35th International Electric Vehicle Symposium and Exhibition (EVS35)
Oslo, Norway, June 11-15, 2022

Norwegians' attitudes towards future travel with all-electric aircraft

Paal Brevik Wangsness[1], Knut Veisten, Eivind Farstad & Inga Margrete Ydersbond

[1] *Institute of Transport Economics, Gaustadalléen 21, 0349 Oslo, Norway, pbw@toi.no*

Summary

A sample of one thousand transport users traveling between Bergen and Stavanger have been asked about travel activity, attitudes, and preferences for a future electric plane option on this route. The respondents show some concern about the safety and range of electric planes, but they have a high level of trust in the certification process. A majority of the respondents would consider flying electric. We also investigate how much more different respondents would be willing to pay for an electric flight compared to a conventional flight, or whether they would require a discount.

Keywords: consumers, mobility concepts, range, research, user behaviour

1 Introduction

The aviation sector contributes to about 2% of global CO_2 emissions, and when the non-CO_2 effects (such as contrail cirrus clouds) are included aviation represents around 3.5% of the warming impact caused by humans in the present day [1]. In the EU, the aviation sector in 2016 was responsible for 3.6% of total GHG emissions [2] rising to 4,9% in 2019 according to recent data [3]. Reducing these emissions, while maintaining high levels of air travel, will be challenging [e.g. 4, 5]. There are promising technological developments for small electric aircraft, to our knowledge with more than hundred projects going on globally, which can serve as a possible solution for small short-haul commercial passenger flights already during this decade [5]. Electric passenger aircraft feature numerous potential benefits in the future, not only eliminating emissions, but also reducing noise pollution and costs of energy and maintenance [6].

In Norway, a country with relatively low electricity prices, several airports located at short distances from each other where alternative modes of travel often are deemed unattractive due to long travel times, and high volumes of short-haul air travel, there is an ongoing project to establish a demonstration case for commercial flights with small all-electric aircraft between the cities Bergen and Stavanger in the second half of the 2020s [7]. The authors of this paper have published an extensive report [8] analyzing several aspects of this project and the societal aspects of electrification of the domestic aviation sector. In this paper, however, we focus our analysis on the attitudes of travellers in the western part of Norway towards future travel with all-electric aircraft.

There are several barriers to introducing all-electric aircraft. Technologically, the energy density of batteries are regarded as the largest barrier [9]. So far, the only electric aircraft certified for commercial operations is an

electric two-seater, Pipistrel Velis Electro [10]. Another important barrier is on the human level: whether passengers will be willing to travel with all-electric aircraft when they are certified and in operation on ordinary passenger routes. This topic has so far received relatively little research attention, particularly the attitudes of people with other than American backgrounds.

Han, Yu [11] investigated travellers' decision-making process when deciding whether to buy tickets with electric aircraft. They sent out a survey to US airline customers and got 309 valid responses. Their analysis reveals that personal norms towards conducting "green acts", social norms, a products' green image were among the factors influencing decisions. Female and younger respondents were more likely to be positive. Han, Yu [12] also investigated attitudes towards electric aircraft among a sample of 321 American respondents. If respondents perceived electric aircraft to involve various types of risk, they were negative to flying with them. However, with new product knowledge, the respondents were more positive and could trust and potentially in the future use an electric aircraft. Han, Lee [13] investigated which factors could predict who would have the intention to use and recommend electric aircraft. They found that concerns for the environment, social norms, positive anticipated effects, and a sense of obligation to make pro-environmental actions positively influenced the respondent's intentions. Here, the sample was of 285 respondents and the methodology was also an online survey of US airline customers.

In our study, a sample of one thousand transport users traveling between Bergen and Stavanger were in the spring of 2021 asked about travel activity, attitudes, and preferences for a future electric plane option on this route. This sample is expected to reflect the views of the underlying population of transport users in these areas.

Our research questions are: 1) What is the distribution of attitudes towards important aspects of electrified air travel, such as safety, noise, and other environmental concerns? 2) What is the distribution between those willing and those unwilling to travel by electric aircraft if given the opportunity in about five years? 3) How is the intensity of this willingness and unwillingness distributed? 4) What personal characteristics are the main drivers behind the willingness or unwillingness to choose electric aircraft – can key consumer segments be identified?

2 Methods and data

The participants were recruited from the survey agency Norstat's respondent internet panel. The requirement for inclusion in the survey was residency in the two city municipalities Stavanger and Bergen or some neighbouring municipalities, as well as having completed at least one trip between the two urban areas over the past three years. The sample includes one thousand respondents with complete survey answers. Table 1 presents descriptive statistics on the respondents' stated travel activity between the Stavanger area and the Bergen area. Many respondents have travelled with more than one mode of transport between the two urban areas, meaning that they have made several trips with different means of transport.

