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Assessing sustainable journey-to-work solutions around stated and revealed employee preferences: the case of Bristol International Airport

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Abstract

From an airport perspective it is important for sustainable surface access plans, related to airport employees, to be informed by employee stakeholder views, attitudes, and preferences. A comprehensive Bristol Airport employee journey-to-work survey was carried out over the summer of 2022 with 326 responses received across 39 different employers with a presence at the airport, including 107 from the airport operator itself. The most popular travel choice amongst respondents was single occupancy petrol or diesel vehicles, which represented 62% of all employee journeys. The remaining 38% of journeys consisted of single occupancy hybrid or electric journeys (15%), Bus trips (13%), Multiple Occupancy vehicle trips (5%), Cycling (2%), Walking (1%), Booked taxis (1%) and Rail/Bus combinations (1%), which represent a significant proportion given the airport's regional location. Factors affecting the commute to work revolved around overall trip cost and convenience, with the environmental impact of travel choices holding a growing but still limited significance. The topography of the land around the airport and the rural nature of the transport network were also considerable influences affecting modal choice. Although more environmentally sustainable modal choices are growing, financial or other incentives would need to be provided to compensate for perceived changes to travel cost and convenience, with the most sought-after amongst Bristol Airport employees being free or discounted public transport and support for electric and hybrid private vehicles.

Keywords: airport surface access strategies; Bristol Airport; employee views; employee attitudes; travel incentives; employee travel.

1.0 - Introduction

Airport surface access choices have received a notable amount of attention since the rapid rise of stricter environmental targets as outlined by global aviation bodies such as the of International Air Transport Association (IATA) and International Civil Aviation Organisation (ICAO) alongside that of Airports Council International (ACI) in a bid to reduce carbon emissions (ICAO, 2022). The greatest polluters in the surface access process and by far the most popular mode of transport for most airports worldwide is that of single occupancy vehicles both for passengers and employees. Employees on average equate to between a quarter and a half of all vehicle traffic heading to airports (Aldridge et al., 2006). Such activity produces a substantial volume of emissions, which could jeopardise any emissions targets put in place by the airport operator. Employees can also take up valued space within designated car parks in and around the airport settings. What is more, with traffic levels slowly rising to similar levels to those seen before the Covid-19 pandemic started, more employees will need to service this rise in passengers, putting a substantial strain on conventional surface access modes (Weston et al., 2022).

With travel preferences and modes differing significantly between each airport, and vastly between urban and more rural airports, implementing more sustainable travel options is complex (CAA, 2022). Urban airport employees, such as those of some of the London airports, have numerous travel options, many of which would involve more sustainable public transport alternatives. The role of public transport, however, cannot be underestimated, with a many-to-one stop approach - in taking many people to a single hub (e.g. to airports), being able to considerably cut the volume of single occupancy vehicles journeys and therefore emissions as a direct result (Chen, 2017). By working closely with transport providers such as rail and bus companies, airport operators can secure a reliable and convenient transportation system for all stakeholders concerned often being an important metric for airport surface access benchmarking.

In order to convince a large workforce to commute using alternative, sustainable modes of commute, especially for those working within a rural airport environment, one option is to incorporate incentive schemes into the workplace. Indeed, research suggests that in the post-Covid era, 86% of employers believe that if they incentivised the commute, employees will be more likely to return to the office, with 76% of employees believing that if the commute time was paid, even more would return to the office space (Musson, 2022). The power that incentives hold is underestimated within the airport sector, especially when one considers the rising impacts of climate change and the need to reduce emissions. Of course, incentives are nothing new, employers have been using such tools for many years, however in a culture that is shifting to become more sustainable, businesses are increasingly using such schemes to change commuting habits to aid a reduction in carbon emission. With private modes of sustainable commuting often still too new to become widely cost effective to most, the price tag associated with electrically charged vehicles is slowly reducing, heralding in a new era of sustainable vehicle transportation.

Building on research conducted by Risby et al., (2022) on surface access habits of employees within Bristol International Airport but using a more limited sample, this study aims to assess a full range of employee travel to work preferences to help determine a shortlist of workable incentive schemes within the regional airport environment of Bristol International Airport. With Risby et al's (2022) research establishing the foundations for surface access to Bristol Airport, this study details how the airport authority could increase the use of more sustainable commuting methods within the wider base of on-site employers. The study also considers evidence of a wider range of travel modes, with new details surrounding hybrid and electric vehicles as well as car sharing. With limited transportation modes and the semi-rural nature of the airport in question, Bristol International Airport provides a unique insight into how semi-rural regional airports can encourage sustainable commuting behaviour within an airport setting bringing this aspect into line with the sector's ambitious Scope 3 emissions targets. The paper is set out as follows: Section 2 details the literature on airport surface access, including that of employee surface access at regional airports, section 3 details the chosen methodology, section 4 and 5 reveal the main survey results and discussion points respectively and section 6 concludes.

2.0 - Literature Review

Environmentally friendly transportation networks have been increasingly rising on the regional and global agenda in recent years, with employers actively incentivising employees to use cleaner modes of commuting (Marx et al., 2020). Indeed, since the Covid-19 pandemic, working from home has become increasingly popular amongst employers. In the UK, for example, it was found that 44% of jobs can be done from home (Nathan, 2020). Recent figures suggest that remote working reduced transport commuting emissions by 43% in 2019 and 97% in 2020 (Sutton-Parker, 2021) –it is worth noting this was heavily influenced by various lockdowns. With this being a temporary solution in the face of a global pandemic, significant interest has been placed within Workplace-Based Mobility Management Intervention Schemes (WMMS) with the employer being the instigating party in taking more responsibility in organising car shares, and taking more of an active role in reducing commuter emissions (Bartle et al. 2019., Esztergar-Kiss et al., 2021., Enoch, 2016). WMMS, as a 'soft approach' could be highly impactful in encouraging employees to switch to more sustainable means of transport, especially within urban environments where alternative modes of commuting are plentiful and can be very helpful in the planning and development of new transport modes (Lah, 2019).

This enables the employer to provide promotional measures, organisational and coordination measures and education for employees to opt into making more sustainable transport decisions (Figg, 2021). Indeed, WMMS can enable the workforce to intermingle and build a better working environment in which employees of different ages and backgrounds interact, supporting a friendlier organisational culture (Eppler-Hattab at al.,2019). Further research concludes that when active travel plans at the workplace were introduced to encourage more active commuting, 4-6% of the population switched to using more active modes, which suggests the workforce are willing to cooperate in such schemes. Additionally, a similar study concluded that WMMS significantly improved employee well-being with staff traveling on similar routes, sometimes using the same mode, encouraged conversations and thus positivity (Petrunoff et al., 2016., Neumeier et al., 2017). This suggests that perhaps employers adopting a more active role in implementing environmentally friendly modes of commuting could not only reduce workforce emissions but build a more cohesive environment within the organisation.

Commuter habits are hard to adapt due the embedded routines employees take daily. However, Castellani et al. (2016) highlights that commuting is a key domain in which sustainable transportation can be promoted due to the very habit of the commute. Indeed, Cloutier et al. (2017) goes a step further underlining that "the ways in which we travel – by mode, for how long and for what purpose – can affect our sense of happiness and well-being" therefore sustainable commuter modes not only benefit the environment, but also the employee's well-being (Zinke-Wehlmann, 2019). However, for this shift to become more embedded in societal norms for the commute, the establishments and businesses must be seen to promote, use and grow existing and new sustainable 4 technology modes (Hoerler et al., 2019). Indeed, with millions of people having access to smart phones and have thus become increasingly interconnected through Information and Communication Technology (ICT), this could be used to influence individuals to travel sustainably (Lierop et al., 2021).

