Sustainable Energy Technologies and Assessments 29 (2018) 60–69

Contents lists available at ScienceDirect

Sustainable Energy Technologies and Assessments

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

Original article

Preferences for bio jet fuel in Sweden: The case of business travel from a city airport

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ARTICLE INFO

Keywords:
Willingness-to-pay
Air transportation
Linear mixed model
Policy instruments

ABSTRACT

A viable green alternative to petroleum-based jet fuel is urgently needed in order for the aviation industry to meet its environmental targets. This study elicited Swedish business organisations' willingness to pay (WTP) a price premium for flights using bio-fuel blends using a contingent valuation approach. It also examined whether certain company characteristics had an effect on the stated WTP. It was found that the overall mean price premium amounted to 11.9 percent of the base price of flights, which is not high enough to cover the actual costs to airlines of using a 50/50 fuel blend. Only one-third of the respondents reported sufficiently high WTP to cover the associated costs of using bio jet fuel at current price levels. Furthermore, organisations that encouraged employees to choose the least expensive ticket at all times had lower WTP than organisations with no explicit travel policy. Accordingly, use of least-cost travel policies would prevent commercialisation of bio jet fuel. Moreover, voluntary actions by organisations in the form of price premiums on green flights could not create Swedish market demand for bio jet fuel. Development of other policy instruments is therefore vital to establish long-term market predictability and demand.

Introduction

One of the main challenges for the aviation industry is to manage the social and economic benefits deriving from modern air travel, while minimising the environmental impact rising from high levels of carbon dioxide (CO_2) emissions. It has been estimated that modern air travel accounts for around 2 percent of global CO_2 emissions, a figure expected to increase in coming decades [33]. This expected increase has recently prompted development of new goals and strategies by the International Air Transport Association (IATA) to achieve long-term sustainability [28]. Use of bio jet fuel, which is one of four strategies developed by IATA, is seen as a credible and effective option for achieving the climate goal set by the organisation of reducing aviation emissions by 50 percent of the 2005 level by 2050 [29]. However, airline demand for bio jet fuel is low, as it is three- to nine-fold more expensive than conventional jet fuel derived from petroleum [60]. According to the International Civil Aviation Organization (ICAO), large-scale continuous production of the green alternative is needed to decrease the relative price difference [27,32].

Biofuel markets are strongly affected by political decisions. Therefore, effective policies to overcome the economic losses to society of climate change and to achieve the environmental goals within the aviation industry are urgently needed. Policy instruments, including taxes, subsidies on renewable jet fuel, blending quotas and cap-and-trade regimes, have already been implemented or proposed by policy-makers and other relevant parties to help bring about a reduction in environmental degradation [55]. However, at present there is no regulatory framework with the primary objective of increasing the use of bio jet fuel, apart from current Norwegian legislation [52]. Policy instruments for carbon offsetting and an emissions trading scheme have been developed by the European Union, through the Aviation Directive (Directive 2008/101/EC of 19 November 2008 amending Directive 2003/87/EC) and ICAO. ICAO has proposed a global market-based measure (MBM) to play a major role in achieving climate goals through CO_2 compensation. This so-called Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) was agreed by 191 Member States in October 2016 and is to be implemented in 2021. This is the first global MBM scheme for an entire sector [32]. However, taking the economic and environmental impact of the different policy instruments into consideration, disagreements remain about which

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https://doi.org/10.1016/j.seta.2018.06.015
Received 20 October 2017; Received in revised form 4 May 2018; Accepted 28 June 2018

instrument is most advantageous [22].

In parallel to the regulatory process, an environmental movement whereby individuals and organisations decide to take action against climate degradation for which they themselves are responsible has emerged. Since 2016, more than 30 IATA member airlines offer their passengers the opportunity to compensate for the CO_2 emissions from their flight, either as an integral part of their website sales engine or through a third-party offset provider [26]. This market for CO_2 compensation results in an indirect reduction in carbon emissions. However, the price of carbon offsetting has been criticised by experts as too low to cover the actual costs of environmental degradation [44]. It has also been argued that there is a climate risk of compensating for black coal while increasing the uptake of 'green coal' through planting trees [23]. The impact on net carbon emissions from air travel thus ultimately directly depends on the extent to which airlines, and their customers, adopt and adhere to such compensation schemes. Brouwer et al. [6] found that the most important reason for consumers not participating in programmes to compensate for their CO_2 emissions is that they doubt that these programmes will have any substantial impact on the environment.

The use of bio jet fuel would provide a direct means for flight passengers to reduce their climate impact, as less CO_2 would be emitted in the first place. The main difference between the indirect (climate compensation) and direct approach is thus the 'pollute and pay indirectly' principle set against the 'pollute less and pay directly' principle. In addition, direct offsetting of CO_2 emissions is more administratively efficient and avoids constraining flight passengers to rely on airlines' active choice to carbon offset on their passengers' behalf. A study by Mayer et al. [40] showed that flight passengers perceived that use of bio jet fuel was a more effective measure than CO_2 compensation to make flying more environmentally friendly.

