussed the avoidance of regulatory risks like taxes or flight bans but also increased pressure coming from corporate customers. As more companies have begun to "green" their supply change also the airline's environmental performance start to become an issue.

Finally differences in terms of environmental performance between airlines can also be found in the business model they follow. Especially the opening of markets through deregulation and the hereby resulted tougher competition has led to efficiency improvements. A business model which especially stands out in this regard is the low-cost carrier. Both Coles et al. (2011) and Barbot, Costa and Sochirca (2008) see the way in which low-cost carriers operate as much more sustainable compared to network carriers, because resources are used much wiser and operations are more efficient. Due to higher seat density, better load factors and the use of winglets Hagmann et al. (2015) considered low-cost carriers as environmentally friendlier. Also in terms of emission trading, low-cost carriers can be seen as the winners of the system as they use more modern and fuel-efficient equipment (Forsyth, 2011). Nevertheless, on the other hand low-cost carriers have also increased the total environmental impacts of aviation due to the fact that they have generated additional demand which otherwise would have not existed (Adler & Gellman, 2012; Graham & Shaw, 2008).

2.1.4 Behavioral change among air passengers

After I discussed in which way airlines can mitigate environmental impacts of aviation through pro-environmental initiatives I will now look into the air passenger's role. Previous literature has hereby mainly investigated behavioral change in the form of motivation and willingness to pay for carbon offset (e.g. Gössling et al., 2009; Mair, 2011; van Birgelen et al., 2011), which I will explain in this chapter in greater detail, or discussed changes of travel behavior in terms of using alternative transportation modes (e.g. train, boat, coach or car) or avoiding holidays overseas (e.g. Davison et al., 2014; Higham & Cohen, 2011; Sgouridis et al., 2011). Only a few studies have discussed the issue of mitigating environmental impacts through behavioral change by air passengers' actively selecting airlines or flights that are less polluting (Mayer et al., 2012; Wittmer & Wegelin, 2012). As this dissertation focuses on reducing aviation's environmental impacts through less polluting flight options, instead of avoiding air traveling, I won't discuss here alternative transportation modes or avoiding holidays overseas as form of behavioral change any further. Instead I will exclusively focus on air passengers' actively selecting airlines or flights that are less polluting.

Benady (2007) found that the general public has a negative picture about airlines in terms of environmental friendliness. This makes it even more difficult for airlines to differentiate themselves in terms of environmental performance. Nevertheless, Mayer et al. (2012) also found that over half of the partici-

pants in their study thought that some airlines take more actions in mitigating environmental impacts than others. Hagmann et al. (2015) came up with similar results, showing that air passengers actually differentiate between airlines in terms of environmental performance. Further Mayer et al. (2012) found that the consumer's perception of an airline being environmentally committed plays a crucial role in building a green airline image. Lynes and Dredge (2006) confirmed this finding when they studied Scandinavian Airline's green image which, as they found, had positively affected the airline's overall image. Mayer et al. (2012) also showed that low-cost airlines were not perceived as less environmentally friendly than network carriers. In terms of concrete actions take, an airline using newer aircraft was perceived as the most effective way to mitigate environmental impacts by air passengers (Mayer et al., 2012).

Hagmann et al. (2015) also found that the green image of an airline had influenced air passenger's airline choice to some extent. Although environmental issues are not a major criteria for the selection of an airline yet, both Gössling et al. (2009) and Lynes and Dredge (2006) found that air passengers expect from airlines to address this issue more seriously. When looking at the criterion for air passenger's flight choice, Hagmann et al. (2015) found that price was actually not the most important criterion but flying non-stop. In general environmental attributes played a significantly lower role in air passenger's flight choice than non-environmental attributes but they certainly affected air passenger's airline choice. Nevertheless, Wittmer and Wegelin (2012) found that the ticket price is still more important to the air passengers than the environmental responsibility of an airline. However, Kelly, Haider, Williams & Englund (2007) could also show that air travellers do accept additional environmental fees added to their flight ticket if they know for certain that those revenues are used to mitigate climate change. In a recent study by Hagmann et al. (2015) even every second air passenger showed a willingness to pay for a less polluting flight.

In order to concretely measure air passenger's willingness to pay, previous literature has mainly utilized carbon offset as an instrument. Although the outcomes of carbon offset are questionable air passenger's participation can certainly provide a good estimate on how much willingness to pay exists for mitigating climate change. As van Birgelen et al. (2011) found, air passenger's perception of the environmental impacts of flying had significantly influenced the willingness to pay for carbon offset. Nevertheless, there is a huge difference between the stated willingness to pay and the actual amount air passengers paid for carbon offset. While surveys conducted by van Birgelen et al. (2011) and Brouwer et al. (2008) showed a high willingness to pay, 84% of the participants in case of van Birgelen et al. (2011) with compensations ranging at 24 euros for a short-haul and 55 euros for a long-haul flight, in the case of Hagmann et al. (2015) only 23% of the participants had actually paid for carbon offset and in Wittmer and Wegelin's (2012) study it was even less than 4%. These results show that there are air passengers who are interested in mitigating their environmental impacts of flying in form of voluntary donations however, this certainly is not the majority. Although carbon offset gives the air passenger a

chance to take action in the fight against climate change its effectiveness is still questionable. Araghi et al. (2014) see hereby major drawbacks in the limitations of afforestation and the lack in credible calculation methods. Wittmer and Wegelin (2012) criticize also the fact that carbon offset allows airlines to outsource their environmental responsibility, transferring it to the air passenger, who in turn might voluntarily offset the carbon emissions or not. Further Walker and Cook (2009) see here also a moral question of whether carbon offsets just deviate from real solutions such as flying less. Finally carbon offset might also lead to a rebound effect where air passengers might even fly more (Eijgelaar & de Kinderen, 2014) as they don't see environmental harm anymore in air transportation.

2.2 Eco-labels as a new approach

Summarizing chapter 2.1 we can conclude that first of all aviation has extensively grown in the past and will continue to grow in the future and so will its environmental impacts. To avoid regulatory restrictions the aviation industry needs to enter a more sustainable growth path. Of all the mitigation methods currently available, behavioral change was seen as the one with the greatest potential (Davison et al., 2014; Gössling et al., 2007). Secondly, some airlines have engaged in pro-environmental initiatives by going beyond compliance. Thirdly, air passengers can change behavior by actively selecting airlines which engage in those pro-environmental initiatives. Air passengers have certain perceptions on the environmental friendliness of airlines and some show also a willingness to pay for less polluting flights.

Although it is clear that some airlines engage in pro-environmental initiatives and that behavioral change among air passenger can lead to the anticipated reduction of the environmental impacts, the question that still remains is how to bring both sides together? Obviously there is green offer and also green demand. However, as Gössling et al. (2009) found, some air passengers would like to make choices based on airline's environmental performance but this is currently not possible due to the lack of information. It would actually require expert knowledge to really be able to compare the environmental performance of individual airlines or flights (Gössling et al., 2009). Hagmann et al. (2015) identified the lack of suitable measures that help validate the environmental friendliness of airlines as one of the biggest challenges. At the same time and due to the immense environmental impacts of air transportation it is very difficult for an airline to differentiate itself as green even though it is doing everything possible to keep its environmental impacts at a minimum (Lynes & Dredge, 2006). To easily an airline will find itself accused by environmental organizations of 'greenwashing' when trying to communicate its environmental efforts too openly (Walker and Cook, 2009). Unfortunately pro-environmental initiatives of airlines are less visible for air passengers and need therefore to be clearly communicated in order to receive a proper response (Mayer et al., 2012).

In order to overcome the suspicion of 'greenwashing' airlines need to find ways how to communicate environmental improvements more clearly (Mayer et al., 2012). Nevertheless, Lynes and Dredge (2006) also think that the puzzle of how to define and communicate what a "green" airline actually means, is still not solved. As it is almost impossible for an air passenger to identify environmentally responsible airlines and very difficult for these kinds of airlines to clearly communicate this issue, Miyoshi and Mason (2009) claim that air passengers need to be able to access the environmental performance of airlines so that they can make better informed choices. Both Cohen and Higham (2011) and Hares et al. (2010) support this point as they see a clear need for more publically available information on the environmental impacts of air travel in order to lead consumers to behavioral change and meet climate targets. According to Cowper-Smith and de Grosbois (2011) currently performed environmental actions by airlines are largely unknown which certainly limits the extent to which air passengers will take those into account in their decision making. They call therefore for the introduction of a standardized framework that would compare and highlight those actions and allow air passengers to make better informed decisions. Analyzing the environmental reports of major airlines, Lynes and Dredge (2006) found that several players, such as British Airways or SAS, had been calling for an environmental standard to benchmark but also monitor the environmental performance of individual airlines. SAS in particular sees a great demand for an indicator that measures the environmental performance of airlines, hereby making airlines environmentally comparable, and that this could effectively stimulate airlines to improve their performance. Also Cowper-Smith and de Grosbois (2011) found in several CSR reports that airlines had been developing environmental indices in order to capture their environmental impacts in relation to their outputs. According to Lynes and Dredge (2006) the currently only ways for airlines to communicate their additional environmental efforts are ISO 14001 certification or being listed in the Green Globe 21. However, both ISO 14001 and Green Globe 21 haven't found much use or recognition within the industry. Only a few airlines have obtained ISO 14001 certification and Singapore Airlines as the only airline ever listed in the Green Globe 21 is no longer part of the scheme (Green Globe, 2016).

Although several airlines have begun to develop indicators to measure and report their environmental performance, these haven't reached the demand side yet and therefore not affected or changed air passenger's behavior. Nevertheless, it appears as if the use of an indicator could display a feasible solution to the above discussed problem. However, to really make airlines and flights comparable for the air passenger it needs an industry wide recognized indicator. Hereby the use of an eco-label could display a possible solution. Eco-labels are tools that provide the buyer with information on the environmental impacts of products (Bratt et al., 2011; Buckley, 2002), allowing them to compare different products based on their environmental performance. Eco-labels can help change consumption patterns by stimulating more sustainable purchases, and

at the same time also motivate producers or service providers to raise their environmental standards (Gallastegui, 2002).

So far the idea of using eco-labels in the aviation industry as an instrument for behavioral change hasn't received much attention in the literature. However, those authors who have discussed the idea certainly showed a lot of support. Gössling and Buckley (2016) clearly advocate the use of eco-labels in the aviation industry as they see a defined need for enabling air passengers to compare individual flights on particular routes. Also Hagmann et al. (2015) see a great potential in eco-labels bringing more transparency into the industry. Miyoshi and Mason (2009) predicted that once the environmental performance of airlines would become available, the demand factor would drive airlines to reduce their impacts in order to stay competitive. Finally Gössling et al. (2009) found also evidence for air passengers' interest in integrating environmental information into their booking decision once the information would become available. Araghi et al. (2014) confirmed these findings in their study, based on a stated choice experiment, demonstrating that an airline eco-efficiency index had strongly influenced the participants' airline choice. Nevertheless, none of the above mentioned studies discussed the idea in more depth which is the aim of this dissertation.

2.3 Aviation and eco-labels

In this third subchapter of my theoretical foundations I will provide a brief introduction on eco-labels, discuss how eco-labels can lead to behavioral change and what the critical issues for their success are. Finally I will look into specific eco-label features relevant for the airline industry.

2.3.1 Eco-labels

2.3.1.1 How eco-labels function

There is no doubt that a significant part of the environmental problems which we are facing today are caused by the consumption of goods. It is therefore crucial that the consumers influence the way how goods are produced, how efficient they perform and how well they can be disposed or recycled. Eco-labels hereby provide the necessary information to the consumer to make decisions that can have an influence (Gallastegui, 2002). Eco-labels inform the consumer about the environmental quality of products (Bratt et al. 2011) and can thereby function as a further product characteristic, that consumer can take into account when comparing different product choices (Buckley, 2002). Eco-labels help to distinguish products that are environmentally less harmful from the remaining products (Grankvist, Dahlstrand and Biel, 2004). Consumers often do not have the knowledge or time to investigate the environmental impacts of products (Houe & Grabot, 2009), or lack access of information regarding environmental

performance of products (Buckley, 2002). Eco-labels can hereby assist the consumer as they convert credence attributes into search attributes and reduce hereby consumer's search cost (Buckley, 2002; Thøgersen, Haugaard & Olesen, 2010). By providing information on the environmental quality of products or services eco-labels give the consumer the opportunity to choose products that meet their environmental expectations, fulfilling their needs or help them reaching their goals (Thøgersen et al., 2010). Besides that eco-labels act also as a reminder to take environmental issues into account (Bratt et al., 2011; Thøgersen et al., 2010). Additionally, eco-labels promote pro-environmental behavior without limiting consumers in their freedom of choice (Grunert & Wills, 2007). Even though the consumer considers the eco-label during decision-making, still the possibility remains to reject the eco-labeled product (Thøgersen et al., 2010). Finally, as eco-labels can help address the psychological disconnect between human and nature, by providing consumers with information on the environmental effects of their purchase decisions, eco-labels give them the chance to instantly take environmental actions (Anderson et al., 2013).

2.3.1.2 Types of eco-labels

Eco-labels can at least be classified into three different types (D'Souza, Taghian, Lamb & Peretiatko, 2007; Gallastegui, 2002; Houe & Grabot, 2009). The International Organization for Standardization (ISO) has released ISO standards for all three types of eco-labels. Type I eco-labels are according to ISO 14024 voluntary, third party verified, multi-criteria-based eco-labels that are based on life cycle considerations (ISO, 2007a). Type II, so called 'environmental claims', are eco-labels that are, according to ISO 14021, self-declarations made by manufacturers, importers or distributors regarding environmental attributes of products (ISO, 2007b). Environmental claims are usually not third party verified. Type III called environmental declarations use, according to ISO 14025, third party verified life cycle assessments based on pre-set indices to provide quantified environmental product information (ISO, 2007c). According to Houe and Grabot (2009), type I labels have by far been the most successful compared to type II which lack in recognition because of being self-declared and type III labels are still rare. In addition to the above mentioned three types of eco-labels there exists a fourth type of eco-label which is often referred to 'type I-like' eco-label or more commonly known as 'energy label'. Type I-like eco-labels undergo the same third party verification process as type I eco-labels they differ however in the sense that they focus more on single issues such as energy consumption or sustainable forestry (United Nations, 2009). The advantage of energy labels is that they not only label products positively but also negatively. This means that they can work in both directions, promoting less polluting products as positive and more polluting products as negative. They not only show the consumer which products are desirable but also which ones should be avoided from an environmental perspective. I will discuss the impacts of positive and negative product labelling more in chapter 2.3.3.

2.3.1.3 Eco-label as market mechanism

Eco-labels help closing the gap of information asymmetry between consumers and producers over the question what environmental attributes of products are (De Boer, 2003; Rex & Baumann, 2007). Eco-label can hereby be understood as a market mechanism (Bratt et al., 2011), the responsibility for improvements lay in the consumer's hands. By utilizing information provided by the eco-label, consumers can actively demand products that harm the environment less (Buckley, 2002). According to Morris (1997), the advantage of eco-labels is, that they provide consumers with reliable information on environmental impacts of products which they would otherwise not obtain, due to limited time or understanding. At the same time eco-labels can encourage companies to account for the environmental impacts caused by their products, which can also help them to improve their image as well as sales. In terms of producers, eco-labels can hereby also be understood as a benchmark for environmental improvements and competitiveness (Bratt et al., 2011). Finally eco-labels create more environmental awareness among consumers encouraging them to change their purchase behavior, more actively choosing the environmentally less harmful product, which protects in return the environment (Morris, 1997).

2.3.1.4 Reasons for consumers to respond or not respond to eco-labels

According to Fairweather, Maslin and Simmons (2005) the success of an eco-label depends on the level of understanding and awareness consumers have on the product or service certified. An eco-labelling scheme can only provide consumers with value for money when the product substantively differs in its environmental performance from competing products and when the label is immediately withdrawn in case this condition doesn't hold any longer (Buckley, 2002). Whether consumers adopt to a new eco-label depends first of all on their motivation to buy the eco-labeled product, secondly on their issue-relevant knowledge (Thøgersen et al., 2010) and thirdly on the significance and meaning of terms used in the eco-label (Buckley, 2002). How quickly the adoption takes place again depends on the motivation, past experience with eco-labels and trust into the organization releasing the eco-label (Thøgersen et al., 2010). However, consumers only consider eco-label as part of their purchase decision if they trust the information the eco-label provides them (Thøgersen, 2002). The presence of too many eco-labels or of too complex schemes can easily lead to confusion, resulting in ignorance among consumers due to information overload (Buckley, 2002; Thøgersen et al., 2010) and erode trust into the eco-label (Bratt et al. 2011). Further, products being promoted as "green" often let consumer fear that they might be cheated and suspicion of "greenwashing" easily occur (Thøgersen et al., 2010). D'Souza et al. (2007) found that eco-labels which are third party verified (type I and III) were perceived as more credible and consumers set more trust in those than eco-labels of the type II. The only disadvantage of third party verification is the additional costs that arise from the certification process. In terms of consumer responses, eco-labels normally attract at

first those consumers who are already environmentally aware however, they serve also as a communication vehicle increasing awareness among the entire market (Bratt et al. 2011). Although often assumed, D'Souza, Taghian and Lamb (2006) found that the majority of consumers don't perceive eco-labelled products as of lower quality than conventional products. Nevertheless, if the price for an eco-labelled product is high some consumers might do some trade-offs among other product features or they might choose another (cheaper) product not in favor of the eco-label (D'Souza et al., 2007). Finally, Gallastegui (2002) stated that eco-labels in general also show particular weak points. Among those are lacking objectivity when establishing criteria, difficulties in the settings of product category boundaries, the lack of immediate rewards for environmental product improvements as well as the shortness of the validity of many eco-labels. Besides that it is also often difficult to estimate the demand for the product once it contains the eco-label.

2.3.2 Eco-label as an instrument for behavioral change

The basic purpose of an eco-label is to inform consumers about environmental impacts caused by the production, consumption and disposal of a product or service (Gallastegui, 2002). According to Buckley (2002), an eco-label defines, compiles, tests and summarizes all environmental information relevant to a product or service, making its environmental performance comparable with competing products, and transforms thereby into an additional product attribute, a consumer might take into consideration during his or her purchase decision. Eco-labels empower consumers to mitigate environmental impacts by systematically spending money on products that cause less harm to the ecosystem (Dietz & Stern, 2002). The ultimate goal of eco-labels is to generate a change towards more pro-environmental behavior in form of environmentally friendlier consumption patterns (Budeanu, 2007; Gallastegui, 2002).

Studies covering various fields and industries have revealed that eco-labels can lead to behavioral change among consumers: In purchasing washing machines (Sammer & Wüstenhagen, 2006), eco-labelled seafood (Brécard, Hlaimi, Lucas, Perraudeau & Salladarre, 2009), fair trade coffee (Loureiro & Lotade, 2005), eco-labelled wines (Delmas & Lessem, 2015), Dolphin-safe tuna (Teisl, Roe & Hicks, 2002) or even when buying a new car (Noblet, Teisl & Rubin, 2006). Hahnel, Arnold, Waschto, Korcaj, Hillmann, Roser and Spada (2015) found that under some circumstances the presence of an eco-label might even override other product information. Nevertheless, there is also a considerable amount of studies that have questioned whether eco-label alone would lead to behavioral change (e.g. Leire & Thidell, 2005; Rahbar & Wahid, 2011; van Amstel, Driessen & Glasbergen, 2008; Young, Hwang, McDonald & Oates, 2010).

Although there are many examples showing that eco-labels can act as an instrument for behavioral change, there are also numerous studies that proved the opposite. So far however, we have only assumed that providing information in form of an eco-label alone should be enough to change behavior leading consumers to choose the more environmentally friendly product. Reality however

looks different. Kollmuss and Agyeman (2002) found that providing information alone won't necessarily lead to pro-environmental behavior. There are as well other, additional, factors that influence human behavior and determine whether consumers change behavior or not. Kollmuss and Agyeman (2002) further argue that it is difficult to define and also distinguish those additional factors as they often show interrelations and lack of clear boundaries. Nevertheless, they were able to broadly classify those factors into three categories: demographic factors, external factors and internal factors. External factors hereby are institutional, economic, social and cultural factors while internal factors are more like motivation, environmental knowledge, awareness, values, attitudes, emotion, locus of control, responsibility and priority. When looking into previous studies a large variety of additional factors were found that had an influence on whether behavioral change towards more environmentally friendly behavior took place under the presence of an eco-label. Among those factors were: trust (Thøgersen, 2002) understanding of what the eco-label stands for (Grankvist et al., 2004), geographic location and income of consumer (Houe & Grabot, 2009), performance and quality of the product, credibility of the eco-label (Gallastegui, 2002), environmental values of the consumer (Magnusson, Arvola, Koivisto Hursti, Åberg & Sjödén, 2001), the significance and meaning of terms used in the eco-label (Buckley 2002), or the amount of information available for the product (Thøgersen et al., 2010).

Kollmuss and Agyeman (2002) found that there is still a lot of uncertainty and lack of knowledge regarding those additional factors and how they influence pro-environmental behavior. Those additional factors certainly play a crucial role whether consumers will choose the environmentally friendly product or not. Nevertheless, without the presence of an eco-label and the additional environmental information it provides, certainly the chances for behavioral change will be less.

When looking at the conditions that need to be fulfilled in order for an eco-label to lead to pro-environmental behavior among consumers it is certain that using an eco-label just for creating environmental awareness alone won't be enough (Pedersen & Neergaard, 2006). In order for an eco-label to lead to behavioral change it needs to provide information on an environmental concern that already exists among the consumer, making him or her alter the purchase decision in favor of the eco-labeled product (Teisl et al., 2002). Although there is still uncertainty regarding the impacts of climate change among the public, the majority identifies air travel as a major source for climate change (Mayer et al., 2012) meaning that the impact of air travel is an environmental concern that already exists. Nevertheless, Cohen and Higham (2011) also found that the awareness of air passenger's behavior of the direct impacts on climate change caused by them is still low. Further, they found that many do not consider the environment when planning a trip. Hares et al. (2010) detected three barriers for behavioral change among air passengers. The first barrier is the lack of alternative transportation modes which indeed is often a challenge especially when one is planning a holiday overseas. But even when planning a trip within one's

own country, land-based transportation is sometimes so slow that flying represents the only option to complete the journey within the limited time frame. The second barrier is the importance of the holidays. Air passengers don't want to give up the freedom to travel and although they might be concerned about the environmental impacts of their flying behavior, still they don't want to sacrifice their well-deserved holidays for the climate's sake. The third barrier to behavioral change Hares et al. (2010) certainly see in the fact that air passengers see the responsibility for climate change in the hands of others. They expect that first other large polluters, such as manufacturing industries, start to reduce their environmental impacts and that the impact of a single flight is rather insignificant compared to an entire production facility. While it seems very difficult to overcome those barriers and asking air passengers to cut back on their flying behavior, we should rather consider the way we fly than whether to fly or not to fly. Behavioral change would not necessarily mean that we have to stop flying but rather that we have a closer look at the different flight options and that we are more actively choose those ones which generate less environmental impacts. The eco-label could hereby be a critical aid, providing us with the relevant information which flight we should prefer and which one we should avoid.

As we have so far only looked at eco-labels affecting the behavior of consumers, we haven't discussed how this behavioral change might affect the producer's or service provider's environmental behavior. Obviously, the first objective of an eco-label is to provide information to consumers. Gallastegui (2002) certainly sees the second objective in encouraging producers to increase their environmental standards regarding their products and services. Behavioral change among consumers selecting more eco-labelled products can lead to more pro-environmental behavioral among producers as the eco-label provides an incentive for environmental product differentiation (Bleda & Valente, 2009; Jordan, Wurzel & Zito, 2003; Teisl et al., 2002). While eco-labels encourage more pro-environmental purchase behavior, at the same time they also encourage companies to meet higher standards (Anderson et al., 2013). According to Gallastegui (2002) the market impact of an eco-label depends not only on consumer's degree of environmental awareness but also on the demand for green products. Increasing demand has in many cases encouraged producers to raise environmental standards and to apply for eco-labels (Gallastegui, 2002). Teisl and Roe (2005) emphasize hereby that it only needs a subset of consumers, which respond to the eco-label, in order to make producers modify their existing products or developing new ones, changing their marketing strategy or to target green consumers. Therefore, eco-labels can play a crucial part in the transition towards a sustainable society by changing consumption and production decisions through the provision of information (Bratt et al. 2011). Among the factors that promote pro-environmental behavior through the use of eco-labels among producers or service providers are: meeting customer or stakeholder demand, pressure from competitors, improved company image but also avoiding regulatory actions and fines (Anderson et al., 2013; Lynes & Andrachuk,

2008; Lynes & Dredge, 2006). Besides that the adoption of an eco-label can also bring companies competitive advantage while at the same time push producers, which show the lowest environmental performance, out of the market (Grankvist et al., 2004). In the long run, companies that do not comply with the eco-label might even lose their 'license to operate' (Buckley 2002). Last but not least, an eco-label might in some cases also entitle a producer to ask for a premium price (Gallastegui, 2002).

2.3.3 Issues Critical to the Introduction and Success of Eco-labels

In this chapter I will discuss issues critical to the introduction and success of a new eco-label. Table 2 provides hereby an overview over these critical issues. As indicated the success of a new eco-label depends on the design of the label, the clarity of its criteria and process, customer group specific features and the benefits it potentially creates for companies.

TABLE 2 Criteria and features critical for introduction a new eco-label

Criteria	**Features critical for introduction of new eco-label**
Design of eco-label	• Identification of need • Support consumer in decision making • Enforced by law / policy makers
Clarity of criteria and process	• Clear definition of objectives • Transparent communication of objectives • Strategic development of objectives • Third party verification
Customer specific features	• Concern, understanding and awareness of consumer • Focus on right consumer group • Consumer adoption of an eco-label
Benefits for companies	• Competitive advantage for certified companies • Market pressure on non-certified companies • Support traditional producers in market positioning

First, the design of an eco-label should be based on the identification of need. Before introducing an eco-label into a new industry or market, it is essential to determine whether there is demand for such a label (Anderson et al., 2013; Gallastegui, 2002). The eco-label should then be designed so that it supports consumers in their decision making when they compare different products regarding their environmental impacts. The eco-label needs to define, compile, test, and summarize the environmental performance of each product and present it to the consumer in the easiest way possible (Buckley, 2002; Gallastegui, 2002). Eco-labels may also need to be enforced by policymakers and environmental regulation (Buckley, 2002; Grankvist et al., 2004).

Second, the clarity of criteria and process for product eco-labeling was shown to influence the introduction of the eco-label. For the criteria, the particular environmental parameter or issue to which the eco-label refers needs to be

clearly stated (Buckley, 2002), communicated (Thøgersen et al., 2010), and there should be no language barrier hindering the understanding (Houe & Grabot, 2009). The degree of consensus regarding the meaning and significance of terms used in the eco-label means that the terminology used to communicate about it is clearly defined and that the practices undertaken or outcomes of the eco-label are transparent and understandable to all parties involved (Buckley, 2002). Furthermore, Bratt et al. (2011) and Gallastegui (2002) added that the criteria for an eco-label need to be strategically developed, meaning that objectives are clearly defined and the strategies to reach these objectives are clearly laid out. Consumers must be informed of the eco-label's meaning, its characteristics, requirements, and guarantees in order to avoid unclear and confusing messages (Testa, Iraldo, Vaccari, & Ferrari, 2013), such as failure to assure the buyer about the product's ecological impact, the insufficient information about the producer's compliance, and the presence of recommendations (van Amstel et al., 2008). Research has further shown that, to be convincing, an eco-label needs to be verified by a third party. Claims made by manufacturers or service providers do not really build trust on the consumer's side and such a label might fail (Anderson et al., 2013; D'Souza et al., 2007; Gallastegui, 2002). This lack may explain why Testa et al. (2013) found that consumers had the most trust in the so-called official eco-labels (i.e., the EU eco-label and FCS label).

Third, the success of an eco-label depends on customer group specific features. These features include the level of concern, understanding, and awareness a consumer has about the eco-label itself in regard to the product being certified (Anderson et al., 2013; Buckley, 2002). The research has also revealed individual and group- or country-based variation in the willingness to adopt new eco-labels. Factors that influence the consumer's adoption of a new eco-label scheme are environmental factors (social norms, media, campaigns), personal factors (personality, demographics, relevant knowledge) and product-related factors (certifying body, information on the product). The adoption process consists of six steps: exposure – perception – understanding – liking – adoption – continued adoption (Thøgersen et al., 2010). When it comes to demographics, older consumers (50–60+ years) are more likely to respond to eco-labels, but they also appear to be the most critical regarding the content and claims of such labels (D'Souza et al., 2007). From a geographical point of view, the consumers most responsive to eco-labels are found in the Nordic countries, Germany, and Japan, but there is growing interest in the other European countries as well as in the USA, with the reason being seen as the higher income levels in these countries (Houe & Grabot, 2009). Adoption further depends on individual characteristics such as values and motivation: whether and how quickly consumers adopt a new eco-label depends on their motivation, past experience with eco-labels as well as the trust in the verifying organization (Thøgersen et al., 2010). Consumers with no or weak interest in environmental issues do not respond to any eco-label; consumers with an intermediate interest avoid products with negative (red) labels; and consumers with a strong interest in environmental issues are affected by negative and positive labels equally

(Araghi et al., 2014; Grankvist et al., 2004). These findings suggest that the new eco-label should be based on identifying the needs and goals of consumers, which is important in order to start the process of adopting a new eco-label (Thøgersen et al., 2010). This may lead to a situation in which a consumer has adopted an eco-label when he or she is actively, repeatedly, and consistently considering the label whenever a purchase decision is due (Thøgersen et al., 2010).

Finally, research has suggested that the introduction of a new eco-label may be supported by the potential benefits it can create for companies. Eco-labels should motivate companies to improve their performance by creating competitive advantage for those producers who use the label while driving out the remaining producers from the market (Anderson et al., 2013; Berghoef & Dodds, 2013; Grankvist et al., 2004; Buckley, 2002; Thøgersen et al., 2002). Berghoef and Dodds (2013) noticed that the introduction of an eco-label could be supported by motivating industry members to make environmental improvements, increased visibility, and improved public perception. At the same time, it may motivate competitors to adapt in order to stay in the market (Anderson et al., 2013). It has been suggested that eco-labels may help traditional manufacturers (i.e., full-service carriers) to position themselves better in the battle with low-cost producers (i.e., low-cost carriers) by gaining competitive advantage through environmental product differentiation (Anderson et al., 2013; Houe & Grabot, 2009). However, these views have been questioned by Delmas and Grant (2014), D'Souza et al. (2007) and Grankvist et al. (2004), who highlight the possible negative impact on product prices. In addition, because most consumers are rather price-sensitive, they might make a trade-off in their purchase decision by not choosing the most expensive product (D'Souza et al., 2007), in which case consumers might pass up the green-labeled product as too expensive. However, they would certainly avoid a product which carries a negative (red) label (Grankvist et al., 2004).

2.3.4 Specific Features for an Airline Industry Eco-label

Next I will review literature on airline industry specific aspects of eco-labelling. Based on previous literature I will discuss how an eco-label should be designed so that it meets the needs of the airline industry.

According to Walker and Cook (2009) the meaning of the term sustainability, and its significance for aviation, is still much debated by different aviation stakeholder groups. As discussed in the previous chapter it is essential for the successful introduction of a new eco-label scheme that the objectives of an eco-label are clearly defined and strategically developed. Further, there is also a clear need of transparent communication of these objectives. Therefore it will be essential for the introduction of an airline eco-label that a consensus is found what the term sustainability stands for within this industry.

The second critical issue is the use of only one globally recognized eco-label within the industry. If there is more than one eco-label in a specific market, this can lead to confusion and ignorance by the consumer (Bratt et al., 2011;

Buckley, 2002; Gallastegui, 2002). As Thøgersen et al. (2010) found, the presence of too many eco-labels can lead to information overload that results in consumers either ignoring eco-labels or even worse suspecting 'greenwashing' behind the environmentally friendly claims. In addition, an internationally competitive industry – such as the airline industry – needs a globally recognized eco-label scheme (Buckley, 2002).

Following the example of the EU Energy Label (European Commission, 2016), it would be advisable to use a color-coded eco-label scheme which is much easier to understand and interpret for air passengers than the provision of carbon figures (Gössling & Buckley, 2016). Further it would be beneficial for an airline eco-label not only to use positive but also negative labels. This would give consumers the possibility to compare all flights environmentally. When using both positive and negative environmental labels Grankvist et al. (2004) found that consumers that didn't show any interesting in environmental issues were not affected by either type of label. Consumers with intermediate environmental interests were however affected but only by the negative label. As those consumers would less likely choose positively labelled products, they also wouldn't respond to any conventional eco-label which is only granted to products that are environmentally superior. However, the presence of a negative label certainly affects also consumers with only intermediate environmental interest as they will start to avoid products which have a negative environmental outcome. Consumers which strong environmental interest were on the other side equally affected by both types of labels. The green label might represent a positive outcome for the environment, while the yellow label might be perceived as a neutral outcome, neither improving nor further diminishing the current state of the environment. The red label is clearly identified as a negative outcome leading to further environmental damage (Grankvist et al., 2004). However, as already discussed earlier, in terms of air transportation we cannot in any case speak of an improvement of the current state of the environment even if the flight is labelled green. Only the avoidance to fly could lead to a neutral outcome. Although currently used eco-label schemes are mainly voluntary, using as well negative labels would require that such a scheme is enforced by regulation. One good example for an enforced labelling scheme is the EU Energy Label (Sammer & Wüstenhagen, 2006). Further, as more and more consumers would avoid products that contain the red label, this would push producers to either improve their environmental standard or they would otherwise be driven out of the market (Grankvist et al., 2004). This certainly could motivate the most polluting airlines to improve their environmental performance, as they would otherwise loose market shares or have to exit the market. Airlines would no longer only compete over prices or service but also regarding environmental performance.

Further on, the eco-label would also benefit those airlines that are standing out in their environmental performance. According to Forbes, Cohen, Cullen, Wratten and Fountain (2009) an eco-label can help those producers who are 'going green' to differentiate their products in crowded marketplaces and to

gain competitive advantage (Buckley, 2002). Competitive advantage obtained through the use of eco-labels can reward companies both in form of better image but also in terms of increased market shares (Houe & Grabot, 2009). Additionally, Lee and Park (2010) found that being more environmentally responsible has a positive relationship with value performance in the airline industry, especially in the financial markets, which may consider firm value to increase when such practices are implemented. On top of that Lynes and Dredge (2006) identified that airline's environmental commitment can also lead to additional financial gains (meaning both the money saved and money earned), maintaining good relationships within the aviation community as well as improved corporate image. Finally, the use of eco-labels can also help industries to avoid regulatory restrictions (Buckley, 2002) which is certainly a threat the airline industry is facing, should its environmental impacts further grow at rates seen in the past, as discussed earlier.

2.4 Measuring environmental impacts of aviation

In this chapter I will discuss how the actual environmental impacts of air transportation can be measured. Measuring the impacts is essential for the use of an eco-label as these measures provide the basis to determine to whom the eco-label might be granted and to whom not. As this dissertation focuses exclusively on aviation's impacts on climate change I will limit the environmental impacts discussed in this chapter to emissions produced by aircrafts which are CO_2, NO_X, H_2O, SO_X, soot particles, condensation trails and cirrus clouds (Daley, 2010). From all these emissions, carbon dioxide is clearly identified and seen as the major contributor to climate change (Green, 2003). The atmospheric lifetime of carbon dioxide goes with 50-100 years far beyond that of any other greenhouse gas released by aircrafts (Rogers et al., 2002) and may affect the climate system therefore for hundreds and thousands of years (Archer, 2005). While there is a high scientific understanding on the radiative forcing of CO_2 emissions, the understanding of non-CO_2 emissions is to date still uncertain (Preston et al., 2012). Some emissions released from aircraft have even cooling effects (Lee et al., 2009). Being aware of the uncertainty, previous research has mainly excluded remaining emissions and only focused on carbon dioxide emissions (Sgouridis et al., 2011), whose course of climate change is clearly identified. Forsyth (2011) sees a clear need to also integrate non-CO_2 emissions into the assessment of aviation's environmental impacts, however, as current measures are still not precise enough such an integration does not make much sense at the given point. Due to the importance of carbon dioxide emissions as the major contributor to climate change and the remaining uncertainty on the understanding of the effects of non-CO_2 emission I will, as well, follow previous literature and focus my research on CO_2 emissions exclusively.

In terms of carbon dioxide emissions a number of carbon calculators have become available in recent years which made the environmental impact of

flying easier measurable. Unfortunately there is a lack of consistency and different calculators produce different outcomes for the same journey (Miyoshi & Mason, 2009) as also shown in table 3.

TABLE 3 Results of different emissions calculators for a New York-Helsinki flight

JFK-HEL	ICAO	Climate Care	Atmosfair	Finnair
Distance	6,603 km	6,607 km	6,653 km	6,962km
CO_2 (kg)/passenger	426.49 kg	920.00 kg	640.00 kg	379.44 kg

Sources: Atmosfair, 2015b; Climate Care, 2015; Finnair, 2015; ICAO, 2015.

To sum up it can be said that so far no consensus exists on how to calculate carbon emissions produced from air transportation. Nevertheless, as Jardine (2009) found all aviation emissions calculators utilize broadly the same methodology. However, while methodologies applied are similar there is a huge difference among the data used within the emission calculators. This can range from the use of very simplified data like indicative short, medium and long haul aircraft, as in the case of the DEFRA calculator (DEFRA, 2012), up to the use of actual fuel data like in case of Finnair's emissions calculator (Finnair, 2015). Table 4 illustrates the range of inputs different emissions calculators utilize.

In addition to the different data used also the data sources can differ as data can be acquired from various sources both publically available and private data sources. While data regarding distance, aircraft type, freight factor, passenger load factor and seating configuration is publically available, the actual fuel consumption isn't. To my knowledge only the Finnair emissions calculator utilizes actual fuel data while all other emissions calculators have to rely on average data. However, software exists (e.g. Piano-X or FAA's AEDT) which is able to model the fuel consumption of individual airplanes very precisely by also taking critical parameters into account such as weight, speed and flight level (Piano-X, 2008).Unfortunately these programs are not freely available. Therefore most of the emissions calculators rely on data that comes from publically available emissions inventory guidebooks. A widely used guidebook is EMEP/ Corinair published by the European Environment Agency (EEA, 2007) which provides fuel consumption data of 44 aircraft types over 16 stage lengths. Fuel data is provided for the entire flight including taxing, take-off, climb, cruise, approach and landing. The advantage of this method is that it also accounts for the fact that short haul flights burn more fuel per kilometer due to the energy intense take-off compared to the rather short cruise. The same accounts for ultra-long haul flights because of the additional weight of the fuel that needs to be carried to fly the longer distance. The disadvantage however is that EMEP/Corinair does not provide any information on fuel consumption

based on different weight, speed and flight level which certainly has an influence on the fuel consumption, too (Filippone, 2008).Besides many commonly used emissions calculators also numerous studies (e.g. Givoni & Rietveld, 2010; Loo, Li, Psaraki & Pagoni, 2014; Romano, Gaudioso & De Lauretis, 1999; Winther, Kousgaard & Oxbol, 2006) have based their calculations on the EMEP/Corinair database.

TABLE 4 Key features of different emissions calculators

Parameter	ICAO	DEFRA	Finnair
Great circle distance correction	Up to 11%	9%	5% + 20km
Plane type	50 aircraft types, some representatives	3 aircraft types, short medium and long haul	Actual aircraft
Fuel burn data	EMEP/ Corinair	EMEP/ Corinair	Real data
Freight factor	Wide body: 72.9%-90.3% Narrow body: 91.7%-99.6%	Domestic: 99.8% Short haul: 99.4% Long haul: 88.1%	Real data
Load factor	Wide body: 64.5%-83.6% Narrow body: 67.3%-81.8%	Domestic: 66.4% Short haul: 83.4% Long haul: 81.9%	Real data
Seat configuration	Number of economy seats that fit into the aircraft	Representative from CAA data	Real data

Sources: DEFRA, 2012; Finnair, 2015; ICAO, 2014.

A major drawback of the EMEP/Corinair inventory guidebook is that it doesn't distinguish between the different types within aircraft families (e.g. Airbus A319, A320) and has no data on newer aircraft models like the Airbus A380. In 2009 the EEA (2009) published therefore a revised version, the EMEP/EEA in-

ventory guidebook, that contains 75 aircraft types featuring different types within aircraft families and also represent newer aircraft models. The high relevancy of the EMEP/EEA fuel burn data was also confirmed by Park and O'Kelly (2014) who performed validation analysis by comparing it with more sophisticated fuel burn data determining a relationship of R^2 at 0.92. But even with the availability of detailed fuel data and actual flight data such as distance, aircraft type, freight factor, passenger load factor and seating configuration many emissions calculators still base their calculations on average data, providing users only with CO_2 emissions of a 'typical' flight. As Miyoshi and Mason (2009) found currently available emissions calculators treat all flights the same way, without distinguishing between the different environmental performances of individual airlines or flights. This starts often with the aircraft type. Some emissions calculators use only a few generic types of aircrafts instead of the specific aircraft that is operating the actual flight. This of course has consequences on the fuel burn and amount of seats or passengers. Another common way of simplifying the calculations is the use of average passenger and freight load factors which according to Miyoshi and Mason (2009) are often unrealistically high. Finally most of the emissions calculators don't distinguish between the different seat layouts which can differ significantly between airlines and certainly can play an important role in terms of per passenger carbon emissions (Bofinger & Strand, 2013; Park & O'Kelly, 2014). While information on a 'typical' flight might provide some estimation on how much CO_2 emissions a flight produces, it would not be sufficient enough to be used for an eco-label. Especially when the eco-label is flight specific, as discussed in the previous chapter. In order to make individual flights comparable the calculation methods needs to be more accurate.

Previous literature in this regard hasn't focused on the carbon emissions of individual flights so far but has rather locked into the CO_2 emissions of routes (Givoni & Rietveld, 2010; Hanandeh, 2013; Jamin, Schafer, Ben-Akiva & Waitz, 2004; Loo et al., 2014; Miyoshi, 2014; Miyoshi & Mason, 2009) or airlines (Miyoshi, 2014; Miyoshi & Mason, 2009; Romano, Gaudioso & De Lauretis, 1999) mainly utilizing average data in terms of aircraft (Smith & Rodger, 2009), load factors (Gössling et al., 2005; Miyoshi & Mason, 2009; Smith & Rodger, 2009), seat configurations (Miyoshi & Mason, 2009; Smith & Rodger, 2009) or fuel burn per passenger kilometer (Gössling et al., 2005; Jamin et al., 2004; Peeters, Szimba & Dujinisveld, 2007; Smith & Rodger, 2009). In order to determine the actual environmental impacts of individual flights and to make them comparable through an eco-label the use of actual data is inevitable.

3 RESEARCH DESIGN AND METHODS

This dissertation builds on four articles which are all based on empirical research. It follows hereby different methodological approaches, ontological and epistemological assumptions, logics of reasoning and uses different ways of data collection and analysis. Table 5 provides an overview of the research approach, materials and its analysis used in this dissertation and I will further elaborate on these aspects in this chapter.