Having access to key transport hubs is a priority for every national and regional government, especially when one considers the importance of aviation to economies. In the UK economy, for instance, aviation contributes £52 billion per annum to the economy and employs 961,000 people (Sustainable Aviation, 2016). Ensuring employees and indeed passengers can gain access has been high on the agenda since the industry's inception, more often relying on vehicles and public transport links. Yilmaz et al. (2021) comments that the pandemic has changed the way in which employees travel to and from the airport setting, often not wanting to travel on public transport due to the increased risk of infection, cost and risk of delay (Yazdanpanah, 2016., Tsamboluas, 2012). Instead, Yilmaz et al. (2021) states that increased car use amongst employees will cause problems for parking availability around airport settings, recommending that single occupancy car use should be actively discouraged (Vanoutrive, 2018). Furthermore, Ricard (2012) makes an additional point that due to the immediate locality of employees to the airport, most would commute by vehicle multiple times a day, contributing to more road congestion, greater emissions and fewer car parking areas for passengers and fellow staff alike (Domingo et al. 2015).

Public transport still has an important part to play, however, in airport access. Environmental concerns are an important factor on employees' minds, with public transport often being far more sustainable and encouraging greater economic growth (Budd, 2016). Indeed, Manchester Airport, in a bid to reduce car use amongst employees, considered introducing a £2 carbon charge for commuter vehicles, which contributed to 9.3% of employees considering changing travel mode as a result (Miyoshi, 2016). With greater pressure coming from stakeholders, shareholders, customers, and employees themselves, authorities are being forced to assess their socioeconomic impacts of airport access in a sustainable manner, which can only grow the environmental agenda (Dimitriou et al., 2022). Furthermore, the rise in taxi services, such as that of Uber, have caused car numbers in some airports to reduce, although as you might expect this does not reduce carbon emissions due to the persistent problem of single occupancy vehicles. However, car parking availability can be freed up (Wadud, 2020). This suggests that regional airport employees, given the right deterrents or opportunities, could be persuaded to review their commuting choices (Ralph, 2021).

Regional airports in the UK, that is airports outside of London and major UK Cities, are important connections for regional business, people, and the wider regional economy (Volkausen, 2022). However, due to the nature of their operations, expanding transport facilities to incorporate a larger catchment area or to cover costs through non-aeronautical revenues are often more challenging due to their remote nature, not to mention increasing environmental costs (Kazda, 2017., Ison, 2014., Cidell, 2015). Nonetheless, regional airports are important for the local economy, with the passenger base often having strong preferences to travel from their regional airport wherever possible; the same being for those wanting to work in the airport sector (Wiltshire, 2018). However, additional problems arise surrounding commuting time and modes of transport, with regional airports not having the as frequent access to public transport that city hubs tend to benefit from mostly due to infrastructural costs (Verduzco, 2022., Coyle, 2019).

Ionescu (2017) states that greater technological innovations in sustainable surface access modes and employee commuting behavioural changes are the main the drivers for sustainable regional airport commute access improvements. Namdeo (2014) backs this argument when discussing electric charging points arguing that the mass roll out of Electric Vehicles (EV's) is largely underpinned by 5 electronic charging points. If this is to happen, behavioural changes in transport choices needs to occur (Namdeo et al., 2014.,). Work conducted by Ryley (2012) through the 'ABC' Project: Airports and Behavioural Change: Towards Environmental Surface Access Travel conducted by Loughborough University concluded a similar outcome to Ionescu (2017) in that regional hubs rely on commuter behavioural changes as opposed to direct infrastructural changes, to reduce commuter carbon emissions (Foreman, 2016., Audrey et al., 2019). Although Page et al. (2017) disputes this the research shows that employees backed the use and integration of more sustainable mobility options, especially electrically assisted bikes (e-bikes) sighting benefits in the health and wellbeing of employees.

The main challenge for regional airports is to reduce the use of single occupancy vehicles, which significantly increases an airport's emissions (Risby et al., 2022). In a bid to do so, more employee incentives are being set up to encourage employees to travel green, with schemes focussing on reducing single occupancy vehicle commutes through financial incentives and by gradually reducing choice for employees (Whillans et al., 2021). One such method of doing so is to spread out the morning arrival times for office-based employee commuters. Research conducted by Zhang (2021), highlights that perhaps the way to manage this is through employees pre-paying for parking spaces at airports to arrive at specific times of the morning. This will show employees how many spaces are left and, in some cases, encourage employees to take public transport, being more efficient over a single occupancy car. Zhang's data, however, focuses on urban areas in which multiple commuter options are available as opposed to more rural airports where car use may be the only option for many employees.

At the national level policy is being introduced to encourage airports to produce Airport Surface Access Strategies (ASAS's), in communication with each authority, to establish a harmonised approach to reducing the workforce's dependency on single occupant car use (Humphreys, 2005., Ison et al., 2007). The fact remains however that urban

airports are substantially better placed to incorporate sustainable commute modes than regional hubs, simply due to greater opportunities in passenger footfall and a more densely populated worker population (Boloukian et al., 2016). Although this does shed hope for the instigation of more sustainable options the literature does not take into account the affordability of such schemes and as such although they may be substantial greener, if the employee base cannot afford to commute on such modes, the system can weaken considerably. There is a continued gap in research with respect to employee journey pattern data at regional airports, and how such regional airports can use this data to create sustainable surface access strategies, when often faced with remoter locations and more limited transport infrastructure – hence Bristol International Airport was chosen as a UK regional airport case study, which other UK and non-UK regional airports can use as a benchmark for generating their own workforce travel data and sustainable strategies.

3.0 - Methodology

With the research focussed on obtaining a broader view of ground access modal choices in the employee commuting population at Bristol International Airport, a quantitative approach was taken also due to the significant size of the population and the multiple variants that would need to be included in the analysis. The quantitative methodology took the form of a journey-to-work survey, which was primarily sent to employers at Bristol airport through multiple emails sent by the Airport's sustainability team at regular intervals throughout the data collection process. A subscription to JISC Surveys was used to generate an online survey, which, was also sent out to employees, by the Airport's sustainability team over a period of six weeks between July and September 2022.

A total of 19 questions were developed with sections related to employee attributes (GDPR compliant)[*], revealed travel preferences, stated preferences based on a series of hypothetical travel scenarios and a section exploring changing attitudes towards environmental aspects of trips to and from the airport. A pilot was undertaken in July 2022 with the co-operation of a sample of eight 6 Bristol Airport employees with some useful recommendations such as the simplification of the stated preference questions being incorporated into the main survey.

Using an unknown working population for Bristol Airport employees, for the data to be significant with at the 90% confidence level, the population size needed to be 273 participants. The survey led to 325 valid responses from a representative selection of companies located at the airport, confirming the validity and significance of the data obtained. The questions within the survey used a mixture of mainly closed questions linked to the surface access literature and some open questions to ensure that participants maintained interest in the study. There were a series of attribute questions in order to analyse results at a disaggregated level. Anonymity of respondents was affirmed through the structure of the questions, fulfilling data protection regulations.

With a significant percentage of the Bristol working population being operational staff with intermittent access to on-line portals, a day in August was selected for a small research team to assist employees to fill in the on-line survey with a handheld device. This increased the number of responses by around 50 within the 24 hours.

4.0 – Presentation of results

Figure 1 breaks down the specific category of employment. The most common job description was Operational Based employee at 56.1% with Operational Based supervisors making up a 10th of the respondents. As expected, Office based directors made up the least percentage at 1.5% with blank responses making up 3.1%. Thus, working operational based jobs made up the majority of employee respondents having a combined percentage of 78.1% compared with office desk staff at 17.7%. Though there is no population breakdown across all employers based a

[*] Copies of the survey can be obtained on request from the corresponding author

Bristol Airport, anecdotally this represents an accurate representation of the split in different job roles types at the airport in 2022.

