Introduction

Cambridge has always been known as Britain's Cycling City, but recently it has adopted a new form of micro-mobility, the E-Scooter. With the approval of the Cambridgeshire and Peterborough Combined Authority (CPCA) and against a background of rapid population growth, VOI, a Stockholm based E-Scooter company has been conducting an extended trial.

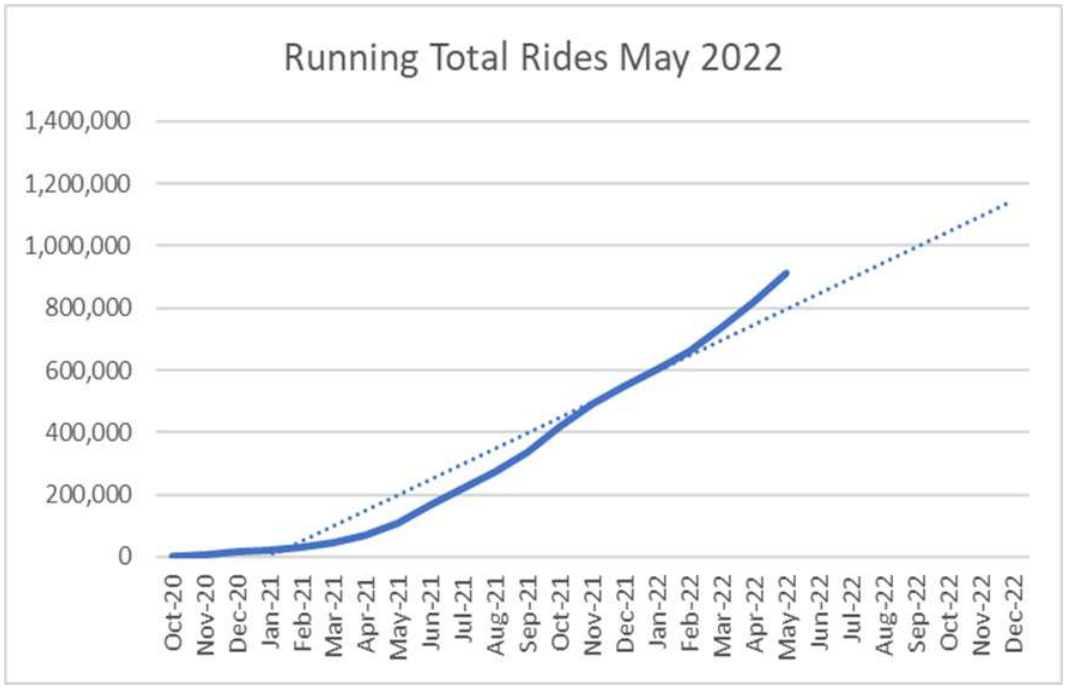
The 2021 Census confirmed that Cambridge is one of the fastest growing places in the UK. The population has increased by 17.6%, from around 123,900 in 2011 to 145,700 in 2021. This is higher than the overall increase for England (6.6%). As of 2021, Cambridge is the fifth most densely populated of the East of England's 45 local authority areas, with around 26 people living on each football pitch-sized area of land[1]. With this increase in density comes the need to provide a range of cost-effective mobility choices for city residents. Choices that support the wider sustainability goals for the city, cutting CO2 emissions and improving air quality. In this group of data stories, we explore how the adoption of E-Scooters could help.

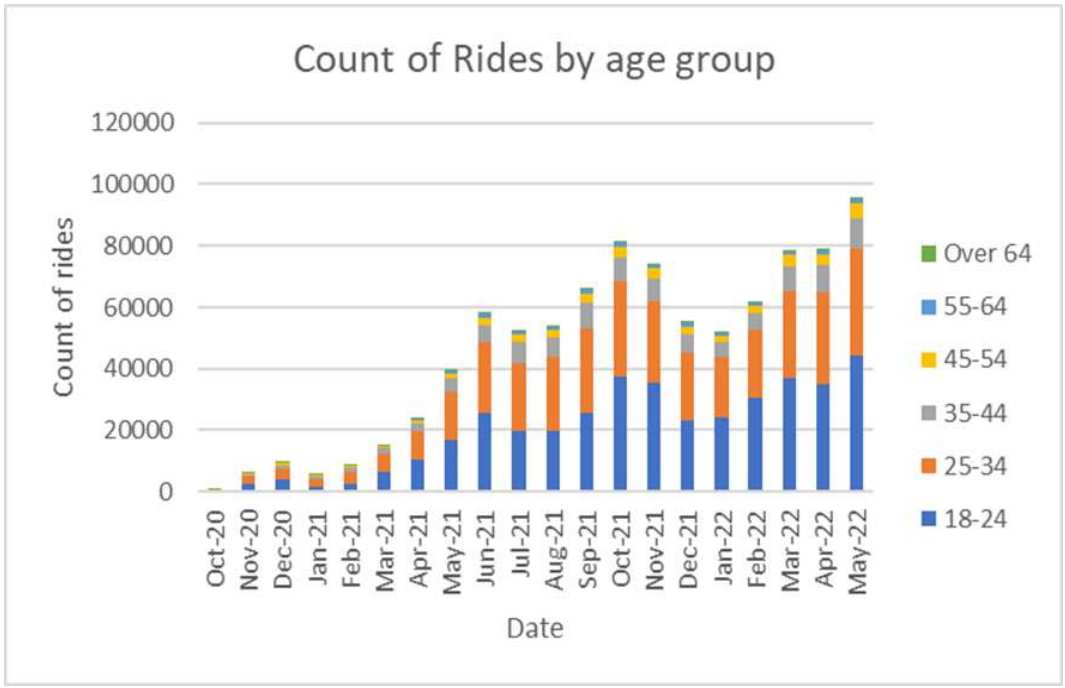
We use three sources of data across our data stories that has been made available from Voi to look at usage in more detail. The First is 'ride' data, information recorded every time a scooter is used. The second is 'survey' data, in depth questions answered by a sample of riders in Cambridge during July 2021 and February 2022. The third is 'incident' data, which details all safety incidents that have occurred during the trial. We have complemented this with the use of secondary research (reviewing other literature and studies) to bring greater depth to the analysis.

Part One - Who Rides the Scooters

Since the beginning of the trial, the number of rides taken has dramatically increased from the monthly count of 461 in October 2020, to a count in May 2022 of 95,410. Indeed, the introduction of this form of micro-mobility has been so successful that in just over two years Voi have recently confirmed that the number of rides has surpassed 1,000,000! As of May 2022, a total of 82,365 people have taken an E-Scooter trip. With 65% of these riders taking more than one trip in the city, E-Scooters have become an important component of travel for residents and visitors.