TABLE 5 Research design and methods of the dissertation

Article	Approach	Ontological & epistemological assumptions	Reasoning	Data collection	Data analysis
I	Quantitative	Positivistic	Deductive	Survey	Statistical
II	Qualitative	Realistic	Inductive	Interviews	Thematic
III	Quantitative	Positivistic	Deductive	Secondary data	Statistical
IV	Quantitative	Positivistic	Deductive	Survey	Statistical

3.1 Research approach

Ontology refers to the reality investigated by the researcher, in terms of what exists, while epistemology pertains to knowledge in form of what is known and to what extend it is known (Healy & Perry, 2000). The four articles included in this dissertation follow two different types of assumptions: positivism and realism. Article I, which can be regarded more as a pre-study on the investigated topic follows the scientific paradigm of positivism and a deductive logic of reasoning. Positivism takes usually a quantitative approach and the researchers separate themselves from the world studied, which means the data and its analysis become value-free and does not change due to observation (Healy & Perry, 2000). In the first article I studied air passenger's opinion on airline's pro-

environmental initiatives. As I was more interested in air passenger's opinion in general than the opinions of individual respondents (Robson, 1993) a positivistic approach seemed more sound. Based on the results of article I the idea of using an industry wide recognized airline eco-label was born in my mind. In the second article I studied this idea more in-depth by interviewing aviation industry experts, using a realistic approach and inductive reasoning. Realism, which is based on a qualitative approach, is following the believe that abstract things, which are in researcher's mind, do exist out there in the real world (Healy & Perry, 2000). I chose this approach in order to gain more understanding on the idea of using an industry wide eco-label which didn't exist so far in the real world but only in my mind. Based on the findings of the second article two major issues remained open, which are essential for answering the main research question. I addressed these two issues in article III and IV. The third article focused on the issues of differences in the environmental performance of individual flights which as claimed by the interviewees do exist. As this needed to be proved with numbers article III followed again a positivistic approach and deductive reasoning. Finally article IV addressed the issue of whether eco-labels would lead to behavioral change among air passengers as discussed in article II. I wanted to investigate this issue value-free through a "one-way mirror" (Guba & Lincoln, 1994) ensuring that the air passenger's responses weren't affected by my observations. I saw this as crucial as I was studying their booking behavior through an experiment. Therefore also in article IV I chose a positivistic approach with deductive reasoning.

Methodology refers to the technique that the researcher utilizes in order to investigate reality (Healy & Perry, 2000). Based on the nature of the phenomenon investigated, different research methods and techniques may be selected (Fleetwood, 2004). According to Creswell (2009) the distinction between qualitative and quantitative research is not always so clear, in reality a study tends to be more qualitative or more quantitative. Saunders, Lewis and Thornhill (2007) defined quantitative research as "a synonym for any data collection technique (such as a questionnaire) or data analysis procedure (such as graphs or statistics) that generates or uses numerical data." In contrast to that, qualitative research generates only non-numerical data. According to Creswell (2009), a qualitative study uses more commonly words than numbers like the quantitative does. In quantitative studies the use of closed-ended questions is more common while in qualitative research open-ended questions are more the case. In addition to this, there exists a third approach that combines both qualitative and quantitative techniques also known as triangulation or mixed-methods approach (Hurmerinta-Peltomäki & Nummela, 2006). According to Creswell (2009) mixed- method studies combine in a single study both qualitative data collecting and/or analysis and quantitative data collection and/or analysis. Data collection might be taking place concurrently or sequentially and data shall be combined at one or several stages during the research process (Hurmerinta-Peltomäki & Nummela, 2006). The here presented dissertation follows a mixed-methods approach as its four articles used both qualitative and quantitative

methods. The main reason for this approach was in order to first gain deeper understanding on the topic investigated (Erzberger & Kelle, 2003). While the first article, based on a quantitative study collecting data through a survey, initiated the idea of using an eco-label in the airline industry, I was still lacking of more understanding on this topic. Neither did this idea exist in reality nor could I rely on any existing literature. Therefore, in order to build more understanding and generate more ideas on this topic I decided to speak first to those who most likely are able to comment on this idea. Article II is based on standardized open-ended interviews with aviation industry experts. Based on the result from the second article two more issues emerged that required further investigation. Due to the nature of these issues and as already described in the previous chapter article III and IV are again based on a quantitative approach.

3.2 Research material and its analysis

Next I will elaborate on the research material that has been used in this dissertation and the way the material has been analyzed. Altogether the research material used for this dissertation consists of four data sets: 148 survey responses to a questionnaire, 12 aviation industry expert interviews, 118 individual flights that have been analyzed in-depth and finally a set of 554 responses to a second questionnaire.

The first data set is based on a quantitative survey in which 148 air passengers took part. This study was conducted as part of my Master's Thesis and in close cooperating with the Finnish national carrier Finnair. As Finnair was not able to provide me with any customer data I had to find other ways to get in touch with Finnair's customers. Therefore, for a period of two months, the questionnaire was accessible online through a link on Finnair's international webpage in English. I had hereby to rely on convenience sampling as the link was accessible to anybody visiting the website. According to Davies (2007) convenience sampling means that the researcher collects data where ever he or she gets it most easily. The data itself was collected with the help of the web-based interview program mrInterview and the questions were developed in close cooperation with Finnair. The survey questions can be found in Appendix 1. After a pilot test with 10 participants, testing the functionalities of the questionnaire, the link became accessible on Finnair's webpage in March 2011. The link was activated 512 times during the two-month period. Altogether 148 participants completed the questionnaire successfully and answered all the questions, yielding a response rate of 28.9%. The questionnaire also collected socio-demographic data and information on participant's travel history.

The participants rated first the importance of the following aspects when booking a flight: ticket price, non-stop flight option, total flight time (including transfers) and suitable departure/arrival time. For the second question, they stated if they take any environmental aspects into consideration when booking a flight. If the answer was yes, they were asked to specify what kinds of aspects

they consider. The respondents then answered various questions concerning their opinions regarding three of Finnair's environmental initiatives (modern fleet, direct flight and carbon offset). They stated if they saw value in them and whether they would show willingness to pay a premium. For these questions, a five-point Likert scale was used. In the questions concerning the modern fleet, they stated whether they think operating a modern fleet is better for the environment and whether they are ready to pay more for a flight that produces fewer emissions. For the questions about direct flights, the participants' reported how important they rate direct flights among other aspects. In a second question they were asked if they would accept stopovers on their way to their final destination if the airfare were lower. In terms of carbon offset, the participants were asked for their opinion on whether paying for carbon offset has a positive effect on the environment or not and in the following question they were asked to state whether they have ever paid for carbon offset. Finally using Finnair as a concrete example, the participants were asked whether they think Finnair has a leading role in terms of environmental responsibility or not.

Statistical analysis of the data was performed using SPSS. Significance testing was carried out by applying Pearson's chi-square test. The chi-square test is usually applied when the statistical significance of differences between the cells of a cross tabulation need to be tested (Davies, 2007). Whether a result can be claimed as statistical significant depends on the p value. In this study the critical level for significance testing was set at $p < 0.05$. Further also mean and standard deviation has been calculated using SPSS.

The second data set is based on a qualitative study for which I conducted interviews with 12 aviation industry experts. Due to the novelty of the topic, which hadn't received much attention in the literature, my co-author and I decided to select a qualitative (Silverman 2006) and inductive (Eriksson and Kovalainen 2008) approach and to proceed without binding assumptions arising from any prior theory. This approach allowed us to focus on the perspectives that arose from the empirical data. This qualitative and inductive nature led us to approach the topic by conducting in-depth interviews with experts that had been actively involved in the sustainable development of the airline industry. The data collection took place in two steps. The first step included informal interviews among participants at a professional conference and the second step consisted of standardized interviews with 12 airline industry experts. This approach was chosen in order to first gather an understanding of the topic and second to build contacts with the industry in order to find suitable experts for in-depth interviews.

The potential idea for using an eco-label within the airline industry was first discussed among the participants at the Air Transport World 5th Annual Eco-Aviation Conference in Washington, D.C. in June 2012. The participants, which were all CSR professionals, represented major airlines from the United States, Europe and Asia, all major airframe makers and engine producers, international airports, airline trade associations as well as aviation industry service providers. The discussions took place during breaks and when there was

room for socializing. The discussions, with three to five participants each, were informal and unstructured and took place in a focus-group setting. The participants were presented with samples of Flybe's and CheapTickets.nl's eco-labels and were asked to comment on the ideas and whether they thought something similar could be introduced industry-wide.

Even though the conference participants were very positive about the idea of using eco-labels in the airline industry the question remained whether there is a clear need for such labels, something that could not have been discussed during these short discussion rounds. Also the issue of how the eco-label should be designed in terms of appearance and distribution was another question that could not be answered. Finally, one of the greatest obstacles was seen in finding common agreement within the industry on the eco-label, a topic which certainly needed to be discussed more in detail.

The 12 interviewees were selected according to recommendations and contacts provided by the conference participants. At the beginning of the interview all interviewees were presented with the eco-labelling scheme presented by Flybe and the eco value scheme used by CheapTickets.nl. After that, major themes identified during the conference were discussed. Standardized open-ended interviews with 12 airline industry experts (see Table 6) were conducted between June 2012 and April 2013. The interview framework can be found in Appendix 2.

TABLE 6 Industry experts who participated in the interviews

Position	**Industry sector**
Senior sales manager	Aviation fuels
Environmental manager	Air traffic and airport authority
Senior manager	Maintenance and waste treatment
Senior manager	Aviation fuels / biofuels
Client director	Airline management consultancy
Environmental manager	Major network carrier
VP environmental issues	Major network carrier
CEO	Regional airline
Communication manager	International business travel agency
VP sustainable development	Major network carrier
Managing director	Global transaction processor
Group environmental officer	Global transaction processor

The work of all 12 experts was directly related to environmental issues and all of them hold positions responsible for sustainable development or CSR within

the organization they belonged to. The interviewees represented major international and regional airlines, air traffic and airport authorities, global transaction processors, IT solutions providers, airline management consultant companies, international business travel agencies, aviation fuel suppliers as well as facility maintenance and waste treatment service providers. Most of the interviews were conducted face-to-face at the expert's workplaces in three European countries: Germany, Finland and Spain. Two interviews were conducted over the phone. The length of each interview varied between 40 and 120 minutes. Although all 12 experts were based in Europe, the focus of the interviews was kept on a global scale, meaning only experts who worked for large international corporations were interviewed. All experts were capable of answering the questions from a global perspective. All 12 interviews were transcribed and then thematically analyzed based on the three themes that emerged from the discussions at the conference and provided then the bases for reporting the results.

The interview data was analyzed inductively and thematically (Bryman and Bell, 2007; Tuomi and Sarajärvi, 2009). This means that the data was analyzed based on its contents and without binding rules coming from theory. The analysis questions were created in the interaction with the data. In the first phase of the analysis, I read through the data multiple times and coded the key aspects that arose from the industry expert's views on the potential idea of introducing eco-labels in the airline industry. Based on those codes, I then wrote summaries of each interview and the key aspects identified in them. In the second phase of the analysis, the similarities and differences in the summaries written in the first phase were identified and those sections of summaries that contained crucial themes emerging from the interviews for a potential eco-label introduction were classified. In this phase both my co-author and I reviewed the summaries. The main themes identified were listed and the list provided the basis for reporting the results. Finally, in the third phase of the analysis it was noticed that each of the identified themes represented a possibility or a prerequisite for the potential idea of introducing an ecolabel in the airline industry. The summaries on each theme were then further analyzed and categorized into possibilities and prerequisites.

The third data set consisting of 118 individual flights was collected in order to conduct carbon dioxide emissions calculations to be able to proof the tremendous differences in the environmental performance of individual flights. Emissions were hereby calculated following the methodology provided by ICAO (2014). This methodology is most widely recognized within the aviation industry and has been adopted by many emissions calculators. Also in existing literature many studies (e.g. Hanandeh, 2013; Lu & Shon, 2012) have utilized the ICAO method. However, as discussed earlier the ICAO Carbon Emissions Calculator relies mainly on average data while I wanted to base my calculations on actual data. My calculation method therefore differs from the ICAO methodology as I acquired real traffic data from the United States Department of Transportation (USDOT) in order to calculate load factors, passenger to freight factors and number of seats supplied on each flight. Also in terms of fuel data I

based my calculations on the revised EMEP/EEA inventory guidebook, being able to calculate with more accurate data as this approach allowed me to distinguish between different types within aircraft families. The fuel data itself was calculated by interpolation, using a linear regression method. This was considered as reasonable as the fuel consumption curve approaches a linear relationship to distance on medium and long haul flights. In case of short haul flights I applied the same method which I considered as safe due to the fact that I had more accurate data available as the distance steps in the fuel database were smaller (125nm, 250nm, 500nm, 750nm). I am however aware that only real fuel data would result in accurate consumption figures. Nevertheless, comparing my results with that of Finnair's emissions calculator gave me confidence on the accuracy of my calculation method. The Great Circle Distance (GCD) between the origin and destination was also acquired from the USDOT database. I used a correction factor in order to account for stacking, traffic and weather-driven diversion from the GCD. I hereby added 50 km to flights less than 550 km, 100 km to flights between 550 km and 5,500 km and 125 km to all flights beyond 5,500 km. To calculate carbon dioxide emissions per passenger I used the following formula as stated in the ICAO Carbon Emissions Calculator manual Version 7 (June 2014):

$$CO2\ per\ passenger\ =\ 3.157\ *\frac{(total\ fuel * passenger\ to\ freight\ factor)}{(number\ of\ seats * passenger\ load\ factor)}$$

The constant of 3.157 represents hereby the number of tons of CO_2 produced when burning one ton of aviation fuel (Dings, Wit, Leurs, Davidson & Fransen, 2003; Sutkus, Baugcum & DuBois, 2001). The flight connection data was acquired from OAG (Official Aviation Guide) Flight Schedule which provided information on departure and arrival times, flight numbers, aircraft type and cabin classes. Figure 3 gives an overview of the different inputs needed in order to calculate CO_2 emissions based on the ICAO methodology. Cabin seat charts that helped mapping the seat configuration of various aircrafts and the amount of seats in each cabin class were extracted from Seat Guru. The maximum seating capacity of each aircraft used in the study was acquired from the aircraft manufacturers directly. All CO_2 emissions were calculated on a per passenger or per passenger kilometer base. I hereby always calculated the emissions per passenger regardless of cabin class. Certainly I am aware that due to the higher amount of space a premium class seat occupies, the carbon dioxide emissions of an individual air passenger can be up to eightfold, compared to a passenger flying in economy class (Bofinger & Strand, 2013). While previous studies have built their emissions calculations on a large amount of routes (e.g. Hanandeh, 2013; Loo et al., 2014; Miyoshi & Mason, 2009) I decided to focus only on selected flights of three routes and to analyze these in-depth instead.

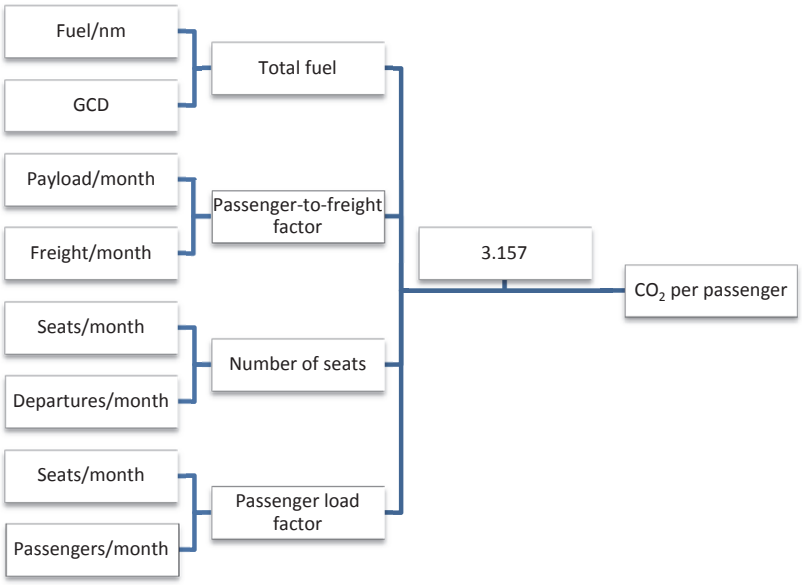


FIGURE 3 Carbon dioxide emissions per passenger for a specific flight

Nevertheless, the selected routes cover three geographical markets of short, medium and long haul flights. On the short haul market I chose the busiest domestic route in the U.S. from Los Angeles (LAX) to San Francisco (SFO). This route was of special interest for me because the variety of aircrafts used on this route is large. Still the route is not too short to only be operated non-stop giving me also the chance to compare non-stop with connecting flights on a short haul route. For the medium haul route I chose the second busiest medium haul route in the United States, Los Angeles (LAX) to New York (JFK). This route was chosen over Miami (MIA) to New York (NYC) because of the much greater diversity of operators and aircrafts used on the LAX to JFK route. For the long haul route I chose Los Angeles (LAX) to London (LHR) which is the third busiest U.S. American international route after New York (JFK) to London (LHR) and Honolulu (HNL) to Tokyo (NRT). I chose this route over the others because it offers more connecting flights than the two other routes. Besides that, the diversity of operators and aircrafts was higher, giving more opportunities to compare different operators and aircrafts. On the short and medium haul routes I did not analyze all flights but chose instead a time frame for departures that allowed me to include all major operators and the most common aircrafts used on these particular routes. For the Los Angeles to San Francisco route I analyzed all departures between 10 am and 12 pm and on the Los Angeles to New York (JFK) route I chose all departures between 6 am and 7 am. On the long haul route I considered all late afternoon departures that took place between 5 pm and midnight. On all three routes all direct flights and all connecting flights

that were listed on the OAG Flight Engine were taken into consideration however, only flights were considered that operated at least 5 times a week. I calculated carbon emissions for each and every individual flight. Of 68 flight connections operated by 118 different flights, connecting these three chosen city pairs. Appendix 3 provides an overview of all flights that were included in the study.

The fourth data set is based on a discrete choice experiment in which 554 air passengers participated. In order to study the effects of the use of eco-labels in the airline industry in the most realistic way, I decided to conduct a discrete choice experiment. The advantage of this method is that it allowed me to mirror real-world choices while still being able to randomize across product attributes which would not have been possible with real-world data. Besides that it also allowed me to examine only those product attributes most relevant to my dissertation. In my discrete choice experiment, respondents were asked to imagine taking a transcontinental flight from Los Angeles (LAX) to New York (JFK). Consumers were then presented with nine choice sets each containing three flight options from which the participants were asked to choose one. Attributes and attribute levels are presented in table 7. Each flight option contained the ticket price, the duration of the flight connection and an eco-label. Ticket prices varied from $205 to $245, reflecting prevailing airline prices for economy class on way flights on the Los Angeles to New York route. Also the total journey time including stops and layovers were taken from existing schedules ranging from 5 hours and 20 minutes equal to a non-stop flight to 7 hours and 50 minutes, equivalent to a flight with a long layover or a flight with two short stops. Participants were not informed about where the stop might take place in order to avoid biases in terms of possible earlier experiences made at intermediate airports (e.g. delays, baggage loss, negative reputation). For similar reasons also the choice of airline wasn't displayed. Finally each flight was environmentally rated with an eco-label using a three color scheme, green standing for the environmentally most desirable option, yellow for an average flight and red for a flight that should be avoided.

TABLE 7 Attributes and attribute levels for discrete choice experiment

Attribute	Attribute level
Ticket price	$205
	$225
	$245
Total time	5hr 20min
	6hr 35min
	7hr 50min
Eco-label	Green
	Yellow
	Red

To keep environmental ratings realistic I had utilized results from the third article of this dissertation, where I had undertaken carbon dioxide emissions calcu-

lations for flights on the Los Angeles to New York route. Those results had unrevealed that all in the experiment presented combinations were possible to occur also in reality. It was possible that flight options labelled green, yellow and red could occur among the entire price range as well as range of duration, meaning that even non-stop flights could be labelled red and flights with two stops be labelled green. Participants were put into two treatment groups, half of the participants received only brief information on the eco-label, telling them what the different colors stand for while the other half were presented with some more detailed information. The second group received information on what the eco-label stands for, how the eco-label concretely works and that compared to other eco-labels green options are not necessarily more expensive. Participants in this group were also presented with a graph (see figure 4) comparing four flight options on the LAX to JFK route showing tremendous differences, where the least efficient flight producing twice as much carbon dioxide per passenger than the most efficient, showing the significance in terms of environmental impacts their flight choice can make. The numbers in the graph were based on my calculations I did for the third article of this dissertation.

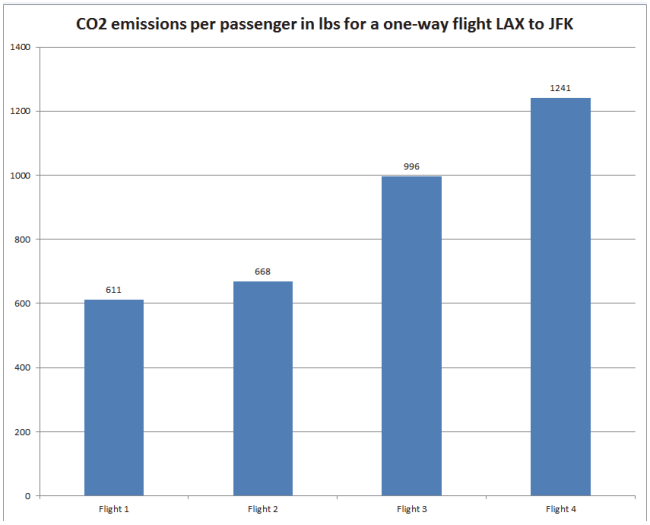


FIGURE 4 Example provided to treatment group

Followed by the nine choice sets demographic data was collected. Finally, the participants were asked screening questions (see Table 8) in order to determine how environmentally minded they were. With exception of the fifth question all answers were recorded with a 5-point Likert scale. These five questions were asked in order to identify environmentally minded consumers. The survey questions can also be found in Appendix 4.

TABLE 8 Screening questions for environmental mindedness in article IV

Questions
How strongly would you rate the importance of the eco-label for the booking choices you made?
How frequently do you purchase organic products?
How often do you purchase voluntary carbon offsets when booking a flight?
How concerned are you about the future state of our environment?
Are you a member of an environmental organization?

Similar experiments had been conducted earlier by Hagmann et al. (2015) or Araghi et al. (2014) which studied the effect of environmental product attributes on flight booking choices in discrete choice experiment settings. Unlike those studies which had collected data from actual air passengers at airports I decided to conduct the choice experiment online, as this came closer to reality of making booking decisions when buying airplane tickets online, than a paper based survey. I recruited my participants using Amazon Mechanical Turk (MTurk). Amazon MTurk is a crowdsourcing internet marketplace that provides relatively cheap and fast access to human intelligence that can perform tasks such as answering questionnaires. Although still a rather new recruitment method, Amazon MTurk has received very positive reviews compare to traditional methods (Berinsky, Huber & Lenz, 2012), especially in terms of data quality and reliability (Buhrmester, Kwang & Gosling, 2011). Casler, Bickel and Hackett (2013) even found that Amazon MTurk can in some instances be superior compared to previous methods, for example in behavioral testing. Participants receive a small compensation for their effort which depends on the time and demand of the task. In my study each participant received a $0.50 compensation, which was a slightly above average pay based on the given task. Altogether 617 participants completed the survey from which 554 useful answers could be obtained. The main reason for removing participant's answer were that they did not reside in the United States but were from India, the two countries in which Amazon Mechanical Turk is currently available. Based on 9 choice sets I made 5,553 observations of which 4,986 were analyzed.

Altogether five hypotheses were tested (see table 9) using t-test method. Since population parameters such as mean and variance were unknown, t-test analysis was conducted on random samples with large sample size to represent the population as whole following the Central Limit Theorem (Johnson, 2004).

TABLE 9 Hypotheses tested in article IV

Hypotheses
H1 Passengers who are environmentally minded will more likely choose flight options that are green-labeled.
H2a Passengers will book green-labeled flights that cost less than average flights.
H2b Passengers will book green-labeled flights that cost more than average flights.
H3a Positive product attributes (lower ticket price and shorter flight) will enhance passengers' preference towards the green label.
H3b Negative product attributes (higher ticket price and longer flight) will reduce passengers' preference towards the green label.
H4 Passengers will mainly choose yellow-labeled flights.
H5 Additional information on the eco-label will increase passengers' likelihood of adopting the new label.

For testing the first hypothesis the likelihood of participants selecting green labelled flights was evaluated comparing environmentally minded with the remaining participants. Hereby the screening questions presented in table 8 were used in order to determine to which of the two groups participants belonged. Based on the recorded answers, scores were assigned to each participant. Participants who had scored at the top 25% were considered as environmentally minded consumers. For testing the second hypothesis the likelihood of participants selecting green labelled flights in comparison to the ticket price was evaluated. As the average ticket price in the choice sets was $225, for H2a the ticket price less than average was set at $205 and for H2b the ticket price more than average at $245. For the third hypothesis, similarly as in H2, the likelihood for participants selecting green-labelled flights was tested but in addition to ticket price also the relation to flight time was studied. Both product attributes, positive (lower ticket price and shorter flight) as well as negative (higher ticket price and longer flight), were tested together and separately. As the average flight time in the choice sets was 6 hours 35 minutes, for H3a the shorter than average flight time was set at 5 hours 20 minutes and for H3b the longer than average flight time at 7 hours 50 minutes. In terms of the fourth hypothesis, it was tested whether participants would most likely select the yellow-labelled flights over all the other colors (green and red). Finally in the fifth hypothesis it was tested whether participants who had received treatment were more likely to select green-labelled flights and more likely avoid yellow- and red-labelled flights than participants who had not received treatment. In addition to the fifth hypothesis all hypotheses were tested two-fold in order to compare results be-

tween all participants and the ones who had received treatment. A detailed overview of the different test methods is provided in table 10 below.

TABLE 10 Summary of hypothesis test methods used in article IV

Hypotheses	Basic analysis	Comparing different treatment groups
H1	One Sample t-test	One Sample t-test
H2	One Sample t-test	Two Sample t-test
H3	Two Sample t-test	Paired t-test
H4	One Sample t-test	Welch Two Sample t-test
H5	Two Sample t-test	Welch Two Sample t-test

4 REVIEWING THE CONTRIBUTION OF THE ARTICLES

In this chapter I will examine each of my four articles, review their research results, answer the individual research questions they present, highlight their contribution to this dissertation and answer the main research question of this study.

4.1 Article 1 – Are airline's pro-environmental initiatives actually visible to air passengers?

My first article sheds light on the first research question: are airline's pro-environmental initiatives actually visible to air passengers? The article describes hereby a situation where an airline has engaged in pro-environmental initiatives by going beyond compliance. The Finnish flag carrier Finnair was here used as an example and three environmental initiatives performed by Finnair were studied more in detail: modern fleet, shorter routes and carbon offset. The two objectives of the study were to find out whether Finnair performing these environmental activities would trigger a change among air passenger's behavior towards i) more favoring an environmentally friendlier carrier such as Finnair and ii) generating a willingness among air passengers to pay more for a less polluting flight. Competitive advantage was hereby seen as one possible motive or positive outcome for an airline to engage in pro-environmental initiatives, as already discussed in the literature review. For this study an online survey was conducted among Finnair's customers and 148 answers were recorded. The participants were asked about their attitudes towards these three initiatives and whether they see value in them.

The results of the study showed that **air passengers see value** in pro-environmental initiatives of airlines. All three initiatives presented to the participants were perceived as positive and valuable. The strongest agreement was found regarding the modern fleet. However, the results also showed that these

pro-environmental initiatives can only bring competitive advantage to a particular airline when the **air passengers are aware** that this airline is actually offering these benefits. As I could show in the case of Finnair, even though all these initiatives are offered by Finnair, the same participants (here Finnair customers) who saw value in these initiatives did not necessarily see Finnair as an airline which has a leading role when it comes to environmental responsibility. Airlines going beyond compliance must therefore find **better ways to communicate** their environmental efforts as they otherwise won't gain any competitive advantage from pro-environmental behavior.

Further results showed that although these environmental initiatives are appealing to air passengers and they see value in them, the **price sensitivity** among air passengers is still high. Even if airlines go beyond compliance, they will face difficulties finding willingness among air passengers to pay an environmental premium for their products. For two-thirds of the participants, ticket price was the most important criterion when booking a flight. Beside this price-consciousness, the results also detected that seeing value in an initiatives does not necessarily lead to a **willingness to pay** for it. This attitude was revealed by the example of carbon offset. Those participants who considered carbon offset as positive for the environment were not the same ones who had also paid for carbon offset earlier.

Thirdly, the study found that there is a small but considerable share of air passengers who **consider the environment** when booking a flight. For those airlines which show more commitment to environmental responsibility, this share should not be underestimated. Airlines should work to identify this specific customer segment, so it could be served with a unique product based on the customer's environmental needs using a product differentiation strategy. When airlines make the additional value and the input to their value chain better visible to these customers, more willingness to pay a premium may emerge. For the remaining air passengers who do not prioritize or even consider the environment when booking a flight, environmental product differentiation could still work as a selling point. For these customers, ticket price may remain the major selling point and aspects such as a modern fleet might stand more for safety and direct flights more for convenience, but these pro-environmental initiatives could still **add some value** to these customers.

4.2 Article 2 – How should and airline eco-label been developed to function as a driver for behavioral change?

My second article set out to explore the potential idea of an eco-label for the airline industry, which so far hasn't received much attention. It answers the second research question: how should an airline eco-label been developed to function as a driver for behavioral change? To gain a deeper understanding, 12

interviews with airline industry experts were conducted and the results were thematically analyzed.

The article revealed a **clear need** for an eco-label in the airline industry due to the fact that air passengers are currently unable to compare flights environmentally. It is basically impossible for an air passenger to obtain all the relevant information in order to make an informed decision as acquiring this kind of information would require expert knowledge. An eco-label instead would compile and present all information at the time of booking without compromising freedom of choice. It would support air passengers in selecting flights with fewer environmental impacts if they want to. An eco-label would lower search costs and transform the environment, currently a credence attribute, into a real search attribute.

Making the environmental performances visible could help **build more awareness**. It was found that air passengers currently still lack of environmental awareness and that their focus is more on ticket price. However, it was also found that the percentage of air passengers who are concerned with environmental issues is growing. The reason for low environmental awareness was seen in the lack of credible information. An eco-label could here help build more awareness by making the environmental performance of flights visible:

> "It might be that you favor only the fastest flight […] it might be that you favor the cheapest flight, but it can also be that you want to compare […] how strongly it is polluting […]. So again therefore I think it is so relevant that there is this standard." Managing director, global transaction processor (February 27, 2013)

This awareness could turn into environmental concern and lead to behavioral change among air passengers in the long term.

Making environmental performance visible would also **stimulate more competition** in this area between airlines. It was clearly identified that some airlines demonstrate better environmental performance than others. An eco-label could create competitive advantage to those airlines showing the best performance by giving them the chance to communicate this advantage with clear evidence. At the same time it could also motivate remaining airlines to improve their environmental performance in order to stay in the market. This approach could make the entire airline industry more sustainable and reduce the possible risk of regulatory restrictions. At the moment it is easy for an airline to compete on price because everyone can compare it, but comparing the environmental performance of airlines is currently impossible. It is therefore not surprising that the amount of environmental competition has been low, with airlines choosing rather to cooperate in this field. It must be difficult for an airline to differentiate itself if the environmental performance of all airlines is perceived as being more or less the same. Standing out from the grey mass could easily be considered to be greenwashing. These challenges mean that there is basically no point in competing as long as there is no parameter indicating the differences in environmental performance from one airline to the next.

In order to make flights comparable the airline eco-label needs to cover **all commercial passenger flights worldwide**. However, it is also important that

there is **only one airline eco-label**, otherwise air passengers cannot compare 'apples with apples'. With multiple labels, the idea of making the airline industry more sustainable through eco-labels would fail:

> "…if we don't have [a] common approach, we lose a lot of credibility and it takes ages to regain that credibility." Group environmental office, global transaction processor (April 24, 2013)

Due to the differences in aircraft types, load factors, and the routing on each flight connection, the environmental performance of airlines differs. Therefore an eco-label should not be granted to individual airlines but should instead be **flight specific**. This approach to the label also has the advantage that changes to a flight connection, such as the use of a more fuel-efficient aircraft, can be immediately taken into account. In order to ensure comparability, all flights need to be **displayed equally** so that air passengers can consider all parameters: airline, price, amount of stopovers, journey duration as well as environmental performance. Although an eco-label integrated in the booking process provides sufficient information for decision making, there would still be a need to **integrate additional information into the label**. This would ensure trustworthiness and avoid suspicion of greenwashing. To make the label fully transparent, the methodology behind it, with all parameters taken into account and their sources, should be made accessible. To make flights comparable and ensure effectiveness, the eco-label should be easy to understand. Therefore the use of **energy labels**, with their self-explanatory color scheme, was recommended:

> "I think it is good […] this format of having those green A's and red E's […] it is easy to understand and easy to see which options are good [and] which options are not so good..." Communication manager, international business travel agency (December 4, 2012)

Using widely known energy labels also has the advantage that consumers who already use them for other purchases might adapt more quickly. However, because of the use of negative labels this scheme **cannot be voluntarily**. Otherwise, airlines with poorer environmental performance would refuse to participate. The advantage of using negative labels is that once environmental awareness through an eco-label is built, air passengers might start to avoid these flights, putting pressure on airlines with poorer environmental performance to act. In order to ensure credibility and trustworthiness, it was further found that the eco-label should be **released by an independent authority**. Trying to develop the standards for an eco-label within the industry was seen as controversial:

> "So, I indeed don't see this [environmental] rating possible as an initiative that could be agreed inside the industry. It would need to come [from] outside the industry and need to be […] built up without full [industry] consensus." Environmental manager, air traffic and airport authority (June 29, 2012)

Due to the tough competition between airlines, it would be impossible to find industry agreement, just as the example of the failure to come up with a common approach for an emissions calculator demonstrated. The label needs to

come from an independent party in order to ensure trustworthiness and to avoid the suspicion of greenwashing. ICAO, as a United Nations specialized agency, was seen as the best solution due to its independent position:

> "…basically ICAO is the only organization who can [bring this up] internationally…" CEO, regional airline (November 23, 2012)

4.3 Article 3 – Are there differences in the environmental performance of individual flights?

The third article studied the differences of the environmental performance of individual flights which is the basic principle for the use of an eco-label. It answers the third research question: Are there differences in the environmental performance of individual flights? The use of an eco-label in the airline industry only makes sense when the environmental performance of individual flights really differs. To provide evidence for the differences, carbon dioxide emissions calculations comparing 118 individual flights between three city pairs based on actual data had been conducted. The article further examined whether currently existing (post eco-label) and most common environmental measures such as flying on modern, fuel-efficient aircraft and flying non-stop are really effective in mitigating the environmental impacts of air passengers.

The study found that there are clear **differences between flights**, because the carbon emissions per passenger can vary tremendously. It found that sometimes just choosing one flight over another, while both having similar departure and arrival times or ticket prices, can make a real difference in terms of an air passenger's individual carbon footprint. Figure 5 showing the carbon dioxide emissions of all 118 flights illustrates these immense differences quite clearly. In the case of a short-haul route like Los Angeles to San Francisco, emissions can range from 71 kg of CO_2 per passenger for a direct flight up to more than five times or 374 kg for a connecting flight via Dallas/Fort Worth. On a transcontinental route like Los Angeles to New York JFK, emissions can range from 277 kg on a direct flight up to 659 kg on a connecting flight via San Francisco. In the case of an intercontinental flight like Los Angeles to London Heathrow, emissions can range from 594 kg for a non-stop flight up to 1,207 kg of CO_2 with a transfer through Istanbul. The differences can actually be so large that for example a transcontinental flight from Los Angeles to New York can exceed the per passenger emissions of an intercontinental flight from Los Angeles to London which is remarkable because the distance between those two cities is more than twice as long. When these figures are brought into perspective with the target of the 2015's Paris Climate Change Conference of capping **global warming at 2 degrees** Celsius above pre-industrial levels, the differences in emissions become even more significant. According to the German Advisory Council on Global Change (2009), to achieve this climate target, each human

would only be allowed an annual climate budget of 2,300 kg CO_2. Nevertheless, only one-fourth (575 kg CO_2) could be spent on mobility.

Due to the lack of information, as discussed in the literature review, it is currently difficult for air passengers to make informed choices. As the article unrevealed, to date, air passengers who want to mitigate their environmental impact of flying have to rely on some vague environmental measures, such as using modern and fuel efficient aircrafts or flying non-stop. However, the results also suggested that these measures do **not always correctly indicate** the true environmental impact of individual flights.

Although the results proved that in principle flying on a modern and more fuel-efficient aircraft or flying from a point A to a point B using the shortest distance and avoiding additional landing and take-off cycles, can reduce environmental impacts tremendously, these gains in efficiency might easily be **overridden by factors** airlines certainly can control for. Such factors are for example low passenger load factors, low passenger-to-freight factors or aircrafts equipped with seat layouts that accommodate far less passengers than the aircraft was originally designed for. Here once again the pressing need for an eco-label taking those additional factors into account becomes obvious as choosing to fly on a modern and fuel-efficient aircraft or avoiding stop-overs not always necessarily lead to the anticipated least environmental impact.

Finally, the article also showed that there are currently no carbon calculators available that allow air passengers to compare individual flight options. The current calculators rely too heavily on average data in terms of fuel burn, load factors, passenger-to-freight factors and seat layouts. The results clearly indicated that only when **calculating with real data** can the differences in the environmental performance of flights be made visible. This clearly shows the limitation of existing carbon calculators as tools for air passengers to make informed choices about which flight to choose.

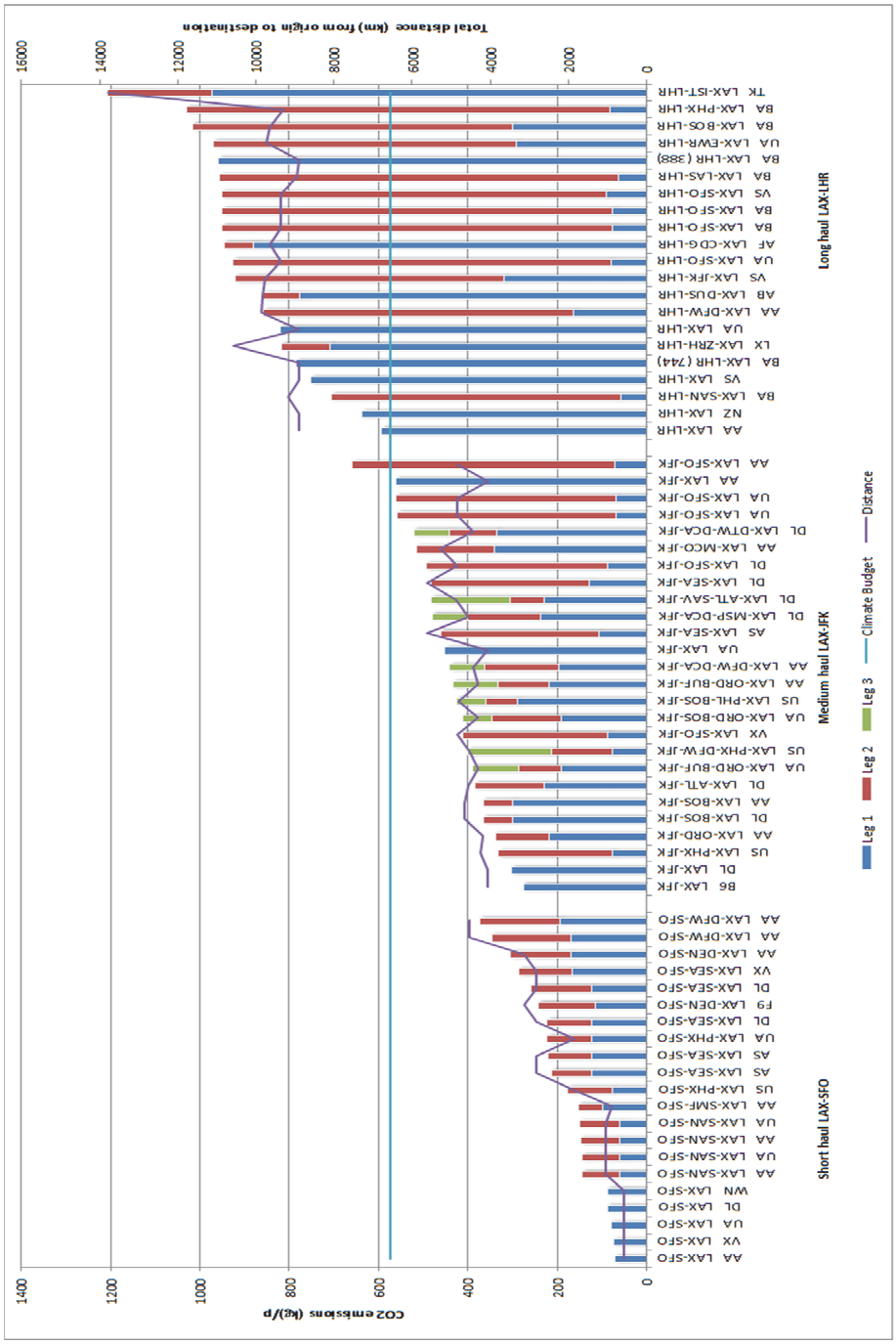


FIGURE 5 CO_2 emissions (kg)/passenger of selected flights in three geographical markets

4.4 Article 4 – Would an airline eco-label affect the booking decisions of air passengers?

My fourth article finally investigated the effect an eco-label has on the booking decision of air passengers and whether it could function as a driver for behavioral change. It answers the fourth research question: Would an airline eco-label affect the booking decisions of air passengers? For this purpose I have conducted a stated choice experiment in which 554 air passengers had taken part.

The study could clearly provide empirical evidence that airline eco-labels do **affect the booking decision** of air passengers and that by providing sufficient information on the eco-label this certainly lead to a change in behavior. Further five hypotheses were tested, the first focusing on the question whether only environmentally minded consumers would be affected by the airline eco-label. As choosing a less polluting flight doesn't bring any immediate benefits to consumer, it was assumed that the airline eco-label might only be attractive to those who are concerned about the environment. The study actually found that **environmentally minded consumers** would adapt to the new eco-label immediately and even without receiving much information what the airline eco-label stands for. This is probably also due to their past experience with eco-labels which not only creates trust but speeds also up the adoption process. Nevertheless, surprising was that also the remaining consumers showed a high rate of adaption, once they had been provided with additional information. Additional information was hereby provided in form of a short description of what the eco-label stands for and how much the environmental impacts of individual flights can differ. Therefore, it is of paramount importance to provide this additional information, in order to reach all consumers with the eco-label, not only the environmentally minded ones.

Eco-labels are often brought in context with price premiums which producers normally justify with additional production cost for the higher environmental quality. However, in terms of air transportation reduced environmental impacts normally achieved through efficiency gains mean usually also costs saved. Therefore a less polluting flight should be cheaper. Although a higher ticket price wouldn't necessarily reflect on the environmental friendliness of a flight, airlines could create additional value to their customers by offering greener flight options for which they could charge a premium price, utilizing the eco-label as an instrument to communicate this additional value. Nevertheless, as the results showed an eco-label alone won't trigger willingness, unless consumers are provided with additional information on the eco-label. Therefore, in order to generate a **willingness to pay** and to achieve an eco-premium for green-labeled flights, providing additional information would also in this case inevitable.