Table 1: Respondents' stated travel activity between the Stavanger and Bergen area in the period 2019 to May 2021

Transport mode used for travel between the Stavanger area and the Bergen area 2019-2021	Respondents	Percent of sample
Plane	673	67,3 %
Bus	165	16,5 %
Car (incl. motorcycle)	602	60,2 %
Boat/Ferry (e.g. Fjordline)	161	16,1 %

The sample population matches the adult population in the greater Bergen and Stavanger areas in terms of age, but average income, education and car ownership levels are higher. Air travel has historically been a "luxury good" (see e.g. [14]), and in a global context travelling by plane is still something for the few, see e.g. [15], thus a positive correlation between air travel frequency and income levels can probably also still be expected in the Norwegian context. We expect the sample to be more representative of the part of the population with relatively

high levels of travel between these two urban areas, than being representative of the population as a whole. Table 2 presents descriptive statistics on some of these variables.

Table 2: Distribution of respondents' age, income, and household size

Demographic and socio-economic variables	Median	Mean	Max	No. of respondents
Age	46	45,9	86	1000
Personal income (interval midpoint)	650	705	1250	831
Household income (in NOK 1000; interval midpoint)	1250	1113	2250	815
Number of people in the household	2	2,6	13	1000

3 Results

3.1 Attitudes and preferences for electric aircraft as an alternative mode of transport

The respondents were asked to choose to what extent they agree or disagree with 13 statements about the use and possible benefits (or disbenefits) of electric aircraft, on topics such as environmental aspects, safety, and noise. Fig 1. summarizes the answer distributions to these 13 statements about electric aircraft.

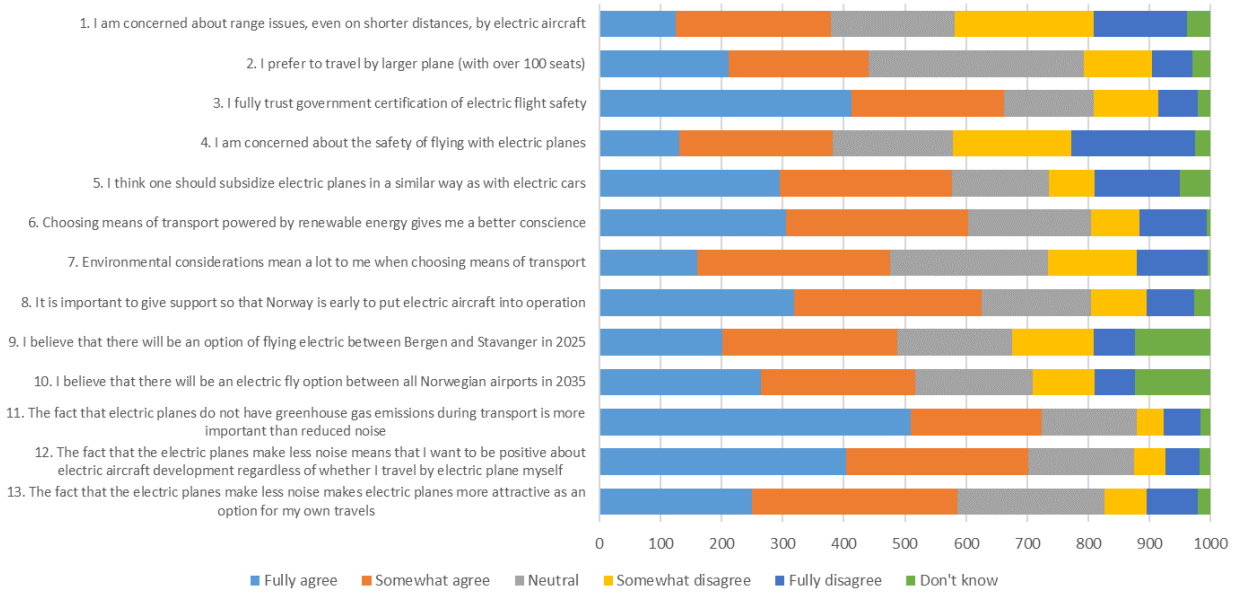

Figure 1: Answer distribution to statements on the introduction of electric aircraft in Norway

The respondents demonstrate some concern about the safety and range of electric planes (statements 1 and 4), but they have a high level of trust in the certification process (statement 3). Regarding the other statements, which had a positive angle regarding the introduction of electric aircraft or the benefits of electric aircraft, most of the respondents fully agree or somewhat agree with the statements.