In an already price-sensitive market, the price difference to conventional jet fuel, with inadequate regulation and lack of investment as additional barriers, is the main explanation for the slow transition by airlines towards implementing bio jet fuel [20]. Policy instruments and willingness among air travellers to pay a price premium for flights using bio jet fuel could enable commercial deployment.

The objective of this study was therefore to examine willingness to pay (WTP) a price premium for CO_2 reduction by choosing flights using bio jet fuel, using the case of domestic flights to and from Bromma Stockholm Airport in Sweden. As in other European countries, the market for bio jet fuel in Sweden is still in the introductory phase and, as far as we are aware, this study is the first to examine air travellers' demand and WTP for flying with the greener alternative. If such a voluntary and direct approach could ensure market demand for flights using biofuel blends, then it would provide the intrinsic features necessary for considering this fuel alternative cost-effective and economically efficient (e.g. [49]). This study could therefore provide actors in the aviation industry, both from the demand side and the supply side, with valuable information about whether there is a sufficient market price premium to create a market demand for bio jet fuels or whether more societally costly policy options are required to establish market demand.

Bromma Stockholm Airport was selected as the study case because of its role as the most important hub for business travel in Sweden and because its presence has been associated with conflicting environmental and economic impact on the Stockholm region [53]. A further aim was therefore to examine whether organisational characteristics, such as an organisation's environmental engagement and the design of its travel policies when booking flight tickets, have an effect on that organisation's WTP a price premium for flying with bio jet fuel. Bromma Stockholm Airport is a city airport and the third largest airport in Sweden, and during 2016 had over 2.5 million flight passengers [54]. However, the high flight activity around the city airport is accompanied by high levels of CO_2 and other greenhouse gas (GHG) emissions. On national level, the aviation industry accounts for approximately 11.9 percent of GHG emissions from transport[3] and 4–5 percent of total CO_2 emissions from all sectors. The Swedish Parliament has decided on the environmental target of no net GHG emissions by 2045 (Swedish Environmental Protection [57]. According to the 2016 environmental report, the CO_2 emitted from air travel below 915 m altitude around Bromma Stockholm Airport corresponds to 18,885 tons of CO_2 emissions [54].

The continuing presence of Bromma Stockholm Airport has become a matter of recent dispute and the subject of political debate in Sweden, with Stockholm City Council proposing that the airport be shut down and replaced by housing, while other parties argue that closure would have detrimental consequences for economic growth and development, not only for the Stockholm region but also for the country. The reason is that the city airport plays an important role in maintaining Stockholm as a strong economic engine [18]. According to a recent estimate, up to 90 percent of all passengers flying via Bromma Stockholm Airport are on business-related travel and shutdown of the airport could cause 24,000 jobs to be lost [51].

Study background

Development of commercial deployment of bio jet fuel

The main barrier to commercial deployment of bio jet fuel is not technological constraints, but rather the existing regulatory and economic situation [60]. With few exceptions, there are generally no policies in place to support the deployment of bio jet fuel, while there are several mandates and acquis for road transportation [27]. Moreover, in the European Commission's new legislative proposals introduced in November 2016, there are no measures specifically aiming towards commercialisation of bio jet fuel [16]. Yet, there are initiatives worldwide, at low scale and high scale, with the common aim of increasing the share of the green jet fuel alternative [27]. One of these is the European Advanced Biofuels Flightpath, which was launched by the European Commission, Airbus, leading European airlines and biofuel producers in June 2011 [15]. The parties have agreed to accelerate the process of implementing bio jet fuel in the market, in order to reach the target for the aviation industry of using 2 million tons of bio jet fuel by 2020. In addition, in 2011 the European Commission introduced a target of using 40 percent sustainable low-carbon fuel in aviation by 2050.

Jet fuel costs and labour costs represent the largest cost items for airlines [23]. Jet fuel costs as a proportion of airline passenger revenue are estimated to vary between 15 and 35 percent, with the variation depending mainly on the current price of conventional jet fuel, whether the airline is a low-cost model and the specific airline's business model [61]. In 2016, the fuel cost share declined to 19.2 percent on average, from 27 percent in 2015 [31,30]. Given the relative price difference, an average fuel cost share of 19.2 percent and a 50/50 fuel blend, the pre-tax cost of flight tickets would increase by 19 percent (lower range) to 77 percent (upper range) if airlines decided on large-scale use.

Impact of bio jet fuel on climate and sustainability

There are at least three benefits to the aviation industry from introduction of bio jet fuel as a sustainability strategy. First, bio jet fuel is produced from renewable biological resources, including plant material and forest residues. In contrast to conventional jet fuel, this enables flexible production that can be spread worldwide and can include several different crops, meaning that its availability is less sensitive to geo-political risks. Moreover, it reduces airline exposure to the fuel cost volatility resulting from having a single source of energy. Second, bio

[3] Domestic and international (only emissions from international bunkering) transportation included.