



Bristol Clean Air Plan

Bristol City Council

Stated Preference Survey Report

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Contents

1.	Introduction.....	2
1.1	Overview of the Study	2
1.2	Purpose of this Report.....	3
1.3	Report Structure	3
2.	Survey Design.....	5
2.1	Overview	5
2.2	Questionnaire Structure.....	5
2.3	Screening Questions	5
2.4	Vehicle Questions.....	6
2.5	Frequency of driving to the centre of Bath	6
2.6	Clean Air Zone: Introduction.....	6
2.7	Clean Air Zone Exercise 1	6
2.8	Clean Air Zone Exercise 2.....	7
2.9	Questionnaire Assessment	7
2.10	Demographic questions	8
2.11	Questionnaire versions.....	8
3.	Implementation and Sampling	9
3.1	Implementation and Sampling.....	9
3.2	Testing Surveys	9
3.3	Survey Pilot	10
3.4	Quotas Achieved	10
3.5	Ineligible respondents.....	11
3.6	Sample profile.....	11
4.	Data Checks and Cleaning	16
4.1	Sense Checks.	16
4.2	Logic Checks	19
4.3	Summary	20
5.	Stated Preference Analysis and Results.....	21
5.1	Segmentation	21
5.2	Factoring.....	21
5.3	Weighting.....	21
5.4	Exercise 2 Model and Results (Pay Charge or Replace Vehicle)	22
5.4.1	Trading – non-trading bias	22
5.4.2	Statistical Model Form and Fitting	23
5.4.3	Results.....	23
5.5	Exercise 1 Model and Results: (Pay Charge or Changing Travel Behaviour)	24
5.5.1	Model Form and Fitting.....	25
5.5.2	Results.....	25
5.6	Combined Model	26
6.	Summary	30

Appendix A. Survey Questionnaire

Appendix B. Model Detailed Analysis

B.1 Significance of Variables

B.1.1 Trip Frequency

B.1.2 Home Origin

B.1.3 Income

Acronyms and Abbreviations

AQMA	Air Quality Management Area
AQAP	Air Quality Action Plan
AQO	Air Quality Objective
B&NES	Bath and North East Somerset
BCC	Bristol City Council
CAZ	Clean Air Zone
Defra	Department for Environment, Food & Rural Affairs
DfT	Department for Transport
EU	European Union
EV	Electric Vehicle
HGV	Heavy Goods Vehicle
JAQU	Joint Air Quality Unit
LA	Local Authority
LGV	Light Goods Vehicle
NOx	Nitrogen Oxides
NO2	Nitrogen Dioxide
SP	Stated Preference

1. Introduction

Due to air quality exceedances Bristol City Council (BCC) has been directed by Defra to produce a Clean Air Plan to achieve air quality improvements in the shortest possible time. As part of the Plan, BCC is considering implementation of a Clean Air Zone (CAZ), possibly including both charging and non-charging measures. Jacobs has been commissioned by BCC to assess potential options in order to establish which will deliver compliance in the shortest possible time possible.

This document is written to support the OBC and details the Stated Preference surveys undertaken to determine localised response rates of car or van drivers to potential charging zones.

1.1 Overview of the Study

In order to help understand travel behaviour within the zones and how this could change should charging be introduced, a survey of those who drive in the proposed zones was conducted using stated preference techniques. The survey also collected information on respondents' demographics and existing vehicle replacement plans.

The extent of the proposed CAZs presented in the survey are depicted in Figure 1-1 and Figure 1-2.

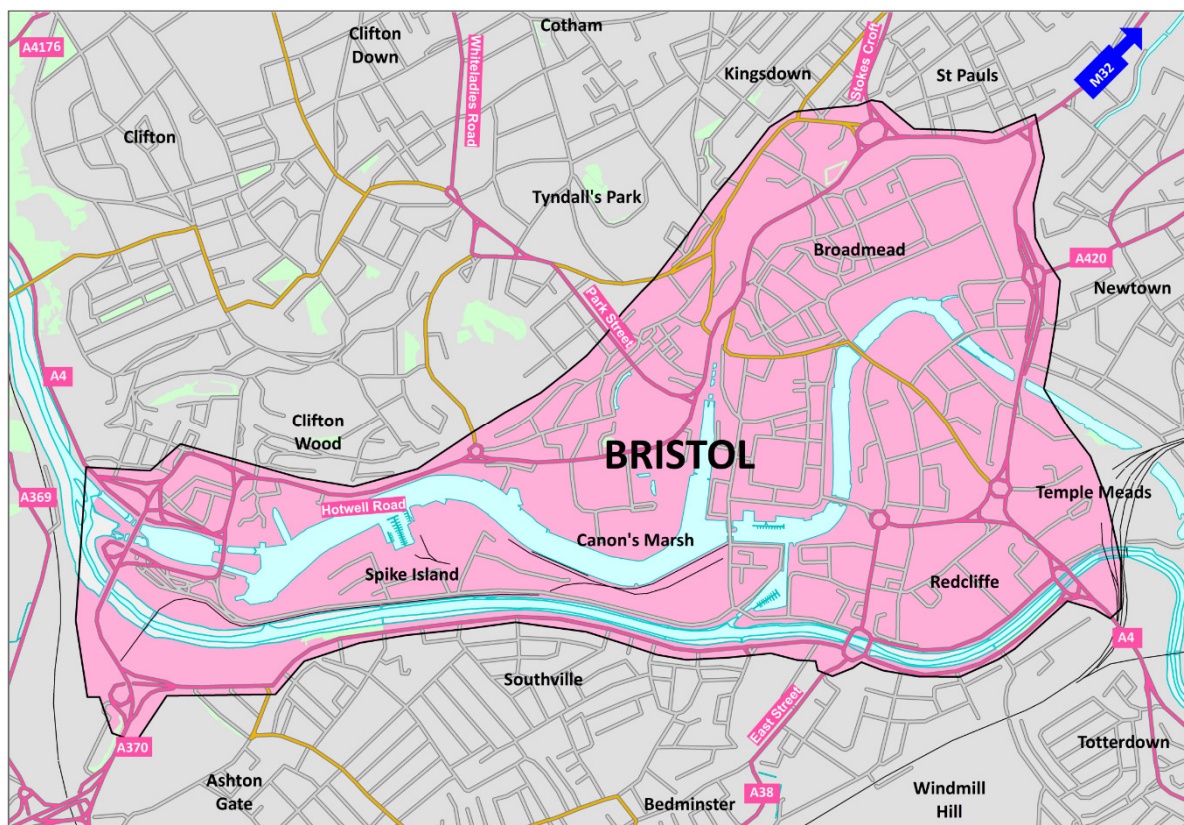
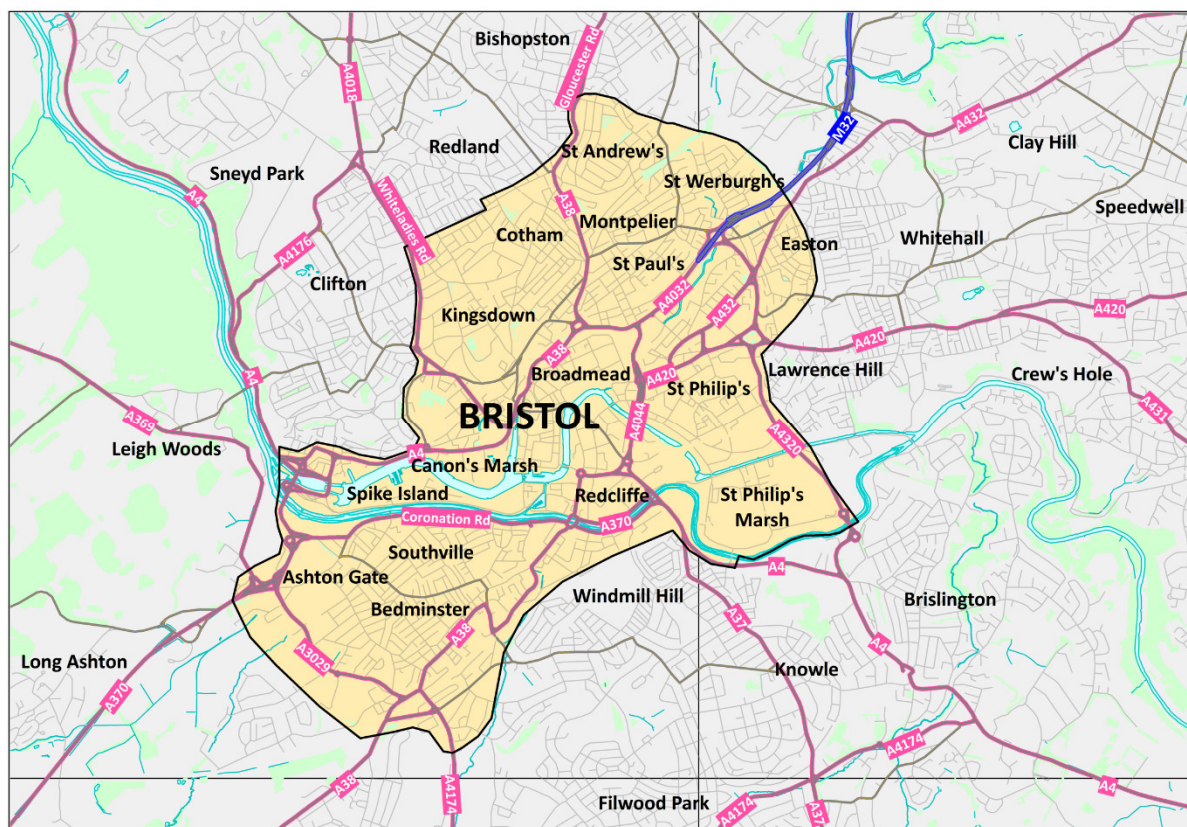


Figure 1-1: Small Clean Air Zone



The main focus of the survey was on motorists who own and drive a car or van that does not comply with the limits in Defra's CAZ Framework¹, specifically:

- The survey period was conducted between 22 February and 12 March 2018.

1.2 Purpose of this Report

It also provides an overview of the data processing, final results and conclusions from the conducted study.

1.3 Report Structure

The report covers the following sections:

¹ Clean Air Zone Framework, Principles for setting up Clean Air Zones in England, Department for Environment Food & Rural Affairs & Department for Transport, May 2017

- **Survey Design:** provides an overview of the key stages in the development of the stated preference survey.
- **Implementation and Sampling:** describes the data collection and sampling methodologies.
- **Data Checks and Cleaning:** describes sense and logic checks, and the data cleaning process.
- **Stated Preference Analysis and Results:** describes the methods to analyse the stated preference exercises and an overview of the results from these.
- **Conclusion:** summary of the headline results and conclusions from the survey.

2. Survey Design

2.1 Overview

The survey was conducted among residents of Bristol City Council and the surrounding Local Authorities. Participants were obtained from an online market research panel allowing the survey to be targeted at a representative sample (age, gender) of the resident population.

Initial screening questions then limited the main survey to those who have recently driven within the proposed medium clean air zone boundary in a car or light van (under 3.5 tonnes) that does not comply with the standards, which are:

- Petrol vehicles with emissions standards at least Euro 4/IV (approx. registered 2006 or later); and
- Diesel vehicles with emissions standard Euro 6/VI (approx. registered pre-2015 or later).

Vehicles which meet the standards of the CAZ framework, and therefore would not be charged within a charging CAZ (barring potential exemptions), are referred to as 'compliant' vehicles within the remainder of this report, and vice versa for 'uncompliant' vehicles.

The questionnaire collected information on the most recent trips of drivers of non-compliant vehicles within the affected zone and how the drivers may respond to various levels of proposed charge. The questionnaire also collected information on the vehicle replacement plans in terms of timescales and likely type of vehicle.

To identify the behavioural changes, two exercises were included in the questionnaire, testing responses to possible charges. All of the data was collected using an online questionnaire.

Exercise 1 provided a number of possible actions the respondent might have taken if charging had been in place the last time they drove in the CAZ. One of the options was continuing to use their current vehicle to make the journey and pay the charge.

The purpose of Exercise 2 was to work out whether the respondent would replace the vehicle with a compliant one if CAZ charging is implemented. The respondent had a choice between two options: either continue to pay the charge or replace their vehicle.

The questionnaire used in the London Ultra Low Emission Zone stated preference survey, conducted for Transport for London by Steer Davies Gleave, was used as a basis to design the questionnaire used in Bristol study.

The purpose of the survey was specifically to determine the response of local travellers to a Charging Clean Air Zone and therefore questions did not cover other potential Clean Air Plan measures such as improved alternatives or full exclusions of certain vehicle types.

2.2 Questionnaire Structure

A summary of the questionnaire is provided in this section. The full survey can be found in Appendix A.

2.3 Screening Questions

The questionnaire started with a series of screening questions in order to exclude all non-eligible participants early in the process. The screening was based on the following criteria:

- Home postcode;
- Age of the respondent (to check whether he/she is eligible to drive);
- Vehicle type;
- Registration date;

- Decision making over vehicle replacement;
- Vehicle fuel type; and
- Frequency of travel to CAZ.

This was used to ensure that only people who drive a non-compliant car or LGV within the CAZ at least once every 6 months, make the decision about its replacement and live in either City of Bristol, South Gloucestershire, B&NES or North Somerset Local Authority (LA) areas were included in this survey.

2.4 Vehicle Questions

This section included questions about the respondent's current vehicle, including size and age of the vehicle, as well as the number of additional vehicles in the household (if any). The information about the additional vehicles in the household was required to work out if any of these were compliant and if the respondent is likely to use it to travel in/through the zone in light of the introduction of the charging scheme.

The section also collected information on the vehicle replacement plans, including planned timescales for replacing the vehicle, as well as expected age, size and fuel type of the replacement vehicle. These questions are all asked before any mention of the proposed clean air charge to avoid this information influencing these choices.

2.5 Frequency of driving to the centre of Bath

This question was asked to measure the overlap between driving in central Bristol and Bath, where a Clean Air Zone is also being considered.

2.6 Clean Air Zone: Introduction

This section started with an introduction to the Clean Air Zone and the proposed charging scheme. This is the first time within the survey that the concept of a Clean Air Zone is mentioned.

The question about the compliancy of additional vehicles available in the household (if any) was also asked in this section.

This section collected information on the purpose of the most recent journey the respondent had made to the study zone.

2.7 Clean Air Zone Exercise 1

The next section consisted of an exercise to help understand the possible short-term behaviour of the respondent assuming CAZ charging is introduced. For this exercise the respondent was asked to choose between several possible alternatives in relation to their most recent journey:

- Making the same journey using your own vehicle and paying the charge (varies by scenario);
- Making the same journey but using a different mode (e.g. public transport, cycle, walk);
- Not making the journey;
- Changing destination to avoid the charging area;
- Changing route to avoid the charge; and
- Making the same journey but using a compliant vehicle available in your household. (only included if respondent had indicated they had access to such a vehicle).

Asking specifically for the most recent journey is intended to obtain a split of different journey purposes rather than just asking about the most frequent trip the respondent makes in the zone.

The exercise consisted of four different scenarios where the only difference was the charge level. Half the sample were shown one set of 4 charges and the other half of the sample were shown another set of 4 charges; thus, across the survey, 8 charge levels were tested.

The different charge levels for Exercise 1 are summarised in Table 2-2.

Table 2-1: Exercise 1 Charge Levels

Charge (£)	
<i>Subgroup 1</i>	<i>Subgroup 2</i>
£5.00	£3.00
£7.00	£6.00
£9.50	£8.00
£12.50	£10.50

2.8 Clean Air Zone Exercise 2

The second exercise concerned the potential long-term behaviour assuming CAZ charging was in place.

The only options provided in this exercise were to either continue paying the charge when travelling in/through CAZ using the current vehicle, or to replace the vehicle with a compliant one at a given hypothetical cost. The respondents were asked to assume that this cost was sufficient to replace their vehicle with a compliant one and to set aside any considerations about their current vehicle type and replacement plans.

The purpose of this exercise was to establish whether the respondent is likely to switch to a compliant vehicle assuming a CAZ is in place, and how this decision would vary depending on the charge level/vehicle replacement cost.

For this exercise respondents had to complete six different scenarios. The difference between the scenarios was the combination of charge level and replacement cost. Across the survey 12 scenarios were assessed, 6 to each half of the sample, the combinations are shown in the following table:

Table 2-2: Exercise 1 Charge Levels

Subgroup 1		Subgroup 2	
<i>Charge (£)</i>	<i>Replace (£)</i>	<i>Charge (£)</i>	<i>Replace (£)</i>
£3.00	£9,000	£5.00	£10,000
£4.00	£3,000	£6.00	£1,000
£10.00	£10,000	£6.00	£6,000
£9.00	£2,000	£8.00	£5,000
£11.00	£6,000	£12.00	£8,000
£7.00	£8,000	£13.00	£4,000

2.9 Questionnaire Assessment

In the next section the respondent was asked to provide their assessment of the survey, covering topics such as:

- Complexity of the survey;
- Clarity of descriptions and explanations used in the questionnaire; and
- Practicality of the vehicle replacement costs.

