The CoFFEE Project

Findings: Survey of Airlander in South Yorkshire

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Executive Summary

The study explored public perceptions of Airlander in the Doncaster area, focusing on:

1. Its economic and environmental impacts.
2. Public awareness and alignment with the UKRI Future Flight initiative.

Broad Awareness: 75% of respondents had heard of Airlander, primarily through digital media. The aircraft is recognised for its sustainability and novel design, although some link it to older airship technology.

Economic and Local Impacts: Over 90% believe the production facility will generate "good jobs". Most respondents expressed optimism about Doncaster's role in sustainable aviation. Concerns about road traffic and wildlife impacts were noted but did not dominate opinions.

Sustainability: Airlander's low emissions and innovative use of materials resonated with respondents. Sustainability attributes like renewable energy use and recyclable materials were highly valued. Local manufacturing was seen as crucial for economic revival.

Future Transport Potential: Respondents favoured Airlander for freight, remote surveying, and domestic leisure travel. Passengers' top concerns, especially among younger groups in the sample (mainly aged 40-80), were environmental impact and cost. Attributes like journey time and comfort were rated moderately important, while onboard entertainment was less critical.

Emotional Responses: 85% expressed positive feelings about the project, including optimism, excitement, and relaxation. Prior knowledge of Airlander correlated with stronger positive responses and reduced scepticism.

Challenges and Considerations: Public expectations about fares (£69 average estimate for a Doncaster-London trip) were benchmarked by some against rail. Though minor, concerns about wildlife and infrastructure impacts suggest areas for stakeholder communication. Generational differences in cost sensitivity and environmental priorities highlight the need for targeted messaging.

In conclusion, the survey reflects strong public support for Airlander as a sustainable and economically beneficial innovation. Clear communication on environmental and economic benefits will be critical for broader acceptance. Future research should address the identified sample bias and investigate nuanced societal trends.

Contents

1 Introduction

The City of Doncaster Council and South Yorkshire Mayoral Combined Authority are promoting South Yorkshire as a hub for green aerospace as part of the South Yorkshire Investment Zone. Developments relating to this initiative include the relaunch of the airport as 'South Yorkshire Airport City' and the agreement with Hybrid Air Vehicles Limited (HAV Ltd) [1] to locate the production facility for its Airlander 10 aircraft at Carcroft Common [3] within the City of Doncaster boundary. Development of the site is underway, with the first aircraft entering commercial service following a four-year production and Type Certification programme.

Notably, hybrid aircraft are not mentioned as an aircraft type[1] in UK Research and Innovation's Future Flight Vision and Roadmap [6]. One of the domains of UKRI interest is 'regional air mobility'. Airlander promises to meet many of the initiative's objectives.

1.1 The Research Opportunity

Sustainable development, as defined by the UN Sustainable Development Goals [7], is a holistic concept which entails people having opportunities for *"decent work and economic growth"* (SDG8) and the need for *"industry, innovation and infrastructure"* (SDG9) whilst also emphasising the need for *"responsible production and consumption"* (SDG12) and *"climate action"* (SDG13). However, most forms of aviation remain highly dependent on fossil fuels, with only limited opportunities emerging for using renewable energy. Furthermore, those opportunities tend to be limited to short-range aviation or rely on biomass, raising other sustainability concerns. Therefore, whilst aircraft production and air services potentially support SDGs 8 and 9, most aviation is currently in conflict with achieving goals 12 and 13.

Airlander represents a radically different approach, combining proven aerospace technologies, such as buoyant lift from airships and aerodynamic lift from fixed-wing aircraft. Airlander 10 has a 100-passenger capacity, a freight payload of 10 tonnes, or a combination of the two. Airlander obtains 60% lift from buoyancy due to its helium-filled envelope, with the other 40% achieved due to the airframe when under power. Propulsion is currently achieved by kerosine combustion. However, energy consumption and carbon emissions are up to 75% lower than a comparable conventional fixed-wing aircraft. It is intended to eliminate carbon emissions by powering electric motors with hydrogen fuel cells. HAV Airlander is well-suited by design to carry hydrogen storage for this purpose.

Other sustainability benefits include:

- A lower flight ceiling, which avoids contrail production (which contributes to the radiative forcing that causes climate change).
- No cabin pressurisation, which is better for passenger health.
- Reduced need for specific ground infrastructure.

[1] The word 'hybrid' is used but in the different context of powertrains, not airframe.

- Ability to serve a broader range of destinations more directly (due to independence from traditional airport infrastructure).

Efficient operation also means that Airlander, dependent upon payload, can remain airborne for up to five days. However, a key difference with current commercial aviation is Airlander's cruising speed of around 70 knots (130kmh / 80 mph). This speed is, critically, 4-8 times slower than turbofan-powered airliners. The speed differential can be considered in two ways:

1. **Airlander's attributes lend it to serve a series of niches *now* for which speed is not the most important factor, including:**

    a. Freight or passenger transport where the 'competition' is from surface modes which achieve similar or lower commercial speeds,

    b. Short-range movements for which the time airborne is a relatively small part of the overall journey time once surface journey legs and time in terminals are added – this niche is dependent on Airlander being able to provide a more direct air service and avoid the time-consuming passenger and baggage logistics of typical airports,

    c. Leisure and tourism travel for which slow speed and quiet operation are desirable, to create a relaxing experience, observing the world from above.

2. **As Airlander represents a radical alternative, new niches might *emerge* as people respond to its opportunity.**

    a. Airlander would be well placed to benefit from a change in attitudes about travel and transport practices to reduce environmental impacts. In the same way that rail travel is promoted as an alternative to jet-based aviation, Airlander could offer a moderate-speed alternative, providing a generous space allocation per passenger but avoiding some of the constraints of rail travel, such as changing trains and manhandling luggage.

    b. As with rail travel, sleeper service might be offered so that travel occurs when people sleep.

To be a holistically sustainable form of aviation, the Airlander production facility's environmental impact must be as low as possible. Furthermore, the sourcing of materials and components must consider the sustainability impacts of the supply chain.

To make a positive socioeconomic contribution, HAV Ltd must be part of a 'Future Flight' ecosystem, which encourages the development of specialist suppliers and layout market skills over the long run. Recent global events have indicated that - other things being equal - shorter (more local) supply chains can be more resilient and have lower supply chain carbon costs.

1.2 Research Aims

Hence, the research reported here aimed to:

1. Explore how the public in Carcroft Common and Doncaster understands Airlander as:
    a. a new feature of the local economy and labour market,
    b. a contribution to sustainable aviation.
2. Consider how hybrid aircraft fit into the UKRI Future Flight initiative.

2 Methodology

2.1 Setting and Sample

As part of the CoFFEE project [5], the research sought to address the aims by surveying residents of the Doncaster area, with a particular focus on Carcroft Common, the location of the Airlander production facility. Awareness of Airlander was expected to be relatively high for this study population. This is due to local media activity, particularly that occurring at the time of signing the production site agreement.

The CoFFEE project principles include the importance of co-creating flight scenarios with the stakeholders, emphasising diverse 'publics' as stakeholders engaging with Airlander's broad vision.

Data collection sought to cover the following topics in greater or lesser detail:

a. Understanding the level of awareness of Airlander (what it is, how it differs from existing aviation options, and how its environmental performance is different).

b. Expectations about the benefits of hosting the production facility (jobs, additional economic activity in the local community, awareness raised of capabilities of Carcroft/Doncaster).

c. Perceptions of possible local environmental impacts from the production facility (housing, traffic, noise and emissions from facility, test flight activity).

e. Perceptions of different service niches for Airlander.

f. Expectations about what it would be like to travel on Airlander.

f. Any concerns about travel on Airlander.

As the survey recruitment specifically targeted people living in or near Carcroft Common, participants were recruited mainly via the digital public engagement channels of the City of Doncaster Council. Respondents had to confirm that they lived *"either in the City of Doncaster Council area or one of the neighbouring local authority areas"*. Almost all respondents reported a 'DN' postcode, with just 4% indicating an 'S' postcode. Thirty-five per cent of respondents indicated their home addresses as being in the DN5 and DN6 postcode areas closest to Carcroft.

The mean age of the sample was 63 years, with a strong bias towards participation by the over 30s, with only a few people in their 20s responding. This likely results from the survey opportunity being publicised by local authority social media channels, which will tend to attract well or long-established residents with a connection to the council (e.g. as a council taxpayer) and through employers. Therefore, adults in education and training were less likely to be reached.

Two-thirds of respondents identified as male, and one-third as female.

Forty-two per cent of respondents were in work. Professional and senior managers were over-represented in the sample. Most of those not in work reported that they were retired.

To characterise the sample according to its use of aviation, two questions were asked about previous experience. Nearly all respondents had flown at some point in the past (Q18); just under half had done so in the last year (Q17, see Figure 1), and around a fifth had taken three or more return trips in the previous year.

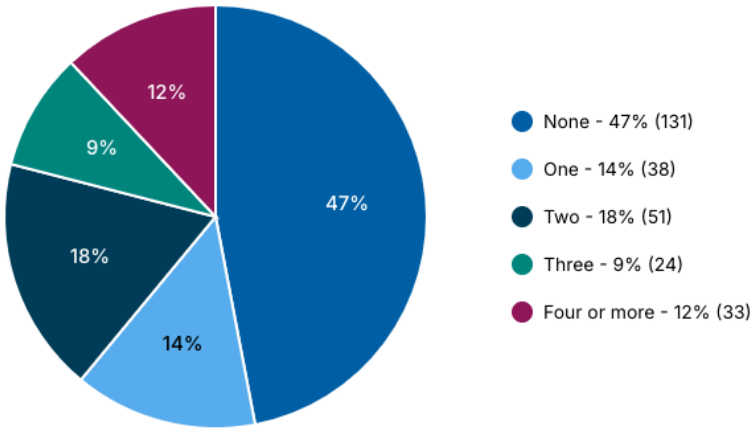


Figure 1. (Q17) How many trips by air have you made in the last 12 months? Please count outward and return flights and any transfers as one trip. N=277

2.2 Data Collection

Survey data was collected through the web-based survey platform 'Online Surveys' [5]. The advantages of taking a survey approach are:

- Information could be obtained from a relatively wide group of people (response rates can be high, particularly if a small prize is offered).
- Surveys allow people to participate at a convenient time.
- Information could be processed and available quickly.
- Survey information could help us frame more nuanced and interactive data collection at a later stage, such as focus groups or deliberative workshops.

Disadvantages of taking a survey approach:

- The questions must be 'fixed choice' in the main.

- What drives people's responses is unclear beyond the information presented in the question. However, statistical analysis can indicate the underlying motivations by associating responses to different questions or sociodemographic variables.
- We don't always know if people have interpreted the question correctly.
- Online surveys (as was the case for this research) can be 'digitally exclusive'.

2.3 Data Analysis

Quantitative data was analysed with SPSS [4].

Due to the modest sample size of this study, we have only included outcomes with medium or higher effect sizes. With a larger sample, it is possible that more nuanced and challenging-to-detect trends in society can be revealed.

The interpretation of effect sizes for ANOVA[2] was based on Cohen [2:284–7], classifying .01 as small, .06 as medium, and .14 as large.

Kappa Measure of Agreement[3] values were interpreted in line with Peat, with a value of .5 representing moderate agreement, .7 representing good agreement, and .8 and above representing very good agreement.

Between-groups analysis investigated potential differences associated with:

- Age
- Gender
- Employment level
- Prior knowledge of the Carcroft Development
- Number of flights made in the last 12 months
- Cost estimate of a one-way trip from Doncaster to London

Due to the low sample size of participants under 40 and over 80, these participants are excluded from statistical analysis of age's association with the survey scales.

3 Results: Broad Knowledge about Airlander as an Aircraft

Three-quarters of respondents had at least heard of Airlander before being recruited for the survey; a quarter had not, see Figure 2.