The third hypothesis focused on the interaction of the airline eco-label with other product attributes such as price and flight time. The results clearly showed that ticket price had a much stronger **interaction** with the likelihood of

consumers choosing green-labeled flights than the flight time. This information is especially useful for airlines, which in the future might consider to also trim their offerings according to the eco-label, providing them with the knowledge that consumers are more focused on the cross-section of eco-label and ticket price than the schedule or flight time. While consumer might interpret higher ticket prices in relation to green-labeled flights as a sign of additional value, flight times didn't show much interaction with the purchase decision of participants in the study.

The fourth hypothesis studied air passenger's booking decision in relation to the color scheme used in the eco-label which was presented to them in the form of a 'type I-like' energy label. The eco-label certainly made consumers avoid red-labeled flights, which as such sends a strong signal to airlines operating those. As this outcome was kind of expected, there had also been the assumption that consumers might as an alternative choose more the (neutral) **yellow label**, while the green-labeled flights might more remain as a kind of premium choice. Although the amount of different eco-labels had been equally distributed among the flight choices given in the discrete choice exercise, the majority of flight choices had been to the favor of green-labeled flights. Also here providing additional information had led to behavioral change towards green-labeled flights. Therefore, for airlines to remain competitive, it is not only enough to satisfy the requirements to obtain the yellow label but rather to strive for the green label as this certainly is the most preferred choice of the consumer.

The fifth hypothesis, claiming that additional information on the eco-label will increase the likelihood of adoption, could be fully supported. Providing additional information had turned out to be crucial for the eco-label's success, as already discussed above. This is probably due to the fact that eco-labels haven't been used in the aviation industry so far and might in some cases even irritate consumers, as they are not expected to find them on a flight-booking site. However, communicating the environmental concern such an eco-label answers certainly works as our results showed and lead to a change in behavior among consumers. **Providing additional information** on the eco-label might especially be crucial during the implementation phase while the eco-label is still new to the consumer. Therefore, if the aviation industry decides to roll out an eco-label its success certainly will depend on the provision of additional information to the air passenger.

4.5 Synthesis of the results

The overall aim of this dissertation was to study whether an eco-label in the airline industry could lead to behavioral change among air passengers with the overall goal of mitigating environmental impacts of air transportation. The first article describes hereby a situation where an airline has engaged in pro-environmental initiatives that are meant to reduce the environmental impact of their services. The study's aim was hereby to find out whether this kind of initi-

atives creates value for the air passenger leading to behavioral change among them. Further it was tested whether this kind of initiatives would generate a willingness to pay a higher airfare among air passengers. Both, air passengers more favoring an airline for its environmental performance, which means an increase in market share, and the willingness to pay more for this aspect would create competitive advantage for an airline. However, while the study found that some air passengers see value in these particular initiatives they didn't necessarily bring this in connection with any particular airline. Also the willingness to pay any extra for these initiatives was rather low. Finally it was also found difficult for an airline to communicate these kinds of initiatives both to the small but considerable share of air passengers that, as the study found consider the environment when booking a flight, and the remaining market. In conclusion, this article clearly showed that there is indeed a need for an instrument that could help airlines to i) better communicate their environmental initiatives ii) help them to show the additional value that arises from these initiatives and iii) reach those air passengers who are considering the environment during flight booking as well as the remaining market.

While the first article described a gap the second article tried to explore whether this gap could be filled by introducing a new instrument to the airline industry in form of an eco-label. As this idea hadn't receive much attention so far, I set first out to discuss it with experts working within the industry in order to receive approval for this idea, building the fundament for further investigations. The industry expert certainly approved the proposed idea of using an eco-label in the airline industry as they could clearly detect a need for an eco-label within the industry, because it is currently not possible for air passengers to compare individual flights from an environmental standpoint, making it difficult for them to change behavior. Further, an eco-label was also seen as the ideal instrument in order to increase awareness among air passengers in order to take the environment into account when booking a flight and leading to a change in behavior. Finally, it was also stated that an eco-label could lead to more competition between airlines regarding their environmental performance, motivating them to engage in more pro-environmental initiatives in order to keep up with the competitors. In addition to the industry approval the experts provided also many valuable in-sights on how an airline eco-label scheme should be developed and introduced in order to lead to behavioral change: the scheme should cover all commercial flights worldwide, there should only be one eco-label, it should be flight specific and displayed equally to other parameters, additional information should be provided, it should be an energy label which means it cannot be voluntarily and finally it should be introduced by an independent authority.

Although the idea of using an eco-label was approved by the industry, still the question remained open, whether individual flights really differ that much in terms of their environmental performance? Are the differences so significant that classifying them with an energy label scheme would really be feasible and would air passengers' changing behavior really have such a huge im-

pact? Even though, as described in the second article, industry experts had claimed that there are significant differences, existing literature didn't really provide any clear evidence. Therefore the third paper set out to proof this point. Comparing the carbon emissions of individual flights in three geographical markets could certainly provide empirical evidence that the environmental performance of individual flights differs tremendously and that the introduction of an eco-label would be sensible. Those differences became even more relevant when they were put in relation to the anticipated 2 degree climate target. In addition to that, the article could further justify the need for an eco-label, as it also unrevealed that currently existing measures that air passengers might take into account, as a form of behavioral change, such as selecting flights operated by modern and fuel efficient aircraft or flying non-stop, not always lead to the lowest carbon emissions. Also currently available carbon calculators do not necessarily provide air passengers with the information they might need to make informed choices.

Finally the fourth paper set out to test whether an airline eco-label could really lead to behavioral change among air passengers, as predicted by the industry experts in the second paper. The stated choice experiment was able to provide empirical evidence that an airline eco-label does affect the booking decision of air passengers and therefore lead to behavioral change. It was hereby also found that an eco-label would not only make those change behavior who are environmentally minded and who do perhaps already take environmental aspects into account when selecting a flight, but can also lead to a change in behavior among the remaining consumers. Also the lack of willingness to pay for a flight that is less polluting, as discussed in the first article, could be overcome by an eco-label as the stated choice experiment could clearly show. The focus on price, as already detected in the first article, was also confirmed by the fourth study. However, the presence of a green label had led to behavioral change among air passengers as it generated a willingness to pay more for a 'greener' flight. The idea of using an energy label, as discussed in the second article, leading air passengers to avoid red-labeled flights was confirmed as operational. The green label had actually so strongly influenced participants in the stated choice experiment that it made them change behavior in a way that they not only avoided red but also yellow-labeled flights. Nevertheless, the fourth article also found that providing additional information, such as discussed by the industry experts in the second paper, had changed air passenger's behavior towards the selection of green-labeled flights significantly.

5 CONCLUDING REMARKS

5.1 Scientific implications

In this chapter I will present the scientific implications of my research. I will hereby present six broader topics related to the introduction and use of eco-labels in the airline industry where this study was able to fill gaps in current literature. Besides that I will also show where my research was able to confirm previous findings and where it contradicts.

5.1.1 Why eco-labels? – An air passenger's perspective

The first topic in terms of scientific implications that I would like to address is, why there is a need for eco-labels from an air passenger's perspective? Previous literature on air passengers mitigating environmental impacts of flying through behavioral change mainly focused on carbon offset (Gössling et al., 2009; Mair 2011; van Birgelen et al., 2011) or discussed changes in behavior such as using alternative transportation modes or avoiding holidays overseas (Davidson et al., 2014; Higham & Cohen, 2011; Sgouridis et al., 2011) but only a few studies have looked into air passengers actively selecting less polluting flights (Mayer et al., 2012; Wittmer & Wegelin, 2012). My study adds to the limited amount of literature, studying this issue more in-depth, by presenting a possible instrument that could help air passengers to better select the right flight choices. According to Morris (1997) eco-labels can create more environmental awareness among consumers and encourage them to change behavior. My industry expert interviews revealed that due to the lack of credible information the environmental awareness among air travelers is still low, but that an eco-label could help to overcome this. This finding on low awareness confirms also earlier findings (Becken, 2007; Cohen & Higham, 2011; Gössling & Peeters, 2007; Hares et al., 2010). Hagmann et al. (2015) see the problem in a lack of suitable measures for air passengers to identify green flight options. Cowper-Smith and de Grosbois (2011) actually called for the introduction of a standardized framework that

would allow air passengers to compare the environmental actions taken by airlines. The here proposed eco-label could close this gap compiling airline's environmental actions and making them comparable. Both Cohen and Higham (2011) and Hares et al. (2010) see a clear need for more publically available information on environmental impacts of air travel in order to lead consumers to change behavior and meeting climate targets. My study was able to show that selecting one flight over another, both operated on the same schedule, can make a significant difference in terms of meeting climate targets such as the 2 degree Celsius target anticipated by the 2015's Paris Climate Change Conference. Nevertheless, Gössling et al. (2009) found that it would currently require expert knowledge in order to really compare individual flights or airlines according to their environmental performance. My findings support this view as the aviation industry experts I interviewed were making the same claim. Further I could also show that the complexity of acquiring actual data and undertaking carbon emissions calculations in order to be able to measure the real carbon footprint of one's individual flight had really proven the need of expert knowledge. While an eco-label could help overcome this problem the question remains whether air passengers would respond to such a label? In terms of air passenger's respond to environmental issues Hagmann et al. (2015) found that environmental attributes had played a role in air passenger's booking decision. I could provide even more support to this finding as I was able to show with my choice experiment that environmental attributes compiled in form of an eco-label had actually strongly influenced the booking decision of air passengers. Further, my finding also supports a similar choice experiment conducted by Araghi et al. (2014) where the effect of an airline eco-efficiency index had shown strong influence on participant's airline choice. Regarding the broader discussion whether eco-labels could lead to behavioral change, my study confirms findings of previous studies (e.g. Brécard et al., 2009; Delmas & Lessem, 2015; Loureiro & Lotade, 2005; Noblet et al., 2006; Sammer & Wüstenhagen, 2006; Teisl et al., 2002) while on the other hand also contradicts numerous studies (e.g. Leire & Thidell, 2005; Rahbar & Wahid, 2011; van Amstel et al., 2008; Young et al. 2010) that have questioned this thesis.

5.1.2 Willingness to pay for less polluting flights

While previous literature has very scarcely discussed air passenger's response to airline's environmental offerings, more research has been done on air passenger's willingness to pay for less polluting flights. Carbon offsets have hereby been mainly utilized as an indicator for the willingness to pay. Previous findings (Hagmann et al., 2015; Wittmer & Wegelin, 2012) on air passenger's willingness to pay for carbon offset had rather led to the impression that there isn't much interest to mitigate environmental impacts of air transportation. Although van Birgelen et al. (2011) and Brouwer et al. (2008) could detect a lot of interest among air passengers to offset their carbon emissions, still the actual amount of donations remained quite low (Hagmann et al., 2015; Wittmer & Wegelin, 2012). My study confirms previous findings that many air passengers

were interested in carbon offsets but only a few had actually paid for it. In addition to that, I was able to reveal that those air passengers who saw value in carbon offset were not identical with the ones that had actually offset their carbon emissions in the past. Further, in terms of carbon offsets one of the major drawbacks is seen in the credibility of calculation methods (Araghi et al., 2014). Current carbon calculators rely too much on average data and won't therefore allow to allocate CO_2 emissions to individual flights. By using actual data I was able to make the carbon dioxide emissions of individual flights comparable and to show the significant differences which further underlined the importance of my calculation method. Despite the fact that previous studies on carbon offsets couldn't find much willingness to pay among air passengers, Hagmann et al. (2015) could detect a willingness to pay for less polluting flights and Kelly et al. (2007) was even able to show that air passengers do accept additional environmental fees to their flight ticket. I was able to confirm this finding and could show that less polluting flights, indicated by an eco-label, had actually triggered a willingness to pay among air passengers. Nevertheless, D'Souza et al. (2007) also found that if the price of an eco-labeled product is higher, consumers might do trade-offs, selecting products that do not carry the label. Also this was confirmed by my own findings where air passengers had been selecting green-labelled flight when they were cheaper but not when they were priced high. However, once additional information had been provided, air passengers had also chosen green labelled flights even though they had been more expensive. Further D'Souza et al. (2007) also found that consumers might make trade-offs among other attributes if the product price is high but they want to purchase the eco-labelled product. This conforms to my findings, as well. Air passengers in my study had actually made trade-offs in form of longer flight times.

5.1.3 Airline eco-label target group

Speaking about air passenger's response and willingness to pay for eco-labelled flights the question arises whether the eco-label affects all air passengers equally or only a particular segment? First of all my study found that the percentage of air passengers who are concerned with environmental issues is growing. This finding complements earlier research (Davidson et al., 2014; Gössling et al., 2009; Lu & Shon, 2012). Further, Gössling et al. (2009) found that interest among air passengers to integrate environmental information into their booking decision if those would become available. I was able to support this finding as I could show with my choice experiment that air passengers had taken this environmental information into account while booking flights. Lynes and Dredge (2006) discussed further the idea of airlines engaging in voluntary environmental initiatives in order to respond to the increasing concern among the public. This could create a demand for less polluting flights which so far hasn't existed. With my results I could, as well, show that an eco-label could actually create such a demand for greener flights simply by making the environmental performance of flight visible. Nevertheless, previous studies saw that environmental concerns of flying are more limited to a certain segment. Mayer et al. (2012)

for example stated that airlines should not exclusively focus on the green segment as this segment is still quite small. My findings could complement their views as I was able to detect in my first article a small segment of air passengers that consider the environment when booking a flight, certainly too small to be catered by an airline exclusively. The environmental friendliness of airlines, in the eyes of the majority of air passengers, can more be seen as an add-on than a major sales argument, a finding that I share with Mayer et al. (2012). In terms of consumer response Bratt et al. (2011) found that the environmentally minded consumers are more likely to respond to new eco-labels. This finding was also confirmed by my study where environmentally minded air passengers had immediately adopted the eco-label even without knowing much about its content. One of the reason was probably the previous experience those participants had made with eco-labels. This supports findings by Thøgersen et al. (2010) who proofed that past experience with eco-label had significantly speed up the adoption to new eco-labels. Nevertheless, a key finding of my study was that by providing adequate information on the eco-label it not only attracted the environmentally minded but also large shares of the remaining passengers to adopt the new eco-label.

5.1.4 Prerequisites for an airline eco-label

Next, I would like to discuss prerequisites for the successful introduction of an eco-label in the airline industry. So far existing literature hasn't discussed the idea of using an eco-label in the aviation industry in-depth which is why I will reflect my findings against literature on the successful introduction of eco-labels in general. Essential for the introduction of an eco-label into a new industry is to first study whether there is a clear need for such a label (Anderson et al., 2013; Gallastegui, 2002). My research has clearly identified a need for an eco-label in the airline industry. My findings are in line with earlier research stating that more information needs to be made publically available on the environmental performance of airlines (Cohen & Higham, 2011; Hares et al., 2010; Miyoshi & Mason, 2009). Further Gössling and Buckley (2016) see a clear need for enabling air travellers to be able to compare individual flights with the help of eco-labels. Additionally, my results showed that there should be only one globally recognized airline eco-label, otherwise air passengers would not be able to compare 'apples with apples'. This consists with previous findings (Bratt et al., 2011; Buckley, 2002; Gallastegui, 2002) that using more than one eco-label in a specific market can lead to confusion or ignorance by the consumer. In addition to that my study found that the eco-label should be flight specific in order to take differences of aircraft types, load factors and routings into account. This finding is in line with Gössling and Buckley (2016) who as well see it inevitable that an aviation eco-label is flight specific and not granted to airlines as such. Next, following the examples of previously developed eco-labels in the airline industry as well as based on the recommendations given by the industry experts, the eco-label should come in form of an energy label. An energy label is not only easy to understand but bears also the advantage of not only labelling flights

positively but also negatively. Using negative labels would certainly make air passengers avoid these flights as I was able to show through my results. This finding also compliments earlier studies by Grankvist et al. (2004). However, because of the use of negative labels the scheme cannot be voluntarily as otherwise airlines with a bad environmental record would refuse to participate. On top of that, in order to make the label fully transparent, the methodology behind it, with all parameters taken into account and their sources, should be made accessible. Therefore additional information on the eco-label needs to be provided. The effect of providing additional information leading to an increase in adoption of the new eco-label, which I could show with my results, further underlines the importance of making the methodology of the eco-label fully transparent. Fairweather et al. (2005) found that the success of an eco-label depends on the level of understanding and awareness consumers have on the product or service certified. Further Thøgersen et al. (2010) found that whether consumer buy an eco-labelled product depends on their issue-relevant knowledge. My study could clearly support these views as it found that non-environmentally minded participants had equally fast adapted to the new eco-label than environmentally minded participants once they had received treatment in form of additional information on the eco-label. Similarly my study also found that providing additional information on the eco-label increased willingness to pay for green-labelled flights and made air passengers avoid yellow- and red-labelled flights. Finally, in order to ensure credibility and trustworthiness, it was further found that the eco-label should be released by an independent authority. ICAO, as a United Nations specialized agency, was seen as the best solution due to its independent position.

5.1.5 Why eco-labels? – An airline's perspective

As I already discussed above the question why there is a need for an eco-label from an air passenger's perspective, I also would like to address this topic from an airline's perspective. One of the starting points of this study was the possible risk that regulation might restrict air transportation's further growth, if the industry fails to manage its emissions (Gössling et al., 2007). My research found that using eco-labels could help to get the aviation industry on a sustainable growth path through behavioral change. While Cowper-Smith and de Grosbois (2011) discussed the reduction of emissions through technological changes, such as employing newer and more fuel-efficient aircraft, I was able to show that behavioral changes can in some instances even be more efficient in reducing CO_2 emissions. This finding also supports Davison et al. (2014) and Gössling et al. (2007) who identified behavioral change as the measure with the greatest potential to tackle down aviation's impacts on climate change. Nevertheless, while this study was able to show that there is a great potential for airlines to reduce their environmental impacts through pro-environmental initiatives, still the problem remains that it is difficult for an airline to differentiate itself as the environmental performance of all airlines is perceived as being more or less the same. My findings are in line with Mayer et al. (2012) who stat-

ed that pro-environmental initiatives of airlines are less visible. My research was able to show that visible aspects such as whether the airline operates modern aircrafts or offers non-stop flights hadn't proven as relevant as more hidden aspects like the passenger load factors, passenger-to-freight factors or seat layouts. These hidden aspects hadn't been discussed so far in previous literature (e.g. Cowper-Smith and de Grosbois, 2011) as effective ways for airlines to address environmental impacts. However, my results also showed that standing out from the grey mass, an airlines environmental efforts would easily be perceived as greenwashing. Lynes and Dredge (2006) criticized that it is currently difficult for airlines to communicate their environmental efforts. My study was able to proof that the here proposed eco-label could help to overcome this challenge. Further, while Miyoshi and Mason (2009) indicated that there is a difference between the environmental performances of individual airlines, my paper was able to prove that there is actually also a difference between the environmental performances of individual flights. This I was able to show by refining current carbon calculation methods and through the use of actual data. This certainly matters as the emissions of individual flights operated on the exact same route by the exact same aircraft can vary tremendously. As the basic idea of an eco-label is to help consumers to distinguish products that are environmentally less harmful from the remaining ones (Grankvist et al., 2004) it was important to proof that the environmental performance of individual flights differ. Only if there is a difference between individual flights the use of an eco-label in the airline industry is justifiable.

5.1.6 Competitive advantage for airline's environmental differentiation

Finally, another topic that hasn't received adequate attention in current literature is the question how airlines can gain competitive advantage based on environmental differentiation. Although earlier research by Hagmann et al. (2015) found that there is a great potential for airlines to gain competitive advantage through environmental differentiation, my research couldn't fully support this finding as engaging in pro-environmental initiatives alone, as described with the example of Finnair, didn't lead to competitive advantage. In order to gain competitive advantage airlines need to find a way to communicate their additional efforts. I was able to show that airlines that engage in pro-environmental initiatives can gain competitive advantage in form of a price premium when these changes are made visible through an eco-label. An eco-label could create competitive advantage for those airlines showing the best performance by giving them the chance to communicate this advantage with clear evidence. Eco-labels can also be seen as a benchmark for environmental improvements (Bratt et al., 2011). Miyoshi and Mason (2009) saw in this regard a great potential for more competition between airlines once individual environmental performance would become available. My results concretely showed that making individual flights, with an eco-label, environmentally comparable would stimulate more competition between airlines. Further I found that an eco-label would push lower performing airlines to improve their environmental performance as they

otherwise would drop out of the market. This confirms earlier findings (Anderson et al., 2013; Berghoef & Dodds, 2013; Buckley, 2002; Grankvist et al., 2004; Thøgersen, 2002), that one of the gains of eco-labels is that they drive out the worst performing producers from the market.

5.2 Practical implications for the airline industry

In this chapter I am going to present practical implications of my study. Based on the here presented findings a clear recommendation can be given to the airline industry to introduce an eco-label. As discussed in the beginning the aviation industry needs to manage its environmental impacts as it might otherwise face restrictions in the future (Gössling et al., 2007). This study was able to show that the aviation industry could indeed mitigate environmental impacts through an eco-label that would lead to behavioral change among air passengers. Labelling flights has been found significant as the environmental performances of individual flights differ tremendously. When these differences are brought in connection with anticipated climate targets their significance becomes even more obvious. At the same time it would also answer increasing concern among air passengers. As it was found, there are air passengers who consider the environment when booking a flight. Further the eco-label also bears the potential of raising environmental awareness among the remaining passengers. An airline eco-label could help air passengers to compare flights environmentally, something that currently still requires expert knowledge (Gössling et al., 2009). This would give them the freedom to not only choose flights based on ticket price, airlines, duration or amount of stopovers but also based on environmental considerations. At the same time air passenger would not need to rely anymore on outdated environmental measures such as selecting flights operated by modern and fuel-efficient aircrafts or only selecting nonstop flights which anyhow have proven wrong in many instances. That air passengers would consider the eco-label and that it would lead them to change behavior towards selecting greener flight options could clearly be proven. As using an eco-label in the airline industry would lead to behavioral change among air passengers this in turn could also push the airlines to improve their environmental performance. Airlines could no longer hide behind sustainability reports and fancy websites or articles in inflight magazines where they are claiming that they take the environment very serious, but would face a situation where their environmental performance would become comparable for all air passengers. This could lead to more competition between airlines not only based on price but also on the environmental performance. Although not all air passengers might be equally affected by this information, the findings of this study clearly showed that the eco-label would not only attract the environmentally minded passengers but also the remaining consumers. Shifting demand away from the red and yellow labelled flights together with a willingness to pay and making trade-offs in terms of flight duration, all in favor of a green-

labelled flights, certainly shows that eco-labels are able to create demand for less polluting flights. This would mean competitive advantage for those airlines performing the green labelled flights due to increasing market share and even the possibility of asking for a premium price. On the other hand it would put pressure on the airlines performing yellow and red labelled flights to either improve their environmental performance or to otherwise drop out of the market. It only requires more pro-environmental initiatives in form of adjustments such as increasing load factors, increased amount of cargo carried and especially changing the seat layout of aircrafts. Through this mechanism the airline industry could constantly improve its environmental performance as the eco-label would always reward the best performing airlines and motivate the remaining airlines to keep up. While short and mid-term improvements such as high load factors, more cargo carried and denser seat layouts with less premium class seats would become the rule in the industry, forerunners could again strive for new inventions to hunt down emissions in order to keep their leading position as the most environmentally friendly airlines.

In terms of the design of the airline eco-label it is of paramount importance to provide the air passengers with sufficient information on the eco-label. Making the methodology behind accessible and showing the passenger how much of a difference his or her booking decision can make is essential for the adoption and success of the label as my findings revealed. Information on the eco-label should especially be provided in the beginning when the eco-label is still new and air passengers unfamiliar with the label. As the results showed those passengers who had past experiences with eco-labels had quicker adopted the airline eco-label than the remaining passengers. However, once the remaining passengers had received additional information, the rate of adoption reached equal levels. In order to allow passengers to compare 'apples with apples' only one globally recognized eco-label should be used within the airline industry. Otherwise if various organizations or perhaps airlines themselves introduce different types of eco-labels the whole discussion might easily lose credibility. Different standards and ways of calculating aircraft emissions might create a situation like we face these days among carbon offsets where prices for offsets are varying immensely (Araghi et al., 2014). In addition to that eco-labels should not be granted to individual airlines but should be rather flight specific. As my results showed two flights operated by the same airline on the same route can differ tremendously in their environmental performance. Granting eco-labels to airlines would not necessarily reflect how well their individual flights perform environmentally, although it can be assumed that some airlines do in general perform better than others e.g. because they offer less premium class seats. In addition to that passengers do usually not compare airlines but individual flights when booking a trip. In order to not only labelling the best but also the worst performing flights, the use of an energy label is recommended. This recommendation follows also previous attempts that have been made within the industry to develop an eco-label (e.g. CheapTickets.nl, Flybe or Atmosfair). An energy label is easy to understand and to interpret. The universal

three color code is recognized worldwide as it is used in traffic signaling. Any human being can understand the meaning of these three colors in this particular context. The advantage of the energy label is that it makes all flights environmentally comparable and does not only show which ones are the best. By also labelling some flights negatively, the eco-label functions in two ways, promoting green flights on the one hand and penalizing the most polluting ones on the other. That this has a strong impact on the air passenger's booking decision could clearly be shown through my results. Red labelled flights had sent such a strong signal that it made air passengers avoid these flights. However, because this scheme would also penalize some of the airlines it cannot be voluntary but rather needs to be enforced. Otherwise the worst performing airlines would refuse their participation. It therefore needs an independent third party that is capable of enforcing the scheme. ICAO as a United Nations specialized agency has hereby been seen as the most suitable instance. The largest obstacle here might be seen in finding agreement among all member states to agree on such an eco-label scheme as well as on the exact parameters that will determine which flights will receive which color in the end.

5.3 Reliability and validity

In this chapter I will discuss limitations and the generalizability of my research. Regarding the limitations, certainly some limitations can be seen in the sample size and the sampling of some of the studies. Article I relies only on 148 observations and the sample was draw randomly. Due to the fact that participants were invited to participate in a survey on "airlines and environmental responsibility" answers might have been bias as perhaps a large part of the participants had already a particular interest in this topic. Also Article II was only based on 12 industry expert interviews which were selected based on recommendations given at a conference. Although a wide range of different fields and expertise were covered still there are high chances that not all relevant experts had been interviewed. Further, Article III was limited to only 3 routes and 118 flights, while previous studies have utilized many more routes and obtained several thousand observations. Finally Article IV didn't suffer in terms of sample size (N=554) but sampling was again done randomly. This was due to the nature of the study design, utilizing Amazon Mechanical Turk to recruit participants. This sampling method didn't allow me to control for who falls into the sample and therefore also didn't allow me to draw a representative sample of the U.S. population.

In addition to this some of the studies might also be geographically limited. Although the scope of the dissertation was to discuss a global airline eco-label, both Article II and IV show here certain limitations. The industry expert interviews took place in Europe and mainly in Finland with only three experts interviewed in Germany and Spain. Even though the experts were asked to provide their views from a global perspective, still the outcomes might be geo-

graphically limited. Article IV on the other hand was conducted in the United States and reflects only on the purchasing behavior of U.S. citizens. It is therefore not known if the same results would have been obtained in case the study would have been conducted in various countries or regions.

On top of that the results of the stated choice experiment might also be limited in the regard that participants might have been biased. Especially the participants in the treatment group, who received additional information on the eco-label, might have more likely chosen green-labelled flights, although they were more expensive or longer. They might have understood that the aim of the study was to exactly proof this. Also the provided payment might have influenced their decision making. Last but not least the experiment setting itself shows limitations as only three attributes had been used. While this allowed me to better control for certain attributes, it might have also biased the participant's decision making, drawing their attention too much on this limited amount of attributes. Finally Article III utilized only CO_2 emissions even though carbon dioxide is by far not the only greenhouse gas emitted by aircraft. Therefore this study might not reflect on the entire impact of aviation on climate change.

In terms of generalizability, limited sample size and random sampling methods used might have compromised the generalizability of some of the results in this study. Especially the results of Article I have to be interpreted with care. However, even though the sample size was low and the sampling random, still the conclusion can be drawn that airlines face difficulties in communicating their environmental efforts which was the starting point of the investigation of this dissertation. In Article II perhaps not all industry experts had been heard on this topic, still the question remains how to identify and access all existing experts. Instead I tried to balance the sample by interviewing industry experts working in various fields within the industry. The purpose was to achieve more diversity in views on the investigated topic in order to compensate for the limited amount of interviews and perhaps missing views of some experts. In Article III the sample size is, compared to previous studies, certainly limited. Nevertheless, the reason behind was that I had undertaken more detailed calculations than previous studies based on actual data, whose acquisition was more complex and time consuming. After all I have still made calculations in three geographical markets containing short- medium- and long-haul routes. Besides that also the routes had been carefully chosen in order to maximize the comparability of environmental performances of individual flights. Therefore, although the sample size was limited, the results certainly allowed for generalization. In the fourth study random sampling didn't allow for drawing an accurate sample of the U.S. population however, as the aim was to study air passenger's attitudes towards an eco-label in the United States, and not the attitudes of U.S. population, this issue certainly can be neglected. However, the fact that the participants received a compensation for participating in the study, which might have rather attracted participants that rely on such income, might have biased the sample to same extend. On the other hand the income distribution did not

confirm such a bias. In terms of sample size, this study certainly allowed for generalization.

Regarding the geographical limitations in Article II, even though most of the interviews took place in Finland still all the interviewees were representing globally operating organizations and hold positions that allowed them to provide qualifying answers. Therefore I assume that the opinions shared during the interviews were valid in regard to the anticipated scope of the dissertation. Concerning Article IV, as the study was limited to the U.S., there might be limitations in generalizing the results to the entire world population, especially in terms of the willingness to pay for less polluting flights. If the study would have been conducted in countries with lower incomes these results might have been different.

Although the stated choice experiment has its limitations and bears a risk of participant's bias, still it is one of the most accurate methods to simulate real life choices. Only actual observations of purchase behavior could provide exacter data but as no airline eco-label exists so far relying on a choice experiment was under current circumstances the most reliable approach. Therefore generalizing the findings from the choice experiment can be considered as valid as long as no real data is available.

Finally, even though in Article III the results of the flights analyzed don't reflect on the entire impact they cause on climate change, still the CO_2 figures provide a very good estimate on the different performances of individual flights and how much they differ. Also, as discussed earlier, while there is a high scientific understanding on the radiative forcing of CO_2 emissions, there still is a lot of uncertainty about the effects of the remaining emissions released by aircrafts as some of them might have even cooling effects.

5.4 Directions for further research

As this dissertation has reached out to discuss a completely new idea, it has naturally raised many questions in need of further investigation. Because this study detected a willingness among passengers to pay for green-labeled flights, further research could look into more concrete numbers regarding how much more passengers are willing to pay for a flight that features the green eco-label. This could help airlines to better estimate how much of a premium they can ask for flights that bear the green label. In addition to that, it was also discussed in the study that eco-labels could generate more environmental awareness among air passengers in general. Further research could investigate whether the presence of an eco-label really lead to more environmental awareness among the air passengers. Regarding the stated choice experiment that had been conducted for this study, perhaps similar studies could be launched in different countries and results compared. This would give a more holistic view on how eco-label would affect the booking decision of air passengers not only in the U.S. Besides that, also more attributes could be taken into consideration in order to make the

experiment more realistic. Further attributes could include the amount of stop-overs, the amount of available seats for a particular price, and the airline or aircraft type. Future research could further examine the interaction of the airline eco-label with these additional product attributes. In terms of the results on carbon dioxide calculations presented in this study, perhaps a follow up study could be conducted featuring more routes and flights. This might allow for more detailed analysis on the differences in the environmental performance of individual flights based on aspects that haven't been investigated such as regional differences, differences between airline business models or differences between various aircraft types. A more detailed analysis might lead to new insights that could also be relevant for the design of an airline eco-label.

Further research could also be conducted on the question whether an eco-label leads to behavioral change among airlines once such an eco-label has been implemented in the industry. Such a study could be of longitudinal nature observing the process of how airlines adapt to the eco-label and how it leads them to behavioral change. It could look into different mitigation strategies airlines might apply in order to keep up with the environmental competition that might emerge between airlines once the eco-label is in place. At the same time also the question could be investigated whether an eco-label really leads to more competition between individual carriers or whether airlines would still rather cooperate in this area, as they currently do. Together with that also the question could be raised whether using an airline eco-label would really bring competitive advantage to those airlines that perform environmentally better than the average. However, also this topic can only be investigated once an eco-label would be implemented in the airline industry.

YHTEENVETO (SUMMARY IN FINNISH)

Ilmastonmuutos on suurin haaste, minkä ihmiskunta on ikinä kohdannut, ja sen tärkein syy on epäilemättä ihmisen toiminta. Paljon huomiota tässä keskustelussa on saanut lentoliikenne. Vaikka sen vaikutus on vielä maltillinen, lentoteollisuus kasvaa nopeasti ja samalla myös sen vaikutus ilmastomuutokseen. Jotta myös tulevaisuudessa voitaisiin nauttia lentoliikenteen sosiaalisista ja taloudellisista eduista ja välttää mahdolliset lainsäädännölliset rajoitukset, lentoteollisuuden ympäristövaikutukset täytyy pitää kurissa. On olemassa useita lieventämisstrategioita, kuten teknologiset, markkinapohjaiset, operatiiviset, säätelevät sekä käyttäytymisen muutokset. Tämä väitöskirja keskittyy käyttäytymisen muutokseen. Yksi käyttäytymisen muuttamiseen tähtäävä väline on ympäristömerkki.

Tämä väitöskirja esittelee ja tutkii ideaa ympäristömerkin käyttämisestä ilmailuteollisuudessa. Väitöskirjan kaksi tavoitetta ovat 1) tutkia mitkä edellytykset ovat oleellisia ympäristömerkin käyttämiseen ilmailualalla ja 2) tutkia ympäristömerkin mahdollista vaikutusta lentomatkustajien käyttäytymisen muutokseen ja sitä kautta ilmastonmuutoksen hillitsemiseen.

Tämä väitöskirja perustuu neljään artikkeliin ja käyttää mixed-methods -menetelmää. Tutkimusaineisto koostuu kahdesta kyselystä (N=148, N=554), kahdestatoista teollisuusasiantuntijan haastattelusta sekä sekundaarilähteistä saaduista lento- ja polttoainetiedoista.

Tulokset osoittivat, että lentomatkustajien on vaikea tunnistaa vihreää lentovaihtoehtoa. Koska erot lentovaihtoehtojen ympäristövaikutuksissa kuitenkin ovat huomattavat, vihreän lennon valitsemisella olisi merkitystä. Ympäristömerkki voisi johtaa käyttäytymisen muutokseen auttamalla lentomatkustajia tunnistamaan vihreämmän lennon. Tulokset osoittivat, että ilmailuympäristömerkki on vaikuttanut lentomatkustajien varausvalintoihin ja johtanut käyttäytymisen muutokseen. Lentomatkustajien käyttäytymisen muutos vaatisi myös ilmailuteollisuutta vastaamaan omasta ympäristövaikutuksestaan, mikä saisi lentoyhtiöt kilpailemaan ympäristövaikutuksillaan.

Tulokset puoltavat selvästi ympäristömerkin käyttämistä lentoteollisuudessa. Ympäristömerkit voisivat johtaa lentomatkustajien käyttäytymisen muutokseen, mikä vähentäisi päästöjä ja ilmakuljetuksen vaikutusta ilmastonmuutokseen.

ZUSAMMENFASSUNG (SUMMARY IN GERMAN)

Der Klimawandel stellt die bislang größte Herausforderung dar, welchem sich die Menschheit jemals stellen musste und es steht außer Frage, dass menschliche Aktivitäten die Hauptursache für den Klimawandel sind. Luftverkehr, als eine Form menschlicher Aktivitäten, wird hierbei oft als einer der Hauptverursacher genannt. Wenngleich die Klimaauswirkungen zum gegebenen Zeitpunkt eher moderat ausfallen, so verzeichnet die Luftfahrtindustrie doch hohe Zuwächse, was sich auch in der Zunahme klimaschädlicher Emissionen niederschlägt. Um auch in der Zukunft von den sozialen und ökonomischen Vorzügen des Luftverkehrs profitieren zu können und um mögliche gesetzliche Einschränkungen des Luftverkehrs abzuwenden, muss die Industrie Wege finden ihre Umweltauswirkungen zu reduzieren. Es existieren hierbei fünf verschiedene Ansätze zur Reduzierung der Umweltauswirkungen: technologische Veränderungen, marktbasierende Veränderungen, operationelle Veränderungen, regulatorische Veränderungen sowie Verhaltensänderungen. Diese Arbeit befasst sich ausschließlich mit Verhaltensänderungen. Ein Instrument, das zur Erlangung von Verhaltensänderungen oft diskutiert wird, ist das Umweltkennzeichen, auch bekannt als Ökolabel.

Diese Dissertation untersucht die Einführung eines Umweltkennzeichens in der Luftfahrtindustrie. Das Ziel der Arbeit ist 1) die Voraussetzungen für die Einführung eines Umweltkennzeichens in der Luftfahrtindustrie zu prüfen und 2) die möglichen Auswirkungen eines Luftverkehrs-Ökolabels auf das Verhalten von Fluggäste, mit Hinblick auf die Reduzierung von Umweltauswirkungen, zu untersuchen.

Die Dissertation basiert auf vier wissenschaftlichen Veröffentlichungen und weißt eine gemischte Methodenanwendung auf. Es wurden hierbei Daten aus zwei Befragungen (n=148 und n=554), zwölf Experteninterviews und sowie Flugplan- und Treibstoffdaten aus sekundären Quellen verwendet.

Die Ergebnisse zeigen, dass es für Fluggäste oft schwierig ist klimaunschädlichere Flüge zu identifizieren. Jedoch wäre das von Bedeutung, da diese Dissertation klar aufzeigen konnte, dass ungemeine Unterschiede in der Klimabilanz spezifischer Flüge bestehen. Die Wahl des Fluges kann deshalb einen beträchtlichen Unterschied darstellen. Ein Luftverkehrs-Ökolabel könnte diese Unterschiede sichtbar machen und dem Fluggast helfen klimaunschädlichere Flüge leichter zu erkennen. Die Ergebnisse zeigen auch, dass das Vorhandensein eines Umweltkennzeichens das Buchungsverhalten von Fluggästen positiv beeinflusst und zu Verhaltensänderungen führte. Veränderungen im Buchungsverhalten von Fluggästen würden auch zu mehr Wettbewerb bei den Airlines führen und Anreize für eine bessere Klimabilanz schaffen.

Basierend auf den Ergebnissen dieser Dissertation, kann eine klare Empfehlung zur Einführung eines Luftverkehrs-Ökolabels erteilt werden. Eine solche Kennzeichnung würde zu Verhaltensänderungen auf Seiten der Fluggäste führen, was sich wiederum in der Reduzierung der Umweltauswirkungen des Luftverkehrs sichtbar machen würde.

REFERENCES

Adler, N. & Gellman, A. 2012. Strategies for managing risk in a changing aviation environment. Journal of Air Transport Management 21, 24-35.

Alibeli, M. & Johnson, C. 2009. Environmental Concern: A Cross National Analysis. Journal of International and Cross-Cultural Studies 3, 1-10.

Anderson, L., Mastrangelo, C., Chase, L., Kestenbaum, D. & Kolodinsky, J. 2013. Eco-labelling motorcoach operators in the North American travel tour industry: analysing the role of tour operators. Journal of Sustainable Tourism 21 (5), 750-764.

Araghi, Y., Kroesen, M., Molin, E. & van Wee, B. 2014. Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment. Transportation Research D 26, 42-46.

Archer, D. 2005. Fate of fossil fuel CO_2 in geologic time. Journal of Geophysical Research 110, 2156-2202.

Atmosfair. 2015a. Airline Index. Available in: https://www.atmosfair.de/en/atmosfair_airline_index (accessed November 3, 2015)

Atmosfair. 2015b. Calculate Emissions. Available in: https://www.atmosfair.de/en/ kompensieren/flug (accessed on September 29, 2015)

Barbot, C., Costa, A. & Sochirca, E. 2008. Airlines performance in the new market context: A comparative productivity and efficiency analysis. Journal of Air Transport Management 14, 270-274.

Barr, S., Shaw, G., Coles, T. & Prillwitz, J. 2010. 'A holiday is a holiday': practicing sustainability, home and away. Journal of Transport Geography 18, 474-481.

Baumeister, S. 2010. Strategische Positionierung von Fluggesellschaften vor dem Hintergrund der Deregulierung des Luftverkehrs. Saarbrücken: VDM Verlag.

Baumeister, S. 2011. Finnair competitive advantage through environmental responsibility. Available in: https://jyx.jyu.fi/dspace/handle/123456789/36762 (accessed on June 27, 2016)

Becken, S. 2007. Tourists' Perception of International Air Travel's Impact on the Global Climate and Potential Climate Change Policies. Journal of Sustainable Tourism 15, 351-368.

Benady, S. 2007. Brands Show True Colours. Marketing Week, 31st May, 20-21. Available in: http://www.marketingweek.com/2007/05/30/brands-show-true-colours/ (accessed on June 27, 2016)

Berghoef, N. & Dodds, R. 2013. Determinants of interest in eco-labelling in the Ontario wine industry. Journal of Cleaner Production 52, 263-271.

Berinsky, A., Huber, G. & Lenz, G. 2012. Evaluation Online Labor Markets for Experimental Research: Amazon.com's Mechanical Turk. Political Analysis 20, 351-368.

Bleda, M. & Valente, V. 2009. Graded eco-labels: A demand-oriented approach to reduce pollution. Technological Forecasting & Social Change 76, 512-524.

Bofinger, H. & Strand, J. 2013. Calculating the Carbon Footprint from Different Classes of Air Travel. The World Bank, Development Research Group Environment and Energy Team.

Bonini, S. & Oppenheim, J. 2008. Cultivating the Green Consume. Stanford Social Innovation Review, Fall 2008, 56-61.

Bratt, C., Hallstedt, S., Robert, K., Broman, G. & Oldmark, J. 2011. Assessment of eco-labelling criteria development from a strategic sustainability perspective. Journal of Cleaner Production 19, 1631-1638.

Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y. & Salladarré, F. 2009. Determinants of demand for green products: An application to eco-label demand for fish in Europe. Ecological Economics 69, 115-125.

Brewer, G. & Stern, P. 2005. Decision Making for the Environment: Social and Behavioral Science Research Priorities. Washington, DC: National Academic Press.

Brouwer, R., Brander, L. & van Beukering, P. 2008. "A convenient truth": air travel passengers' willingness to pay to offset their CO_2 emissions. Climatic Change 90, 299-313.

Bryman, A. & Bell, E. 2007. Business research methods. Oxford: Oxford University Press.

Buckley, R. 2002. Tourism Ecolabels. Annals of Tourism Research 29 (1), 183-208.

Budeanu, A. 2007. Sustainable tourist behaviour – a discussion of opportunities for change. International Journal of Consumer Studies 31, 499-508.

Buhrmester, M., Kwang, T. & Gosling, S. 2011. Amazon's Mechanical Turk: A New Source of Inexpensive, Yet High-Quality, Data? Perspectives on Psychological Science 6, 3-5.