[1] How the population changed in Cambridge, Census 2021 - ONS

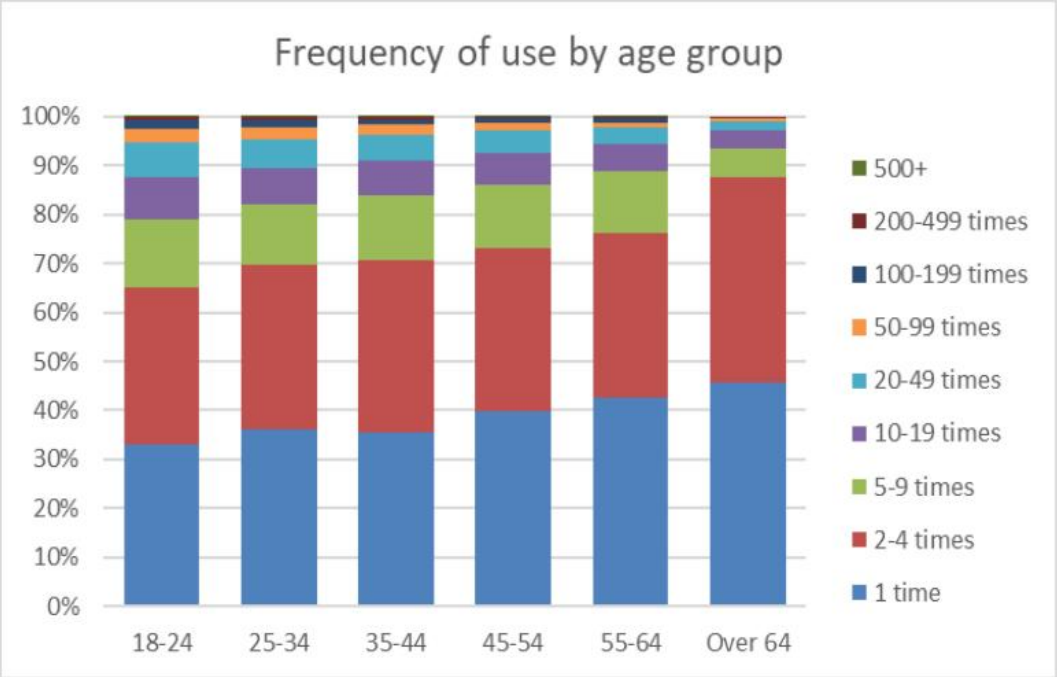




Age

As is common with new technology, usage of E-Scooters is concentrated amongst the young. We have analysed the ride data to separate rides taken by users and the individual riders. This shows that 44% of rides and 40% of riders are 18-24 and 39% of rides and riders are 25-34 (83% of rides and 79% of riders are under 34). At the other end of the age spectrum only 0.15% of rides and 0.34% of riders are over 64. Frequency of use by age group shows a decline in proportion of high frequency use the the higher the age bracket. The proportion of users that use an e-scooter in the lower use brackets (between 1-4 times) increases from 65% of 18-24's to 88% of over 64's. Average Distance

travelled differs by age group with it increasing with age, the only exception to this is the over 64 age group whose mileage is on a par with the 25-34 age group.