[2] Analysis of Variance: a statistical test to investigate the association of two or more groups
[3] A statistical test to investigate the level of agreement between two groups

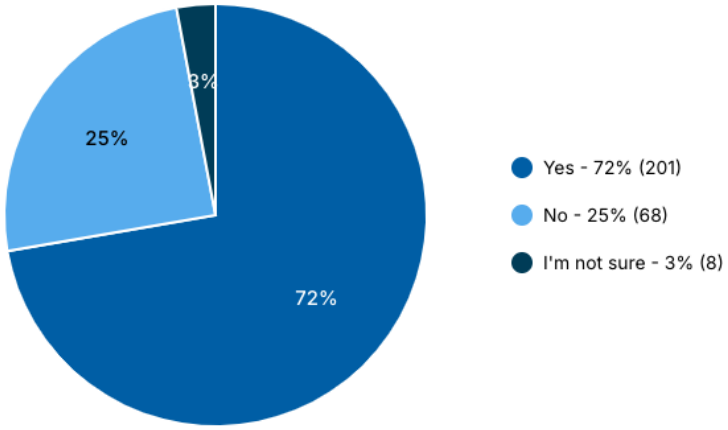


Figure 2. (Q3) Had you heard about Airlander before you began this survey today? N=277

Regarding the medium through which people had heard about Airlander (see Figure 3), the importance of digital channels was clear, with over half having heard online or via social media. This is notable given the mean age of the sample, as it contained few 'digital natives'. However, as all participants completed the survey digitally, the sample may have under-represented those who rely on traditional media. Television was still responsible for introducing around a quarter of respondents to Airlander, and printed materials provided information for more than 10%.

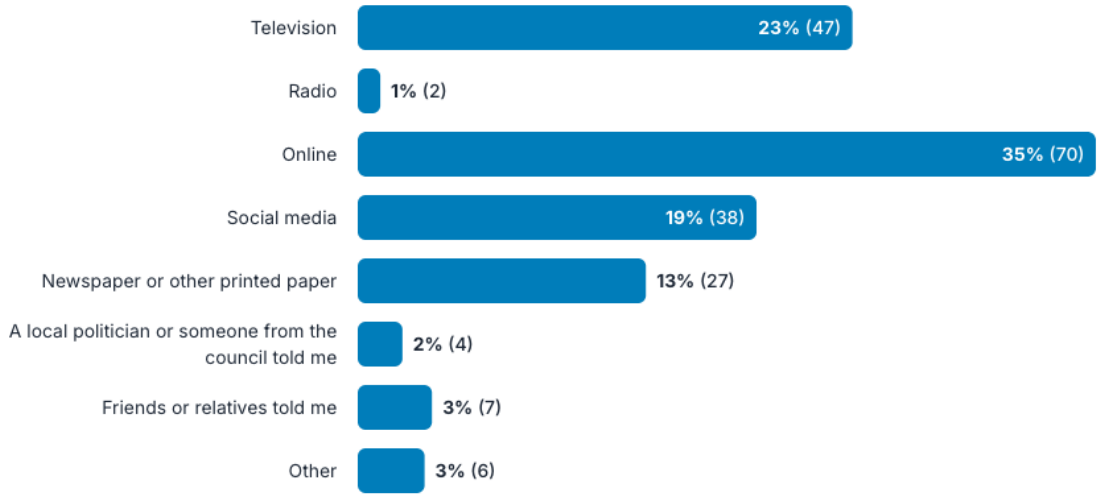


Figure 3. (Q4) How did you hear about Airlander? N=201

Two hundred of those who had heard of Airlander provided qualitative comments about what they knew. The responses' overwhelming mood was factual or positive. Just a handful of people questioned whether public money from the council was involved or the environmental credentials. One contributor recalled an incident with the prototype in 2016.

Many respondents acknowledged that they knew little or nothing beyond hearing the name. Some linked Airlander with "airships", "blimps", or "Zeppelins", mostly caveating that it would be a modern or improved version of the earlier technology. There were very few mentions of historic disasters with 20th Century airships.

The more informed responses emphasised:

- Economic factors, that Airlander was being produced locally and would create jobs
- That Airlander would represent a more sustainable form of aviation
- That Airlander would carry people, or freight, or both

"…what was reported on by the news article on TV. They are wanting to build air vehicles and regenerate the Carcroft area of Doncaster by providing a number of job opportunities for local residents to apply for. The [Hybrid Aircraft] will be a more environmentally friendly form of travel, which will be good. I cannot remember which country Airlander are based."

"I heard the company had reached an agreement with City of Doncaster Council to use land on Carcroft Common as a site to manufacture low-emission aircraft. I heard SYMCA and national government have funding for this, but it wasn't clear if the funding is for research and development or factory building and production. I don't know how much is concept and how much is reality, but great to think it's coming to Doncaster."

"…welcome investment in Doncaster and job creation. Good to build more environmentally friendly aircraft."

A few respondents could provide more technical details regarding how many aircraft would initially be produced, design details, or how it would be powered. In a few cases, the responses seemed to come from people who had engaged with the details of information about Airlander in the public domain. However, the detailed information could include inaccuracies:

"I believe they wanted to open production near the airport initially so they could use their check-in facilities, although the new airships will take off vertically, so had no need for the runway."

"Know that the Airlander 10 is being built by [Hybrid Aircraft]. The prototype was tested at Cardington, but production assembly will be at a new facility at Carcroft. Air Nostrum has 20 on order."

"Flies using both aerostatic and aerodynamic lift and is powered by four diesel engine-driven ducted propellers."

An example of one of the few negative commentaries was the following:

"Airships are tried and failed technology, with a terrible safety record. At least three airships based at Howden crashed with huge loss of life in the 20th century. Don't invest any council money in this enterprise that's doomed to failure."

3.1 Q7: Expectations

The survey then probed some specific expectations about Airlander (Q7). These statements were suggested to participants, and there may have been an element of 'acquiescence' or 'suggestion' bias[4] in their responses.

Most respondents (78%) recognised that Airlander is intended to be a more sustainable, low-emissions aircraft and over half identified it as novel. These findings complement the identification of Airlander as a new kind of more sustainable aircraft in the earlier unprompted question about what people knew about Airlander. Given that the airship concept is not itself novel, it is notable that many respondents thought of Airlander as different from the previous technology.

Few participants misidentified Airlander as a conventional passenger jet or a private jet. Notably, only a minority recognised that Airlander can also carry freight; see Figure 4.

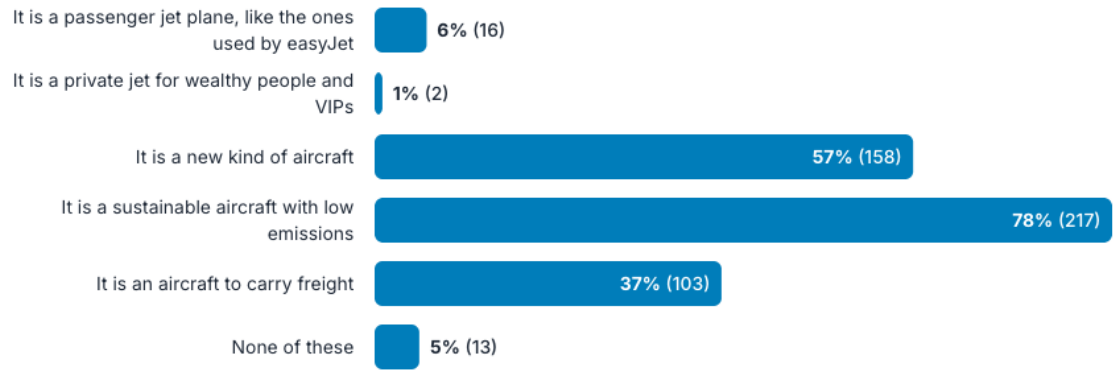


Figure 4. (Q7) Which of the following do you think are true about Airlander? (Pick as many as you like). N=277

Statistical analysis showed that prior knowledge of Airlander did not influence participants knowing that it's a new kind of aircraft. Still, prior knowledge significantly associated with selecting '*it's a sustainable aircraft with low emissions'* and '*it's an aircraft to carry freight'*. Too few participants selected '*it's a passenger jet plane'* or '*it's a private jet for wealthy people'* to allow for statistical analysis.

A chi-square test for independence indicated no significant association between hearing about Airlander before and selecting *"it's a new kind of aircraft"*, $\chi^2(1, n = 269) = 2.16, p = .14. phi = .09.$

However, a chi-square test for independence indicated a significant association between hearing about Airlander before and selecting *"it's a sustainable aircraft with low emissions"*, $\chi^2(1, n = 269) = 27.38, p < .001. phi = .32$; see Figure 5.

[4]Responses in line with what respondents believe the researchers want to be told, or what has been suggested to them.

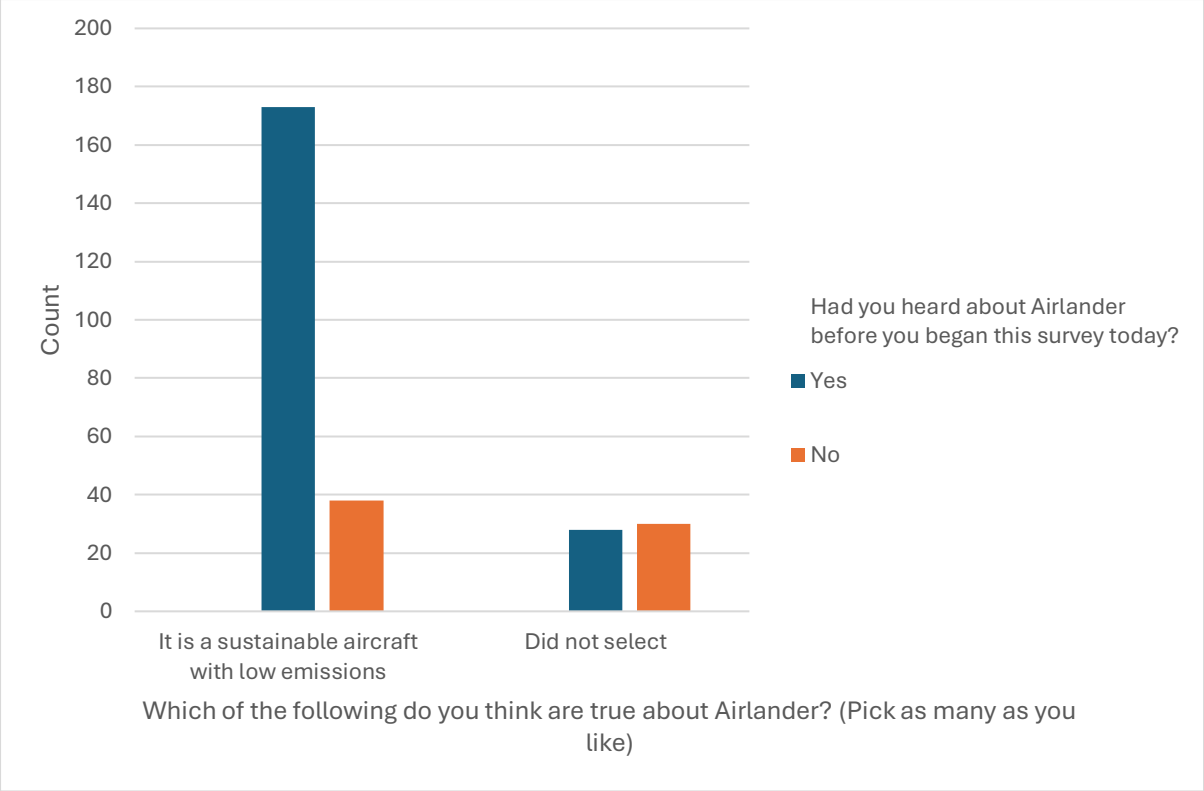


Figure 5. Prior knowledge of Airlander and thinking that it's a sustainable aircraft with low emissions

Similarly, a chi-square test for independence indicated a significant association between hearing about Airlander before and selecting *"it's an aircraft to carry freight"*, $\chi^2(1, n = 269) = 16.65, p < .001. phi = .25$; see Figure 6.

