THE POTENTIAL FOR 'GREEN' FISCAL POLICY MEASURES TO INFLUENCE INDIVIDUALS' VEHICLE PURCHASING DECISIONS IN SCOTLAND

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ABSTRACT

Climate change is recognised worldwide as a major concern, with serious repercussions. Observed temperature rises are increasingly being linked to human activity. Evidence indicates a strengthening vehicle-orientated society, with negative implications for climate change. To achieve the targets to mitigate climate change, governments have undertaken a series of environmental reforms to their policy measures. Pricing signals, designed to shape individuals' behaviour with incentives/disincentives, are provided via government-led fiscal policy.

This research focuses upon those measures targeting individuals' future vehicle purchasing behaviour. Environmental savings are achieved by purchasing a relatively lower emission vehicle than the vehicle most often used at present. This research explores the weighting of situational and psychological factors shaping individuals' future vehicle purchasing decisions. The modifications to current taxation policy, deemed necessary to *start* thinking about, *seriously* think about and *definitely* buy a lower emission vehicle, are also investigated. The potential influence of hypothetical policy measures to further encourage a lower emission vehicle purchase is also considered.

To address the aforementioned research topics, a postal questionnaire survey was administered to a sample of Scottish motorists. 1,336 responses were collected, equating to a response rate of 28.3%. Cluster analysis was applied to the overall population, and the differences subsequently evaluated.

For the Scottish motoring population, situational factors were generally more influential than psychological factors in informing individuals' future vehicle purchasing decisions. Disaggregating the population into segments indicates variation in the factors driving individuals' future vehicle purchasing behaviour. Revised behavioural models were presented to visually demonstrate the differences. The strength of psychological constructs provides insight into the preparedness of individuals to purchase a lower emission vehicle, and thus the type of policy interventions most effective in influencing future vehicle purchasing behaviour.

Results indicate a sizeable potential for using vehicle excise duty, value added tax, hydrocarbon oil duty and the plug-in car grant to shape individuals' future vehicle purchasing decisions towards a lower emission vehicle. This reported influence was generally found to increase as individuals become more prepared to purchase a lower emission vehicle in the future. Tax incentives were identified as more influential than disincentives in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. This is particularly so as individuals become more prepared to purchase a lower emission vehicle. In keeping with established psychological theory regarding behaviour change, individuals were found to require a progressively greater tax incentive/disincentive to advance through the behaviour change process towards purchasing a lower emission vehicle. Those individuals most prepared to purchase a lower emission vehicle were generally found to require the lowest incentive/disincentive to change their future vehicle purchasing behaviour towards such a vehicle.

Motorists were found to be most influenced by hypothetical policy measures reoccurring throughout the period of vehicle ownership, followed closely by those present at the time of vehicle acquisition. Across all segments, a proposed 'feebate' system presents the best opportunity for shaping future vehicle purchasing behaviour towards a lower emission vehicle. However, the reported influence of hypothetical policy measures was largely found to increase as individuals become more prepared to purchase a lower emission vehicle.

Collected results are discussed in context of past research and current transport policy. A series of recommendations, directed towards both future researchers and policy makers, are then presented.

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ACRONYMS

AFV	Alternative Fuelled Vehicle
ANOVA	Analysis Of Variance
BI	Behavioural Intention
CCs	Cubic Centimetres
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
EC	European Commission
EU	European Union
FDE	Fuel Duty Escalator
FYR	First Year Rate
g/km	Grams per Vehicle Kilometre
GHG	Greenhouse Gas
HOD	Hydrocarbon Oil Duty
IPCC	Intergovernmental Panel on Climate Change
LEVL	Low Emission Vehicle Lane
LPG	Liquefied Petroleum Gas
MaxSem	MAX Self Regulation Model
MPG	Miles Per Gallon
N/A	Non Applicable
PICG	Plug-In Car Grant
PPKG	Pence Per Kilogram
PPL	Pence Per Litre
RTFO	Renewable Transport Fuel Obligation
RUC	Road User Charging
SHS	Scottish Household Survey
SIS	Scrappage Incentive Scheme
SP	Stated Preference
SPSS	Statistical Package for the Social Sciences
SR	Standard Rate
TPB	Theory of Planned Behaviour
UK	United Kingdom
URL	Uniform Resource Locator
USA	United States of America
VAT	Value Added Tax
VBN	Values Beliefs Norms
VED	Vehicle Excise Duty

1 INTRODUCTION

1.1 Chapter overview

This chapter initially presents the context for this research. It discusses the issue of climate change and its relationship with road transport. The research focus is then considered: examining individuals' future vehicle purchasing behaviour and the potential for policy interventions to encourage the purchase of a less environmentally damaging vehicle. The chapter concludes with an overview of the five remaining chapters.

1.2 Climate change

Energy consumption is considered a key driver in the development of industry and society in the 21st century. The 'industrial revolution' has greatly contributed towards growing energy consumption. As new means of producing energy are developed, new uses are found, thus increasing demand. Energy consumption increased radically from the mid-1980s in the United Kingdom (UK), peaking at 236.9 million tonnes of oil equivalent in 2001. In the past decade, energy consumption has reduced towards 200 million tonnes, which is nevertheless an improvement, but still a substantial amount (DECC, 2012a).

Energy consumption does, however, come with a price. Burning fossil fuel results in the production and release of greenhouse gases (GHGs) into the atmosphere. Six primary GHGs are recognised by the UN Framework Convention on Climate Change (2013): carbon dioxide (CO_2); methane; nitrous oxide; hydrofluorocarbons; perfluorocarbons; and sulphur hexafluoride. Whilst CO_2 is not the most harmful GHG, it is produced in the largest quantities, making it the most significant pollutant. Global GHG emissions have increased by 70% from 1970-2004, whilst global CO_2 emissions rose by 80% during the same period, representing 77% of total emissions (Barker *et al.*, 2007). Further growth for GHG emissions, including CO_2, is forecast if no corrective action is taken (Solomon *et al.*, 2007).

The concentration of GHGs around the Earth trap too much heat from the sun, causing global warming. By 2080, Hulme *et al*. (2002) estimates the UK to have experienced temperature increases up to 3.5^{o}C, with up to 30% more annual precipitation in winter and 50% less annual precipitation in summer. The Intergovernmental Panel on Climate Change (IPCC) offers various projections regarding future climate changes (Solomon *et al.*, 2007). Further estimates have also been produced for regions across the UK regarding precipitation and temperature up to 2080. For example, Scotland is set to face warmer, wetter winters and hotter, drier summers (UK Climate Projections, 2012). DEFRA (2012a) also recognises some characteristics specific to Scotland resulting in different opportunities/threats and scale of future climate impacts. Beyond the obvious changes in climate, there are also spillover effects on the natural environment, agriculture and forestry, businesses, buildings and infrastructure, health and wellbeing which should not be disregarded (Barker *et al*., 2007; DEFRA, 2012b).

Climate change has been recognised as a major concern with serious repercussions worldwide. More importantly, it is *"not just a threat for the future... it is a reality now"* (Scottish Government, 2012a, p.1). Stern (2006) argues the consequences for the global economy would be catastrophic if mitigation techniques are delayed. The cost of climate change mitigation now is estimated by Stern (2006) as 1% of gross domestic product, a significant yet manageable amount. Mitigation costs could, however, rise to 20% of gross domestic product if action is delayed. This stresses the importance of not delaying remedial action.

There is a growing consensus that past temperature increases were linked to human activity. The IPCC have concluded it was *"very likely"* most of the warming observed since the 1950s could be attributed to anthropogenic forces (Solomon *et al*., 2007, p.10). Their 2013 report advocated even greater certainty regarding the influence of human behaviour upon climate change (Alexander *et al*., 2013). The potential for climate change mitigation is therefore within the control of the population.

1.3 Government targets for climate change mitigation

The European Commission (EC, 2007a) acknowledges a 2^{o}C ceiling for global surface temperatures relative to pre-industrial levels to prevent dangerous and irreversible anthropogenic climate change. To achieve this, Barker *et al*. (2007) indicates global GHGs should peak no later than 2015. Subsequent reductions of 50-80% should also be realised by 2050 compared to 2000 levels.

Consequently, numerous targets and agreements have been implemented by governments, both nationally and internationally, to manage the growing problem of climate change. In the European Union (EU), for example, EU-15 countries had a collective target of an 8% reduction from 1990 levels for the period 2008-2012 under the Kyoto Protocol. In 2011, all countries except Slovenia were likely to meet this target

(European Environment Agency, 2012a,b). For 2012-2020, the EU has pledged to reduce GHG emissions by 20% from the 1990 baseline for the EU Climate and Energy Package. The 2012 estimates suggest that most countries are confident in meeting the 2020 targets (European Environment Agency, 2012b). Individual targets were also issued to individual countries within the EU. For example, the UK was to reduce GHG emissions by 12.5% from 1990 levels for 2008-2012. The target intensifies to a 16% reduction from 2005 levels for 2013-2020. By 2011, a 24.7% reduction had been satisfied (European Environment Agency, 2012b; EC, 2013a). In 2008, the UK was the first country worldwide to impose a legal commitment to reduce GHG emissions (the same six gases recognised by the UN Framework Convention on Climate Change, 2013). The Climate Change Act 2008 requires an 80% emissions reduction by 2050 from 1990 levels (Climate Change Act, 2008).

Specific to Scotland, the Climate Change Scotland Act received Royal Assent in 2009 (Climate Change Scotland Act, 2009). Akin to the UK Climate Change Act 2008, an 80% GHG emissions reduction (using the UN Framework Convention on Climate Change, 2013 definition) has been targeted for achievement by 2050. Interim and annual targets have also been established to drive progress (Climate Change Annual Targets Scotland Order, 2010; Scottish Government, 2011a). Scotland's target is recognised as a *"historic, groundbreaking bill that sets an international example"* (Scottish Government, 2013a, p.1). Despite Scotland being responsible for only 0.2% of global GHG emissions (Scottish Government, 2009a), Scotland is seemingly keen to excel in GHG mitigation. This is evident from previous GHG reductions, where Scotland led the EU-15 league table for 1990-2011 with a 29.6% reduction, compared to the average of only 12.7% (Scottish Government, 2013b).