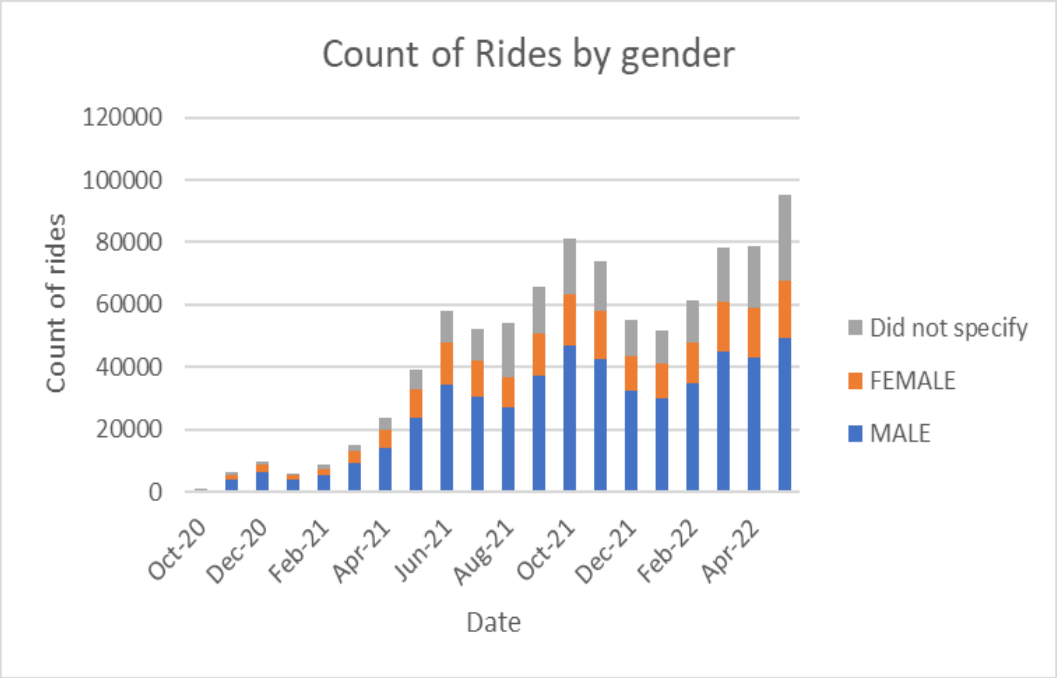


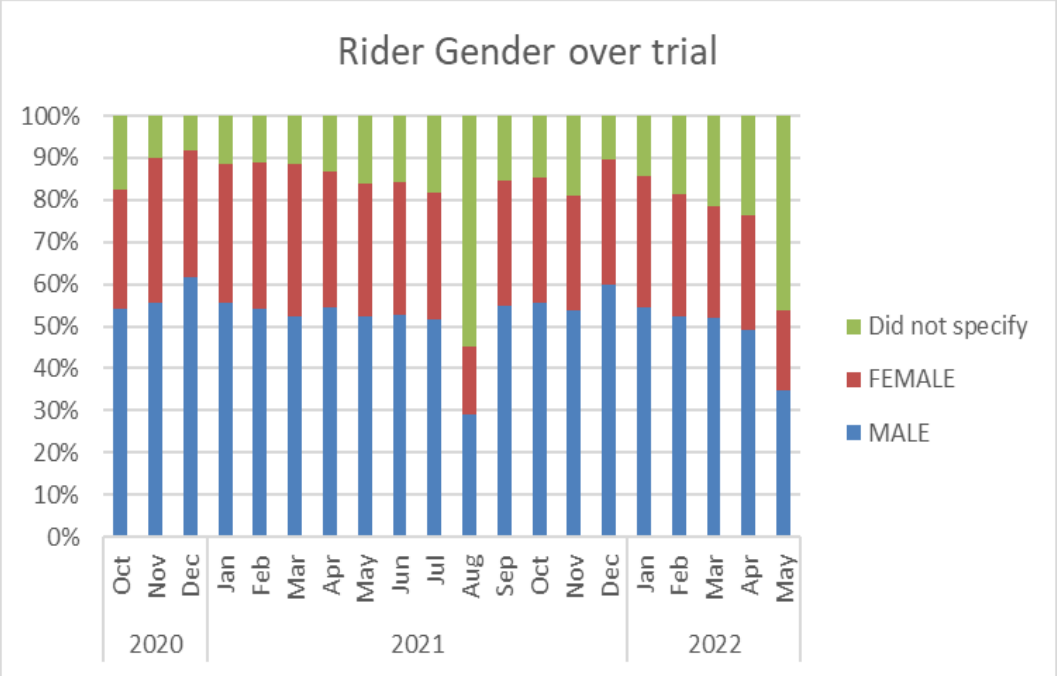
Gender

The starkest difference in the user data can be found in the gender breakdown of ride data. The Voi data can be interpreted in different forms. Of all riders to have taken at least one ride, riders reported that 51% were male, 28% were female and 21% did not specify. When looking at all rides by gender it is reported that 57% were male, 21% were female and 22% did not specify. The graphs below show the total rides data over time. The majority male ridership is consistent across national analysis of micro-mobility, including cycling. Cycling UK in their Cycling Statistics 2022 publication report that Men take 2.5 times more trip than women. However, it is inconsistent with cycling research local to Cambridge (2017 GCP 'Big Conversation' travel survey)[2] which suggested Cambridge cycling is closer to being gender neutral with 46% of cyclists being women. A study explaining Gender Difference in cycling behaviour in the United States[3] highlights that a higher proportion of women intercepted cycling did not have children compared to the men asked. This report puts this down to women taking larger 'household responsibilities,' however looking at the gender breakdowns across age groups in Voi Ride data there doesn't appear to be a large drop off in female participation in e-scooter travel in common childbearing years, but rather a general decline in gender share as age increases. Other key aspects noted in the study were that women were more receptive to safety concerns than men, and exposure to cycling in childhood made use more likely. From these points it can be argued that Cambridges cycling culture perpetuates a gender-neutral engagement from citizens and improvement to cycling lanes has put to ease safety concerns. Female riders may be put off by the perceived safety concerns regarding e-scooters, however such conclusions would need further research to gather more evidence than is currently available.

[2] Data Story Series: What we know about cycling in and around Cambridge: Episode One | Cambridgeshire Insight Open Data

[3] Explaining Gender Difference in Bicycling Behavior - Catherine R. Emond, Wei Tang, Susan L. Handy, 2009 (sagepub.com)





Part One - Conclusion

The number of riders in Cambridge is increasing at a significant pace. The data provided confirms a common theme among journal articles. That the main users of e-scooters are young and male. This can be partially explained with reference to younger age groups having an orientation towards trying new things as well as the presence of a very large student / post-graduate population in the city. The gender disparity is a common theme of micro-mobility, Literature on the subject makes a go of trying to find the reason for this, but without local surveys asking women to give their views we risk making large gender-based assumptions. An issue with the ride data is that there are a significant proportion of individuals that do not specify their gender. If women make up the vast majority of those who do not specify, in theory participation could be more gender neutral. Improvements could be made to ride data collection by offering broader gender identity choices, being inclusive while

capturing the reality of demographic trends. As E-Scooters mature into the daily lives of our cities we may well see higher adoption from women and older age brackets. The priority in the meantime is to make sure any fears are allayed and the benefits of using such a device are widely known.

Part 2 - Where do they go?

Cambridge as confirmed in our previous data story is experiencing an increase in the number of rides of E-Scooters. However, to truly understand the benefit for users we must look at where riders travel and the purpose of the trip. To understand this, we need to look deeper past the ride data into the survey data to understand what they are used for in Cambridge.

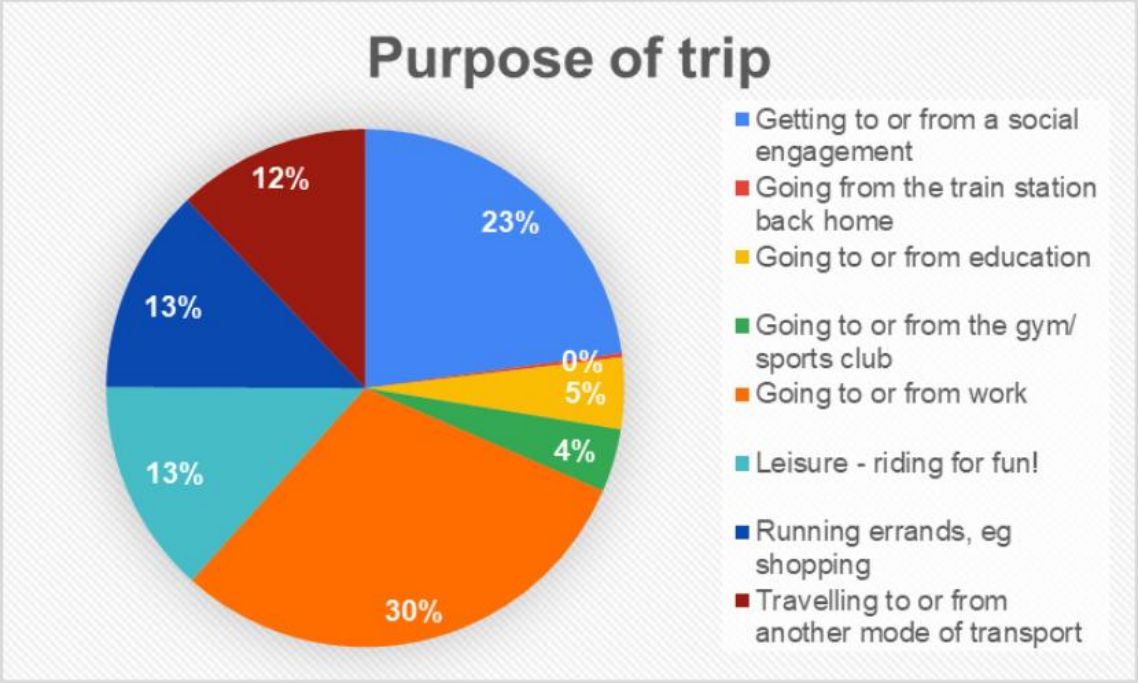
When riders choose to travel can help show their motivations. Our first step in the analysis was to work out if E-Scooters were used as a commuting method. Using ride data we calculated the total number of trips taken by hour of the day and day of the week. Assuming that peak commuting times were summarized as being between 7am-9am and 4pm – 7pm.

The table below shows the percentage of trips taken in a particular hour of the week as a proportion of all rides taken. To estimate the proportion of rides taken for commuting purposes, the numerator used was hours during work week at peak commuting times, divided by the denominator all trips taken. This calculation results in 23.21% were at the assumed peak commuting times. However, only 3.94% took place in morning peak times, while 19.28% were in the late afternoon peak times. In addition, on the weekend ride count was high during the PM peak. This suggests that either individuals are taking one way commuter trips, or the afternoon peak times are not representative of commuters and rather show rides for leisure activities after work finishes. This would mean that commuting is not a substantial proportion of total rides.