Button, K. 2007. Airlines: Sustainable development in a transatlantic context. In: Rietveld, P., Stough, R. (eds) Institutions and sustainable transport: Regulatory reform in advanced economies. Cheltenham: Edward Elgar.

Button, K. & Neiva, R. 2013. Single European Sky and the functional airspace blocks: Will they improve economic efficiency? Journal of Air Transport Management 33, 73-80.

Casler, K., Bickel, L. & Hackett, E. 2013. Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. Computers in Human Behavior 29, 2156-2160.

Chapman, L. 2007. Transport and climate change: a review. Journal of Transport Geography 15 (5), 354-367.

CheapTickets.nl. 2016. Available in: http://www.cheaptickets.nl/ (accessed June 27, 2016)

Climate Care. 2015. Carbon Calculator. Available in: http://www.climatecare.org/home.aspx (accessed on September 29, 2015)

Cohen, S. & Higham, E. 2011. Eyes wide shut? UK consumer perception of aviation climate impacts and travel decisions to New Zealand. Current Issues in Tourism 14, 323-335.

Coles, T., Fenclova, E. & Dinan, C. 2011. Responsibilities, recession and the tourism sector: perspectives on CSR among low-fares airline during the economic downturn in the UK. Current Issues in Tourism 14 (6), 519-536.

Cowper-Smith, A. & de Grosbois, D. 2011. The adoption of corporate social responsibility practices in the airline industry. Journal of Sustainable Tourism 19 (1), 59-77.

Creswell, J. 2009. Research Design – Qualitative, Quantitative, and Mixed Methods Approaches. Third Edition. Thousand Oaks: Sage.

Cutter, S., Mitchell, J., Hill, A., Harrington, L., Katkins, S., Muraco, W., DeHart, J., Reynolds, A. & Shudak, R. 2002. Attitudes towards reducing greenhouse gas emissions from local places. In: Association of American Geographers Global Change in Local Places (GLCP) Working Group (eds) Global Change and Local Places: Estimating, Understanding, and Reducing Greenhouse Gases. Cambridge: Cambridge University Press.

D'Souza, C., Taghian, M. & Lamb, P. 2006. An empirical study on the influence of environmental labels on consumers. Corporate Communications 11 (2), 162-173.

D'Souza, C., Taghian, M., Lamb, P. & Peretiatko, R. 2007. Green decisions: demographics and consumer understanding of environmental labels. International Journal of Consumer Studies 31, 371-376.

Daley, B. 2010. Air Transport and the Environment. Wey Court East: Ashgate.

Dauvergne, P. & Lister, J. 2010. The prospects and limits of eco-consumerism: shopping our way to less deforestation? Organization Environment 23 (2), 132-154.

Davies, M. 2007. Doing a successful research project: Using qualitative and quantitative methods. New York: Palegrave Macmillian.

Davison, L., Littleford, C. & Ryley, T. 2014. Air travel attitudes and behaviours: the development of environment-based segments. Journal of Air Transport Management 36, 13-22.

De Boer, J. 2003. Sustainability labelling schemes: The logic of their claims and their functions for stakeholders. Business Strategy and the Environment 12, 254-264.

Degenhardt, L. 2002. Why do people act in sustainable ways? Results of an empirical survey of lifestyle pioneers. In: Schmuck, P., Schultz, W. (eds) Psychology of Sustainable Development. New York: Springer.

DEFRA. 2011. Framework for Sustainable Lifestyle. Available in: http:// webarchive. nationalarchives.gov.uk/20130123162956/http:// archive. defra.gov.uk/environment/economy/documents/sustainable-life-framework.pdf

DEFRA. 2012. Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors, July 2012.

Delmas, M. & Grant, L. 2014. Eco-labelling strategies and price-premium: the wine industry puzzle. Business & Society 53, 6-44.

Delmas, M. & Lessem, N. 2015. Eco-premium or eco-penalty? Eco-labels and quality in the organic wine market. Business & Society, 1-39.

Dickinson, J., Robbins, D. & Lumsdon, L. 2010. Holiday travel discourses and climate change. Journal of Transport Geography 18, 482-489.

Dietz, T. & Stern, P. 2002. Exploring new tools for environmental protection: education, information, and voluntary measures. Washington, DC: National Academy Press.

Dings, J., Wit, R., Leurs, B., Davidson, M. & Fransen, W. 2003. External Costs of Aviation. Berlin: German Federal Environmental Agency.

Direct Flights. 2016. Cheap Flights Finder. Available in: http://directflights.com/ (accessed June 27, 2016)

Doganis, R. 2002. Flying of Course: the Economics of International Airlines. Third Edition. London: Routledge.

Dubois, G. & Ceron, J. 2006. Tourism/leisure greenhouse gas emissions forecast for 2050: Factors for change in France. Journal of Sustainable Tourism 17, 17-37.

EEA. 2007. EMEP/CORINAIR Emissions Inventory Guidebook - 2007. Brussels: EEA.

EEA. 2009. EMEP/EEA Air Pollutant Emissions Inventory Guidebook - 2009. Brussels: EEA.

Egelhofer, R., Marizy, C. & Cros, C. 2007. Climate impact of aircraft technology and design changes. Journal of Air Transportation 12, 72-97.

Eijgelaar, E. & de Kinderen, D. 2014. Carbon offsetting: motives for participation and impacts on travel behaviour. In: Cohen, S., Higham, J., Peeters, P., Gössling, S. (eds) Understanding and Governing Sustainable Tourism Mobility: Psychological and Behavioural Approaches. London: Routledge.

Eriksson, P. & Kovalainen, A. 2008. Qualitative methods in business research. London: Sage.

Erzberger, C. & Kelle, U. 2003. Making inferences in mixed methods: the rules of integration. In: Tashakkori, A., Teddlie, C. (eds) Handbook of Mixed Methods in Social and Behavioral Research. Thousand Oaks: Sage.

European Commission. 2016. Energy labelling. Available in: https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products (accessed on June 27, 2016)

Fairweather, J., Maslin, C. & Simmons, D. 2005. Environmental values and response to ecolabels among international visitors to New Zealand. Journal of Sustainable Tourism 13, 82-98.

Filippone, A. 2008. Analysis of Carbon-Dioxide Emissions from Transport Aircraft. Journal of Aircraft 45, 185-197.

Finnair. 2015. Emissions Calculator. Available in: http://www.finnair.com/FI/FI/emissions-calculator (accessed on September 29, 2015)

Fleetwood, S. 2004. An ontology for organisation and management studies. In: S. Fleetwood S., Ackroyd, S. (eds) Critical realist applications in organization and management studies. London: Routledge.

Flybe. 2016a. Eco-labelling scheme. Available in: http://www.flybe.com/corporate/sustainability/eco_labelling_scheme.htm (accessed on January 27, 2016)

Flybe. 2016b. Compare Flybe's fleet. Available in: http://www.flybe.com/pdf/eco_labels_make_own.pdf (accessed on January 27, 2016)

Forbes, S., Cohen, D., Cullen, R., Wratten, D. & Fountain, J. 2009. Consumer attitudes regarding environmentally sustainable wine: an exploratory study of the New Zealand marketplace. Journal of Cleaner Production 17, 1195-1199.

Forsyth, P. 2011. Environmental and financial sustainability of air transport: Are they incompatible? Journal of Air Transport Management 17, 27-32.

Gallastegui, I. 2002. The use of eco-labels: A review of the literature. European Environment 12, 316-331.

German Advisory Council on Global Change. 2009. Solving the climate dilemma: The budget approach. Berlin: WBGU.

Givoni, M. & Rietveld, P. 2010. The environmental implications of airlines' choice of aircraft size. Journal of Air Transport Management 16, 159-167.

Gössling, S. & Hall, M. 2005. An introduction to tourism and global environmental change. In: Gössling, S., Hall, M. (eds) Tourism and Global Environmental Change. Ecological, Social, Economic and Political Interrelationships. Routledge: London.

Gössling, S., Peeters, P., Ceron, J-P., Dubois, G, Pattersson, T. & Richardson, R. 2005. The eco-efficiency of tourism. Ecological Economics 54 (4), 417-434.

Gössling, S., Broderick, J., Upham, P., Ceron, J.-P., Dubois, G., Peeters, P. & Strasdas, W., 2007. Voluntary Carbon Offsetting Schemes for Aviation: Efficiency, Credibility and Sustainable Tourism. Journal of Sustainable Tourism 15, 223-248.

Gössling, S. & Peeters, P. 2007. It does not harm the environment! An analysis of industry discourses on tourism, air travel and the environment. Journal of Sustainable Tourism 15 (4), 402-417.

Gössling, S., Haglund, L., Kallgren, H., Revahl, M. & Hultman, J. 2009. Swedish air travellers and voluntary carbon offsets: towards the co-creation of environmental values? Current Issues in Tourism 12 (1), 1-19.

Gössling, S. & Buckley, R. 2016. Carbon labels in tourism: persuasive communication? Journal of Cleaner Production 111, 358-369.

Graham, B. & Shaw, J. 2008. Low-cost airlines in Europe: Reconciling liberalization and sustainability. Geoforum 39, 1439-1451.

Grankvist, G., Dahlstrand, U. & Biel, A. 2004. The Impact of Environmental Labelling on Consumer Preference: Negative vs. Positive Labels. Journal of Consumer Policy 27, 213-230.

Green Globe. 2016. Available in: http://greenglobe.com/ (accessed on June 27, 2016)

Green, J. 2003. Civil aviation and the environmental challenge. The Aeronautical Journal, 281-299.

Grunert, K. & Wills, J. 2007. A review of European research on consumer response to nutrition information on food labels. Journal of Public Health 15, 385-399.

Guba, E. & Lincoln, Y. 1994. Competing paradigms in qualitative research. In: Denzin, N., Lincoln, Y. (eds) Handbook of Qualitative Research. Newbury Park: Sage.

Hagmann, C., Semeijn, J. & Vellenga, D. 2015. Exploring the green image of airlines: Passenger perceptions and airline choice. Journal of Air Transport Management 43, 37-45.

Hahnel, U., Arnold, O., Waschto, M., Korcaj, L., Hillmann, K., Roser, D. & Spada, H. 2015. The power of putting a label on it: green labels weigh heavier than contradicting product information for consumers' purchase decisions and post-purchase behavior. Frontiers in Psychology 6, 1-17.

Hanandeh, A. 2013. Quantifying the carbon footprint of religious tourism: the case of Hajj. Journal of Cleaner Production 52, 53-60.

Hares, A., Dickinson, J. & Wilkes, K. 2010. Climate change and the air travel decision of UK tourists. Journal of Transport Geography 18, 466-473.

Healy, M. & Perry, C. 2000. Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. Qualitative Market Research: An International Journal 3 (3), 118-126.

Hillman, M. 2004. How we can save the planet. London: Penguin Books.

Houe, R. & Grabot, B. 2009. Assessing the compliance of a product with an eco-label : From standards to constraints. International Journal of Production Economics 121, 21-38.

House of Commons Treasury Committee. 2008. Climate change and the Stern Review: the implications for Treasury policy, Fourth Report of Session 2007-08. Available in: http://www.publications.parliament.uk/pa/cm200708/cmselect/cmtreasy/231/231.pdf (accessed on November 3, 2015)

Howe, S., Kolios, A. & Brennan, F. 2013. Environmental life cycle assessment of commercial passenger jet airlines. Transportation Research Part D 19, 34-41.

Hurmerinta-Peltomäki, L. & Nummela, N. 2006. Mixed methods in international business research: a value-added perspective. Management International Review 46, 439-459.

IATA. 2016. IATA Members. Available in: http://www.iata.org/about/members/pages/index.aspx (accessed on June 15, 2016)

ICAO. 2014. Carbon Emissions Calculator Methodology Version 7, June 2014.

ICAO. 2015. Carbon Emissions Calculator. Available in: http://www.icao.int/environmentalprotection/CarbonOffset/Pages/default.aspx (accessed on September 29, 2015)
ICAO. 2016a. Forecasts of Scheduled Passenger and Freight Traffic. Available in: http://www.icao.int/sustainability/pages/eap_fp_forecastmed.aspx (accessed on June 15, 2016)
ICAO. 2016b. What is CORSIA and how does it work? Available in: http://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ2.aspx (accessed on November 2, 2016)
IEA. 2009. Transport, Energy and CO2: Moving towards Sustainability. Available in: http://www.iea.org/publications/freepublications/publication/transport-energy-and-co2--moving-toward-sustainability.html (accessed on June 15, 2016)
IEA. 2015. CO2 Emissions from Fuel Combustion – 2015 edition – excerpt. Available in: http://www.iea.org/publications/ freepublications/publication/co2-emissions-from-fuel-combustion---2015-edition---excerpt.html (accessed on June 15, 2016)
IPCC. 1999. Aviation and the global atmosphere. Available in: http://www.ipcc.ch/pdf/special-reports/spm/av-en.pdf (accessed on January 27, 2016)
ISO. 2007a. ISO 14024: Environmental labels and declarations – Type I environmental labelling – Principles and procedures. Geneva: International Organization for Standardization.
ISO. 2007b. ISO 14021: Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling). Geneva: International Organization for Standardization.
ISO. 2007c. ISO 14025: Environmental labels and declarations – Type III environmental declarations – Principles and procedures. Geneva: International Organization for Standardization.
Jamin, S., Schafer, A., Ben-Akiva, M. & Waitz, I. 2004. Aviation emissions and abatement policies in the United States: a city-pair analysis. Transportation Research Part D 9, 295-317.
Janic, M. 2004. An application of the methodology for assessment of the sustainability of the air transport system. Journal of Air Transportation 9 (2), 40-82.
Jardine, C. 2009. Calculating the carbon dioxide emissions of flights. Environmental Change Institute. Oxford: Oxford University Centre of the Environment.
Johnson, O. 2004. Information Theory and the Central Limit Theorem. London: Imperial College Press.
Jordan, A., Wurzel, R. & Zito, A. (2003). 'New' Instruments of Environmental Governance: Patterns and Pathways of Change. Environmental Politics 12, 1-24.

Kelly, J., Haider, W., Williams, P.W., & Englund, K. 2007. Stated preferences of tourists for eco-efficient destination planning options. Tourism Management 28, 377-390.

Koh, L. & Ghazoul, J. 2008. Biofuels, biodiversity, and people: Understanding the conflicts and finding opportunities. Biological Conversation 141 (10), 2450-2460.

Kollmuss, A. & Agyeman, J. 2002. Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research 8 (3), 239-260.

Lassen, C. 2010. Environmentalist in Business Class: An Analysis of Air Travel and Environmental Attitude. Transport Review 30, 733-751.

Lee, D., Fahey, D., Forster, P., Newton, P., Wit, R., Lim, L., Owen, B. & Sausen, R. 2009. Aviation and global climate change in the 21st century. Atmospheric Environment 43 (22-23), 3520-3537.

Lee, S. & Park, S. 2010. Financial impacts of socially responsible activities on airline companies. Journal of Hospitality & Tourism Research 34, 185-203.

Leire, C. & Thidell, Å. 2005. Product-related environmental information to guide consumer purchases - review and analysis of research on perceptions, understanding and use among Nordic consumers. Journal of Cleaner Production 13, 1061-1070.

Loo, B., Li, L., Psaraki, V. & Pagoni, I. 2014. CO_2 emissions associated with hubbing activities in air transport: an international comparison. Journal of Transport Geography 34, 185-193.

Loureiro, M. & Lotade, J. 2005. Do fair trade and eco-labels in coffee wake up the consumer conscience? Ecological Economics 53, 129-138.

Lu, J.-L. & Shon, Z. 2012. Exploring airline passengers' willingness to pay for carbon offsets. Journal of Transportation Research Part D 17, 124-128.

Lynes, J. & Andrachuk, M. 2008. Motivations for corporate social and environmental responsibility: A case study of Scandinavian Airlines. Journal of International Management 14, 377-390.

Lynes, J. & Dredge, D. 2006. Going green: motivations for environmental commitment in the airline industry. A case study of Scandinavian airlines. Journal of Sustainable Tourism 14, 116-138.

Macintosh, A. & Wallace, L. 2009. International aviation emissions to 2025: Can emissions be stabilised without restricting demand? Energy Policy 37, 264-273.

Magnusson, M., Arvola, A., Koivisto Hursti, U-K., Åberg, L. & Sjödén, P-O. 2001. Attitudes towards organic foods among Swedish consumers. British Food Journal 103 (3), 209-227.

Mair, J. 2011. Exploring air travellers' voluntary carbon-offsetting behaviour. Journal of Sustainable Tourism 19, 215-230.

Mayer, R., Ryley, T. & Gillingwater D. 2012. Passenger perceptions of the green image associated with airlines. Journal of Transport Geography 22, 179-186.

McKinnon, C. 2012. Climate Change and Future Justice: Precaution, Compensation and Triage. New York: Routledge.
Miller, G., Rathouse, K., Scarles, C., Holmes, K. & Tribe, J. 2010. Public Understanding of Sustainable Tourism. Annals of Tourism Research 37, 627-645.
Miyoshi, C. & Mason, K. 2009. The carbon emissions of selected airlines and aircraft types in three geographic markets. Journal of Air Transport Management 15, 138-147.
Miyoshi, C. 2014. Assessing the equity of the European Union Emission Trading Scheme on an African airline. Transport Policy 33, 56-64.
Moores, J. 2016. Oslo Airport first to offer mains-supplied biofuel. Air Transport World. Available in: http://atwonline.com/eco-aviation/oslo-airport-first-offer-mains-supplied-biofuel?NL=ATW-04&Issue=ATW-04_20160126_ATW-04_147&sfvc4enews=42&cl=article_5_b&utm_rid=CPEN1000000423834&utm_campaign=4799&utm_medium=email&elq2=5ac5292c28d341aea61cb1dfae58bb49# (accessed on January 27, 2016)
Morris, J. 1997. Green Goods?: Consumers, Product Labels and The Environment, Studies on the Environment 8: IEA.
NASA. 2016. Scientific consensus: Earth's climate is warming. Available in: http://climate.nasa.gov/scientific-consensus/ (accessed on June 15, 2016)
Nicholls, A. & Opal, C. 2005. Fair trade: market-driven ethical consumption. London: Sage.
Noblet, C., Teisl, M. & Rubin, J. 2006. Factors affecting consumer assessment of eco-labeled vehicles. Transportation Research Part D 11, 422-431.
Ohlden, A. 2008. More environmental awareness in flights thanks to energy label. Available in: http://www.science20.com/newswire/more_environmental_awareness_in_flights_thanks_to_energy_label (accessed on June 27, 2016)
Owen, B., Lee, D. & Lim, L. 2010. Flying into the Future: Aviation Emissions Scenarios to 2050. Environmental Science & Technology 44, 2255-2260.
Park, Y. & O'Kelly, M. 2014. Fuel burn rates of commercial passenger aircraft: variations by seat configuration and stage distance. Journal of Transport Geography 41, 137-147.
Pedersen, E. & Neergaard, P. 2006. Caveat Emptor – Let the Buyer Beware! Environmental Labelling and the Limitations of 'Green' Consumerism. Business Strategy and the Environment 15, 15-29.
Peeters, P. & Schouten, F. 2006. Reducing the ecological footprint of inbound tourism and transport to Amsterdam. Journal of Sustainable Tourism 14, 157-171.
Peeters, P., Szimba, E. & Dujinisveld, M. 2007. Major environmental impacts of European tourist transport. Journal of Transport Geography 15, 83-93.
Penner, J., Lister, D., Griggs, D., Dokken, D. & McFarland, M. (eds). 1999. Aviation and the Global Atmosphere; A Special Report of IPCC Working Groups I and II. Cambridge: Cambridge University Press.

Piano-X. 2008. User's guide. Available in: http://www.piano.aero/ (accessed on September 29, 2015)

PR Newswire. 2011. Searching for a Greener Flight? The New Directflights.com Site Can Now Find the Most Carbon-friendly and Cheapest Flights. Available in: http://www.prnewswire.com/news-releases/searching-for-a-greener-flight-the-new-directflightscom-site-can-now-find-the-most-carbon-friendly-and-cheapest-flights-114629734.html (accessed on June 27, 2016)

Preston, H., Lee, D. & Hooper, P. 2012. The inclusion of the aviation sector within the European Union's Emissions Trading Scheme: What are the prospects for a more sustainable aviation industry? Environmental Development 2, 48-56.

Rahbar, E. & Wahid, N. 2011. Investigation of green marketing tools' effect on consumers' purchase behavior. Business Strategy Series 12, 73-83.

Randles, S. & Mander, S. 2009. Practice(s) and ratchet(s): A sociological examination of frequent flying. In: Gössling, S., Upham, P. (eds) Climate change and aviation: Issues, challenges and solutions. London: Earthscan.

Rex, E. & Baumann, H. 2007. Beyond ecolabels: What green marketing can learn from conventional marketing. Journal of Cleaner Production 15, 567-576.

Robson, C. 1993. Real World Research: a Resource for Social Scientists and Practitioners-Researchers. Oxford: Basil Blackwell.

Rogers, H., Lee, D., Raper, D., Foster, P., Wilson, C. & Newton, P. 2002. The impacts of aviation on the atmosphere. The Aeronautical Journal 106, 521-546.

Romano, D., Gaudioso, D. & De Lauretis, R. 1999. Aircraft emissions: a comparison of methodologies based on different data availability. Environmental Monitoring and Assessment 56, 51-74.

Rosenthal, E. 2010. Can we kick our addiction to flying? The Guardian (24. May, 2010). Available in: http://www.theguardian.com/environment/2010/may/24/kick-addiction-flying (accessed on January 27, 2016)

Rosenthal, E. 2013. Your Biggest Carbon Sin May Be Air Travel. New York Times (26. January, 2013). Available in: http://www.nytimes.com/2013/01/27/sunday-review/the-biggest-carbon-sin-air-travel.html?_r=0 (accessed on January 27, 2016)

Rothengatter, W. 2010. Climate change and the contribution of transport: Basic facts and the role of aviation. Transportation Research Part D 15 (1), 5-13.

Sammer, K. & Wüstenhagen, R. 2006. The influence of eco-labelling on consumer behaviour – results of a discrete choice analysis for washing machines. Business Strategy and the Environment 15, 185-199.

Saunders, M., Lewis, P. & Thornhill, A. 2007. Research Methods for Business Students. Fourth Edition. Prentice Hall: Harlow.

Scheelhaase, J. & Grimme, W. 2007. Emissions trading for international aviation – an estimation of the economic impact on selected European airlines. Journal of Air Transport Management 13 (5), 253-263.

Sgouridis, S., Bonnefoy, P. & Hansman, R. 2011. Air transportation in a carbon constrained world: Long-term dynamics of policies and strategies for mitigating the carbon footprint of commercial aviation. Transportation Research Part A 45, 1077-1091.

Shaw, S. & Thomas, C. 2006. Discussion Note: Social and Cultural Dimensions of Air Travel Demand: Hyper-Mobility in the UK? Journal of Sustainable Tourism 14 (2), 209-215.

Silverman, D. 2006. Interpreting qualitative data. London: Sage.

Smith, I. & Rodger, C. 2009. Carbon emission offsets for aviation-generated emissions due to international travel to and from New Zealand. Energy Policy 37, 3438-3447.

Sorrell, S. 2009. Jevon's Paradox revisited: The evidence for backfire from improved energy efficiency. Energy Policy 37, 1456-1469.

Steg, L. & Vlek, C. 2009. Encouraging pro-environmental behavior: An integrative review and research agenda. Journal of Environmental Psychology 29, 309-317.

Steg, L., van den Berg, A. & De Groot, J. 2013. Environmental Psychology an Introduction. Chichester: BPS Blackwell.

Stern, N. 2007. The Economics of Climate Change: The Stern Review. Cambridge: Cambridge University Press.

Stern, P. 2000. Toward a coherent theory of environmentally significant behavior. Journal of Social Issues 56 (3), 407-424.

Sutkus, D., Baugcum, S. & DuBois, D. 2001. Scheduled Civil Aircraft Emissions Inventories for 1999: Database Development and Analysis. NASA/CR-2001-211216. Washington, DC: NASA.

Teisl, M., Roe, B. & Hicks, R. 2002. Can Eco-Labels Tune a Market? Evidence from Dolphin-Safe Labeling. Journal of Environmental Economics and Management 43, 339-359.

Teisl, M. & Roe, B. 2005. Evaluating the factors that impact the effectiveness of eco-labelling programmes In: Krarup, S., Russell, C. (eds) Environment, Information and Consumer Behaviour. Cheltenham: Edward Elgar.

Testa, F., Iraldo, F., Vaccari, A. & Ferrari, E. 2013. Why eco-labels can be effective marketing tools: evidence from a study of Italian consumers. Business Strategy and the Environment 24, 252-265.

Thøgersen, J. 2002. Promoting green consumer behavior with eco-labels. In: Thomas, D., Paul, S. (eds) New tools for Environmental Protection: Education, Information, and Voluntary Measures. Washington, DC: National Academic Press.

Thøgersen, J., Haugaard, P. & Olesen, A. 2010. Consumer responses to eco labels. European Journal of Marketing 44 (11), 1787-1810.

Thomas Cook. 2015. Looking after the environment. Available in: http://www.thomascook.com/sustainable-tourism/looking-after-the-environment/ (accessed on November 3, 2015)

Tuomi, J. & Sarajärvi, A. 2009. Laadullinen tutkimus ja sisällönanalyysi. Latvia: Liviano.

United Nations. 2009. A Guide to Environmental Labels – for Procurement Practitioners of the United Nations Systems. Available in: https://www.ungm.org/Areas/Public/Downloads/Executive%20summary_EnvLabels.pdf (accessed on January 27, 2016)

Van Amstel, M., Driessen, P. & Glasbergen, P. 2008. Eco-labelling and information asymmetry: a comparison of five eco-labels in Netherlands. Journal of Cleaner Production 16, 263-276.

Van Birgelen, M., Semeijn, J. & Behrens, P. 2011. Explaining pro-environmental consumer behavior in air travel. Journal of Air Transport Management 17, 125-128.

Walker, S. & Cook, M. 2009. The Contested Concept of Sustainable Aviation. Sustainable Development 17, 378-390.

Winther, M., Kousgaard, U. & Oxbol, A. 2006. Calculation of odour emissions from aircraft engines at Copenhagen Airport. Science of the Total Environment 366, 218-232.

Wittmer, A. & Wegelin, L. 2012. Influence of Airlines' Environmental Activities on Passengers. Journal of Air Transport Studies 3, 73-99.

Wüstenhagen, R. & Bilharz, M. 2006. Green energy market development in Germany: effective public policy and emerging customer demand. Energy Policy 34, 1681-1696.

Young, W., Hwang, K., McDonald, S. & Oates, C. 2010. Sustainable Consumption: Green Consumer Behavior when Purchasing Products. Sustainable Development 18, 20-31.

Åkerman, J. 2005. Sustainable air transport – on track in 2050. Transportation Research Part D 10, 111-126.

APPENDIX 1: SURVEY QUESTIONS FOR ARTICLE I

1. Introduction

Dear participant!

In the field of environmental responsibility, airlines are currently playing a particularly important role in the climate change debate. Finnair wants to be the choice for environmentally conscious travelers and is seeking for new ways how to reduce its emissions.

Taking care of the environment is a very crucial issue and your views are highly valued. Taking part in the questionnaire should not take more than 10 minutes.

This web interview is part of a Master's Thesis research project and is carried out by the University of Jyväskylä, the School of Business and Economics.

The information provided by you will only be used for data analysis within the University of Jyväskylä, individual participants cannot be identified from the report and your responses are absolutely confidential.

Thank you for taking part in this questionnaire!

2. How often do you usually fly with Finnair?

□ Once a year □ 2-3 times per year □ Every month
□ I never flew with Finnair so far

3. When booking a flight how important are the following aspects for you?

a. **Price**
□ Very important □ Important □ Less important □ Not important

b. **Total flight time (including transfers)**
□ Very important □ Important □ Less important □ Not important

c. **Non-stop flight to final destination**
□ Very important □ Important □ Less important □ Not important

d. **Suitable departure and arrival time**
□ Very important □ Important □ Less important □ Not important

e. **Finnair's new identity as a design airline**
□ Very important □ Important □ Less important □ Not important

4. Do you take environmental aspects into consideration when booking a flight?

□ Yes
□ No

If yes please specify what kind of environmental aspects you are taking into consideration when booking a flight:

5. In the following section we will present you several statements and ask you kindly to respond whether you agree or you not agree.

6. Finnair has a leading role in Europe when it comes to environmental responsibility.

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

7. Operating a modern fleet (that means flying new planes) is better for the environment.

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

8. I accept stopovers on my way to my final destination if the ticket prices are therefore much lower (e.g. flying from Helsinki to Frankfurt with changing planes in Riga or Copenhagen).

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

9. I am ready to pay more for a flight that is producing less emissions.

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

10. I am interested in donating some of my Finnair Plus-Points to projects aiming the recovery of our nature e.g. to the Baltic Sea Action Group or the Finnish Association for Nature Conservation / Suomen Luonnonsuojeluliitto.

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

11. I think paying for carbon offset has a positive effect on the environment.

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

12. Finnair should offer the possibility to pay for carbon offset as well.

□ I fully agree □ I agree □ I don't know □ I disagree □ I fully disagree

13. Have you ever paid for carbon offset while you booked a flight?

□ Yes
□ No

14. Have you heard about Finnair's new emissions calculator? (that is based on actual cargo, passenger and fuel consumption figures, not averages or assumptions and is certified by PricewaterhouseCoopers.)

□ Yes
□ No

15. Have you tried the new Finnair emissions calculator?

□ Yes
□ No

16. Do you think that the Finnair emissions calculator will have any impact when you make travel plans in the future?

□ Yes
□ No

Please specify in which way the results of Finnair's emissions calculator could influence your decision making about further travelling plans:

17. The following section contains questions about background information. The information provided by you will only be used for data analysis, individual participants cannot be identified from the report and your responses are absolutely confidential.

18. What is your gender?

□ Female
□ Male

19. What is your current age?

□ under 25 □ 26-39 □ 40-59 □ over 60

20. Are you a Finnair Plus member?

□ Yes
□ No

21. What is your Finnair Plus member status?

□ Finnair Plus Basic □ Finnair Plus Silver □ Finnair Plus Gold
□ Finnair Plus Platinum □ Finnair Plus Junior

22. Do you have any comments or notes?

APPENDIX 2: INTERVIEW FRAMEWORK FOR ARTICLE II

1. **Do you consider the environment when booking a flight?**
    - Which of the three flight options displayed would you choose and why?
    - Do you consider the environment when booking a flight?
    - Do you think that there is a difference between the environmental performances of individual airlines?
    - How can these differences been measures, where do you personally see the main differences?
2. **How would you distinguish a responsible airline?**
    - How would you distinguish airlines according to their environmental performance?
    - Do you think an eco-label could help distinguish airlines according to their environmental performance?
    - What do you think about Flybe's eco-label?
3. **How could more awareness been built among air travelers?**
    - Do you think the average air traveler is aware of these differences?
    - What do you think could help to build more awareness among air traveler in this content?
    - Do you think air travelers would consider an aviation eco-label and that this would influence their booking decision?
4. **How could an industry wide eco-label be realized?**
    - Could you imagine that something similar to the shown eco-labels could be introduced industry wide?
    - What should be the criteria for an aviation eco-label? Age of fleet? Fuel consumption? CO_2-Emissions? Noise rating? Waste handling?
    - Who should introduce and control such a kind of eco-label? The IATA? The ICAO?
5. **Is there still something you would like to tell or something you would like to add to the former discussions?**

APPENDIX 3: FLIGHTS INCLUDED IN ARTICLE III

1. Short-haul: Los Angeles (LAX) to San Francisco (SFO)

Dep.	Flight#	A/C	Stop	Flight#	A/C	Arr.	CO2(kg)/p
10.00a	DL 6428	E75				11.29a	88,872
10.20a	AA 2378	738				11.40a	71,086
10.30a	UA 318	319				12.06p	81,473
10.50a	WN 1453	733				12.05p	88,619
11.00a	DL 6430	E75				12.30p	88,872
11.25a	VX 927	320				12.45p	75,088
11.50a	WN 1900	733				1.10p	88,619
11.53a	UA 731	319				1.20p	81,473
12.00p	DL 6532	E75				1.30p	88,872
10.04a	UA 6325	EM2	SAN	UA 1424	738	2.05p	135,224
10.04a	UA 6325	EM2	SAN	UA 706	320	3.15p	139,548
10.05a	US 544	321	PHX	US 407	321	4.00p	176,346
10.20a	AA 2626	CR2	SAN	UA 1424	738	2.05p	143,972
10.20a	AA 2626	CR2	SAN	UA 706	320	3.15p	148,296
10.30a	DL 896	738	SEA	DL 5738	E75	4.35p	259,774
10.30a	DL 896	738	SEA	UA 1476	739	6.25p	222,881
10.30a	AA 2413	763	DFW	AA 1393	738	7.25p	374,050
10.40a	AS 475	738	SEA	AS 316	739	4.41p	212,545
10.40a	AS 475	738	SEA	UA 1476	739	6.25p	221,192
10.40a	AA 2619	CR2	SMF	US 5463	EM2	4.01p	145,019
11.00a	UA 6522	CR7	PHX	US 407	321	4.00p	222,367
11.40a	VX 783	319	SEA	VX 755	320	7.15p	287,186
11.45a	AA 2419	321	DFW	AA 1393	738	7.25p	348,046
11.50a	F9 412	319	DEN	F9 667	319	10.59p	242,278
11.59a	AA 5393	CR9	DEN	UA 1041	739	7.49p	305,413

2. Medium-haul: Los Angeles (LAX) to New York (JFK)

Dep.	Flight#	A/C	Stop	Flight#	A/C	Stop	Flight#	A/C	Arr.	CO2(kg)/p
6.00a	AA 292	321							2.20p	562,596
6.05a	UA 212	752							2.22p	452,359
6.30a	B6 24	321							2.46p	277,400
6.45a	DL 1762	763							3.10p	303,410
6.00a	AA 1515	738	ORD	AA 198	738				4.15p	339,932
6.00a	UA 1679	738	SFO	UA 898	752				5.29p	559,060
6.00a	UA 1679	738	SFO	AA 164	321				5.25p	655,838
6.00a	UA 1679	738	SFO	DL 414	752				5.03p	472,781
6.10a	AS 477	739	SEA	DL 173	752				7.18p	461,900
6.15a	DL 1888	320	SEA	DL 182	752				10.00p	482,676
6.15a	DL 1888	320	SEA	DL 173	752				7.18p	482,676
6.30a	US 649	321	PHX	US 425	321				5.00p	331,663
6.30a	DL 2154	753	ATL	DL 478	M88				6.35p	384,117
6.38a	UA 591	320	SFO	UA 760	752				7.25p	561,035
6.38a	UA 591	320	SFO	AA 16	321				9.10p	657,813
6.38a	UA 591	320	SFO	DL 468	752				7.58p	474,755
6.45a	AA 222	738	BOS	AA 1096	738				8.20p	365,246
6.45a	AA 222	738	BOS	DL 793	717				6.59p	365,833
6.55a	DL 1506	752	DTW	DL 3366	CR9				5.40p	464,334
6.55a	AA 160	738	SFO	AA 16	321				9.10p	658,960
6.55a	AA 160	738	SFO	UA 760	752				7.25p	562,182
6.55a	AA 160	738	SFO	DL 468	752				7.58p	475,903
7.00a	VX 925	319	SFO	VX 22	320				5.55p	410,278
7.00a	DL 6422	E75	SFO	AA 16	321				9.10p	676,746
7.00a	DL 6422	E75	SFO	UA 760	752				7.25p	579,968
7.00a	DL 6422	E75	SFO	DL 468	752				7.58p	493,688
7.00a	AA 2381	752	MCO	AA 2285	752				9.45p	515,537
6.00a	AA 1515	738	ORD	AA 4327	E75	BUF	DL 6039	ER4	7.19p	433,971
6.05a	UA 1183	739	ORD	UA 532	752	BOS	DL 793	717	6.59p	412,968
6.05a	UA 1183	739	ORD	UA 477	319	BUF	DL 6039	ER4	7.19p	390,107
6.25a	US 598	321	PHL	US 723	319	BOS	DL 793	717	6.59p	426,516
6.30a	US 649	321	PHX	US 649	321	DFW	AA 1453	738	9.00p	400,943
6.30a	DL 2154	753	ATL	DL 1983	M88	SAV	DL 3319	CR9	6.59p	481,813
6.55a	DL 1212	752	MSP	DL 1864	738	DCA	DL 3394	CR9	7.40p	480,366
6.55a	DL 1506	752	DTW	DL 1144	M88	DCA	DL 3394	CR9	7.40p	522,511
7.00a	AA 2426	752	DFW	AA 248	738	DCA	AA 1029	738	7.40p	440,980

3. Long-haul: Los Angeles (LAX) to London (LHR)

Dep.	Flight#	A/C	Stop	Flight#	A/C	Arr.	CO2(kg)/p
5.00p	NZ 2	773				10.40a	639,228
7.50p	AA 136	77W				1.15p	594,087
5.55p	UA 934	772				11.30a	822,043
6.15p	VS 8	346				12.00p	752,555
9.45p	BA 268	388				3.00 p	959,150
5.10p	BA 282	744				10.35a	784,607
4.00p	AA 209	738	SFO	BA 286	744	2.15p	950,742
4.25p	US 548	321	PHX	BA 288	744	12.40p	1030,587
4.45p	AF 65	388	CDG	AF 1780	321	1.45p	947,663
4.50p	AA 2460	738	DFW	AA 80	763	1.05p	860,001
5.00p	DL 6442	E75	SFO	VS 20	744	1.35p	953,124
5.00p	AA 2624	CR2	SAN	BA 272	772	2.00p	705,401
5.16p	UA 529	752	SFO	UA 930	772	2.05p	926,448
5.55p	AA 168	321	LAS	BA 274	744	2.15p	955,977
6.00p	AA 219	738	SFO	BA 286	744	2.15p	950,742
6.55p	AB 7431	332	DUS	BA 945	319	7.45p	861,040
7.45p	TK 10	77W	IST	TK 1983	321	9.00p	1206,254
8.30p	LX 41	343	ZRH	LX 326	320	5.50p	817,063
9.40p	AA 192	738	BOS	BA 238	772	7.15p	1018,035
10.55p	DL 1262	763	JFK	VS 26	346	8.10p	920,859
11.53p	UA 1557	738	EWR	UA 42	763	9.25p	971,429

APPENDIX 4: SURVEY QUESTIONS FOR ARTICLE IV

1. Consent form

Dear Participant,

This survey is being conducted by researchers at the University of California, Los Angeles (UCLA). Your participation is appreciated in an effort to better understand consumer perceptions of different flight options. By participating in this study we ask you to make choices between different flight options displayed to you. We will also collect some demographical data and ask you a few question about your consumption behavior.

- Completing the survey should take about 10-12 minutes.

- There are no anticipated risks or discomfort by participating.

- Any information that is obtained in connection with this study and that can identify you will remain confidential. It will be disclosed only with your permission or as required by law.

- Your MTurk worker ID will only be collected for the purpose of distributing participation compensations and will not be shared with anyone outside our research team or linked to your personal survey responses in any way.

- Participation in this study is voluntary.

- You must be 18 years of age or older to complete this questionnaire.

Please answer every question, as incomplete answers will impact the results of our study. We will pay you $1.00 for your participation. You will find an individual code at the end of the survey that will help you receive credit for taking part in our survey.

If you have any further questions please do not hesitate to contact our research team:

Magali Delmas, Professor
delmas@ioes.ucla.edu

Stefan Baumeister, Doctoral Student
stefan.c.baumeister@ucla.edu

If you have questions about your rights while taking part in this study, or you have concerns or suggestions and you want to talk to someone other than the researchers about the study, please call the OHRPP at (310) 825-7122 or write to: UCLA Office of the Human Research Protection Program, 11000 Kinross Avenue, Suite 211, Box 951694, Los Angeles, CA 90095-1694.

2. Introduction

Let's assume you have to travel from **Los Angeles (LAX)** to **New York (JFK)** by airplane next month and you are searching for a flight online.

In the following 9 pages, you will be shown 3 flight options. Select 1 flight on each page that you think displays the best choice.

Each flight option contains **ticket price**, **total time** and an **eco-label**:

- **Ticket price**: Final price in US$ including all taxes, fees, two carry-ons and one checked bag.

- **Total time**: Total travel time from Los Angeles (LAX) to New York (JFK) including flight time and layovers.

- **Eco-label**: Measures the environmental impact of each flight based on CO_2 (carbon dioxide) emissions. A (green) displays the least polluting option, B (yellow) the average option and C (red) a flight that should be avoided.

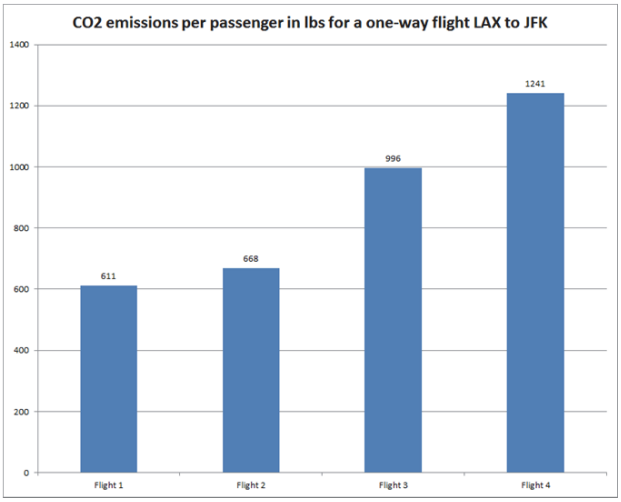
Click "Next" to learn more about the eco-label.

3. Treatment

What does the aviation eco-label stand for?

The aviation eco-label measures the carbon dioxide emissions created by individual flights. Carbon dioxide emissions are a major cause of climate change. Climate change is one of the biggest challenges humanity has ever faced and its predicted impacts could alter our current lifestyle and that of coming generations significantly. Rising sea levels, severe droughts and stronger storms caused by climate change are just a few examples that could endanger our habitat. Air travelling has been identified as a significant source of manmade climate change due to the high amount of fossil fuels burned in jet engines.

However, there are differences between flights operated by different airlines. In fact selecting a particular flight can reduce our personal impact on climate change by more than 50%. The example below compares four flights from Los Angeles (LAX) to New York (JFK) based on their CO_2 emissions, showing significant differences. Flight 4 for example releases twice as much CO_2 per passenger than flight 1. The purpose of the eco-label is to identify these greener options and make them visible during the booking process so that mitigating climate change can become part of our decision making.



How does the eco-label work?

The eco-label is using a simple color scheme known from traffic lights. Each flight option has been evaluated according to the three above described environmental impacts of aviation. The flights with the lowest impact are labelled green, they display the most preferable choice. Flights performing average are labelled yellow. Flights that perform below average, having the highest impact on the environment, are labelled red. If possible these flights should be avoided. Systematically avoiding red labelled flights can send a strong signal to those airlines operating these flights pushing them to improve their environmental performance. At the same time it also shows support for those airlines that make an extra effort for the environment by supporting their green agenda.

How much does it cost?

Different from many other eco-labelled products, flights that are labelled green not necessarily need to be more expensive as ticket prices are not depending on the environmental performance of flights.

Click "Next" to proceed to the survey.