1.4 Vehicle ownership trends

There is substantial evidence indicating a strengthening vehicle-orientated society, both nationally and internationally (Goodwin, 1999). This is reinforced by motor car advertising and peer-group pressure (Stradling, 2000; Ison and Ryley, 2007). Stradling *et al*. (2000a) identified six main journey types undertaken by individuals in their private vehicle (***Figure 1***), highlighting the range of uses and dominance.

Driving as part of work

- Stradling *et al.* (2000b) identified 64% of employees drove a car as part of their work at least some of the time.

Driving to and from work

- Stradling *et al.* (2000b) found 69% of car driving employees used their car to travel to and from work every working day.

Child escort duties

- Ferrying children around, including locations such as schools.

Life and network maintenance

- Activities such as shopping, visiting friends/relations and evenings out.

Driving for holidays

- Including weekends away.

Life enhancement activities

- Activities such as voluntary work, hobby support or simply driving for pleasure.

Figure 1: Six main journey types undertaken by motorists in a private vehicle (Stradling et al., 2000a)

The proportion of the UK population with a full driving-licence (a general prerequisite for vehicle ownership) has been gradually increasing over the past decade. From 2002-2010, a further 3% of motorists now hold a full driving-licence (72.8% in 2010; DFT, 2010a). The equivalent Scottish figure is 67.6% which is still sizeable, although slightly less than the UK overall (Scottish Government, 2012b).

Approximately 200 million passenger vehicles were licensed in EU-15 countries in 2010, representing a 13% increase from 2002 (Scottish Government, 2003, 2012b). Relative to the population, this equals 50.5 passenger vehicles per 100 population in 2010, compared to only 46.9 in 2002. New registrations have however fallen since 2002. 12.3 million new vehicles were registered in 2011, compared to 14.3 million in 2002. This equates to 3.1 new vehicles per 100 population in 2011, falling from 3.8 in 2002 (Scottish Government, 2003, 2012b). This indicates that older vehicles are remaining in circulation longer to increase the overall vehicle fleet.

A similar situation is observed in the UK. Passenger vehicles have increased by 17% to 29.3 million from 2002-2010 (slightly higher than the growth experienced in EU-15 countries). This translates as 47 passenger vehicles per 100 population, having increased from 41.9 in 2002 (slightly lower than the equivalent for EU-15 countries; Scottish Government, 2003, 2012b). New UK vehicle registrations also fell from 3.7 per 100 population in 2002 to 3.1 in 2011 (identical to the EU-15 figure; Scottish Government, 2003, 2012b). The DFT (2012a) attributes this reduction to the recession in the 2000s and prevailing economic conditions.

Vehicle ownership is also increasing in Scotland. In 2010, a record 2.7 million motor vehicles were licensed (Scottish Government, 2012b). The number of licensed vehicles has increased by 15.2% from 2002 (slightly less than the UK overall, but greater than the EU-15 figure) and almost 200% from 1962 (Scottish Government, 2003, 2012b). This translates as 43.6 vehicles per 100 population in Scotland in 2010 (lower than the UK and EU-15 figures). 208,000 new vehicles were registered in 2010 in Scotland. This figure has fluctuated over the years, having fallen by 20% from 2002, but increased by 135% from 1962 (Scottish Government, 2003, 2012b). New vehicle registrations in Scotland equates to 3.2 vehicles per 100 population in 2011 (still slightly greater than the UK and EU-15 figures), although this figure is lower than 2002 at 3.7.

The composition of cars per household also reflects vehicle growth on Scotland’s roads. From 2002-2010, the proportion of households with no vehicle access has fallen to 30%. Conversely, households with access to at least one vehicle have increased to 70% during the same period (Scottish Government, 2012b). This figure is slightly below the 75% UK average, although still substantial and likely to increase over time (Scottish Government, 2012c).

Vehicle ownership in Scotland is also affected by urban/rural differences. 94% of Scottish land mass is classed as ‘rural’, with almost 20% of the population residing in such locations (Scottish Government, 2012d). The Scottish Government uses a six-fold urban/rural classification based on population size and accessibility (***Figure 2***).

Vehicle accessibility varies across the six-fold urban/rural classification. For example, 87% of households in 2011 in accessible rural areas had access to at least one vehicle, compared to only 61% of households in large urban areas. Similarly, 44% of accessible rural areas in 2011 had access to two or more vehicles; contrasted with only 18% of households in large urban areas (Scottish Government, 2012b). Vehicle ownership is recognised as a prerequisite for an acceptable standard of living recognising the absence, cost or inconvenience of public transport (Farrington *et al*., 1995; Shucksmith *et al*. 1996; Gray *et al*., 2001). Further differences are observed regarding the proportion of the population with a full driving-licence, ranging from 60% in large urban areas to 82% in accessible rural towns. Furthermore, the population in rural Scotland has increased at a faster rate than the rest of Scotland. Specifically, a 6.2% population increase in remote rural areas from 2001-2010, a 12.1% increase for accessible rural areas, and only a 1.7% increase for the rest of Scotland (Scottish Government, 2012b). Recognising this structure, it is likely vehicle ownership will increase in Scotland (Scottish Government, 2012d).

Large urban areas
- Over 125,000 people.

Other urban areas
- 10,000-125,000 people.

Accessible small towns
- 3,000-10,000 people residing within a 30 minute drive to a settlement with at least 10,000 people.

Remote small towns
- 3,000-10,000 people, with at least a 30 minute drive to a settlement with at least 10,000 people.

Accessible rural areas
- Less than 3,000 people residing within a 30 minute drive to a settlement with at least 10,000 people.

Remote rural areas
- Less than 3,000 people, with at least a 30 minutes drive to a settlement with at least 10,000 people.

Figure 2: Six-fold urban/rural classification (Scottish Government, 2012d)

A final point to consider is the possibility of ‘peak car’. That is, observations of low growth or even a decline of car use per head. Studying UK data from 1990 to 2009, Goodwin (2012) argued that vehicle miles driven and overall automobile usage per head had in fact plateaued. Similar views were expressed by Metz (2010, 2012). Nevertheless, other researchers such as Glaister (UK Parliament, 2011) advocate steady growth in total traffic since the 1950s. Indeed, the UK DFT (2012f) forecast a return to the road traffic growth trend evident before the recession, with a 44% growth anticipated from 2010 to 2035. In assessing the phenomenon of ‘peak car’, consideration must be given not only to vehicle mileage per head, but also car ownership. Le Vine and Jones (2012) reviewed British data from the National Travel Survey from 1995 to 2007. Whilst a reduction in mileage per car was observed, car ownership had in fact increased during that time period. Collectively, this resulted in a 3% increase in average mileage per person, deemed a relatively “stable” level of growth from 1995 (Le Vine and Jones, 2012, p.109).

1.5 Environmental trends from the transport sector

Whilst the transport sector is a major player in economic growth, the environmental impact is far from positive. The aforementioned vehicle ownership growth will contribute negatively towards the environment, with the burning of fossil fuels to transport individuals/goods. Although GHG emissions arise from all sectors of industry, the transport sector is underperforming in GHG/climate change mitigation. In EU-15 countries, for example, total GHG emissions from all sectors fell by 10.9% from 1990-2010. In contrast, road transport GHG emissions increased by 16.3% over the same period (European Environment Agency, 2013). The EC (2007a) notes the transport sector potentially jeopardises improvements made by other sectors. Worryingly, the EC (2012a) suggests the growth from transport could have been much higher without the economic recession of the 2000s.

A similar situation is evident for UK road transport. GHG emissions from all sources fell by 23.6% from 1990-2010; whilst emissions from transport increased by 1.6% during the same period (DFT, 2012a). This is largely consistent with the situation in Scotland. Emissions from all sectors fell by 22.8% from 1990-2010; whilst road transport emissions increased by 3.8% (Scottish Government, 2012b). In 1990, only 12% of Scotland's total GHG emissions were attributable to road transport, rising to 16.9% by 2010 (Scottish Government, 2012b). Scotland contributed 8.5% of the UK's total GHG emissions from road transport. Whilst this figure does not appear overly threatening, it has been rising slowly from 1990 (AEA, 2012).

1.6 Policy measures to mitigate CO_2 emissions from transport

In 2005, the European Parliament called for *"a policy of strong measures to reduce emissions from transport"* (EC, 2005a, p.5). European policy embraces a range of measures targeting both market supply and demand (EC, 2007a). Voluntary or mandatory agreements with the automobile industry are a good example of a supply-orientated measure. The presence of a target should inspire innovation and technological advancement (EC, 2007a).

Regarding demand-orientated approaches, the provision of consumer information is an important part of European policy. This includes the colour-coded labelling of fuel economy and CO_2 emissions for new cars in showrooms, for more informed decision making at the point of sale. Poster displays within dealerships and the inclusion of fuel efficiency data in promotional material also better informs individuals' vehicle purchasing behaviour (EC, 2000a).

Another example of a demand-orientated measure is fiscal based. Taxation measures can be used to shape motoring behaviour by simply making CO_2 emissions or fuel economy/miles per gallon (MPG) as the tax base (EC, 2000b). The EC (2007b) maintains environmental taxation as a proven instrument to influence individuals' vehicle purchasing behaviour and thus support environmental policy goals. European countries were noted to have an important responsibility in setting their vehicle taxation policy (EC, 2007c). The more rigorous application of CO_2-related tax and other fiscal incentives has been advocated for future policy (EC, 2005b, 2007a).