Hour of day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
24	1.82%	1.56%	1.91%	1.82%	2.00%	3.02%	4.36%
1	0.99%	0.89%	0.99%	1.06%	1.10%	2.10%	2.70%
2	0.66%	0.58%	0.64%	0.72%	0.73%	1.43%	1.80%
3	0.55%	0.46%	0.54%	0.60%	0.55%	0.99%	1.31%
4	0.43%	0.38%	0.38%	0.38%	0.47%	0.68%	0.85%
5	0.69%	0.67%	0.67%	0.64%	0.58%	0.43%	0.45%
6	2.04%	2.05%	2.02%	1.92%	1.50%	0.80%	0.81%
7	4.12%	4.65%	4.57%	4.37%	3.40%	1.34%	1.27%
8	5.82%	6.24%	5.94%	5.79%	4.89%	2.23%	1.82%
9	4.24%	4.41%	4.15%	4.30%	3.67%	2.92%	3.26%
10	3.65%	3.59%	3.30%	3.43%	3.19%	3.83%	4.51%
11	4.13%	3.79%	3.70%	3.78%	3.79%	5.10%	5.76%
12	4.89%	4.47%	4.50%	4.66%	4.67%	5.56%	6.60%
13	5.43%	4.91%	4.95%	5.07%	5.32%	6.16%	7.22%
14	5.79%	5.16%	5.19%	5.24%	5.56%	6.79%	7.61%
15	6.63%	6.19%	6.18%	6.28%	6.17%	7.16%	7.85%
16	8.46%	8.34%	7.86%	7.95%	7.72%	7.28%	7.66%
17	8.99%	8.88%	8.78%	8.71%	8.23%	7.57%	7.01%
18	7.80%	8.20%	8.38%	8.08%	8.03%	7.03%	6.27%
19	6.32%	6.74%	6.84%	6.62%	6.99%	6.79%	5.84%
20	5.17%	5.05%	5.27%	5.31%	5.88%	5.70%	4.77%
21	4.40%	4.69%	4.74%	4.86%	5.26%	5.15%	4.01%
22	4.00%	4.70%	4.71%	4.62%	5.41%	5.27%	3.50%
23	2.96%	3.39%	3.78%	3.78%	4.90%	4.67%	2.77%

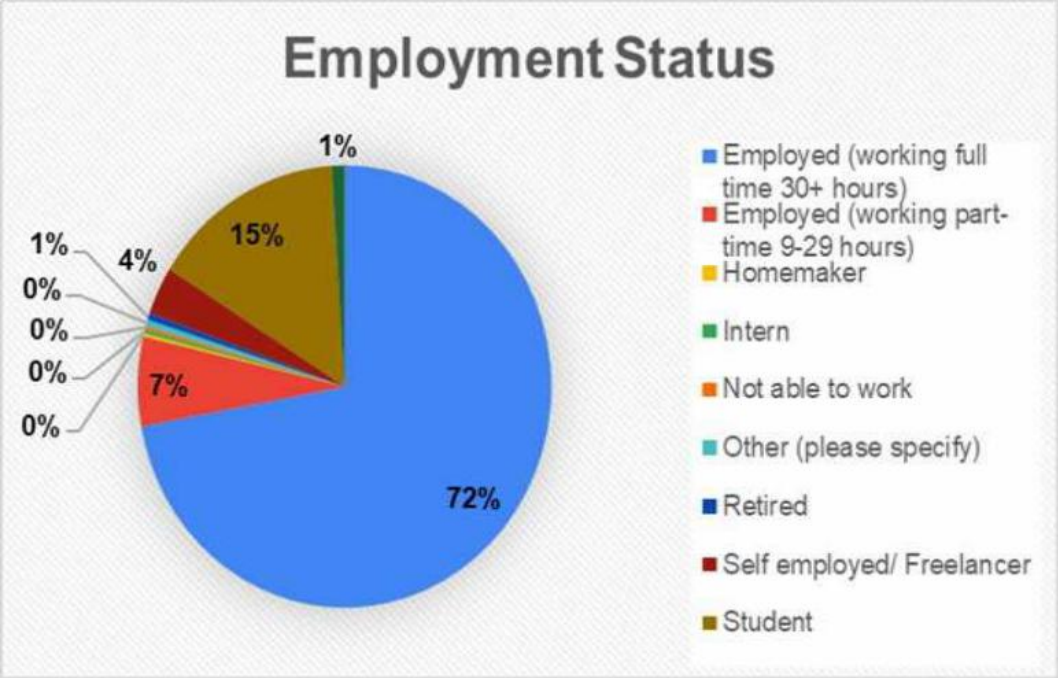
However, despite the given standard error on sample surveys, the survey data for July 2021 shows a proportion at 22% of respondents stating that their purpose of travel was ‘commuting’, which is similar to the total 23% calculated within commuting times from the ride data. This could mean that the first hypothesis of one-way commutes is more probable. Due to the new nature of the e-scooter, perhaps individuals may be testing the use for travel in the late afternoon when there is less

pressure of being on time. While commuting may be a substantial component of total rider data, total ride data places an emphasis on frequency, those who commute may not be using it to do so frequently and so are a lower share of ride data. Alternatively, as after work peaks are busier in general, a one-way PM commute may be combined with other after work activities. The second highest answer in the July 2021 survey is 'leisure' at 32%, followed by 'running errands i.e. shopping' at 19%. The more recent February 2022 survey shows a jump to 30% of respondents 'going to and from work' becoming the primary reason of travel for participants, followed by going to/ from social engagement at 23% and then leisure and running errands tied at 13% each.



To further explore this, we can look the reported Employment status that can be drawn from the surveys. 68% and 72% respectively of the July 2021 and February 2022 surveys were full-time workers, this group were followed by students at 14% and 15%, part-time employees at 7% for both surveys and self-employed at 6% and 4%. The surveys show very similar results which gives us confidence that these are accurate. The clear conclusion that can be taken from these figures is that the groups that use E-Scooters have the most have disposable income available to them. Research backs this up with a study investigating the relationship between low income and E-Scooter usage in the United States showing 'that low income negatively impacts e-scooter use in terms of number of trips, with all cities in the study showing decreases that range between 2.2% and 23.3%.' [4] Voi do offer various discounts to make rides cheaper for those on lower income, e.g. VOI 4 All. However, a further study would be needed to determine whether take-up in Cambridge bucks this trend.

[4] Causal effect of low-income areas on shared dockless e-scooter use - ScienceDirect



A point that is worth considering when observing where people travel and their reasons is the surrounding infrastructure to facilitate such use. A study on behavioral intervention for micro mobility adoption in New York explores how nudges, policy designed to create a change in behavior, that being towards adoption in the case of E-Scooter's. The study found that the 'biggest obstacles in adoption attitudes is the lack of e-scooters, be it ownership or provision of shared rental systems.'[5] Clarifying that this 'is unique to e-scooters as a budding technology.' Currently in Cambridge we have designated hubs where E-Scooters are grouped to facilitate easy access for potential users. An example of this are the two hubs by Cambridge Station. This enables the use of Scooters for the last mile of travel as part of a commute that started with the train. The Greater Cambridge Greenways project is an example of infrastructure designed to encourage cycling between our market towns and into the centre of Cambridge from the surrounding area.[6] Such routes with the creation of new E-Scooter hubs, could become the arteries of a major micro-mobility shift. However, such a move would need local support and observation to monitor whether there was an impact on cycling take up.