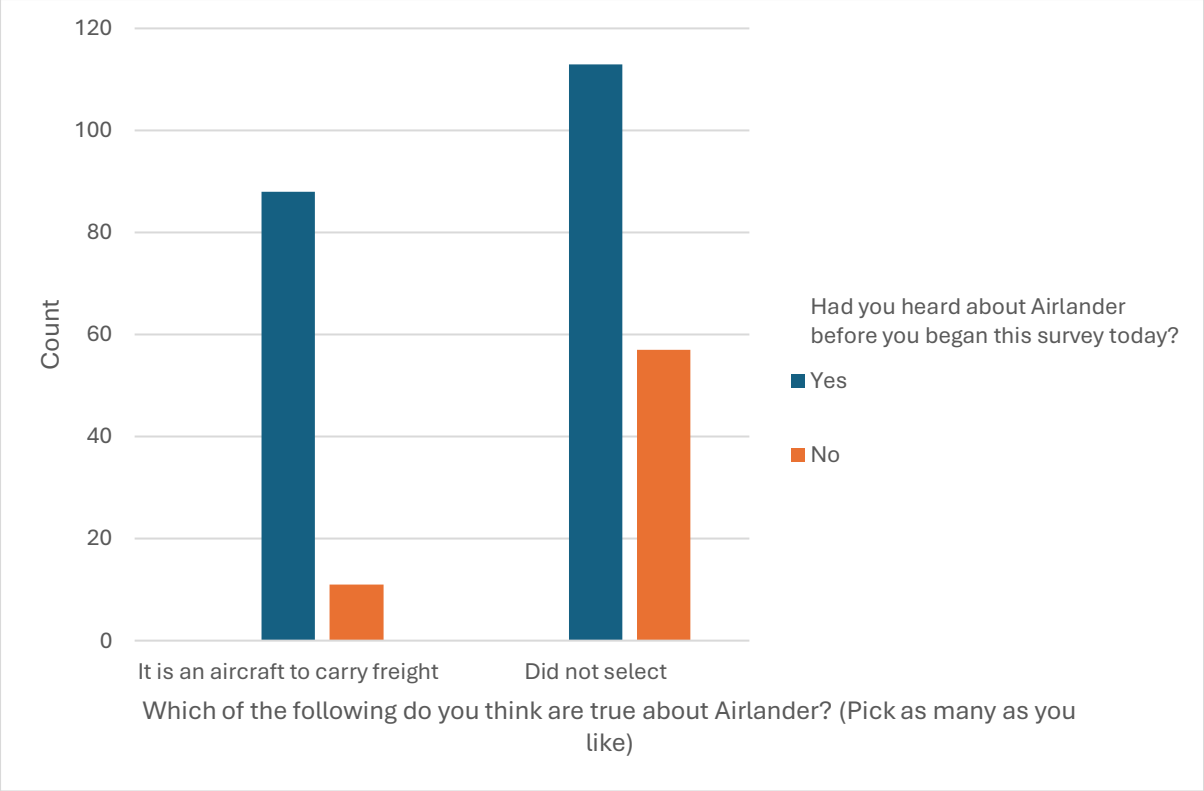


Figure 6. Prior knowledge of Airlander and thinking that it's an aircraft to carry freight

4 Results: Views on the Airlander Production Facility

4.1 Q8: Prior knowledge of Airlander

Two-thirds of the participants confirmed that they had known before taking part in the survey that Airlander would be built at Carcroft Common, near Doncaster (Q8, see Figure 7).

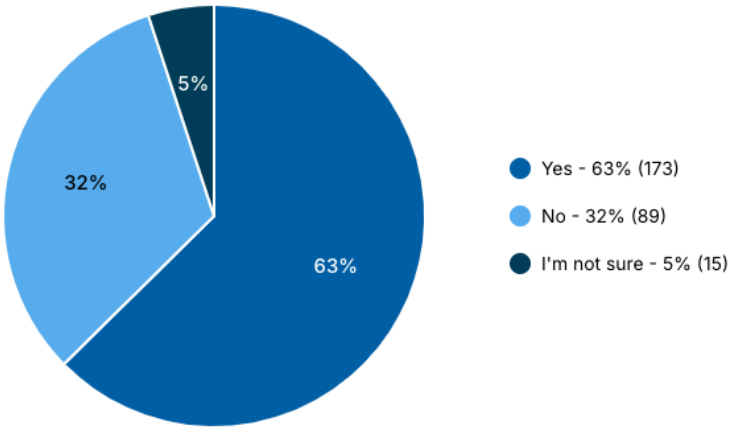


Figure 7. (Q8) Before you began this survey today, did you already know that Airlander will be built at Carcroft Common? N=277

4.2 Q9: Impacts of the Carcroft Factory

Participants were given a series of statements about the possible impacts of the factory being provided at Carcroft and asked to indicate the extent to which they agreed or disagreed with them (Q9, see Figure 8).

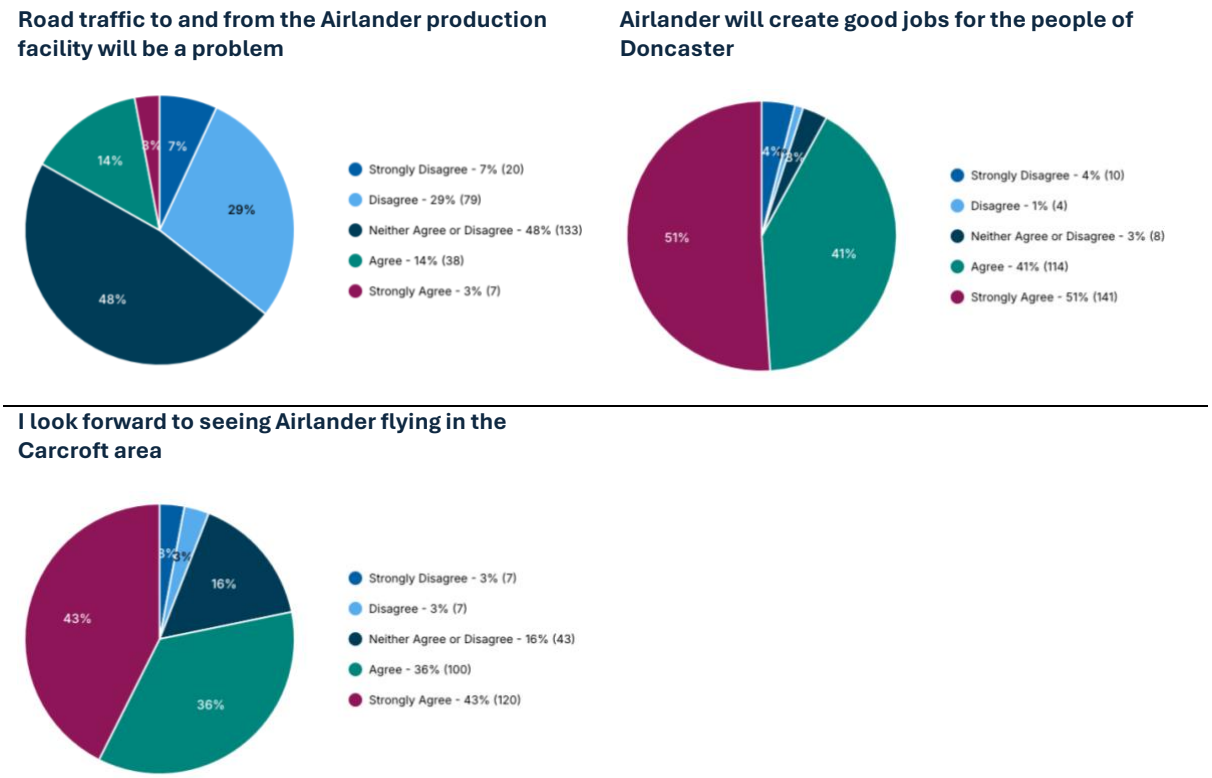


Figure 8. (Q9) We are now going to give you some statements about Hybrid Aircraft in Carcroft. N=277

Regarding impacts on road traffic, around half did not have a strong view on this issue. Those who expressed a view tended to disagree that '*road traffic…will be a problem'*. Fewer than 20% agreed it would be a problem.

On the question of creating '*good jobs',* more than 90% agreed that this would be an outcome, and more than half of respondents strongly agreed.

Eighty per cent also agreed that they '*look forward to seeing Airlander flying in the Carcroft area'*, with more than half agreeing strongly. Most of those not expressing a positive answer were unsure either way.

Interestingly, a one-way between-groups ANOVA explored the association between 'prior knowledge of the Carcroft development' and anticipation of seeing Airlander fly in this area. There was a statistically significant difference between those with previous knowledge ($M = 3.31, SD = .91$), those without ($M = 2.87, SD = .99$), and those who are unsure ($M = 3.00, SD = .76$); $F(2,274) = 7.04, p = .001$; see Figure 9. The effect size was small to medium (eta-squared = .49), indicating that the effects are genuinely noticeable within the population. Post-hoc comparisons using the Tukey HSD test revealed statistically significant differences between those with and without prior knowledge (mean difference = .447, $p < .001$).

People with previous knowledge of the Carcroft development are significantly more favourable than those who were hearing about it through this survey.

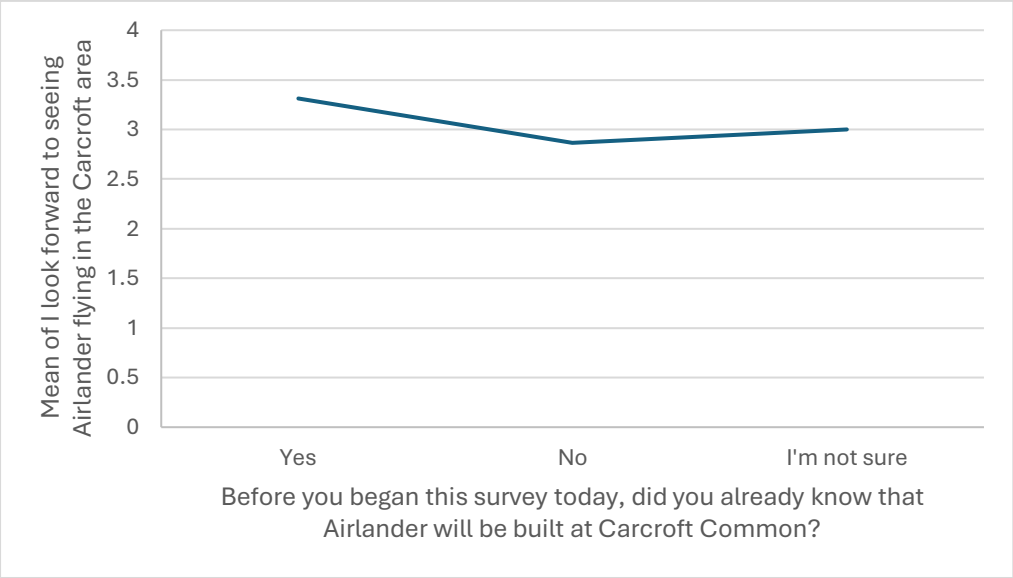


Figure 9. Prior Knowledge of Carcroft Development and Anticipation of Airlander

Support for Carcroft '*building an aircraft which is better for the environment'* showed a similar pattern to people looking forward to seeing Airlander flying in the Carcroft Area. Respondents broadly felt '*proud of Doncaster's role in sustainable aviation' and* agreed that '*Airlander is a good fit for Doncaster'; see* Figure 10.