It also allowed for the respondent to expand on why they had found the exercise difficult to complete or why the vehicle replacement costs seemed very unrealistic should they have selected these responses.

2.10 Demographic questions

The last section collected demographic information about the respondent, including employment status, occupation, household income, gender, ethnicity and disabilities.

This information is useful to analyse the demographic make-up of the sample and its representativeness, potential demographic related variances in response to the charge zone as well as assist in the segmentation of the results for use in the transport modelling.

The questionnaire finishes with an open-ended question which gives an opportunity for the respondent to provide any comments about the survey or the topic itself.

2.11 Questionnaire versions

There were 4 versions of the questionnaire which were the possible combinations of two sets of charge levels and two orders in which the Medium and Small Zones were presented. The version assigned was randomly selected so that each version was completed by approximately a quarter of the respondents.

To further avoid order bias, the order in which charge levels and charge levels/replacement costs were presented in Exercises 1 and 2 was randomised.

3. Implementation and Sampling

3.1 Implementation and Sampling

Crystal Market Research worked with Jacobs throughout the survey development and implementation process. The questionnaire used in the London Ultra Low Emission Zone stated preference survey conducted for Transport for London by Steer Davies Gleave was reviewed and adapted for the purposes of the study in Bristol. The online version of the questionnaire was programmed by Indiefield – to be usable on all types of device.

The survey participants were recruited using a market research panel held by Indiefield. A panel is a database of people who have ‘signed up’ to take part in market research studies and receive a small payment for doing so. They have provided contact, demographic, behavioural and ownership details about themselves that enables targeting of relevant types of people for a particular survey

For this survey a representative sample of the Indiefield panel living in the LA areas, based on quotas for gender and age (17-34, 35-54, 55+) using 2011 Census data, was contacted by email and invited to take part in the survey. Each participant was offered a small financial incentive to complete the survey. The panel sample was contacted in batches and email reminders were sent out to those who had not responded. Each invitation email contained a questionnaire link with a unique ID that was possible to open only once, thereby preventing an individual questionnaire from being completed multiple times.

Clicking on the survey link took invites to a series of ‘screening’ questions (as described in section 2.3) to establish whether or not they met the requirements for completing the main questionnaire. To be eligible to complete the main questionnaire the respondent had to:

- Live in City of Bristol, South Gloucestershire, North Somerset or B&NES LAs;
- Be aged 17+;
- Drive a car or LGV that is non-compliant under the Defra CAZ Framework;
- Be a joint or sole decision maker over the replacement of that vehicle;
- Drive in the proposed small and/or medium clean air zones in Bristol at least once every 6 months; and
- The target completion rate for respondents was 1,100 for the Medium CAZ and 700 for the Small CAZ.

Table 3-1 below summarises the target splits by Local Authority for the required questionnaire completion rate. Initial targets were calculated from 2011 travel to work Census data with minor adjustments during the survey based on the eligibility rates (i.e. the % of initial respondents passing the screening questions).

Table 3-1: Target Splits by Local Authority

Local Authority	Number of Respondents	Proportion
Bristol	550	50%
South Gloucestershire	275	25%
North Somerset	165	15%
B&NES	110	10%
Total	1100	-

The survey was targeted at a representative sample (of age and gender) to the population of panel members.

3.2 Testing Surveys

The questionnaire underwent internal testing prior being sent to the survey panel. The key focus of the tests was to check:

- The sequence and logic of the questions;
- That the screening out process worked correctly;
- The randomisation of scenarios worked for all of the exercises; and
- That no technical issues occur during the completion of the survey.

3.3 Survey Pilot

A pilot of the online survey was launched amongst CH2M and CMR associates who did not have a direct involvement in the study. 35 questionnaires were completed.

The purpose of the pilot was to collect broader feedback on the questionnaire prior to launching the final version online. Below are the key areas assessed:

- Overall length and completion time of the survey;
- Questionnaire design flaws/technical issues;
- Complexity of the terminology/wording used in the survey;
- Complexity and understanding of the exercises;
- Appropriateness of vehicle trade-in (upgrade costs);
- Overall feedback on the questionnaire.

This feedback helped to inform a number of amendments to the questionnaires including:

- Simplification of the wording of the introductory text and questions;
- Structure and presentation of the exercises simplified and clarified;
- Exercises changed from asking all participants all 8 options in both exercises to two subgroups of 4 and 6 for exercises 1 and 2 respectively, and;
- Maps amended for clarity and increase the distinction between the two zones.

Once amended, the post-pilot versions then underwent further checks and testing to ensure that all of the amendments were applied correctly to the final version of the questionnaires.

3.4 Quotas Achieved

The survey was conducted between the dates of 22 February and 12 March 2018 with a total of 1103 questionnaires completed from a target of 1100.

Table 3-2 and Table 3-3 provide a summary of the target and achieved sample sizes.

Table 3-2: Target Splits by Local Authority

Zone	Target	Actual
Medium CAZ	1100	1103
Small CAZ	700	967

Table 3-3: Local Authority Targets and Achieved Sample

Local Authority	Target	%Target	Actual	%Actual
B&NES	110	10%	110	10%
Bristol	550	50%	554	50%
North Somerset	165	15%	176	16%
South Gloucestershire	275	25%	263	24%
Total	1100	-	1103	-

3.5 Ineligible respondents

Of the respondents who opened the link only 42% were eligible to complete the full questionnaire. Figure 3-1 shows the proportion that were eliminated at each of the screening questions.

Notable reasons for elimination were: not driving a car or van (11% of those starting the questionnaire), vehicle too new (32%) and not driving in the zone either at all, or within the last 6 months (9%). When interpreting these numbers, care should be taken to note that the questions were asked in order and only up until the point that the respondent was found to be ineligible. Thus, of those eliminated because their vehicle was already compliant, a number may have also not driven in the zone.

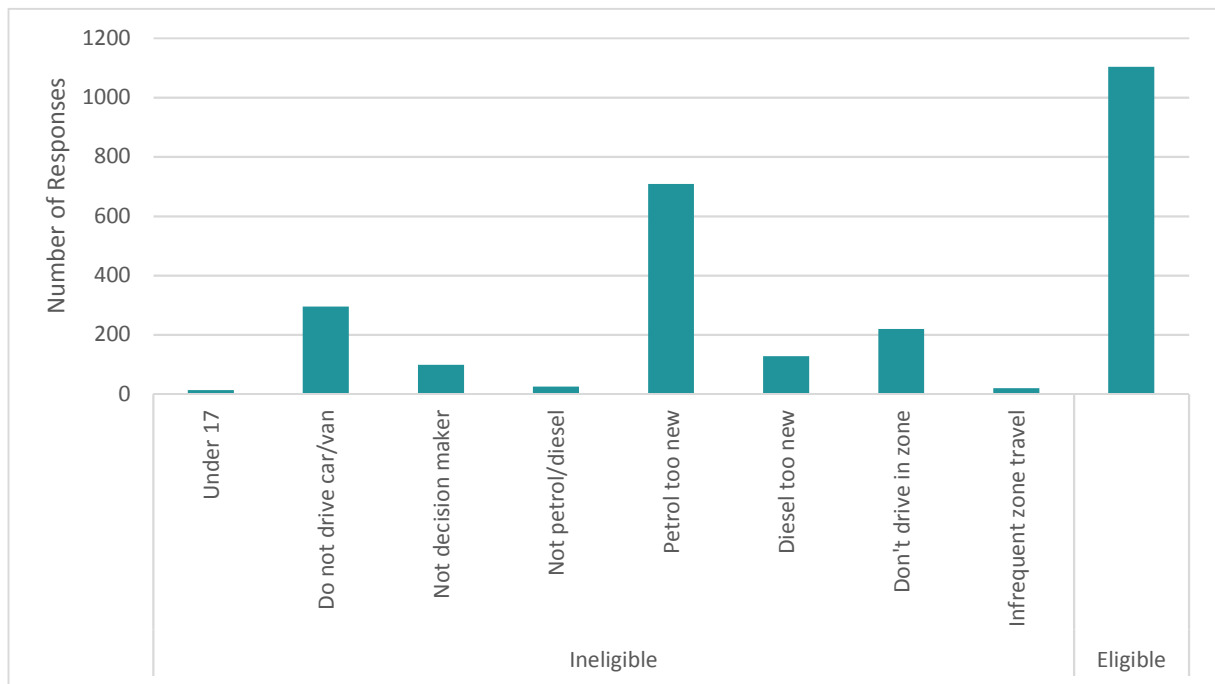


Figure 3-1: Ineligible Respondents

3.6 Sample profile

The split of respondents in each individual age group both before and after screening questions is presented in Figure 3-2. Approximately 90% of the eligible sample falls within the age range of 17 to 54, with the highest proportion of respondents in age group 35-44 followed closely by age group 25-34. The age profile of the sample is also compared with both age profile of the eligible area according to the 2011 Census (with under 17s excluded).

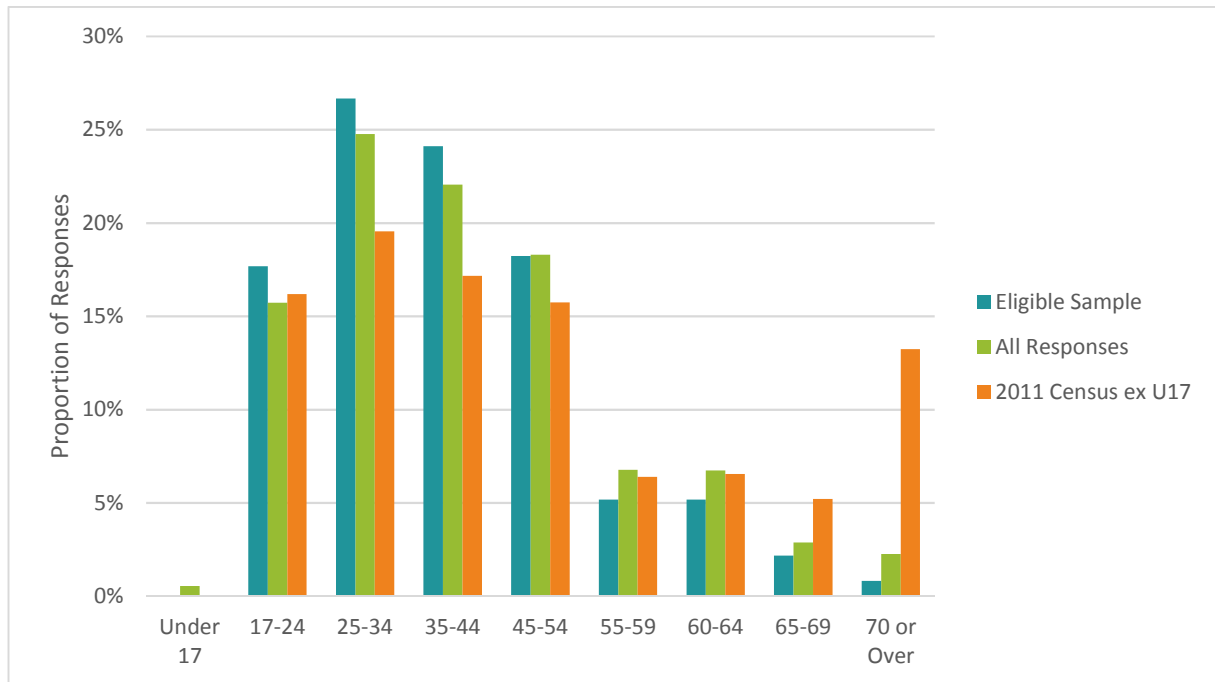


Figure 3-2: Respondents by Age Group

The screening process skews the sample slightly towards younger people. It is thought that there could be two main drivers behind this. First, younger people are more likely to be economically active and therefore travel within the zone more often. Secondly, older people have a number of potential reasons to be less likely to be eligible. The demographic tends to be wealthier and therefore may be more likely to already have a compliant vehicle and also have more attractive alternatives such as free bus travel.

Comparing the profile of pre-screening responses to the age profile of residents in 2011 shows a further skew towards ages 25-45 and away from those over 65. This is likely in part due to the online nature of the panel. Though emails were targeted at a representative sample, there is likely still a limitation in the response rate/engagement from older demographics.

Given the low eligibility rates amongst these ages noted, it is considered that the impact of this on the final results is limited with, at most, 70 more respondents in the younger age bands and correspondingly fewer in the eldest two.

Participants were asked about the fuel type of their vehicle and, as can be seen in Figure 3-3, a higher share of respondents had a petrol vehicle.

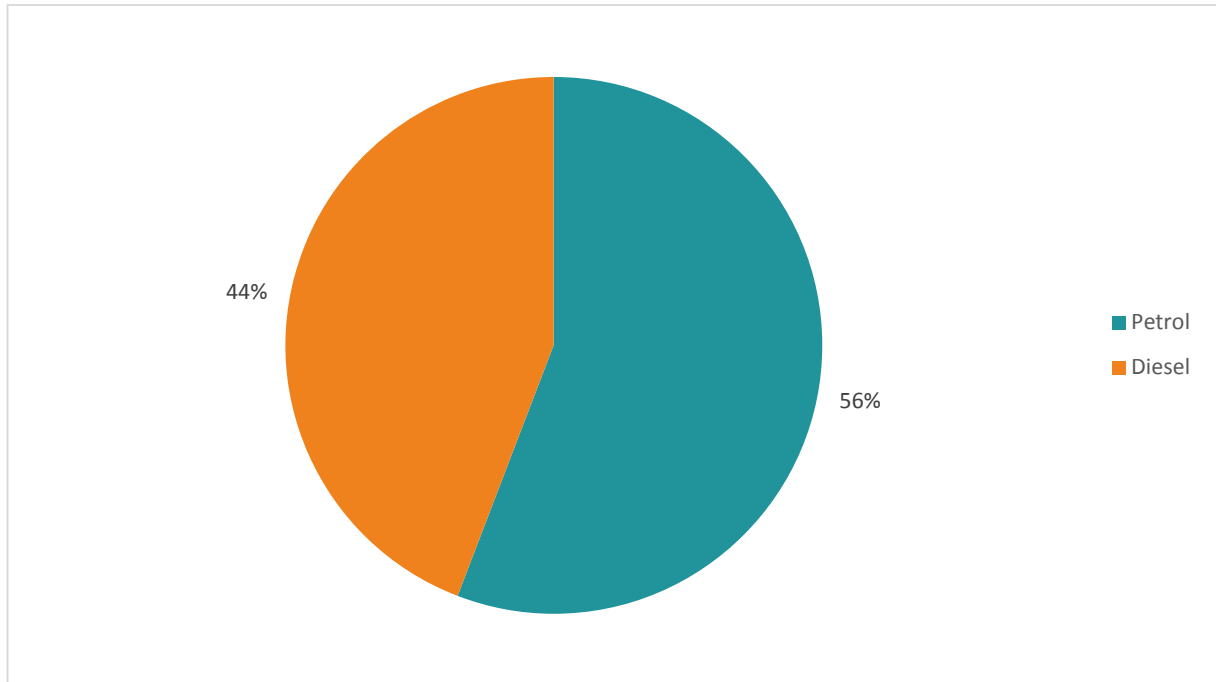


Figure 3-3: Respondent's Non-Compliant Vehicles by Fuel Type

Figure 3-4 and Figure 3-5 show that majority of the respondents (70%) were in full-time employment in a range of different occupations.

