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The attitudes of UK tourists to the use of biofuels in civil aviation: An exploratory study

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ABSTRACT

Tourism generates substantial carbon footprint with its air transport sector holding the largest share. Biofuel technology has been repeatedly trialled in aviation to minimise this carbon footprint. While biofuels can become mainstream aviation fuels in the near future, little is known about public knowledge on and perception of its use within the air transport sector. This signifies considerable knowledge gap as the level of public awareness of a new technology determines the speed of its societal acceptance and may affect its market success. This study explores the attitudes of UK tourists to the use of biofuels in aviation. It finds that while the public are generally aware of biofuel technology, public knowledge of its specific application in aviation alongside the carbon benefits this brings is limited. Future policy-making and managerial measures should aim at enhancing public understanding of biofuel technology use in aviation in the UK.

1. Introduction

Tourism is an important contributor to anthropogenic climate change (Djerba Declaration, 2003). It is estimated that about 5% of human-made greenhouse gas (GHG) emissions are attributed to travel with leisure purposes (United Nations World Tourism Organisation–UNWTO, 2007). This figure is expected to grow given the continued increase in the number of international tourist arrivals (UNWTO, 2016).

Among the different sectors of the tourism industry, transportation holds the largest share of its carbon footprint (Davos Declaration, 2007). Aviation generates more than 50% of the industry's GHG emissions (UNWTO, 2007). Air travel remains the key means of tourist transport from origin to destination and its steady growth is anticipated in the near future due to the continued rise in international tourism (Dubois and Ceron, 2006; Gössling and Peeters, 2007; Scott et al., 2010).

The importance of reducing carbon intensity of tourism has been repeatedly emphasised (Gössling et al., 2011). Air travel should be a primary target of the industry's GHG mitigation efforts given the profound role it plays in the generation of its carbon footprint (Gössling and Peeters, 2007). Mitigation can be achieved via voluntary changes in consumer behaviour (McKercher et al., 2010); market-based and regulatory instruments can be applied to facilitate these changes (Tol, 2007); lastly, technological advancements are expected to contribute to carbon abatement within the sector (Peeters et al., 2016). The combination of all these approaches represents the most effective pathway towards the mitigation of GHG emissions in tourism (Capstick et al., 2014; Gössling et al., 2012; Higham et al., 2016b).

There is limited evidence to suggest that tourists will voluntarily change their behaviour towards more climate-benign holidaying practices (Truong and Hall, 2017). This is due to limited public understanding of the inter-linkages between tourism and climate change (Dillimono and Dickinson, 2015; Hares et al., 2010; Higham et al., 2014). Tourists fail to associate the carbon footprint generation with their holidaying choices as a result (Cohen and Higham, 2011; Dickinson et al., 2013; Higham et al., 2016a). Lastly, although there are tourists who claim to be prepared to change their holidaying behaviour (for instance, by taking fewer flights or holidaying closer to home), they do not necessarily do so in reality (Gössling et al., 2012). The latter phenomenon is known as the 'attitude-behaviour' gap in consumer behaviour research which represents a key obstacle for voluntary behavioural change to serve as a facilitator of the GHG emissions mitigation in tourism (Hibbert et al., 2013). The 'attitude-behaviour' gap underlines the important

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role of technology as a means of advancing the tourism industry towards the goal of environmental sustainability.

Technology can play a manifold role in reducing the carbon footprint of flying. This can be achieved through the improvements in aircraft design and operational efficiency (Grote et al., 2014), or via the adoption of more climate-benign aviation fuels (Gegg et al., 2014; Hari et al., 2015; Krammer et al., 2013). Biofuels are considered a viable alternative to aviation fuels (Kivits et al., 2010) and their potential to reduce carbon intensity of flying has been estimated as significant (Marsh, 2008). To-date, biofuels have been repeatedly trialled in the air travel sector with a view to make it mainstream aviation fuels in the foreseeable future (Appleyard, 2014).

While the potential of biofuels to mitigate the carbon footprint of air travel is recognised, public awareness of the use of biofuel technology in aviation alongside the carbon benefits this technology brings remains unexplored. Better understanding of the public perceptions of a new technology is important as these can often determine success of its societal acceptance and market rollout (Wegener and Kelly, 2008). Public awareness of a new technology represents a particularly interesting research object in the air transport context where public safety considerations can hamper the adoption of innovations (Greiner and Franza, 2003).

This paper contributes to knowledge by exploring tourist attitudes to the use of biofuel in aviation. The goal of the paper is threefold. First, it contributes to the scientific discourse on the public perception of tourism as an industry associated with significant environmental pressures, including carbon footprint generation. Second, it explores public knowledge on the application of biofuel technology in civil aviation, including its perceived carbon benefits. Lastly, the paper investigates if tourists consider biofuels as a safe alternative to conventional aviation fuels.