4. Choice Experiment

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$225	$205	$225
Total time	7hr 50min	5hr 20min	5hr 20min
Eco-label	B	A	C

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$245	$205	$205
Total time	6hr 35min	5hr 20min	7hr 50min
Eco-label	B	C	A

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$245	$225	$245
Total time	7hr 50min	6hr 35min	6hr 35min
Eco-label	A	C	A

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$245	$245	$225
Total time	7hr 50min	5hr 20min	6hr 35min
Eco-label	B	A	A

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$205	$225	$225
Total time	7hr 50min	5hr 20min	7hr 50min
Eco-label	B	B	C

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$205	$245	$225
Total time	6hr 35min	7hr 50min	5hr 20min
Eco-label	C	C	A

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$205	$205	$245
Total time	6hr 35min	5hr 20min	5hr 20min
Eco-label	A	B	B

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$205	$205	$245
Total time	7hr 50min	6hr 35min	6hr 35min
Eco-label	C	B	C

Select the flight you like to book by clicking on it. Please select only **one** flight. Your selection will be highlighted in **green**. Press "Next" to continue.

Flight Option	Flight 1	Flight 2	Flight 3
Ticket price	$245	$225	$225
Total time	5hr 20min	6hr 35min	7hr 50min
Eco-label	C	B	A

5. Demographics

What is your gender?

- Male
- Female

What is your age?

under 18 18-24 25-34 35-44 45-54 55-64 65-74
75-84 85+

What is your household's annual income?

- Less than $10,000
- $10,000-$14,999
- $15,000-$24,999
- $25,000-$34,999
- $35,000-$49,999
- $50,000-$74,999
- $75,000-$99,999
- $100,000-$149,999
- $150,000-$199,999
- $200,000 or more

What is the highest level of formal education that you have completed?

- Below Grade 12
- High School Diploma
- Associate's Degree
- Bachelor's Degree
- Graduate / Professional Degree
- Doctorate Degree

In which country do you reside?

→Dropdown menu with all countries

In what state do you currently reside?

→Dropdown menu with all states

6. Testing environmental mindedness

How strongly would you rate the importance of the eco-label for the booking choices you made above?

- Unimportant
- Of little importance
- Moderately important
- Important
- Very important

How frequently do you purchase organic products?

- Never
- Sometimes (once every 10 trips to the grocery store)
- Occasionally (once every 5 trips to the grocery store)
- Often (every other trip to the grocery store)
- Always (every trip to the grocery store)

How often do you purchase voluntary Carbon Offsets when booking a flight?

- Never
- Sometimes
- Occasionally
- Often
- Always
- I don't know what Carbon Offset is

How concerned are you about the future state of our environment?

- Not at all concerned
- Slightly concerned
- Moderately concerned
- Very concerned
- Extremely concerned

Are you a member of an environmental organization?

- Yes
- No

7. Comments and payment

Please provide any comments you might have about this survey.

Thank you for participating in our survey!

Your survey code is: XXXXXXXXXXXX

Please enter this code at the Amazon Mechanical Turk website in order to receive credit for taking our survey.

ORIGINAL PAPERS

I

ENVIRONMENTAL RESPONSIBILITY AS A FACTOR IN GAINING COMPETITIVE ADVANTAGE IN THE AVIATION INDUSTRY

by

Stefan Baumeister, 2015

Journal of Geotechnical and Transportation Engineering 1 (2), 43-48

Journal of Geotechnical and Transportation Engineering
Volume 1 | Issue 2
Environmental Responsibility as a Factor in Gaining Competitive Advantage in the Aviation Industry
Baumeister

Received 10/29/2015 Accepted 11/19/2015
Published 12/15/2015
Corresponding Author:
S.Baumeister; stefan.c.baumeister@ucla.edu

Environmental Responsibility as a Factor in Gaining Competitive Advantage in the Aviation Industry

Stefan Baumeister
University of Jyväskylä/School of Business and Economics, Jyväskylä, Finland
University of California, Los Angeles/Institute of the Environment and Sustainability, Los Angeles, USA
Email: stefan.c.baumeister@ucla.edu

Abstract

In recent years there has been increasing interest in the environmental impacts of aviation, and some airlines have begun to address this issue more seriously. At the same time, competition in the aviation industry has become much tougher. This study focuses on the question of whether showing proactive environmental behavior could work as a differentiation strategy for airlines that are acting more responsibly, and thus help them to improve their competitiveness. This paper presents the results of a questionnaire conducted among 148 air travelers on their opinions and attitudes towards environmental aspects of flying, such as a modern and fuel-efficient fleet, direct flights, and carbon offset. The results showed that indeed there are air passengers who consider the environment when booking a flight, although they were not in the majority. The study also found that the participants saw additional value in a modern fleet, direct flights, and carbon offset, however, not all of them showed a willingness to pay a premium for those aspects.

Keywords: environment, aviation, competition, differentiation

1. Introduction

Air transport has become an essential part of our everyday life. It brings people to business, products to their markets, tourists to their holiday destinations, and it unites families and friends all over the planet. So air transport has made the global village a reality, but it has also, like the entire transportation sector, had a large impact on our environment. According to Green [1], the three main impacts of aviation on the environment are noise, air pollution around airports, and influences on climate change. Hereby the contribution to climate change is seen as the impact with the greatest significance.

Aviation currently accounts for only 2% of the global carbon dioxide emissions [2], but the industry is growing at a fast rate. In the past, the growth rate has been about 4.4% per annum [3]. For the future an even larger rate is predicted [4, 5]. This growth has also had an impact on the emissions released by aircraft. For example, between 1991 and 2003, aviation's carbon dioxide emissions grew by 87% [6]. At the same time, however, competition in the aviation industry has also increased tremendously due to liberalization and the opening of markets, changes which have resulted in falling airfares and caused huge changes to the established airlines, state carriers in particular [7]. Interest in the environmental impacts of the aviation industry has increased in recent years and in response several airlines have started to address this issue more seriously [8, 9]. In addition, these airlines have tried to use their pro-environmental approach to build up a positive corporate image [10]. As Liou and Chuang [11] found in their study, when the importance of corporate image in the aviation industry is evaluated, that image can be a strong tool for stimulating purchases and to differentiate an airline from its competitors. So far, a lot of research has been done on how businesses could use their environmental responsibility as a differentiation factor in order to gain competitive advantage [12, 13] but no single study has focused on the aviation industry. One research paper was found that answered at least the question of what motivates airlines to act in an environmentally responsible manner. In their case study of Scandinavian Airlines, Lynes and Dredge [14] found that one motivational factor for an airline to act environmentally responsibly is competitive advantage. Our paper aims to bring together the two subjects of environmental responsibility and competitive advantage within the aviation industry, which so far has received little attention.

The basic aim of this study is to determine whether showing proactive environmental behavior could work as a differentiation strategy for airlines that are acting more responsibly and thereby help them to improve their competitiveness. In order to measure how the air traveler perceives this pro-environmental behavior an online questionnaire among 148 air travelers was conducted. The basic research question of this study is: Do air travelers see value in airline's environmental responsibility initiatives. To answer this question three environmental aspects were chosen and tested. These aspects included a modern and fuel efficient fleet, direct flights, and carbon offset. The participants were asked about their attitudes towards these aspects and whether they see value in them. Together with the theory presented, the participant's answers were analyzed and conclusions were drawn as to whether and how airlines could gain competitive advantage by showing pro-environmental behavior.

2. Environmental competitive advantage

Over the past decades many studies have focused on the question of whether environmental responsibility could bring competitive advantage to companies and in which way it could deliver it. The question of "Does it pay to be green" has been raised many times. Shrivastava [15], for example, found that the use of environmental technology (e.g., pollution control equipment or waste management practices) has the potential to be a strong source of competitive advantage. Russo and Fouts [16], who focused on high-growth industries and their environmental responsibility strategies, came up with similar results. King and Lenox [17] conducted a longitudinal study among 652 manufacturing firms in the United States and they found that environmental responsibility can bring competitive advantage to companies.

According to Orsato [18], in general there are two major approaches in the current literature regarding sources of competitive advantage: the first is resource-based and the second is the positioning school. In the resource-based approach, a company gains competitive advantage based on its ability to use existing resources in a more deliberate way than its competing entities [19]. Resources for competitive advantage could be technical capabilities, organizational structure and culture, or the way how resources are acquired and managed [18]. The second approach, the positioning school, on which this study will focus on, follows the model presented by Michael Porter. According to Porter [20], competitive advantage can be defined as the value a company creates for its customers that exceeds the company's costs of producing it. Therefore, to achieve more value and competitive advantage a company should offer a product that either has the same advantages as a competitor's product but with a lower price (cost leadership) or they should offer a product with more advantages that justifies a higher sales price (differentiation).

Within the aviation industry, many examples of these two strategies can be found. The business model of low-cost carriers is a good example of a successful cost leadership strategy. Other airlines instead have chosen the differentiation strategy. For instance, Finnair, the cooperation partner of this research, intends to become the leading airline in terms of environmental responsibility. This goal clearly indicates an environmental product differentiation strategy.

According to Schaltegger et al. [21], environmental product differentiation is based on the idea that a company creates a product that provides either greater environmental benefits or has a smaller environmental impact. In addition to these benefits, or alternatively, the creation of the product or service might be carried out in a way that is less environmentally harmful than the production processes of the company's competitors [22]. One example of this approach is operating a modern and fuel- efficient fleet that produces fewer emissions during the flight.

However, according to Porter [20], a differentiation strategy can only lead to competitive advantage when the company succeeds in offering a unique product based on attributes that produce what is known as buyer value. These attributes can be anything that is part of the company's product, such as the product itself, the way it is delivered, the marketing approach as well as a broad range of other factors that differentiate the product from the competitors' products [20].

To understand what is valuable for buyers we have to look into the buyer's value chain. Any product or service purchased by buyers becomes an input in their value chain. These inputs determine the buyers' needs and the way they use the product in their value chains [20]. Only if the product adds value to the buyer it can generate a willingness within the buyer to pay a premium for it [23]. According to Porter [20], there are two ways a company can provide value to its buyers through differentiation, either by lowering the buyer costs or by raising the buyer performance. Lowering buyer costs means offering a product that helps buyers save costs.

In environmental product differentiation, examples of lowering buyer costs include products that consume less fuel, products that fulfill certain environmental requirements and standards, and products that help buyers reduce their carbon footprint. The second approach, raising buyer performance, could be achieved through products that bring additional environmental benefits to buyers. These benefits include organic food products that are better for the health or products that help improve buyers' image or status by using them [22].

In their study of environmental responsibility in small to medium enterprises, Simpson et al. [13] clearly established links between a firm's environmental performance and competitive advantage. They found that for some of the companies in their study, activities related to environmental responsibility had become a major selling point because these activities added additional value to their customers.

3. Environmental aspects of aviation

As discussed above, environmental product differentiation can be achieved by offering a product that provides either greater environmental benefits or a product that has a smaller environmental impact. In the aviation industry many initiatives or aspects can be identified that are beneficial for or have less impact on the environment: operating a modern fleet, offering direct flights, high load factors, reduced take-off trust, using electric vehicles for ground services, using biofuels, making aircrafts lighter or offering carbon offset. These three aspects have been chosen because this study focuses on air travelers' attitudes towards environmental aspects of flying, and these three aspects are considered to be the most visible for the air traveler.

Operating a modern fleet has a significant impact on cutting down carbon dioxide emissions. Increased efficiency leads to a reduction of fuel consumption and to fewer emissions, which results in a lower impact on the environment [24]. In recent decades, the achievements in efficiency have been tremendous. When the first commercial jet airliners designed in the mid-1950s are compared with the most advanced jet aircrafts currently available on the market, engine fuel consumption has dropped by more than 40%. When consumption is translated into fuel burn per seat, the drop reaches even 70% [25].

According to Hileman et al. [26], the most efficient way to get from point A to point B is to use the shortest distance, which is also known as the great-circle distance. Any diversion from the great-circle distance decreases the productivity of the flight. This diversion might lead to additional fuel consumption and more emissions, especially in cases of bad weather or air space restrictions. These negative effects may also apply in the routing of a flight connection, particularly when it is not a direct flight but has stopovers between origin and final destination [27]. The inefficiency increases even more when the flight is routed via a major airport due to the higher traffic volume and often limited runway capacity, making it often necessary for airplanes to fly holding patterns before finally approaching the runway [28].

Following the polluter pays principle, individuals, companies, and governments can purchase offsets on the carbon market to mitigate their own carbon dioxide emissions [29]. Surveys conducted by van Birgelen et al. [30] as well as Brouwer et al.

[29] showed that there is a high willingness among air passengers to pay for carbon offset. Only around 15% of the respondents did not show any willingness to pay for carbon offset. Brouwer et al. [29] found that the motivation among air travelers to pay for carbon offset comes not from existing values such as giving to good causes or charity but from the primarily motive to take responsibility by paying for one's contribution to climate change. The motivation could be explained more as a moral obligation paired with concerns about our environment and future generations.

4. Methods

This research is based on a quantitative survey in which 148 air travelers took part. For a period of two months, the questionnaire was accessible online through a link on Finnair's international webpage in English. It was conducted with the help of a web-based interview program and the questions were developed in close cooperation with Finnair. After a pilot test with 10 participants in which the functionalities of the questionnaire were tested, the link became accessible on Finnair's webpage in March 2011. The link was clicked 512 times during the two-month period. Altogether 148 participants completed the questionnaire successfully and answered all the questions, yielding a response rate of 28.9%. The questionnaire also collected socio-demographic data and information about the participant's travel history.

The participants rated first the importance of the following aspects when booking a flight: ticket price, non-stop flight option, total flight time (including transfers) and suitable departure/arrival time. For the second question, they stated if they take any environmental aspects into consideration when booking a flight. If the answer was yes, they specified what kinds of aspects they consider. The respondents then answered various questions concerning their opinions about the three environmental aspects of aviation presented above. They stated if they saw value in them and whether they would show willingness to pay a premium for them. For these questions, a five-point Likert scale was used, where 1 means fully agree and 5 means fully disagree. In the questions concerning the modern fleet, they stated whether they think operating a modern fleet is better for the environment and whether they are ready to pay more for a flight that produces fewer emissions. For the questions about direct flights, the participants' reported how important they rate direct flights among other aspects. In a second question they said if they would accept stopovers on their way to their final destination if the airfare were lower. In terms of carbon offset, the participants gave their opinion on whether paying for carbon offset has a positive effect on the environment or not and in the following question they stated whether they have ever paid for carbon offset. Finally using Finnair as a concrete example, the participants were asked whether they think Finnair has a leading role in terms of environmental responsibility or not.

5. Results and discussion

The survey found that only 30% of the participants take aspects related to the environment into consideration when booking a flight. No significant difference was detected between male and female participants ($p > 0.05$) or different age groups ($p > 0.05$). These results confirm what similar studies have found [29, 31, 32], the amount of air travelers who consider environmental aspects of flying are in general quite low.

To understand which environmental aspects are important for the participants who consider the environment when booking a flight, they were asked to give concrete examples. Aspects related to a modern and fuel-efficient fleet as well as direct flights were mentioned the most. Many participants stated that they actively search for alternatives to flying or even consider not making the trip at all. Several participants also said that they look for flight options that include the possibility to carbon offset. Beside that participants mentioned aspects related to the airline's environmental practices regarding waste handling, the reduced use of paper as well as the use of metal cutlery and reusable dinnerware. Other participants also stated that they prefer flying with airlines that show strong environmental initiatives.

As stated above for those participants who consider the environment when booking a flight, a modern fleet was seen as the most important aspect. This view was confirmed by the next question, in which almost 90% of the respondents agreed that operating a modern and fuel efficient fleet is better for the environment. The mean was 1.61 and the standard deviation was .686. Only a small percentage (11.0%) did not have an answer to this question. No participant disagreed with this statement. A significant difference was identified between male and female respondents in regard to whether they perceived a modern and fuel efficient fleet as better for the environment or not ($p < 0.01$), with male participants more strongly agreeing with this statement. One possible explanation for this difference could be that males more often have a technical orientation than females. The male participants may be applying the knowledge that using the latest technology has helped to reduce fuel consumption of vehicles to the aviation industry. However, no significant difference in the respondents' views on this issue could be found regarding their age ($p > 0.05$). The results showed that the participants see value in a modern and fuel efficient fleet and that they think that operating such a fleet is better for the environment. Other studies also came up with similar findings. Wittmer and Wegelin [9], for example, found that air passengers believe that, when it is compared to other environmental initiatives, operating a modern fleet can be seen as the strongest commitment an environmentally aware airline can show.

However, when the participants were asked whether they would be ready to pay a premium for flying on a modern fleet the results looked different. Only 6% fully agreed that they would be willing to pay more and 28% showed some willingness to pay, but almost 40% were not ready to pay a premium for a less polluting flight. When looking at the demographics, the data gave the impression that female passengers and the age group of 40-59 year olds showed more willingness to pay a premium. Several studies have found that females are more environmentally concerned [33] and it is also commonly known that the 40-59 age group has access to the highest income. Regardless of this observation, no significant difference could been found between male and female participants ($p > 0.05$) or different age groups ($p > 0.05$).

These results suggest that an airline could gain competitive advantage by operating a modern fleet, because this aspect is perceived positively by air travelers. A modern fleet can help air travelers to reduce the environmental impacts of their flying as well as lower their environmental costs, thereby adding value to their value chain. But even though the participants saw value in a modern fleet, airlines might face difficulties in asking a premium price based on this aspect because in this case the willingness to pay a premium didn't appear to be high. However some air travelers might also prefer a modern fleet for other reasons (e.g., safety, convenience, or cleanness), so there might be some willingness that is not only ecologically driven to pay more for a flight operated with modern aircraft.

Direct flights were mentioned the second most by those participants who consider the environment when booking a flight. The survey however found that the ticket price seemed to be more important for the majority of participants than a direct flight. While 66% of the respondents considered the ticket price as a very important factor when booking a flight, only 27% saw non-stop flights to the final destination as a very important factor. Still, 36% of the respondents described direct flights as an important factor but the remaining 37% of the participants considered non-stop flights as less important or not important at all when making a booking decision. The fact that air travelers are highly price sensitive, as found in this study, confirmed what previous studies had discovered [34]. The survey also found that almost three-quarters of the participants (73.0%) would accept stopovers on their way to their final destination if the flight were cheaper. Only 5% fully disagreed with this statement. The mean here was 2.20 and the standard deviation was 1.245.

The results of the questionnaire showed that the respondents see a certain value in direct flights and many of them were aware of the environmental impacts of connecting flights and unnecessary take-off and landing cycles. Nevertheless, the results of the survey also showed that ticket price is still the major criterion when choosing a flight and there was not much willingness among the respondents to pay more for a direct flight. An airline might be able to gain competitive advantage by offering a direct flight on a certain route, but it won't find much willingness to pay an environmental premium for that among air travelers. However, when combined with other non-environmental aspects direct flights could be considered as positive inputs to the buyer's value chain and might even attract air traveler's willingness to pay more. In addition to the environmental aspect, direct flights also offer other advantages, such as the convenience of arriving more quickly to the final destination or by avoiding stopovers at larger airports with the risk of missing the connecting flight, losing luggage, or longer layoffs.

Offsetting carbon emissions was another aspect mentioned by several participants as an environmental aspect they take into consideration when booking a flight. In the survey almost half of the participants (47.0%) stated that they think carbon offset has a positive effect on the environment while one-quarter (25.0%) disagreed. The mean here was 2.74 and the standard deviation was 1.127. These results confirm what earlier studies have found [30, 29] that many air travelers have a positive attitude towards carbon offset and many participants in these studies also expressed their willingness to pay for carbon offset. However, the studies presented above did not ask the participants whether they had ever paid for carbon offset. In this study the participants were directly asked if they had paid for carbon offset before, but only 20% stated that they had and the remaining 80% stated that they had not. It was interesting to see that so many participants considered carbon offset as having a positive effect on the environment but so few had ever paid for it. A similar study of departing passengers at Zurich Airport came up with an even lower result. In it, less than 4% of the participants had offset the carbon emissions for the flight they were going to take, but a large number of them perceived carbon offset as something positive for the environment [9]. One might assume that those participants who paid for carbon offset before are also among those who think it has a positive effect on the environment. Surprisingly, no significance could be detected ($p > 0.05$) between those participants who had paid for carbon offset and those ones who think that carbon offset is better for the environment.

Offering carbon offset could certainly lead to competitive advantage for an airline. Many air travelers see value in it because they perceive it as something positive for the environment, even though only a few might really go for this voluntary option. The airlines would not gain any additional revenues from offering carbon offset, but the practice would certainly strengthen their environmental image among those customers who care about environmental aspects of flying and see value in carbon offset.

Having shown that some air travelers do take environmental aspects into consideration when booking a flight and that a certain percentage of participants see value in a modern fleet, direct flights and carbon offset, the question remains: do they also see these aspects in relation to particular airlines? This survey was conducted among Finnair's customers and Finnair can certainly be considered as a leading airline in terms of environmental responsibility. Therefore the participants were asked how they evaluate the environmental performance of Finnair in comparison to other airlines. In the survey, 59% of the participants neither agreed nor disagreed with the question of whether they think Finnair has a leading role when it comes to environmental responsibility. The majority of participants did not have an opinion on this question. The remaining participants mainly agreed (34.0%), with only 7% disagreeing. The mean was 2.66 and the standard deviation was .779.

Even though a considerable amount of participants have stated that they consider the environment when booking a flight and many more also see value in the presented aspects of environmental differentiation, most of them could not distinguish Finnair's environmental performance from its competitors'. Differentiation only works, however, if the customer perceives the additional value the product or service really provides. If the customers are not aware of the environmental work an airline performs, it will be difficult for that particular airline to gain competitive advantage based on such work. Interesting was also that no significance ($p > 0.05$) was detected between those participants who consider the environment when booking a flight and those who think that Finnair has a leading role in terms of environmental responsibility. This result again confirms that environmentally conscious participants did not necessarily see Finnair's environmental performance as anything remarkable when it was compared to other airlines.

6. Conclusion

Within the aviation industry, competition has become much tougher in the recent years and at the same time the interest in the environmental impacts of aviation has increased. This research has elaborated on the question of whether showing pro-active environmental behavior could work as a differentiation strategy for airlines and help them gain competitive advantage.

The results of the study showed that air travelers see value in the environmental responsibility initiatives of airlines. All three environmental aspects presented to the participants were perceived as positive and valuable. The strongest agreement was found regarding the modern fleet. However, the results also showed that these environmental aspects can only bring competitive advantage to a particular airline when the air travelers are aware that this airline is actually offering these benefits. As we saw in the case of Finnair, even though all these aspects are offered by Finnair, the same participants (here Finnair customers) who saw value in these aspects did not necessarily see Finnair as an airline which has a leading role when it comes to environmental responsibility. Airlines must therefore communicate these environmental aspects clearly, otherwise they may have difficulty gaining competitive advantage based on environmental product differentiation.

Even though these environmental aspects are appealing to air travelers and they see value in them, this study found that price sensitivity among air travelers is high. So even if airlines successfully pursue an environmental product differentiation strategy, they will face difficulties finding willingness among air travelers to pay an environmental premium for the products. For two-thirds of the participants, ticket price was the most important criterion when booking a flight. Beside this price-consciousness, the results also detected that seeing value in an aspect does not necessarily lead to a willingness to pay for it. This attitude was revealed by the example of carbon offset. Those participants who considered carbon offset as positive for the environment were not the same ones who had also paid for carbon offset earlier.

Nevertheless, the study found that there is a small but considerable share of air travelers who consider the environment when booking a flight. For those airlines which show more commitment to environmental responsibility, this share should not be underestimated. Airlines should work to identify this specific customer segment, so it could be served with a unique product based on the customer's environmental needs using a product differentiation strategy. When airlines make the additional value and the input to their value chain more visible to these customers, more willingness to pay a premium may emerge. For the remaining air travelers who do not prioritize or even consider the environment when booking a flight, environmental product differentiation could still work as a selling point. For these customers, ticket price may remain the major selling point and aspects such as a modern fleet might stand more for safety and direct flights more for convenience, but the environmental aspect could still add some value for these customers.

For the future, further studies could be conducted on the question of how this specific customer segment, which considers the environment when booking a flight, could be identified and what would be the most efficient way to communicate environmental product differentiation to them. Further investigation could also look at what factors affect the willingness to pay a premium among air travelers and the question of how much more they would be ready to pay for a flight that has less impact on the environment.

Acknowledgement

The author wish to thank Finnair for providing valuable space on their website for the link to the online questionnaire as well as Kati Ihamäki and Laura Kantanen for all their assistance and support in the production of this paper. This work was supported in part by a Fulbright Graduate Grant.

References

[1] Green, J. "Civil aviation and the environmental challenge". The Aeronautical Journal, vol. 107, pp: 281–299, 2003.

[2] International Air Transportation Association. (2015, October 28). *Fact sheet: Climate change (June 2015)*. Available: https://www.iata.org/policy/environment/Documents/iata-factsheet-climatechange.pdf

[3] International Civil Aviation Organization. (2015, October 28). *Environmental Report 2010*. Available: http://www.icao.int/environmentalprotection/Documents/EnvironmentReport-2010/ENV_Report_2010.pdf

[4] Button, K. "Airlines: Sustainable development in a transatlantic context", In Rietveld, P., Stough, R. Institutions and sustainable transport: Regulatory reform in advanced economies. Cheltenham, UK: Edward Elgar, 2007, pp. 155–187.

[5] Gössling, S., Peeters, P. "It does not harm the environment! An analysis of industry discourses on tourism, air travel and the environment". Journal of Sustainable Tourism, vol. 15, pp: 402–417, 2007.

[6] Rothengatter, W. "Climate change and the contribution of transport: Basic facts and the role of aviation". Transportation Research Part D, vol. 15, pp: 5–13, 2010.

[7] Sowawattanakul, P., Wongsurawat, W. "Domestic airline networks and passenger demand in Thailand after deregulation". International Journal of Aviation Management, vol. 2, pp: 35–53, 2013.

[8] Chapman, L. "Transport and climate change: a review". Journal of Transport Geography, vol. 15, pp: 354–367, 2007.

[9] Wittmer, A., Wegelin, L. "Influence of Airlines' environmental activities on passengers". Journal of Air Transport Studies, vol. 3, pp: 73–99, 2012.

[10] Mayer, R., Ryley, T., Gillingwater, D. "Passenger perception of the green image associated with airlines". Journal of Transport Geography, vol. 22, pp: 179–186, 2012.

[11] Liou, J., Chuang, M. "Evaluating corporate image and reputation using fuzzy MCDM approach in airline market". Quality and Quantity, vol. 44, pp: 1079–1091, 2009.

[12] López-Gamero, M., Molina-Azorin, J., Claver-Cortés, E. "The whole relationship between environmental variables and firm performance: Competitive advantage and firm resources as mediator variables". Journal of Environmental Management, vol. 90, pp: 3110–3121, 2009.

[13] Simpson, M., Taylor, N., Barker, K. "Environmental responsibility in SMEs: does it deliver competitive advantage?" Business Strategy and the Environment, vol. 13, pp: 156–171, 2004.

[14] Lynes, J., Dredge, D. "Going Green: Motivations for Environmental Commitment in the Airline Industry. A Case Study of Scandinavian Airlines". Journal of Sustainable Tourism, vol. 14, pp: 116–138, 2006.

[15] Shrivastava, P. "Environmental Technologies and Competitive Advantage". Strategic Management Journal, vol. 16, pp: 183–200, 1995.

[16] Russo, M., Fouts, P. "A Resource-based Perspective on Corporate Environmental Performance and Profitability". Academy of Management Journal, vol. 40, pp: 534–554, 1997.

[17] King, A., Lenox, M. "Does it really Pay to be Green? An Empirical Study of Firm Environmental and Financial Performance". Journal of Industrial Ecology, vol. 5, pp: 105–116, 2002.

[18] Orsato, R. "Competitive Environmental Strategies: When Does it Pay to be Green?" California Management Review, vol. 48, pp: 127–143, 2006.

[19] Mintzberg, H., Ahlstrand, B., Lampel, J. "Strategy Safari – A Guided Tourthrough the Wilds of Strategic Management". New York: Free Press, 1998.

[20] Porter, M. "Competitive Advantage - Creating and Sustaining Superior Performance". New York: Free Press, 1998.

[21] Schaltegger, S., Burritt, R., Peterson, H. "An introduction to corporate environmental management". Sheffield, UK: Greenleaf, 2003.

[22] Reinhardt, F. "Environmental Product Differentiation: Implications for Corporate Strategy". California Management Review, vol. 40, pp: 43–73, 1998.

[23] Magretta, J. "Understanding Michael Porter". Boston: Harvard Business Review Press, 2012.

[24] Egelhofer, R., Marizy, C., Cros, C. "Climate impact of aircraft technology and design changes". Journal of Air Transportation, vol. 12, pp: 72–97, 2007.

[25] European Commission. (2015, October 28). *Fuel and air transport*. Available: http://ec.europa.eu/transport/air/doc/fuel_report_final.pdf

[26] Hileman, J., Katz, J., Mantilla, J., Fleming, G. "Payload fuel energy efficiency as a metric for aviation environmental performance" in 26th International Congress of the Aeronautical Sciences, Anchorage, Alaska, 2008, pp. 1-11.

[27] Hansen, M., Smirti, M., Zou, B. (2008). *A Comparative Evaluation of Greenhouse Gas Emission Reduction Strategies for the Maritime Shipping and Aviation Sectors*. Available FTP: scholarship.org Directory: uc/item/ File: 4j3573wm

[28] Reynolds, T., Gillingwater, D., Caves, R., Budd, L., "Climate Related Air Traffic Management Final Report," Loughborough University, 2009.

[29] Brouwer, R., Brander, L., Van Beukering, P. "A convenient truth: air travel passengers' willingness to pay to offset their CO_2 emissions". Climatic Change, vol. 90, pp: 299–313, 2008.

[30] van Birgelen, M., Semeijn, J., Behrens, P. "Explaining pro-environmental consumer behavior in air travel". Journal of Air Transport Management, vol. 17, pp: 125–128, 2011.

[31] Hares, A., Dickinson, J., Wilkes, K. "Climate change and the air travel decisions of UK tourists". Journal of Transport Geography, vol. 18, pp: 466–473, 2010.

[32] Miller, G., Rathouse, K., Scarles, C., Holmes, K., Tribe, J. "Public Understanding of Sustainable Tourism". Annals of Tourism Research, vol. 37, pp: 627–645, 2010.

[33] Thompson, D., Anderson, R., Hansen, E., Kahle, L. "Green segmentation and environmental certification: Insights from forest products". Business Strategy and the Environment, vol. 19, pp: 319–334, 2010.

[34] Bieger, T., Wittmer, A., Laesser, C. "What is driving the continued growth in demand for air travel? Customer value of air transport". Journal of Air Transport Management, vol. 13, pp: 31–36, 2007.

II

AN ECO-LABEL FOR THE AIRLINE INDUSTRY?

by

Stefan Baumeister & Tiina Onkila, 2017

Journal of Cleaner Production 142 (4), 1368-1376

Journal of Cleaner Production 142 (2017) 1368–1376

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

An eco-label for the airline industry?

Stefan Baumeister [a, b, *], Tiina Onkila [a]

[a] School of Business and Economics, University of Jyväskylä, Finland
[b] Institute of the Environment and Sustainability, University of California, Los Angeles, USA

ARTICLE INFO

Article history:
Received 14 April 2016
Received in revised form
24 November 2016
Accepted 27 November 2016
Available online 29 November 2016

Keywords:
Airline
Eco-label
Environmental label
Behavioral change
Sustainability

ABSTRACT

Air travel plays a vital role in today's life because it makes remote destinations accessible and short getaways possible. Despite its benefits, air transportation contributes heavily to climate change. Behavioral change is seen as a key driver in mitigating the environmental impacts of air travel. One way to encourage behavioral change is to use eco-labels. This study explores how an eco-label could be developed for the airline industry to function as a potential driver for behavioral change. 12 interviews with airline industry experts were conducted and thematically analyzed. Empirical results were then combined with prior research and the following five criteria essential for the development of an airline eco-label were identified: credibility, comparability, clarity, transparency and participation. Out of these five criteria, participation seemed to be the most challenging to realize. Based on these criteria, this paper could be understood as a first step towards the introduction of an industry-wide eco-labelling scheme for the airline industry that could help reduce the environmental impacts of aviation through behavioral change.

1. Introduction

Since the transformation of air travel from a luxury product into a mode of mass transportation, long-distance travel and more frequent vacations, also referred to as hypermobility, have become a reality (Gössling and Peeters, 2007; Hares et al., 2010). However, although air travel opens up new opportunities, it also heavily contributes to climate change. It is estimated that for a vacation including air transportation, 60%–95% of the impacts on climate change are caused by the flight itself (Gössling and Peeters, 2007; Peeters and Schouten, 2006). Aviation currently accounts for about 3.5% of worldwide CO_2 emissions (Penner et al., 1999). However, because its growth is projected to continue at a level of about 5% annually and the industry itself is still not facing any restrictions on its emissions growth, it is estimated that aviation's share of worldwide CO_2 emissions could reach a level between 15% and 40% by 2050 (Cohen and Higham, 2011; Gössling and Peeters, 2007).

Under these circumstances, there is a possible risk that regulation might restrict air transportation's future growth (Gössling et al., 2007). To avoid the possible risk of restrictions and to put aviation on a sustainable growth path, it needs to reduce its environmental impacts (Adler and Gellman, 2012). According to Hares et al. (2010), the environmental impact of air travel can be reduced through technological changes, market-based changes and behavioral changes. Gössling et al. (2007) identified behavioral changes as the key to reducing the environmental impacts of air transportation. One approach to encourage behavioral change is the use of environmental labels as described by Anderson et al. (2013), who studied the impact of a newly released eco-label on the North American motorcoach travel tour industry. Eco-labels are tools that provide the buyer with information on the environmental impacts of products (Bratt et al., 2011; Buckley, 2002), allowing them to compare different products based on their environmental performance. Eco-labels can help change consumption patterns by stimulating more sustainable purchases, and at the same time they can also motivate producers or service providers to raise their environmental standards (Gallastegui, 2002).

This study explores how an eco-label could be developed for aviation to function as a potential driver for behavioral change, which so far hasn't received much attention in the literature. Previous studies by Gössling et al. (2009), Hagmann et al. (2015) as well as Lynes and Dredge (2006) have outlined the importance of making flights environmentally comparable by using environmental indicators. Gössling et al. (2009) found evidence for air

* Corresponding author. Permanent address: P.O. Box 35, 40014, University of Jyväskylä, Finland.
E-mail address: stefan.c.baumeister@jyu.fi (S. Baumeister).

http://dx.doi.org/10.1016/j.jclepro.2016.11.170
0959-6526/

travelers' interest in integrating environmental information into their booking decision once the information would become available. Araghi et al. (2014) confirmed these findings in their study, based on a stated choice experiment, demonstrating that an eco-label had strongly influenced the participants' airline choice. Nevertheless, none of the above mentioned studies discussed the idea in more depth by asking how an eco-label should be developed for the airline industry to potentially support behavioral change. This study explores the views of airline industry experts regarding the development of the eco-label to support behavioral change. This research question was addressed inductively based on interviews with 12 airline industry experts. The results of the study suggest that an airline eco-label should be developed based on the following five criteria: credibility, comparability, clarity, transparency, and participation.

2. Eco-label development and behavioral change

2.1. Eco-labels

Eco-labels are aimed at informing consumers about more sustainable consumption decisions without compromising their freedom of choice. The main function of eco-labels is to serve as a component of consumer choice (Buckley, 2002), but eco-labels are supposed to also act as a reminder to take environmental issues into account (Bratt et al., 2011; Thøgersen et al., 2010). Based on the eco-label, consumers should be able to compare different products regarding their environmental impacts. Eco-labels help close the asymmetrical information gap between consumers and producers over the question of what the environmental attributes of products are (De Boer, 2003; Rex and Baumann, 2007). The eco-label needs to define, compile, test, and summarize the environmental performance of each product and present it to the consumer in the easiest way possible (Buckley, 2002; Gallastegui, 2002).

2.2. Eco-labels and behavioral change

Although eco-labels can create environmental awareness, this alone will not necessarily lead to behavioral change (Pedersen and Neergaard, 2006). In order for an eco-label to lead to behavioral change, it needs to provide information on an environmental concern that already exists among the consumer, making him or her alter the purchase decision in favor of the eco-labelled product (Teisl et al., 2002). Hahnel et al. (2015) found that under some circumstances the presence of an eco-label might even override other product information. Behavioral change among consumers selecting more eco-labelled products can also lead to behavioral change among producers, because the eco-label provides an incentive for environmental product differentiation (Bleda and Valente, 2009; Teisl et al., 2002). Teisl and Roe (2005) emphasize that only a subset of consumers responding to an eco-label is needed in order to make producers modify their existing products or develop new ones, change their marketing strategy or target green consumers. A vast amount of studies, covering various fields and industries, revealed that eco-labels can lead to behavioral change among consumers such as in purchasing washing machines (Sammer and Wüstenhagen, 2006), eco-labelled seafood (Brécard et al., 2009), fair trade coffee (Loureiro and Lotade, 2005), eco-labelled wines (Delmas and Lessem, 2014), dolphin-safe tuna (Teisl et al., 2002) or even when buying a new car (Noblet et al., 2006). However, there also exist a fair amount of studies (e.g. Leire and Thidell, 2005; Rahbar and Wahid, 2011; van Amstel et al., 2008; Young et al., 2010) that have questioned whether eco-labels can really lead to behavioral change. Prior research has identified three possible reasons that might explain the lack of behavioral response to eco-labels: the multiplicity of eco-labels that leads to confusion (Budeanu, 2007; Font, 2002), the lack of awareness among consumers of the existence of eco-labels (Fairweather et al., 2005; Puhakka and Siikamäki, 2012), and deficits in the communication of what the eco-label stands for (Gössling and Buckley, 2016; Kozak and Nield, 2004). Thus it seems that the lack of behavioral response to eco-labels can, to a large extent, be explained by deficiencies in the design and governance of eco-labels. Design and governance need to be taken into account in the development of a new eco-label in order to overcome the lack of behavioral response.

2.3. Design and governance of eco-labels to support behavioral change

Prior research has identified multiple issues as being important for the development of eco-labels. Those can be divided into design factors and governance factors (Castka and Corbett, 2016; Marx, 2013). First, the design of an eco-label should be based on the identification of need. Before introducing an eco-label into a new industry or market, it is essential to determine whether there is demand for such a label (Anderson et al., 2013; Gallastegui, 2002). Second, the eco-label should be designed so that it supports consumers in their decision making when they compare different products regarding their environmental impacts. The eco-label needs to define, compile, test, and summarize the environmental performance of each product and present it to the consumer in the easiest way possible (Buckley, 2002; Gallastegui, 2002). Third, in order to make flights comparable the eco-label should be designed in the form of an energy label. Energy labels allow for both positive as well as negative product labelling (Grankvist et al., 2004). Prior research on energy labels has found that consumers with no or weak interest in environmental issues do not respond to any eco-label; consumers with an intermediate interest avoid products with negative (red) labels; and consumers with a strong interest in environmental issues are affected by negative and positive labels equally (Araghi et al., 2014; Grankvist et al., 2004).

Furthermore, prior research has suggested that there should be a single label for the market, because a proliferation of labels creates confusion among customers. Prado (2013), for example, described how many industries have multiple schemes and the firms have to choose among those. This choice is eventually influenced by multiple factors, such as self-regulation, adoption of technological standards, and institutional forces. If there is more than one eco-label in a specific market, this can lead to confusion and ignorance in the consumer (Bratt et al., 2011; Buckley, 2002). In addition, an internationally competitive industry – such as the airline industry – needs a globally recognized eco-label (Buckley, 2002).

Finally, the participation of multiple stakeholders has been understood as important for the design process. Balzarova and Castka (2012) mention the benefits of multiple stakeholder participation during the standard development process, which may help eliminate controversial and undesirable issues, reinforce important issues and consensus-seeking, and improve the content of the standard. This can also help to avoid the risk of consumers' experiencing information overload or suspecting greenwashing behind the environmentally friendly claim (Thøgersen et al., 2010).

Concerning the governance of eco-labels, researchers have especially stressed the importance of third-party verification (Chkanikova and Lehner, 2015). Claims made by manufacturers or service providers do not really build trust on the consumer's side and such a label might fail (Anderson et al., 2013; D'Souza et al., 2007). This lack may explain why Testa et al. (2013) found that consumers had the most trust in the so-called official eco-labels

(i.e., the EU eco-label and the FCS label). In addition, Castka and Corbett (2016) found that both media and eco-label experts consider schemes with more external party involvement to be better governed. Castka and Corbett (2016) further claim that the specifics of the design of the eco-label may be even less important than the presence of external parties in the assurance process.

In addition to these factors, the particular environmental parameter or issue to which the eco-label refers needs to be clearly stated (Buckley, 2002) as well as communicated (Thøgersen et al., 2010), and there should be no language barrier hindering the understanding (Houe and Grabot, 2009). The degree of consensus regarding the meaning and significance of terms used to communicate about the eco-label indicates that the terminology needs to be clearly defined and that the practices undertaken or outcomes of the eco-label are transparent and understandable to all parties involved (Buckley, 2002). Furthermore, Bratt et al. (2011) and Gallastegui (2002) added that the criteria for an eco-label need to be strategically developed, meaning that objectives are clearly defined and the strategies to reach these objectives are clearly laid out. Consumers must be informed of the eco-label's meaning, its characteristics, requirements, and guarantees in order to avoid unclear and confusing messages (Testa et al., 2013), such as failure to assure the buyer about the product's ecological impact, insufficient information about the producer's compliance, and the presence of recommendations (van Amstel et al., 2008). Finally, concerning the design of eco-labels, it has been suggested that in order to use, like with energy labels, positive as well as negative eco-labels, the scheme cannot be voluntarily, but needs to be enforced by a policymaker and environmental regulation (Grankvist et al., 2004; Buckley, 2002).

2.4. Eco-labels in the airline industry

Since the introduction of the first aircraft eco-labeling scheme by the British low-cost carrier Flybe (2015a) in June 2007, many discussions have arisen among various groups of airline stakeholders regarding the need for and importance of such a labeling scheme. The eco-label presented by Flybe provides simple information on the environmental performance of aircraft in the form of an energy label similar to the one known from white goods (see Fig. 1). Flybe has integrated this eco-labelling scheme into its online booking system and placed the label on its aircraft as well. The methodology is openly available and allows any airline to create their own eco-label. So far not many have followed, Thomas Cook UK (2015) being one of the few.

Based on the Flybe idea, the findings from the Stern Review and after hearings with representatives from the International Air Transport Association (IATA), British Airways, Virgin Atlantic, and EasyJet, the UK House of Commons Treasury Committee (2008) recommended that the airline industry join forces in developing a common eco-label scheme for the industry. The committee saw that this scheme should independently rate the environmental impacts of each flight and the information should become available for passengers at the point of purchase. While such a scheme would help passengers to make more environmentally-conscious choices, they argued, it would also encourage airlines to improve their environmental performance, which in turn could lead to more environmental competition. Although the airline representatives at the hearing agreed to commit to establishing such a scheme, no further steps have been taken by the airlines, a lack of action that may have been caused by the 2008 financial crisis and subsequent economic downturn.