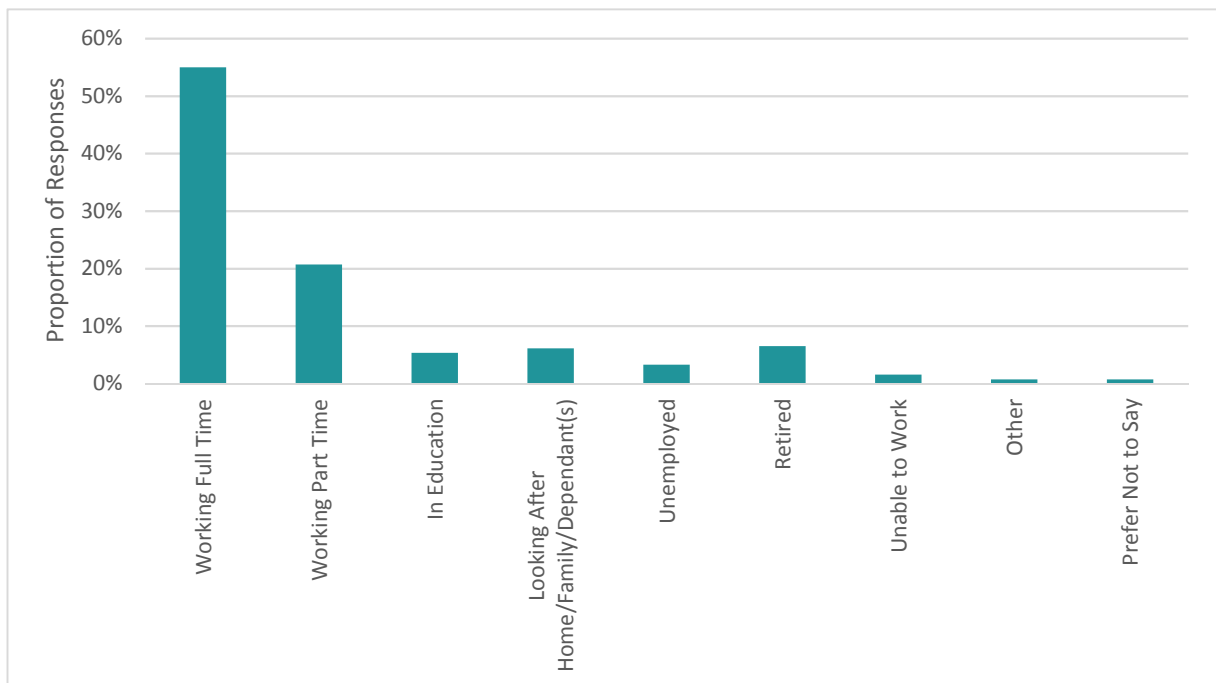


Figure 3-4: Number of Respondents by Employment Status

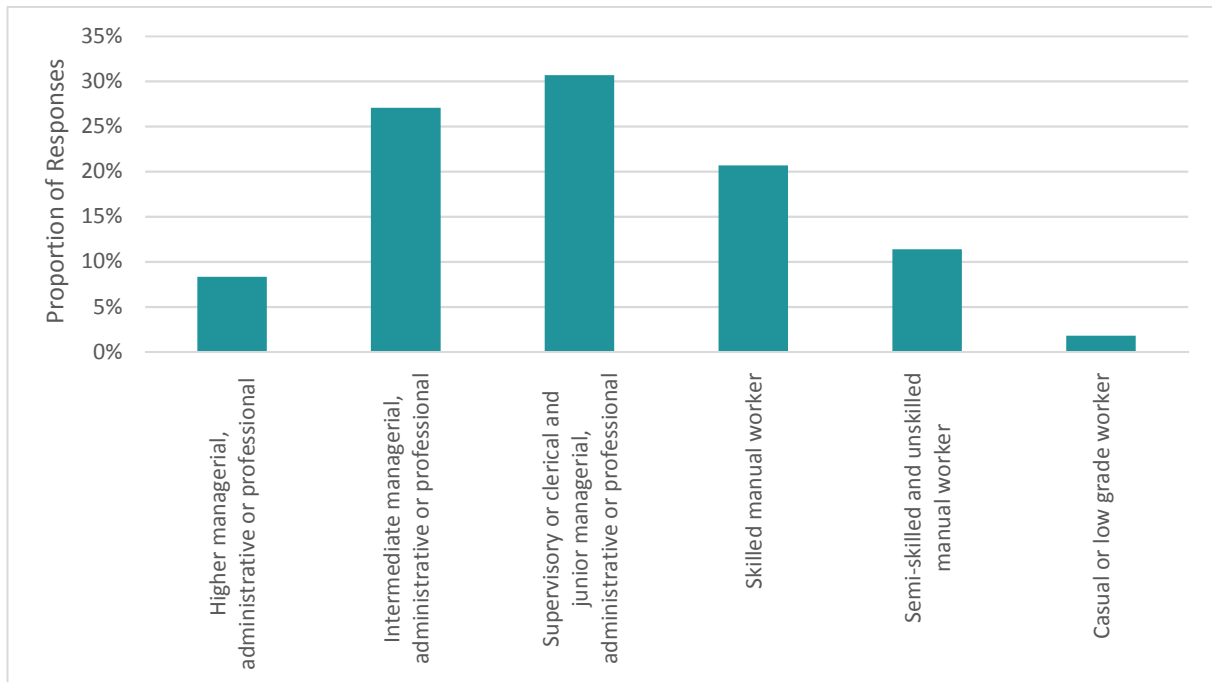


Figure 3-5: Number of Respondents by Occupation

The income profile of respondents is shown in Figure 3-6. The £35,000-£49,999 household income band has the highest number of respondents, with 36% between £25,000 and £49,999. A significant proportion declined to share their income.

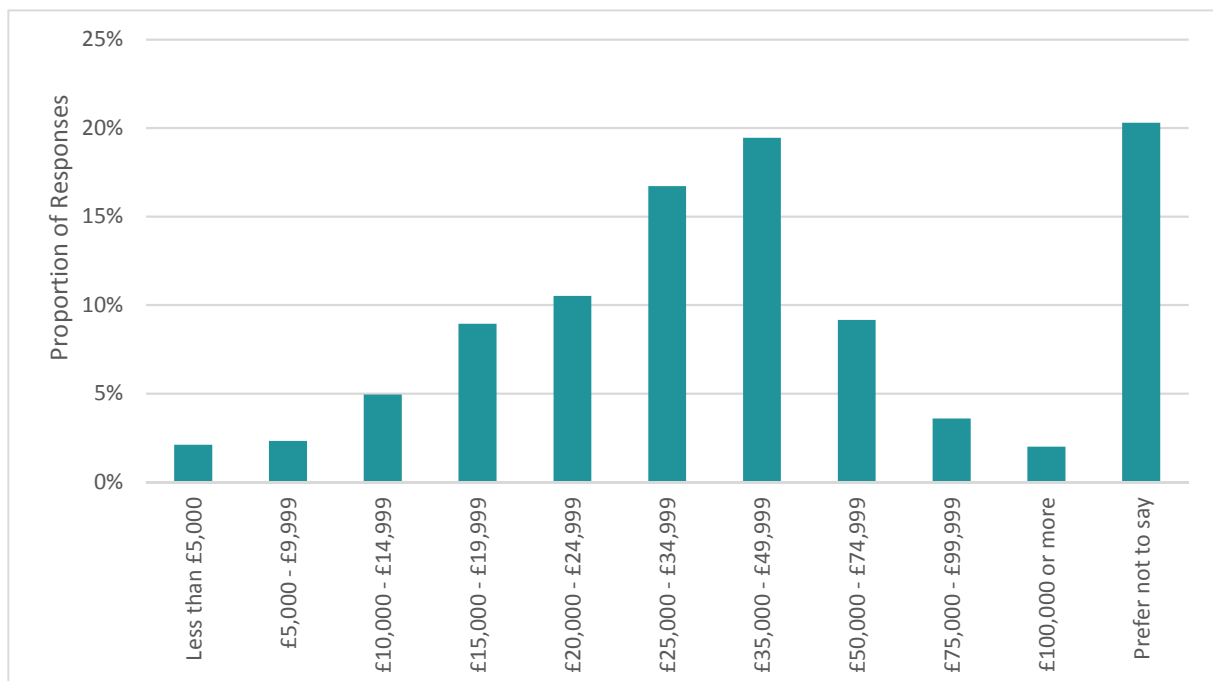


Figure 3-6: Household Income Distribution

Figure 3-7 shows a relatively broad mix of trip purposes were sampled by the survey. The last trips undertaken in the small zone comprised a much lower proportion of commuting and higher proportion of education escort. This may reflect the lack of central parking availability and higher use of other modes to commute into this area. Meanwhile there are a number of primary schools close to the Small Zone boundary generating short distance pupil ferrying.

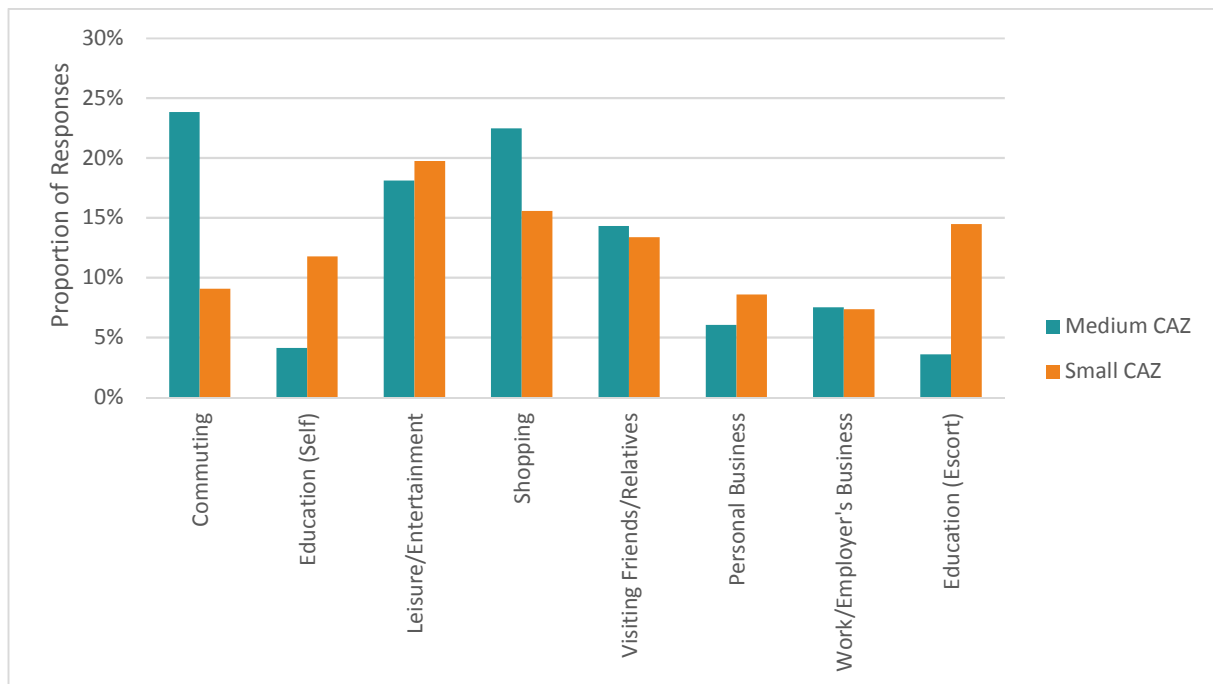


Figure 3-7: Trip Purposes Sampled

4. Data Checks and Cleaning

The data collected via the online survey underwent a number of sense and logic checks in order to discard any non-sensical data.

Rather than excluding a questionnaire on specific automated criteria, a series of checks were set up to flag a subset of the responses for further investigation. The internal consistency of each questionnaire was then manually assessed and a decision made on whether to discard the record. This section discusses the aspects considered in this process.

4.1 Sense Checks.

The following aspects were considered in detail during the sense checks of questionnaires:

- Questionnaire completion time;
- Respondent's assessment of the survey;
- Overall logic of the responses; and
- Answers to open ended questions.

Questionnaire completion times were analysed in more detail to identify the amount of time considered to be sufficient to complete the questionnaire. The questionnaires completed outside the identified time range were checked in more detail for overall logic of the responses as these can indicate a questionnaire filled in without much thought or in a distracted manner. Out of 1103 questionnaires completed:

- 20 questionnaires were completed in 7 minutes or less;
- 23 were completed in 35 minutes or more.

Figure 4-1 below provides a summary of the completion times for all of the questionnaires collected as part of the study. Long completion times were likely due to a respondent completing part of the survey and then returning to it later.

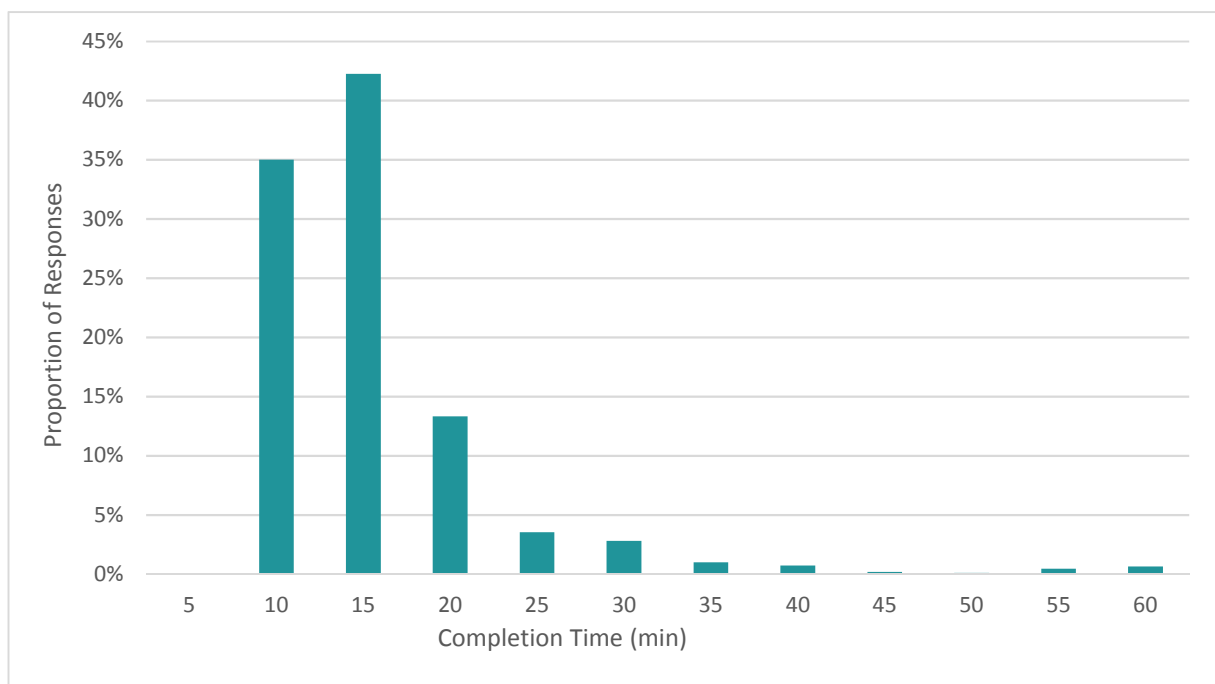


Figure 4-1: Questionnaire Completion Time (min)

The design of the questionnaire allowed for the respondent's assessment of:

- Overall difficulty of the survey;
- Clarity of the definitions and explanations; and
- Practicality of vehicle trade-in (replacement) costs.

If the respondent found either of the exercises particularly difficult or the vehicle replacement costs very unreasonable, there was an option to provide reasoning in a comment box.

The questionnaires where the respondent found the stated preference exercise too difficult to complete, the definitions and explanations very unclear or the vehicle replacement too unrealistic, were analysed in more detail. It was considered that the responses provided in such questionnaires might not be sufficiently accurate.

From 1103 respondents that completed the stated preference questionnaire:

- 1 respondent found the exercise very difficult;
- 3 respondents found the survey explanations and definitions very unclear; and
- 57 respondents considered the replacement costs very unrealistic.

Figure 4-2 below provides the proportion of responses by the perceived difficulty of the questionnaire for the survey prior to any data cleaning or elimination.

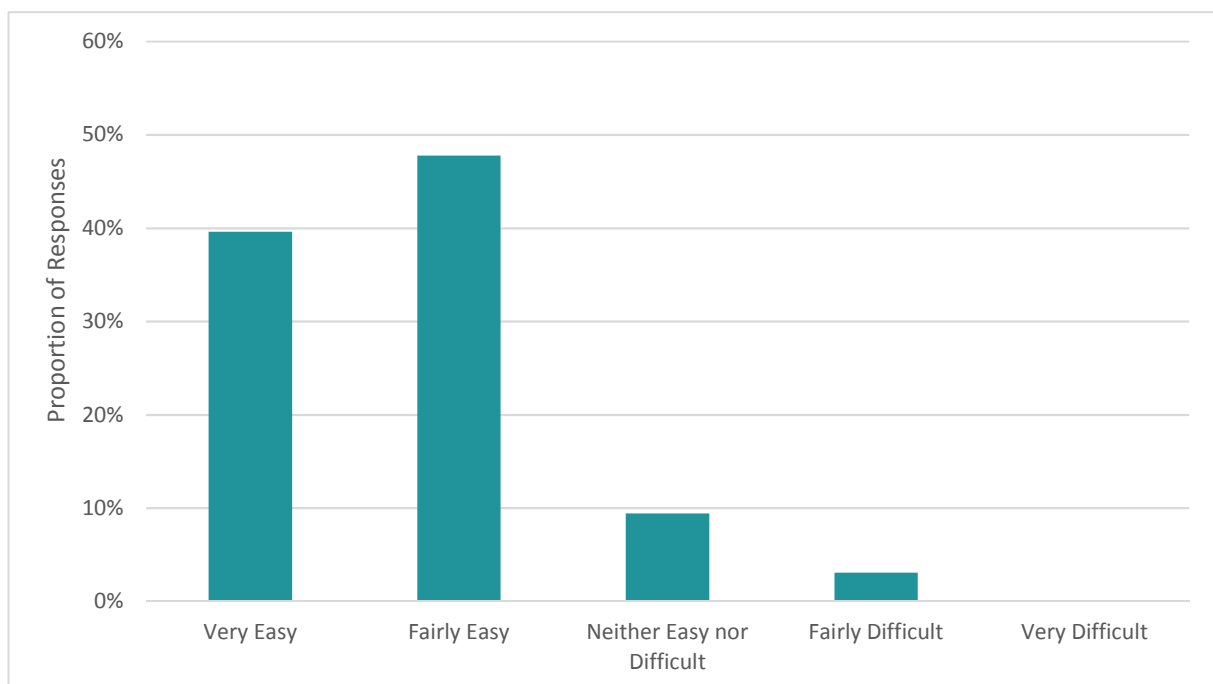


Figure 4-2: Assessment of the Questionnaire Difficulty

Figure 4-3 shows the number of responses by perceived clarity of the explanations and definitions used in the stated preference questionnaire for the survey prior to any data cleaning or elimination.