Part Two - Conclusion

Survey respondents highlight use for commuting as the most popular reason for using an e-scooter, however this lining up with the results of the ride data takes a stretch in unusual assumptions, such as heavy commuting use in the late afternoon, but not in the morning. Leisure activities are the second most popular answer with this confirmed by the ride data in when the peak use times are, primarily after the traditional 9-5 working hours, and with heavy usage on the weekend. The survey data shows that the primary users are the full-time employed, this raises questions about the impact of level of income on E-Scooter usage. While the survey does not ask for such information, other studies predominantly in the United States have shown that there is a correlation between low

[5] Behavioural interventions for micro-mobility adoption: Low-hanging fruits or hard nuts to crack? | Elsevier Enhanced Reader

[6] Greater Cambridge Greenways

income and lower usage of E-Scooters. If policymakers wish to influence behavior, nudge techniques are a valid option, for example where E-Scooters are stationed may induce demand. Projects such as the Greenways initiative for bicycles could be altered to facilitate greater take-up. More detailed studies are needed to tease out finer points on ridership behavior, in particular exploring afternoon and morning usage thoroughly in direct contact with users. These are early days for this new form of transport, commuting as a reason for travel may increase over the coming years with greater acceptance and assurance of reliability.

Part 3 – Safety

Where E-Scooters face most opposition from the public is the perception of an increased risk to safety for users and also for pedestrians that may encounter the E-Scooters. The July 2021 VOI user survey asks to what extent do you agree with the statement 'I Feel Safe riding a Voi E-Scooter.' 29.68% of respondents, the largest response group, stated they strongly agree. This suggests that those that use that E-Scooters generally feel comfortable about their safety. The Department for Transport (DfT) commissioned a report by Kantar looking into the perceptions of current and future e-scooter use. The report shows that 'safety was seen as the overriding disadvantage among respondents, cited by 53%. Within this, 41% were concerned about the safety of pedestrians, while 35% mentioned rider safety.' In addition, numerous newspaper articles reflect fear to safety with by-lines such as 'Cambs police would never do anything else if they confiscated every e-scooter used illegally'.[7] Beyond the title, the article quotes a police sergeant's view that better education and clear legislation without grey areas should be the priority rather than calling for an outright end to the trial. The article acknowledged that Voi has worked with Police providing an app for officers to report offences such as riding with two people onboard and riding on pavements.

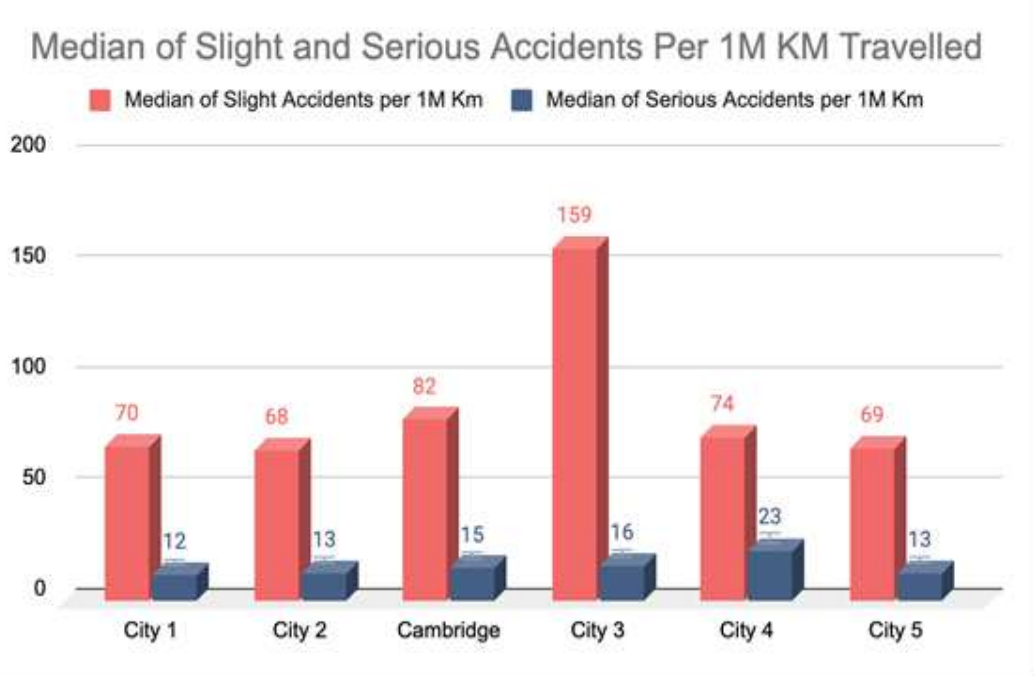
In addition to this Voi has launched a variety of safety measures. Voi has an online safety school called Ride like Voila. The V4 Scooter has replaced all scooters in use. It includes features such as turning indicators, a reinforced fender and improved suspension to aid shock absorption and impact of cobblestones. They have engaged with in-person events on safety issuing free helmets at these events. Scooters have a reaction test feature to encourage riders to think twice before using the scooter intoxicated. They have introduced a helmet selfie feature that awards loyalty points for proving they are wearing a helmet to incentivise use. Therefore, we should consider if negative reactions are a symptom of being a new invention? Despite its destiny to become one of the most popular means of transport the advent of the automobile was not met with widespread affection in the beginning. Critics lamented the displacement of horses and the safety issues, perhaps it is instinctual to be sceptical of the new, especially when concerns about safety arise.

In Collaboration with VOI a study of the severity of musculoskeletal e-scooter injuries in Liverpool ("The Liverpool Study") in the 7 months following the introduction of an e-scooter rental Pilot scheme showed that the injury rate and pattern is similar to those of bicycles in an inner city metropolitan area with a slightly higher rate of 26.1 injuries per million km ridden compared to 24.1 injuries per million km travelled on bicycles.[8] An issue apparent is the focus on musculoskeletal injuries, with the report stating that upon a scoping review the most common e-scooter injuries were head injuries, not recorded in the trial. In the Voi Survey 26% of respondents answered that they wear a helmet, with most feeling it unnecessary or inconvenient to carry. Voi's suggestion of a shared helmet solution had a negative response with 61% of respondents stating they would not use such a scheme. 78.54% of respondents stated hygiene concerns as a primary issue. The graph below shows a clearer image of where Cambridge is in the e-scooter landscape presenting a fuller picture