Figure 1: Job category of respondents

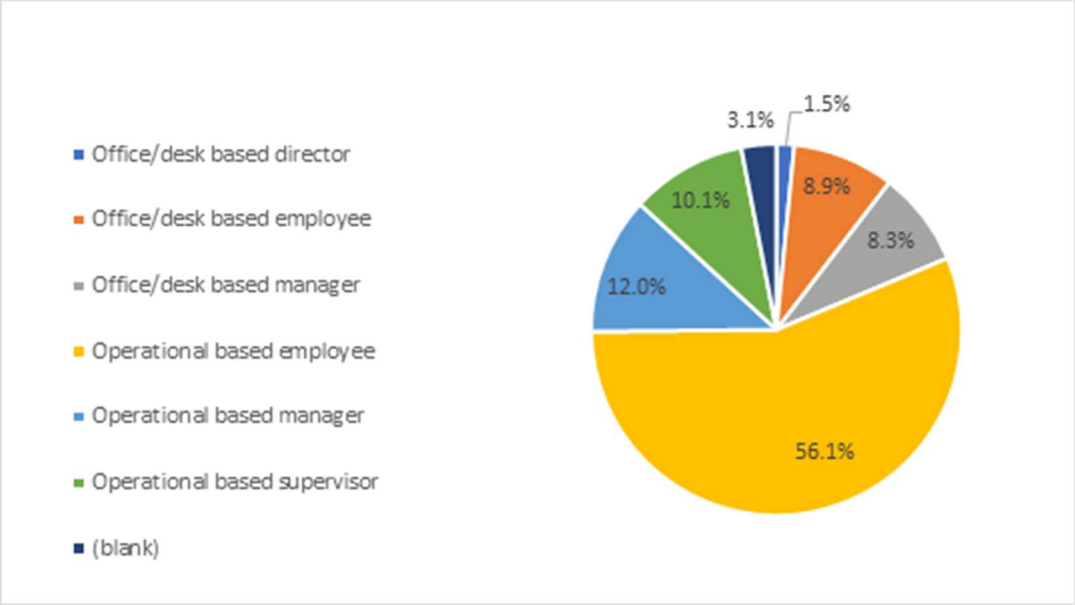

Table 1 shows a cross-tabulation of the relationship between a participant's job category and the mode of transport for their commute. Those in management roles where far more likely to use a 1.5% 8.9% 8.3% 56.1% 12.0% 10.1% 3.1% Office/desk based director Office/desk based employee Office/desk based manager Operational based employee Operational based manager Operational based supervisor (blank) 7 single occupancy vehicle over that of other employees with 19 office-based managers using a single occupancy conventional vehicle compared with 27 for operational based managers. Those working in any operational profession where also more likely to use public transport (either bus or a combination of rail and bus).

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Table 1: Job category and mode of transport

	Mode									
Job Categories	**Bus**	**Taxi**	**Walk**	**Cycle**	**Multiple Occupancy Electric /Hybrid Vehicle**	**Multiple Occupancy Petrol /Diesel Vehicle**	**Rail and Bus**	**Single Occupancy Electric /Hybrid Vehicle**	**Single Occupancy Petrol /Diesel Vehicle**	**Total**
Office Based Director	0	0	0	0	0	0	0	2	3	5
Office Based Employee	3	0	0	0	0	1	0	2	24	30
Office Based Manager	0	0	0	1	1	1	0	7	19	29
Operations Based Employee	36	3	4	2	3	7	2	30	114	201
Operational Based Manager	2	0	0	1	0	2	1	9	27	42
Operational Based Supervisor	6	0	1	2	0	1	0	3	24	37
Blanks	0	0	0	0	0	2	0	1	7	10
Total	47	3	5	6	4	14	3	54	218	

Figure 2 shows a breakdown of how employees commuted to work on daily basis. The majority mode was single occupancy petrol or diesel vehicles making up 61.6% of employees. A combined percentage of 76.9% travelled by either a fuel or electric powered vehicle. Active commuting to work, through either cycling or walking, equated to only 1.7% and 1.4% of the population respectively with 14.1% opting for public transport though either traveling by bus or by a combination or rail and bus services. This represents a modest shift for the airport away from private to public transport travel options since data was last collected in 2018.

Figure 2: Travel mode breakdown

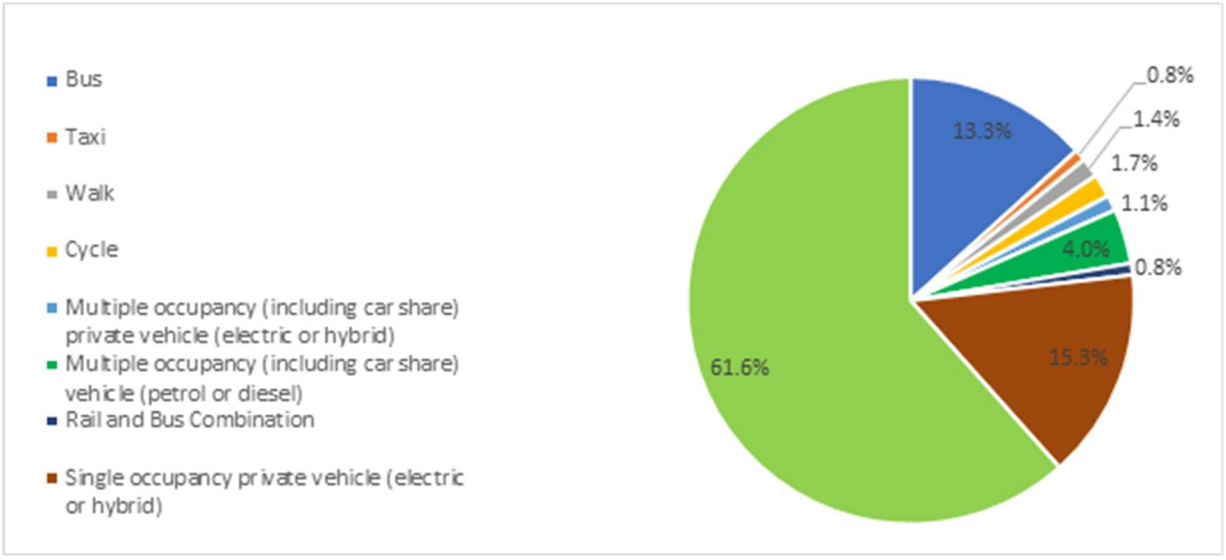
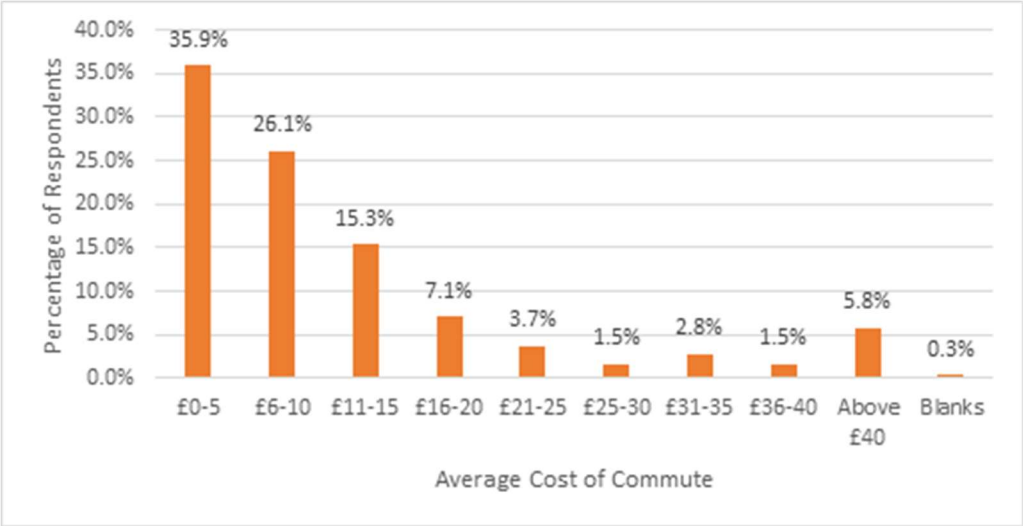


Figure 3: Commonly cited incentives

Figure 3 shows the most prevalent comments made by participants when asked what travel incentives staff would like to see offered by their employer. Unsurprisingly, most of preferences involve a financial investment by airport employers and together they also reflect the message that employees want to safeguard their ability to choose between private and public travel modes. Calculating and analysing how much each person spent on traveling to and from work is useful to compare with how far and by what mode each person is taking to highlight the most

cost-effective method of travel. Figure 4 highlights the cost of commuting to and from the airport each day. For most respondents the daily commute cost them between £0-5 with 15.3% stating a cost of between £11-15 a day. Only 5.8% of employees pay above £40 per day. On average respondents stated they travel to the airport for 4.24 days out of every eight, so weekly travel costs can quickly add up making up an average cost of £47.64 per week.