The survey participants were presented with the following future scenario and question:

After 2025, the first aircraft with only battery-electric propulsion (electric aircraft) are expected to be deployed on the route between Bergen (Flesland airport) and Stavanger (Sola airport).

The electric planes that are put into operation will have been through extensive testing and will be as safe as conventional aircraft.

Would you consider electric planes as a transport option between the Bergen area and the Stavanger area/Jæren when this becomes available?

The distribution of answers is shown in Figure 2:

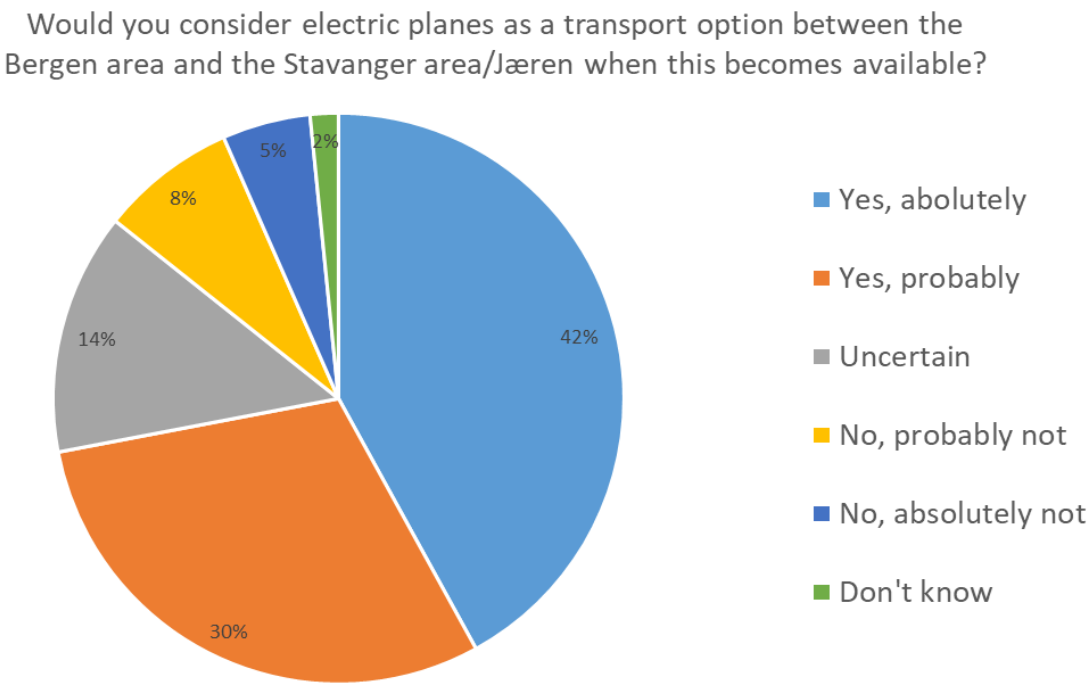

Figure 2: Whether electric planes would be considered as a transport option between Bergen and Stavanger

A clear majority of the respondents would consider electric plane as a transport option when this becomes available. We have analysed the relationship between the "yes" answers to this question and characteristics of the respondent in a logistic regression analysis, shown in Table 3:

This model indicates that

- There is an increased likelihood of a "yes" response with
  - age under 30 years,
  - completed university/college education,
  - access to electric car,
  - household income (on a natural logarithmic scale),
  - flight frequency abroad (on a natural logarithmic scale),
  - travelling with SAS/Norwegian between Bergen and Stavanger, and
  - the purpose of the last flight Bergen-Stavanger – that this was business or leisure travel (as opposed to other travel purposes and not flying);

- and that there is a reduced likelihood of "yes" responses with
    - age over 50 years and
    - flight frequency Bergen-Stavanger (on a natural logarithmic scale).

Table 3: Logistic regression models of "yes" responses to electric planes being considered as an option for travel between Bergen and Stavanger