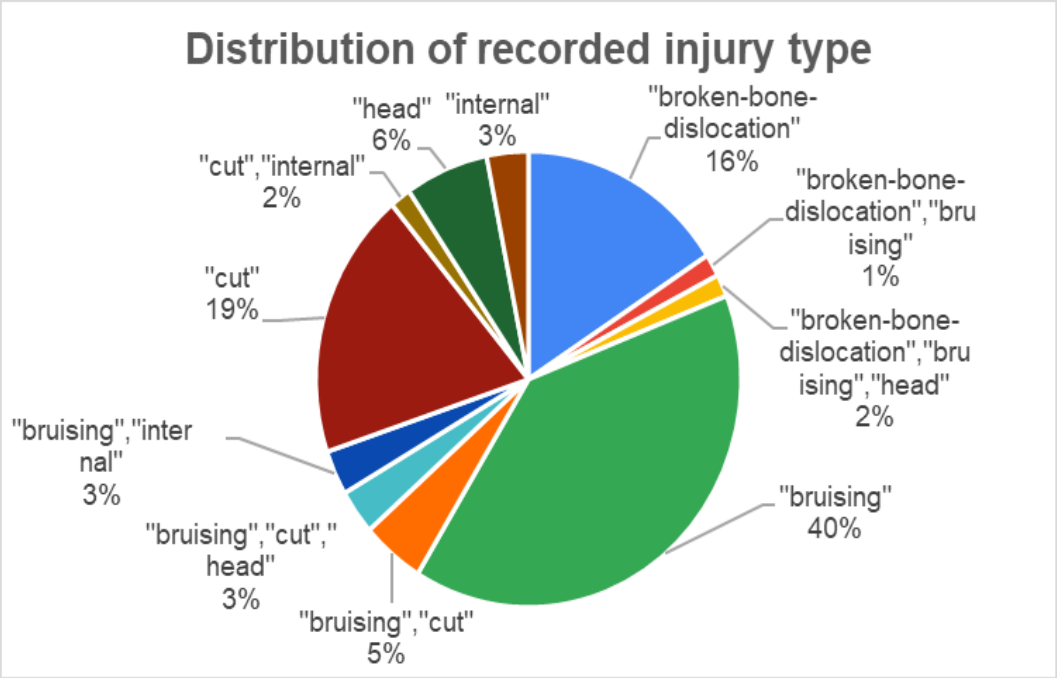
[7] Cambs police would 'never do anything else' if they confiscated every e-scooter used illegally - Cambridgeshire Live (cambridge-news.co.uk)

[8] Legalisation of e-scooters in the UK: the injury rate and pattern is similar to those of bicycles in an inner city metropolitan area - ScienceDirect

than the Liverpool studies' focus on a particular type of injury. It shows that Cambridge is currently around the UK average for slight and serious incidents as defined by the Department for Transport.

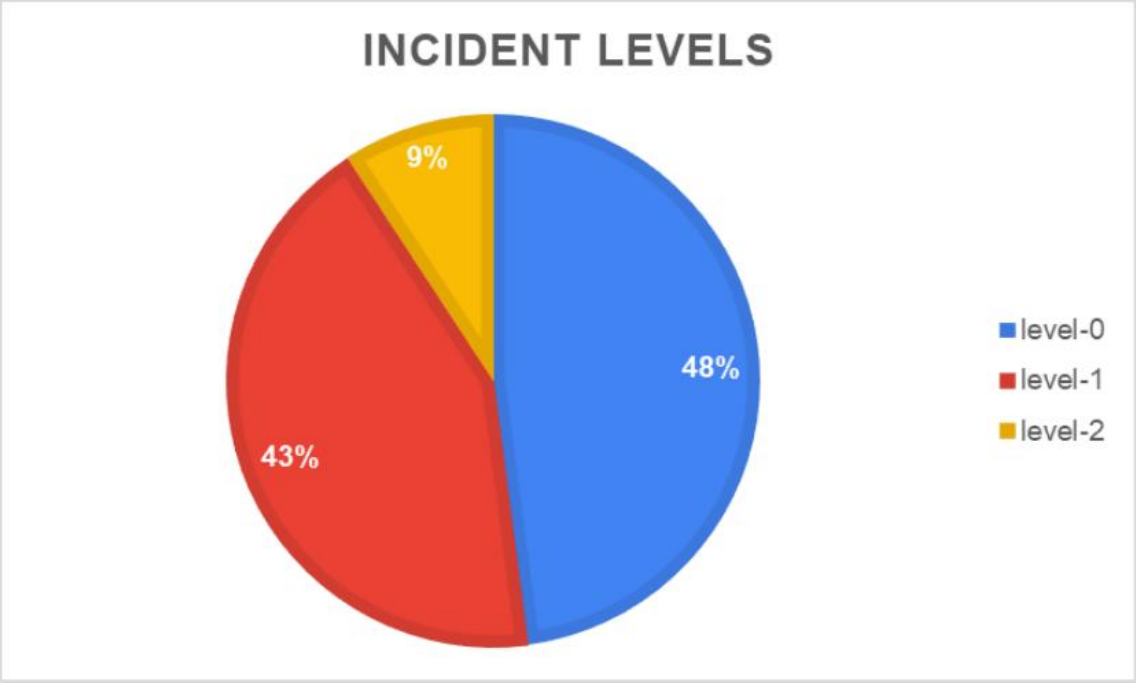


An incident dataset provided by VOI shows that there were 511 incidents ranging from level 0 to level 2, in addition to 1056 almost incidents reported. These are near miss situations that result in no damage to vehicle or any form of injury to the rider or others. Level 0 equates to damaged material items/ property (cars, bikes, property, phones). Level 1 is minor physical damages such as scrape, scratches and bruises. Level 2 are major injuries, including broken bones, sprains, lacerations, concussions and fractures to body. Of the 511 accidents reported, 98 of them reported the type of injury sustained. Below is a pie chart showing the breakdown of the 98 injuries. Bruising appears to be the most common injury at 40% of the 98. This shows an altogether very different result to the Liverpool study with musculoskeletal injuries and head injuries not as significant. However, as this only represents a 1/5 of incidents further studies would have to be taken to confirm the validity of this breakdown.



The Liverpool Study states in the occurrence of injury adherence to rules such as not consuming alcohol, age requirement, driving licence requirement and use of a helmet has been reported to be poor. The study reports that just over 10% of patients had taken alcohol whilst riding e-scooters and over half of e-scooter injuries occurred on pavements or pedestrian zones where pedestrians were also at risk of injury. Voi's survey shows that 94% of respondents know it is forbidden to ride on pavements and 97% know it is forbidden to ride under the influence of drugs or alcohol. While this is more positive, any figure less than 100% can be questioned as not being sufficient, particularly among users engaged enough to take a survey.

While the Liverpool study of Voi data showed that in central areas where accidents were more likely, despite the higher number of pedestrians, they recorded no cases of pedestrian injuries in any area. The Voi incident dataset backs this up showing that pedestrian involvement represents only 2.54% of all accidents, a total of 13 cases over the course of the trial. The findings suggest that riders themselves are most at risk of injury, despite the widespread fear of e-scooters impact on others. Of concern is that in the Voi survey 51% of participants answered that they have completed an online e-scooter traffic school, this figure could be improved upon and consideration should be made to whether such classes could be incentivized to ensure best riding practice and reduce the likelihood of injuries. As shown in the pie chart below, severity of injuries is focused in the first two levels, with the most severe injuries representing only 9% of accidents.