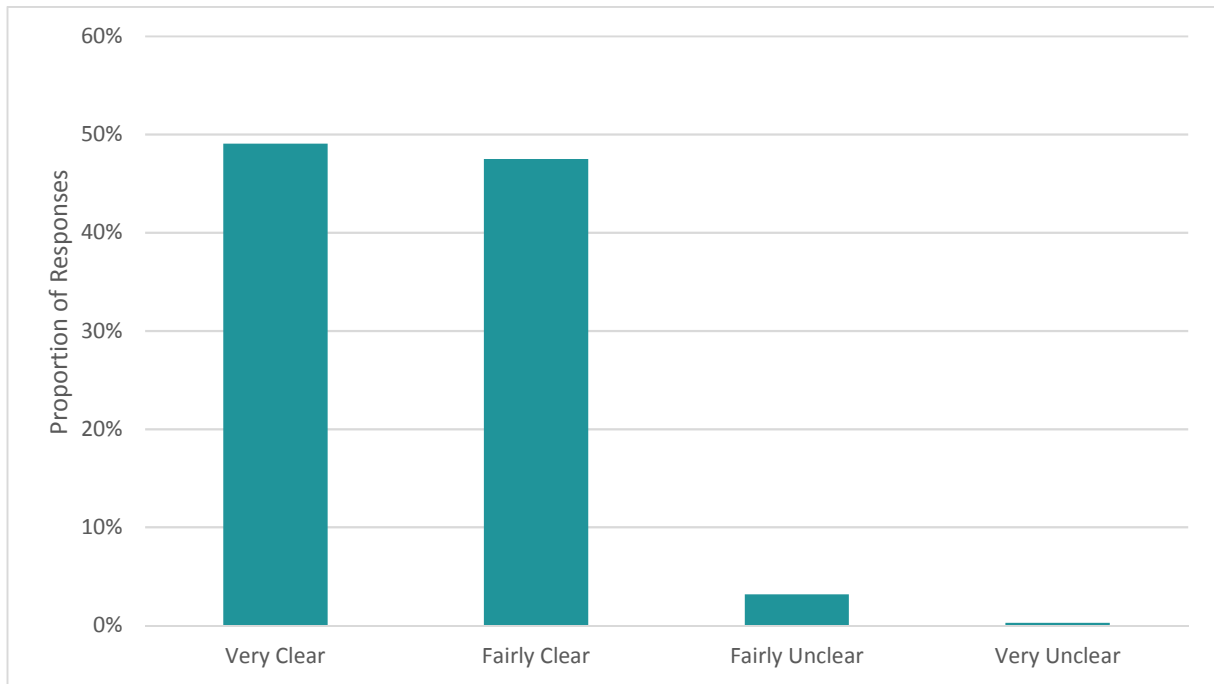


Figure 4-3: Assessment of the Clarity of the Explanations and Definitions

Figure 4-4 shows the perceived realism of vehicle replacement costs for the survey prior to any data cleaning or elimination.

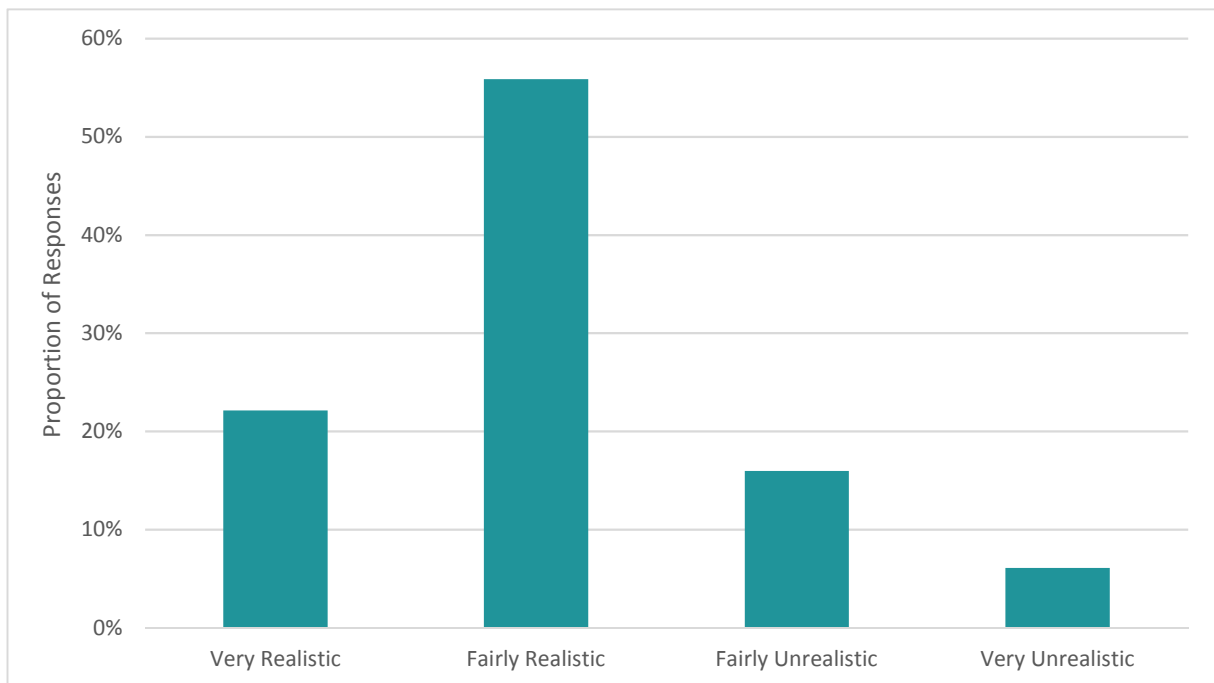


Figure 4-4: Practicality of the Vehicle Trade-in (Replacement) Costs

If a respondent chose to pay the CAZ charge at all levels at Exercise 1 they were asked to explain why. Likewise, if, at Exercise 2, a respondent always chose to pay the charge or always chose to replace their vehicle, regardless of charge level/ replacement cost, they were asked to give an explanation.

At the end of the survey the respondents also had an option to provide general comments on the topic of the survey or the questionnaire itself. Any questionnaires containing non-sensical or highly emotional written answers or comments were investigated in more detail to assess the overall logic of the responses. In addition,

further checks were done for the questionnaires where the respondent seemed particularly biased towards or against the CAZ scheme, to see if this might have had an impact on the responses to exercises.

The key factor in the sense checks was the internal consistency of each questionnaire. Some of these checks included the relation between:

- Respondent's occupation and household income;
- Residential postcode and frequency of travel to a particular zone;
- Travel purpose and frequency of travel; and
- Near-identical record data indicating duplicate submission.

4.2 Logic Checks

To review the responses to exercises 1 and 2 some logic checks were used to remove illogical responses that suggested the respondent either did not understand the questionnaire or was not thinking about the answers and selecting responses at random.

Exercise 1: Pay charge vs behaviour change

For the short term response exercise, responses were flagged where the respondent had suggested they would pay a more expensive CAZ charge but change behaviour for a cheaper CAZ charge.

Exercise 2: Pay charge vs replace vehicle

For the second exercise, where the respondent had selected a mix of choices, (i.e. to pay the charge to some combinations of charge and cost but replace vehicle to others), the average replacement cost per charge was computed for both the 'pay charge' and 'replace vehicle' responses. If this average value was higher for the 'replace vehicle' responses then the record was discarded from consideration as this suggests the respondent would be prepared to pay the charge for relatively high charges to low replacement costs and vice versa.

Consider the following two hypothetical responses to Subgroup 2:

Table 4-1: Example of Exercise 2 Logic Check

Charge (£)	5	6	6	8	12	13
Replacement Cost (£)	10,000	1,000	6,000	5,000	8,000	4,000
Average replacement cost per charge (£)	2,000	167	1,000	625	667	308
Respondent 1 decision	Pay charge	Replace	Pay charge	Replace	Replace	Replace
Respondent 2 decision	Pay charge	Pay charge	Replace	Pay charge	Pay charge	Pay charge

For respondent 1, the average 'replacement cost per charge' of the choices to pay the charge are 1,500 while for upgrading it is 442, the difference of 1058 is therefore positive and the questionnaire is not discarded. This is reflected in the answers; respondent 1 has consistently chosen to pay the charge when it is relatively cheaper (e.g. first column) but replace the vehicle when the charge is relatively expensive (second column).

Respondent 2, meanwhile has an average of 753 for the selections to pay the charge and 1,000 for replacing the vehicle. The difference is therefore a negative, -247. This is reflected in the answers, particularly the second and third columns: for the same £6 charge respondent 2 has elected to replace the vehicle if it would cost them £6,000 but not if it only cost £1,000. Data for this participant would not be included in the final analysis for exercise 2.

Surveys that were excluded in this manner were not excluded from other analysis providing the responses were otherwise logical. This is considered reasonable as the hypothetical and somewhat unintuitive nature of

exercise 2 means a respondent may not understand fully what is being asked for but is still able to provide accurate answers to the rest of the survey.

4.3 Summary

As the result of the process, 153 (13.9%) questionnaires out of 1103 were removed entirely from the final dataset. A further 74 records were removed from consideration for Exercise 2 for the Medium CAZ and 50 records for the Small CAZ. This process has ensures that an potentially erroneous data is removed from the sample and is not relied upon when extracting results from the survey data.

5. Stated Preference Analysis and Results

This section presents an overview of the segmentation, factoring and weighting applied to the data. It then discusses the type of statistical model used for each of the exercises and then presents and discusses the final statistical models as used to inform in the transport modelling. As part of the factoring and weighting process, significance testing of a number of potential variables was undertaken. For brevity and clarity, the detail and outputs for this are not included in this section of the report and instead can be found in Appendix B.

5.1 Segmentation

To align with the transport modelling work being undertaken to forecast the impact of a charging clean air zone, the survey data was segmented to align with the GBATS transport model into the following purpose & income combinations:

- Commute/Other – Low Income (annual HH <£25,000);
- Commute/Other – Medium Income (annual HH £25,000 - £49,999);
- Commute/Other – High Income (annual HH >£49,999); and
- Employer's Business.

Further information on the GBATS transport model and its use can be found in the modelling reports OBC-22, OBC-23 and OBC-27.

5.2 Factoring

For the creation of statistical models from the results, responses were factored by the reported frequency of travel in the proposed zone. This serves as a method of transforming the units of the sample from that of unique users into non-compliant car trips into the zone.

This reflects that a 'typical' daytime 5 days a week commuter within the zone who chooses to change mode leads to a one vehicle reduction in flows in both the AM and PM peaks. Someone who only works one day a week, however, will only result in a reduction of 0.2 vehicles when considering an 'average weekday'.

Significance testing indicated that, without factoring, reported frequency is a significant predictor in response to the zone, particularly regarding the choice to replace the vehicle. This is unsurprising as a more frequent traveller will incur the charge more often and therefore replacing the vehicle becomes better value for money. With factoring the influence of reported frequency was considerably reduced though not eliminated.

5.3 Weighting

After factoring by reported frequency, the sample is weighted by trip purpose and fuel type when developing the statistical models. The purpose of this is to better fit the profile of trips in the zone as it is not possible to ensure the survey targets or returns a representative sample of fuel types or trip purposes in the zone.

Purpose

The proportion of Commute and Other purposes within the first three model user classes can be extracted from the GBATS demand model (which treats these separately) as weighting targets and these are shown in Table 5-1.

Table 5-1: Proportions and Weighting for Trip Purpose Medium CAZ

Purpose	2013 GBATS	Exercise 1 Sample	Exercise 1 Weighting	Exercise 2 Sample	Exercise 2 Weighting
<i>Work (Commuting)</i>	41%	49%	0.82	51%	0.77
<i>Other</i>	59%	51%	1.17	49%	1.21

Fuel

The target split of non-compliant petrol and diesel cars in the zone was taken from the ANPR survey conducted for the project. The outcome of this is shown in Table 5-2.

Table 5-2: Proportions and Weighting for Fuel Type

Fuel	ANPR	Sample	Weighting
<i>Petrol</i>	35%	56%	0.63
<i>Diesel</i>	65%	44%	1.47

Home Origin

The significance of Home Origin (considered as distance of the respondent's Post Code from the proposed zone) were also considered. Analysis indicated that Home Origin had some influence over the responses, however, there is little reliable data to serve as a basis for weighting, particularly when considered in the context of who actually travels in the zone (rather than the resident population). As such it was chosen to not attempt to use any weighting or segmentation for this variable. Details and outputs from this process can be found in Appendix B.

5.4 Exercise 2 Model and Results (Pay Charge or Replace Vehicle)

In the final combined statistical model, the choice made in Exercise 2 is considered first and also makes use of a more simple form of logistical regression as it considered just two choices. As such it is appropriate to consider it first in this report.

The second exercise presents a series of choices between paying the charge or upgrading the vehicle to a compliant one for a certain hypothetical cost. Each respondent was presented with one of two sets of six combinations of CAZ charge and replacement costs.

5.4.1 Trading – non-trading bias

As discussed in the survey design, the range of price options was developed with the intention that a majority of people would provide a mix of answers to their six sets of choices with relatively even minorities responding that they would either always replace vehicle or always pay the charge.

Figure 5-1 shows the proportion of traders and non-traders in the responses to Exercise 2.

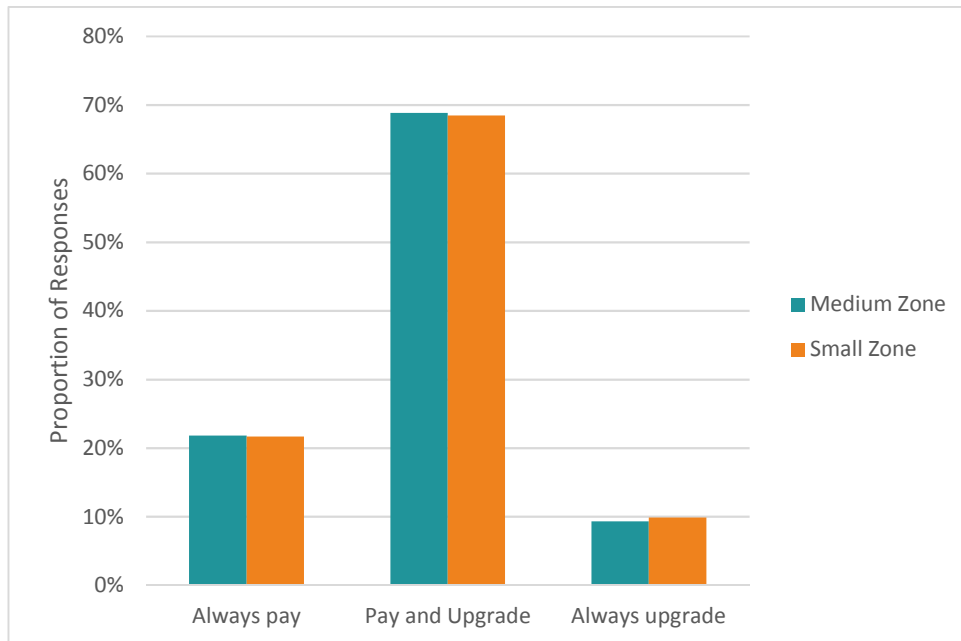


Figure 5-1: Answer splits to Exercise 2

The sample shows that most respondents provide a mix of choices with only small proportions choosing to always replace the vehicle or to always pay. Over twice as many elected to always pay which indicates a somewhat lower willingness to replace the vehicle compared to the data gathered for the London ULEZ. A possible explanation for this is the comparatively lower wage levels in the region.

There is very little difference between responses for the two zones, this is reasonable as it is not expected.

5.4.2 Statistical Model Form and Fitting

Since Exercise 2 considers a binary choice of either paying the charge or replacing the vehicle, logistical regression was used to develop models of this choice. This will produce a best fit log function that will predict the likely split between paying the charge or replacing the vehicle for a given combination of charge and replacement cost.

5.4.3 Results

Model coefficients are reported for a model considering the probability of choosing to pay the charge of the following form:

$$P(\text{charge}) = \frac{1}{1 + e^{-(\text{Const} - \text{coefC} \times \text{Charge} - \text{coefUp} \times \text{Upgrade} \dots \text{etc})}}$$

Further it should be noted that the model coefficients are on the basis that the replacement cost is in units of £000's.

As an example Table 5-3 shows the derived model parameters for the Commute/Other Medium Income segment for the Medium CAZ area in Bristol.