Regarding UK policy to reduce GHG emissions from road transport, the Carbon Plan embraces a similar range of supply and demand orientated measures (HM Government, 2011). Consideration is directed towards research and development for improving the traditional internal combustion engine and developing ultra-low emission vehicles (Ekins *et al*., 2009a; Committee on Climate Change, 2009). Vehicle technology demonstrations are also discussed in the Carbon Plan, attempting to bridge the issue of consumer acceptability. Research by Schneider *et al*. (2014) highlighted the importance of visibility and observability in improving consumer acceptance of novel vehicle technologies. Measures to increase the supply of renewable fuel were also considered at UK level, including the Renewable Transport Fuel Obligation (RTFO) to promote biofuels. The supply of infrastructure to support advancing vehicle technology was also recognised, e.g. for recharging an electric vehicle, managed by the Plugged-in Places programme. The performance standards imposed by the EC, discussed earlier, also feeds through to UK policy to influence supply.

Regarding policy measures shaping consumer behaviour and thus demand, fiscal policy is the main approach considered by the UK Government. Some recognised examples include the plug-in car grant (PICG), vehicle excise duty (VED), and company car tax.

The Scottish Government holds responsibility for only some devolved areas of policy. It is thus recognised that *"Scotland is supported, and constrained, by levels of ambition and policy levers held at UK and EU levels"* (Scottish Government, 2009b, p.3). A number of key policy measures therefore exist beyond the scope of the Scottish Government, including vehicle taxation administered at UK level. In addition to the aforementioned UK and EU policy measures, Scotland's remit for reducing road transport emissions includes a focus on infrastructure. Research and development for advancing vehicle technologies including fuel sources is also considered; for example the Hydrogen and Fuel Cells Support Scheme (Scottish Government, 2009c). Incentives for both the supply and demand of alternative road-fuels in Scotland are also embraced by the Scottish Government (2009c).

1.7 Research focus

This research recognises the significance of climate change and the damaging contribution arising from road transport. This research investigates the purchasing decision for a private vehicle in Scotland. It therefore provides further insight into vehicle demand management. Greater knowledge of how transport policy can shape individuals' future vehicle purchasing behaviour will benefit those responsible for policy decisions at government level. The results of this research will also benefit academics, with a greater understanding of the behaviour change process for purchasing a vehicle.

In 2010, Transport Secretary Philip Hammond acknowledged the dominance of road vehicles across the UK. He argued *"we can't ignore [the fact] that 84% of journeys are made by car and there is no realistic prospect of displacing the private car for point to point complex journeys"* (DFT, 2010b, p.1). Whilst there is some evidence of the 'peak car' phenomenon in the UK (***section 1.4***), the observed growth in car ownership signifies the need for further research focussing upon vehicle purchasing behaviour, including the type of vehicle bought. Indeed, the 'peak car' analysis fails to recognise the environmental properties of vehicles being driven less often.

Hammond has also argued that environmental mitigation would *"not be achieved by forcing people off the road"* (DFT, 2010b, p.1). This viewpoint is advocated in this research, recognising that environmental savings can be achieved by purchasing a relatively lower emission vehicle than the vehicle most often used at present. Lower emission vehicles can provide the majority, if not all, the benefits of private motoring but with a lower environmental impact/carbon footprint (Pindyck, 1980; Environmental Audit Committee, 2008).

The range of vehicles falling under the definition of a lower emission vehicle is entirely dependent upon the current vehicle owned. For example, if motorist A currently drives a vehicle emitting 200 grams per vehicle kilometre (g/km) of CO_2, a lower emission vehicle would emit 199g/km of CO_2 or less. If motorist B currently drives a vehicle emitting 120g/km of CO_2, a lower emission vehicle would emit a maximum of 119g/km of CO_2. The range of possible lower emission vehicles for motorist A is therefore much bigger than those available to motorist B. A minimum 1g/km saving of CO_2 may sound insignificant, but this will accumulate over every km driven. Average annual mileage of UK private vehicles was 7,800 (DFT, 2013a), equating to 12,553km[1] and thus 12,553 grams of CO_2 saved during only one year.

A lower emission vehicle may be fuelled by an alternative fuel source, e.g. biofuels, electricity, hydrogen (collectively referred to as an alternative fuelled vehicle; AFV[2]). Conversely, a lower emission vehicle may simply utilise a conventional petrol/diesel internal combustion engine. Conventional fuelled vehicles are argued to bring the largest short to medium term emission savings, rather than AFVs (WWF, 2011; Kay *et al*., 2013). For a lower emission vehicle, the crucial feature is the carbon footprint must be lower than the current vehicle. All other vehicle characteristics are at the discretion of the motorist. Thus, conventionally powered petrol/diesel vehicles and AFVs are considered in the remaining chapters as possible types of lower emission vehicles.

Lower emission vehicles exist within the same vehicle class (King, 2008; Kay *et al*., 2013). For example, the SMMT (2011a) calculates an emission saving of at least 25.7% by choosing the best-in-class CO_2 emitting vehicle rather than the average emitting vehicle. Even within the same vehicle model, Peters *et al*. (2008) acknowledges the scope for improving CO_2 emissions. For example, CO_2 emissions for subcompact petrol engine vehicles are estimated to range from 140-200g/km (Ryan *et al*., 2009). However, there is a popular misconception amongst motorists that little difference exists between vehicles in the same class and vehicle model (Ryan *et al*., 2009; Lane and Banks, 2010).

However, the lower emission vehicle definition does become ill-defined when individuals are acquiring a vehicle for the first time. No previous vehicle therefore exists as a starting point for calculating a lower emission vehicle. This aspect was considered as a separate piece of research (***Appendix A2***) to complement the main thrust of this research focusing only upon 'active' motorists.

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[1] Where 1 mile equals 1.6093km.
[2] AFVs are thus considered as a possible lower emission vehicles in remaining chapters.

1.8 Research aim

The overriding aim of this research is to examine individuals' future vehicle purchasing decisions, with particular focus towards the role of 'green' fiscal policy measures in shaping purchasing behaviour towards lower emission vehicles. Specific research questions are presented in ***Section 2.12.2***.

1.9 Structure of remaining chapters

Chapter 2 provides a review of literature regarding individuals' vehicle purchasing behaviour. The chapter begins with an overview of current understanding of the behaviour change process. Individuals' future vehicle purchasing behaviour is considered next, recognising the range of situational and psychological factors influencing vehicle choice. The significance of this research through identification of gaps in existing literature concludes this chapter.

Chapter 3 discusses the research methods applied in this study. The chapter included consideration of the rationale for the questionnaire survey. The target population and sampling approach is subsequently documented, followed by the design and content of the questionnaire. The data collection process and analytical techniques employed are then discussed.

Chapters 4-7 present the results of the questionnaire survey. Results are considered for the Scottish motoring population overall and the sub-groups within the population. Specifically, individuals with either a Low, Medium or High behavioural intention (BI) towards purchasing a lower emission vehicle in the future; and the 'green' segments identified according to the factors shaping future vehicle purchasing behaviour.

A profile of the sample is first presented in ***Chapter 4***, considering both socio-demographic factors and motoring behaviour. The importance of situational and psychological factors in individuals' future vehicle purchasing decisions are presented in ***Chapter 5***. The modification to current taxation measures to encourage a lower emission vehicle purchase are documented in ***Chapter 6***. This is followed by the hypothetical policy measures to potentially be introduced to further encourage a lower emission vehicle purchase in ***Chapter 7***.

Chapter 8 offers a discussion of the findings. This includes consideration of current knowledge relative to the results and a reflection on the apparent success of current transport policy in the UK/Scotland.

Chapter 9 concludes the thesis, including final consideration of the research questions, and a summary of the main findings. Research limitations and the implications on the results are then discussed. Recommendations for future policy setting and future research conclude this chapter.

2 LITERATURE REVIEW

2.1 Chapter overview

This chapter presents the current state of knowledge regarding individuals' future vehicle purchasing behaviour and the potential for behaviour change. Models of behaviour and the behaviour change process are discussed in context of purchasing a lower emission vehicle in the future. The Lane and Potter (2007) model of factors influencing individuals' future vehicle purchasing behaviour underpins this research. This model is subsequently evaluated in-depth, including situational and psychological factors. Particular attention is directed towards the economic environment, primarily taxation and subsidies. Previous attempts at segmentation are then considered, including those relating to individual's current transport behaviour and attitudes towards the environment. This chapter concludes with an evaluation of the significance of this research through identification of the gaps in the existing literature. The research aim/objectives end this chapter.

2.2 Understanding behaviour and behaviour change

It is vital to understand individuals' future vehicle purchasing behaviour and the thought process informing the decision. Greater comprehension will better inform policy making and ultimately achieve the desired behaviour shift (Carreno and Welsch, 2009). Various theories and conceptualisations of behaviour and behaviour change are subsequently considered.

2.2.1 Models of behaviour and theories of change

Behavioural models have been studied since the mid-twentieth century, initially used in health and social sciences, but more recently applied to transport. Models are used to understand specific behaviours and the factors/motivations behind them (Darnton, 2008a). The drivers of behaviour change can therefore be identified and policy interventions can be designed accordingly (Jackson, 2005).

Despite the widespread use of behavioural models, some limitations should be recognised. Whilst the factors influencing behaviour are demonstrated, Darnton (2008b) suggests the behaviour change process is somewhat implied. Indeed, Triandis (1977, p.20) argues models should be viewed as *"a quick and imprecise way of organising a lot of information… to make more theoretical statements possible"*. Models are also deliberately simple to aid understanding. Observed behaviour is often more complex and there are likely to be other unconsidered factors beyond the model (Ajzen, 1991). Models are also argued not to differentiate between various audience groups, instead often focusing on the behaviour of the population overall. However, cluster analysis can be utilised to highlight the significance of constructs to each identified population group (Darnton, 2008a). The results for each segment can also be presented in a behavioural model.