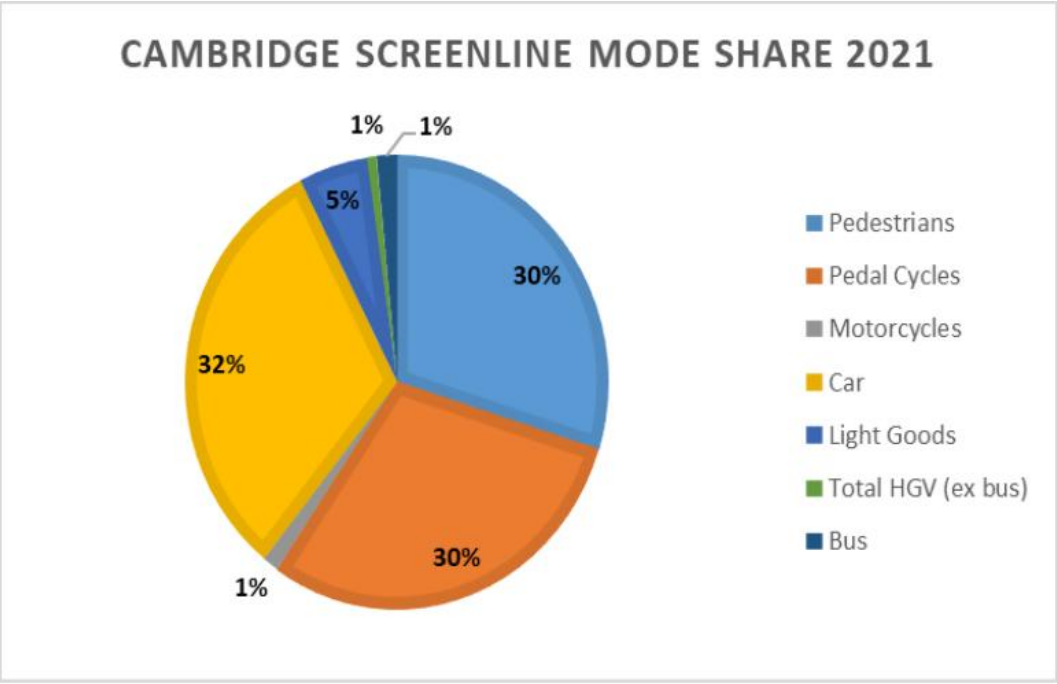
Part 3 - Conclusion

Safety concerns are of key importance going forward to maximise engagement with E-Scooters. Studies and news articles paint a very negative picture of E-Scooter use, while the truth is more nuanced. Safety is an issue, but it is primarily in regards to riders own well-being rather than the safety of pedestrians. A narrow majority have completed a traffic school that teaches fundamentals, most riders surveyed do not use helmets, offers of shared helmets are rejected, not all users realise that riding on pavements and being under the influence of alcohol/drugs are not allowed. However, these are not insurmountable challenges. There is a role to be played by regulation, perhaps by requiring frequent users to take the training. While Voi has taken positive steps to improving safety of scooters, more can be done in relation to helmets and tackling intoxicated use. Trackable shared helmets could be introduced at VOI hubs, when the user has finished use, a drop box could be used for the user to hand-in the helmet, for the operator to clean before reuse to tackle the fear of bad hygiene. The current method of encouraging positive self-responsibility through a reaction test is encouraging but is unlikely to stop an inebriated individual from riding if they are determined to ignore soft warnings. If Cameras were installed on the e-scooters as has been trialed in Northampton[9] with computer vision technology, after failing the test, the camera could be switched on to record the act. Coupled with clear warnings, this could reduce inebriated use. However, such solutions are expensive by nature and would require effective planning to ensure that they did not make the service significantly more expensive. It should also be noted that beyond Voi, these suggestions could be applied by other companies, including those that operate shared bike schemes. With greater monitoring and innovation the benefits of using e-scooters can be maximised while limiting any risk riders and those within the vicinity of a rider face.

[9] Voi launches e-scooter trial of computer vision technology designed to prevent pavement riding (voiscooters.com)

Part 4 - Modal Shift

People plan their lives around Public Transport. Where we live, where we work and where we socialise are all determined by how, when, and how fast we can travel. Public Transport is often defined by fixed rigid routes concentrated where footfall is highest, these routes do not service customers door-to-door but rely on customers finding a means to travel to both the initial transport node and from the final node to their destination. This issue is referred to as the first mile/last mile problem. The consumer has to settle for the best available fit for their journey, the issue can be amplified by routes not taking into consideration other transport modes such as changing from a train to an inter-city bus. Where travel is inconvenient consumers out of necessity opt for a more tailored route. The primary means of travel is often to rely on privately owned cars; at 32% being the largest mode share of the Cambridge Screenline for 2021.[10] Those without access to a car may opt for the much more expensive taxi, or take Cambridge's famed popular mobility option, the bicycle. Currently traffic count data for the Cambridge Screenline published by Cambridgeshire County council shows that in 2021 Cycling represented 25.09% of total transport. However, this can be physically demanding and while exercise is certainly healthy, building up a sweat before entering the office or meeting friends will not be for everyone. Giving people more choice, more flexibility, more cost effective and less environmentally damaging means of transport must be the focus of local and national government transport plans.



E-Scooter's are a new mode of transport that offer such a solution. The mean distance of a ride on a VOI E-Scooter is 2408 meters, equating to 1.5 miles. According to the Hubbub Foundation, around 50% of car journeys are 2 miles or less[11] and walking this distance would take at least half an hour. Users can choose when they use the e-scooter, allowing combination with other forms of transport. In Voi's customer survey, for the July 2021 survey 19% of respondents stated they used E-Scooters in combination with Public Transport, while in the February 2022 Survey this response rises to 28%.

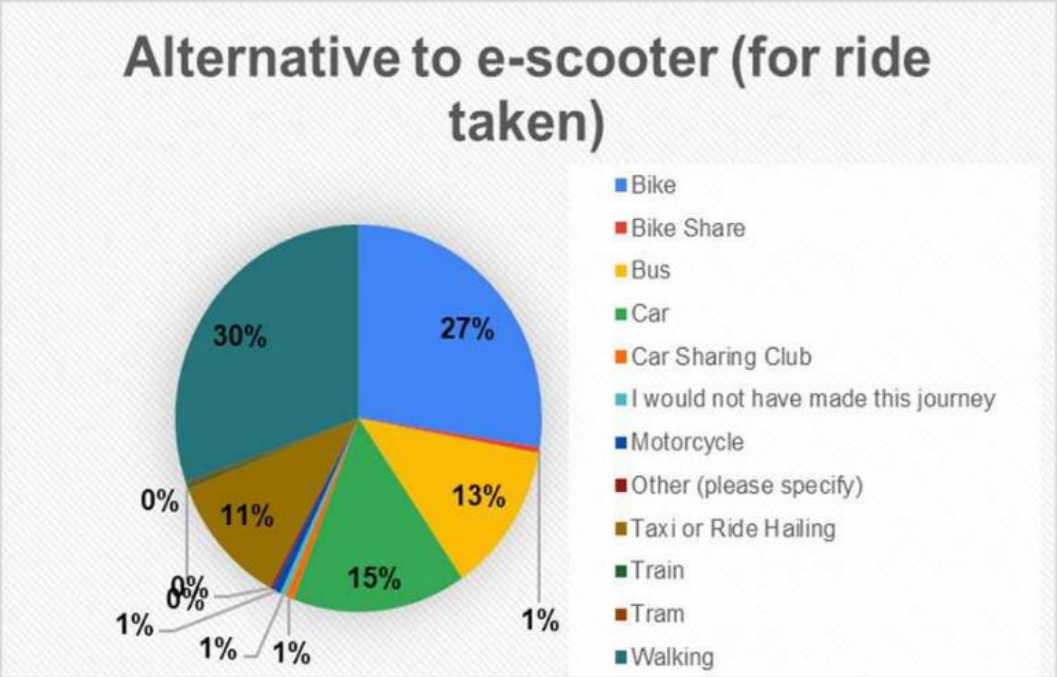
[10] Road traffic data - Cambridgeshire County Council
[11] Switch short car journeys to cycle, walk or take public transport | Hubbub Foundation