	«Yes» = 1	«Yes, absolutely» = 1
Nat.log. of household income interval-midpoint., missing set at 0	0,04 ** (0,01)	0,02 (0,01)
Nat.log. of plane travel Bergen-Stavanger 2019	-0,25 * (0,11)	-0,14 (0,1)
Nat.log. of plane travel abroad 2019	0,24 ** (0,09)	0,18 * (0,08)
Under 30 years	0,56 * (0,26)	0,61 ** (0,21)
Over 50 years	-0,66 *** (0,17)	-0,42 ** (0,15)
Woman	-0,22 (0,16)	-0,41 ** (0,15)
University or college degree	0,68 *** (0,16)	0,43 ** (0,15)
Works at least 32 hours per week	-0,29 (0,18)	0,02 (0,16)
Access to electric car	0,4 ** (0,15)	0,39 ** (0,14)
Last plane trip Bergen-Stavanger was a business trip	0,58 * (0,24)	0,43 * (0,22)
Last plane trip Bergen-Stavanger was a leisure trip	0,68 ** (0,24)	0,46 * (0,21)
Has flown with SAS/Norwegian Bergen-Stavanger in the last 2-3 years	0,49 * (0,24)	0,35 (0,22)
Constant	-0,28 (0,3)	-1,4 *** (0,28)
Likelihood function (log L)	-540,6	-642,8
Akaike's information criterium (AIC)	1107,2	1311,5
Hosmer & Lemeshow (χ^2)	12,18 (df =8)	5,27 (df = 8)
Cox & Snell's pseudo-R^2	9,9 %	7,2 %
Nagelkerke's pseudo-R^2	14,3 %	9,7 %
Number of observations (n)	1000	1000

Note: Coefficients standard errors in parenthesis. Level of significance, p-values: ***<0,001, **<0,01, *<0,05, .<0,1

3.2 Willingness to pay for an electric flight compared to a conventional flight

The sample was divided into two parts when given questions about willingness to pay for travel by electric aircraft per se:

Those who had answered "yes" (i.e., answering either "yes, absolutely" or "yes, probably") were asked about the willingness to pay a higher price for an electric flight than for a conventional flight (720 respondents).

Those who had *not* answered "yes" (i.e., they answered either "no, absolutely not", "no, probably not", "uncertain", or "don't know") were asked about the willingness to choose an electric flight if they could pay a lower price for the electric flight than for the conventional flight (280 respondents).

Below we present the (translated from Norwegian) questions asked. The words that varied between the two types of questions (either a price increase for electric flight or a price discount) are put in brackets:

Ticket prices for direct flights between Bergen and Stavanger vary greatly, depending on the time of travel and ticket type, from less than NOK 500 to over NOK 3000 one way.

Suppose that the tickets for an electric flight would be 50% [higher][lower] than for a conventional flight, such as NOK [1500][500] instead of NOK 1000.

If electric planes were an option today, would you choose the electric flight instead of the conventional flight if the electric flight had a 50% [higher][lower] ticket price?

Respondents received (randomly) either a 50%, 10% or 90% price change. The answer they gave, "yes" or "no" (or possibly "don't", which we interpret as "no"), was expected to depend on this percentage change in prices. The following figures, Fig. 3 and Fig. 4, summarize the proportions "yes" to the electric alternative if faced with a price reduction (n=280) or a price increase (n=720).