Aside from these efforts, two more players who have developed an airline eco-label have emerged. The first is the Dutch-based online travel service company CheapTickets.nl, which integrated an energy label called eco value into its flight booking site in 2008 (PR Newswire, 2008). This energy label rated all flight options displayed according to their environmental impacts on a scale from A to E by taking the flight distance and amount of stopovers into account. This gave the users of CheapTickets.nl the chance to easily compare and choose different flight options by also taking environmental aspects into consideration. As the company indicated on its website, there were plans to integrate aircraft type and other factors into the calculations. However, in the meantime, eco value has been removed from the booking site and is no longer used by CheapTickets.nl (2016). The more recent development comes from Atmosfair, a German-based climate protection organization and aviation carbon offset provider. Since 2011, Atmosfair (2016) has annually released the Atmosfair Airline Index, which ranks and compares almost 200 airlines according to their environmental efficiency. The results are presented in an energy-label–like rating. Passenger load factors and the aircraft type used by the airline have the strongest impact on the calculations, but seat and cargo capacity as well as the engines installed on the aircraft are also taken into account.

Even though the importance of an airline eco-label scheme has been understood and several attempts have been made by various industry players to develop such a label, no industry-wide standard currently exists. Air travelers are not able to make environmentally conscious decisions because they are not able to compare different flight options at the time of booking in terms of environmental impacts.

3. Material and methods

Because this study focuses on charting the views of industry experts on the novel topic of eco-label construction for aviation, an empirical approach was chosen that was qualitative (Silverman, 2006) and inductive (Eriksson and Kovalainen, 2008), and allowed to proceed without binding assumptions arising from any prior theory. This approach allows us to focus on the perspectives that arise from the empirical data. This qualitative and inductive nature led us to approach the topic by conducting in-depth interviews with experts that have been actively involved in the sustainable development of the airline industry. The data collection took place in two steps. The first step included informal interviews among participants at a professional conference and the second step consisted of standardized interviews with 12 airline industry experts. This approach was chosen in order to first gather an understanding of a topic which has not, to date, received much attention in the literature. The second reason was to build contacts with the industry in order to find suitable experts for in-depth interviews.

The potential idea for an industry-wide eco-label within the airline industry was first discussed among the participants at the Air Transport World 5th Annual Eco-Aviation Conference in Washington, D.C. in June 2012. The participants, all CSR professionals, represented major airlines from the United States, Europe and Asia, all major airframe makers and engine producers, international airports, airline trade associations as well as aviation industry service providers. The discussions took place during breaks and when there was time for socializing. The discussions, with three to five participants each, were informal and unstructured and took place in a focus-group setting. The participants looked at samples of Flybe's and CheapTickets.nl's eco-labels and commented on the idea and whether they thought something similar could be introduced industry-wide. Even though the conference participants were very positive about the idea of using eco-labels in the airline industry, the question remained of how it should be developed, something that could not have been

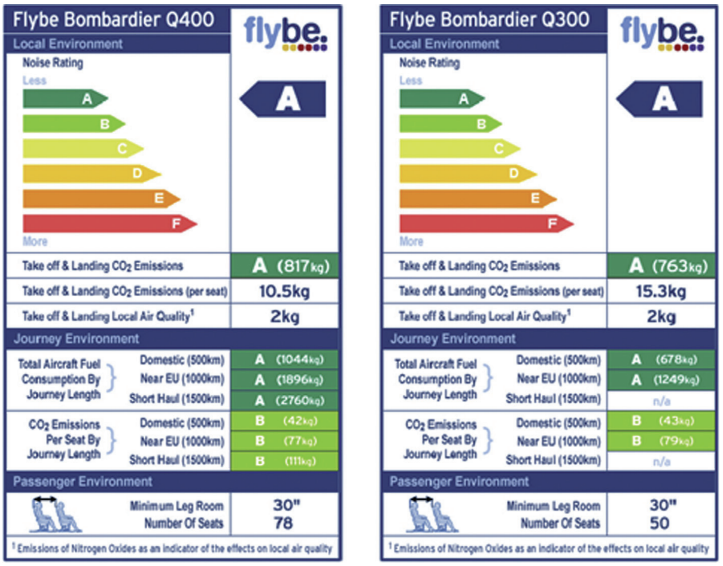


Fig. 1. Flybe eco-labelling scheme (Flybe, 2015b).

discussed during these short discussion rounds.

The interviewees were selected according to recommendations and contacts given by the conference participants. At the beginning of the interview all interviewees were presented with the eco-labelling scheme presented by Flybe and the eco value scheme used by CheapTickets.nl. After that, major themes identified during the conference were discussed. Standardized open-ended interviews with 12 airline industry experts (see Table 1) were conducted between June 2012 and April 2013. The work of all 12 experts was directly related to environmental issues and all of them hold positions responsible for sustainable development or CSR within the organization they belonged to. The interviewees represented major international and regional airlines, air traffic and airport authorities, global transaction processors, IT solutions providers, airline management consultant companies, international business travel agencies, aviation fuel suppliers as well as facility maintenance and waste treatment service providers.

Most of the interviews were conducted face-to-face at the experts' workplaces in three European countries: Germany, Finland and Spain. Two interviews were conducted over the phone. The length of each interview varied between 40 and 120 min. Although all 12 experts were based in Europe, the focus of the interviews was kept on a global scale, meaning only experts who worked for large international corporations were chosen. All of the experts were capable of answering the questions from a global perspective. All 12 interviews were transcribed and thematically analyzed based on the three themes that emerged from the discussions at the conference and provided then the bases for reporting the results.

Table 1
Industry experts who participated in the interviews.

Position	Industry sector
Senior sales manager	Aviation fuels
Environmental manager	Air traffic and airport authority
Senior manager	Maintenance and waste treatment
Senior manager	Aviation fuels/ biofuels
Client director	Airline management consultancy
Environmental manager	Major network carrier
VP environmental issues	Major network carrier
CEO	Regional airline
Communication manager	International business travel agency
VP sustainable development	Major network carrier
Managing director	Global transaction processor
Group environmental officer	Global transaction processor

The interview data were first analyzed inductively and thematically (Bryman and Bell, 2007; Tuomi and Sarajärvi, 2009) and the empirical results were then connected with prior research in order to respond to the research question. This means that the data was first analyzed based on its contents, without binding rules coming from theory. The analysis was conducted in four phases:

1. The first author read through the data multiple times and coded the key aspects that arose from the industry experts' views on the idea of developing the eco-label to potentially support behavioral change.
2. Based on those codes, he then wrote summaries of each interview and the key aspects identified in them concerning the development of eco-labels. During this phase, different aspects related to the question of developing the eco-label to potentially support behavioral change were grouped in each summary.
3. Summaries were compared to each other, based on their similarities and differences. In this phase, both researchers participated in the process. Similarities and differences between the interviews were identified. Based on the similarities, original themes were then formed. The themes were named based on their content. Seven themes were identified: identification of the need for an eco-label, simple message at the right time, using an energy label, flight specific, only one eco-label, creating an industry standard, and key actors.
4. After working inductively with the empirical data, prior research results were integrated. The aforementioned themes were, therefore, categorized as those that deal with the design of

eco-labels and those that deal with the governance of eco-labels. Finally, the results of the empirical data and prior research were integrated to identify the criteria that different themes would support in the development process. Thus criteria for the development of an airline eco-label (Table 2) were created. Based on the prior literature and the empirical results, five criteria for eco-label development were identified: credibility, comparability, clarity, transparency, and participation.

4. Results

4.1. Development of an eco-label based on expert views

This section presents the empirical results of the thematically analyzed interviews with 12 airline industry experts. The results have been divided into two different themes, focusing on the design and the governance of an airline eco-label separately.

4.1.1. Design of airline eco-label

4.1.1.1. Identification of the need for an airline eco-label. All of the interviewed industry experts agreed that there is a difference between the environmental performance of airlines, and choosing a flight according to environmental aspects can make a real difference.

> "When I have given some examples based on our emissions reports most of the people just [couldn't] believe that there can be so big differences even these days and even with so-called modern airlines. […] I have noticed it can be almost doubled, those emissions, on some routes." Communication manager, international business travel agency (December 4, 2012)

The industry experts saw possibilities in making flights environmentally comparable through an eco-label. They believed that it could lead to more competition between airlines. The industry experts do not currently see that much competition exists between airlines on environmental issues. It is more the case that airlines are cooperating in this field through, for example, collective lobbying or by sharing best practices. Most airlines just follow the minimum environmental legislation, and only a few go beyond compliance. However, these differences are hardly noticed by the average air traveler. It is therefore still difficult for airlines that go beyond compliance to differentiate themselves from their competitors. Nevertheless, if the environmental performance of each and every airline were to become visible to the air traveler, the situation might change. This change would reward airlines which have been going beyond compliance.

> "… in five years' time I think it is more common […] that you look not only [at the] price […] and the total flying time […] you also [will] have the third parameter which is how eco is it to travel. […] one day [it] will be as common as you go to the store and you look for those apples and you take the best apples there although it is a bit more expensive." Managing director, global transaction processor (February 27, 2013)

At the same time, a label would also push those airlines that have only followed the minimum legislation to become more active because they might otherwise be driven out of business.

4.1.1.2. Simple message at the right time. The industry experts felt that these environmental aspects continue to be difficult to communicate for airlines. Several airlines had, in fact, been harshly criticized for their environmental communication. It was also found that the general public has a negative environmental image of airlines and that environmental communication might easily be perceived as greenwashing. Therefore industry experts saw a clear need to communicate the environmental responsibility of airlines with concrete figures, meaning the message should be simple and easy to understand for everyone. It was seen as important that the message is integrated into the booking process so that the right information is available at the right time when the booking decision is made.

> "Now the indicators […] are price, route, how many times you need to change and what time you are [at the] destination […] but if there would be one more issue [like a] green factor […] then it would start to become [part] of our decision making." Senior manager, aviation fuels/biofuels (July 4, 2012)

> "It might be that you favor only the fastest flight […] it might be that you favor the cheapest flight, but it can also be that you want to compare […] how strongly it is polluting […]. So again therefore I think it is so relevant that there is this standard." Managing director, global transaction processor (February 27, 2013)

Table 2
Five criteria based on theory and empirical results.

		Credibility	Comparability	Clarity	Transparency	Participation
Theory	Design	Eco-label should be globally recognized	Eco-label should support consumer in decision making Eco-label should be energy label	Multiple eco-label schemes should be avoided	Identification of need for eco-label	Multiple stakeholder participation should be encouraged
	Governance	Eco-label should be third party verified Eco-label should be enforced through policymaker		Eco-label objectives should be clearly defined Eco-label objectives should be strategically developed	Eco-label objectives should be transparently communicated	
Empirical results	Design	All greenhouse gases should be included	Eco-label supports air traveler through easily accessible information at the right time Eco-label should be flight specific and not granted to individual airlines	Energy label provides easy-to-understand information There should be only one airline eco-label in order to avoid confusion and ignorance	Clear need for airline eco-label identified	Finding a common industry approach might be difficult
	Governance	Industry standard should be created utilizing one common methodology				Travel agents or ICAO could become key actors in implementation

4.1.1.3. Using energy label. Most interviewees recognized that the information provided by using an energy label would be sufficient. The information an energy label provides was seen as easy to understand, visible and available while choosing between different flight options. Some participants, however, demanded more detailed information for those users who want to learn more about the methodology in order to ensure transparency and trustworthiness. Nevertheless, several participants warned that if the information provided is too complex, it might result in disinterest. The following extracts exemplify how the interviewees expressed their support for the energy label.

> "I see, this is a splendid idea, very interesting if you go to a shop and try to buy a refrigerator […] you have the [same kind of] labelling for energy efficiency." Environmental manager, air traffic and airport authority (June 29, 2012)

> "… it already feels familiar because we have […] used these kinds […] of symbols in those household machines and it is very illustrative and […] easy to understand." Communication manager, international business travel agency (December 4, 2012)

4.1.1.4. Flight specific. The industry experts emphasized an airline eco-label should not be granted to a particular airline and should, instead, be flight specific. Which airline is the best choice depends on many factors and might vary from route to route. The air traveler should be provided with easy-to-read information on which airline and flight is the best on the particular route and day she wants to travel.

> "I think it is good […] this format of having those green A's and red E's […] it is easy to understand and easy to see which options are good [and] which options are not so good …" Communication manager, international business travel agency (December 4, 2012)

> "I think this would be the easiest way for passengers to quickly check." Vice-president, sustainable development, major network carrier (January 30, 2013)

In terms of flight specific environmental aspects that should be considered, the industry experts had many suggestions. However, all acknowledged that at least the aircraft type and its configuration (engines, seat layout, cargo capacity, winglets/sharklets), the average load factor and the route (amount of stopovers, capacity of airports, local noise issues) should be considered. There was also strong agreement to calculate not only CO2 emissions but to take all greenhouse gases into account.

4.1.1.5. Only one eco-label. The industry experts underlined that an industry standard is inevitable. If every airline were to create their own measurements, the whole discussion would lose credibility and air travelers would not be able to compare "apples with apples."

> "… if we don't have [a] common approach, we lose a lot of credibility and it takes ages to regain that credibility." Group environmental office, global transaction processor (April 24, 2013)

As much as the participants appreciated the idea of an industry-wide environmental label, the major concern they shared was if and how there will ever be an agreement on the methodology. The experts definitely concurred that there should be only one eco-label that covers all flights, but such a label would also require an agreement by all of the parties involved.

> "So, I indeed don't see this [environmental] rating possible as an initiative that could be agreed inside the industry. It would need to come [from] outside the industry and need to be […] built up without full [industry] consensus." Environmental manager, air traffic and airport authority (June 29, 2012)

Several participants mentioned the problems with the emissions calculator IATA tried to develop. Because airlines were not able to agree on one common methodology, in the end every airline developed their own calculator. The only independent emissions calculator currently existing was developed by the International Civil Aviation Organization (ICAO).

4.1.2. Governance of airline eco-label

4.1.2.1. Creating an industry standard. Creating an industry standard in the form of an easy-to-understand environmental indicator (e.g. an eco-label) was seen by many interviewees as invaluable. Such an indicator would make flights environmentally comparable and, if they so desire, give air travelers the possibility to actively choose the environmentally more preferable flights.

> "I think it will be a matter of combining efforts […] to raise awareness and also eventually to promote rather than penalize environmentally friendly [flight] options. […] It will be, of course, something very valuable for individuals […] to have this information. Whether they use it [in] one way or the other, I don't know, but at least it would be good to have that information." Group environmental office, global transaction processor (April 24, 2013)

According to the interviewees, environmental indicators are already used in corporate purchasing and reporting and many travel agents have been providing their corporate customers with carbon footprints or CO_2 figures of their flights for years. To date, however, no industry standard exists and travel agents use various methodologies to calculate emissions. Even though the environmental indicators have mainly been used for reporting purposes, corporate customers have begun asking for environmental information about flights already at the booking stage.

> "… more and more [of our corporate] customers would like to know the emissions of their flights beforehand …" Communication manager, international business travel agency (December 4, 2012)

The interviewees therefore appreciated the idea of an eco-label as industry wide standard. Under such circumstances, an airline not participating in the labelling scheme would lose its "license to operate," because not using the industry-wide label would look suspicious to air travelers. The standard should also be on an international level to ensure that all flights are comparable.

4.1.2.2. Key actors. As for the introduction of an airline eco-label, the industry experts named two potential actors that could facilitate the introduction. Because it might be difficult to find common agreement between airlines and because it might not look trustworthy when airlines release their own eco-label, several participants discussed the idea of using travel agents to introduce an industry-wide eco-label. As mentioned earlier, many travel agents have developed and are using their own environmental indicators.

The figures used there could easily be translated into symbols rating flights on a scale from A to E.

> "But of course I don't see why can't there be one row saying emissions in numbers there. […] considering consumers, it is a very good idea to use these symbols because they are so much easier to understand." Communication manager, international business travel agency (December 4, 2012)

Another advantage is also that travel agents have easy access to the information needed to evaluate flights individually, such as aircraft type, cabin layout or load factors. Although travel agents currently use various methodologies to calculate environmental impacts, the industry experts did not see a major problem in finding common agreement among them. However, industry experts recognized that the best solution for an industry-wide eco-label would be to go through an independent authority. Different possible authorities were discussed, but all participants ultimately agreed that ICAO represents the most suitable option.

> "… out of the many possibilities I believe ICAO is the best option." Group environmental office, global transaction processor (personal communication, April 24, 2013)

> "… basically ICAO is the only organization who can [bring this up] internationally …" CEO, regional airline (November 23, 2012)

The advantage of this approach is that problems with finding agreement or trustworthiness could be overcome. The experts shared the opinion that this approach is the only one that could lead to an industry standard all players would comply with. Finally, Fig. 2 provides an overview of the content and themes the interviewees identified as critical for the development of an eco-label scheme for the airline industry.

4.2. Criteria for airline eco-label development

Based on theory and our empirical results, five criteria for the development of an airline eco-label have been identified, as displayed in Fig. 3.

These five criteria are: credibility, comparability, clarity, transparency, and participation. Credibility in terms of eco-labeling refers to trust or positive reputation built through quality assurance (Nilsson et al., 2004). Based on theory and empirical results presented in this study the credibility of an airline eco-label can be established through global recognition, third-party verification, enforcement by policymakers, a commonly agreed methodology, and the inclusion of all greenhouse gas emissions. The second criterion, comparability, refers, in terms of eco-labeling, to making the environmental performance of products comparable. Based on the findings of our literature review and the results of our industry expert interviews, the comparability of an airline eco-label can be ensured through the use of energy labels, by making the label flight-specific and designing it in a way that makes information available easily and at the right time, supporting the air traveler in his decision making. The third criterion is clarity, which refers in terms of eco-labels to a clear understanding of what the eco-label stands for (Delmas et al., 2013). The relevant theories as well as our results show that the clarity of an airline eco-label depends on the clear definition and strategic development of objectives as well as on the existence of a single airline eco-label on the market. The fourth criterion, transparency, refers to the open communication and detailed description of the eco-label's criteria to the consumer (Font and Buckley, 2001). The transparency of an airline eco-label thus depends on the communication of objectives as well as on identifying the need for an eco-label. Finally, the fifth criterion, participation, refers to the stakeholders that are involved in the development process of an eco-label. For an airline eco-label, it was seen as essential to have multiple stakeholders, common industry agreement, and a key actor to drive the idea forward. Table 2 provides an overview of all five criteria based on findings from theory and empirical results.

5. Discussion and conclusion

This study set out to explore how an eco-label could be developed for the airline industry to function as a potential driver for behavioral change. To gain a deeper understanding, 12 interviews with airline industry experts were conducted and the results were thematically analyzed. The identified themes were divided into design factors (identification of need, simple message at the right time, using energy label, flight specific, and only one eco-label) and governance factors (creating an industry standard and key actors). The study further identified five criteria that are essential for the development of an airline eco-label to support behavioral change. These criteria were developed based on the theoretical foundations and empirical findings of the study: credibility, comparability, clarity, transparency and participation.

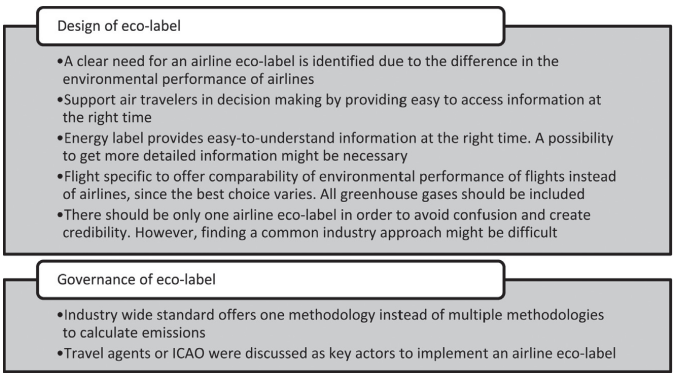


Fig. 2. Critical factors for the development of an airline eco-label.

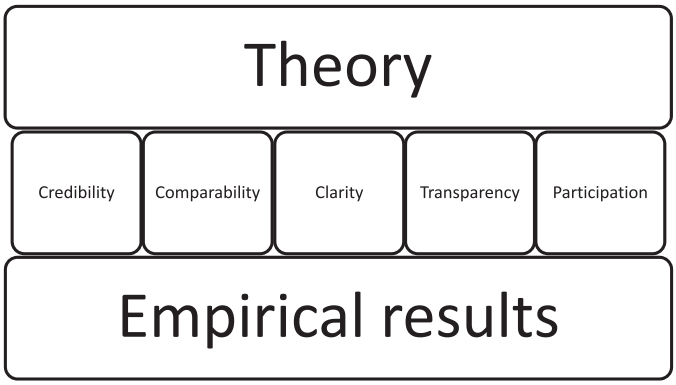


Fig. 3. Criteria for the development of an airline eco-label.

The findings revealed a clear need for an eco-label in the airline industry due to the fact that air travelers are currently unable to compare flights environmentally. Determining such a need has been identified as crucial for the introduction of an eco-label into a new industry or market (Anderson et al., 2013; Gallastegui, 2002). In terms of the five criteria essential for the development of an airline eco-label, the results suggested that the first four criteria (credibility, comparability, clarity, and transparency) seemed possible to implement, despite a few minor unresolved issues, such as how to find industry agreement on the eco-label methodology or which greenhouse gas emissions should be included. However, in regards to participation, namely about who should develop the eco-label and which stakeholders should be involved, many questions remained open. Nevertheless, this study was able to identify the participation of certain stakeholders as a necessity for the development of an eco-label and not just beneficial for the process, as claimed by Balzarova and Castka (2012). Although the industry experts provided some ideas on who the key actors could be, no clear consensus emerged. Finding the right actor to drive such a labeling scheme forward has already proven difficult in the past. For example, in 2008 the UK House of Commons Treasury Committee recommended the development of a common eco-label scheme for the industry, but this has not led to any further action. This paper lacks the ability to answer the question of who should participate in the development of such an eco-labeling scheme, but there is certainly room for further research.

In addition, the empirical findings supported prior research concerning the focus on energy labelling (Araghi et al., 2014; Grankvist et al., 2004) and the need for a single eco-label in an industry to create comparability (Bratt et al., 2011; Buckley, 2002). The findings also supported Araghi et al. (2014) view that energy labelling has the possibility to reach not only green consumers but also the remaining ones. On the basis of the current study, it can be concluded that while traditional eco-labels designate only the environmentally most preferable choices, an energy label provides more room to choose not only the greenest flight but also some option in between. At the same time, it clearly provides the chance to avoid the environmentally least preferable option. In line with Teisl et al. (2002), who have argued that eco-label development should be based on existing environmental concerns, using an energy label would provide an opportunity to answer the concerns of the green consumer as well as those of the remaining consumers. However, whether an energy label would really lead to behavioral change in air travelers' booking decisions and make them avoid red-labelled flights could not be answered with this study. To address this issue, the use of an experimental study design seems more appropriate, which could be subject for further research.

Finally, if the airline eco-label were to be an energy label, then enforcement by a policymaker would be inevitable, as discussed earlier by Grankvist et al. (2004). Otherwise, without enforcement, some airlines would probably refuse to participate in the scheme and the opportunity to make flights equally comparable could not be realized. Who the enforcing policymaker could be again refers to the criterion of participation, which has not been solved in this paper and therefore provides an additional source for further research.

This study is the first to discuss the idea of an airline eco-label in more depth through industry expert interviews. The findings increase understanding of the role that design and governance factors play in the development of an airline eco-label. Furthermore, the findings open up new avenues for scientific discussions, as many new factors relevant to the development of an airline eco-label arose. The major contribution, however, lays in the identification of five criteria essential for the development of an airline eco-label. Nevertheless, even though this study focused exclusively on the airline industry, these five criteria could certainly be applied in the development of eco-labels in other sectors. As its practical contribution, this study identified a clear need for an airline eco-label, and could therefore be understood as a first step towards the introduction of an industry-wide eco-labelling scheme.

Acknowledgements

This work was supported by the Finnish Funding Agency for Innovation (TEKES), the Finnish Work Environment Fund and a Fulbright Graduate Grant.

References

Adler, N., Gellman, A., 2012. Strategies for managing risk in a changing aviation environment. J. Air Transp. Manag. 21, 24–35. http://dx.doi.org/10.1016/j.jairtraman.2011.12.014.

Anderson, L., Mastrangelo, C., Chase, L., Kestenbaum, D., Kolodinsky, J., 2013. Eco-labelling motorcoach operators in the North American travel tour industry: analysing the role of tour operators. J. Sustain. Tour. 21, 750–764. http://dx.doi.org/10.1080/09669582.2012.709859.

Araghi, Y., Kroesen, M., Molin, E., van Wee, B., 2014. Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment. Transp. Res. D. 26, 42–46. http://dx.doi.org/10.1016/j.trd.2013.10.008.

Atmosfair, 2016. https://www.atmosfair.de/en/atmosfair_airline_index (Accessed 13

March 2016).
Balzarova, M., Castka, P., 2012. Stakeholders' influence and contribution to social standards development: the case of multiple stakeholder approach to ISO 26000 development. J. Bus. Ethics 111, 265–279.
Bleda, M., Valente, V., 2009. Graded eco-labels: a demand-oriented approach to reduce pollution. Technol. Forecast. Soc. Change 76, 512–524. http://dx.doi.org/10.1016/j.techfore.2008.05.003.
Bratt, C., Hallstedt, S., Robert, K., Broman, G., Oldmark, J., 2011. Assessment of eco-labelling criteria development from a strategic sustainability perspective. J. Clean. Prod. 19, 1631–1638. http://dx.doi.org/10.1016/j.jclepro.2011.05.012.
Brécard, D., Hlaimi, B., Lucas, S., Perraudeau, Y., Salladarré, F., 2009. Determinants of demand for green products: an application to eco-label demand for fish in Europe. Ecol. Econ. 69, 115–125. http://dx.doi.org/10.1016/j.ecolecon.2009.07.017.
Bryman, A., Bell, E., 2007. Business Research Methods. Oxford University Press, Oxford.
Buckley, R., 2002. Tourism ecolabels. Ann. Tour. Res. 29, 183–208. http://dx.doi.org/10.1016/S0160-7383(01)00035-4.
Budeanu, A., 2007. Sustainable tourist behaviour – a discussion of opportunities for change. Int. J. Consum. Stud. 31, 499–508.
Castka, P., Corbett, C., 2016. Governance of eco-labels: expert opinion and media coverage. J. Bus. Ethics 135 (2), 309–326.
CheapTickets.nl, 2016. http://www.cheaptickets.nl/ (Accessed 13 March 2016).
Chkanikova, O., Lehner, M., 2015. Private eco-brands and green market development: towards new forms of sustainability governance in the food retailing. J. Clean. Prod. 107, 74–84.
Cohen, S., Higham, E., 2011. Eyes wide shut? UK consumer perception of aviation climate impacts and travel decisions to New Zealand. Curr. Issues Tour. 14, 323–335. http://dx.doi.org/10.1080/13683501003653387.
De Boer, J., 2003. Sustainability labelling schemes: the logic of their claims and their functions for stakeholders. Bus. Strategy Environ. 12, 254–264. http://dx.doi.org/10.1002/bse.362.
Delmas, M., Lessem, N., 2014. Eco-premium or eco-penalty? Eco-labels and quality in the organic wine market. Bus. Soc 1–39.
Delmas, M., Nairn-Birch, N., Balzarova, M., 2013. Choosing the right eco-label for your product. MIT Sloan Manag. Rev. 54 (4), 10–12.
D'Souza, C., Taghian, M., Lamb, P., Peretiatko, R., 2007. Green decisions: demographics and consumer understanding of environmental labels. Int. J. Consum. Stud. 31, 371–376. http://dx.doi.org/10.1111/j.1470-6431.2006.00567.x.
Eriksson, P., Kovalainen, A., 2008. Qualitative Methods in Business Research. Sage, London.
Fairweather, J., Maslin, C., Simmons, D., 2005. Environmental values and response to ecolabels among international visitors to New Zealand. J. Sustain. Tour. 13, 82–98. http://dx.doi.org/10.1080/17501220508668474.
Flybe, 2015a. http://www.flybe.com/corporate/sustainability/eco_labelling_scheme.htm (Accessed 9 November 2015).
Flybe, 2015b. http://www.flybe.com/pdf/eco_labels_make_own.pdf (Accessed 9 November 2015).
Font, X., 2002. Environmental certification in tourism and hospitality: progress, process and prospects. Tour. Manag. 23, 197–205. http://dx.doi.org/10.1016/S0261-5177(1)00084-X.
Font, X., Buckley, R., 2001. Tourism Ecolabelling: Certification and Promotion of Sustainable Management. CABI, Wallingford.
Gallastegui, I., 2002. The use of eco-labels: a review of the literature. Eur. Environ. 12, 316–331. http://dx.doi.org/10.1002/eet.304.
Gössling, S., Buckley, R., 2016. Carbon labels in tourism: persuasive communication? J. Clean. Prod. 111, 358–369. http://dx.doi.org/10.1016/j.jclepro.2014.08.067.
Gössling, S., Peeters, P., 2007. It does not harm the environment! an analysis of industry discourses on tourism, air travel and the environment. J. Sustain. Tour. 15, 402–417. http://dx.doi.org/10.2167/jost672.0.
Gössling, S., Broderick, J., Upham, P., Ceron, J.-P., Dubois, G., Peeters, P., Strasdas, W., 2007. Voluntary carbon offsetting schemes for aviation: efficiency, credibility and sustainable tourism. J. Sustain. Tour. 15, 223–248. http://dx.doi.org/10.2167/jost758.0.
Gössling, S., Haglund, L., Kallgren, H., Revahl, M., Hultman, J., 2009. Swedish air travellers and voluntary carbon offsets: towards the co-creation of environmental value? Curr. Issues Tour. 12, 1–9. http://dx.doi.org/10.1080/13683500802220687.
Grankvist, G., Dahlstrand, U., Biel, A., 2004. The impact of environmental labelling on consumer preference: negative vs. Positive labels. J. Consum. Policy 27, 213–230. http://dx.doi.org/10.1023/B:COPO.0000028167.54739.94.
Hagmann, C., Semeijn, J., Vellenga, D., 2015. Exploring the green image of airlines: passenger perceptions and airline choice. J. Air Transp. Manag. 43, 37–45. http://dx.doi.org/10.1016/j.jairtraman.2015.01.003.
Hahnel, U., Arnold, O., Waschto, M., Korcaj, L., Hillmann, K., Roser, D., Spada, H., 2015. The power of putting a label on it: green labels weigh heavier than contradicting product information for consumers' purchase decisions and post-purchase behavior. Front. Psychol. 6, 1–17. http://dx.doi.org/10.3389/fpsyg.2015.01392.
Hares, A., Dickinson, J., Wilkes, K., 2010. Climate change and the air travel decision of UK tourists. J. Transp. Geogr. 18, 466–473. http://dx.doi.org/10.1016/j.jtrangeo.2009.06.018.
Houe, R., Grabot, B., 2009. Assessing the compliance of a product with an eco-label: from standards to constraints. Int. J. Prod. Econ. 121, 21–38. http://dx.doi.org/10.1015/j.ijpe.2008.03.014.
House of Commons Treasury Committee, 2008. http://www.publications.parliament.uk/pa/cm200708/cmselect/cmtreasy/231/231.pdf (Accessed 9 November 2015).
Kozak, M., Nield, K., 2004. The role of quality and eco-labelling systems in destination benchmarking. J. Sustain. Tour. 12, 138–147. http://dx.doi.org/10.1080/09669580408667229.
Leire, C., Thidell, Å., 2005. Product-related environmental information to guide consumer purchases - review and analysis of research on perceptions, understanding and use among Nordic consumers. J. Clean. Prod. 13, 1061–1070. http://dx.doi.org/10.1016/j.jclepro.2004.12.004.
Loureiro, M., Lotade, J., 2005. Do fair trade and eco-labels in coffee wake up the consumer conscience? Ecol. Econ. 53, 129–138. http://dx.doi.org/10.1016/j.ecolecon.2004.11.002.
Lynes, J., Dredge, D., 2006. Going green: motivations for environmental commitment in the airline industry. A case study of Scandinavian airlines. J. Sustain. Tour. 14, 116–138 doi:10.1080.09669580608669048.
Marx, A., 2013. Varieties of legitimacy: a configurational institutional design analysis of eco- labels. Innov. Eur. J. Soc. Sci. Res. 26 (3), 268–287.
PR Newswire, 2008. http://www.prnewswire.com/news-releases/more-environmental-awareness-in-flight-thanks-to-energy-label-65116902.html (Accessed 9 November 2015).
Nilsson, H., Tuncer, B., Thidell, Å., 2004. The use of eco-labeling like initiatives on food products to promote quality assurance-is there enough credibility? J. Clean. Prod. 12 (5), 517–526.
Noblet, C., Teisl, M., Rubin, J., 2006. Factors affecting consumer assessment of eco-labeled vehicles. Transp. Res. Part D. 11, 422–431. http://dx.doi.org/10.1016/j.trd.2006.08.002.
Pedersen, E., Neergaard, P., 2006. Caveat emptor – let the buyer beware! environmental labelling and the limitations of 'green' consumerism. Bus. Strategy Environ. 15, 15–29. http://dx.doi.org/10.1002/bse.434.
Peeters, P., Schouten, F., 2006. Reducing the ecological footprint of inbound tourism and transport to Amsterdam. J. Sustain. Tour. 14, 157–171. http://dx.doi.org/10.1080/09669580508669050.
A Special Report of IPCC Working Groups I and II. In: Penner, J., Lister, D., Griggs, D., Dokken, D., McFarland, M. (Eds.), 1999. Aviation and the Global Atmosphere. Cambridge University Press, Cambridge.
Prado, A., 2013. Competition among self-regulatory institutions: sustainability certifications in the cut-flower industry. Bus. Soc. 52 (4), 686–707.
Puhakka, R., Siikamäki, P., 2012. Nature tourist's response to ecolabels in Oulanka PAN park. Finl. J. Ecotour 11, 56–73. http://dx.doi.org/10.1080/14724049.2011.647917.
Rahbar, E., Wahid, N., 2011. Investigation of green marketing tools' effect on consumers' purchase behavior. Bus. Strategy Ser. 12, 73–83. http://dx.doi.org/10.1108/17515631111114877.
Rex, E., Baumann, H., 2007. Beyond ecolabels: what green marketing can learn from conventional marketing. J. Clean. Prod. 15, 567–576. http://dx.doi.org/10.1016/j.jclepro.2006.05.013.
Sammer, K., Wüstenhagen, R., 2006. The influence of eco-labelling on consumer behavior – results of a discrete choice analysis for washing machines. Bus. Strategy Environ. 15, 185–199. http://dx.doi.org/10.1002/bse.522.
Silverman, D., 2006. Interpreting Qualitative Data. Sage, London.
Teisl, M., Roe, B., 2005. Evaluating the factors that impact the effectiveness of eco-labelling programmes. In: Krarup, S., Russell, C. (Eds.), Environment, Information and Consumer Behaviour. Edward Elgar, Cheltenham, pp. 65–90.
Teisl, M., Roe, B., Hicks, R., 2002. Can eco-labels tune a market? Evidence from dolphin- safe labeling. J. Environ. Econ. Manag. 43, 339–359. http://dx.doi.org/10.1006/jeem.2000.1186.
Testa, F., Iraldo, F., Vaccari, A., Ferrari, E., 2013. Why eco-labels can be effective marketing tools: evidence from a study of Italian consumers. Bus. Strategy Environ. 24, 252–265. http://dx.doi.org/10.1002/bse.1821.
Thøgersen, J., Haugaard, P., Olesen, A., 2010. Consumer responses to ecolabels. Eur. J. Mark. 44, 1787–1810. http://dx.doi.org/10.1108/03090561011079882.
Thomas Cook, 2015. http://www.thomascook.com/sustainable-tourism/looking-after-the-environment/ (Accessed 9 November 2015).
Tuomi, J., Sarajärvi, A., 2009. Laadullinen Tutkimus Ja Sisällönanalyysi. Liviano, Latvia.
van Amstel, M., Driessen, P., Glasbergen, P., 2008. Eco-labelling and information asymmetry: a comparison of five eco-labels in Netherlands. J. Clean. Prod. 16, 263–276. http://dx.doi.org/10.1016/j.jclepro.2006.07.039.
Young, W., Hwang, K., McDonald, S., Oates, C., 2010. Sustainable consumption: green consumer behavior when purchasing products. Sustain. Dev. 18, 20–31. http://dx.doi.org/10.1002/sd.394.

III

‘EACH FLIGHT IS DIFFERENT’: CARBON EMISSIONS OF SELECTED FLIGHTS IN THREE GEOGRAPHICAL MARKETS

by

Stefan Baumeister, 2017

Manuscript, accepted for publication in Transportation Research Part D: Transport and the Environment.

'Each flight is different': Carbon emissions of selected flights in three geographical markets

Stefan Baumeister [a, b]

[a] University of Jyväskylä, School of Business and Economics, P.O. Box 35, 40014 University of Jyväskylä, Finland (permanent address)

[b] University of California, Los Angeles, Institute of the Environment and Sustainability, P.O. Box 951496, Los Angeles, CA 90095, USA

stefan.c.baumeister@jyu.fi

Abstract

Air travel is considered the biggest individual climate sin. Avoiding flying, however, seems impossible. In this paper we argue that the flight a passenger chooses can be significant. For this purpose we compared the carbon emissions of selected flights in three geographical markets. We found tremendous differences in the environmental performance of individual flights. Furthermore, we also found that flying with the most modern aircraft or flying non-stop represents, in many cases, the least polluting option. Nevertheless, we were able to show that there are exceptions to this rule. Based on our results, we provide recommendations to the industry and for further research.

Keywords: Carbon calculators; climate change; flight choice; modern aircraft; non-stop flight.

1. Introduction

According to an article in the New York Times, air travel is considered the biggest individual climate sin (Rosenthal, 2013). Ironically, it is the middle-class that is the most environmentally aware (Alibeli and Johnson, 2009) but also the group who flies the most (Randles and Mander, 2009). Even though several studies found that consumers do identify air traveling as a cause of climate change (Bonini and Oppenheim, 2008; Brouwer et al., 2008) still there is little willingness to change the flying behavior or to sacrifice vacations for the environment's sake (Cohen and Higham, 2011; Lassen, 2010). For many, such changes would be considered a restriction of the personal freedom to travel (Becken, 2007). As Rosenthal (2010) argues, air passengers are caught in a "flying dilemma" where one's individual self-concept as an environmentally responsible consumer conflicts with the environmental impacts of frequent air travel. Though some consumers might act in environmentally conscious ways in everyday situations (e.g. by using public transport, recycling or going paperless), transferring these values to their flying behavior is considered to be difficult (Barr et al., 2009). Davison et al. (2014) clearly see a value-action gap when it comes to consumers' knowledge about the environmental impacts of air travel and their actual behavior. However, when looking at the barriers that prevent consumers from changing their behavior, as presented by Hares et al. (2010), it becomes obvious why the gap still exists: There is (a) a lack of alternatives to flying, (b) an unwillingness to change travel behavior and, (c) the contribution of one individual to climate change through air travel is seen as being insignificant.

While not to fly does not seem to be a feasible option, the question becomes whether there is a possibility to mitigate the environmental impacts by the way in which we fly. Miyoshi and Mason (2009) indicate that there is a difference between the environmental performances of individual

airlines. Based on that, we argue that choosing the right flight could have an impact on the environmental outcome of our flying behavior. In order to support this argument we have conducted carbon dioxide emissions calculations for selected flights in three geographic markets. We then compared these figures with the often stated goal of keeping global warming below 2 degrees Celsius, based on pre-industrial levels. According to the German Advisory Council on Global Change (2009), to achieve the climate goal, each human would only be allowed an annual climate budget of 2,300 kg CO_2. Nevertheless, only one-fourth (575 kg CO_2) could be spent on mobility. The first objective of this paper is to show that there are differences between flight options and that, from an environmental point of view, these differences are indeed significant. Making those differences visible to the consumer could have great potential for mitigating the environmental impacts of flying, because the consumer could actively choose flights that are less polluting. Although a fair amount of air passengers are able to differentiate between the environmental friendliness of airlines (Mayer et al., 2012), Gössling et al. (2009) also found that it would require expert knowledge in order to be able to compare the environmental performance of airlines or individual flights. All that an average air passenger can currently rely on are some general environmental measures, such as flying on modern and fuel-efficient aircraft or flying non-stop. The second objective of this paper is therefore to analyze the effectiveness of these environmental measures, with the help of carbon emissions calculations. This paper is structured as follows. We first discuss environmental measures in more detail. Next, we examine emissions calculations by discussing different approaches and the limitations of existing methods. We then present our calculation method. After that we proceed with the results of our study, followed by a conclusion with recommendations to the industry as well as for further research.

2. Environmental measures for air passengers

Previous literature investigating the mitigation of environmental impacts of air travel through behavioral change has mainly examined air passengers' motivation and willingness to pay for carbon offset (e.g. Mair, 2011; van Birgelen et al., 2011; Gössling et al., 2009) or discussed changes of travel behavior in terms of using alternative transportation modes or avoiding holidays overseas (e.g. Davison et al., 2014; Sgouridis et al., 2011; Higham and Cohen, 2011). Only a few studies have discussed the issue of mitigating environmental impacts through behavioral change by air passengers actively selecting airlines or flights that are less polluting (Mayer et al., 2012; Wittmer and Wegelin, 2012). However, those studies have mainly focused on the environmental image of airlines and how this might affect an air passenger's booking decision. Concrete environmental measures and their effectiveness in reducing carbon dioxide emissions have not yet been

investigated. Because the current literature lacks examples of environmental measures, we turned our attention to commonly shared knowledge and recommendations on how to choose an airline or flight that is less polluting. Table 1 illustrates recommendations provided by various environmental organizations for how the general public can reduce the environmental impacts of air transport. These recommendations range from choosing eco-friendly airlines all the way to the total avoidance of flights in general. When focusing on the measures relevant for air passengers in terms of choosing a flight that has fewer environmental impacts, two measures were mentioned the most often and by almost all the environmental organizations: flying on a modern and fuel-efficient aircraft and flying non-stop. Because these two environmental measures are seen as the most crucial for making environmentally conscious flight choices, we will focus our further investigation on them.

Table 1. Environmental measures provided by environmental organization regarding less polluting flights.

Environmental Organization	Environmental Measures
Brighter Planet	**Fly direct**, avoid business or first class, **fly on modern aircraft** with high load factor and freight share, pack light, find alternatives to flying
Union of Concerned Scientists	Fly economy class, use aircraft with economy class seating only, **fly non-stop**, **choose fuel-efficient airplanes**, avoid airports with long delays
Treehugger	**Use modern aircraft**, choose flights with very few or no premium seats and high load factors, avoid low cost carriers, use turbo prop aircraft
WWF	Choose flights with high load factors, **fly on more efficient aircraft**, buy carbon offset, avoid short-haul flights, take vacations closer to home
Smart Travel	**Fly non-stop**, **choose efficient airplanes**, choose airports with fewer delays, buy carbon offset, use airlines testing biofuels
Friends of the Earth	Fly less frequently, avoid short-haul flights, search for alternative transportation modes, spend vacations closer to your home
Ecolife	Avoid business or first class, **fly non-stop**, use e-ticketing, reduce baggage weight, recycle onboard waste in the airport, use restroom before boarding, pay for carbon offset
Greenpeace	Avoid flying, search for alternative transportation options, don't use short-haul flights
Ecology Center	**Fly non-stop**, avoid short-haul flights, search for alternatives transportation, spend vacations closer to home
Sustainable Travel	**Avoid stopovers**, look for alternative travel modes, pack lightly, use restroom before getting on board, purchase carbon offset, recycle during the flight, avoid long-haul short-stay trips

Source: Environmental organization websites (accessed January 2015).