2.2.2 Economic theory of behaviour

The rational choice or expectancy-value model is founded upon standard economic theory. Individuals are said to be motivated by their wants/goals, representing their preferences (Crouch, 1979). Choices are made to reflect these goals and the means of achieving these goals, including finance and time (Scott, 2000). Recognising the problem of scarcity (Heath, 1976; Levi, 1997), individuals undergo a cost-benefit analysis for each possible course of action (Simon, 1955; Coleman, 1973). Individuals strive for a positive balance of benefits over costs to maximise their own personal benefit/utility (Homans, 1961; Simon, 1997). In context of purchasing a lower emission vehicle, the rational choice model indicates individuals will evaluate all the associated costs and benefits of the decision. This will be used to decide whether purchasing a lower emission vehicle will bring a net benefit.

The rational choice model has, however, been subject to criticism. Information availability is often limited for individuals to base their decision (Simon, 1957), which invalidates the model's assumption of perfect information. Information asymmetry is also recognised, particularly for AFVs (Kurani *et al*., 2007a). Uncertainties exist in assessing future costs and benefits, e.g. quantifying environmental impacts. Furthermore, future predictions are not always accurate (Steg, 2003). For example, Turrentine and Kurani (2007) suggest individuals are often unaware of their current vehicle's fuel consumption and running costs. These are often used as a benchmark for calculating future potential savings. Dawnay and Shah (2005) suggest individuals often lack computational skills for decision making, including calculation of the payback period (Anable *et al*., 2008; Lane and Banks, 2010).

Furthermore, Jackson (2005) argues human behaviour is also influenced by non-economically rational aspects, including moral, social and altruistic behaviour. Heuristics and cognitive evaluation is also recognised by Bettman *et al*. (1998) and Kahneman (2003). Psychological factors have thus been advocated to better explain human decision making.

2.2.3 Psychological considerations of behaviour

Psychology offers a wide range of approaches/models to explain behaviour. "*Behaviour is such a complex one that it cannot be visualised through one single framework or diagram"* (Kollmuss and Agyeman, 2002, p.239). Even if there was accord, individuals are not necessarily consistent in their values, thoughts and ultimately their behaviour (Kurani and Turrentine, 2002; Darnton, 2008a).

Research has highlighted two key facts essential to understanding behaviour and the process of change from a psychological perspective (Carreno and Welsch, 2009). First, some individuals are recognised as more susceptible or ready to change their behaviour than others within the population (Anable, 2005; Anable *et al*., 2006). The barriers to behaviour change can be psychological, e.g. attitudes, or situational in nature, e.g. infrastructure (Steg, 2003; Carreno and Welsch, 2009). Policy interventions should therefore recognise not only the variation in obstacles, but also the variation in individuals. Segmentation is a key tool to illustrate these differences. Second, the behaviour change process is increasingly acknowledged not to necessarily occur in a single transformation. Instead, it manifests itself over a series of transitional stages (Bamberg *et al*., 2011; Bamberg, 2013). Individuals progress through various steps towards the actual behaviour change. Regarding policy interventions, actual behaviour change may not always appear. Instead, subtle changes in individuals' attitudes and perceptions may arise, making individuals more ready to change their behaviour (Carreno and Welsch, 2009). It is thus important to measure these subtle changes, all contributing towards the ultimate behaviour change.

2.2.4 Past attempts to conceptualise individuals' future vehicle purchasing behaviour

Past conceptualisations of individuals' future vehicle purchasing behaviour have traditionally focused upon aspects such as vehicle attributes, e.g. fuel efficiency and financial considerations, and the characteristics of the household/principal driver, e.g. household/individual income, education and age (Train, 1986; Golob *et al*., 1997; Choo and Mokhtarian, 2004; Sprei and Wickelgren, 2011). Models have since been expanded to include aspects such as attitudes, personality and lifestyle choices (Choo and Mokhtarian, 2004; Turrentine and Kurani, 2007; Nayum *et al*., 2013). Models lacking these subjective aspects are argued by Kurani *et al*. (2007b) as somewhat misleading in understanding individuals' future vehicle purchasing behaviour. Kollmuss and Agyeman (2002) and Steg (2003) recognise the influence of situational and psychological strategies to induce behaviour change. They advocate a two-way relationship between the factors. That is, situational changes may influence the preferences and attitudes of individuals; and changes in psychological standing may lead to the transformation of social structures. Subjective perceptions of situational factors are recognised as often influencing purchasing behaviour, rather than the actual situational factors prevailing (LowCVP, 2006; Lane and Potter, 2007).

One of the most comprehensive models explaining individuals' future vehicle purchasing behaviour is the Lane and Potter (2007) model (***Figure 3***). The model highlights the multifaceted nature of individuals' future vehicle purchasing decisions. Situational and psychological factors are recognised, including the role of feedback in reinforcing/rejecting past decisions.

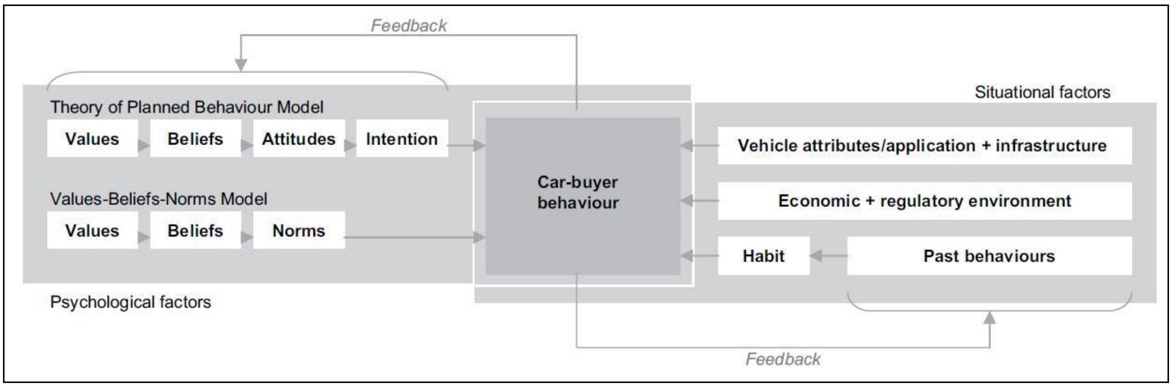

Figure 3: Model of factors influencing individuals' future vehicle purchasing behaviour (Lane and Potter, 2007)

Situational factors concern the social conditions and structures prevailing. Lane and Potter (2007) identify: vehicle attributes/application; the provision of infrastructure; the economic and regulatory environment; past behaviour and habits. In contrast, psychological factors relate to individuals' attitudes, perceptions, beliefs, values and norms (Schade and Schlag, 2003). These subjective factors make some individuals more predisposed or willing to change their behaviour, e.g. purchase a lower emission vehicle, than others (Bamberg *et al*., 2011). Two behavioural models are recognised by Lane and

Potter (2007), each comprising a range of psychological constructs, conceptualising a different thought process towards a new behaviour. Namely, the Theory of Planned Behaviour (TPB), recognising values, beliefs, attitudes and intention; and the Values Beliefs Norms Model (VBN), recognising values, beliefs and norms.

Feedback is recognised by Lane and Potter (2007) as influencing individuals' future vehicle purchasing behaviour. Feedback is received on past vehicle purchasing behaviour, including financial signals from taxation/subsidies, rewarding/penalising according to behaviour (Scott, 2000). This feeds into individual's purchasing habits and ultimately future vehicle purchasing behaviour. Feedback received on past behaviour can also be used to reinforce or reject individuals' psychological standing. For example, attitudes and perceptions towards the car as a status symbol may lead to self-sustaining but non-environmental behaviour (Golob and Hensher, 1998). An *ex-post* evaluation is likely to inform future behaviour.

Several weaknesses of the Lane and Potter (2007) model should also be acknowledged. First, the model assumes an equal weighting of: [1] situational to psychological factors; and [2] all types of situational/psychological factors to one another. Second, advances have been made in understanding behaviour beyond the TPB and VBN model identified by Lane and Potter (2007). Finally, the Lane and Potter (2007) model is a one-size-fits-all conceptualisation of vehicle purchasing behaviour. The merits of segmenting the population are outwith the scope of the Lane and Potter (2007) model. Recognising these inherent weaknesses, a revised behavioural model derived from the results of this research is presented in ***Chapter 5***. The situational and psychological factors identified by Lane and Potter (2007) are subsequently discussed, with particular reference to a lower emission vehicle purchase.

2.3 Vehicle attributes/application as a situational factor

When contemplating future vehicle choice and the necessary attributes, the deliberation process comprises two stages (Mueller and de Haan, 2009). The first step includes vehicle class (Boardman *et al*., 2000), performance and price (DFT, 2003; Lane, 2005; Mueller and de Haan, 2009). This is used to derive a list of vehicles for consideration in the second stage. The best alternative is identified based on considerations such as running costs, vehicle performance, available fuel types, engine sizes, image/style and reliability (DFT, 2003; Mueller and de Haan, 2009). The final sales package offered by the vehicle dealership can often secure the vehicle selection (DFT, 2003). When visiting a vehicle showroom, the majority of individuals are likely to have already identified at least two vehicle models they are most interested in potentially buying (Boardman *et al*., 2000; Lane and Banks, 2010).