66% of user surveyed in the Kantar study on perceptions towards E-Scooters main reason for using them was so they can decide where exactly they would like to travel to a specific destination.[12]

E-Scooter use is affordable, which means that a broader demographic of society can make use of them. As use does not require exertion other than balance and standing, E-Scooter's can convince those who would not have considered micro-mobility previously to switch their use away from cars. Furthermore, promotion of shared transport options can be seen as a move towards a circular economy. Whereby we can encourage the switch away from single use or personal use products and services towards shared and reusable solutions. In the context of travel, moving away from a car centric urban environment towards viable permanent solutions to travel needs. [13]

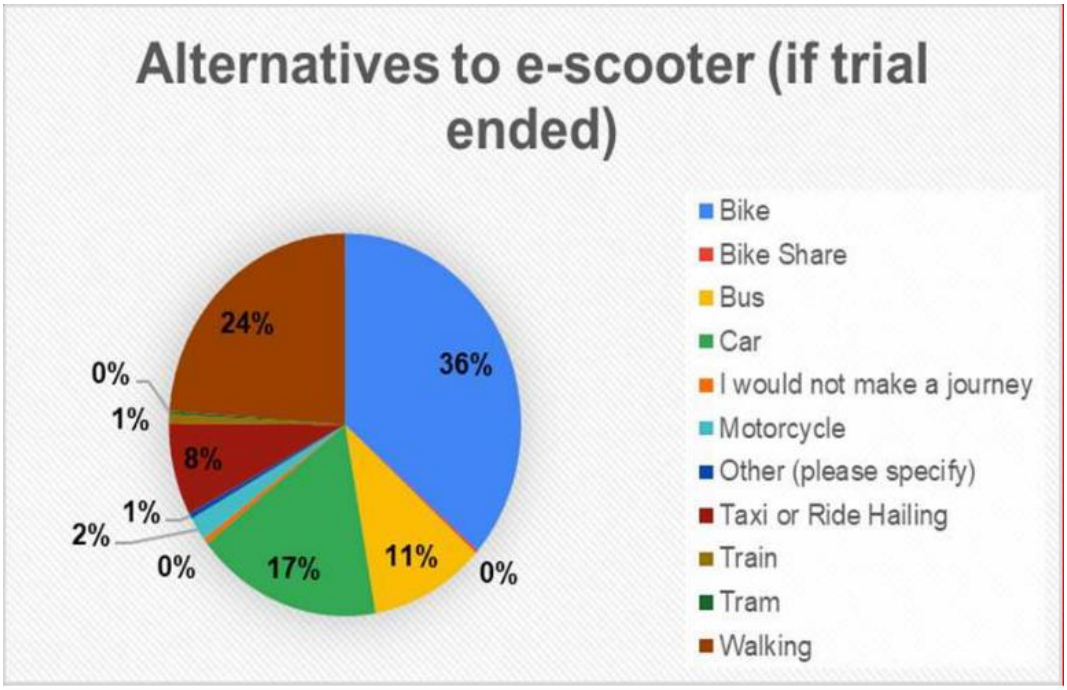
Substitution of more polluting means of transport with greener alternatives is a priority for public policy and urban planning, understanding which modes are impacted by a degree of substitution is crucial. The February 2022 VOI user survey asked whether participants had access to a car/van and access to a bike. 61% of respondents had access to a car/van, while 73% had access to a bike. This shows that most respondents to the survey had alternative means of making their trip.

Both July 2021 and February 2022 user surveys ask participants regarding the trip they took before answering the survey which alternative mode of transport they could have used. Across both Surveys walking was the highest choice at 30%. This was followed by the Bike and then the Car. The Surveys followed this question with, 'if the E-Scooter trial ended what mode of transport would you use?' Walking was less prominent in the answers given, compared to Cycling and Car use.



[12] Perceptions of current and future e-scooter use in the UK (publishing.service.gov.uk)

[13] Planning for effective transport | Shared by Business (thirdlight.com)



The Kantar study on E-Scooter perceptions shows that 'a majority of respondents (82%) who thought they would buy or hire an e-scooter anticipated that they would reduce or stop using at least one mode of transport, with walking being the most commonly mentioned transport mode that would be reduced by e-scooter use (39%).'[12] This shows that a lot of users took a ride on an e-scooter as a convenient alternative to walking, but longer term when making frequent trips they would look for a quicker alternative. A possible negative impact could be the switching from cycling to using an e-scooter, the loss of exercise having a negative health impact.

However, when understanding how to bring about a mode shift it is important to understand the nature of induced demand. This is 'the increment in new usage that would not have occurred without the improvement of the network capacity'.[14] This not only creates a situation of substitution but also convinces those who would not have previously travelled to make a trip. Examples could be that the ability to use an e-scooter can convince someone who may have shopped online to instead take a trip to the city centre. Instead of waiting for a new movie to be released on a streaming service, they take a trip to the cinema. This increase in economic activity is a boon to the local economy and will contribute towards the survival of our high streets.

In conclusion, E-Scooters are a valuable addition to the urban transport scene that not only encourages a move away from polluting alternatives but expands convenience and encourages economic activity. E-Scooters have a place in a vision for a more connected Cambridgeshire and Peterborough. Transport solutions that give individuals freedom to tailor their route are fundamental in the transition away from cars. By enabling greater flexibility E-Scooters improve riders productivity, such improvements in time efficiency in particular are often the justification for new infrastructure projects such as roads, this also can be the justification for embracing new modes of transport. The combined authority in addition to support of the trial of e-scooters, has trialled a new form of demand responsive transport in Huntingdonshire, whereby those who live in the surrounding villages can order a bus service on the Ting app, with the provider creating an ad-hoc

[14] Latest evidence on induced travel demand: an evidence review (publishing.service.gov.uk)

bus route based on the demand of app users, allowing those who were without a public transport solution the means to travel. More work is needed to create the incentive structure that can trigger a large-scale modal shift. However, without effective alternatives such as e-scooter we cannot lay the building blocks for such a change. A collective vision that embraces innovative alternatives across our region can overcome transport planning issues and ensure everyone can make the travel they desire accessing both employment opportunities and social activities, while ensuring we meet our responsibility to future generations by cutting emissions.