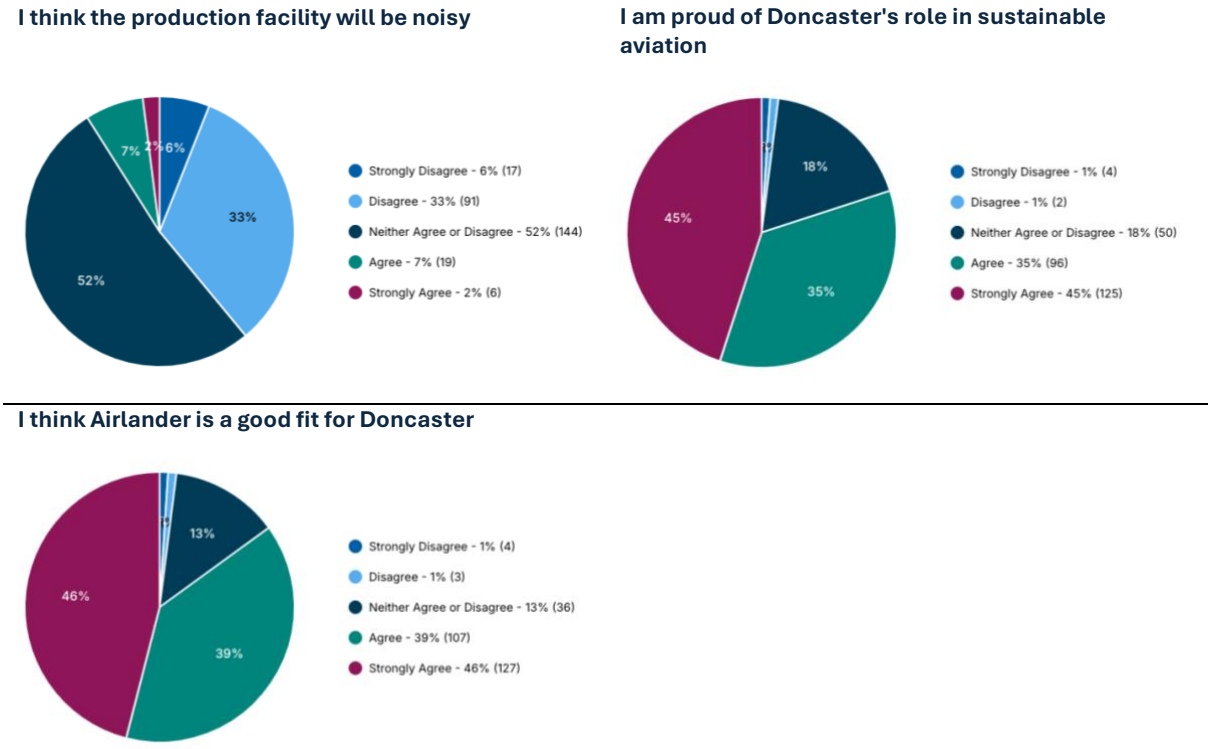


Figure 10. (Q9). We are now going to give you some statements about Hybrid Aircraft in Carcroft. N=277

While *"I am proud of Doncaster's role in sustainable aviation"* and *"I think Airlander is a good fit for Doncaster"* appear to be very similar, appear to be veery similar in Figure 10,

a Kappa Measure of Agreement only produced a moderate significant similarity between the two raters ($K = .65, p < .001$). The most notable agreement between the two factors is 91.2% of people that strongly agreed with question 1 also agreed with question 2; see **Error! Not a valid bookmark self-reference.**. Therefore, there is more variance in the agreement with the statements than the pie charts suggest.

Table 1. Level of agreement between 'Good fit for Doncaster' and 'Proud of Doncaster's sustainable aviation history'

			I think Airlander is a good fit for Doncaster				
			Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I am proud of Doncaster's role in sustainable aviation	Strongly Disagree	Count	2	1	0	1	0
		% within I am proud of Doncaster's role in sustainable aviation	50.0%	25.0%	0.0%	25.0%	0.0%
	Disagree	Count	0	1	1	0	0
		% within I am proud of Doncaster's role in sustainable aviation	0.0%	50.0%	50.0%	0.0%	0.0%
	Neither Agree or Disagree	Count	1	0	23	23	3
		% within I am proud of Doncaster's role in sustainable aviation	2.0%	0.0%	46.0%	46.0%	6.0%
	Agree	Count	1	1	8	76	10
		% within I am proud of Doncaster's role in sustainable aviation	1.0%	1.0%	8.3%	79.2%	10.4%
	Strongly Agree	Count	0	0	4	7	114
		% within I am proud of Doncaster's role in sustainable aviation	0.0%	0.0%	3.2%	5.6%	91.2%

Aviation, in general, provokes strong safety awareness; see Figure 11. Therefore, the profile of responses about the safe production facility was more cautious than expected. However, this was mainly demonstrated by lower levels of strong agreement and higher levels of uncommitted responses. Most people agreed it would be safe, and only a handful of respondents disagreed.

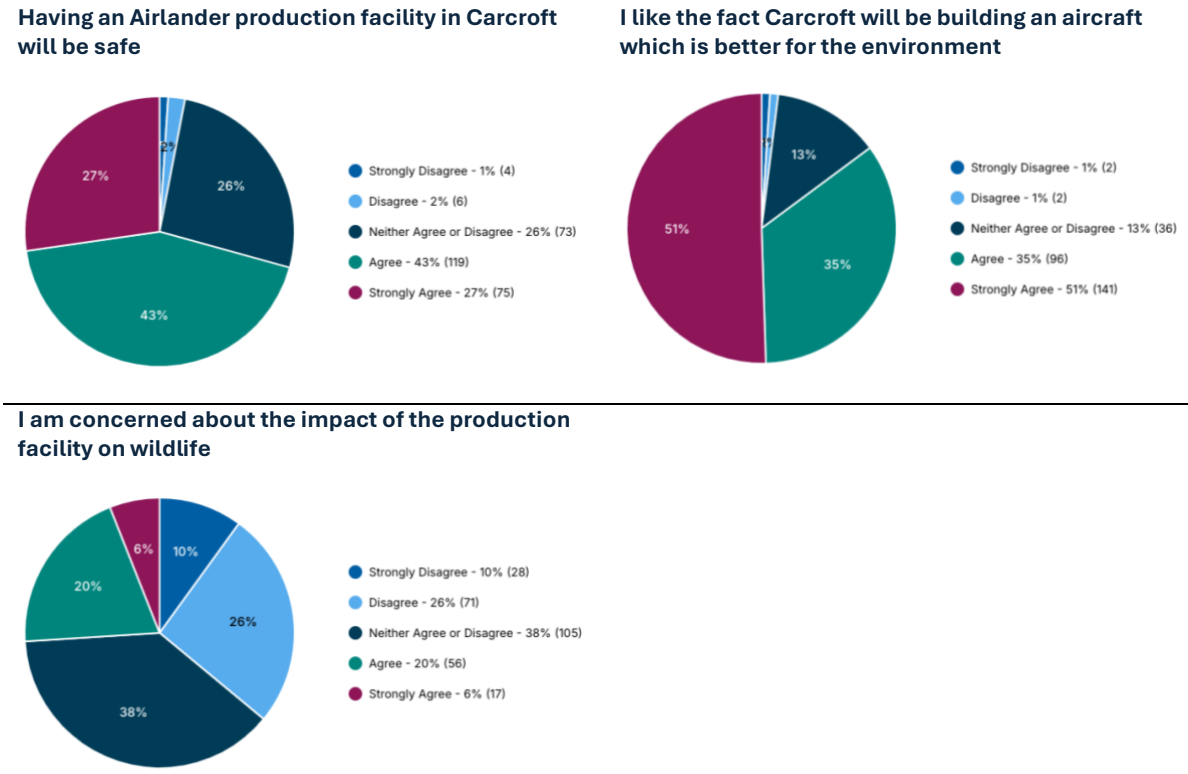


Figure 11. (Q9). We are now going to give you some statements about Hybrid Aircraft in Carcroft. N=277

Concerns about an Airlander production facility were more cautious, considering the possible impacts on wildlife and noise. However, in both cases, the largest groups of respondents neither agreed nor disagreed that they were concerned, and even for those expressing a view, more people disagreed that there would be a problem than agreed.

Over a quarter were concerned about the impact on wildlife. This may reflect 'common-sense' reasoning that any new factory requires land clearance and, therefore, disturbs wildlife, e.g., creating uncertainties about mitigation.

4.3 Q10: Feelings about Airlander being built at Carcroft

When asked to consider their 'overall feelings' about Airlander being built at Carcroft, there was an overwhelming selection of the positive attributes suggested (Q10); see Figure 12.

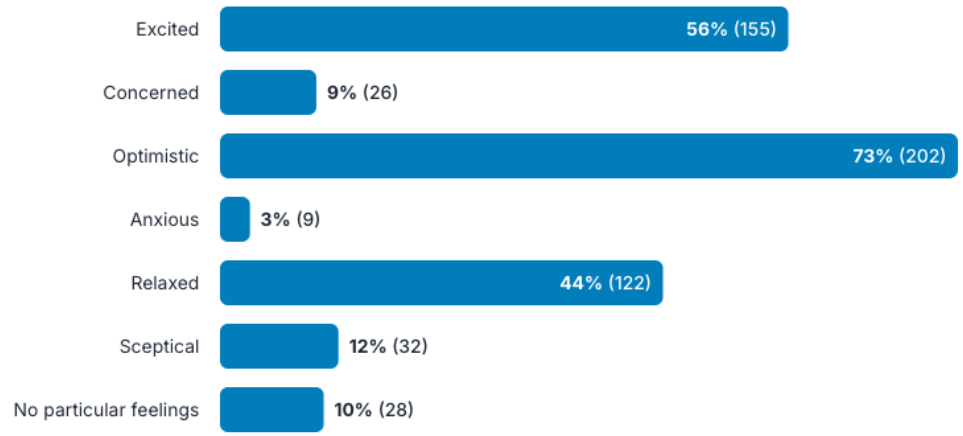


Figure 12. Overall, how do you feel about Airlander being built in Carcroft (select up to three responses)? N=277

Eighty-five per cent of responses were positive, with optimistic, excited, and relaxed comprising over two thirds of choices. Three-quarters indicated they were *"optimistic"*, and around half each that they were *"excited"* or *"relaxed"*, with very few respondents selecting *"concerned"* or *"anxious"*. Around one in ten did identify as *"sceptical"*, with a similar number indicating they had no *"particular feelings"*.

4.3.1 Excitement

A chi-square test for independence indicated a significant association between hearing about Airlander before and selecting *"excited"*, $\chi^2(1, n = 269) = 4.73, p = .03, phi = .13$; see Figure 13.

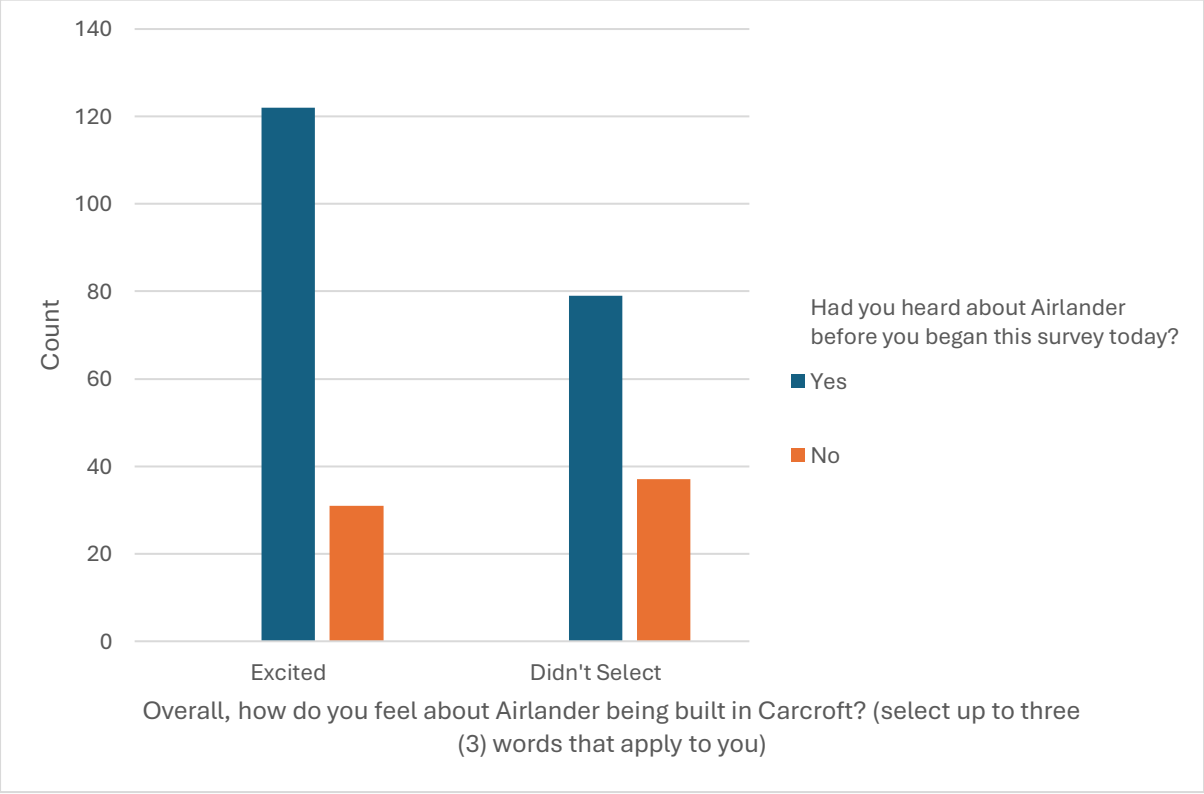


Figure 13. Prior knowledge of Airlander and Excitement

A direct logistic regression was performed to assess the impact of many factors on the likelihood that respondents would select 'excited'. The model contained five independent variables (concern about the impact on wildlife, direct services, road traffic increase, being built in Carcroft, and 'a good fit for Doncaster'). The full model containing all predictors was statistically significant, $\chi^2(5, N = 277) = 123.04, p < .001$, indicating that the model could distinguish between respondents who selected 'excited' and those who did not. The model explained between 35.9% (Cox & Snell R Squire) and 48.1% (Nagelkerke R Squire) of the variance in excitement and correctly classified 76.9% of cases.