Numerous studies have investigated the importance of vehicle attributes in individuals' future vehicle purchasing decisions (***Figure 4***). There is a general consensus in past research regarding the importance of financial considerations, e.g. price and running costs, and vehicle performance, e.g. fuel consumption, size, reliability, comfort and safety features (Boardman *et al*., 2000; DFT, 2003; Lehman *et al*., 2003; Anable *et al*., 2008; Lane and Banks, 2010). However, slight variation exists between past research. For example, the three most important factors identified by Lane and Banks (2010) were fuel

Lehman *et al.* (2003)	DFT (2003)	King (2007)	Lane and Banks (2010)
• Price	• Price	• Vehicle price	• Fuel consumption
• MPG / fuel consumption	• Reliability	• Size	• Size / practicality
• Size / practicality	• Size / practicality	• Reliability	• Price
• Reliability	• MPG / fuel consumption	• Comfort	• Style / appearance
• Comfort	• Comfort	• Safety	• Reliability
• Safety	• Brand / image	• Running costs	• Comfort
• Running costs	• Running costs	• Fuel consumption	• Safety
• Style / appearance / colour	• Style / appearance / colour	• Appearance	• Brand
• Performance / power	• Insurance costs / group	• Performance	• Condition / age
• Image / style / street credibility	• Safety	• Power	• Emissions
• Brand name	• Performance / power	• Image	• Performance / power
• Insurance costs	• Engine size (medium / large)	• Brand name	• Fuel / vehicle type
• Engine size	• Engine size (small)	• Insurance costs	• Driver experience
• Equipment levels	• Equipment levels	• Engine size	• Engine size
• Depreciation	• Personal / previous experience	• Equipment	• VED band / cost
• Personal experience	• Recommendation	• Depreciation	• Features
• Sales package	• Sales package	• Sales package	• Gadgets
• Dealership	• Depreciation	• Personal experience	• Mileage
• Emissions re global warming	• Emissions re global warming	• Dealership	• Maintenance
• VED band	• Dealership	• Recommendation	• Transmission
• Emissions re air quality	• Emissions re air quality	• VED	• Quality
• Environmentally friendly	• Alternative fuels	• Environment	• Insurance cost / group
• Recommendation	• VED band	• Vehicle emissions	
• Alternative fuels	• Environmentally friendly	• Alternative fuel	

Figure 4: Ranked attributes of importance in individuals' future vehicle purchasing decisions

economy/running costs, size/practicality and the purchase price. Conversely, Lehman *et al*. (2003) reports price as the most important factor, then fuel consumption and size/practicality. There are a number of aspects often viewed as added-bonuses once the essential attributes have been satisfied (DFT, 2003). Aspects include: colour; interior design features, e.g. air conditioning; exterior design features, e.g. metallic paint; gadgets, e.g. satellite navigation; anticipated depreciation; and manoeuvrability.

Overall, a number of key attributes shaping individuals' future vehicle purchasing behaviour are evident, including price, reliability, safety, comfort and fuel consumption/MPG. However, the final combination of salient factors is dependent on the individual and their exact requirements (DFT, 2003). Upon reflection of initial aspirations and vehicle requirements, initial preferences for vehicle attributes are liable to change during the decision making process (Turrentine and Kurani, 2007; Anable *et al*., 2008).

2.3.1 Financial considerations, including vehicle taxation

The economic recession of the 2000s resulted in even greater importance being placed upon purchase price and future running costs during individuals' future vehicle purchasing decisions (SMMT, 2011a). The DFT (2011a) observed costs at the time of purchase as most important in shaping individuals' future vehicle purchasing behaviour. Costs reoccurring throughout the vehicle ownership cycle are relatively less important. Various studies have explored the importance of different running costs during individuals' future vehicle purchasing decisions. Lehman *et al*. (2003) identified fuel consumption and insurance as highly important, whilst VED was less important in deciding the make and model of vehicle to purchase. Research by the DFT (2003, 2011a) confirms the low influence of VED in shaping future vehicle choice.

Past research suggests motorists often fail to comprehend the full amount and structure of motoring costs (Kurani *et al*., 1994; Kurani and Turrentine, 2002). For example, the RAC (2012) found more than 50% of UK motorists could not estimate the proportion of their income spent on motoring. The same proportion could not surmise whether motoring costs had increased/decreased over time. For those who could provide an estimate, the average percentage of income was 20%. Official figures by the ONS (2011) estimate only 11.1% of gross income was spent on motoring, indicating motorists overestimate their motoring costs by a factor of two. Regarding taxation, the RAC (2004) suggests vehicle owners are most aware of fuel costs, VED and insurance, tending to be most visible to motorists. Taxation is considered in detail in ***Section 2.5***.

Research by the RAC (2004) and Lane (2005) attempted to quantify the sensitivity of motorists to annual motoring cost increases. Private motorists are reported willing to endure an additional £1,000 before purchasing a vehicle with a smaller engine size or an AFV to save on running costs. Costs must rise to £1,150 for motorists to switch to a smaller sized vehicle.

2.3.2 Environmental considerations

Past research has revealed environmental considerations as of limited importance in individuals' future vehicle purchasing decisions. For example, Lehman *et al*. (2003) and Anable *et al*. (2008) both report this factor as considered by less than 5% of respondents. Nevertheless, a DFT (2011a) survey indicates environmental considerations as important for 38% of respondents when purchasing a vehicle. However, considerations of cost and reliability were selected by almost twice as many respondents. Furthermore, the growing importance of financial considerations during the recession of the 2000s was at the expense of environmental concerns (SMMT, 2011a).

Motorists often recognise that no vehicle is 'green' (DFT, 2003). The act of driving could be considered the *"antithesis of being 'green'"* (Lane, 2005, p.30). Motorists have little interest seeking out information on the environmental properties of a vehicle. Such information is often considered relatively dull during the decision making process (DFT, 2003).

Past research suggests the environmental benefits of purchasing a lower emission vehicle do not stimulate its purchase. Instead, longer term financial savings, including reduced running costs, is the primary incentive (DFT, 2003; Lehman *et al*., 2003; Gärtner, 2005; RAC, 2011). Lower CO_2 emissions are considered a bonus once the principal objectives, e.g. size, functionality and price, have been achieved (DFT, 2003; Lane and Banks, 2010; Wallis, 2011).

2.3.2.1 Attitudes towards climate change

The concept of climate change is generally well recognised and commonplace amongst individuals (Anable *et al*., 2006). Research by King *et al*. (2009) and Whitmarsh, *et al*.

(2011) indicates at least 90% of the public are aware of climate change. Concern over climate change has also been studied in past research. Lehman *et al*. (2003) indicates 34% of motorists were very worried and a further 49% were fairly worried about climate change. More recently, the DFT (2011a) suggest 65% are at least fairly concerned about climate change. Comparable Scottish studies indicate similar results. The Scottish Executive (2005) estimate 25% of individuals were very worried and a further 42% were quite worried about climate change. However, the level of concern has been steadily falling. The DFT (2011a) observed a 16% reduction from 2006-2011 for individuals who are at least fairly concerned about climate change.

Despite the apparent concern over climate change, the level of urgency and awareness of its seriousness fails to correspond. Uncertainty exists as to when, to what extent and whether climate change will occur (Lorenzoni and Pidgeon, 2005; Lowe *et al*., 2006; Whitmarsh *et al*., 2011). Indeed, the proportion of individuals who are at least fairly convinced climate change is happening has steadily fallen from 87% to 76% from 2007-2011 (DFT, 2011a). Climate change is therefore interpreted as a non-urgent personal threat (Bord *et al*., 2000; Lowe *et al*., 2006). Accordingly, difficulty exists in engaging pro-environmental public behaviour (Lorenzoni and Langford, 2001; Slovic *et al*., 2002; Pidgeon, 2010).

Furthermore, many individuals view the risk of climate change outwith their personal domain. The consequences of climate change are anticipated to affect individuals in other locations and those born in the future (Upham *et al.*, 2009; Leiserowitz *et al*., 2010). Fewer than 10% of individuals were keen to accept personal responsibility for protecting the environment (Poortinga *et al*., 2006; Spence *et al*., 2010). Focusing solely on private vehicle owners, similar findings exist. For example, only 10% of motorists acknowledge a primary responsibility to protect the environment (Lehman *et al*., 2003). Low individual responsibility suggests a means to evade individual action, illustrating a ‘tragedy of the commons’ situation (Hardin, 1968; Lowe *et al*., 2006). Individuals are also sceptical regarding the sacrifices made by others towards a joint contribution to help the environment (Bord *et al*., 1998; Lorenzoni and Langford, 2001; DFT, 2003).

A DFT (2011a) survey indicated 65% of individuals are willing to change their behaviour to mitigate climate change. This figure has, however, fallen from 77% in 2006. Specific to the purchase of a lower emission vehicle, 70-80% of motorists were willing to change their behaviour to mitigate climate change (DFT, 2011a, 2012b). A strong correlation is recognised between environmental attitudes and a willingness to behave pro-environmentally in the transport sector (Maloney and Ward, 1973; Garvill, 1999; Lane, 2005). However, a lower proportion of individuals, i.e. 46%, would *"actively"* seek the purchase of a lower emission vehicle, as opposed to being only willing (RAC, 2009, p.29). Only one-fifth of individuals actively making the effort to be pro-environmental actually believe their contribution will have a positive effect on the environment (TNS Social Opinion, 2002). A lack of harmony exists between the acknowledgement of human behaviour in climate change and the acceptance that behaviour change will make a difference to the environment (King *et al*., 2009).

2.3.3 Attitudes towards AFVs

When asked to conceptualise an 'environmentally-friendly' or 'green' vehicle, the DFT (2003) indicates most individuals think of an AFV. Actually, such vehicles only form part of the suggested solution to manage transport emissions. Market forecasts predict conventional internal combustion engines to remain the dominant powertrain until at least 2030 (Kay *et al*., 2013). In the 2011 new car market, AFVs made up only 1.3% of the total market share (SMMT, 2012a). However, the number of AFVs have gradually increased from 2000 (SMMT, 2012b). Technological advancements in conventional internal combustion engines have been suggested as providing competition for AFVs. Many low emission internal combustion engines are now in the same emissions category as high emission AFVs (SMMT, 2011b; Transport Committee, 2012).