Table 5-3: Exercise 2 Model Parameters for Medium CAZ (CO Med Income, weighted by purpose & fuel type n=361)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Constant	-0.39736	0.189867	2.092828	0.036365		
Charge	-0.14124	0.018822	7.504117	6.18E-14	-0.17813	-0.10435
Replace	0.297453	0.020387	14.59049	3.23E-48	0.257495	0.33741

It can be seen that the coefficient for the charge is negative while for replacing the vehicle it is positive. This makes sense as both a lower charge and a higher replacement cost means it is more likely that someone will pay the charge.

In this case, with a £1 charge and £1000 replacement cost, the model predicts that 45% will pay the charge while at £10 charge and £10,000 replacement cost the model predicts that 64% will pay the charge.

Based on this model, a prediction of the compliance rate for any given charge and replacement cost assumption can be established. For example, the chart in Figure 5-2 shows the surface indicating the proportion who continue to pay the charge predicted by the model across the range of charges and replacement costs considered.

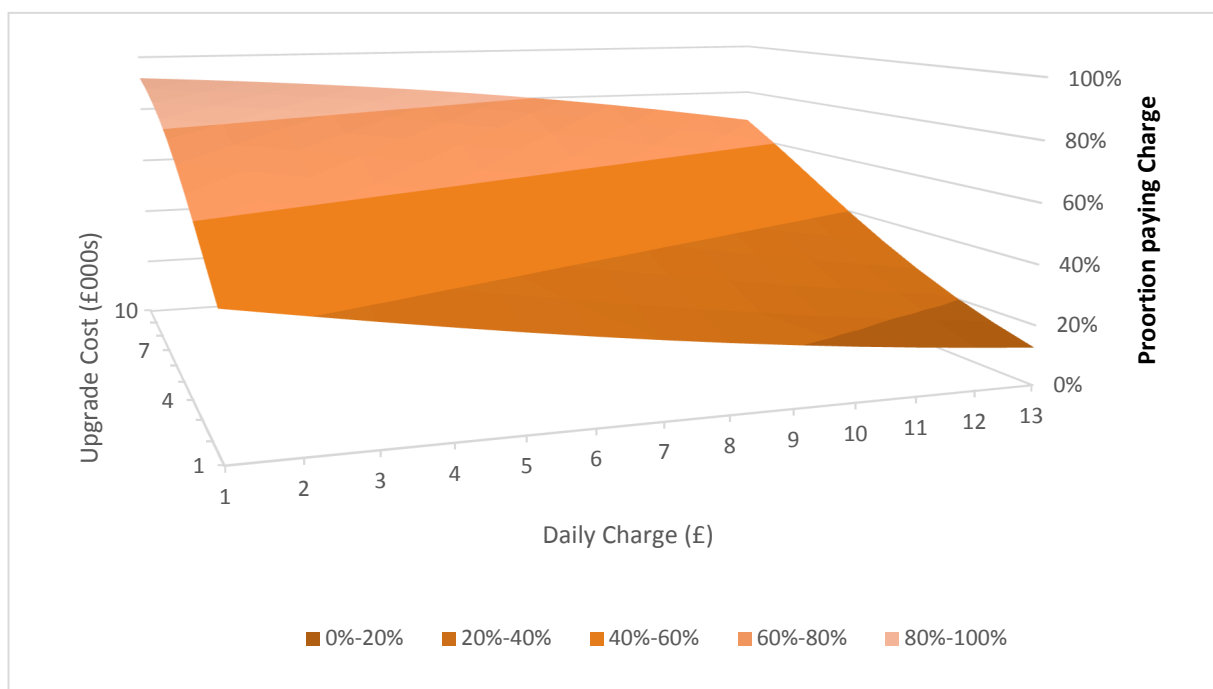


Figure 5-2: Exercise 2 Model (CO Med Income, weighted by purpose & fuel type n=361)

5.5 Exercise 1 Model and Results: (Pay Charge or Changing Travel Behaviour)

The first exercise asked respondents whether, for their most recent journey, if a CAZ was in place, they would have paid the charge or made a change in behaviour that would avoid the charge. Each respondent was presented with one of two sets of four charge levels for the proposed zone and for each charge the respondent was given 5 or 6 choices:

- Pay the charge and travel as before;
- Make the same journey but by a different mode;
- Not have made the journey;
- Made the same journey purpose but changed the destination (e.g. someone could shop elsewhere);

- Made the same journey but changed route to avoid the zone, and;
- Made the same journey but switched to another compliant vehicle in their household (this option was only shown if they had previously indicated such a vehicle existed).

5.5.1 Model Form and Fitting

As there is only a single variable here, the proposed daily charge, it is possible to use simple interpolation between the surveyed charge values. However, because participants were asked only half of the charge values, there are differences due to sampling error between the two sets of response that can cause unrealistic marginal changes between each 50p increase in charge.

For example, if those presented with the charges in Subgroup 1 (Table 2-1) had a somewhat higher willingness to pay the charge then simple interpolation may find the proportion paying the charge decreases more slowly between £5 and £6 than between £6 and £7 but then slower again above £7.

When looking at smaller sub samples (e.g. employer's business trips only), the random error can be sufficiently large that parts of the scale can show an increasing rate of payment with increasing daily charge which is clearly illogical.

Given this it is considered that undertaking a multinomial logistic regression will provide a more consistent statistical model for use in predicting the response to various charge levels.

Multinomial logistic regression is a generalisation of the binomial model used in Exercise 2 above to be able to consider more than two choices. It handles this by fitting and combining binomial models of one specific choice (or reference outcome) against each other choice in turn.

5.5.2 Results

The model has the following form:

$$P(Y) = \frac{e^{\beta_{0Y} + \beta_{1Y}C}}{\sum_{k=1}^K e^{\beta_{0k} + \beta_{1k}C}}$$

where $P(Y)$ is the probability of choice Y , C is the charge and β_{0Y} and β_{1Y} are the coefficients for choice Y . In the divisor, β_{0k} and β_{1k} are the coefficients for each possible choice k in turn.

Table 5-4 shows the coefficients for the fitted model for the Commuting/Other Medium Income segment. In this case, paying the charge is selected as the reference outcome and hence has coefficients of zero. The selection of which choice is the reference outcome has no impact on the final model.

Table 5-4: Exercise 1 Model Coefficients for Medium CAZ (CO Med Income, weighted by purpose & fuel type n=396)

Outcome	Pay Charge	Change Mode	Not Travel	Change Destination	Change Route	Switch Vehicle
Constant	0	-2.23	-2.3396	-2.74744	-1.67103	-3.02627
Charge	0	0.32	0.303245	0.313131	0.304578	0.225364

Figure 5-3 shows the output of this model across the range of surveyed charges.

The graph shows a notable decrease in the propensity to pay the charge as the charge increases. The alternative response to the introduction of charging for the majority of the respondents was either to use a different mode or change the destination to avoid the charging area.

It can be noted how the propensity to use a different mode, to change route/destination or to not travel increases with the increase in charge level. The proportion switching vehicle shows a notably lower sensitivity. This seems reasonable as for those for which this is an option it is generally a low cost choice to make.

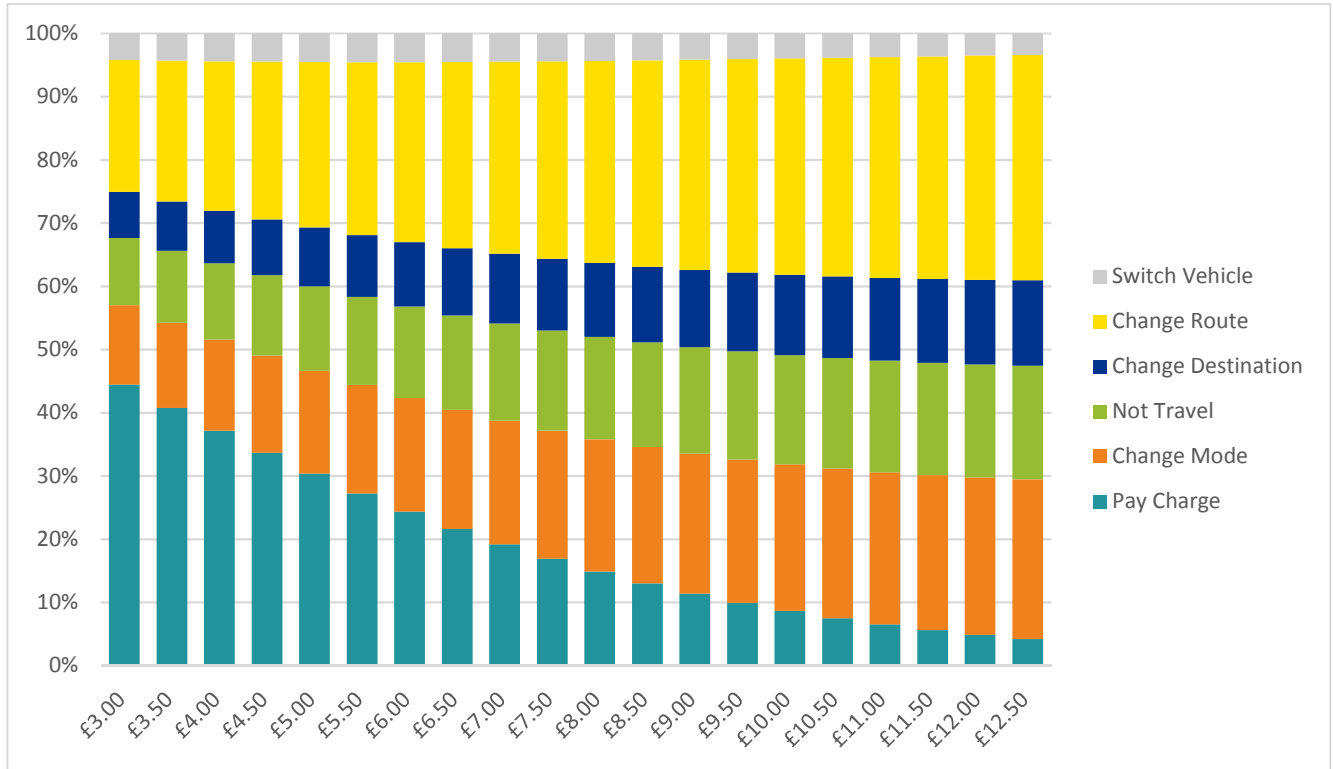


Figure 5-3: Exercise 1 Responses for Medium CAZ (CO Med Income, weighted by purpose & fuel type n=396)

5.6 Combined Model

To estimate the overall response to different levels of charge the models can be combined as follows:

The choice from Exercise 2 is applied first on the basis that people who can afford or choose to replace their vehicle are assumed to do so.

The remaining proportion that are predicted by Exercise 2 to pay the charge are then split by the Exercise 1 results, with splits between the charge levels asked in Exercise 1 estimated by interpolation.

Plots of the outputs from the combined models are shown in Figure 5-4 to Figure 5-7 for the four car user classes in GBATS for the Medium CAZ area for a replacement cost of £4,884 that has been used in the modelling as the typical car replacement cost. This cost is based on a combination of industry data on the most common car purchases, ANPR data and current market prices of vehicles. Derivation of these costs are discussed in more detail in OBC-26 Response Rates Technical Note, in Appendix E of the OBC.

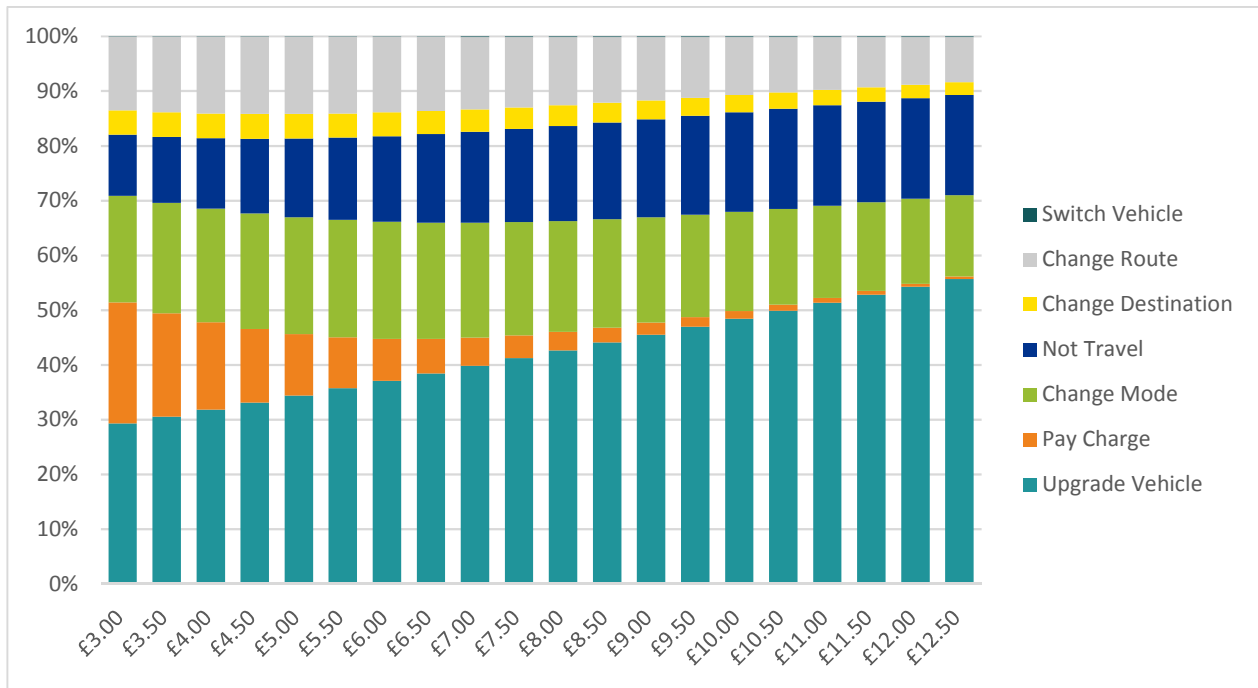


Figure 5-4: Combined Model for CO Low Income Medium CAZ (weighted by purpose & fuel type, n=164/140)

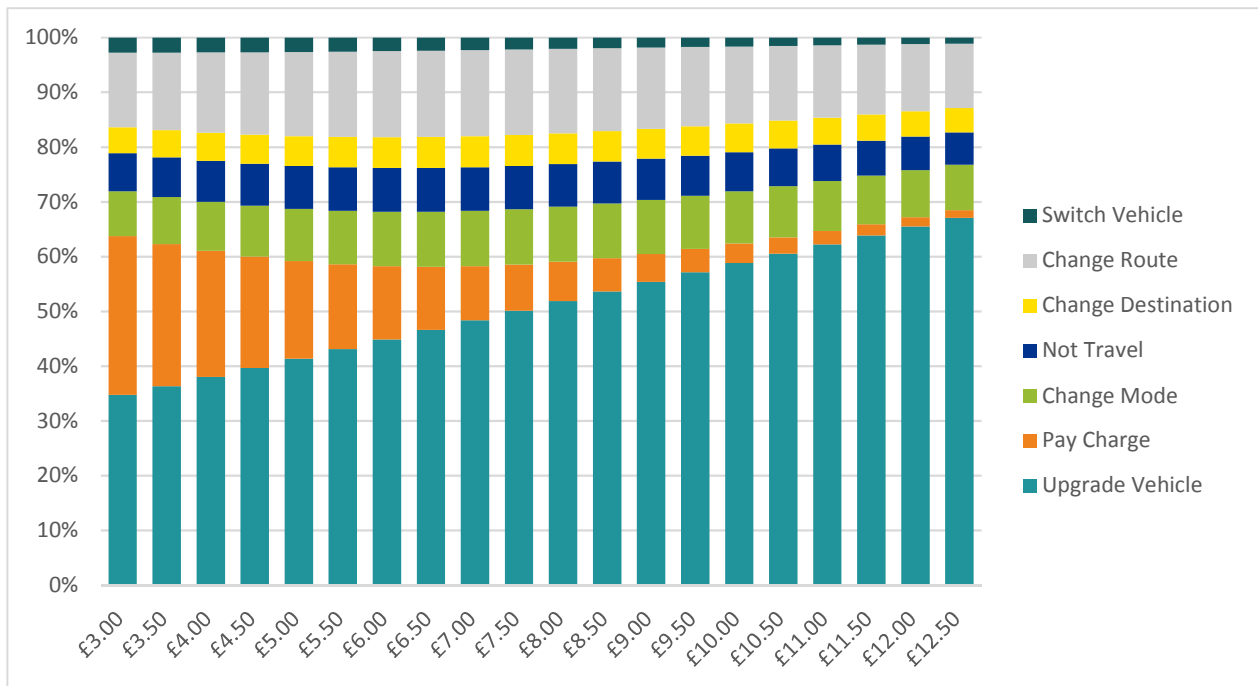


Figure 5-5: Combined Model for CO Medium Income Medium CAZ (weighted by purpose & fuel type, n=396/361)