3. Carbon calculators

In recent years, a number of carbon calculators have become available, which made the environmental impact of flying more easily measurable. Unfortunately, there is a lack of consistency and different calculators produce different outcomes for the same journey (Miyoshi and Mason, 2009) as is shown in Table 2. So far no consensus exists on how to calculate the carbon emissions produced from air transportation. Nevertheless, as Jardine (2009) found, all aviation carbon calculators broadly utilize the same methodology.

Table 2. Results of different carbon calculators for a New York (JFK) to Helsinki (HEL) flight.

JFK-HEL (Economy)	ICAO	Climate Care	Atmosfair	Finnair	Our approach
Distance	6,603 km	6,607 km	6,653km	6,962km	6,750 km
CO_2 (kg)/p	426.49 kg	920.00 kg	640.00 kg	379.44 kg	395.99 kg

Sources: ICAO, 2015; Climate Care, 2015; Atmosfair, 2015; Finnair, 2015.

However, while the methodologies applied in the carbon calculators are similar, there are huge differences in the data they use. These differences can range from the use of simplified data indicating only short-, medium- and long-haul aircraft, as in the case of the UK Department for Environment, Food & Rural Affairs (DEFRA) calculator (DEFRA, 2012), to the use of actual fuel data, as in the case of Finnair's Emissions Calculator (Finnair, 2015). Table 3 illustrates the range of inputs different carbon calculators utilize. In addition, the data itself can be acquired from various sources, including both publically available sources and private ones. While data regarding distance, aircraft type, freight factor, passenger load factor and seating configuration is to a certain extend publically available, the actual fuel consumption is not. To our knowledge, only the Finnair Emissions Calculator utilizes actual fuel data, while all other carbon calculators have to rely on average data. However, software exists (e.g. Piano-X or FAA's AEDT) that is able to precisely model the fuel consumption of individual airplanes by also taking critical parameters into account such as weight, speed and flight level (Piano-X, 2008). Unfortunately, these programs are not freely available. Therefore most of the carbon calculators rely on data that come from publicly available emissions inventory guidebooks. A widely used guidebook is EMEP/Corinair, published by the European Environment Agency (EEA, 2007), which provides fuel consumption data of 44 aircraft types over 16 stage lengths. Fuel data is provided for the entire flight, including taxiing, take-off, climb, cruise, approach and landing. This method also accounts for the fact that short-haul flights burn more fuel per kilometer due to the energy intense take-off and rather short cruise. The same applies to ultra-long haul flights because of the additional weight of the fuel that needs to be carried

to fly the longer distance. Nevertheless, EMEP/Corinair does not provide any information on fuel consumption based on different weights, speeds and flight levels, all of which certainly have an influence on the fuel consumption as well (Filippone, 2008).

Table 3. Key features of different carbon calculators.

Parameter	ICAO	DEFRA	Finnair	Our approach
Great circle distance correction	Up to 11%	9%	5% + 20km	Up to 11%
Plane type	50 aircraft types, some representative	3 aircraft types, short, medium and long-haul	Actual aircraft	75 aircraft types, no representatives
Fuel burn data	EMEP/ Corinair	EMEP/ Corinair	Real data	EMEP/EEA
Freight factor	Wide body: 72.9%–90.3% Narrow body: 91.7%–99.6%	Domestic: 99.8% Short-haul: 99.4% Long-haul: 88.1%	Real data	Real data
Load factor	Wide body: 64.5%–83.6% Narrow body: 67.3%–81.8%	Domestic: 66.4% Short-haul: 83.4% Long-haul: 81.9%	Real data	Real data
Seat configuration	Number of economy seats that fit into the aircraft	Representative from CAA data	Real data	Real data

Sources: ICAO, 2014; DEFRA, 2012; Finnair, 2015.

In addition to many of the commonly used carbon calculators, numerous studies (e.g. Loo et al., 2014; Givoni and Rietveld, 2010; Winther et al., 2006; Romano et al., 1999) have based their calculations on the EMEP/Corinair database. A major drawback of the EMEP/Corinair inventory guidebook is that it does not distinguish between the different types within aircraft families (e.g. Airbus A319, A320) and has no data on newer aircraft models, such as the Airbus A380. In 2013, the EEA (2013) therefore published a revised version, the EMEP/EEA inventory guidebook, that contains 75 aircraft types featuring different types within the aircraft families and also includes newer aircraft models. We have based our calculations on this revised guidebook being now able to calculate with more accurate data by distinguish between different types within aircraft families.

The high relevancy of the EMEP/EEA fuel burn data was also confirmed by Park and O'Kelly (2014), who performed validation analysis by comparing the data with more sophisticated fuel burn data, determining a relationship of R^2 at 0.92. But even with the availability of detailed fuel data and actual flight data – such as distance, aircraft type, freight factor, passenger load factor and seating configuration – many carbon calculators still base their calculations on average data, providing users with only the CO_2 emissions of a so-called typical flight. As Miyoshi and Mason (2009) found, currently available carbon calculators treat all flights in the same manner, without distinguishing between the different environmental performances of individual airlines or flights. This problematic approach often starts with the aircraft type. Some carbon calculators use only a few generic types of aircraft instead of the specific aircraft that is operating the actual flight. This of course has consequences for the fuel burn and the amount of seats or passengers. Another common way of simplifying the calculations is the use of average passenger and freight load factors which, according to Miyoshi and Mason (2009), are often unrealistically high. Finally, most of the carbon calculators fail to distinguish between different seat layouts, which can differ tremendously between airlines and can certainly play an important role in terms of per passenger carbon emissions (Park and O'Kelly, 2014; Bofinger and Strand, 2013). While information on a typical flight might provide some estimation of how many CO_2 emissions a flight might produce, it does not allow air passengers to compare different flight options in the cases when there is more than one available. We argue that in order to make informed choices the carbon emissions of each and every flight needs to be calculated individually, which requires the utilization of all the actual and flight-specific data available. Once air passengers can compare individual flights based on their carbon dioxide emissions, they will be able to make environmentally conscious choices based on facts and not just on assumptions as discussed above.

Additionally, previous literature has not focused on the carbon emissions of individual flights but has instead looked on the CO_2 emissions of routes (Loo et al., 2014; Miyoshi, 2014; Hanandeh, 2013; Givoni and Rietveld, 2010; Miyoshi and Mason, 2009; Jamin et al., 2004) or airlines (Miyoshi, 2014; Miyoshi and Mason, 2009; Romano et al., 1999), mainly utilizing average data in terms of aircraft (Smith and Rodger, 2009), load factors (Miyoshi and Mason, 2009; Smith and Rodger, 2009; Gössling et al., 2005), seat configurations (Miyoshi and Mason, 2009; Smith and Rodger, 2009) or fuel burn per passenger-kilometer (Smith and Rodger, 2009; Peeters et al., 2007; Gössling et al., 2005; Jamin et al., 2004). With this study we want to go beyond average figures and show that significant differences exist between the environmental performance of individual flights even when operated by the same aircraft or the same airline on the same route.

4. Methods

Carbon dioxide emissions were calculated following the methodology provided by ICAO (2014). This methodology is most widely recognized within the aviation industry and has been adopted by many carbon calculators. Furthermore, in the existing literature many studies (e.g. Hanandeh, 2013; Lu and Shon, 2012) have utilized the ICAO method. However, as discussed earlier, the ICAO Carbon Emissions Calculator relies mainly on average data, while we wanted to base our calculations on actual data. Our approach therefore differs from the ICAO methodology because we acquired real traffic data from the United States Department of Transportation (USDOT) in order to calculate load factors, passenger-to-freight factors and the number of seats supplied on each flight. USDOT traffic data was available on a monthly basis and flight-specific data was collected by using the flight number as an indicator. The data used in this study was from April 2014.

The fuel data was calculated by interpolation, using a linear regression method. This was considered to be reasonable because the fuel consumption curve approaches a linear relationship to distance on medium- and long-haul flights. For short-haul flights, we applied the same method, which we considered to be appropriate because we had more accurate data available due to the smaller distance steps in the fuel database (125 nm, 250 nm, 500 nm, 750 nm). We are, however, aware that only real fuel data would result in accurate consumption figures. Nevertheless, comparing our results with that of Finnair's Emissions Calculator (see Table 2) gave us confidence in the accuracy of our calculation method. The Great Circle Distance (GCD) between the origin and destination was also acquired from the USDOT database. We used a correction factor in order to account for stacking, traffic and weather-driven diversion from the GCD. We hereby added 50 km to flights less than 550 km, 100 km to flights between 550 km and 5,500 km and 125 km to all flights longer than 5,500 km. To calculate carbon dioxide emissions per passenger, we used the following formula 1, as stated in the ICAO Carbon Emissions Calculator manual Version 7 (June 2014):

$$CO2\ per\ passenger = 3.157 * \frac{(total\ fuel * passenger\ to\ freight\ factor)}{(number\ of\ seats * passenger\ load\ factor)} \quad (1)$$

The constant of 3.157 represents hereby the number of tons of CO_2 produced when burning one ton of aviation fuel (Dings et al., 2003; Sutkus et al., 2001). The passenger-to-freight factor allocates how much of the total payload carried by the aircraft accounts for carrying the passengers. It is calculated by deducting freight and mail from the payload divided by the payload. The higher

the passenger-to-freight factor is, the less freight and mail is carried by the aircraft which means more of the total emissions produced by the flight have to be allocated to the passengers. The flight connection data was acquired from the Official Aviation Guide (OAG) Flight Schedule, which provided information on departure and arrival times, flight numbers, aircraft type and cabin classes. All CO_2 emissions were calculated on a per passenger or per passenger-kilometer basis. All calculations of emissions per passenger were made regardless of cabin class. We did this while also being aware that the carbon dioxide emissions of an air passenger flying in premium class can be up to eightfold higher than the emissions of a passenger flying in economy class due to the higher amount of space a premium class seat occupies (Bofinger and Strand, 2013). In addition to using actual data, we also performed some maximum efficiency calculations where all factors were maximized in order to show the potentials of efficiency improvements based on currently employed aircraft technology. In these calculations, load factors were set up to 100%, while the passenger-to-freight factor was decreased to 75.73% (wide body) or 83.92% (narrow body), which equals the lowest factors that could be found within the ICAO Carbon Emissions Calculator's manual, and the maximum amount of seats aircraft were designed for were applied. In order to compare the aircraft's seat configuration with the designed maximum seating capacity, we determined a so-called seat ratio. Cabin seat charts helped to map the seat configuration of various aircraft and the amount of seats in each cabin class. This information was obtained from Seat Guru, which features one of the largest collections of aircraft seat maps online. The maximum seating capacity of each aircraft used in the study was acquired from the aircraft manufacturers directly. Based on these data, the seat ratio was calculated using the following formula 2:

$$Seat\ Ratio = \frac{Actual\ amount\ of\ seats\ the\ aircraft\ is\ currently\ equipped\ with}{Maximum\ amount\ of\ seats\ the\ aircraft\ was\ designed\ for} \quad (2)$$

While previous studies have built their emissions calculations on a large amount of routes (e.g. Loo et al., 2014; Hanandeh, 2013; Miyoshi and Mason, 2009), we decided to focus on selected flights of three routes and to instead analyze these in-depth. Nevertheless, our routes cover three geographical markets of short-, medium- and long-haul flights. For the short-haul market, we chose the busiest domestic route in the United States, Los Angeles (LAX) to San Francisco (SFO). This route was of special interest for us because the variety of aircraft used on this route is large. Still, the route is not so short that it would be operated as non-stop only, providing the chance to compare non-stop flights with connecting flights on a short-haul route. For the medium-haul route we chose

the second busiest medium-haul route in the United States, Los Angeles (LAX) to New York (JFK). This route was chosen over Miami (MIA) to New York (NYC) because of the much greater diversity of operators and aircraft used on the LAX to JFK route. For the long-haul route we chose Los Angeles (LAX) to London (LHR), which is the third busiest U.S. international route after New York (JFK) to London (LHR) and Honolulu (HNL) to Tokyo (NRT). We chose this route over the others because it offers more connecting flights than the other two routes. In addition, the diversity of operators and aircraft was higher, giving more opportunities to compare different operators and aircraft. On the short- and medium-haul routes we did not analyze all flights but chose instead a time frame for departures that allowed us to include all major operators and the most common aircraft used on these particular routes. For the Los Angeles to San Francisco route we analyzed all departures between 10 a.m. and 12 p.m. and on the Los Angeles to New York (JFK) route we chose all departures between 6 a.m. and 7 a.m. On the long-haul route we considered all late afternoon departures that took place between 5 p.m. and midnight. On all three routes, all direct flights and all connecting flights that were listed on the OAG Flight Schedule were taken into consideration. Even flight connections that required longer detours were taken into account because they might be appealing to some air passengers due to lower airfares or loyalty to an airline that does not offer a non-stop flight. However, only flights were considered that operated at least five times a week. We calculated carbon emissions for each and every individual flight. Altogether, 68 flight connections operated by 118 different flights, connecting our three chosen city pairs, were included in this study.

5. Results & discussion

Figure 1 shows the total CO_2 emissions in kilograms per passenger for all 68 connections analyzed in this study. The figure illustrates clearly that which flight option passengers choose can make a huge difference because the emissions per passenger between the most efficient flight and the least efficient flight differ significantly. In the case of the short-haul route from Los Angeles to San Francisco, emissions range from 71 kg of CO_2 per passenger for a direct flight up to more than five times or 374 kg for a connecting flight via Dallas/Fort Worth. On the medium-haul route from Los Angeles to New York JFK, emissions range from 277 kg on a direct flight up to 659 kg on a connecting flight via San Francisco. In the case of a long-haul flight from Los Angeles to London Heathrow, emissions range from 594 kg for a non-stop flight up to 1,207 kg of CO_2 with a transfer through Istanbul. When these figures are brought into perspective with the often stated goal of keeping global warming below 2 degrees Celsius, the differences in emissions become even more significant. All one-way flights from Los Angeles to London exceed the goal of 575 kg of CO_2 and

even some of the most inefficient one-way flights from Los Angeles to New York are close to doing so. In Figure 1, it is also of interest to note that some medium-haul flights from Los Angeles to New York nearly reach and in some cases even exceed the per passenger emissions of a long-haul flight from Los Angeles to London. This is remarkable because the distance between those two city pairs is more than twice as long.

5.1. Flying the most modern aircraft

As shown above it certainly matters which flight passengers take, especially when we look at it from a broader perspective such as climate change. One option to reduce carbon dioxide emissions often discussed in the literature (e.g. Davison et al., 2014; Mayer et al., 2012; Cowper-Smith and de Grosbois, 2011) is to fly on a modern and fuel-efficient airplane. With every new aircraft generation, the fuel efficiency increases, which results in a lower carbon dioxide emission per passenger.

Figure 2 shows the maximum efficiency carbon dioxide emissions per passenger-kilometer of all intra-North American flights used in this study (blue bar). It then compares these emissions with the actual emissions these flights produced based on the actual data (blue + red bar). In this way, all relevant parameters for the emissions calculations, such as fuel consumption, load factor, passenger-to-freight factor and seat ratio are added, through which the differences in performance can be explained. When we first look at the maximum efficiency (blue bar), we can certainly see that the most modern aircraft just recently introduced by American Airlines, the Airbus A321ER Transcontinental, would outperform all the older aircraft emitting only 42 g of CO_2 per passenger-kilometer. The oldest aircraft, in this case the McDonnell Douglas MD-88, doubles this value by almost 74 g. Were all flights to be operated in the most efficient manner, flying on the most modern aircraft would be the best choice.

However, as the actual numbers (blue + red bar) show, the reality looks different. The brand new American A321ER emits 138 g of CO_2 per passenger-kilometer, 22 g more than the Delta McDonnell Douglas MD-88, designed in the 1980s. While the load factor and the passenger-to-freight factor of both flights are almost equal, the A321ER shows a much lower seat ratio than the MD-88. The A321ER seats only 102 passengers in a three-class configuration, which is less than half of the 240 seats the aircraft was designed for. The MD-88 instead has quite dense seating, with 149 out of 172 possible seats in a two-class configuration. Among the most efficient flights are the ones operated on the Airbus A321 by JetBlue Airways and US Airways. All three flights show relatively high load factors, high seat ratios and low passenger-to-freight factors. The Delta 757-300 also displayed good performance due to its high load factor of 96%.

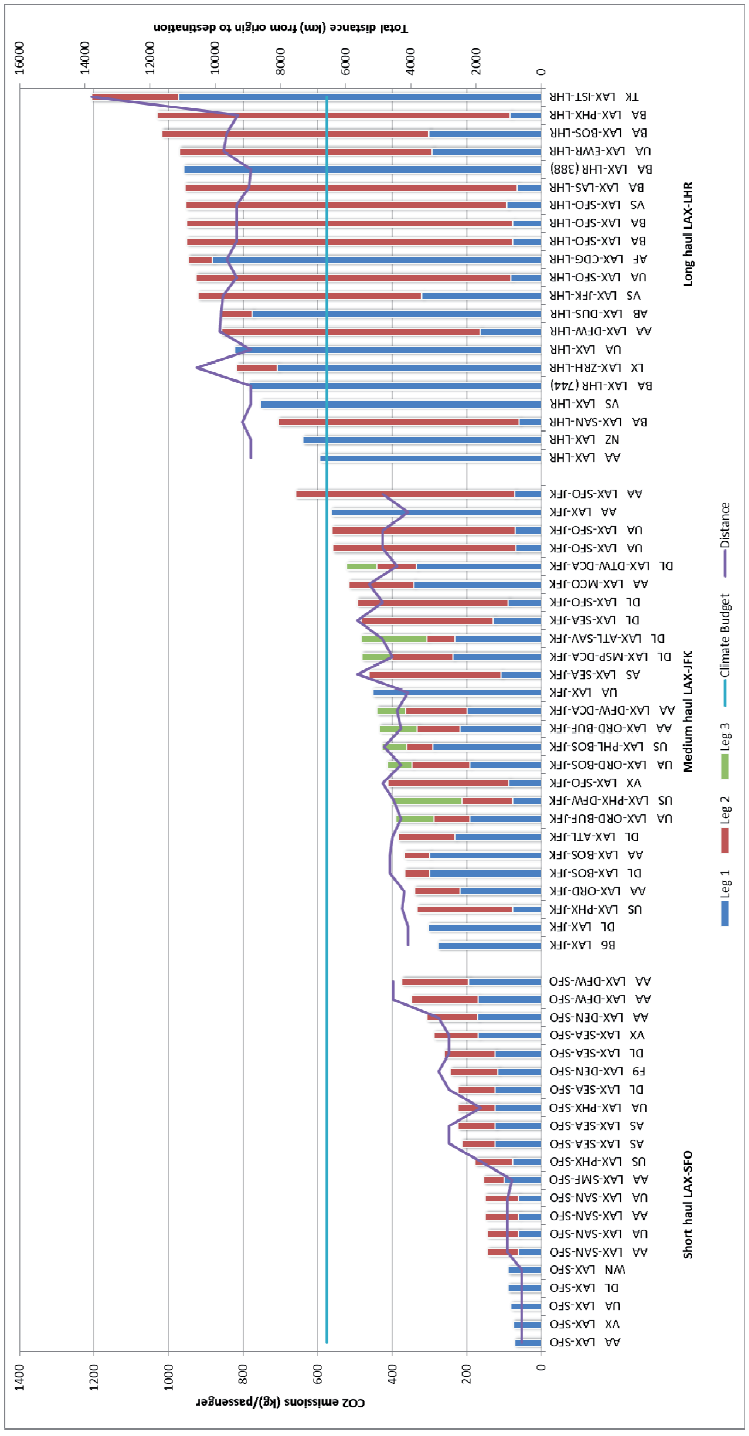


Fig. 1. CO_2 emissions (kg)/passenger of selected flights in three geographical markets.

Figure 2 reveals a clear trend for low performing flights, which either have a low load factor or a low seat ratio. The only exception is the MD-88. In this case, the passenger-to-freight factor does not play a large role, because narrow body aircraft in general do not carry much freight or mail. The only exception seen in Figure 2 is the Delta Boeing 767-300, which shows a low passenger-to-freight factor that helps compensate for the low seat ratio of only 64%.

Figure 3 shows similar results. For long-haul flights when comparing the different flights in the maximum efficiency scenario (blue bar), we can see that twin-engine aircraft (B777, B767 and A330) certainly outperform the larger four-engine jets (A340, B747 and A380). The only exception is the Turkish Boeing 777-300ER. However, the higher CO_2 emissions per passenger-kilometer can be explained by the fact that this flight is significantly longer than the others and therefore has to carry additional fuel, which makes the aircraft heavier. Even though the differences between the flights displayed are not that large, a clear trend can be detected towards more modern aircraft performing better than older ones, for example when comparing the A380 with the Boeing 747. However, the picture changes completely once we examine actual performance (blue + red bar).

Now the Boeing 747-400 actually produces fewer carbon dioxide emissions per passenger-kilometer than the next generation A380, both operated by British Airways on the very same route. This result is because the 747 operates with a higher load factor and carries more freight than the A380. But also flights operated with the same aircraft can differ tremendously, as we can see in the example of two British Airways flights both operated by Boeing 777-200. While the first flight emits 134 g of CO_2 per passenger-kilometer, the second flight emits only 72 g of carbon dioxide. This gap is because the second flight has 50 seats more due to the absence of a first class and a smaller business class section. In addition, it is also much better occupied and carries more freight and mail than the first flight.

Figure 4 compares the total carbon dioxide emissions per passenger on three short-haul routes. In contrast to medium- and long-haul flights where CO_2 emissions are almost linear to distance, this is not the case for short-haul flights where the take-off is rather energy intense compared to the much shorter cruise. We were therefore unable to compare short-haul flights of various lengths on a passenger-kilometer base. Once again, when looking at the maximum efficiency scenario (blue bar), modern aircraft lead the way. For example, on the Los Angeles to San Francisco route the modern Boeing 737-800 shows the best performance while its predecessor the 737-300 emits 28% more carbon dioxide per passenger. The two other routes in Figure 4 reveal another interesting phenomenon: in both cases regional jets show much higher carbon dioxide emissions per passenger than other aircraft even though the regional jets in this comparison are fairly modern.

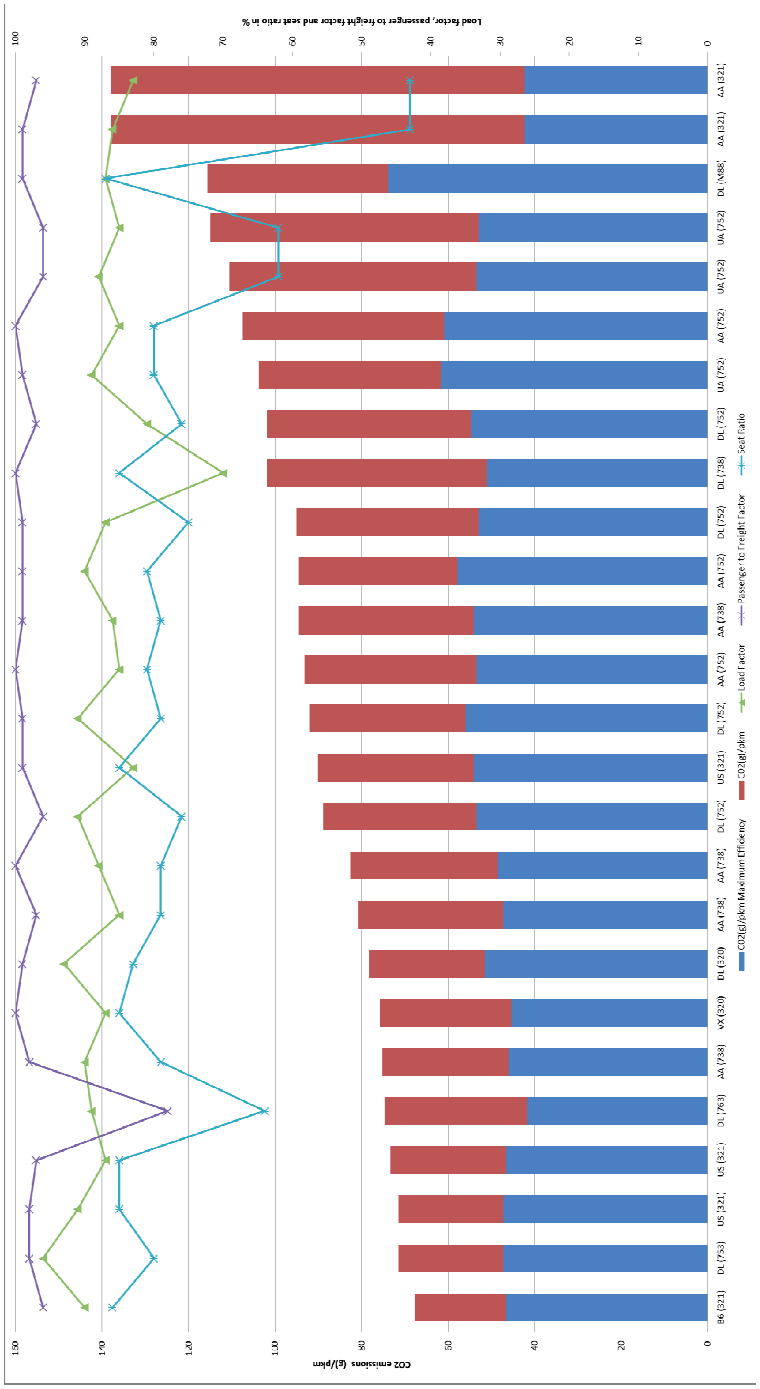


Fig. 2. CO_2 emissions (g)/pkm on selected U.S. medium-haul flights.

This confirms earlier studies by Babikian, Lukachko and Waitz (2002), who found that regional jets are 40–60% less fuel efficient than larger narrow- and wide-body jet aircraft and 10–60% less efficient than turboprop planes. On the Los Angeles to Phoenix route, the Airbus A321 emits only 77 kg of CO_2 per passenger while the Canadair Regional Jet 700 accounts for 123 kg. On the Los Angeles to San Diego route, the turboprop Embraer 120 outperforms the Canadair Regional Jet 200 by 25% even with a 4% lower load factor. Unfortunately, turboprop aircraft are often considered to be old-fashioned while regional jets are perceived to be more modern, making them appear more efficient although they are not.

5.2. Flying non-stop

A second option to reduce carbon emissions often discussed is to avoid stopovers because they increase the distance travelled and require additional landing and take-off (LTO) cycles. Jamin et al. (2004), for example, found that an average of 10% in fuel burn and CO_2 emissions reduction could be achieved when substituting a connecting flight with a direct flight on U.S. domestic routes, with 4% accounting for the shorter flight distance and 6% for the additional LTO cycle. When the most efficient flights in all three markets are considered, as displayed in Figure 1, it confirms that the most efficient flights are also the ones without stopovers. Especially in the short-haul market, connecting flights cannot compete with non-stop flights in terms of carbon dioxide emissions. In the case of the medium-haul market, however, the picture looks different. Here even flights with two stopovers perform better than some of the non-stop flights, which is certainly an unexpected finding. In fact, two of the four non-stop flights were outperformed by many flights with two stopovers as well as by flights with large detours of more than 1,500 kilometers, such as the Alaska Airlines flight via Seattle. Similar results can also be reported from the long-haul market. Even though several non-stop flights lead the market, some of the non-stop flights were outperformed by connecting flights. However, the vast majority of connecting flights did show higher carbon dioxide emissions. An interesting observation was also made among the two North Atlantic Airbus A380 flights operated by British Airways and Air France. Even with a stopover in Paris that requires a 742 km long detour and an additional LTO cycle, the Air France flight still emits 12 kg of CO_2 per passenger less than the non-stop British Airways service. The answer to this surprising result can be found in Figure 3 in which both flights are directly compared to each other on the basis of carbon dioxide emissions per passenger-kilometer. Not only does the Air France flight have a higher load factor of 91% versus 86%, but it also shows a higher seat ratio with altogether 516 seats while British Airways only has 469 seats on board its A380.

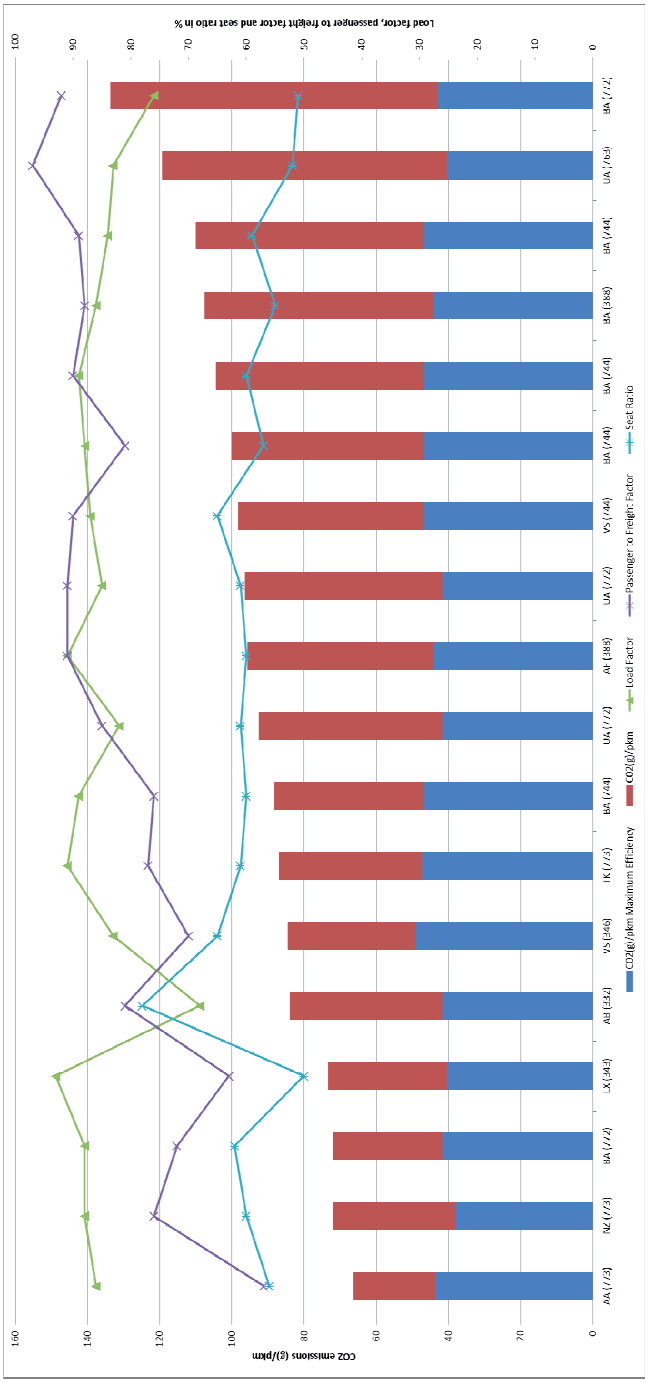


Fig. 3. CO_2 emissions (g)/pkm on selected North Atlantic flights.

Even though the difference between these two flights does not appear to be large, it certainly ranges on the level of an additional short-haul flight from Paris to London. This finding confirms what Loo et al. (2014) found, namely, that applying a hub-and-spoke operation can indeed reduce environmental impacts due to the fact that bundling passenger streams can lead to the use of larger aircraft and higher load factors. Flying non-stop does not always represent the cleanest option.

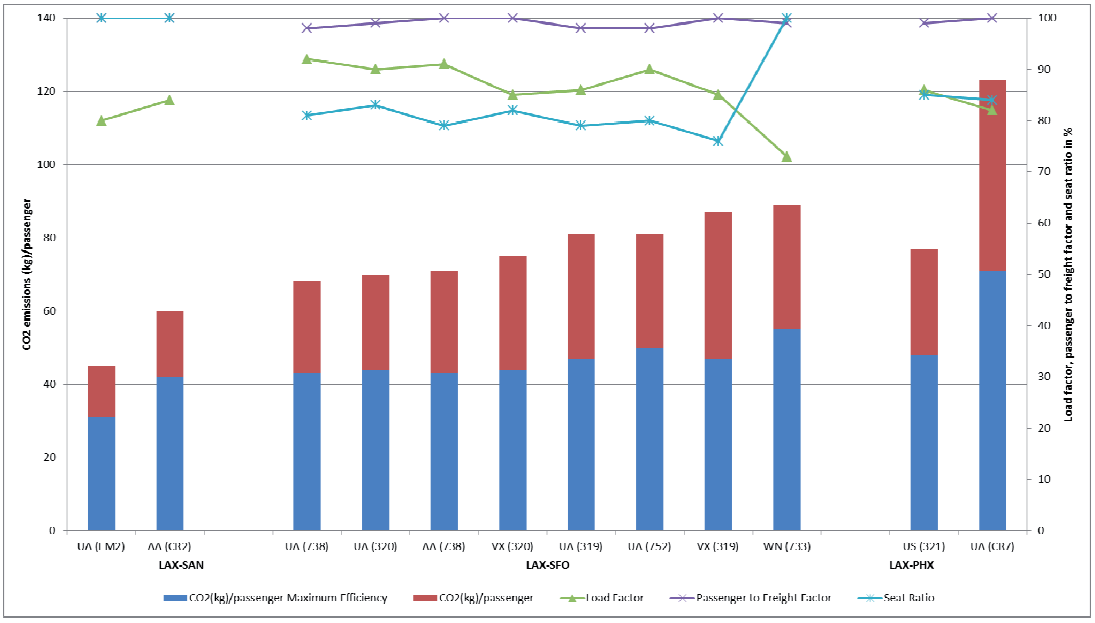


Fig. 4. CO_2 emissions (kg)/passenger on selected short- and medium-haul flights in the U.S.

6. Conclusion

This study set out to investigate whether the flights air passengers select really can make a difference in terms of environmental impacts. It further examined whether general environmental measures such as flying on modern, fuel-efficient aircraft and flying non-stop are really effective in mitigating the environmental impacts of individual air passengers.

The study found that there are clear differences between flights, because the carbon emissions per passenger can vary tremendously. The relevancy of this finding becomes especially obvious when the calculated emissions are observed from the broader perspective of climate change. Unfortunately, there are currently no carbon calculators available that allow air passengers to

compare individual flight options. The current calculators rely too heavily on average data in terms of fuel burn, load factors, passenger-to-freight factors and seat layouts. The results clearly indicated that only when calculating with real data can the differences in the environmental performance of flights be made visible. This clearly shows the limitation of existing carbon calculators as tools for air passengers to make informed choices about which flight to choose. To date, air passengers who want to mitigate their environmental impact of flying have to rely on some environmental measures, such as using modern and fuel efficient aircraft or flying non-stop. However, the results suggested that sometimes these measures do not correctly indicate the true environmental impact of individual flights because there are exceptions to this rule. Therefore, it can be concluded that these two measures do not necessarily provide the full picture to the environmentally concerned air passenger.

The problem remains that air passengers are currently not able to choose flights that generate lower carbon dioxide emissions per passenger. We therefore see a clear need for more credible information to be provided to air passengers in an easy-to-understand way at the time of booking. Sometimes just choosing one flight over another, while both having similar departure and arrival times or ticket prices, can make a real difference in terms of an air passenger's individual carbon footprint. At the same time, this choice can also send a strong signal to airlines operating flights that emit more carbon dioxide per passenger, making them alter their operations because demand might otherwise shift to more eco-friendly airlines. An eco-label, as proposed by Baumeister and Onkila (2017), providing information on the environmental performance could be one way to provide information to air passengers at the time of booking. Such an eco-label would give them the opportunity to make better informed choices and actively select cleaner flight options if they want to do so. Further research should examine ways to better inform air passengers about the environmental impacts of individual flights as well as methods to address the environmental impacts of aviation through a market-driven approach.

Funding

This work was supported by an ASLA-Fulbright Graduate Grant and two grants from the Foundation for Economic Education, Helsinki (grant numbers 2-970-35, 4-2175-22).

References

Alibeli, M.A., Johnson, C., 2009. Environmental Concern: A Cross National Analysis. Journal of International and Cross-Cultural Studies 3, 1–10.

Atmosfair, 2015. Calculate Emissions. https://www.atmosfair.de/en/kompensieren/flug

Babikian, R., Lukachko, S.P., Waitz, I.A., 2002. The historical fuel efficiency characteristics of regional aircraft from technological, operational, and cost perspectives. Journal of Air Transport Management 8, 389–400.

Barr, S., Shaw, G., Coles, T., Prillwitz, J., 2009. 'A holiday is a holiday': practicing sustainability, home and away. Journal of Transport Geography 18, 474–481.

Baumeister, S., Onkila, T., 2017. An eco-label for the airline industry? Journal of Cleaner Production 142, 1368-1376.

Becken, S., 2007. Tourists' Perception of International Air Travel's Impact on the Global Climate and Potential Climate Change Policies. Journal of Sustainable Tourism 15, 351–368.

Bofinger, H., Strand, J., 2013. Calculating the Carbon Footprint from Different Classes of Air Travel. The World Bank, Development Research Group Environment and Energy Team.

Bonini, S., Oppenheim, J., 2008. Cultivating the Green Consume. Stanford Social Innovation Review Fall 2008, 56–61.

Brighter Planet, 2010. Flying Greener: Understanding and reducing the climate impact of business air travel. http://www.etctravel.com/fly_green.pdf

Brouwer, R., Brander, L., Van Beukering, P., 2008. „A convenient truth": air travel passengers' willingness to pay to offset their CO_2 emissions. Climatic Change 90, 299–313.

Climate Care, 2015. Carbon Calculator. http://www.climatecare.org/home.aspx

Cohen, S., Higham, E., 2011. Eyes wide shut? UK consumer perception of aviation climate impacts and travel decisions to New Zealand. Current Issues in Tourism 14, 323–335.

Cowper-Smith, A. and de Grosbois, D., 2011. The adoption of corporate social responsibility practices in the airline industry. Journal of Sustainable Tourism 19, 59–77.

Davison, L., Littleford, C., Ryley, T., 2014. Air travel attitudes and behaviors: the development of environment-based segments. Journal of Air Transport Management 36, 13–22.

DEFRA [Department for Environment, Food & Rural Affairs], 2012. 2012 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting: Methodology Paper for Emission Factors, July 2012.

Dings, J., Wit, R., Leurs, B., Davidson, M., Fransen, W., 2003. External Costs of Aviation, German Federal Environmental Agency, Berlin, 2003.

Eco Life, 2015. Book your Air Travel with a Green Airline. http://www.ecolife.com/travel/air-travel/choosing-a-green-airline.html

Ecology Center, 2015. Tips for Eco-friendlier travel. http://ecologycenter.org/factsheets/travel_tips/

EEA [European Environment Agency], 2007. EMEP/CORINAIR Emissions Inventory Guidebook - 2007, EEA, Brussels, 2007.

EEA [European Environment Agency], 2013. EMEP/EEA Air Pollutant Emissions Inventory Guidebook - 2013, EEA, Brussels, 2013.

Filippone, A., 2008. Analysis of Carbon-Dioxide Emissions from Transport Aircraft. Journal of Aircraft 45, 185–197.

Finnair, 2015. Emissions Calculator. http://www.finnair.com/FI/FI/emissions-calculator

Friends of the Earth, 2015. Aviation and global climate change. http://www.foe.co.uk/sites/default/files/downloads/aviation_climate_change.pdf

German Advisory Council on Global Change, 2009. Solving the climate dilemma: The budget approach, WBGU, Berlin, 2009.

Givoni, M., Rietveld, P., 2010. The environmental implications of airlines' choice of aircraft size. Journal of Air Transport Management 16, 159–167.

Greenpeace, 2015. Aviation: Frequently Asked Questions. http://www.greenpeace.org.uk/climate/aviation/faq

Gössling, S., Peeters, P., Ceron, J-P., Dubois, G., Patterson, T., Richardson, R., 2005. The eco-efficiency of tourism. Ecological Economics 54, 417–434.

Gössling, S., Haglund, L., Kallgren, H., Revahl, M., Hultman, J., 2009. Swedish air travellers and voluntary carbon offsets: towards the co-creation of environmental value? Current Issues in Tourism 12, 1–9.

Hanandeh, A.E., 2013. Quantifying the carbon footprint of religious tourism: the case of Hajj. Journal of Cleaner Production 52, 53–60.

Hares, A., Dickinson, J., Wilkes, K., 2010. Climate change and the air travel decision of UK tourists. Journal of Transport Geography18, 466–473.

Higham, J., Cohen, S., 2011. Canary in the coalmine: Norwegian attitudes towards climate change and extreme long-haul air travel to Aotearoal/New Zealand. Tourism Management 32, 98–105.

ICAO [International Civil Aviation Organization], 2014. Carbon Emissions Calculator Methodology Version 7, June 2014.

ICAO [International Civil Aviation Organization], 2015. Carbon Emissions Calculator. http://www.icao.int/environmental-protection/CarbonOffset/Pages/default.aspx

Jardine, C.N., 2009. Calculating the carbon dioxide emissions of flights, Environmental Change Institute, Oxford University Centre of the Environment, Oxford, 2009.

Jamin, S., Schafer, A., Ben-Akiva, M.E., Waitz, I.A., 2004. Aviation emissions and abatement policies in the United States: a city-pair analysis. Transportation Research Part D: Transport and Environment 9, 295–317.

Lassen, C., 2010. Environmentalist in Business Class: An Analysis of Air Travel and Environmental Attitude. Transport Review 30, 733–751.

Loo, B., Li, L., Psaraki, V., Pagoni, I., 2014. CO_2 emissions associated with hubbing activities in air transport: an international comparison. Journal of Transport Geography 34, 185–193.

Lu, J.-L., Shon, Z.Y., 2012. Exploring airline passengers' willingness to pay for carbon Offsets. Journal of Transportation Research Part D 17, 124–128.

Mair, J., 2011. Exploring air travellers' voluntary carbon-offsetting behavior. Journal of Sustainable Tourism 19, 215–230.

Mayer, R., Ryley, T., Gillingwater D., 2012. Passenger perceptions of the green image associated with airlines. Journal of Transport Geography 22, 179–186.

Miyoshi, C., 2014. Assessing the equity of the European Union Emission Trading Scheme on an African airline. Transport Policy 33, 56–64.

Miyoshi, C., Mason, K.J., 2009. The carbon emissions of selected airlines and aircraft types in three geographic markets. Journal of Air Transport Management 15, 138–147.

Park, Y., O'Kelly, M.E., 2014. Fuel burn rates of commercial passenger aircraft: variations by seat configuration and stage distance. Journal of Transport Geography 41, 137–147.

Peeters, P., Szimba, E., Dujinisveld, M., 2007. Major environmental impacts of European tourist transport. Journal of Transport Geography 15, 83–93.

Piano-X., 2008. User's guide. http://www.piano.aero/

Randles, S., Mander, S., 2009. "Practice(s) and ratchet(s): A sociological examination of frequent flying", in: Gössling, S. and Upham, P. (Eds.) Earthscan, London, pp. 245–271.

Romano, D., Gaudioso, D., De Lauretis, R., 1999. Aircraft emissions: a comparison of methodologies based on different data availability. Environmental Monitoring and Assessment 56, 51–74.