As outlined in Table 2, four of the five variables were statistically significant. The strongest predictor of participants selecting 'excited', recording an Exp(B) of .37, was the variable *'I like the fact that Carcroft will be building an aircraft which is better for the environment'*. Conversely, the Exp(B) scores of 1.59 and 1.60 for 'concern about the impact of the production facility on wildlife' and 'concern for road traffic to and from the Airlander production facility' indicated that for every additional level of agreement with the prior statements, respondents were 1.6 times *less* likely to select 'excited', controlling for all other factors in the model.

Table 2. Variables influencing participants being 'excited' about the Carcroft development.

								95% C.I. for EXP(B)	
		B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**Lower**	**Upper**
Step 1[a]	**I am concerned about the impact of the production facility on wildlife**	**.462**	**.169**	**7.484**	**1**	**.006**	**1.587**	**1.140**	**2.209**
	Direct service to where I want to go	.419	.218	3.694	1	.055	1.520	.992	2.331
	Road traffic to and from the Airlander production facility will be a problem	**.472**	**.218**	**4.676**	**1**	**.031**	**1.604**	**1.045**	**2.460**
	I like the fact that Carcroft will be building an aircraft which is better for the environment	**-.985**	**.274**	**12.935**	**1**	**<.001**	**.374**	**.218**	**.639**
	I think Airlander is a good fit for Doncaster	**-.960**	**.263**	**13.307**	**1**	**<.001**	**.383**	**.229**	**.641**
	Constant	3.121	1.188	6.896	1	.009	22.659		

a. Variable(s) entered on step 1: I am concerned about the impact of the production facility on wildlife, Direct service to where I want to go, Road traffic to and from the Airlander production facility will be a problem, I like the fact Carcroft will be building an aircraft which is better for the environment, I think Airlander is a good fit for Doncaster.

4.3.2 Concern

While chi-square tests for independence and direct logistic regression tests were performed to assess the association of prior knowledge of Airlander and the effect of variables on concern, no statistically significant outcomes emerged. As such, we cannot predict which opinions increase the likelihood of being concerned.

4.3.3 Optimism

A chi-square test for independence indicated a significant association between hearing about Airlander before and selecting *"optimistic"*, $\chi^2(1, n = 269) = 5.04, p = .025, phi = .14$; see Figure 14.

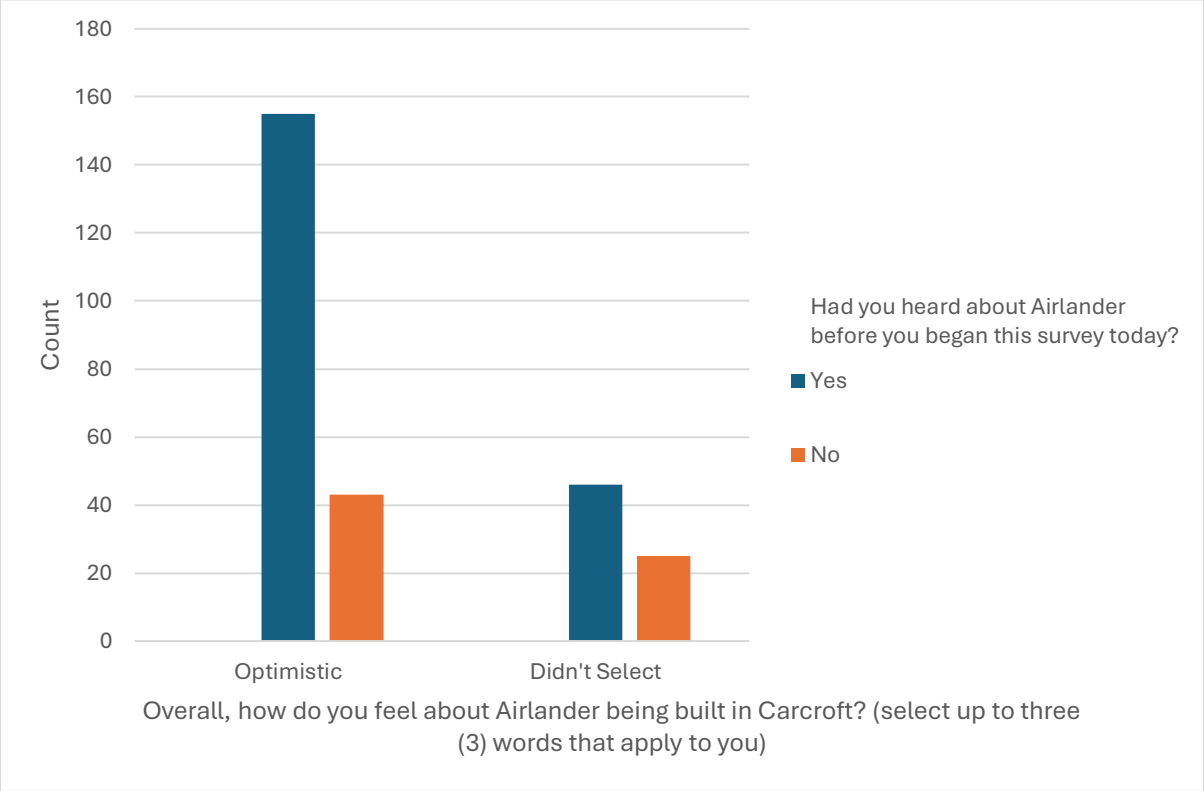


Figure 14. Prior knowledge of Airlander and Optimism

A direct logistic regression was performed to assess the impact of many factors on the likelihood that respondents would select 'excited'. While a full model was statistically significant, $\chi^2(8, N = 277) = 16.46, p = .36$, explained between 15.5% (Cox & Snell R Squire) and 22.5% (Nagelkerke R Squire) of the variance in optimism and correctly predicted 79.4% of optimism selection, only one 'thinking Airlander is a good fit for Doncaster' had a significant outcome ($p < .001, Exp(B) = .328$), which is unsurprising.

4.3.4 Anxiety

While chi-square tests for independence and direct logistic regression tests were performed to assess the association of prior knowledge of Airlander and the effect of variables on anxiety, no statistically significant outcomes emerged. As such, we cannot predict which opinions increase the likelihood of being concerned.

4.3.5 Relaxation

While chi-square tests for independence test were performed to assess the association of prior knowledge of Airlander, no statistically significant outcomes emerged.

However, a direct logistic regression was performed to assess the impact of many factors on the likelihood that respondents would select ‘relaxed’. The model contained nine independent variables (see Table 3). The full model containing all predictors was statistically significant, $\chi^2(13, N = 277) = 56.10, p < .001$, indicating that the model could distinguish between respondents who selected ‘relaxed’ and those who did not. The model as a whole explained between 19.6% (Cox & Snell R Squire) and 26.3% (Nagelkerke R Squire) of the variance in excitement and correctly classified 71.6% of cases.

As shown in Table 3, only three variables were statistically significant. The strongest predictor of participants selecting ‘relaxed’, recording an Exp(B) of .483, was ‘a Good Choice of departure times’.

Table 3. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	As far as possible, the Airlander aircraft is to be built using materials which can be recycled at the end of the aircraft's life	.257	.228	1.271	1	.260	1.293	.827	2.022
	Road traffic to and from the Airlander production facility will be a problem	**.493**	**.197**	**6.285**	**1**	**.012**	**1.637**	**1.114**	**2.406**
	I am concerned about the impact of the production facility on wildlife	.311	.167	3.459	1	.063	1.365	.983	1.894
	I am proud of Doncaster's role in sustainable aviation	.057	.189	.092	1	.762	1.059	.731	1.533
	At least half of the parts come from within the UK	-.452	.255	3.142	1	.076	.636	.386	1.049
	The new buildings fit into the local environment	.331	.202	2.697	1	.101	1.392	.938	2.067
	Direct service to where I want to go	**.660**	**.271**	**5.941**	**1**	**.015**	**1.934**	**1.138**	**3.287**
	Good choice of departure times	**-.727**	**.274**	**7.063**	**1**	**.008**	**.483**	**.283**	**.826**
	Age Groups by Decade			8.088	5	.151			
	Age Groups by Decade (1)	-21.347	40194.624	.000	1	1.000	.000	.000	.
	Age Groups by Decade (2)	-21.571	40194.624	.000	1	1.000	.000	.000	.
	Age Groups by Decade (3)	-21.818	40194.624	.000	1	1.000	.000	.000	.
	Age Groups by Decade (4)	-22.518	40194.624	.000	1	1.000	.000	.000	.
	Age Groups by Decade (5)	-22.307	40194.624	.000	1	1.000	.000	.000	.
	Constant	20.419	40194.624	.000	1	1.000	737394957.400		

a. Variable(s) entered on step 1: As far as possible, the Airlander aircraft to be built using materials which can be recycled at the end of the aircraft's life, Road traffic to and from the Airlander production facility will be a problem, I am concerned about the impact of the production facility on wildlife, I am proud of Doncaster's role in sustainable aviation, At least half of the parts come from within the UK, The new buildings fit into the local environment, Direct service to where I want to go, Good choice of departure times, Age Groups by Decade.

4.3.6 Scepticism

A chi-square test for independence indicated a significant association between hearing about Airlander before and selecting *"optimistic"*, $\chi^2(1, n = 269) = 5.83, p = .016, phi = .15$; see Figure 15. People who had heard of Airlander before were less likely to select Scepticism.

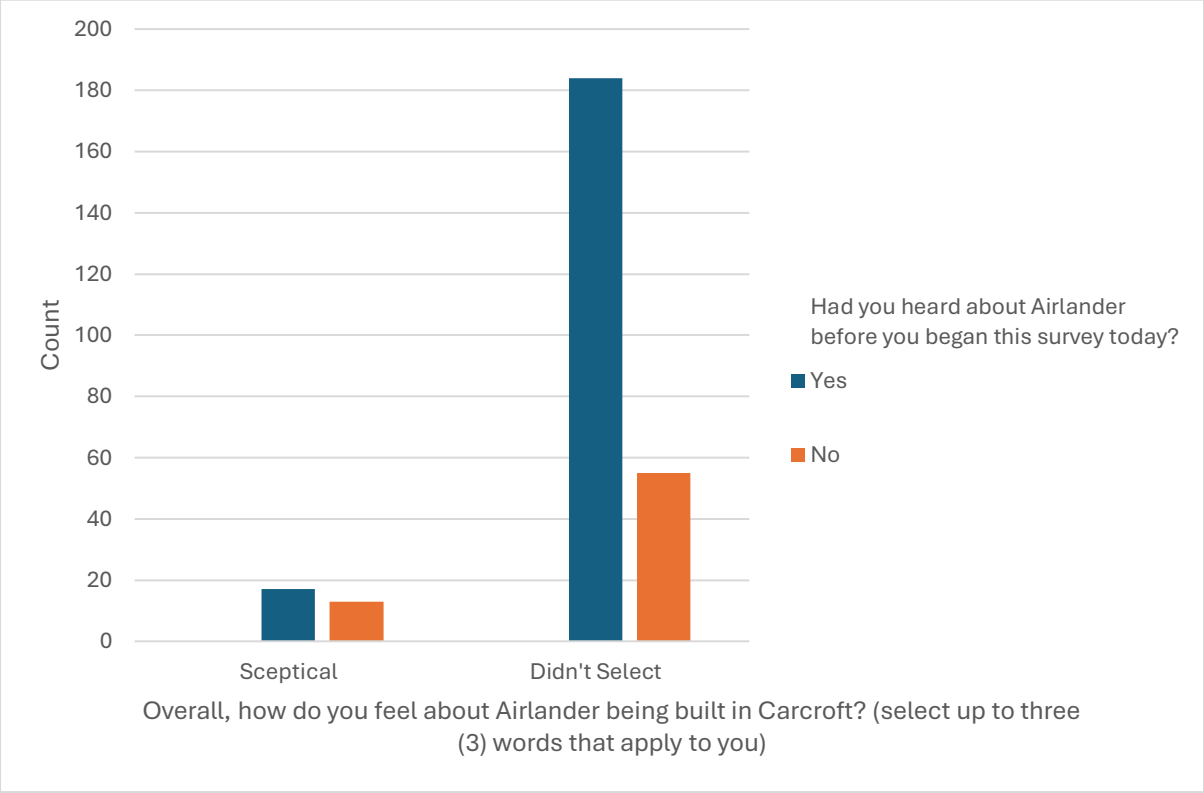


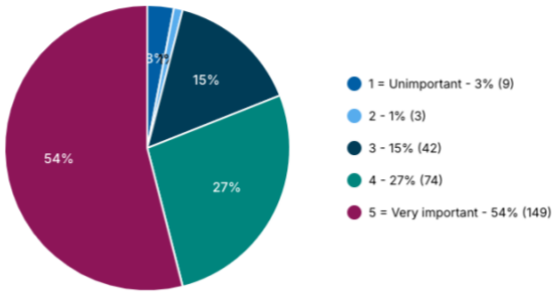
Figure 15. Prior knowledge of Airlander and Scepticism