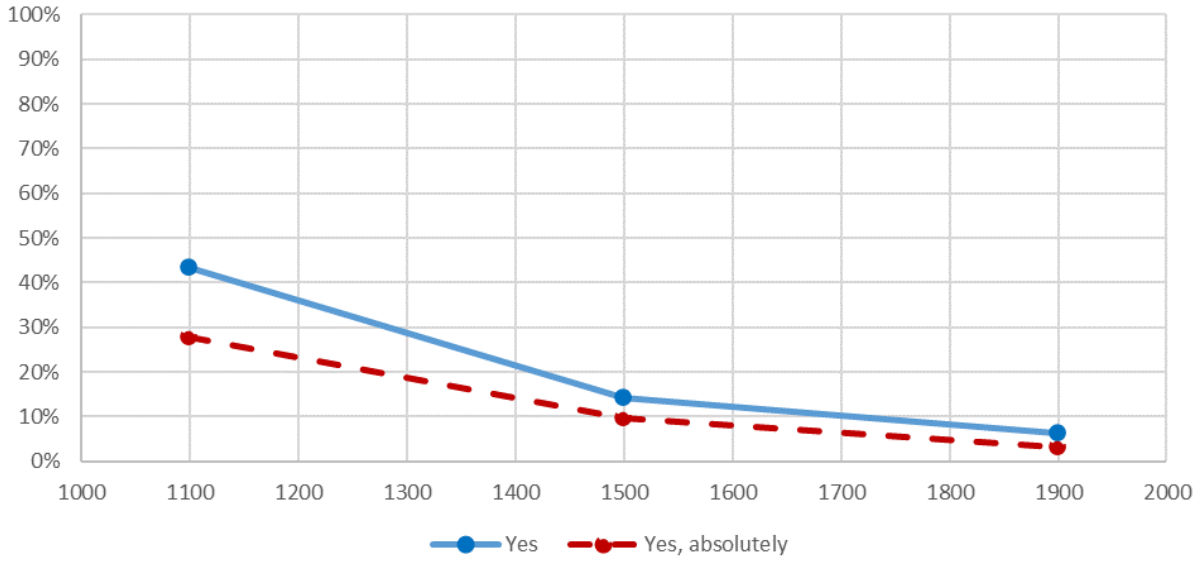

Figure 3: Shares (vertical axis) among the majority who initially were positive to electric planes as an alternative mode of transport, that respond "yes" and "yes, absolutely" to the electric option for a stated price increase (horizontal axis), given that travel by conventional aircraft costs NOK 1000. 720 respondents in total. Average additional WTP for those with a "yes" answer: 24% (max WTP: 2200). Average additional WTP for those with a "yes, absolutely" answer: 17% (max WTP: 2100).

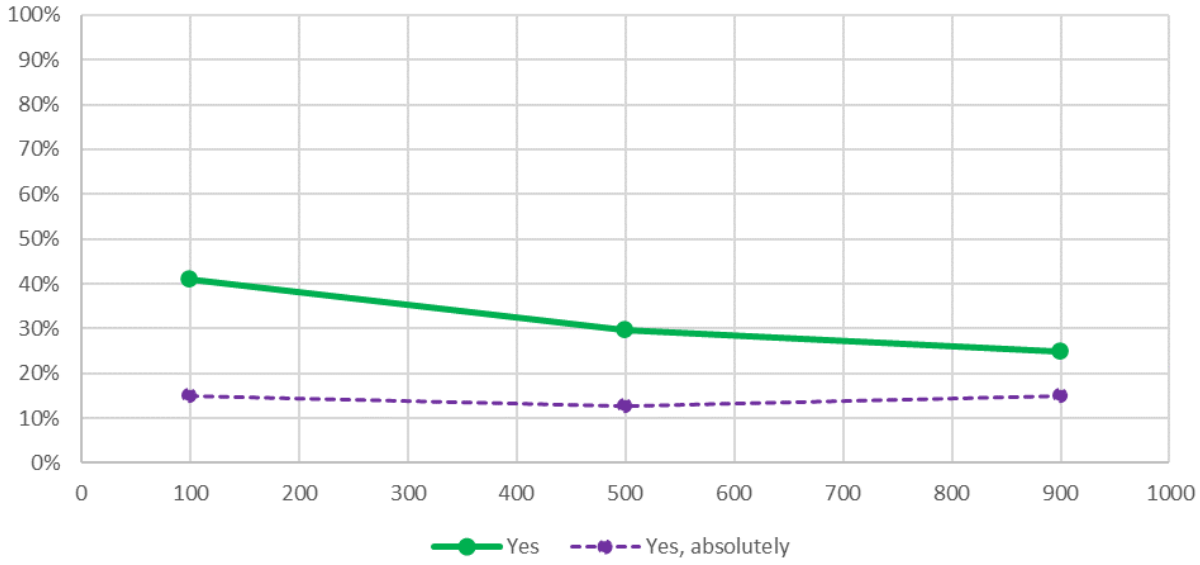

Figure 4: Shares (vertical axis) among the minority who initially were negative or uncertain towards electric planes as an alternative mode of transport, that may be "tempted", i.e. answer "yes" and "yes, absolutely" to the electric option for a stated price discount (horizontal axis), given that travel by conventional aircraft costs NOK 1000. 280 respondents in total. Average compensation needed to get a "yes" answer: -67 %

The individual respondent only gave an answer as a response to one monetary amount, either 10%, 50% or 90% price increase/decrease compared to NOK 1000 for a conventional flight. This concreteness means that we can be confident in that the respondents have generally "responded properly" – that they have considered the price of electric flights when they have responded.

For the choice of electric plane option in the cases of price increases, we observe what the theory predicts. Lower shares correspond "yes" to a relative price increase to NOK 1500 for electric planes (versus NOK 1000 for conventional ones) compared to the share "yes" to NOK 1100 for electric planes, and we get an even lower share of "yes" to NOK 1900 (Fig. 3).

If we extrapolate the curves in Fig. 3 and assume 100% yes to 0% price change (i.e., it costs NOK 1000 just like the conventional alternative) and extrapolate the two yes-curves downwards for amounts over NOK 1900, we get to NOK 2200 (rounded) for "yes" and 2100 for "yes, absolutely". When we aggregate, we get a 24% and 17% in estimated (extra) willingness to pay for electric planes, implying that they would on average pay NOK 1240 and NOK 1170, respectively. We have used the method for calculating averages from yes shares to various price increases described in [16].