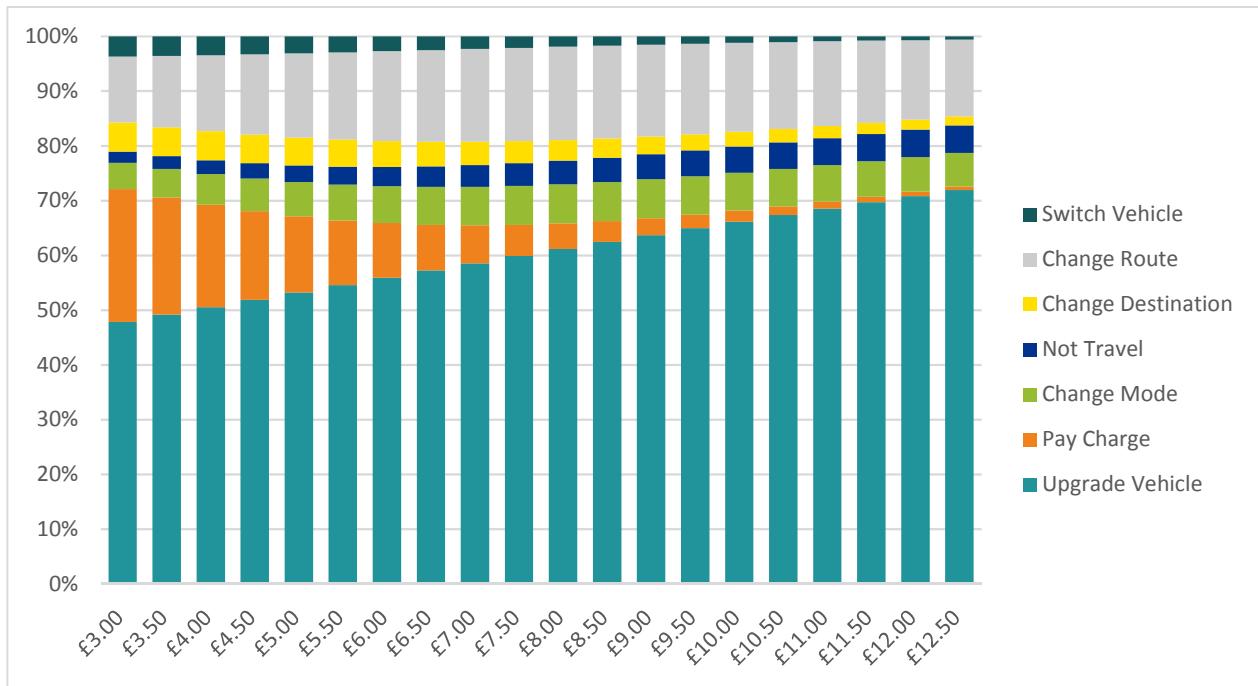


Figure 5-6: Combined Model for CO High Income Medium CAZ (weighted by purpose & fuel type, n=122/113)

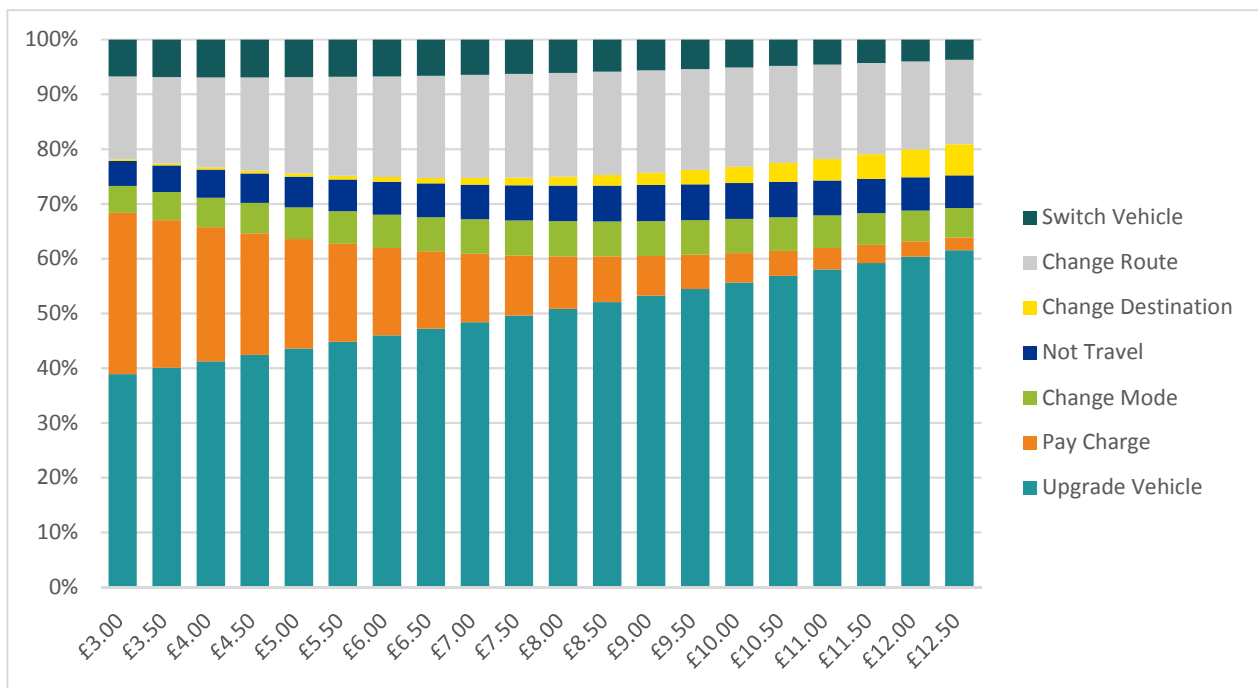


Figure 5-7: Combined Model for Employer's Business Medium CAZ (weighted by purpose & fuel type, n=71/68)

There are some clear trends with rising household income. Willingness to replace the vehicle increases with income. This is expected as higher income households are more likely to have the disposable income required to afford the replacement. This increase largely comes from a reduction in those changing mode or not travelling at all. The switch vehicle response is also not present in the lowest income band reflecting the lower level of car ownership in poorer households. The proportion changing route is similar across income levels and for different level of charge indicating that for those where diverting around the zone is an option, a £3 charge is sufficient to cause this.

With the employer's business group there is a greater willingness to pay the charge which is likely a result that a proportion of those travelling on employer's business are able to pass the charge onto their employer so do not

perceive the cost as much as if it were coming from their own pocket. It may also reflect the nature of a number of employer's business trips meaning that changing mode or destination are not practical alternatives. It should be noted though that some drivers on employer's business will incur the charge themselves and, combined with the relatively small sample size, these figures should be taken with some caution.

6. Summary

A survey was undertaken between 22 February and 12 March 2018 of 1103 residents of Bristol and the surrounding Local Authorities who had recently driven within the proposed CAZ in a car or light van considered non-compliant under the Defra Framework. The survey responses went through a cleaning and checking process leaving 950 responses for analysis.

Along with a number of demographic and other relevant questions, the survey consisted of stated preference exercises where the participant was asked to consider their last trip within the CAZ and if they would have made a different choice as a result. The first exercise asked whether they would have made the same trip again and paid the charge, or have taken one of five alternative actions to avoid the charge such as travel by a different mode or change route.

The second exercise asked whether, if a CAZ was in place, the user would either pay the charge whenever they travelled in the zone, or to spend money upgrading their vehicle to a compliant one that would not incur the charge. The exercises asked about a range charge levels and assumed replacement costs. The two exercises were asked for two difference sizes of CAZ making four exercises in total.

Statistical models were fitted to the data from each exercise and were then combined into a series of models representing the user classes used in the traffic modelling. These models are then used with average replacement costs to extract response rates to inform the traffic modelling of the proposed Clean Air Zone. This process is discussed in OBC-26 Response Rates Technical Note.

Appendix A. Survey Questionnaire

Driving in Bristol Survey

WELCOME

Good (morning/afternoon/evening). Thank you for your interest in our project.

This is an online survey that will take a maximum of 20 minutes to complete. It's an interesting topic concerning an important local issue that could be very relevant to you.

Please note that all personal data will be processed in accordance with the principles of good information handling contained in the Data Protection Act 1998 and the EU General Data Protection Regulation when it comes into force in May 2018. We will not sell this information to any other persons or organisations, and you will receive no marketing material as a result of completing this questionnaire.

[START SURVEY >](#)

Q1 What is your **FULL** home postcode?

[CONTINUE >](#)

If invalid postcode then: Unfortunately, you are not eligible to complete the questionnaire. Thank you for your time. *Close*

Thank you.

Your reference is 15936-1136.

If you experience any problems completing the survey and wish to contact us please quote this reference.

[CONTINUE >](#)

QUESTIONNAIRE A1

Before we start the survey, we need to ask you a few screening questions to make sure you are eligible to complete the survey.

Q2 Which age group do you fall into?

Under 17

17-24

25-34

35-44

45-54

55-59

60-64

65-69

70 or over

[PREV](#) [NEXT](#)

If under 17 then: Unfortunately, only people aged 17 or over are eligible to complete the questionnaire. Thank you for your time. *Close*.

Q3 Are you ...?

Male

Female
Transgender
Prefer not to say

Q4a Do you drive a car or light van (including camper van, pick-up truck)? If you drive more than one vehicle, please answer in relation to the vehicle you **normally** drive.

Car
Light van (under 3.5 tonnes)
No

PREV NEXT

If 'no' then: This survey is for people who drive a car or van so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. *Close.*

Q4b Are you the person who would solely or jointly makes decisions concerning the replacement of your vehicle?

PREV NEXT

If 'no' then: This survey is for people who take the decision about replacing their vehicle so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. *Close.*

Q5 What type of fuel does the vehicle you normally drive use?

Petrol
Diesel
Electric/plug-in
Hybrid
Gas/LPG
Other

PREV NEXT

If not petrol or diesel then: This survey is focussed on petrol and diesel vehicles, so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. *Close.*

Q6a/b How old is your vehicle?

For petrol:

Pre 2006
2006 or more recent

If 2006 or more recent, then: This survey is focussed on older vehicles, so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. *Close.*

For diesel:

Pre 2015
2015 or more recent

PREV NEXT

If 2015 or more recent, then: **This survey is focussed on older vehicles, so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. *Close***

SCREENING A

Q7 In the past 6 months have you used this vehicle to drive within, through, or in/out of the area of Bristol shown in yellow on the map below?

Yes
No

Map of Zone A (yellow)

PREV [NEXT](#)

If 'no' for Zone A then: This survey is focussed on trips in, through or in/out of this area, so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. Close.

Q8a In general, how often do you use your vehicle in this area of Bristol?

6-7 days a week
5 days a week
3-4 days a week
2 days a week
1 day a week
About once a fortnight
About once a month
About once every 2 months
About once every 4-5 months
About once every 6 months
Less often

PREV [NEXT](#)

If 'less often' then: This survey is focussed on people who have used a vehicle in this area in the last 6 months, so unfortunately you are not eligible to complete the questionnaire. Thank you for your time. Close.

Q8b In general, how often do you use your vehicle in Bath city centre?

6-7 days a week
5 days a week
3-4 days a week
2 days a week
1 day a week
About once a fortnight
About once a month
About once every 2 months
About once every 4-5 months
About once every 6 months
Less often/never

PREV [NEXT](#)

YOUR VEHICLE

Q9 What type of vehicle do you drive?

Mini car (e.g. Peugeot 108, Skoda Citigo, Citroen C1)
Small car (e.g. Ford Fiesta, Opel Corsa, Nissan Micra, Renault Clio, Toyota Yaris)
Medium car (e.g. Volkswagen Golf, Skoda Octavia, Toyota Corolla, Ford Focus, BMW 1 Series)
Large car (e.g. Mazda 6, Kia Optima, Audi A5, Toyota Avensis)
Executive (e.g. Audi S7, Mercedes-Benz E-Class, Toyota Avalon, BMW 5-series)
People carrier (MPV) (e.g. Kia Carens, Citroen C4 Picasso, SEAT Alhambra)
Sports utility vehicle (SUV) (e.g. Volkswagen Tiguan, BMW X6, Kia Sorento, Land Rover)
Sports car (e.g. Audi TT, BMW i8, Aston Martin Vanquish)
Other (please state)

[PREV](#) [NEXT](#)

Q10a Are there any other vehicles in this household that you can use?

Yes
No

[PREV](#) [NEXT](#)

Q10b How many other vehicles could you use? _____

[PREV](#) [NEXT](#)

Q11 How many years old is the vehicle you normally drive? ____ (years)

Q12 When do you expect to replace this vehicle?

Within the next 2 years (by 2020)
Within the next 3 years (by 2021)
Within the next 4 years (by 2022)
Within the next 5 years (by 2023)
I have no specific plans right now – *skip to Zone A Preparation Questions*

[PREV](#) [NEXT](#)

Q13 How old do you expect your replacement vehicle will be?

It will be a new vehicle
1-2 years old
3-4 years old
5+ years old
Don't know

Q14 What type of fuel do you expect your replacement vehicle will use?

Petrol
Diesel
Electric/plug-in
Hybrid
Gas/LPG
Other
Don't know

Q15 What do you expect will be the type of your replacement vehicle?

Mini car (e.g. Peugeot 108, Skoda Citigo, Citroen C1)
Small car (e.g. Ford Fiesta, Opel Corsa, Nissan Micra, Renault Clio, Toyota Yaris)
Medium car (e.g. Volkswagen Golf, Skoda Octavia, Toyota Corolla, Ford Focus, BMW 1 Series)
Large car (e.g. Mazda 6, Kia Optima, Audi A5, Toyota Avensis)
Executive (e.g. Audi S7, Mercedes-Benz E-Class, Toyota Avalon, BMW 5-series)
People carrier (MPV) (e.g. Kia Carens, Citroen C4 Picasso, SEAT Alhambra)
Sports utility vehicle (SUV) (e.g. Volkswagen Tiguan, BMW X6, Kia Sorento, Land Rover)
Sports car (e.g. Audi TT, BMW i8, Aston Martin Vanquish)
Other (please state)
Don't know

[PREV](#) [NEXT](#)

CLEAN AIR ZONE A

Bristol City Council has been tasked by Central Government to improve air quality in Bristol in the shortest time possible. In response to this, the introduction of a charging Clean Air Zone covering the yellow area of Bristol shown in the map below is currently being considered. Within this zone any trip made by a petrol vehicle registered before 2006 or a diesel vehicle registered before 2015 would be required to pay a daily charge. Newer vehicles would be considered 'compliant' with the emissions standards and would not have to pay. For the purposes of this survey it should be assumed there would be no exemptions for non-compliant vehicles (e.g. for local residents). The daily charge would cover multiple journeys in one day.

Map of Zone A (yellow)

[PREV](#) [NEXT](#)

If yes at Q10

Q16 You mentioned that there were other vehicles in your household that you could use for the journeys you make in or into the zone shown on the map. Are any of those vehicles compliant with the emissions standards described in the previous screen?

Yes
No
Don't know

[PREV](#) [NEXT](#)

Q17 You mentioned that you have made a journey in/through the yellow area shown in the map below in the last 6 months. Thinking about the most recent journey you made here, what was the main reason for this journey?

Travel to/from work (commuting)
Travel to/from college
Travel for leisure /entertainment
Shopping
Travel to visit friends or relatives
Travel for personal business (e.g. doctor's, bank appointment)
Travel for business reasons (but not commuting)
Taking children to/from education or activity

Map of Zone A (yellow)

PREV [NEXT](#)

CLEAN AIR ZONE A EXERCISE 1

In this section we would like you to think about what you would have done if a Clean Air Zone was in place in the yellow area. We will show you 4 different Clean Air Zone charging prices and, for each, you will be asked which travel option you would have chosen for your most recent journey in or through the area, which you said was ... (**answer at Q17**).

Map of Zone A (yellow)

Q18 Thinking about your most recent journey driving in or through the area, what would you have done, assuming a Clean Air Zone was in place?

* Clean Air Zone daily charge £5

1. Made the same journey using your own vehicle and paid a **£5** charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

* Clean Air Zone daily charge £7

1. Made the same journey using your own vehicle and paid a **£7** charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

* Clean Air Zone daily charge £9.50

1. Made the same journey using your own vehicle and paid a **£9.50** charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

* Clean Air Zone daily charge £12.50

1. Made the same journey using your own vehicle and paid a **£12.50** charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

Note: on screen the options appear horizontally not vertically. The 4 price points should be shown in a random order.

Only show option 6 if Q16 = yes

[PREV](#) [NEXT](#)

If say will pay for all 4 price points ask:

Q19 You selected to pay the charge for each of the price points. Could you please tell us why?

[PREV](#) [NEXT](#)

CLEAN AIR ZONE A EXERCISE 2

In this section, we would like you to again think about what you might do assuming a Clean Air Zone was in place in the yellow area.

We will show you 6 scenarios where you will be asked to choose between continuing to use your current vehicle and paying a Clean Air Zone charge, or replacing it with a compliant vehicle (these are petrol vehicles registered in or after 2006 or diesel vehicles registered in or after 2015).

In each scenario there is a different combination of daily charge and vehicle upgrade cost to choose between. The upgrade cost is the amount you would have to pay for a compliant vehicle, over and above the amount you sold your current vehicle for.