While direct logistic regression was performed to assess the effect of variables on scepticism, no statistically significant outcomes emerged. As such, we cannot predict which opinions increase the likelihood of being concerned.

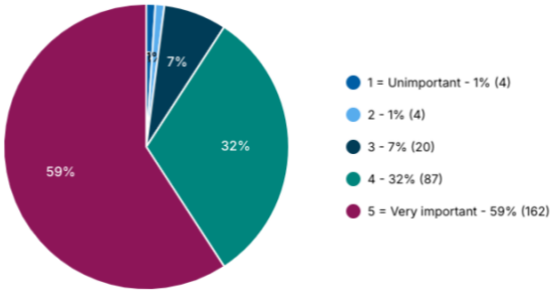
4.4 Q11: Sustainability

Concerning expectations about the sustainability performance of the factory, six potential indicators of high sustainability were suggested to participants (Q11, Figure 16).

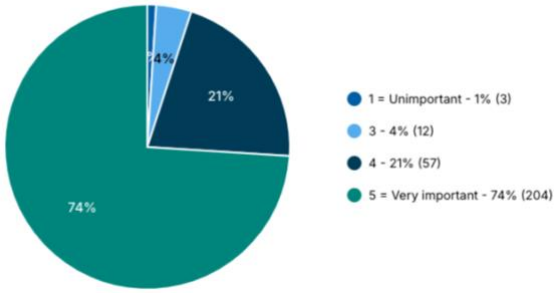
All the energy needed for manufacturing comes from renewable sources, such as solar panels on the roof



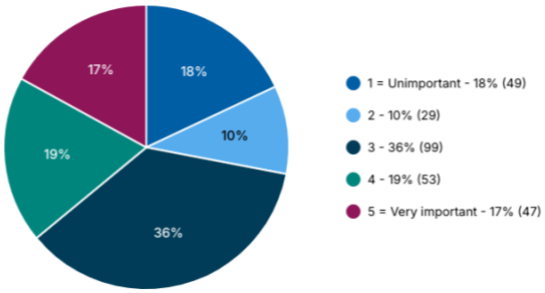
As far as possible the Airlander aircraft to be built using materials which can be recycled at the end of the aircraft's life



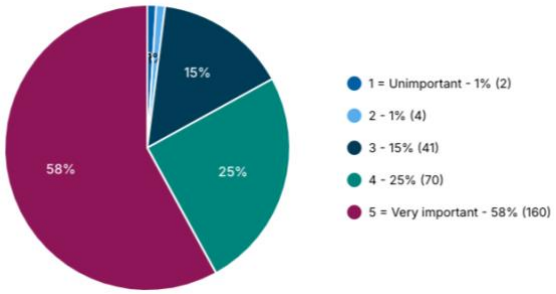
At least half of the parts come from within the UK



People working at the site arrive on foot, bike, bus, or drive electric cars



The new buildings are designed to minimise impacts on local wildlife



The new buildings fit into the local environment

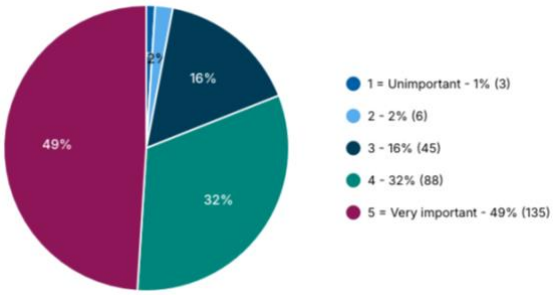


Figure 16. (Q11) The Airlander production facility in Carcroft is planned to be highly sustainable. What would you expect from a sustainable factory? Please tell us how important you think each of the things in this list is. (1= Unimportant, 5= Very important). N=277

Critically, in an area which has suffered from economic turbulence in the last decades, *'at least half of parts come from within the UK'*, with 74% of respondents rating the attribute as 'very important'.

Four other attributes attracted 'very important' ratings from around half or more of the respondents. These concerned the *'energy for manufacturing coming from renewable sources'*, the use of *'materials which can be recycled'*, and two aspects of factory design, that the '*buildings are designed to minimise impacts on local wildlife'* and that they *would 'fit into the local environment'*.

The need for energy to come from renewable sources is interesting as a one-way between-groups ANOVA explored the association of *employment* on perceptions of

energy. There was a *statistically significant* difference between Senior Management ($M = 2.74, SD = 1.31$), Medium Management ($M = 3.25, SD = 1.03$), Junior Management ($M = 3.55, SD = .60$), Skilled ($M = 3.33, SD = .97$), and unskilled labour ($M = 3.67, SD = .65$); $Welch(4, 46.35) = 3.239, p = .014$; see Figure 17. The effect size was medium (eta-squared = .10), indicating that the effects are genuinely noticeable within the population. Post-hoc comparisons using the Tukey HSD test indicated statistically significant differences only exist between Senior Management and Junior Management (mean difference = -.801, $p = .034$).

Communicating the use of renewable energy in the project may help market the Carcroft development to the broad public more than it supports broad investment.

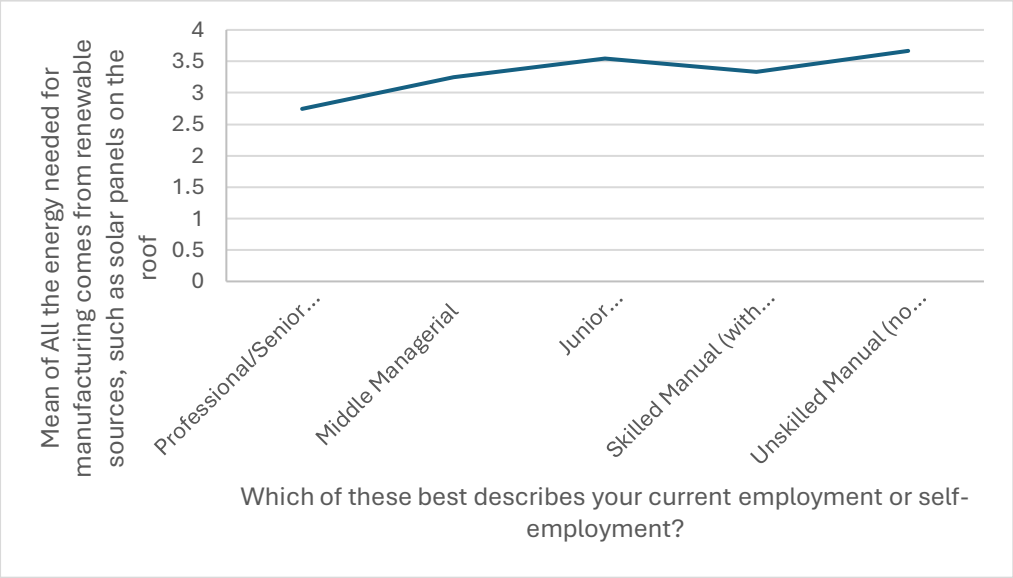


Figure 17. Employment and Energy Sources

Similarly, employment level had a significant association with the views on using recyclable materials, as investigated through a one-way between-groups ANOVA. There was a *statistically significant* difference between Senior Management ($M = 3.09, SD = 1.04$), Medium Management ($M = 3.58, SD = .654$), Junior Management ($M = 3.58, SD = .65$), Skilled ($M = 3.50, SD = .71$), and unskilled labour ($M = 3.83, SD = .40$); $Welch(4, 48.94) = 3.53, p = .003$; see Figure 18. The effect size was, however, medium: eta-squared = .10. Post-hoc comparisons using the Tukey HSD test indicated statistically significant differences only exist between Senior Management and Unskilled labour ($Mean\ Difference = -.740, p = .042$).

Communicating using recycled materials in the project may help market the Carcroft development to the broad public more than it supports broad investment.

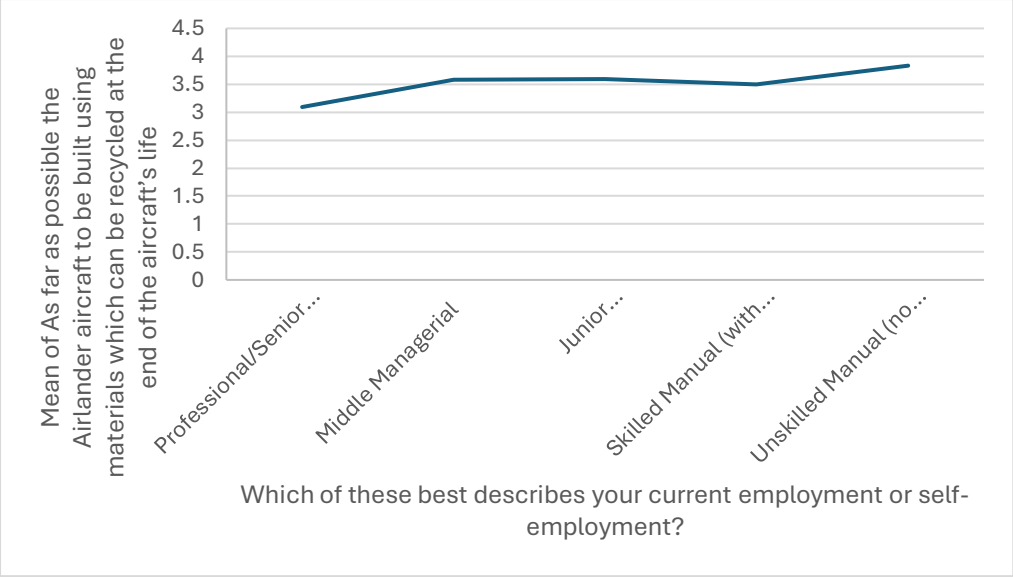


Figure 18. Employment Level and use of recyclable materials

Weaker support came from whether *'people working at the site arrive on foot, bike, bus, or drive electric cars'*. In this case, roughly a third of each gave this attribute importance, selected the intermediate option, or felt it was unimportant.

Notably, one in five selected the more extreme 'unimportant' option. Unlike the other sustainability attributes, this was the only one that implied individual choice and action rather than corporate decision-making. It may be that participants transferred their willingness to commit to sustainable mobility modes onto the future workforce and that the importance of the transport sector to UK greenhouse gas emissions is not understood or is an insufficient motivator for individual change. This finding somewhat contradicts the recognition elsewhere in the survey that aviation, another part of the transport system, has a carbon emissions problem that Airlander might address.

5 Results: Views on Airlander as a Future Transport Option

5.1 Q12: Airlander's Use

Eight possible 'mission' types for Airlander were suggested to participants, who could select as many as they 'imagined' it could be used for (Q12).