Figure 4: Estimated cost of commuting to and from work



Demographic data is an important part of the analysis in explaining why certain respondents take specific transport modes. Figure 5 highlights the relationship between age and the commute mode chosen to get to and from work. The younger generations are much more likely to travel on public transport or undertake active commuting methods with 67% of rail and bus users and 80% of walkers aged between 16-24. Middle aged participants most often cycled to work with 50% of those aged 45-55 and 33% of those aged 35-44 opting for this mode. Inactive choices were split quite evenly between the ages with distance of the commute being a more prevalent influencing factor than age.

Figure 5: Choice of travel mode to and from work by age group

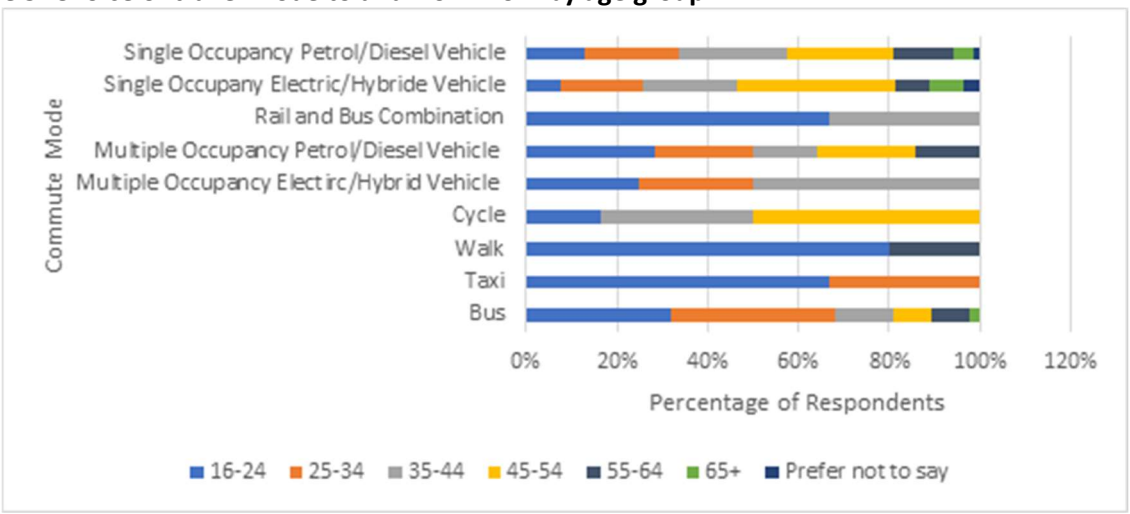


Table 2 shows the relationship between the overall time employees take traveling to and from the working environment against their modal choice. By far the most populous mode to work was through single occupancy petrol or diesel vehicles with only 25 out of the 218 respondents in this group arriving within 30 minutes. Taking the bus also was popular amongst staff with the majority of the 46 employees taking this mode arriving to work in between 1 hour and 1.5 hours. Overall, respondents took between half an hour and 1 hour, on average, with 121 employees commuting during this timeframe. The majority of times and distances involved would prevent most respondents from being able to consider active transport modes (walking and cycling).

Table 2: Travel time and modal selection

	Mode									
Elapsed Time Taken Too and From Work	**Bus**	**Taxi**	**Walk**	**Cycle**	**Multiple Occupancy Electric / Hybrid Vehicle**	**Multiple Occupancy Petrol/Diesel Vehicle**	**Rail and Bus**	**Single Occupancy Electric / Hybrid Vehicle**	**Single Occupancy Petrol/Diesel Vehicle**	**Total**
0 – 30	5	0	4	1	0	1	0	4	25	40
31 – 1:00	12	0	0	4	2	6	1	24	72	121
1:01 – 1:30	13	0	1	1	1	2	0	15	53	86
1:31 – 2:00	6	0	0	0	1	1	1	6	38	53
2:01 – 2:30	2	1	0	0	0	3	0	2	12	20
2:31 – 3:00	3	0	0	0	0	1	1	0	10	15
3:01 +	5	2	0	0	0	1	0	3	8	19
Total	46	3	5	6	4	15	3	54	218	

In order to evaluate the estimated commuting cost to the employee, Figure 6 points to a relationship between the cost of the daily commute and the mode of transport taken. Bus and Rail modes were by far the cheapest alternative with 77% of respondents who took the bus paying under £5 for such journeys. In the rail and bus combination 33% of respondents paid above £40, though this was only a small sub-sample. One of the cleaner vehicle modes, namely a multiple occupancy electric or hybrid vehicle cost respondents on average £11-15 a day with half of respondents in this category highlighting this.

Figure 6: Average daily trip cost and choice of mode

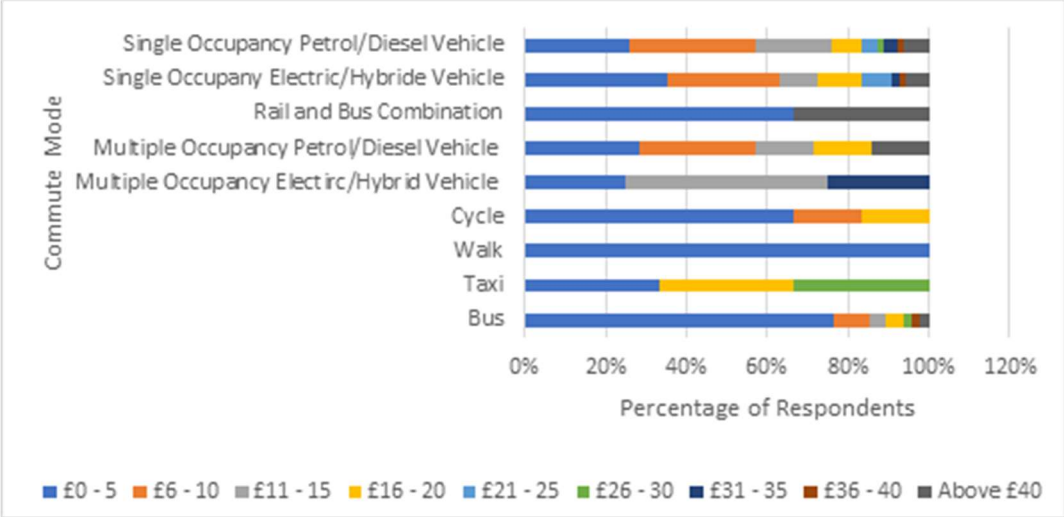


Figure 7 depicts respondent attitudes towards the personal utility generated through their travel choices. Walking was found to be the most reliable mode with 80% stating this was very reliable compared with only 31% for cycling. Respondents who cycled felt very strongly regarding their personal Safety with 69%, stating that they felt average regarding their personal safety.

Figure 7: Stated utility factors by mode (walk and cycle)