We observe somewhat similar patterns when we ask the initially sceptic to the electric alternative about the need for "compensation" in order to choose it. We observe that the cheaper electric planes become compared to conventional ones, the greater the proportion of those initially less interested in the electric option switch to answering "yes" to choosing the electric plane option. However, for "yes, absolutely", we get a virtually flat curve, as if the price reduction has no significance (Fig. 4). Extrapolating the green "yes" curves in Fig 4., with a 100% yes to free electric plane tickets (NOK 0) and a maximum of NOK 1000, this gives an estimated reduced willingness to pay for electric planes (versus non-electric planes) equal to -67%. On average they would pay NOK 333 for the electric option if the conventional option costed NOK 1000. This constitutes a significant estimated ticket price compensation claim for the group that initially seem to be sceptic about electric flights between Bergen and Stavanger.

We have estimated linear-logistical models for different market segments, based on the stated purpose for the last flight between Bergen and Stavanger. The segments are business purposes (n=229) and holiday/leisure purposes

(n=195). We also ran the same model for the group that had not travelled by air between the two cities in the period 2019-21 (n=207). We only made these estimations for the part of the sample that had considered electric flights as a future option for travel between Bergen and Stavanger (which adds up to 720 if we add the 89 who had either travelled to-from work or stated other travel purposes).

Based on this statistical analysis, we can compare the confidence intervals for the estimated willingness to pay across the segments. As a result, all confidence intervals are clearly overlapping. We find no statistically significant differences between the segments' additional willingness to pay, based on this test. We cannot thus prove that there is any difference in extra willingness to pay for electric flights between leisure and business travellers, or other types of travellers for that matter. Table 4 summarizes the comparison of linear-logistic models for different market segments, based on the stated purpose for the last flight between Bergen and Stavanger.

Table 4: Median and average extra willingness to pay for electric plane option ("all else equal") – reference price: NOK 1000 (to travel Bergen-Stavanger by conventional flight) across flight customer segments

	Linear-logistic model for «yes» to a given price increase			
	Business travel	Holiday/leisure travel	Had not travelled by plane in 2019-21	Entire sample
Price increase	-0,0030 *** (0,0006)	-0,0035 *** (0,0007)	-0,0034 *** (0,0007)	-0,0033 *** (0,0004)
Constant	3,08 *** (0,80)	3,64 *** (0,94)	3,39 *** (0,93)	3,27 *** (0,48)
Median	1022 [802,1147]	1032 [812,1147]	1004 [760,1134]	1003 [907,1082]
Mean	1037 [889,1154]	1039 [869,1150]	1013 [828,1137]	1015 [939,1086]
Log-likelihood	-113,6	-83,3	-84,4	-319,1
Baye's information-criterium (BIC)	238,1	177,2	179,5	651,4
Likelihood-rate	32,0	33,9	31,5	106,6
Adjusted McFadden pseudo-R^2	10,80 %	14,91 %	13,74 %	13,78 %
Number of respondents	229	195	207	720

Note: Coefficients' standard errors in parenthesis. confidence intervals (Krinsky & Robb) in brackets. Level of significance, p-values: ***<0,001, **<0,01, *<0,05, .<0,1

We find quite similar estimates for the different segments. There are no statistically significant differences between the median and average additional willingness to pay. All confidence intervals are around NOK 1000 (0% in additional willingness to pay).

We also have estimated linear-logistic regression models with the inclusion of individual characteristics. In these models, we have analysed the relationship between "yes" answers to the question of choosing the electric plane option given a price change. The results show relatively weak correlations between the respondent's stated behavioural intention (choosing the electric option) and the respondents' characteristics. For the willingness to pay a relatively higher price for electric planes, it is the price increase itself that drives the response. This willingness to pay a relatively higher price is distributed relatively evenly between the respondents. There are no segments that strongly stand out statistically. The tables behind this analysis can be found in [3], along with more regression analysis using this dataset.

The measured price sensitivity (the negative size and statistical significance of the price coefficient) was significant in all segments. The price sensitivity was particularly strong for the majority presented with price increases, but the price of the electric flight option also had some effect on the minority presented with the option of choosing the electric option with a price reduction, as expected by consumer theory. This can be partly explained by the range of price changes used (10%, 50%, 90%), but it must also be attributed to the fact that respondents have assessed our described electric aircraft scenario as credible.

If we look at the sample as a whole, the positive group as well as the negative/indeterminate group, we will find that (a weighted) average willingness to pay is close to 0%. If travellers *are given the choice* between electric and conventional aircraft, those with a higher willingness to pay for electric planes will be able to self-select themselves for electric planes. We expect this, all else being equal, will contribute to an improvement in travellers' consumer surplus.