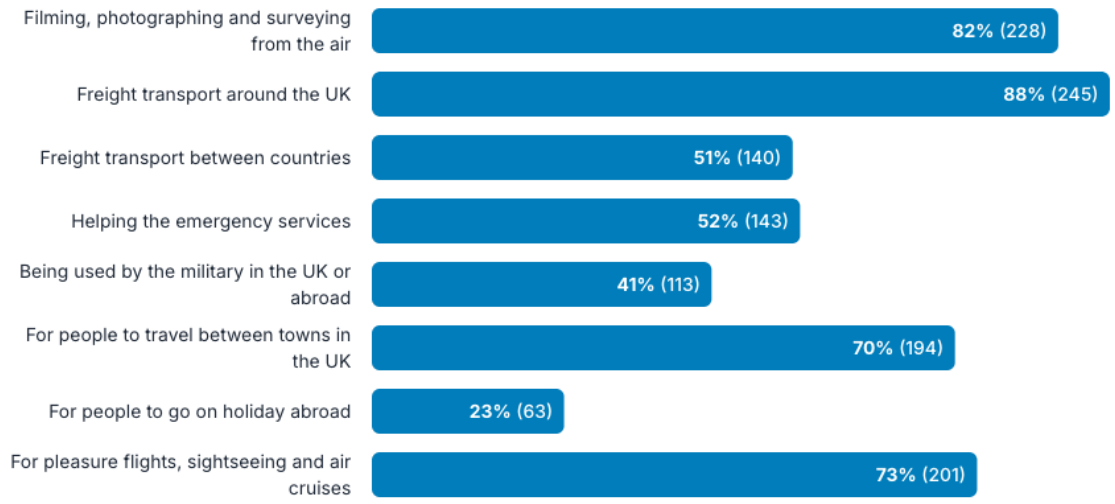


Figure 19. (Q12) Which of the following can you imagine Airlander might be used for?

The two attributes that attracted the most selections were remote surveying (82%) and freight transport around the UK (88%). These high scores apparently reflected greater acceptance for uses not involving personal travel, as personal travel within the UK and pleasure flights attracted 70% and 73% support, respectively. The slight difference between these two, combined with the lowest frequency (23%) referring to personal travel for holidays abroad, may indicate that service attributes, such as speed, are expected by some respondents as being more suited to short-range leisure travel.

The attributes related to international freight and use by the emergency services and military attracted intermediate selection frequencies. These findings may reflect perceptions about capabilities or lack of knowledge about mission needs.

5.2 Q13: Journey Attributes

Participants were then asked to imagine travelling by Airlander and to consider eight attributes of the journey, rating each of these 1-5 in importance (Q13).

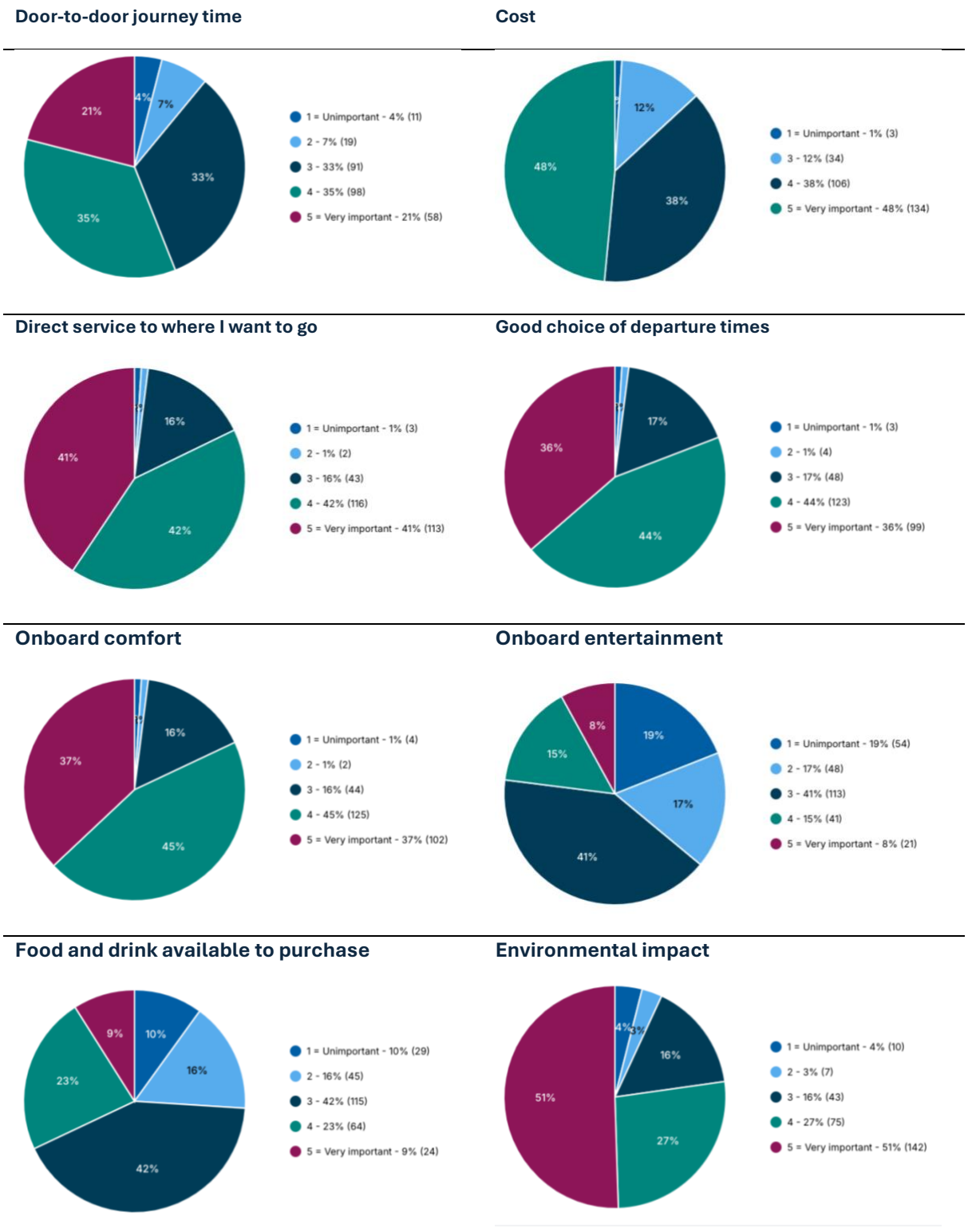


Figure 20. (Q13) Imagine you are taking a journey on Airlander. What would be important to you? Please tell us how important you think each of the things in this list is (1= Unimportant, 5= Very important). N=277

The attributes attracting the highest number of 'very important' preferences were 'cost' and 'environmental impact'. Cost is usually found to attract a high rating by people completing traveller perception surveys. However, the selection of environmental

impact as a critical variable is unusual. Even if, in practice, a lower rating would be placed on environmental performance, the aspiration for greener aviation emerges.

Cost is interesting. A one-way between-groups ANOVA explored the association with 'age'. There was a *statistically significant* difference between 40-49 ($M = 3.65, SD = .63$), 50-59 ($M = 3.39, SD = .78$), 60-69 ($M = 3.33, SD = .80$), and 70-79 ($M = 3.07, SD = .79$); $F(3,240) = 4.23, p = .006$; see Figure 21. While the effect size was small: eta-squared = .05, the modest sample size and close proximity to the .06 threshold make this outcome noteworthy. Post-hoc comparisons using the Tukey HSD test indicated statistically significant differences only exist between 40-49- and 70–79-year-olds (mean difference = .585, $p = .006$).

Middle-aged people are more concerned with the cost of travelling than older people and should be more responsive to information about travel costs. This may be due to the generational distribution of wealth, with older persons in the 'boomer' cohort having relatively high disposable incomes.

While we couldn't include younger persons in our statistical analysis, the available data suggests younger persons are even more cost-conscious: 20-29 ($M = 4.00, SD = .00, n = 4$), 30 – 39 ($M = 3.57, SD = .73, n = 9$), and 80-89 ($M = 3.25, SD = .62, n = 12$).

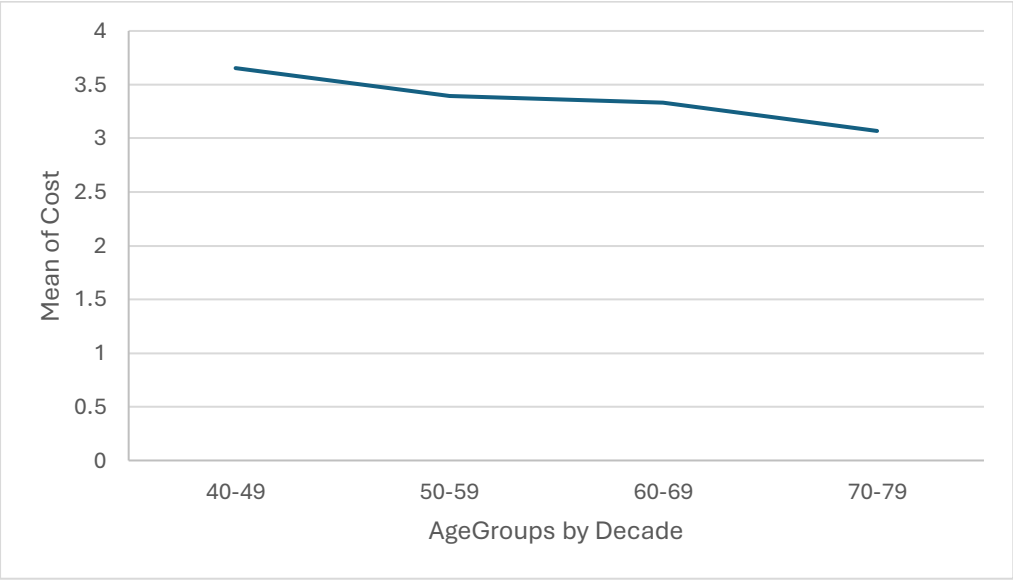


Figure 21. Age Groups and Cost

Furthermore, a one-way between-groups ANOVA explored the association of 'employment level' on perceptions of environmental impact (Figure 22). There was *a statistically significant* difference between senior management ($M = 2.67, SD = 1.34$), middle management ($M = 2.92, SD = 1.41$), junior management ($M = 3.27, SD = .77$), skilled manual ($M = 3.28, SD = .75$), and unskilled manual ($M = 3.67, SD = .65$); $F(4,114) = 2.506, p = .046$. The effect size was medium: eta-squared = .081. However, post-hoc comparisons using the Tukey HSD test indicated no statistically significant differences between pairs.

Communicating the low environmental impact of the project may help market the Carcroft development to the broad public more than it supports broad investment.

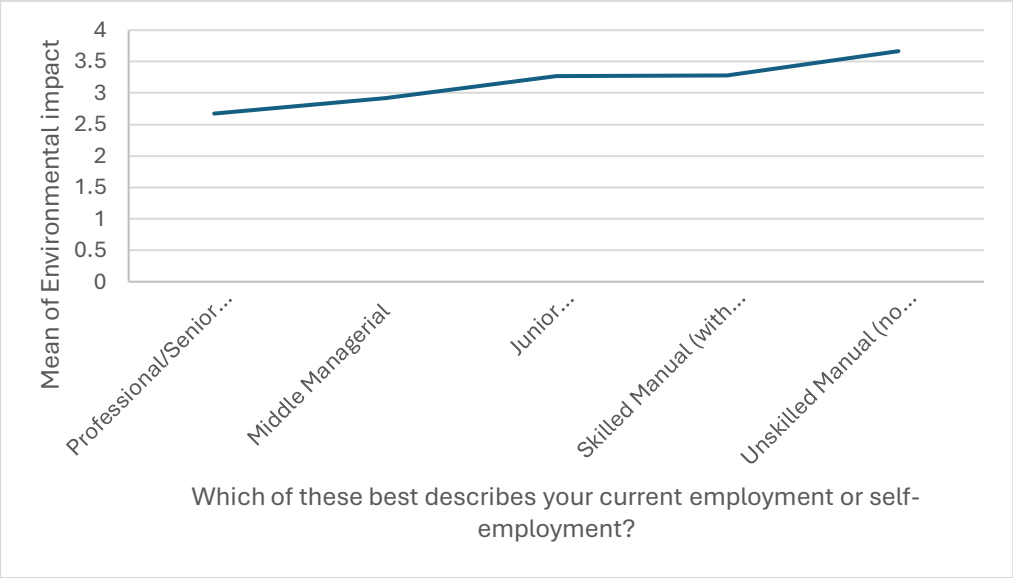


Figure 22. Employment Level and Environmental Impact

The 'logistical' attributes of direct services, range of departure times, and journey times were found to be important, but at lower levels than cost and environmental impact, as was onboard comfort.