A 2009 report suggested a range of AFV technologies should be developed to aid the transition towards lower emission vehicles (New Automotive Innovation & Growth Team, 2009). However, Kurani and Turrentine (2002) note the limited knowledge of many individuals regarding available AFV options. A study by Shell (2004) identified the greatest public awareness of liquefied petroleum gas (LPG); followed by hybrid electric vehicles, fuel cells and hydrogen. Remaining alternative fuel sources were recognised by less than a quarter of respondents, including ethanol, biofuels and compressed natural gas (CNG). Focusing on the suggested future uptake, the ranking loosely corresponds to the level of awareness, i.e. LPG and hybrid electric vehicles are the most popular for future adoption. However, hydrogen vehicles are less attractive for future use despite prior awareness. Knowledge of electric vehicles was assessed by the

DFT (2011a). Results indicate an almost 50:50 split for drivers who had at least a little knowledge of electric vehicles and those who knew hardly anything or indeed nothing on the subject.

Past research has identified vehicle acquisition costs, reliability of the technology, fuel prices and availability as key factors in AFV acceptance and thus future uptake (Boardman *et al*., 2000; Lehman *et al*., 2003; DFT, 2003; Shell, 2004; Karplus *et al*., 2010; Petschni *et al*., 2014). Familiarity with AFV technology was also highlighted as important by Shell (2004) and Bakker and Trip (2013). This allows individuals to contemplate how AFVs can be integrated into their life. Lane (2005) advocates the role of brand reputation and customer loyalty to vehicle manufacturers to manage consumer uncertainty. Past research has considered the 'neighbourhood effect' for individuals' future vehicle purchases (Mau *et al*., 2008; Axsen *et al*., 2009). Namely, consumer preferences alter as new vehicle technologies become more commonplace (Schneider *et al*., 2014). This may be the motivation behind the £5 million electric vehicle programme announced in the 2013 Autumn Statement, targeting public sector fleets. *"Clear leadership by the public sector"* is anticipated *"to encourage future widespread acceptance"* (HM Treasury, 2013a, p.56).

The environmental benefits of AFVs were deemed relatively unimportant compared to vehicle performance and financial aspects (Lane, 2005; Anable *et al*., 2008). When environmental properties are considered, Thatchenkery (2008) argues individuals are unlikely to use this as a deciding factor in individuals' future vehicle purchasing decisions. Nevertheless, Curtin *et al*. (2009) advocates the importance of a commitment to the environment. This can often compensate for greater economic costs associated with purchasing an AFV.

A number of factors are recognised from past research to most likely hinder the acceptance of AFVs. This includes a lack of infrastructure, poor performance and vehicle range, greater financial investment to acquire, poor safety and the issue of sustainability for the future (Dagsvik *et al*., 2002; Shell, 2004; Caulfield *et al*., 2010; Karplus *et al.*, 2010; Nilsson, 2011; DFT, 2011a; EC, 2013b; LowCVP, 2013). Motorists were generally willing to overlook performance and vehicle range; whilst, remaining factors were recognised as non-negotiable (Shell, 2004).

2.4 Infrastructure as a situational factor

The provision and availability of infrastructure is a major factor stimulating behaviour change (Kollmuss and Agyeman, 2002; Darnton, 2004). The importance of infrastructure in individuals' future vehicle purchasing decisions was highlighted in ***Section 2.3.3***. The necessary infrastructure for conventional vehicles is generally well established. This recognises the dominance of the internal combustion engine over the past century (Quarmby, 2010). The main issue lies with AFVs, as they are not yet supported by a comparable network of infrastructure, perhaps hindering the uptake of AFVs as a type of lower emission vehicle (Nemry and Brons, 2010). For electric vehicles, the implications for infrastructure depend on the extent of electrification (Robinson and Gardner, 2012; Kay *et al*., 2013; ***Figure 5***). Only the parallel hybrid can function without connection to the grid. The refuelling infrastructure for conventional vehicles is thus suitable. However, the provision of infrastructure to charge the remaining three types of electric vehicles is clearly a key factor in consumer uptake (Axsen and Kurani, 2012).

Parallel hybrid

- A conventional internal combustion engine with regenerative braking which captures energy and converts it into electricity;
- For example, the 3rd generation Toyota Prius.

Series hybrid

- Powered entirely by an electric engine, whilst the internal combustion engine keeps the battery charged;
- For example, the Vauxhall Ampera.

Plug-in hybrid

- Runs on a conventional internal combustion engine or a rechargeable battery;
- For example, the plug-in hybrid version of the Toyota Prius.

Battery electric

- Powered 100% by electricity via a rechargeable battery pack;
- For example, the Nissan Leaf.

Figure 5: Classification of electric vehicles

The provision of infrastructure for electric vehicles is important in counteracting vehicle range issues (Bakker and Trip, 2013). Past research suggest range-anxiety diminishes when individuals use the technology on a regular basis (Everett *et al*., 2011; Franke and Krems, 2013; Jensen *et al*., 2013; Schneider *et al*., 2014). However, the infrastructure must initially be present to avoid this potential barrier. This can be conceptualised as the chicken-and-egg-problem: *"we have limited infrastructure because we have few electric vehicles, and we have few electric vehicles because we have limited infrastructure"*

(Greening, 2012, p.3). Evidence from the CABLED project trials suggests the presence of visible chargepoints is more important than the actual use of them (Transport Committee, 2012). However, a 2013 survey indicated 80% of car buyers had not seen a public charging point within 5 miles of their home (LowCVP, 2013). More public charging facilities were deemed necessary by 73% of car buyers surveyed.

The UK vision is for plug-in vehicle charging to be located primarily at the owner's home. Charging can therefore be done overnight, during off-peak times (CILT, 2011; OLEV, 2011). To supplement home-charging, workplaces and public places, including supermarkets, retail centres and car parks have been recognised as possible charging locations (OLEV, 2011). From 2009, the UK Plugged-in Places programme has developed infrastructure for electric vehicles. Up to £30 million was available to *"support the installation and trialling of recharging infrastructure"* (OLEV, 2011, p.26). Whilst the aim was to install up to 8,500 chargepoints, only 4,000 were installed by the end of March 2013, including approximately 200 in Scotland (OLEV, 2013a). Further measures to aid an 'electric revolution' were announced in February 2013. £2.6 million will be used to provide free installation of chargepoints at homes, workplaces and public outlets, e.g. leisure facilities and local authority car parks (Scottish Government, 2013c). Across the UK, the coalition government announced plans to enhance electric vehicle charging infrastructure (DFT, 2013b). A chargepoint grant of up to 75% is offered to subsidise the cost of installing chargepoints. The grant is capped at £1,000 for domestic chargepoints and £7,500 for on-street chargepoints and those at railway stations (OLEV, 2013b, c, d). The scheme will run until April 2015, or earlier if the £37 million funding is fully distributed.

Another possibility for electric vehicle infrastructure is battery switching. Instead of recharging depleted batteries, they are simply replaced by fully charged ones[3]. Battery switching infrastructure would eliminate range-anxiety, the inconvenience of long charging times and the need for designated charging points/parking spaces (Transport Committee, 2012). However, battery incompatibility across vehicle manufacturers, the cost of installing the infrastructure and logistical issues in managing battery fleets are potential drawbacks of this approach (Transport Committee, 2012). However, technological advancements in chargepoints could eliminate the need for battery swap

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[3] The Better Place project embraces this type of infrastructure, present in countries such as Japan and Israel. See http://www.betterplace.com/ [last accessed 9 July 2013]

stations (Slater *et al*., 2009). For example, rapid chargepoints can achieve an 80% charge in only 30 minutes.

Regarding biofuels, Norris *et al*. (2011) estimates 1.1% of petrol passenger cars and 4.4% of diesel cars currently use biofuels. No engine modifications are required for fuel blends up to 5% fossil fuels (Bomb *et al*., 2007). For vehicles using greater proportions of fossil fuels, Norris *et al*. (2011) estimated 6.8% of the current vehicle fleet were suitable for B30 biodiesel, 84% for E10 bioethanol but only 0.0025% for E85 bioethanol.

Some biofuels can be sold through existing fuel infrastructure. Hence, there is the possibility of widespread biofuel adoption without major infrastructure investment. Experience in Sweden regarding E85 fuel is a good example of this (Rehnlund and van Walwijk, 2005). Sweden has an established distribution network for both petrol and E85 fuel, with 1,827 fillings stations offering E85 fuel (Swedish Petroleum and Biofuels Institute, 2012). This was initiated by a 2004 mandatory law requiring larger filling stations to offer alternative fuels (Swedish Government, 2004). However, some types of biofuels, such as biogas, require new purpose built filling stations (Evans, 2007). In 2012, there were no UK filling stations selling bioethanol (EST, 2012a) and approximately 50 selling biodiesel (Biodiesel Filling Stations, 2012). Morrisons supermarkets were the UK's biggest supplier of biofuels. However, B30 biodiesel was withdrawn in 2010 after four years, due to the UK government removing the hydrocarbon oil duty (HOD) subsidy. E85 bioethanol was also withdrawn a few years later (Norris *et al*., 2011).

The potential for biofuel filling stations is anticipated by Norris *et al*. (2011) to be bleak. Of the 2,776 fuel dispensing companies surveyed, none considered expansion into higher blended biofuels as *"economically viable"* (Norris *et al*., 2011, p.47). Estimates of the infrastructure costs for biofuel filling stations were compiled by Mulder *et al*. (2009). Modification of existing fuel tanks would require £2,000-£5,000 of capital expenditure, whilst adding new biodiesel and bioethanol capacity would cost around £100,000. The high costs indicate the importance of economic incentives to encourage fuel retailers to engage in biofuel trading. Furthermore, Morrisons' withdrawal from the market is unlikely to encourage other supermarkets and/or fuel retailers to consider venturing into the biofuel market (Hickman, 2010).