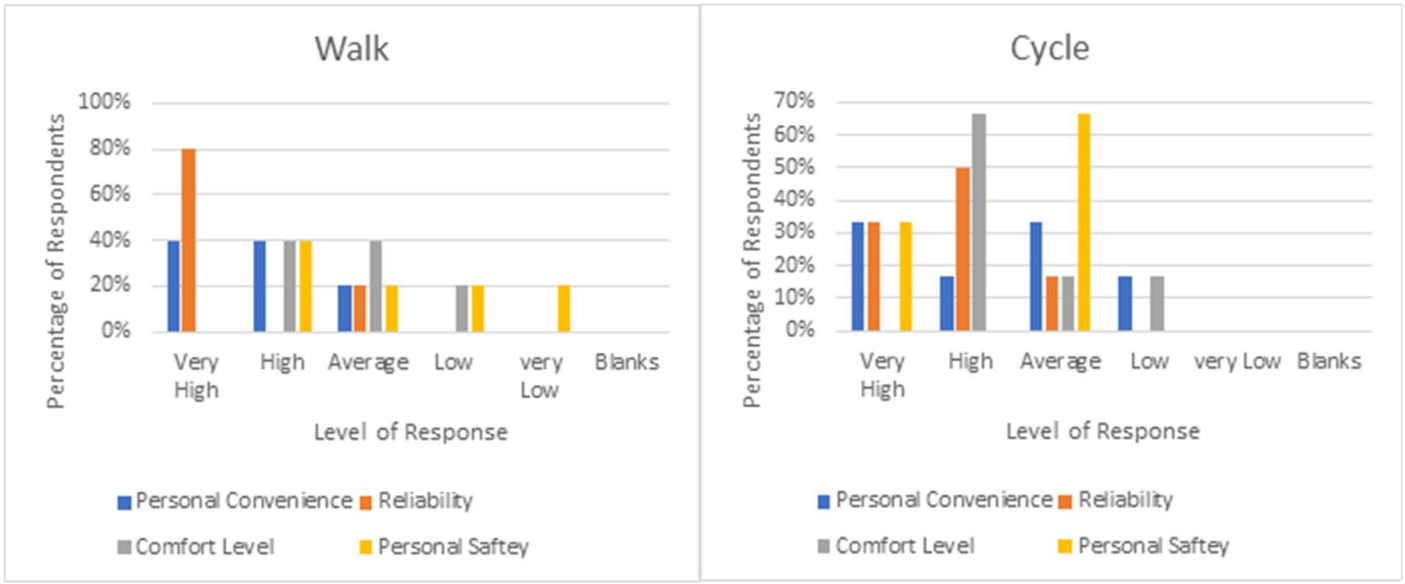


Figure 8: Stated utility factors by mode (rail and bus, bus and taxi)

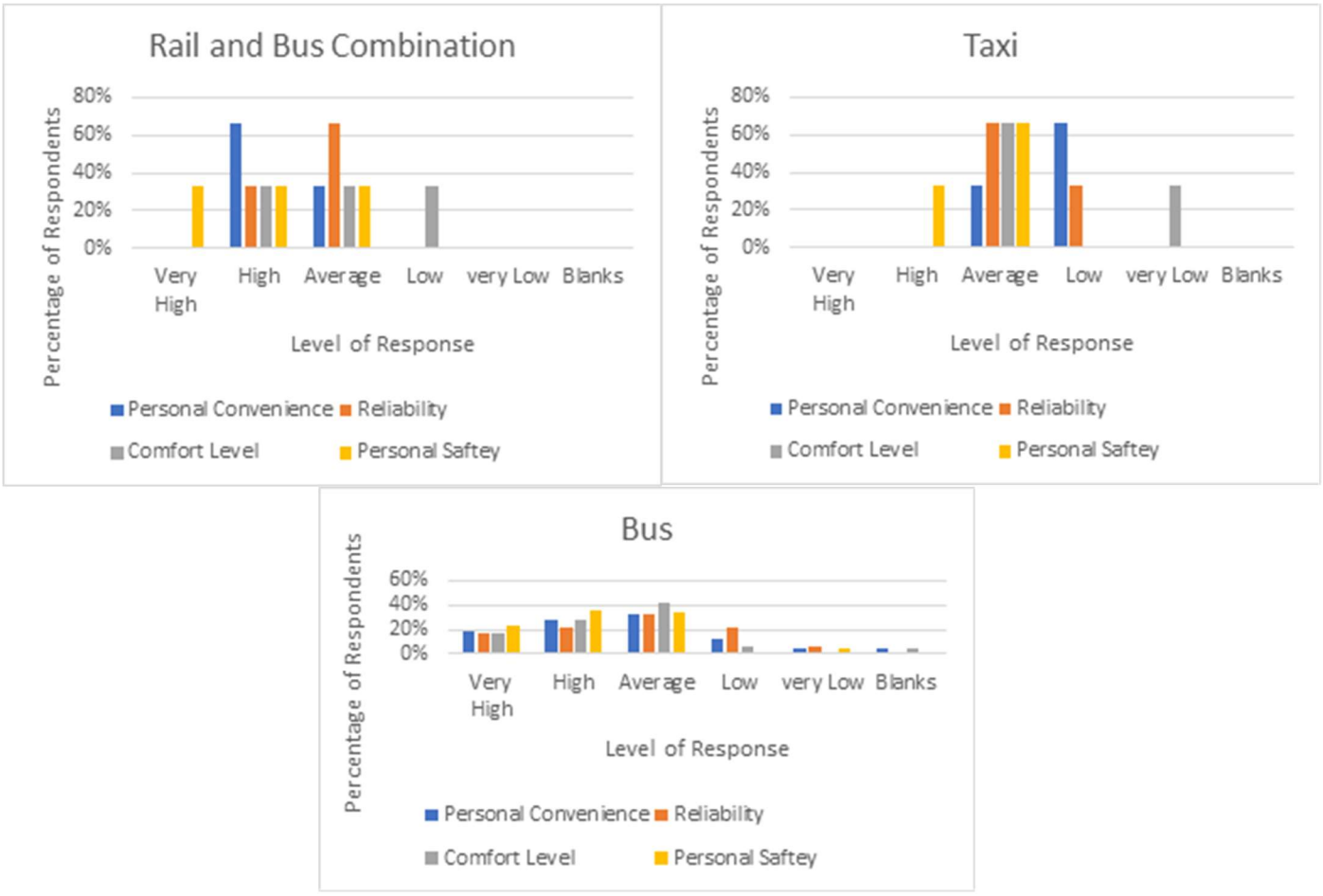


Figure 8 presents results for bus, taxi and rail and bus combination. Rail and bus combinations were found to be the most reliable public transport option with only 31% of respondents agreeing that buses were reliable. Taxi services where the least convenient for respondents with 62% stating that taxis where not convenient.

Single occupancy conventional vehicle users were shown to be either very high or high on reliability (71%), personal convenience (69%), comfort levels (72%) and personal safety (75%), due to the employee being the driver and owner of the vehicle (Figure 9). When compared with multiple occupancy vehicles some utility factors reduced with only 36% rating personal convenience highly for conventional engines increasing to only 50% for multiple occupancy electric vehicles. Having to wait for colleagues on some occasions, clearly had an impact on perceived convenience levels. Comfort levels also reduced from being 48% 'very high' in single occupancy electric and hybrid vehicles to only 21% 'very high' in multiple occupancy petrol and diesel vehicles, perhaps again through the perception of having to share vehicle space with others. The differences in the mean responses between all single occupancy vehicle respondents and users of any other travel choice were found to be statistically significant for all four utility factors at either the 99% confidence level (Reliability and Comfort) or the 95% confidence level (Personal Safety and Convenience), illustrating how strong views are in relation to the benefits of using private vehicles.

Figure 9: Stated utility factors by mode (private vehicle)