A one-way between-groups ANOVA explored the association of 'employment level' on perceptions of departure time. There was a *statistically significant* difference between senior management ($M = 3.02, SD = .86$), middle management ($M = 3.42, SD = .83$), junior management ($M = 2.91, SD = 1.02$), skilled manual ($M = 3.39, SD = .70$), and unskilled manual ($M = 3.75, SD = .45$); $F(4,114) = 3.093, p = .019$; see Figure 23. The effect size was, however, medium: eta-squared = .098. However, post-hoc comparisons using the Tukey HSD test indicated statistically significant differences only exist between junior and unskilled workers (mean difference = -.841, $p = .045$).

While significance is found in our analysis, the variance in the data may be due to chance and a modest sample size rather than communicating a broad trend about employment level and concerns about departure times.

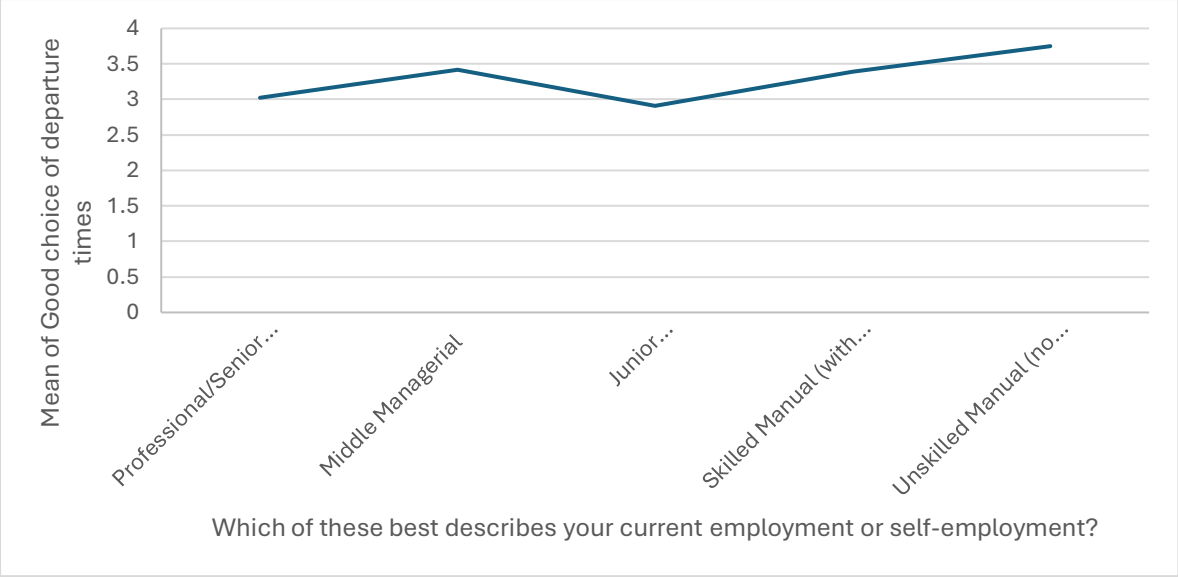


Figure 23. Employment Level and Departure Time

Responses were more neutral about the importance of onboard entertainment and the possibility of purchasing refreshments, with minorities regarding these as very important or unimportant.

The findings are somewhat contradictory, as the findings about journey time (usually very important in travel perception surveys) suggest that Airlander is being rated as a potential leisure mode by some. Still, attributes that might be expected to be important for leisure travel (entertainment, refreshments) were only seen as important by a minority.

5.3 Q14: Cost

When asked to predict the cost of a Doncaster-London one-way trip by Airlander (Q14), most respondents offered a figure in the range of £20 to £200. While the average estimate was £69.26 (SD = 40.41), Figure 24 shows that £41-£60 is the most popular estimate category.

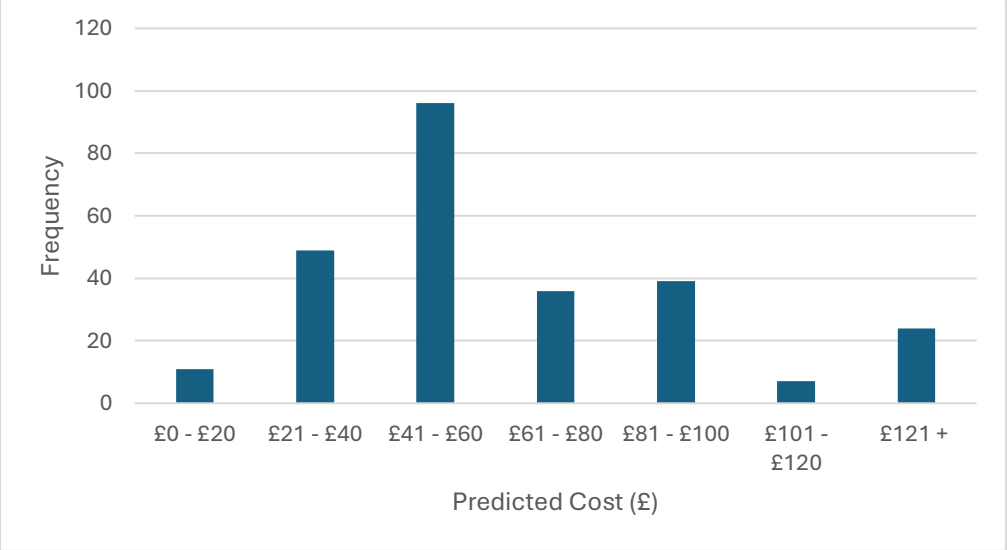


Figure 24. (Q14). Predict the cost of a Doncaster-London one-way trip by Airlander. N=277

Interestingly, when categorising participants by their estimated cost in £33 boundaries, one-way between-groups ANOVA revealed zero significant associations with the survey's questions 9, 11, or 13.

Cost prediction has no association with perceptions of the Carcroft development. This may show people think independently between Airlander's implementation/ construction and their potential future use.

Participants were, perhaps, drawing on the experience of the cheapest and most expensive rail fares. There were three mentions of rail fares as a benchmark; no other modes were identified as comparators. The selection of the Doncaster-London pairing might have encouraged respondents to consider rail comparisons, rail being relatively important for travel to and from the capital.

A small number of respondents indicated they were unable to make an estimate.

Respondents were asked to consider how much longer they would be prepared to spend travelling on a flight to 'help the environment' (Q16, Figure 25).

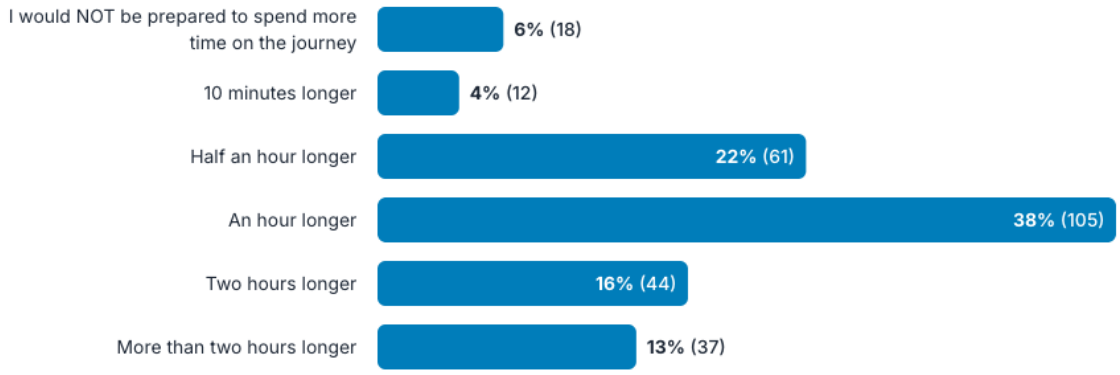


Figure 25. (Q16) We said above that Airlander is better for the environment than a jet aircraft. Imagine you are thinking about making a journey that takes one hour on a jet plane. How much longer would you be willing to spend travelling to help the environment? N=277

Based on a one-hour flight, nearly all were prepared to spend longer. The most popular response was an additional hour (38%), with 16% prepared for the total flight time to be three hours. Some (13%) were prepared to spend more than two hours longer.

6 Conclusion

The CoFFEE study of Airlander set out to explore how the public of South Yorkshire, focussed on Carcroft Common and Doncaster, understands the new aircraft and to consider broadly how hybrid aircraft might fit into the UKRI Future Flight initiative and its emerging ecosystem.

In exploring how the public in Carcroft Common and Doncaster understands Airlander, we showed that digital (online and social media) channels are the most powerful way to convey Airlander's presence. In particular, marketing messages have effectively conveyed positive knowledge about economic factors, that Airlander was being produced locally and would create jobs, that Airlander would represent a more sustainable form of aviation, and that Airlander would carry people, freight, or both. Limited negative views resound from prior suppositions.

Considering Airlander as a new feature of the local economy and labour market, there is a substantial concern from the population that the Carcroft project will increase traffic, a view that significantly reduces the likelihood of participants expressing excitement about the project. Nevertheless, most participants viewed Airlander as suitable for local jobs, despite the most significant association with excitement to see the Airlander in flight being the extent of prior knowledge. In particular, feeling Airlander is suitable for the local area increasing excitement for the venture. Such broad alignment with positive perceptions of Airlander and previous knowledge of the Carcroft development shows that the existing marketing activities seem to be working, at least for those they have reached. Similarly, the most substantial feelings towards Airlander - optimistic, excited, or relaxed – defined 85% of all responses, marking a favourable mood. Such optimism compliments the broad support for the proposition that at least 75% of parts would come from the UK, reflecting a desire to support the local economy within an area with a recent history of economic turbulence.

Most participants consider Airlander's contribution to aviation to be more sustainable than existing forms of air transport. Unsurprisingly, concern for the environment and road traffic decreased excitement, just as liking the environmental status of the Carcroft development increased excitement. This outcome aligns with the positive concern of respondents that Carcroft site workers should arrive by sustainable means. Predictably, expressing a lower level of concern for road traffic positively predicted higher levels of relaxation. Overall, the survey showed that sustainability is, at least in part, a powerful concern for the respondents. Most curiously, the broad concern for the environment is negatively associated with employment seniority. While this may be due to the sample containing a bias (e.g., perhaps professionals well-informed about aviation), this is curious and needs specific mention for further research.

Considering how hybrid aircraft fit into the UKRI Future Flight initiative, few participants misidentify Airlander as a conventional passenger jet service, playing into the positive perspective of Airlander as part of the Future Flight initiative. Safety is a critical component of the UK's move towards innovative flight technologies, which aligns with the participant's broad thoughts that Airlander will be safe. The respondents showed great acceptance of the use of both involving and not involving personal travel. Freight

transport in the UK was the most supposed use (88%), followed by remote sensing (82%), and then as personal travel within the UK and pleasure flights attracted 70% and 73% support, respectively. Considering such personal travel, the inverse relationship between age and concern for cost underscores the need for personal Future Flight initiatives to be accessible to as broad a range of the UK population as possible, rather than becoming the exclusive preserve of the super-rich. This may be challenging as the mean predicted cost is £69 for a notional 165-mile trip, whilst actual operational costs are unknown.

6.1 Study Limitations and Future Research

The study has a modest sample size, so statistical analysis can only comment on the larger differences between groups. With a larger sample, it is possible that more nuanced and challenging-to-detect trends in society could be revealed. This may include gender or other sociodemographic differences.

Furthermore, the sample was not fully representative of the population in terms of age profile or employment profile. Future research with a broader sample could investigate age-related trends further and enable the explanation of the trends associated with professional employment levels.

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