Regarding CNG, the EST (2012b) highlights the absence of UK compatible passenger vehicles. Accordingly, there are no public CNG fuelling facilities. However, UK commercial vans and chassis cab vehicles utilising CNG are available to purchase. Fleet operators must therefore install their own fuelling stations. The chicken-and-egg-problem identified for electric vehicles earlier has also been found for CNG vehicles and the poor provision of infrastructure (Gorman, 1998; Janssen *et al*., 2006).

A similar situation exists for hydrogen fuelled vehicles. Such vehicles are available in limited supply, for demonstration purposes only (DFT, 2012c; EST, 2012c). Consequently, there is no UK fuelling infrastructure present. The Transport Committee (2012) envisage the future dominance of hydrogen vehicles. However, estimates by New Automotive Innovation and Growth Team (2009) suggest mass-market penetration will not occur until 2050. A UKH2Mobility (2013a) report presented more optimism regarding the future of hydrogen vehicles. An estimated 1.6 million hydrogen vehicles are forecast by 2030 with annual sales of 300,000. The importance of infrastructure was also highlighted by UKH2Mobility (2013a,b). The need for a co-ordinated network of 1,150 hydrogen refuelling stations is advocated to meet demand.

The market for LPG enabled vehicles is relatively more established (Lane, 2005). In 2011, there were over 160,000 LPG vehicles in the UK (Environmental Audit Committee, 2011). Existing petrol internal combustion engines can be converted to LPG for approximately £1,500-£2,000 (EST, 2012d). Manufacturer-approved conversions are also possible for some makes/models. Refuelling infrastructure is therefore widespread, with over 1,400 UK outlets in 2012 (Drive LPG, 2012a). The LPG industry is estimated to be worth over £150 million to the UK economy (Transport Committee, 2011).

A final aspect of infrastructure is the availability of maintenance and repairs for AFVs. For example, an undisclosed UK government department is reported to have abandoned their fleet of LPG vehicles after difficulties with maintenance and a lack of experienced technicians (House of Commons Transport Committee, 2004). However, the network of LPG maintenance and servicing has become more established since 2004 (Drive LPG, 2012b). Regarding battery electric vehicles, specialised service networks are often established with the buyer when the vehicle is procured. For example, Nissan established a *"specialised dealer service network that will provide a comfortable vehicle life for the electric vehicle customer"* (Nissan, 2012, p.25). Weaver (2012) reports the process of maintaining and repairing vehicles utilising biofuels, natural gas or a hybrid of technologies as similar to conventional vehicles. This simplifies issues regarding future vehicle servicing.

2.5 Economic environment as a situational factor

Fundamentally, the economic environment concerns transport pricing, including taxation, subsidies and other economic measures. For a lower emission vehicle purchase, a range of economic instruments can and have been implemented to help shape purchasing behaviour via pricing signals (Lehman *et al*., 2003; House of Commons, 2007; Mandell, 2009; de Haan *et al*., 2009; Santos *et al*., 2010; Brand *et al*., 2013). The role of vehicle taxation in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle is subsequently considered.

2.5.1 Vehicle taxation/subsidies as a policy measure

The initial objective of taxation, both in general and for private motoring, is to raise revenue (Potter *et al*., 2005; Reggiani and Schintler, 2005; Santos *et al*., 2010). In response to various concerns, including the environment, tax reforms have occurred (Ryan *et al*., 2009; Rogan *et al*., 2011). An environmental tax is one where the *"tax base is a physical unit (or proxy of it) that has a proven specific impact on the environment"* (Hinnells and Potter, 2001, p.15). This approach is founded on the 'Ecological Taxation Reform'. Taxation should therefore be based on the environmental impact of an action, rather than wealth or income (Whitelegg, 1992; Kerr, 2001). Supplementary to the initial aim of raising revenue, vehicle taxation is now expected to discourage growing car use and to promote the purchase of cleaner, more fuel efficient vehicles (Potter and Parkhurst, 2005).

A system of taxation/subsidies can be introduced based on CO_2 emissions (COWI, 2002; EC, 2007b). Lower taxation payments and/or greater subsidies can be awarded as an incentive for low emission vehicles. This type of approach can be classified as 'carrots' or pull-measures, designed to encourage desirable behaviour (Stradling, 2002). Conversely, greater tax payments and/or lower subsidies can be conferred as a deterrent for higher emission vehicles. This corresponds to a system of 'sticks' or push-measures to discourage undesirable behaviour (Stradling, 2002). If lower emission vehicles become widespread, the revenue raised from taxation will therefore suffer. This presents a conflict of interest between the objectives of taxation (EC, 1997; Potter and Parkhurst, 2005).

Taxation can be designed in numerous ways to accommodate the environment. A 'per-unit' taxation instrument simply charges a fixed amount for every additional 'unit, e.g. g/km of CO_2 (EC, 2002). This linear approach provides a continuous financial incentive for consumers' future vehicle purchasing decisions. Manufacturers are also continuously incentivised for their vehicle supply decisions (Gordon and Levenson, 1989; Greene *et al.*, 2005). A linear setup could instead be graduated, where the same level of tax applies to all vehicles within a specific tax band. This is exemplified by the standard (SR) and first year (FYR) rate of VED (***Sections 2.5.2.1*** and ***2.5.3.1***). A graduated approach is simpler to administer than a linear system. However, problems exist for consumers and manufacturers with a graduated taxation system. Within each tax band, there is little incentive for consumers to choose a vehicle at the lower emitting end of the tax band. No further savings can be made as the tax payment remains the same. From a manufacturer's perspective, inducement exists to improve CO_2 emissions for vehicles close to the next tax band. But there is less incentive when a substantial CO_2 emissions reduction is required (HM Treasury, 1998). For example, in August 2012 almost 40% of all vehicles in tax band C emitted 119g/km of CO_2, narrowly qualifying for the £30 VED payment (VCA, 2012a, b, c). Despite this weakness, a graduated approach tends to be most popular (German and Meszler, 2010). Finally, an 'ad-valorem' approach charges a set percentage of the base value. It can thus be thought of as a sales tax (EC, 2002), such as UK value added tax (VAT; ***Section 2.5.2.2***).

Regarding public support for 'green' vehicle taxation, past research suggests this to be quite high. The UK DFT (2011a) found 54% of respondents supported higher taxes to discourage the purchase of higher emission vehicles, whilst only 28% were opposed. Furthermore, Avery (2009) identified additional taxes on high emission vehicles as the most popular pricing mechanism for addressing climate change. Conversely, the DEFRA (2002) found over 80% support for policies rewarding drivers of low emission vehicles. Specific to AFVs, Shell (2004) found most consumers expect some sort of financial incentive to encourage such a purchase. Regarding the nature of price signals, past research suggests a greater backing for 'carrots', involving no additional cost to individuals. 'Sticks', charging/penalising individuals, receive less support (DEFRA, 2002; Avery, 2009).

2.5.1.1 The economics of vehicle taxation/subsidies

The economic principles of taxation are the same for the per-unit and ad-valorem taxes. However, the effects on the market equilibrium will vary. The use of taxation/subsidies recognises the law of demand. A price increase is said to reduce the quantity demanded, and *vice versa* (Goodwin, 1992). Imposing a per-unit tax will shift the supply curve from S1 to S2, resulting in the price rising to P2 and the quantity falling to Q2 (***Figure 6***, graph (a)). Introducing a per-unit subsidy will shift the supply curve in the opposite direction, where the price falls and quantity rises. Conversely, the impact of an ad-valorem tax depends upon the tax percentage and the original price level. The supply curve will still shift upwards from S1 to S2, but the extent will vary by the price level (***Figure 6***, graph (b)). The amount of tax also varies, e.g. 20% VAT on a vehicle costing £20,000 equals £4,000, compared to 20% VAT on a £10,000 vehicle equalling only £2,000 tax.

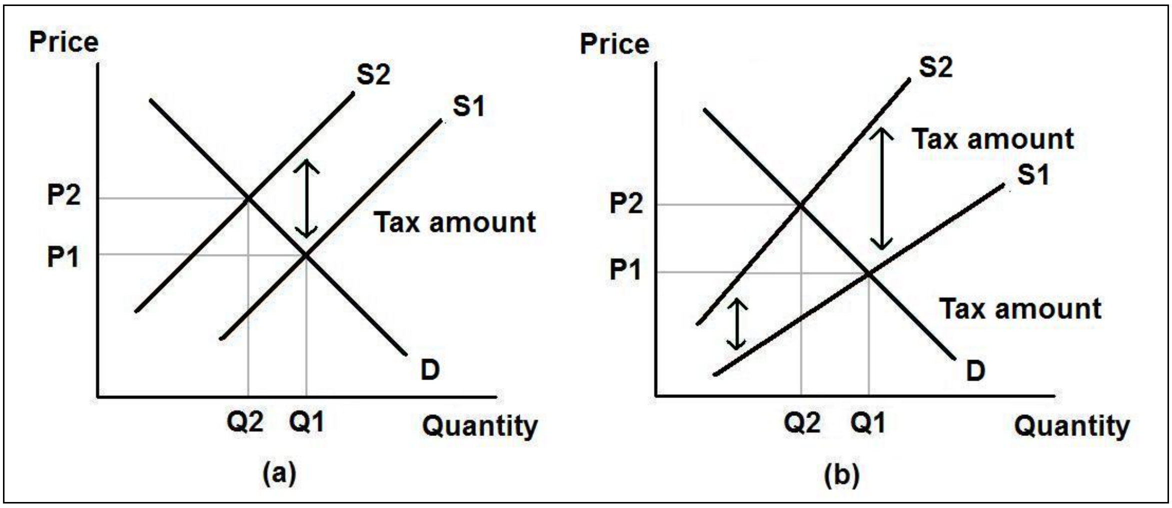

Figure 6: Market equilibrium for (a) a per-unit tax and (b) an ad-valorem tax

Taxation can be used to address the externalities of motoring. The environmental costs of an individual driving a high emission vehicle spillover to society. Marginal social costs (MSC) are therefore greater than the marginal private costs (MC), creating an undesirable externality (***Figure 7***, graph (a)). The additional costs to society may be overlooked by individuals' decision making, encouraging overconsumption at Q1, whilst the socially efficient quantity is less at Q2. In contrast, the environmental benefits of an individual driving a lower emission vehicle spillover to society in a positive manner. The marginal social benefits (MSB) are greater than the marginal private benefits (MB; ***Figure 7***, graph (b)). Without recognising the additional benefits to society, individuals may under-consume at Q1, whilst the socially efficient quantity is greater at Q2.