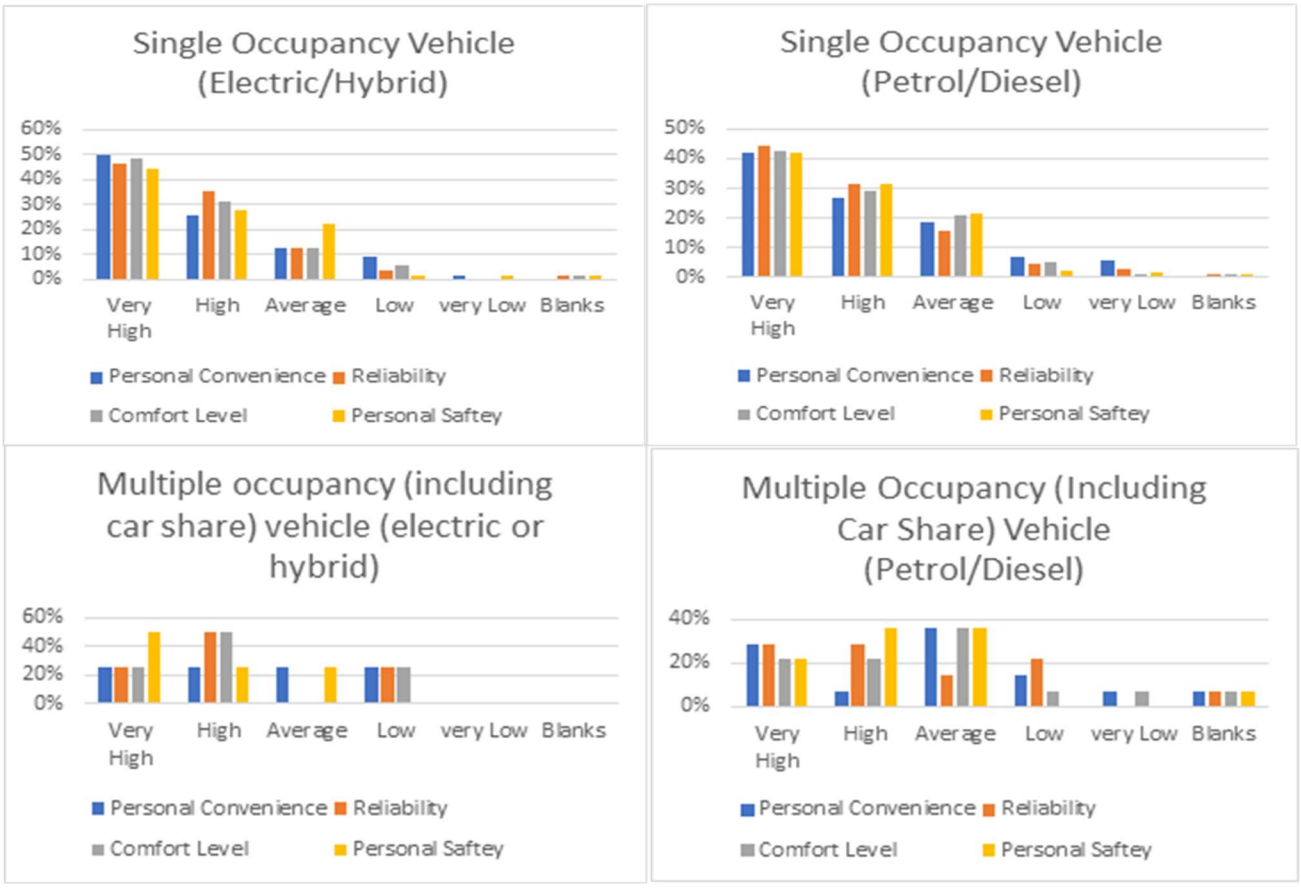


Figure 10 suggests that older participants are more likely to not consider the environmental impact of their choices. 64% of participants 65 years and above would never consider environmental impacts compared with 46% of those aged 16-24. 6% of 34–44-year-olds would always consider their environmental footprint before making a travel choice with a further 7% stating they would consider it most of the time.

Figure 10: Age and environmental considerations

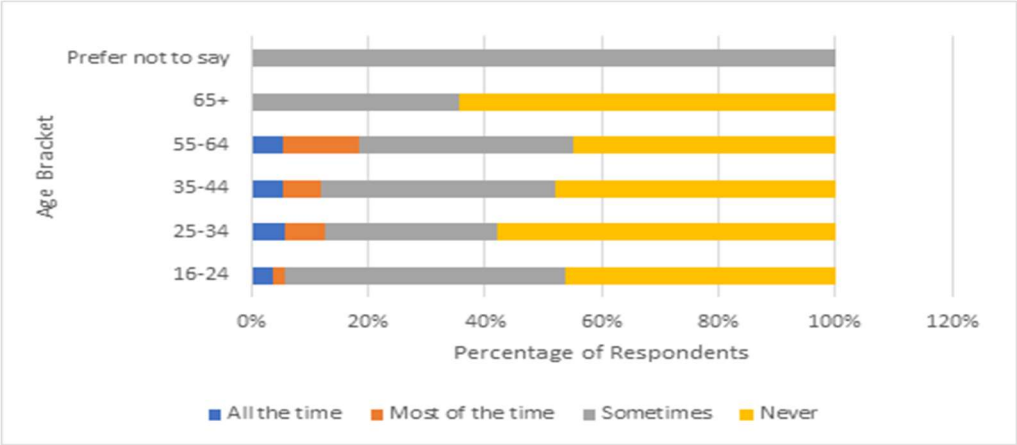


Figure 11 shows the relationship between participants who are enthusiastic regarding bus season ticket incentives and the age bracket of participants. This incentive proved to be very popular with younger staff members with 16–24-year-olds making up 30% as well as 25–34-year-olds making up an additional 30% of those that would be highly encouraged by this incentive. The older age bracket was not as enthusiastic with 65+-year-olds making up only 7% of very high encouragement category.

Figure 11: Age and bus season ticket incentive

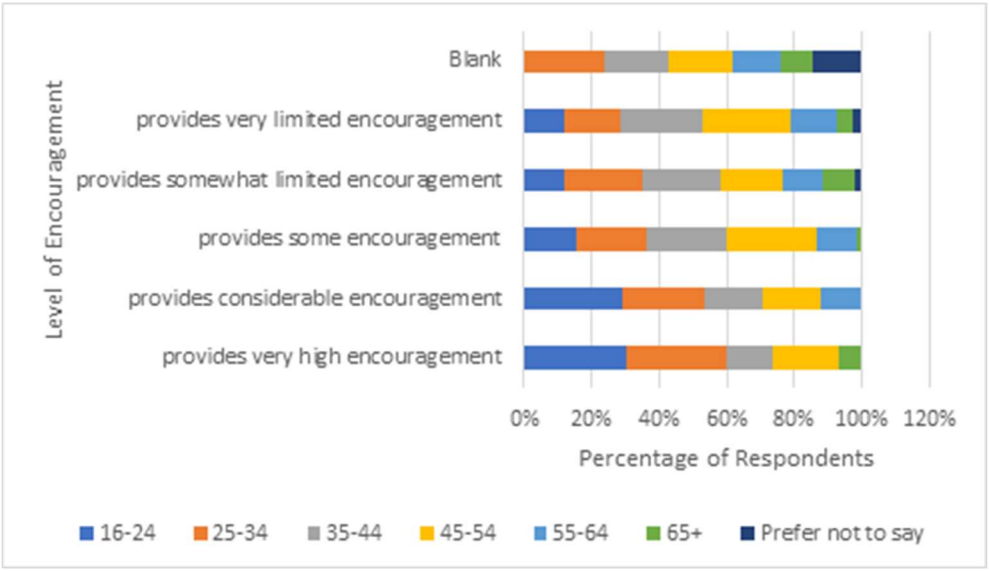


Figure 12 shows a similar incentive to Figure 11 with an equally similar trend in being more popular with the younger age bracket. 26% of those that were highly encouraged and 13% of those considerably encouraged were those aged between 16-24. Those who were aged 35-44 made up 35% of those who were somewhat encouraged and 26% of those who showed limited encouragement.