Map of Zone A (yellow)

For each question please assume that the two choices shown are the only options available to you.

For example, you may want to consider this in terms of costs per year such as:

- with a daily charge of £5, 4 journeys per week for 46 weeks would cost £920 per year
- a vehicle upgrade cost of £5,000 over five years would be £1,000 per year.

For your convenience, there is an on-line calculator that you can use here (the link will open a new tab).

Q20 If the Clean Air Zone was in place which option would you choose in the following 6 scenarios?

* £3 charge v £9,000 upgrade:

Use current vehicle and pay a daily charge of **£3**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£9,000**

and pay **no** charge when you drive in/through the zone ☐

* £4 charge v £3,000 upgrade:

Use current vehicle and pay a daily charge of **£4**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£3,000**

and pay **no** charge when you drive in/through the zone ☐

* £10 charge v £10,000 upgrade:

Use current vehicle and pay a daily charge of **£10**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£10,000**

and pay **no** charge when you drive in/through the zone ☐

* £9 charge v £2,000 upgrade:

Use current vehicle and pay a daily charge of **£9**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£2,000**
and pay **no** charge when you drive in/through the zone ☐

* **£11 charge v £6,000 upgrade:**

Use current vehicle and pay a daily charge of **£11**
when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£6,000**
and pay **no** charge when you drive in/through the zone ☐

* **£7 charge v £8,000 upgrade:**

Use current vehicle and pay a daily charge of **£7**
when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£8,000**
and pay **no** charge when you drive in/through the zone ☐

Note: the six scenarios should be in random order

PREV [NEXT](#)

If say will pay for all 6 options ask:

Q22 You selected to pay the charge in each of the scenarios. Could you please tell us why?

PREV [NEXT](#)

If say will change to a compliant vehicle for all 6 options ask:

Q23 You selected to change to a compliant vehicle in each of the scenarios. Could you please tell us why?

PREV [NEXT](#)

SCREENING B

Q24 In the past 6 months have you used your current vehicle to drive within, through, or in/out of the area of Bristol shown in pink on the map below?

Yes
No

Map of Zone B (pink)

PREV [NEXT](#)

If 'no' skip to questionnaire assessment - Q33

Q25 In general, how often do you use your vehicle in this area?

6-7 days a week

5 days a week

3-4 days a week

2 days a week

1 day a week

About once a fortnight

About once a month

About once every 2 months

About once every 4-5 months

About once every 6 months

Less often

[PREV](#) [NEXT](#)

If 'less often' skip to questionnaire assessment – Q33

CLEAN AIR ZONE B

The introduction of a charging Clean Air Zone covering **a different** area of Bristol is also currently being considered, as shown by the pink area on the map below. Within this zone any trip made by a petrol vehicle registered before 2006, or a diesel vehicle registered before 2015 would be required to pay a daily charge. Newer vehicles would be considered 'compliant' with the emissions standards and would not have to pay. For the purposes of this survey it should be assumed there would be no exemptions for non-compliant vehicles (e.g. for local residents). The daily charge would cover multiple journeys in one day.

Map of Zone B (pink)

[PREV](#) [NEXT](#)

Q26 Thinking about the most recent journey you made in/through this pink area, what was the main reason for this journey?

Travel to/from work (commuting)
Travel to/from college
Travel for leisure /entertainment
Shopping
Travel to visit friends or relatives
Travel for personal business (e.g. doctor's, bank appointment)
Travel for business reasons (but not commuting)
Taking children to/from education or activity

Map of Zone B (pink)

[PREV](#) [NEXT](#)

CLEAN AIR ZONE B EXERCISE 1

In this section we would like you to think about what you would have done if a Clean Air Zone was in place in the pink area. You will notice the following questions are similar to those previously asked. However, **it is very important that you answer these questions as well, for each charging price, as we need to understand how people would react if this area were chosen to be the Clean Air Zone rather than the other area.**

Map of Zone B (pink)

Q27 Thinking about your most recent journey driving in or through the pink area, which you said was ...(answer at Q26), what would you have done, assuming a Clean Air Zone was in place?

* Clean Air Zone daily charge £5

1. Made the same journey using your own vehicle and paid a £5 charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Make the same journey but using a compliant vehicle available in your household

* Clean Air Zone daily charge £7

1. Made the same journey using your own vehicle and paid a £7 charge

2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

* Clean Air Zone daily charge £9.50

1. Made the same journey using your own vehicle and paid a **£9.50** charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

* Clean Air Zone daily charge £12.50

1. Made the same journey using your own vehicle and paid a **£12.50** charge
2. Made the same journey but using a different mode (e.g. public transport, cycle, walk)
3. Would not have made this journey
4. Changed your destination to avoid the charging area
5. Changed your route to avoid the charge
6. Made the same journey but using a compliant vehicle available in your household

Note: on screen the options appear horizontally not vertically. The 4 price points should be shown in a random order.

Only show option 6 if Q16 = yes

PREV [NEXT](#)

If say will pay for all 4 price points ask:

[Q28 You selected to pay the charge for each of the price points. Could you please tell us why?](#)

CLEAN AIR ZONE B EXERCISE 2

In this section, we would like you to again think about what you might do assuming a Clean Air Zone was in place in the pink area.

We will show you 6 scenarios where you will be asked to choose between continuing to use your current vehicle and paying a Clean Air Zone charge, or replacing it with a compliant vehicle (these are petrol vehicles registered in or after 2006 or diesel vehicles registered in or after 2015).

In each scenario there is a different combination of daily charge and vehicle upgrade cost to choose between. The upgrade cost is the amount you would have to pay for a compliant vehicle, over and above the amount you sold your current vehicle for.

Map of Zone B (pink)

For each question please assume that the two choices shown are the only options available to you.

For example, you may want to consider this in terms of costs per year such as:

- with a daily charge of £5, 4 journeys per week for 46 weeks would cost £920 per year
- a vehicle upgrade cost of £5,000 over five years would be £1,000 per year.

For your convenience, there is an on-line calculator that you can use here (the link will open a new tab).

Q29 If the Clean Air Zone was in place which option would you choose in the following 6 scenarios?

* £3 charge v £9,000 upgrade:

Use current vehicle and pay a daily charge of **£3**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£9,000**

and pay **no** charge when you drive in/through the zone ☐

* £4 charge v £3,000 upgrade:

Use current vehicle and pay a daily charge of **£4**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£3,000**

and pay **no** charge when you drive in/through the zone ☐

* £10 charge v £10,000 upgrade:

Use current vehicle and pay a daily charge of **£10**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£10,000**

and pay **no** charge when you drive in/through the zone ☐

* £9 charge v £2,000 upgrade:

Use current vehicle and pay a daily charge of **£9**

when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£2,000**
and pay **no** charge when you drive in/through the zone ☐

* **£11 charge v £6,000 upgrade:**

Use current vehicle and pay a daily charge of **£11**
when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£6,000**
and pay **no** charge when you drive in/through the zone ☐

* **£7 charge v £8,000 upgrade:**

Use current vehicle and pay a daily charge of **£7**
when you drive in/through the zone ☐

Change to a compliant vehicle for an upgrade cost of **£8,000**
and pay **no** charge when you drive in/through the zone ☐

Note: the six scenarios should be in random order

PREV [NEXT](#)

If say will pay for all 6 options ask:

Q31 You selected to pay the charge in each of the scenarios. Could you please tell us why?

PREV [NEXT](#)

If say will change to a compliant vehicle for all 6 options ask:

Q32 You selected to change to a compliant vehicle in each of the scenarios. Could you please tell us why?

PREV [NEXT](#)

YOUR ASSESSMENT OF THE SURVEY

Q33 Please tell us what you thought of this survey. How easy or difficult did you find it?

Very easy
Fairly easy
Neither easy nor difficult
Fairly difficult
Very difficult

PREV [NEXT](#)

If Q33 is 'Very difficult'

Q36 You said you found the exercise very difficult. Could you please tell us why?

Blank response allowed

PREV [NEXT](#)

Q34 Were the descriptions and explanations clear to you?

Very clear

Fairly clear

Fairly unclear

Very unclear

Q35 How realistic were the upgrade costs?

Very realistic

Fairly realistic

Fairly unrealistic

Very unrealistic

PREV [NEXT](#)

If Q35 is or 'Very unrealistic'

Q37 You said you found the upgrade costs very unrealistic. Could you please tell us why?

Allow blank response

PREV [NEXT](#)

About You

Q38 Please indicate your employment status.

- Working full time
- Working part time
- In education
- Looking after home/family/dependent(s)
- Unemployed
- Retired
- Unable to work
- Other
- Prefer not to say

[PREV](#) [NEXT](#)

If working full or part time then ask Q39, else skip to Q40

Q39 Which of the following best describes your occupation?

- Higher managerial, administrative or professional
 - Intermediate managerial, administrative or professional
 - Supervisory or clerical and junior managerial, administrative or professional
 - Skilled manual worker
 - Semi-skilled and unskilled manual worker
 - Casual or low grade worker
-

Q40 Which category corresponds to your annual HOUSEHOLD income? (before tax)

- i. Less than £5,000
- ii. £5,000 - £9,999
- iii. £10,000 - £14,999
- iv. £15,000 - £19,999
- v. £20,000 - £24,999
- vi. £25,000 - £34,999
- vii. £35,000 - £49,999
- viii. £50,000 - £74,999
- ix. £75,000 - £99,999
- x. £100,000 or more
- xi. Prefer not to say

[PREV](#) [NEXT](#)

Q41 Which ethnic group do you consider you belong to?

- i. White - English/Welsh/Scottish/Northern Irish
- ii. White - Other British
- iii. White - Irish
- iv. Other white
- v. Mixed or multiple ethnic groups - White and Black Caribbean
- vi. Mixed or multiple ethnic groups - White and Black African
- vii. Mixed or multiple ethnic groups - White and Asian
- viii. Other Mixed or multiple ethnic background
- ix. Asian or Asian British – Indian
- x. Asian or Asian British - Pakistani
- xi. Asian or Asian British - Bangladeshi
- xii. Asian or Asian British - Chinese

- xiii. Asian or Asian British - Other Asian background
- xiv. Black or Black British - Caribbean
- xv. Black or Black British - African
- xvi. Black or Black British - Other Black background
- xvii. Other Ethnic Group
- xviii. Prefer not to say

PREV [NEXT](#)

Q42 Do you have a long-term physical or mental disability or health issue that limits your ability to travel and get about? Include any issues due to old age.

- i. Yes
- ii. No

PREV [NEXT](#)

If ii, then skip to Q44

Q43 Are you a Blue Badge holder?

- i. Yes
- ii. No

PREV [NEXT](#)

Q44 Do you have any further comments about this topic or the survey itself? If you have no further comments, please select 'No comments'. *This question is limited to 400 characters*

No comments
Yes

PREV [NEXT](#)

Q996 And finally, if we need to, can we contact you again?

- Yes
- No

PREV [NEXT](#)

At what email address would you like to be contacted?

PREV [NEXT](#)

Thank you very much for completing this questionnaire. We appreciate your time and effort.

DONE

This survey has been completed successfully. Thank you once again.

Appendix B. Model Detailed Analysis

B.1 Small CAZ Models

Figure B-1 to Figure B-4 show the statistical models for the 4 small zones.

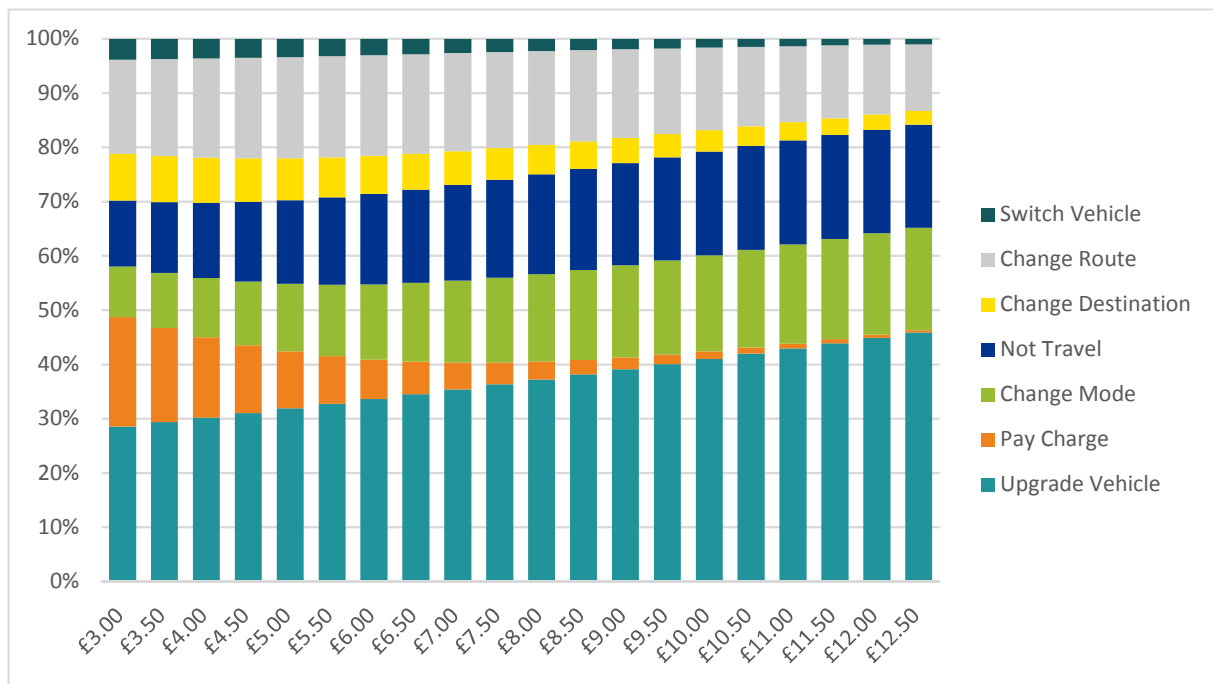


Figure B-1: Combined Model for CO Low Income Small CAZ (weighted by purpose & fuel type, n=135/122)

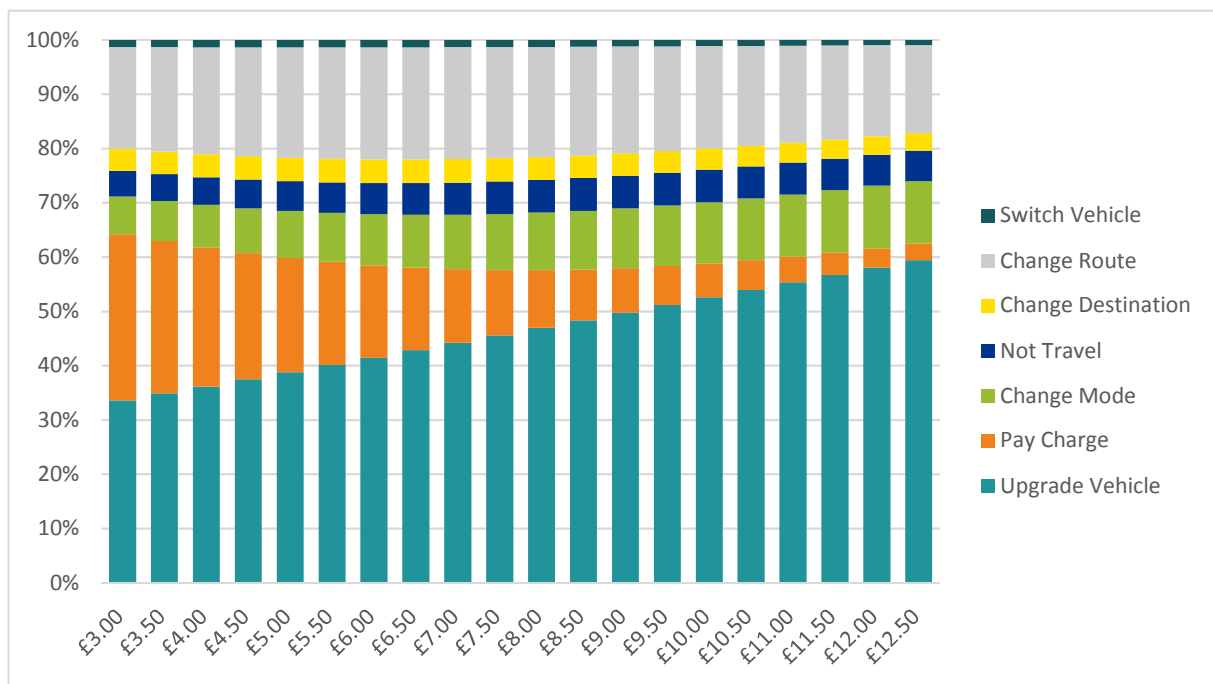


Figure B-2: Combined Model for CO Medium Income Small CAZ (weighted by purpose & fuel type, n=345/322)