4 Discussion and conclusion

In this paper we have analysed the attitudes and preferences towards electric aviation of one thousand respondents who have in the recent years travelled between the Stavanger area and the Bergen area. We argue in section 2 that this sample is more representative of the part of the population with relatively high levels of travel between these two urban areas, than of the population as a whole. The sample therefore represents the most relevant segment of the population, with respect to analysing attitudes, preferences, and willingness to pay, as these are the people who are most likely to face the choice between electric aircraft and other means of transport, when electric flights become available.

When presented with statements about the use and possible benefits (or disbenefits) of electric aircraft, on topics such as environmental aspects, safety, and noise, most of the respondents show a strong or moderately positive attitude towards electric aircraft on most of the statements. They show some concern about the safety and range of electric aircraft, but they have a high level of trust in the government certification process. A reasonable interpretation of this is that if the government certifies electric aircraft as safe as the industry standard for conventional aircraft, it will be a strong and important signal to potential customers. And when this is stated as a foundational assumption for a future scenario where the respondents are asked to consider electric planes as a transport option between the Bergen area and the Stavanger/Jæren area when this becomes available, it may not be very surprising that 72% of the respondents state a willingness to consider this option. At the other end of the spectrum, only 13% of the respondents answer either "No, probably not" or "No, absolutely not". The probability of answering "yes" is strongly correlated with having a university of college degree and being under 30 years of age. Generally, these findings show that most of the respondents have a fairly positive attitude towards a future scenario where electric aircraft is an available travel mode. However, there is a question of how deep this positivity goes.

When we ask the positively inclined majority of the respondents about their willingness to pay for the electric option compared to the conventional option, we find a 24% of additional willingness to pay for the electric option on average for "yes"-respondents. However, there is a large spread of additional willingness to pay among respondents. A small share of these respondents (less than 10%) is willing to pay 90% more or higher, which drives up the average. While there is a larger share of respondents willing to pay 10% more for the electric option, this share is less than half. In other words, there is a high degree of price sensitivity, implying that many customers would choose the conventional option for any price addition to the electric option.

Even if the prices were equal, a sizeable minority would be negative or unsure about choosing the electric option. Within this group, there is a need for large discounts in order to "tempt" them to switch to the electric option. This group's dislike for the electric option, in terms of need for compensation (on average 67%), is so large that it largely cancels out the additional willingness to pay from the positive group. If the conventional option remains available when the electric option arrives, both groups would be able to self-select to the option that gives them the best overall customer experience, and in that way can both groups achieve a higher consumer surplus. However, with the high degree of price sensitivity between choosing the electric and the conventional option, if the price of taking the electric flight is significantly higher than the conventional flight, only a small segment of the airline customers will be willing to go electric.

For airline companies, manufacturers and government agencies wishing to promote low and zero emission aviation, it should be encouraging to see that attitudes are generally positive towards electric aviation, particularly among the young and highly educated. However, they would have to grapple with the challenge of a relatively high price sensitivity. When considering that the economies of scale are likely to disfavor the early electric aircraft

(e.g., a 19-seat electric option against a 100+ seat conventional option), this will pose a challenge, even if the electric option has significantly lower energy costs per passenger. As discussed in [8] and [6], both higher taxes (e.g., fuel taxes and passenger taxes) on conventional aviation and support schemes for zero emission aviation can be used to make sure that the price difference is not too large in the disfavour of zero-emission options. It would make sense to consider such policy options as a part of wider policies on climate and innovation.

The development of electric aircraft is moving fast, and it would be interesting to redo a survey of this kind when the electric option is only a short time away from becoming available. That way, the respondents will assess alternatives that can be expected to be perceived highly realistic. The survey and analysis could be expanded to include more attributes of electric aircraft, in order to inform design and marketing decisions. It could also be expanded to more routes and countries, in order to get a better grasp on the actual market sentiment for electric aircraft.

Acknowledgments

We are grateful for the opportunity to expand on our research conducted in the making of the report *Accelerating the phase in of electric aircraft in Norway - Possible societal impacts and policy instruments,* a research project financed by Start Norge AS.

References

[1.] Carbon Brief. *Guest post: Calculating the true climate impact of aviation emissions*. 2020 [accessed 2021-11-08]; citing Lee, D. S. et al. (2020) The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018, Atmospheric Environment, doi:10.1016/j.atmosenv.2020.117834]. Available from: https://www.carbonbrief.org/guest-post-calculating-the-true-climate-impact-of-aviation-emissions.