Figure 12: Age and free use of bus services

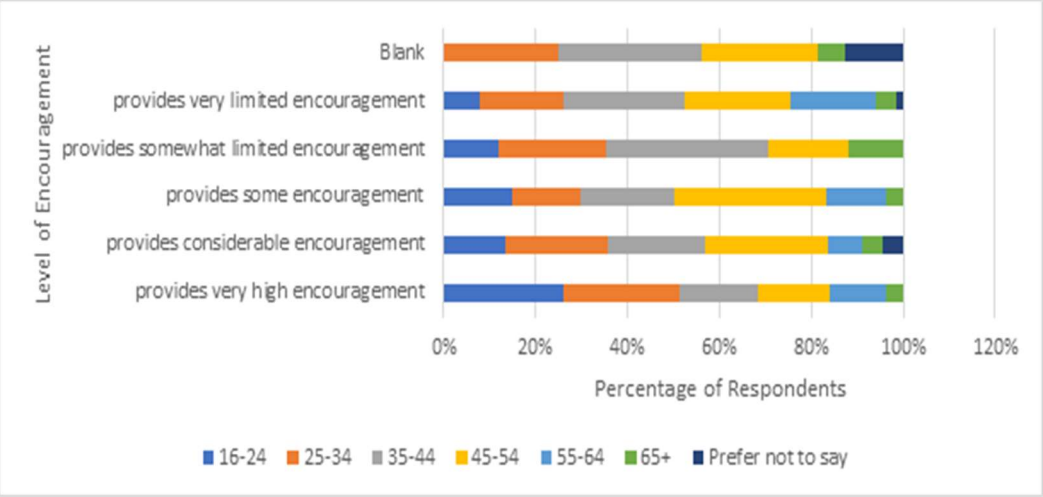
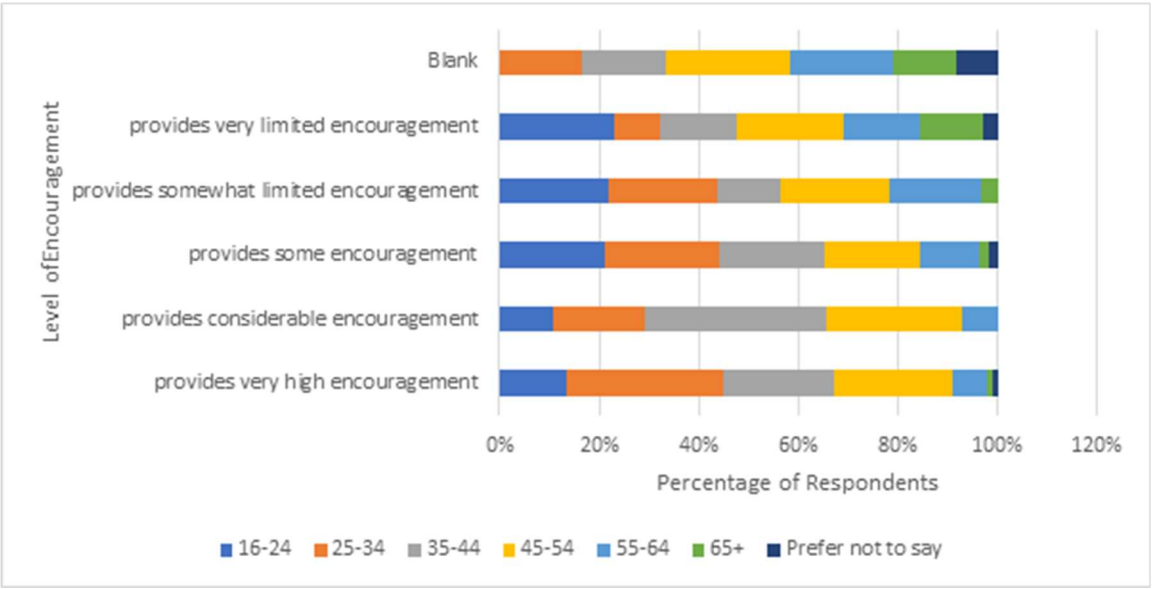


Figure 13 highlights that a sizeable portion of participants felt that more charging points for electric vehicles would provide at least some encouragement to reconsider travel choices. This incentive was most popular within the middle-aged brackets with those aged 24-34, 35-44 and 45-54 making up 32%, 22% and 23% of the very high encouragement category. As was expected due to the ownership makeup of electric vehicles to date, those of the youngest age bracket made up 23% of the very limited encouragement bracket.

Figure 13: Age and provision of EV/plug in hybrid charging points



Figures 14 to 16 detail the results from the three hypothetical stated preference travel questions in the survey and a split by age demographic. When faced with a choice that did not contain a single occupancy vehicle, between a diesel or petrol car share, a diesel operated public bus or a cycle route (Figure 14), 44% chose the shared private vehicle option. As expected in an out-of-town regional airport, only 13% selected to cycle even if there was a

dedicated cycle route. A further 37% opted for diesel bus. The implication from this result is that respondents would benefit from the availability of alternatives when considering primary and secondary transport preferences for journeys to and from Bristol Airport. In choice scenario 2 (Figure 15) 48% of all respondents displayed a preference for the single occupancy vehicle (EV or hybrid) option when faced with a choice between this and a hybrid bus (24%) or a single occupancy petrol or diesel vehicle option (28%). It is evident that when presented with information that demonstrates the benefits from using EV or hybrid private vehicles versus petrol or diesel private vehicles more people would be tempted to select this option. In particular, the reduced emissions and full economic trip costs of the EV/hybrid option within the presented scenario is likely to have increased stated choices for this travel mode. In the final scenario (Figure 16), the single occupancy diesel or petrol option was the clear preference amongst respondents (54%), despite being more environmentally unfriendly and costlier than the rail/bus combination alternative. This demonstrated the value that respondents tend to place on reducing ride trip time and maximising personal control and convenience. Taxi was considered a very niche option, whose very high costs and emissions would only be justifiable when other all options are unavailable.

When splitting the overall trend by age demographic, it is evidence that the younger participants are the more likely to choose the public transport (bus) option and less likely to choose a multiple occupancy car share option. 55% of 16–24-year-olds chose the bus option compared with 40% for 25–34-year-olds and decreasing further to 28% for 35–44-year-olds. The trend then reverses for multiple occupancy vehicles with 37% of 16–24-year-olds choosing such an option over 49% of 25– 34-year-olds and 51% of 35–44-year-olds.

Figure 14: Age and stated preference scenario 1

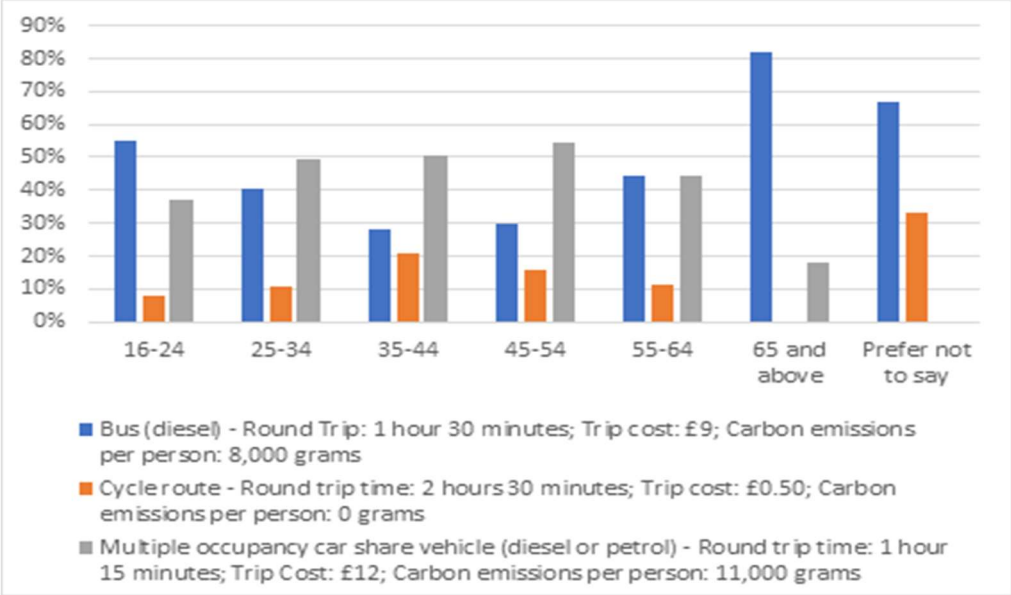
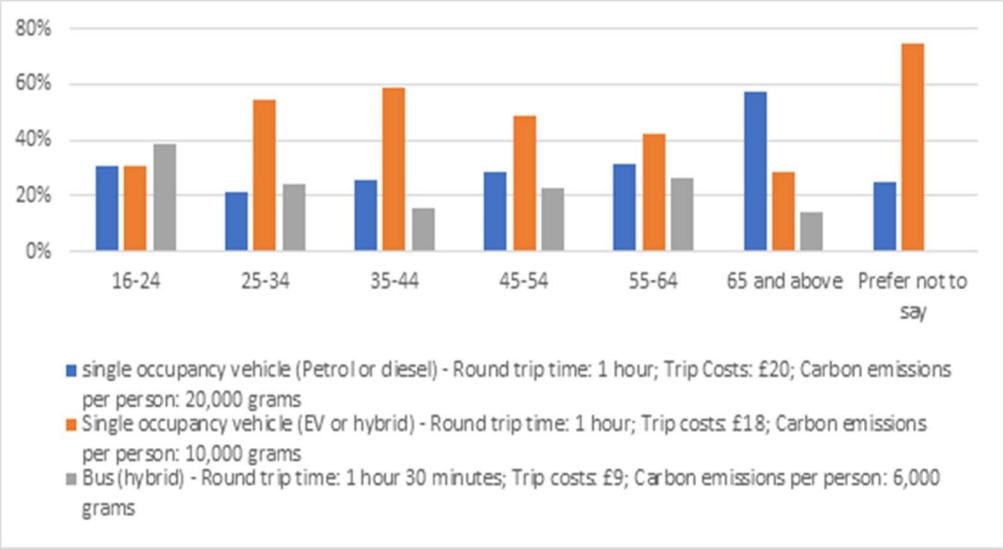
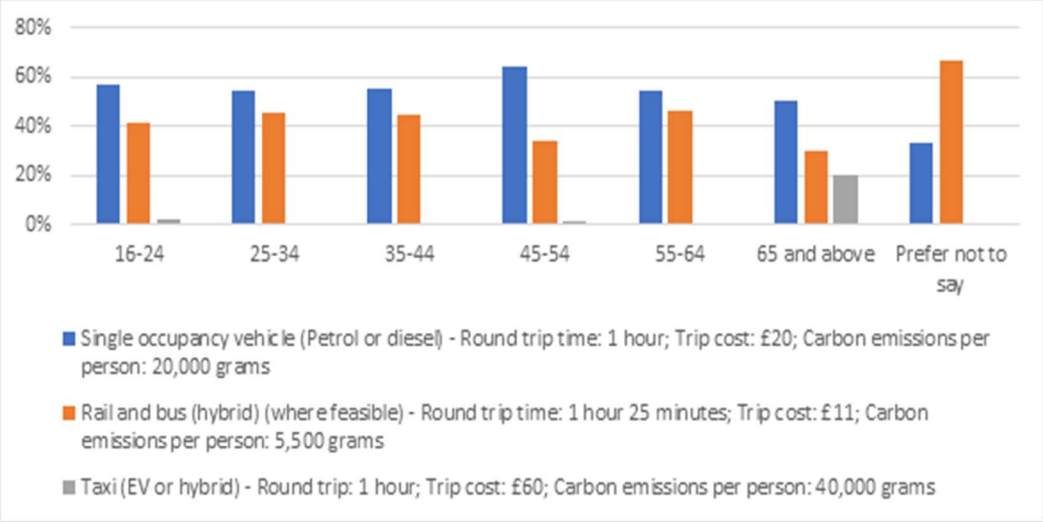