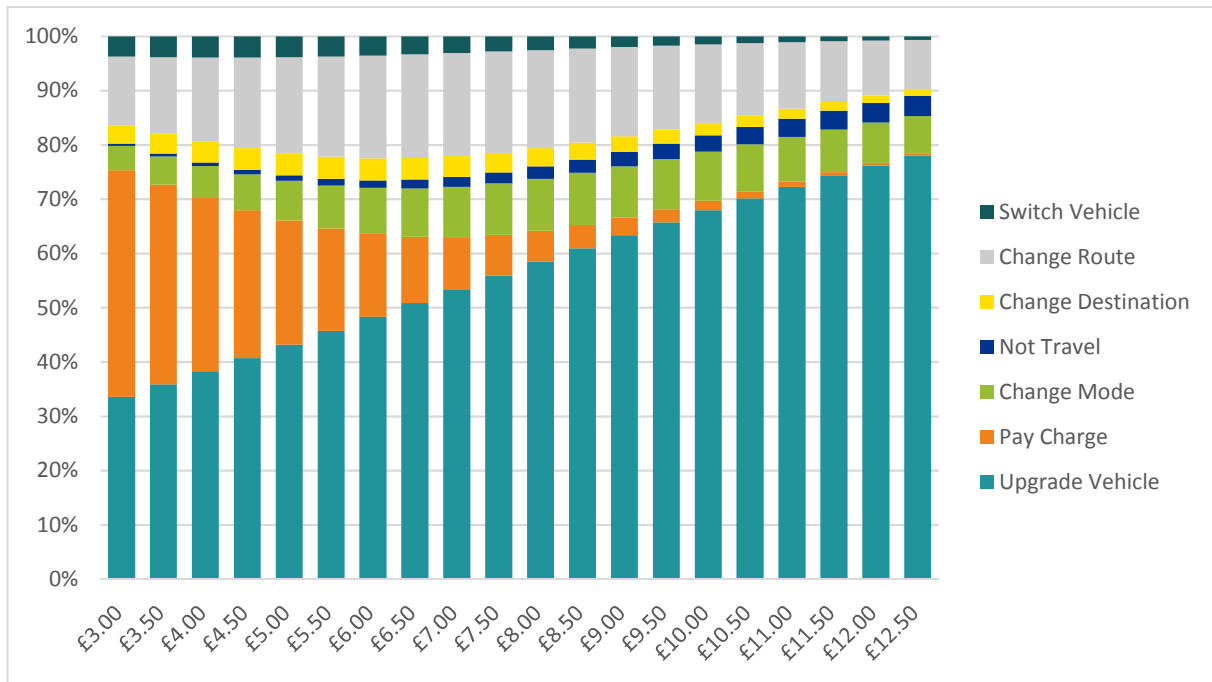


Figure B-3: Combined Model for CO High Income Small CAZ (weighted by purpose & fuel type, n=109/100)

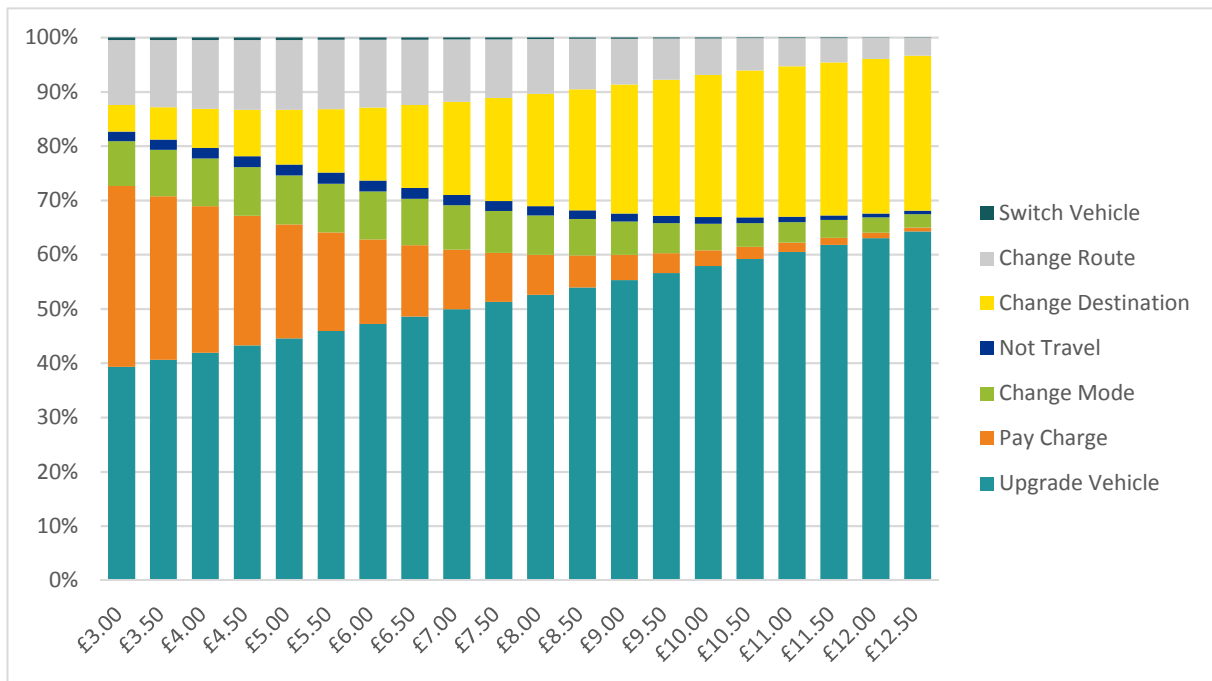


Figure B-4: Combined Model for Employer's Business Small CAZ (weighted by purpose & fuel type, n=51/47)

Results for the small zone are broadly similar to that found for the Medium Zone. Of note is the somewhat higher propensity to change mode, even amongst higher income groups, which may reflect the relatively better provision of non-car transport options into the central area and the reduced response to not travel at all which may reflect that trips into this smaller area are less discretionary.

B.2 Significance of Variables

In the process of creating the statistical models, the significance of a number of variables was considered to establish their potential impact upon the responses. Each variable considered is discussed in the following section.

B.2.1 Trip Frequency

Participants were asked to set out how frequently they drive within the zone, in order to assess whether trip frequency alters the responses to the CAZ. To test the significance of trip frequency, responses were split into 3 bands: 3 or more days a week, 1 or 2 days a week and less often than weekly and were given values of 1 to 3 accordingly.

Logistic regression models (of the same type used for the analysis presented within the main report) were then fitted for both exercises and the parameters are shown in Table B-1 and

Table B-2 for the medium zone and Table B-3 and Table B-4 for the small zone.

Table B-1: Exercise 1 Model Parameters Medium CAZ (All sample, weighted by purpose & fuel type)

Response		Coeff.	Z	p-value
Change Mode	<i>Intercept</i>	-1.675	7.7	
	<i>Charge</i>	0.316	13.1	
	<i>Frequency</i>	-0.220	3.1	0.001642797
Not Travel	<i>Intercept</i>	-2.769	12.1	
	<i>Charge</i>	0.379	15.6	
	<i>Frequency</i>	0.093	1.3	0.182801606
Change Destination	<i>Intercept</i>	-2.965	10.8	
	<i>Charge</i>	0.307	10.8	
	<i>Frequency</i>	0.116	1.4	0.168406238
Change Route	<i>Intercept</i>	-1.376	6.9	
	<i>Charge</i>	0.318	14.2	
	<i>Frequency</i>	-0.158	2.5	0.013304244
Switch Vehicle	<i>Intercept</i>	-4.086	10.7	
	<i>Charge</i>	0.299	8.1	
	<i>Frequency</i>	0.289	2.5	0.011232653

Table B-2: Exercise 2 Model Parameters Medium CAZ (All sample, weighted by purpose & fuel type)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Const	-0.39748	0.145309	7.482348	0.006231	0.672014	
Charge	-0.1213	0.011963	102.8106	3.69E-24	0.885765	0.865237
Replace	0.222495	0.012634	310.1642	2.01E-69	1.249189	1.218638
Frequency	0.22775	0.040274	31.97907	1.56E-08	1.255772	1.160458

Table B-3: Exercise 1 Model Parameters Small CAZ (All sample, weighted by purpose & fuel type)

Response		Coeff.	Z	p-value
Change Mode	<i>Intercept</i>	-2.056	8.7	
	<i>Charge</i>	0.355	13.6	
	<i>Frequency</i>	-0.234	2.9	0.003248804
Not Travel	<i>Intercept</i>	-2.799	10.8	
	<i>Charge</i>	0.345	12.6	
	<i>Frequency</i>	0.081	1.0	0.322241838
Change Destination	<i>Intercept</i>	-2.674	9.2	
	<i>Charge</i>	0.249	8.1	
	<i>Frequency</i>	0.156	1.7	0.096038913
Change Route	<i>Intercept</i>	-0.961	4.7	
	<i>Charge</i>	0.308	13.1	
	<i>Frequency</i>	-0.314	4.5	8.45847E-06
Switch Vehicle	<i>Intercept</i>	-4.197	11.1	
	<i>Charge</i>	0.289	8.0	
	<i>Frequency</i>	0.486	4.2	2.49218E-05

Table B-4: Exercise 2 Model Parameters Small CAZ (All sample, weighted by purpose & fuel type)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Const	-0.34736	0.155897	4.964743	0.025869	0.706548	
Charge	-0.13538	0.013053	107.5736	3.33E-25	0.873384	0.851324
Replace	0.2241	0.013767	264.9694	1.42E-59	1.251196	1.217886
Frequency	0.272278	0.045557	35.72073	2.28E-09	1.312952	1.200801

From the exercise 2 results it is clear that, as would be expected, reported frequency of travel is a significant predictor of the choice between upgrading the vehicle and paying the charge. For a more frequent traveller into the zone it is relatively better value to replace the vehicle.

There is no reliable data available for weighting frequency of trip, however it was considered that, to accurately assess the impact upon the zone that the survey should be weighted or factored by the reported frequency of travel within the zone. The response of someone who travels daily in the zone will have a much larger impact than someone who travels weekly.

After factoring by frequency, the significance of the reported frequency was rechecked and this is shown in Table B-5 to Table B-8.

Table B-5: Exercise 1 Model Parameters Medium CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Response		Coeff.	Z	p-value
Change Mode	<i>Intercept</i>	-1.607	7.5	
	<i>Charge</i>	0.326	13.7	
	<i>Frequency</i>	-0.261	2.5	0.011082144
Not Travel	<i>Intercept</i>	-2.598	11.3	
	<i>Charge</i>	0.364	14.5	
	<i>Frequency</i>	0.084	0.8	0.404998246
Change Destination	<i>Intercept</i>	-3.034	11.1	
	<i>Charge</i>	0.307	10.5	
	<i>Frequency</i>	0.214	1.9	0.06398069
Change Route	<i>Intercept</i>	-1.407	7.0	
	<i>Charge</i>	0.327	14.4	
	<i>Frequency</i>	-0.174	1.8	0.06483828
Switch Vehicle	<i>Intercept</i>	-2.695	7.5	
	<i>Charge</i>	0.235	6.2	
	<i>Frequency</i>	-0.200	1.1	0.254273109

Table B-6: Exercise 2 Model Parameters Medium CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Const	-0.60219	0.135763	19.67479	9.18E-06	0.547609	
Charge	-0.11756	0.011146	111.2486	5.22E-26	0.889088	0.869877
Replace	0.224496	0.011807	361.542	1.3E-80	1.251691	1.223059
Frequency	0.28295	0.0536	27.86718	1.3E-07	1.327039	1.194702

Table B-7: Exercise 1 Model Parameters Small CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Response		Coeff.	Z	p-value
Change Mode	<i>Intercept</i>	-2.230	9.0	
	<i>Charge</i>	0.373	14.5	
	<i>Frequency</i>	-0.233	1.8	0.077271949
Not Travel	<i>Intercept</i>	-2.961	10.9	
	<i>Charge</i>	0.361	12.9	
	<i>Frequency</i>	0.105	0.8	0.43122352
Change Destination	<i>Intercept</i>	-2.961	9.7	
	<i>Charge</i>	0.254	7.9	
	<i>Frequency</i>	0.314	2.2	0.029930043
Change Route	<i>Intercept</i>	-1.219	5.7	
	<i>Charge</i>	0.312	13.4	
	<i>Frequency</i>	-0.218	1.9	0.060052466
Switch Vehicle	<i>Intercept</i>	-3.771	9.5	
	<i>Charge</i>	0.229	5.5	
	<i>Frequency</i>	0.495	2.8	0.004720958

Table B-8: Exercise 2 Model Parameters Small CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Const	-0.24156	0.150087	2.590455	0.107509	0.785399	
Charge	-0.12156	0.012094	101.033	9.05E-24	0.885538	0.864795
Replace	0.232825	0.012889	326.2785	6.21E-73	1.26216	1.230674
Frequency	0.139492	0.06872	4.120347	0.04237	1.14969	1.004815

With this factoring the significance of frequency, while not eliminated, is reduced in both exercises. This drop in significance is reflected in the lower Z value and large spread in the confidence interval.

It is therefore considered that the decision to factor by reported frequency is justified and though, not perfect, is sufficient without an additional source of data for weighting.

B.2.2 Home Origin

To test the significance of home origin, processing in GIS was undertaken in order to calculate the crow fly distance between the centroid of the reported home postcode and the closest point on the boundary of the proposed zone (this value is treated as 0 for those living in the zone).

As for the trip frequency test, responses were split into 3 bands, those within 2km of the zone, those between 2 and 7km and those further than 7km. The distance values were chosen such that numbers of responses in each band were similar.

Logistic regression modelling was again undertaken and the results are shown in Table B-9 to Table B-12.

Table B-9: Exercise 1 Home Origin Test Medium CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Response		Coeff.	Z	p-value
Change Mode	<i>Intercept</i>	-1.423	6.6	
	<i>Charge</i>	0.328	13.7	
	<i>Distance</i>	-0.288	3.8	0.000126102
Not Travel	<i>Intercept</i>	-2.061	8.8	
	<i>Charge</i>	0.366	14.6	
	<i>Distance</i>	-0.231	2.9	0.003487601
Change Destination	<i>Intercept</i>	-2.936	10.2	
	<i>Charge</i>	0.306	10.4	
	<i>Distance</i>	0.102	1.1	0.28148277
Change Route	<i>Intercept</i>	-1.479	7.2	
	<i>Charge</i>	0.327	14.4	
	<i>Distance</i>	-0.083	1.2	0.238457327
Switch Vehicle	<i>Intercept</i>	-3.949	9.9	
	<i>Charge</i>	0.231	6.1	
	<i>Distance</i>	0.479	3.7	0.000195221

Table B-10: Exercise 2 Home Origin Test Medium CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Const	0.003078	0.138034	0.000497	0.98221	1.003083	
Charge	-0.11712	0.011116	111.0231	5.85E-26	0.889474	0.870305
Replace	0.223447	0.011769	360.4584	2.24E-80	1.250379	1.221867
Distance	-0.11566	0.041007	7.955445	0.004794	0.890777	0.821985

Table B-11: Exercise 1 Home Origin Test Small CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Response		Coeff.	Z	p-value
Change Mode	<i>Intercept</i>	-1.532	6.1	
	<i>Charge</i>	0.382	14.7	
	<i>Distance</i>	-0.502	5.9	3.09802E-09
Not Travel	<i>Intercept</i>	-1.883	6.8	
	<i>Charge</i>	0.370	13.1	
	<i>Distance</i>	-0.483	5.2	1.95856E-07
Change Destination	<i>Intercept</i>	-2.622	7.8	
	<i>Charge</i>	0.254	7.9	
	<i>Distance</i>	0.029	0.3	0.793965051
Change Route	<i>Intercept</i>	-0.752	3.4	
	<i>Charge</i>	0.318	13.5	
	<i>Distance</i>	-0.367	4.8	1.28181E-06
Switch Vehicle	<i>Intercept</i>	-5.320	9.1	
	<i>Charge</i>	0.218	5.2	
	<i>Distance</i>	0.922	4.8	1.37065E-06

Table B-12: Exercise 2 Home Origin Test Small CAZ (All sample, factored by frequency, weighted by purpose & fuel type)

Choice	Coeff.	Std. Err.	Z	p-value	95% Conf. Int.	
Const	0.324978	0.15455	4.421514	0.035489	1.384	
Charge	-0.12281	0.012121	102.6584	3.98E-24	0.884432	0.863668
Replace	0.234316	0.012928	328.5021	2.04E-73	1.264044	1.232418
Distance	-0.18798	0.044757	17.64006	2.67E-05	0.828631	0.759038

In Exercise 1 the distance from the zone has some weaker significance for some choices for the medium zone but stronger significant with the smaller zone. This may be because the extent of the medium zone limits options available for the smaller zone. Responses to changing mode and changing route are significantly stronger with the small zone, this matches up with these responses featuring more strongly generally for the smaller zone.

In Exercise 2 some significance is shown with both zones although this is fairly weak with the medium zone. This suggests that not all respondents were considering this exercise in an entirely hypothetical manner.

It was decided not to use any weighting for distance in the statistical model due to the lack of reliable information to weight to. Further the traffic modelling process will already account for the difference of distances from the zone for some of the responses such as trips rerouting around the zone.