[2.] EEA, EASA, and EUROCONTROL, *European Aviation Environmental Report 2019*. 2019, European Environment Agency, European Union Aviation Safety Agency, Eurocontrol: Copenhagen.

[3.] Transport & Environment, *Roadmap to climate neutral aviation in Europe*. 2022, Transport & Environment: Brussels.

[4.] Schäfer, A.W., et al., *Technological, economic and environmental prospects of all-electric aircraft.* Nature Energy, 2019. **4**(2): p. 160-166.

[5.] Eurocontrol, *Aviation Outlook 2050: Main Report*. 2022, Eurocontrol: Brussels.

[6.] Ydersbond, I.M., N.B. Kristensen, and H. Thune-Larsen, *Nordic Sustainable Aviation*. 2020, Nordic Energy Research: Oslo.

[7.] Elflyportalen. 2021 [accessed 2021-11-08]; Available from: https://www.elflyportalen.no/.

[8.] Wangsness, P.B., et al., *Fremskyndet innfasing av elfly i Norge: mulige samfunnsmessige konsekvenser og virkemidler [TØI-rapport 1851/2021]*. 2021.

[9.] Roland Berger, *Think:Act. Aircraft Electrical Propulsion - The Next Chapter of Aviation?* 2017, Roland Berger: London.

[10.] EASA, *EASA certifies electric aircraft, first type certification for fully electric plane world-wide*. 2020, European Union Aviation Safety Agency: Cologne.

[11.] Han, H., J. Yu, and W. Kim, *Investigating airline customers' decision-making process for emerging environmentally-responsible electric airplanes: Influence of gender and age.* Tourism Management Perspectives, 2019. **31**: p. 85-94.

[12.] Han, H., J. Yu, and W. Kim, *An electric airplane: Assessing the effect of travelers' perceived risk, attitude, and new product knowledge.* Journal of Air Transport Management, 2019. **78**(July 2019): p. 33-42.

[13.] Han, H., et al., *Triggers of traveler willingness to use and recommend eco-friendly airplanes.* Journal of Hospitality and Tourism Management, 2019. **38**(March 2019): p. 91-101.

[14.] Aasness, J. and E.R. Larsen, *Distributional effects of environmental taxes on transportation.* Journal of Consumer Policy, 2003. **26**(3): p. 279-300.

[15.] Gössling, S. and A. Humpe, *The global scale, distribution and growth of aviation: Implications for climate change*. Global Environmental Change, 2020. **65**: p. 102194.

[16.] Kriström, B., *A non-parametric approach to the estimation of welfare measures in discrete response valuation studies*. Land economics, 1990. **66**(2): p. 135-139.

Authors

Paal Wangsness is a senior research economist at the Department of Economic Analysis at The Institute of Transport Economics (TØI). Paal is a Master of Economic Theory and Econometrics from the University of Oslo and the University of Minnesota. He joined PwC Consulting after graduating in 2011. He joined TØI in 2014, specializing in transport and environmental economics. He has authored or co-authored 19 TØI-reports (of which 5 as project leader) and 9 peer-reviewed scientific papers since 2014. In 2020 Paal completed his PhD at the Norwegian University of Life Sciences with the doctoral thesis «Economics and policies for the electrification of transport».

Knut Veisten is a senior research economist at the Department of Mobility at The Institute of Transport Economics (TØI). Knut has a PhD in environmental economics and forest economics from the Agricultural University of Norway. His thesis treated the valuation of public goods using survey-based stated preference methods. Veisten's area of expertise include survey-based research, market analysis, and cost-benefit analysis. He has participated in various research projects within the fields of environment and transport.

Eivind Farstad is a senior researcher at the Department of Mobility at the Institute of Transport Economics (TØI). Farstad completed his PhD, dr. oecon., in Marketing in 2003 at the Norwegian School of Economics (NHH). Among his research interests are tourism, shared mobility and sharing economy, leisure travel and environmental impacts, regional development, travel statistics, and economic impact analyses. He joined TØI in 2008 and has published 15 peer-reviewed scientific articles and 17 research reports while working at TØI.

Inga Margrete Ydersbond is a senior researcher at the Department for Economic Analyses at the Institute of Transport Economics. In 2018, she defended her PhD thesis at the Department of Political Science at the University of Oslo about EU's climate and energy policy. Her prime research interests include sustainable energy system development, sustainable transport system development, lobbying, electrification, the role of public authorities, comparative studies and case studies. She joined TØI in 2018. Ydersbond is the first author of 6 peer-reviewed scientific articles and 9 research reports, the co-author of 3 research reports and 1 scientific article and has published numerous other analytic texts for various venues.

.