Figure 15: Age and stated preference scenario 2



64% of 45–54-year-olds stated support for single occupancy vehicles versus only 34% for the rail and bus combination option in scenario 3 (Figure 16). This gap was less pronounced for the other age group categories with an almost universal lack of approval for the taxi option with the exception of the 65+ age group category.

Figure 16: Age and stated preference scenario 3



5.0 - Discussion

One trend highlighted within the data showed that single occupancy vehicles were by far the most popular mode of transport to Bristol Airport for airport employees. This was most popular within those working at a managerial level with 90% of office-based managers and 86% of operational based managers using single occupancy conventional or electric and hybrid vehicles, when compared with 71.6% at the office-based employee level.

Despite single occupancy vehicles being by far the most common mode of travel, there is a fledgling environmentalist movement that has the potential to make employees re-examine their travel to work choices. Of the 10 most popular developments wanted by the Bristol Airport workforce in their journey-to-work, eight relate to developments that boost hybrid or electric vehicles and public transport. Results also showed that those aged between 25 and 34 were the most likely group to choose electric or hybrid vehicles over more conventional vehicles. This suggests that although private petrol and diesel-based vehicles are the most popular choice for airport commuting, more sustainable modes of transport are gradually becoming more prevalent. One of the barriers, as highlighted in the literature review section, to expedited growth in sustainable options, particularly at regional airports is related to the lack of infrastructure, with more limited rail connections and few electric charging points available for staff within designated employee parking zones.

The results highlight that single occupancy petrol and diesel and that of electric or hybrid vehicles were closely associated with higher trip utility. This could suggest that although public transport is often more sustainable than that of single occupancy conventional vehicles, they not perceived as being as reliable, convenient, or safe.
The continued growth of single occupancy electric vehicles is an important factor in reducing overall emissions. The provision of electric charging points and help in renting or leasing an electric car were among the popular suggestions received from respondents. Operating these vehicle types were considered cheaper than that of a conventional vehicle with 35% of hybrid/electric vehicle owners spending between £0-5 and 28% spending between £6-10 per round trip. The suggestion, therefore, is that not only is a single occupancy electric or hybrid vehicle a preferred sustainable alternative, but it could also be cheaper for the employee to operate and would be similar in reliability and convenience to that of a single occupancy conventional vehicle.
These changes would not remove single occupancy vehicles from the roads surrounding the airport, however, with more car park infrastructure needed to accommodate charging points for the use of electric vehicles. Therefore, although such modes would be substantially better for the environment, the long-term issue of the greater number of airport trips required is not reduced. The literature highlights the confusion surrounding what mode of transport would be best used to meet the needs of the workforce whilst maintaining environmental targets with Zhang (2021) adding that perhaps the mode itself not the only problem. By spreading out the commute across a wider time frame during the working day, congestion could be reduced with vehicles producing less emissions as a result, though with the majority of respondents at regional airports including at Bristol would not be able to consider this due to being in shift based operational roles, unless the peaking of airfield operations can be altered. Malandri (2017) and Killkis (2016) also highlight that due to the trend of futureproofing sustainable aviation, there is growing sentiment that this will naturally bring about more sustainable public transport planning including at Bristol International Airport, with a more prominent role for bus and active travel (where feasible) in the absence of airport rail interchanges .

Although car sharing schemes could reduce emissions, the working population at Bristol Airport is not sold on the idea with better convenience and reliability indicators noted for public transport and single occupancy vehicle use. The literature hints at a disparity between the current levels of technology within the transport sector and the need to drive sustainability with Ionescu (2017) stating that technological innovations and changes in commuting behaviour are the main factors affecting sustainable airport surface access. Other regional airports both inside and outside the UK, would be able to benchmark the employee preference data in the Bristol survey against their own employee preferences to detect if any changes in attitudes and preferences reflect more local or universal considerations for regional airports.

6.0 - Conclusions

This research has given insights into the trip methods and preferences of the working population at Bristol International Airport during the busy summer 2022 period, with greater details for the first time on a wider range of travel options including the use of electric vehicles and car sharing methods. The split between the job description of the employee and the selected mode of transport showed that there is a distinction between modal choices and job category, with the shift patterns of some employees and the cost commuting found to be of higher

importance to operational workers in comparison to office workers. Considered a development of Risby et al's (2022) initial findings, this research noted that reducing the use of single occupancy vehicles amongst employees is of vital importance for the purposes of reducing surface access Scope 3 airport emissions at Bristol.

To a high degree of statistical significance ($p<0.01$), respondents placed a higher importance on reliability and comfort when using single occupancy vehicles in comparison to respondents using other travel modes. To a lesser extent the same finding for convenience and personal safety was also significant ($p<0.05$). Encouraging employees to use alternative modes of transport at regional airport like Bristol can therefore be considered a difficult task. As divulged by respondents to the survey, some modal shift could be encouraged through financial incentives provided by the airport operator and other airport employers, which could drive a wider volume of employees to use more sustainable means. Although the data does suggest that financial incentives targeted at public transport would be preferred, more research would need to be conducted on the nature of public transport provision to airports including examining the role local authorities can play, to maximise the benefits of any new provision to employees. These types of incentives can be expensive for airports to provide if fully funded by the airport operator, and there is often a strategic imperative for local authorities to implement sustainable travel measures as part of their own strategic targets, leading to an increased scope in some cases for shared funding. The next steps in the research are to estimate the possible carbon emissions reductions that can be associated with a series of practical, workable and realistic incentive schemes (Work-Based Mobility Management Intervention Schemes - WMMS) for regional airports of Bristol's size, geographical location and infrastructural capacity. These results can then be considered by airport-based employers and linked back to local planning obligations and applications.

7.0 - Reference List

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