Rosenthal, E., 2010. Can we kick our addiction to flying? The Guardian (24. May, 2010). http://www.theguardian.com/environment/2010/may/24/kick-addiction-flying

Rosenthal, E., 2013. Your Biggest Carbon Sin May Be Air Travel. New York Times (26. January, 2013). http://www.nytimes.com/2013/01/27/sunday-review/the-biggest-carbon-sin-air-travel.html?_r=0

Smart Travel, 2015. Easy Ways to Fly Green. http://www.smartertravel.com/blogs/today-in-travel/infographic-easy-ways-to-fly-greener.html?id=18258346

Smith, I.J., Rodger, C.J., 2009. Carbon emission offsets for aviation-generated emissions due to international travel to and from New Zealand. Energy Policy 37, 3438–3447.

Sgouridis, S., Bonnefoy, P.A., Hansman, R.J., 2011. Air transportation in a carbon constrained world: Long-term dynamics of policies and strategies for mitigating the carbon footprint of commercial aviation. Transport Research Part A 45, 1077–1091.

Sustainable Travel, 2015. To fly or not to fly.
http://www.responsibletravelreport.com/component/content/article/2647-to-fly-or-not-to-fly

Sutkus, D., Baugcum, S., DuBois, D., 2001. Scheduled Civil Aircraft Emissions Inventories for 1999: Database Development and Analysis, NASA/CR-2001-211216, Washington DC, 2001.

Treehugger, 2015. Greener Flying: Not all flights are created equal.
http://www.treehugger.com/aviation/greener-flying-not-all-flights-are-created-equal-part-1-of3.html

Union of Concerned Scientists, 2008. Getting There Greener: The Guide to Your Lower-Carbon Vacation, Cambridge, 2008.

van Birgelen, M., Semeijn, J., Behrens, P., 2011. Explaining pro-environmental consumer behavior in air travel. Journal of Air Transport Management 17, 125–128.

Winther, M., Kousgaard, U., Oxbol, A., 2006. Calculation of odour emissions from aircraft engines at Copenhagen Airport. Science of the Total Environment 366, 218–232.

Wittmer, A., Wegelin, L., 2012. Influence of Airlines' Environmental Activities on Passengers. Journal of Air Transport Studies 3, 73–99.

WWF [World Wide Fund], 2015. Travel light.
http://wwf.panda.org/how_you_can_help/live_green/travel/

IV

THE EFFECT OF AN ECO-LABEL ON THE BOOKING DECISIONS OF AIR PASSENGERS

by

Stefan Baumeister & Alex M. Hoffendahl, 2017

Manuscript under review at Journal of Air Transport Management.

The effect of an eco-label on the booking decisions of air passengers

Abstract

In the last few years there has been an increasing attempt to find solutions on how to mitigate the environmental impacts of air travel. Behavioral change has been identified as the key driver. One way to encourage behavioral change is the use of eco-labels. Eco-labels have, to date, received scant attention in the aviation industry, and their effect on air travel behavior is still widely unknown. This study explores the effect of an eco-label on the booking decisions of passengers. We have conducted a discrete choice experiment with 554 air passengers. Our findings showed that providing passengers with an eco-label alone did not lead to behavioral change, because only environmentally minded passengers responded to the label. However, providing additional information on the eco-label did lead to a change in behavior, because it significantly increased the preference for more environmentally friendly flights. At the same time, it also increased the willingness to pay more for a less polluting flight. Based on our results, we provide recommendations to the industry and for further research.

Keywords: Eco-label; behavioral change; choice experiment; booking flight; green flight choice; willingness to pay.

1. Introduction

Air travel is one of the most energy intensive forms of transportation, with huge environmental impacts. Its major impacts are noise, local air pollution, and greenhouse gas emissions, the latter of which has the most significant long-term impact in its contribution to climate change (Green, 2003). While the aviation industry currently accounts for about 3.5% of the total CO_2 emissions worldwide (Penner et al., 1999), it is growing at a very fast rate of about 5% annually, doubling its size every 20 years (Cohen and Higham, 2011; Dubois and Ceron, 2006). Over the past four decades technical improvements were able to compensate for the tremendous growth of the industry, keeping its overall impacts rather constant (Green, 2003; Penner et al. 1999). However, by today the efficiency potentials are nearly exhausted because the current technology has reached its maturity (Gössling and Peeters, 2007). In order to achieve significant efficiency gains, a totally new aircraft design would be needed (Åkerman, 2005). The implementation, however, would take decades because this transition would require major changes in infrastructure at airports around the globe (Green, 2003).

In order to mitigate the environmental impacts of aviation, we should therefore not only rely on technical improvements, but consider other measures as well. In addition to technological changes, there exist other instruments, such as market-based changes or behavioral change (Hares et al., 2010). Market-based changes have been discussed widely in the past decade. Prominent examples of these include emissions trading schemes (e.g., EU-ETS) or the use of carbon offsets. Nevertheless, the measure that has been considered to have the most significant impact on reducing greenhouse gas emissions is behavioral change (Gössling et al., 2007). One approach to encouraging behavioral change is the use of eco-labels (Anderson et al., 2013).

Eco-labels provide buyers with information on the environmental impacts of products (Bratt et al., 2011; Buckley, 2002), giving them the opportunity to compare products based on their environmental performance. On the buyer side, eco-labels can stimulate more sustainable purchases and change consumption patterns while at the same time motivate producers or service providers to raise their environmental standards (Gallastegui, 2002). While eco-labels have proven successful in many markets and can be found on many products, they haven't yet received much attention in the aviation industry.

Previous studies (Gössling et al., 2009; Hagmann et al., 2015; Lynes and Dredge, 2006) have outlined the importance of making flights environmentally comparable by using environmental indicators. Gössling et al. (2009) found that if environmental information would become available, passengers would be interested in integrating that information into their booking decision. This finding was confirmed by Araghi et al. (2014), who studied passengers' preferences towards an airline eco-efficiency index, showing through a discrete choice experiment that such an index had influenced passengers' decision-making. Nevertheless, no study has more closely examined how an aviation eco-label would affect the booking decision of passengers when choosing a flight.

This study aims to deepen current understanding on the effects an environmental label could have on the booking decision of air passengers. By applying a discrete choice experiment, the study tests the effect an aviation eco-label had on the booking decisions of passengers. We simulated a real purchase situation in which participants made choices based on attributes shown to them. We added an eco-label as an additional attribute to the booking decision and tested how this new attribute affects the overall booking decision of passengers. This research expands the current knowledge on how sensible the use of an aviation eco-label could be and provides recommendations to the industry.

2. Literature review

Environmental labels or eco-labels are claims which indicate the environmental aspects of a product or service. They can be found among many products and are used in various industries to verify the environmental superiority of particular goods. Products that carry the eco-label are normally produced in a way that is environmentally less harmful (e.g., made out of recycled material) or are designed in order to minimize the environmental impact during use (e.g., devices that are more energy-efficient). While some eco-labeled products bring consumers direct benefits for their health (e.g., organic food), economic benefits (e.g., Energy Star) or status, others address more general environmental issues, focusing on consumers' biospheric concerns such as the FSC label or dolphin-free tuna. Previous studies (Bratt et al., 2011; Gallastegui, 2002; Houe and Grabot, 2009) have found that eco-labels can have a significant impact on the consumption behavior of individuals, resulting in producers being able to ask for premium prices and gaining competitive advantage over their rival entities. In addition, eco-labels help closing the gap of information asymmetry between consumers and producers over the question of products' environmental attributes (De Boer, 2003; Rex and Baumann, 2007). Finally, eco-labels can stimulate both consumers and producers to behave in a more sustainable manner by encouraging consumers to make more conscious choices towards greener products and motivating producers to offer more such products through the additional benefits that arise from using the eco-label (Houe and Grabot, 2009).

2.1. Environmentally minded passengers

Previous studies have found that passengers are, in general, aware of the negative environmental impacts of flying but that cutting back on the practice is seen as unacceptable because it would restrict the personal freedom to travel (Becken, 2007; Hares et al., 2010). Young et al. (2014) have detected a so-called 'flying dilemma' among passengers in which an individual's self-concept as a responsible consumer conflicts with the environmental impacts caused by air traveling. However, because flying cannot always be avoided, there are ways to mitigate the environmental impacts through, for example, carbon offsets or the here proposed eco-label. Although carbon offsets have received only a moderate response (Gössling et al., 2009; Hagmann et al., 2015; Wittmer and Wegelin, 2012), the eco-label presented in this article could help air passengers to reduce their environmental impact without compromising their freedom to travel or necessarily making them pay more for mitigating their CO_2 emissions. Nevertheless, as Bratt et al. (2011) stated, eco-labels normally attract more environmentally minded consumers.

Those are individuals who are concerned about the environment and who try to reduce environmental impacts through their lifestyle, an attempt which is reflected in the way they consume products and services. Furthermore, van Birgelen et al. (2011) found that consumers who are more environmentally minded in other areas (e.g., recycling) are more likely to transfer this behavior to their air travel. In light of these findings, we hypothesize the following:

H1. Passengers who are environmentally minded will more likely choose flight options that are green labeled.

2.2. Willingness to pay

Eco-labels are often brought up along with price premiums, which producers normally justify with a higher environmental quality of the product (Gallastegui, 2002), such as no use of pesticides in organic farming (Loureiro et al., 2002) or the longer life span and energy savings of LED light bulbs. However, in terms of less polluting flights, reductions in greenhouse gas emissions can mainly be achieved through fuel. Fuel is the largest direct operating cost of any major airline and fuel savings can certainly be translated into lower ticket prices, as seen in the example of low-cost carriers (Whyte and Lohmann, 2015). On the other hand, airlines might also consider charging a premium price for a less polluting flight if they could communicate the higher environmental quality through an eco-label. In terms of testing passengers' willingness to pay more for a less polluting flight, previous studies have mainly focused on carbon offsets. As mentioned previously, the response to carbon offsets has been rather moderate. In a study of passengers' willingness to pay beyond a carbon offset, however, Baumeister (2015a) detected a 34% willingness among participants to pay more for a less polluting flight. In addition, previous studies on eco-labels have found a willingness to pay a premium for eco-labeled products among consumers in various fields (e.g., Ward et al., 2011; Aguilar and Vlosky, 2007; Sammer and Wüstenhagen, 2006). Therefore, the eco-label could stand for higher efficiency and savings in fuel costs as well as for higher quality in terms of reduced environmental impacts. In order to encompass both possible scenarios, our second hypothesis is twofold:

H2a. Passengers will book green-labeled flights that cost more than average flights.

H2b. Passengers will book green-labeled flights that cost less than average flights.

2.3. Interaction with other product attributes

One of the functions of eco-labels is that they transform credence attributes into product attributes (Thøgersen et al., 2010). As the eco-label proposed here would become a further product attribute, we want to study how the eco-label interacts with existing product attributes of flights. In a similar study, Delmas and Lessem (2015) found that the presence of a wine eco-label actually sent negative signals to consumers, who perceived eco-labeled wines as lower quality. We therefore wanted to find out whether an aviation eco-label would interact positively or negatively with existing product attributes. To this end we focused on the attributes used in the experiment: ticket price and flight duration. While the ticket price is either determined by the market or based on bilateral agreements, the duration of a flight depends mainly on the routing, whether the flight is operated non-stop or contains one or several layovers of various lengths. Depending on whether the green-labeled flight is less or more expensive or requires a shorter or longer flight time, adopting the eco-label might represent a gain or a trade-off for the passenger. Therefore, we further hypothesize the following:

H3a. Positive product attributes (lower ticket price and shorter flight) will enhance passengers' preference towards the green label.

H3b. Negative product attributes (higher ticket price and longer flight) will reduce passengers' preference towards the green label.

2.4. Yellow labels

The proposed eco-label comes in the form of an energy label that allows flights to be labeled positively as well as negatively. This is the only way to make flights environmentally comparable. The scale of the label ranges from green (an environmentally preferable flight) to yellow (an environmentally neutral flight) to red (a flight that should be avoided). Previous research on energy labels has shown that the use of negative (red) labels has made consumers avoid those products (Grankvist et al., 2004). However, as D'Souza et al. (2007) found, consumers also tend to avoid green-labeled products, especially when they are attached to a premium price. Yellow-labeled products, therefore, seem to be the most preferable choice. Our fourth hypothesis is as follows:

H4. Passengers will mainly choose yellow-labeled flights.

2.5. Eco-label understanding

With the help of eco-labels, consumers should be able to compare different products regarding their environmental impacts. Eco-labels are designed to define, compile, test, and summarize the environmental performance of products and present them to the consumer in the easiest way possible (Buckley, 2002; Gallastegui, 2002). Nevertheless, the success of an eco-label depends not only on whether it reduces the information and search costs but also on whether the consumer is aware of the eco-label and understands its meaning (Delmas and Lessem, 2015). Understanding in this regard means how well a consumer can connect the eco-label's message to environmental issues and the actions that need to be taken as a result (Banerjee and Solomon, 2003). Although some passengers might be familiar with eco-labels, they have not yet been used in the aviation industry. Furthermore, there is evidence that eco-labels might cause confusion among consumers concerning the eco-label's goals, credibility, and expected benefits, and this confusion might harm the success and adoption of the eco-label (Leire and Thidell, 2005). Because differences in the environmental performance of flights are not common knowledge (Baumeister, 2015b), it might be difficult to communicate this information simply through eco-labels. Passengers need to be made aware of the fact that which flight they choose can make a tremendous difference in terms of its environmental impact and that the eco-label can assist them in making better informed choices. In addition, Thøgersen et al. (2010) found that such green claims can easily lead to the suspicion of greenwashing, especially due to the fact that air traveling is not generally perceived to be environmentally friendly. Providing additional information on the eco-label can improve the eco-label's success tremendously especially when consumers hold incorrect perceptions about the environmental impacts (Teisl et al., 2008). Therefore, in order to create consumer awareness and overcome barriers that hinder passengers' understanding of the new eco-label, which might in turn compromise the eco-label's success, we propose a further hypothesis:

H5. Additional information on the eco-label will increase passengers' likelihood of adopting the new label.

3. Methods

3.1. Survey design

A discrete choice experiment was conducted in which participants were asked to imagine taking a transcontinental flight from Los Angeles (LAX) to New York (JFK). Participants viewed nine choice sets, each containing three flight options, from which they chose one. The option not to fly was not included in the choices as taking the airplane seems to be the only feasible option to cover such a long distance. Participants were presented with three attributes as shown in Table 1. Attribute levels were assigned randomly. Ticket prices reflected the prevailing airline prices for economy class one-way flights on the Los Angeles to New York route. The total journey time, including stops and layovers, were taken from existing schedules. The times ranged from 5 hours and 20 minutes (equal to a non-stop flight) to 7 hours and 50 minutes, equivalent to a flight with a long layover or a flight with two short stops. In order to avoid bias based on possible earlier experiences, participants were not informed about the location of a stop nor which airline was to operate the flight. Finally, each flight was environmentally rated with an eco-label using a three-color scheme. The advantage of this method is that it allowed us to mirror real-world choices while still being able to randomize across product attributes, which would not have been possible with real-world data. In addition, it also allowed us to examine only those product attributes most relevant to our study.

Table 1. Attributes and attribute levels

Attribute	Attribute level
Ticket price	$205
	$225
	$245
Total time	5hr 20min
	6hr 35min
	7hr 50min
Eco-label	Green
	Yellow
	Red

To keep the environmental ratings realistic, we conducted carbon dioxide emissions calculations for flights on the Los Angeles to New York route to ensure that all the combinations presented in the experiment could occur in reality. It was possible that flight options labeled green, yellow, and red could occur among the entire price range as well as in the range of durations, meaning that non-stop flights could be labeled red and flights with two stops could be labeled green. According to Baumeister (2015b), who conducted carbon dioxide emissions calculations based on real data, the emissions don't depend on the amounts of stopovers but much more on the passenger load factors, amount of seats on the aircraft and the amount of cargo carried on the flight. Participants were put into two treatment groups, half of the participants received only brief information on the eco-label, telling them what the different colors stand for. The second group received information on how the eco-label works and that, compared to other eco-labels, green flight options are not necessarily more expensive. Participants in this group were also presented with a graph (see Figure 1) comparing four non-stop flights on the LAX to JFK route and showing the significance their flight choices can make in terms of environmental impacts.

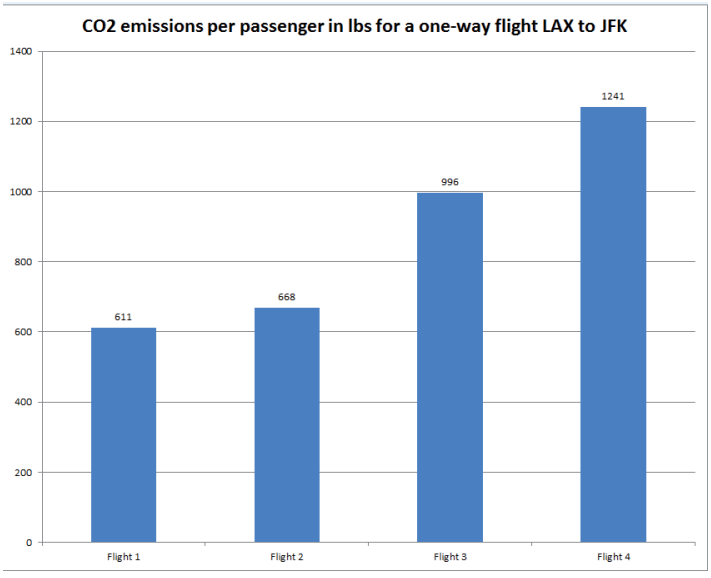


Fig. 1. Example provided to treatment group

After the nine choice sets were presented, demographic data was collected. Finally, the participants were asked screening questions (see Table 2) in order to determine who the environmentally minded passengers were.

Table 2. Screening questions for environmental mindedness

Questions	Mean	Std. dev.
1. How strongly would you rate the importance of the eco-label for the booking choices you made?	2.95	1.14
2. How frequently do you purchase organic products?	2.68	1.21
3. How often do you purchase voluntary carbon offsets when booking a flight?	1.39	0.96
4. How concerned are you about the future state of our environment?	3.30	1.12
5. Are you a member of an environmental organization?	1.88	0.32

3.2. Data collection

Unlike previous choice experiments (Araghi et al., 2014; Hagmann et al., 2015) that have studied the effects of environmental product attributes on the flight choices of passengers with paper-based surveys and at airports, we decided to conduct our study online because this approach came closer to the reality of making booking decisions when buying airplane tickets on the Internet. We recruited our participants using Amazon Mechanical Turk (MTurk). Amazon MTurk is a crowdsourcing Internet marketplace that provides relatively cheap and fast access to human intelligence for performing tasks such as answering questionnaires. Although it is still a rather new recruitment method, Amazon MTurk has received positive reviews in comparisons to traditional methods (Berinsky et al., 2012), especially in data quality and reliability (Buhrmester et al., 2011). Casler et al. (2013) even found that Amazon MTurk can, in some instances, be superior to previous methods in, for example, behavioral testing. Participants receive a small compensation for their effort depending on the time and demands of the task. In our study, each participant received compensation of $0.50, which was a slightly above-average fee based on the given task. The survey was completed by 617 participants, from which 554 useful answers could be obtained. The main reasons for removing participant's answers were that they did not reside in the United States or haven't flown within the last 12 months. Altogether we made 5,553 observations, of which 4,986 were analyzed.

3.3. Evaluation methods

An analysis of the data set showed a normal distribution with skewness ranging from 0.04 to 0.35 and kurtosis values from -1.07 to 0.56, both being well within the acceptable limits of ±2 (Torchim and Donnelly, 2006). Also a Shapiro-Wilk test revealed that our data were significantly normal ($p > 0.001$). This allowed us to perform parametric tests such as the t-test for comparing means and proportions. For answering H1, first environmentally minded passengers had to be identified from the sample. For this purpose, participants were presented with five screening questions (see Table 2). Questions 1, 2 and 4 used a five point Likert scale (1-5), while question 3 had a sixth option (0-6) to accommodate participant's responses in case they had never heard about carbon offset. Question 5 allowed only for a binary response (0-1). Scores were assigned to all participants according to their responses using the following equation:

$$Participant's\ Score = \frac{\sum Participant's\ Responses - 3}{18}$$

The minimum score was 3, the maximum score 21. Participants who scored in the top 25% (at least 15.75) were considered to be environmentally minded. For accepting the null hypothesis the population mean of the participants who had scored in the top 25% needed to be less than 0.5, while for accepting the alternative hypothesis the mean needed to be greater than 0.5.

For H2, the average ticket price was set at $225, the center point between the lowest ticket price at $205 and the highest at $245. In H2a, the condition for accepting the null hypothesis the population mean, of the participants who chose green-labeled flights at a price level of $245 (and $205 in H2b respectively), needed to be less than 0.5, while for accepting the alternative hypothesis greater than 0.5.

For H3, the lower ticket price was defined as the average ticket price or below while the higher ticket price was the average ticket price or above. For the flight time, the average time was also set at the center point of the three attribute levels (6hr 35min) and a short flight time was considered as average or below, while a longer flight time was at average or above. As we were testing two attributes in this hypothesis we had to run the analysis two-fold comparing the effect of ticket price and flight time with both ticket price ($H3a^{cheap}$ / $H3b^{expensive}$) and flight time ($H3a^{short}$ / $H3b^{long}$) alone. In terms of $H3a^{short}$ the null hypothesis was accepted if the population mean of the participants who chose green-labeled flights which had a shorter flight time and lower ticket price versus only a

shorter flight time was below 0, while for accepting the alternative hypothesis the mean needed to be greater than 0. In terms of $H3a^{cheap}$ the null hypothesis was accepted if the population mean of the participants who chose green-labeled flights which had a shorter flight time and lower ticket price versus only a lower ticket price was below 0, while for accepting the alternative hypothesis the mean needed to be greater than 0. In terms of $H3b^{long}$ the null hypothesis was accepted if the population mean of the participants who chose green-labeled flights which had a longer flight time and higher ticket price versus only a longer flight time was below 0, while for accepting the alternative hypothesis the mean needed to be greater than 0. In terms of $H3b^{expensive}$ the null hypothesis was accepted if the population mean of the participants who chose green-labeled flights which had a longer flight time and higher ticket price versus only a higher ticket price was below 0, while for accepting the alternative hypothesis the mean needed to be greater than 0.

For H4, the null hypothesis was accepted if the population mean of the participants that have chosen yellow-labeled flights was below 0.5, while otherwise the alternative hypothesis was accepted if the mean was greater than 0.5. Finally for H5, the null hypothesis was accepted if the population mean of the participants that had received treatment and chosen green-labeled flights was below 0.5, while for accepting the alternative hypothesis the mean needed to be greater than 0.5.

4. Results

As shown in Table 2, more than half of the participants stated that the presence of an eco-label had influenced their booking decision during the choice experiment. The amount of participants who stated that the eco-label had been very important or not important at all in their decision making was almost equal, with about 10% each. The low frequency of carbon offset purchases is also worth noting, where only 18% stated that they had paid for carbon offsets and only 4% stated that they choose carbon offsets for every flight. Table 3 below provides the results from the hypotheses tested.

Table 3. Hypotheses test results

Hypothesis	t	df	*p*	M	95% CI
H1	3.750	552	9.8e-05**	0.529	[0.517, Inf]
H2a	-0.065	552	0.9483	0.495	[0.491, 0.509]
H2b	3.072	552	0.0022**	0.521	[0.509, 0.540]
$H3a^{short}$	11.759	552	2.2e-16**	0.065	[0.056, Inf]
$H3a^{cheap}$	-1.346	552	0.9106	-0.009	[-0.020, Inf]
$H3b^{long}$	15.314	552	3.1e-16**	0.055	[Inf, 0.061]
$H3b^{expensive}$	12.993	552	2.2e-16**	0.062	[0.054, Inf]
H4	-29.761	552	1.0000	0.369	[0.362, Inf]
H5	4.883	551	6.8e-07**	0.513	[0.050, Inf]

** Significant at the 0.01 level.

The analysis showed that there is a significant difference between environmentally minded passengers and other passengers ($p < 0.01$) in that environmentally minded passengers are more likely to choose green-labeled flights. Also the population mean of the participants which had scored in the top 25% was greater than 0.5 which means that more than half of the environmentally minded participants had chosen green-labeled flights. Therefore H1 is supported. Nevertheless, when the two passenger groups are compared based on the treatment, some deviations can be found. No significance ($t(276) = -0.1236$, $p = 0.5491$) could be detected between the two passenger groups regarding which was more likely to choose green-labeled flights when both groups received the treatment providing them with additional information on the meaning of the eco-label. However, when no treatment was provided, the likelihood that environmentally minded passengers would be more likely to choose green-labeled flights compared to the remaining passenger group was significant ($t(275) = 5.7356$, $p = 1.279e\text{-}08$). Additionally, we found that the treatment did not influence environmentally minded passengers' decisions regarding choosing green-labeled flights at all ($t(551) = 3.9888$, $p = 3.769e\text{-}05$).

The second set of hypotheses tested whether passengers would choose green-labeled flights when the ticket price is higher or lower than the average price. As in the case of higher ticket prices, the result from the t-test in regard to the population mean was less than 0.5 and no statistical significant could be found to support that the majority of passengers would chose green-labeled flights if they cost more than average. H2a is therefore rejected. In the case of a lower ticket price, the t-test indicated that the population mean of the participants who had chosen green-labelled flights, that costed less than the average of $225, was greater than 0.5 and the alternative hypothesis was therefore accepted. This finding was also supported by the p-value that confirmed statistical significance ($p < 0.01$). However, when the different treatments were examined, it was found that the additional information on the

eco-label created a willingness to pay more for green-labeled flights. In the case of higher-than-average ticket prices, choosing flights with an above-average price was more significant ($t(551) = 2.6292$, $p = 0.004399$) for passengers who received the treatment whereas those passengers who received no treatment showed less willingness to pay for a green-labeled flight. Similarly, in the case of lower-than-average ticket prices, choosing flights with a below-average price was more significant ($t(276) = 1.8188$, $p = 0.03501$) for passengers who received no treatment. In contrast, the passengers who received the treatment tended to choose green-labeled flights despite those being priced higher than the average flights.

Next we examined the interaction of the eco-label with other product attributes, starting with positive product attributes. We compared whether passengers would choose green-labeled flights with a cheaper ticket price and shorter flight time versus those with only a shorter flight time. The t-test results showed a population mean above 0 and the result was statistically significant ($p < 0.01$), meaning that passengers were more likely to choose a green-labeled flight when it was cheaper and shorter than when it was only shorter. However, when we compared cheaper and shorter flights with only cheaper flights, the population mean was below 0 and no significance could be detected ($p > 0.05$), which indicates that passengers were more likely to choose a green-labeled flight when it was cheaper than when it was cheaper and shorter. It can then be concluded that lower ticket prices increased the likelihood of passengers choosing green-labeled flights more than shorter flight times did. Therefore, H3a can be only partially supported. When the treatments are taken into account, in both cases no differences could be detected. For both groups, choosing cheaper and shorter flights over shorter flights remained statistically significant ($t(275) = 7.5006$, $p = 4.402e\text{-}13$), but for cheaper flights no statistical significance ($t(276) = 0.88$, $p = 0.1898$) could be detected.

We then compared whether passengers would choose green-labeled flights with a higher ticket price and a longer flight time versus those with a longer flight time only. The population mean was above 0 and statistical significance could be detected ($p < 0.01$), meaning that passengers were less likely to choose a green-labeled flight when it was expensive and longer than when it was only longer. In addition, when we compared expensive and longer flights with only expensive flights the t-test again found a population mean above 0 and statistical significance ($p < 0.01$), which indicates that passengers were more likely to choose a green-labeled flight when it was only expensive than when it was expensive and longer. It can therefore be concluded that when ticket prices were higher and flight times longer, the likelihood of passengers choosing green-labeled flights decreased compared

to when only one of the two attributes was negative. In both cases the alternative hypothesis could be accepted and H3b is therefore supported. When looking at the treatments again, in both cases no differences could be detected. Statistical significance ($t(276) = -8.0924$, $p = 9.38e\text{-}15$) could be detected in both groups for choosing expensive and longer flights over longer flights. In comparison to expensive flights, the results also remained statistically significant ($t(276) = -4.4397$, $p = 6.52e\text{-}06$).

The fourth hypothesis, that passengers would mainly choose yellow-labeled flights, could not be supported, because the population mean was below 0.5 and there could also no statistical significance ($p > 0.05$) been detected. However, when the treatment group was compared with the control group, statistical significance could be detected ($t(536.983) = -2.0375$, $p = 0.02105$) showing that the likelihood of passengers who received additional information on the eco-label to book yellow-labeled flights decreased significantly.

Finally, we looked at the impact of additional information and whether it increased the likelihood of adopting the new eco-label. We compared the booking choices of the treatment group with the control group for green-labeled flights. As the population mean was above 0.5 and statistical significance ($p < 0.01$) confirmed, H5 is, therefore, supported. The analysis further showed that providing additional information on the eco-label increased the likelihood that passengers would choose more green-labeled flights and reduced the likelihood that they would choose yellow- or red -labeled flights. The mean values, among the treated participants, for yellow-labeled flights were at 0.3606 and for red-labeled flights at 0.1259. Both results were statistically significant ($p < 0.05$). Table 4 presents a summary of the results for each of the tested hypotheses.

Table 4. Summary of hypothesis test results.

Hypothesis	Support
H1	Supported
H2a/b	Not supported/Supported
H3a/b	Partially supported / Supported
H4	Not supported
H5	Supported

5. Discussion

5.1. Environmentally minded passengers

The results regarding environmentally minded passengers showed that they were more likely to choose green-labeled flights. Nevertheless, once additional information was provided, there was no longer any difference in the likelihood of choosing green-labeled flights between environmentally minded passengers and the other passengers. This suggests that environmentally minded passengers seem to trust the eco-label without having received much information about it. The additional information did not influence environmentally minded passengers' flight choice at all. These findings confirm earlier results by Thøgersen et al. (2010) indicating that consumers with past experience with eco-labels are more likely to adopt a new eco-label without the need for much additional information. Because the group of participants that had been regarded as environmentally minded passengers showed the highest frequency of purchasing organic food, it can be assumed that they had more past experience with eco-labels than the other participants did. It can therefore be concluded that an aviation eco-label would increase the likelihood of environmentally minded passengers choosing flight options that have less impact on the environment. However, providing the remaining passengers with the eco-label and additional information on how adopting the eco-label can impact the environment led them to more probably choose flights that were less polluting. The eco-label therefore not only affects environmentally minded passengers, as we initially assumed, but might also influence the booking decision of other passenger groups if they are properly informed about the label.

5.2. Willingness to pay

The results found that the presence of a green eco-label alone does not increase the willingness to pay extra for a flight among passengers. However, the picture changed once we more closely examined the different treatment groups. Passengers that received no additional information on the eco-label failed to show willingness to pay extra for green-labeled flights, accepting them only if they were below the average price. Nevertheless, when they received treatment, a willingness to pay could be detected. The acquisition of additional knowledge on the importance of flight choice, as a way to reduce the environmental impacts of one's individual flying behavior, shifted passengers' focus away from cheaper tickets. Treated participants were more likely to choose green-labeled flights even though these cost more than the average flight. This result is consistent with Mahenc (2008), who found

that when consumers are informed about environmental impacts, the higher price associated with the product actually functions as a signal for higher environmental performance, which is justified by the less polluting but costlier production and creates, therefore, a willingness to pay.

5.3. Interaction with other product attributes

When we examined the interaction of the eco-label with other product attributes, we clearly detected that the ticket price played a more important role in the likelihood of choosing a green-labeled flight than flight time did. This confirms previous findings by Collins et al. (2012), who detected price as the key factor in their stated choice experiment on air travel behavior. We further observed that participants made trade-offs in flight time for the sake of the ticket price. This could be observed in both cases, among positive as well as negative product attributes. Cheaper flights certainly made the choice for green-labeled flights even easier, while in the case of more expensive flights, the green eco-label might have sent a signal of quality to the buyer. On the other hand, neither a shorter nor a longer flight affected the likelihood for or against choosing a green-labeled flight. Surprisingly, the treatment played no role here, meaning that the ticket price showed a stronger interaction with the eco-label regardless of whether additional information on the eco-label was provided or not.

5.4. Yellow labels

The study revealed that the majority of passengers did not choose yellow-labeled flights. The yellow label appeals as a neutral choice that, according to Grankvist et al. (2004), causes neither too much damage to the environment nor leads to any improvements, but rather maintains status quo. Choosing the yellow label means that the passenger is already doing better by avoiding the red label, which has a definite negative outcome. Compared to green-labeled flights, the yellow label might be a good compromise, especially when those green-labeled flights are more expensive. As our study found, the willingness among untreated passengers to pay extra for green-labeled flights was low. Still, this failed to drive passengers towards the yellow label. In the outcomes of the treated group, we even detected a decrease in the likelihood of choosing yellow-labeled flights. This decrease might also be explained by an increase in the willingness to pay for green-labeled flights among this group. One conclusion that can be drawn is that providing additional information on the eco-label decreases the attractiveness of the yellow

label. It lets passengers not only avoid red-labeled flights but to even go beyond the status quo and more actively choose green-labeled flights.

5.5. Eco-label understanding

As we presented passengers with a new eco-label in a purchase situation where one would not necessarily expect to find one, providing additional information on the eco-label certainly made a difference. Although the results found a high rate of adoption of the eco-label, even without treatment, providing additional information further increased the likelihood of choosing green-labeled flights. Showing participants the environmental impact of choosing the right flight motivated a greater number to choose the greener option. This finding is also consistent with Borin, Cerf, and Krishnan (2011). They found that providing additional environmental information in combination with product labelling increases the purchase of green-labeled products among a larger percentage of consumers.

6. Conclusion

This study set out to enhance current understanding regarding the effects an environmental label could have on the booking decisions of air passengers. The study found that environmentally minded passengers would adopt the new eco-label immediately. Nevertheless, the remaining passengers also showed a high rate of adoption once they had been provided with sufficient information. Therefore, it is essential to provide additional information in order to reach all passengers with the eco-label, not only the environmentally minded ones. Although ticket price does not necessarily reflect the environmental friendliness of a flight, airlines could create additional value for their customers by offering greener flights. Airlines could charge a premium price by utilizing the eco-label as an instrument to communicate this additional value. Nevertheless, the additional information also plays a crucial role in generating a willingness to pay among passengers. It was further found that ticket price showed a much stronger interaction with the likelihood that passengers would choose green-labeled flights than the flight time showed. This might be useful information for airlines that want to better tailor their offerings to the eco-label in terms of ticket prices and flight schedules. The presence of an aviation eco-label led to a strong preference for green-labeled flights, making passengers avoid red- as well as yellow-labeled flights. The provision of additional information reinforced

this trend. Therefore, for airlines to remain competitive, it is not enough to satisfy the requirements for obtaining the yellow label. Instead, they need to strive for the green label because this is clearly the most preferred passenger choice. Finally, providing additional information on the eco-label turned out to be crucial for the eco-label's success. This is probably due to the fact that eco-labels have not yet been used in the aviation industry and might in some cases even irritate passengers, because they do not expect to find such labels on a flight-booking site. Therefore, providing additional information on the eco-label would be crucial during the implementation phase while the eco-label is still new to air passengers.

Because our study detected a willingness among passengers to pay for green-labeled flights, further research could look into more concrete numbers regarding how much more passengers are willing to pay for a flight that features the green eco-label. In terms of limitations, in this study we used only three product attributes, while previous studies have relied on four or five attributes. Further attributes could have included the amount of stopovers, the amount of available seats for a particular price, and the airline or aircraft type. Future research could further examine the interaction of the aviation eco-label with additional product attributes.

Acknowledgements

This work was supported by a Fulbright Graduate Grant and two grants received from the Foundation for Economic Education (grant numbers 2-970-35, 4-2175-22).

References

Aguilar, F., Vlosky, R., 2007. Consumer willingness to pay price premiums for environmentally certified wood products in the U.S. Forest Policy and Economics 9, 1100-1112.

Anderson, L., Mastrangelo, C., Chase, L., Kestenbaum, D., Kolodinsky, J., 2013. Eco-labelling motorcoach operators in the North American travel tour industry: analysing the role of tour operators. Journal of Sustainable Tourism 21, 750-764.

Araghi, Y., Kroesen, M., Molin, E., van Wee, B., 2014. Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment. Transportation Research D 26, 42-46.

Banerjee, A., Solomon, B., 2003. Eco-labeling for energy efficiency and sustainability: A meta-evaluation of US programs. Energy Policy 31(2), 109-123.

Baumeister, S., Onkila, T. 2017. An eco-label for the airline industry? Journal of Cleaner Production 142, 1368-1376.

Baumeister, S., 2015a. Environmental responsibility as a factor in gaining competitive advantage in the aviation industry. Journal of Geotechnical and Transportation Engineering 1(2), 43-48.

Baumeister, S., 2015b. 'Does it really matter which flight to take?' Carbon emissions of selected flights in three geographical markets. In: 19th Air Transport Research Society World Conference, July 2-5, 2015, Singapore.

van Birgelen, M., Semeijn, J., Behrens, P., 2011. Explaining pro-environmental consumer behavior in air travel. Journal of Air Transport Management 17, 125-128.

Becken, S., 2010. Tourists' perception of international air travel's impact on the global climate and potential climate change policies. Journal of Sustainable Tourism 15, 351-368.

Berinsky, A., Huber, G., Lenz, G., 2012. Evaluation Online Labor Markets for Experimental Research: Amazon.com's Mechanical Turk. Political Analysis 20, 351-368.

Borin, N., Cerf, D., Krishnan, R., 2011. Consumer effects of environmental impact in product labeling. Journal of Consumer Marketing 28, 76-86.

Bratt, C., Hallstedt, S., Robert, K.-H., Broman, G., Oldmark, J., 2011. Assessment of eco-labelling criteria development from a strategic sustainability perspective. Journal of Cleaner Production 19, 1631-1638.

Buckley, R., 2002. Tourism Ecolabels. Annals of Tourism Research 29, 183-208.

Buhrmester, M., Kwang, T., Gosling, S., 2011. Amazon's Mechanical Turk: A New Source of Inexpensive, Yet High-Quality, Data? Perspectives on Psychological Science 6, 3-5.

Casler, K., Bickel, L., Hackett, E., 2013. Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. Computers in Human Behavior 29, 2156-2160.

Cohen, S., Higham, E., 2011. Eyes wide shut? UK consumer perception of aviation climate impacts and travel decisions to New Zealand. Current Issues in Tourism 14, 323-335.

Collins, A., Rose, J., Hess, S., 2012. Interactive stated choice surveys: a study of air travel behaviour. Transportation 39, 55-79.

De Boer, J., 2003. Sustainability labeling schemes: The logic of their claims and their functions for stakeholders. Business Strategy and the Environment 12, 254-264.

Delmas, M., Lessem, N., 2015. Eco-premium or eco-penalty? Eco-labels and quality in the organic wine market. Business & Society, 1-39.

D'Souza, C., Taghian, M., Lamb, P., Peretiatko, R., 2007. Green decisions: demographics and consumer understanding of environmental labels. International Journal of Consumer Studies 31, 371-376.

Dubois, G., Ceron, J., 2006. Tourism/leisure greenhouse gas emissions forecast for 2050: Factors for change in France. Journal of Sustainable Tourism 17, 17-37.

Gallastegui, I., 2002. The use of eco-labels: A review of the literature. European Environment 12, 316-331.

Grankvist, G., Dahlstrand, U., Biel, A., 2004. The Impact of Environmental Labelling on Consumer Preference: Negative vs. Positive Labels. Journal of Consumer Policy 27, 213-230.

Green, J., 2003. Civil aviation and the environmental challenge. The Aeronautical Journal 107, 281-299.

Gössling, S., Broderick, J., Upham, P., Ceron, J.-P., Dubois, G., Peeters, P., Strasdas, W., 2007. Voluntary Carbon Offsetting Schemes for Aviation: Efficiency, Credibility and Sustainable Tourism. Journal of Sustainable Tourism 15, 223-248.

Gössling, S., Peeters, P., 2007. It does not harm the environment! An analysis of industry discourses on tourism, air travel and the environment. Journal of Sustainable Tourism 15, 402-417.

Gössling, S., Haglund, L., Kallgren, H., Revahl, M., Hultman, J., 2009. Swedish air travellers and voluntary carbon offsets: towards the co-creation of environmental value? Current Issues in Tourism 12, 1-9.

Hagmann, C., Semeijn, J., Vellenga, D., 2015. Exploring the green image of airlines: Passenger perceptions and airline choice. Journal of Air Transport Management 43, 37-45.

Hares, A., Dickinson, J., Wilkes, K., 2010. Climate change and the air travel decision of UK tourists. Journal of Transport Geography 18, 466-473.

Houe, R., Grabot, B., 2009. Assessing the compliance of a product with an eco-label: From standards to constraints. Int. J. Production Economics 121, 21-38.

Leire, C., Thidell, A., 2005. Product-related environmental information to guide consumer purchases – A review and analysis of research on perceptions, understanding and the use among Nordic consumer. Journal of Cleaner Production 13, 1061-1070.

Loureiro, M., McCluskey, J., Mittelhammer, R., 2002. Will Consumers Pay a Premium for Eco-labeled Apples? Journal of Consumer Affairs 36, 203-219.

Lynes, J., Dredge, D. 2006. Going green: motivations for environmental commitment in the airline industry. A case study of Scandinavian airlines. Journal of Sustainable Tourism 14, 116-138.

Mahenc, P., 2008. Signaling the environmental performance of polluting products to green consumers. International Journal of Industrial Organization 26, 59-68.

Penner, J., Lister, D., Griggs, D., Dokken, D., McFarland (Eds.), 1999. Aviation and the Global Atmosphere; A Special Report of IPCC Working Groups I and II. Cambridge University Press, Cambridge.

Rex, E., Baumann, H., 2007. Beyond ecolabels: What green marketing can learn from conventional marketing. Journal of Cleaner Production 15, 567-576.

Sammer, K., Wüstenhagen, R., 2006. The influence of eco-labelling on consumer behaviour – results of a discrete choice analysis for washing machines. Business Strategy and the Environment 15, 185-199.

Teisl, M., Rubin, J., Noblet, C., 2008. Non-dirty dancing? Interactions between eco-labels and consumers. Journal of Economic Psychology 29, 140-159.

Thøgersen, J., Haugaard, P., Olesen, A., 2010. Consumer responses to ecolabels. European Journal of Marketing 44, 1787-1810.

Torchim, W., Donnelly, J., 2006. The research methods knowledge base, 3rd ed. Atomic Dog, Cincinnati.

Ward, D., Clark, C., Jensen, K., Yen, S., Russell, C., 2011. Factors influencing willingness-to-pay for the ENERGY STAR® label. Energy Policy 39, 1450-1458.

Wittmer, A., Wegelin, L., 2012. Influence of airlines' environmental activities on passengers. Journal of Air Transport Studies 3, 73-99.

Whyte, R., Lohmann, G., 2015. Low-cost long-haul carriers: A hypothetical analysis of a 'Kangaroo route'. Case Studies on Transport Policy 3, 159-165.

Young, M., Higham, J., Reis, A., 2014. 'Up in the air': A conceptual critique of flying addiction. Annals of Tourism Research 49, 51-64.

Åkerman, J., 2005. Sustainable air transport – on Track in 2050. Transportation Research Part D 10, 111-126.