While biofuels have potential to reduce the carbon footprint of flying, there are a number of challenges attributed to the application of biofuel technology in aviation (Marsh, 2008). Increased demand for biofuels may lead to the significant, negative changes in global land use (Grote et al., 2014). This, in turn, is expected to intensify global food shortages, especially in countries of the Global South (Berndes et al., 2003). Furthermore, there is growing evidence to suggest that the level of carbon mitigation achieved through the application of biofuel technology can be lower than commonly anticipated when the indirect, life-cycle related GHG emissions attributed to biofuel production, transportation and distribution are brought into the picture (Repo et al., 2011). The increased biofuel production can further generate significant amounts of nitrous oxide (N_2O) which is a GHG and can therefore negate any carbon savings achieved (Lee et al., 2010). Lastly, there are a number of institutional and managerial barriers to the production scale and broader use of biofuels, including in the sector of air travel (McCormick and Kåberger, 2007). While these issues are acknowledged as being significant, they are beyond the scope of this study whose focus is on tourist knowledge of and tourist attitudes to biofuel use in aviation.

2. Biofuels in the air transport sector

Biofuel technology is not a new invention in transportation as the Henry Ford's original automobile constructed in the 1920s was initially designed to run on bio-ethanol (New York Times, 1925). This notwithstanding, it was not until the energy crisis in the 1970s that the use of alternative fuels would become of interest to the transportation industry and its aviation sector (Lee and Mo, 2011). Since then, the demand for biofuels in the air travel sector has grown manifold, being driven by such factors as the fluctuations in crude oil prices, political instability in crude oil producing regions, increased environmental concerns among the public and regulators, and the emergence of 'greener' business models (Armstrong, 2008; Chiaramonti et al., 2014; Nair and Paulose, 2014).

2.1. Transportation biofuels

Biofuels are produced from biomass substrates (Giampietro and Ulgiati, 1997). In the sector of transportation, biofuels can be used as full or partial substitutes for conventional fossil fuels (Kousoulidou and Lonza, 2016). There are three main types of biofuels, i.e. biogas, ethanol and biodiesel (Naik et al., 2010). Biogas is a product of anaerobic digestion of energy crops, their residues and waste (Weiland, 2010). While it can be used as an energy source for gas-operated and electric vehicles, its application in the aviation sector is limited (Saynor et al., 2003). Furthermore, the use of biogas as a transportation fuel has only been a major breakthrough in Scandinavia, while the adoption of this technology in the rest of the world has been lagging behind (Jönsson and Person, 2003). Ethanol is produced from the plants rich in carbohydrates, such as corn and sugarcane (Balat and Balat, 2009). It is the most commonly used liquid biofuel in the transportation sector, mainly due to the vast production volumes in Americas (Energy Information Administration-EIA, 2007). This notwithstanding, similar to biogas, ethanol is not considered a suitable alternative to conventional aviation fuels due to its limited chemical and physical qualities (Saynor et al., 2003). Lastly, biodiesel is produced from soybeans or other crops containing oil (Moser, 2009). Its chemical qualities are close to those demonstrated by kerosene, a conventional aviation fuel (Wardle, 2003) which determines why biodiesel holds the largest potential for application in aviation (Saynor et al., 2003).

Biogas, ethanol and biodiesel are referred to as the 'first generation' biofuels that have all been an object of significant scientific scrutiny (Naik et al., 2010). Such issues as land use changes, competition for food, freshwater and land, deforestation and cost of production have been raised (Anable and Bristow, 2007; Bailis and Baka, 2010; Marsh, 2008). In response to the criticism, the 'next generation' or advanced biofuels have been developed (Table 1). These have been seen more favourably by the scientific community as they can address some, but not all, of the issues attributed to the production of the 'first generation' biofuels (Fairley, 2011). Escobar et al. (2008) argue that these advanced biofuels have potential to become a commercially feasible technology in transportation within the next 15 years; however, in the short-term perspective, the first and second generation biofuels are likely to remain mainstream in the transportation industry, including its sector of aviation (Doornbosch and Steenblik, 2007; Upham et al., 2009).

2.2. The carbon benefits of biofuels

The carbon abatement potential of biofuels is significant, but varies depending on the production method, production scale, type of feedstock and the country of feedstock origin (Marsh, 2008). The sugarcane and palm oil from tropical and sub-tropical countries are recognised as the most energy rich biofuel feedstock due to long growing seasons, warm climate and fertile soils (Doornbosch and Steenblik, 2007; Steenblik, 2007). IEA (2006 cited in Doornbosch and Steenblik, 2007) suggests that biofuels produced from the Brazilian sugarcane can reduce the GHG emissions from road transportation by about 90%. Likewise, IPC and REIL (2006) posit that the ethanol from cellulosic feedstock can mitigate carbon footprint by 70–90%. Lastly, the World Bank (2008) refers to biodiesel as a carbon efficient fuel which can reduce the GHG emissions from transportation by 50–60%.

While indicating the significant carbon abatement potential