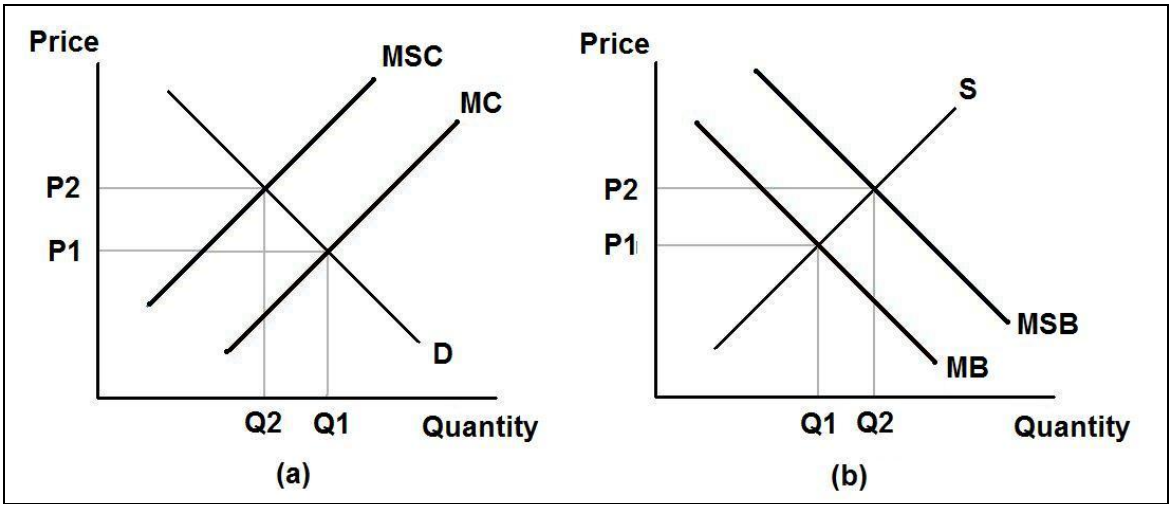

Figure 7: External costs and benefits to society

When positive or negative externalities occur, social efficiency is not achieved. Government intervention, such as taxation/subsidies, can rectify market failure, including Pigouvian taxation to correct negative externalities (Pigou, 1920). The basic premise is to tax items the market produces too much of and subsidise those insufficiently produced (Dasgupta, 1991). To discourage the purchase of a higher emission vehicle, a tax should be introduced equal to the marginal external cost. That is, the vertical distance between S1 and S2 in ***Figure 6***, graph (a), bringing the quantity demanded to Q2, achieving social efficiency. To encourage a lower emission vehicle purchase, a subsidy equal to the marginal external benefit should be introduced. Specifically, the vertical distance S1 and S2 in ***Figure 6***, graph (b), raising the quantity demanded to Q2 to achieve social efficiency. Both these approaches will effectively 'internalise' the externalities of private motoring. It will also help raise awareness of the full costs/benefits associated with an action (Chartered Institute of Taxation, 2009). Such measures are founded upon the polluter-pays-principle, where the pollutant/motorist is responsible for the cost of measures to reduce pollution (Ison and Ryley, 2007; PWC, 2009; Cowie, 2010).

2.5.1.2 Advantages and disadvantages of taxation/subsidies

Taxation/subsidies as a policy measure have a number of advantages. The provision of financial incentives/disincentives provides clear pricing signals to consumers. It can be used to reward behaviour with a lower environmental impact and deter more environmentally damaging activities (Hinnells and Potter, 2001; Bovenberg and Goulder, 2002). Individuals have the discretion to respond as they see fit (Ison and Ryley, 2007). They can either: continue acting as before and accept the financial repercussion; or change their behaviour and benefit financially. There is also flexibility for individuals to decide the extent of their behaviour change. For example, they can choose how ‘green’ their next vehicle is (Royal Commission on Environmental Pollution, 1994; Morrison, 1996). Imposing a tax or awarding a subsidy allows individuals to acknowledge the full social costs and benefits of their actions (Chartered Institute of Taxation, 2009). Taxation/subsidies are also adjustable depending on the magnitude of the problem (PWC, 2009). As the efficiency of the vehicle fleet improves, taxation can be fine-tuned to maintain a sufficient incentive/disincentive. Finally, a system of taxation/subsidies with an environmental base can influence both supply and demand, i.e. vehicle production and vehicle purchasing respectively (Morrison, 1996; Ekins *et al*., 2009b).

However, there are weaknesses with taxation/subsidies. Problems exist in accurately assessing the value of external costs and benefits. Setting the ‘correct’ level of the tax/subsidy is therefore difficult (EC, 2002; Ison and Ryley, 2007). Complexities exist when the costs are uncertain or unrealised until a future date, e.g. the cost of climate change (House of Commons Transport Committee, 2008; Smith *et al*., 2009). Given the difficulties, the aim is to be as close to the optimum as possible or at least heading in the right direction towards the social optimum. The premise of raising prices by imposing a tax may lead to adverse effects on consumer welfare (Sloman and Garratt, 2010; Kallbekken and Sælen, 2011). Problems may exist regarding the price elasticity of demand, i.e. the sensitivity of demand in response to price changes. Where demand is inelastic, the change in demand is proportionately less than the price change. In this case, taxation may have to be substantial to affect demand, which may prove unpopular with users (Environmental Agency, 2007). The introduction of any new tax is often met with aversion from users. ‘Green’ taxes are often disliked more than other forms of taxation (Chartered Institute of Taxation, 2009). Several possible explanations have been suggested. Potter *et al*. (2005) and Smith *et al*. (2009) note the high value placed upon transport as a commodity and a reluctance to be taxed for the privilege. ‘Green’ taxes are not related to the user’s ability to pay, adding to public dissatisfaction. There is also concern over the revenue raising properties of ‘green’ taxes (Chartered Institute of Taxation, 2009). Motoring taxation in the UK and many other countries generates the largest revenue stream compared to other forms of environmental taxation (Ryan *et al*., 2009; Mirrlees *et al*., 2011).

2.5.1.3 Types of vehicle taxation/subsidies

The effectiveness of taxation/subsidies has varying success depending upon their positioning in the vehicle ownership cycle (Jansen and Denis, 1999; Brand *et al*., 2013). Past research has acknowledged the importance of government policy encapsulating a range of taxation measures (European Council of Ministers of Transport, 1997; Hayashi *et al*., 2001; Proost and Van Dender, 2001; Mayeres, 2002; Ryan *et al*., 2009). Kunert and Kuhfeld (2007), Ison and Rye (2008) and Santos *et al*. (2010) recognise three different types of vehicle taxation, split according to their timing in the vehicle ownership cycle: purchase; circulation; and road-fuel taxation (***Figure 8***).

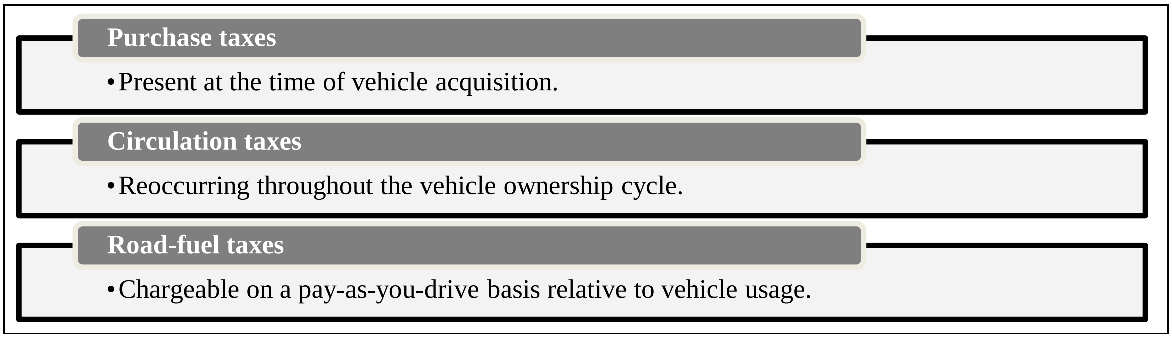

Figure 8: Three types of vehicle taxation

Vehicle taxation across Europe is generally not harmonised. This is due to the initial goal of revenue raising, rather than environmental mitigation (Sterner, 2007). Hence, the amounts charged and tax bases, including engine size, vehicle price, CO_2 emissions, vary substantially between countries. Geographical, social, industrial, energy and environmental considerations can also have an additional bearing upon national policy (EC, 1997). Ryan *et al*. (2009) acknowledges a ‘framework’ of fiscal policy imposed by the majority of European countries, encompassing a vehicle registration tax, VAT on the purchase price, annual circulation tax, and excise duties on fuel. The UK also follows this structure. The following sections are structured around the timing of UK policy measures present. Existing and potential incentives/disincentives to encourage the purchase of a lower emission vehicle are considered.

2.5.2 Purchase policy measures

Purchase taxes/subsidies, present at the time of sale, are argued to have the greatest potential to shape individuals’ future vehicle purchasing decisions (Potter *et al*., 2005; Litman, 2009; Lane, 2011). At the point of sale, it is easiest and most convenient for motorists to change between different vehicle models. Given the difficulty quantifying future fuel costs (***Section 2.2.2***), the timing of this policy measure helps to strengthen the financial signal (Lane, 2011). There is perhaps greater importance placed on purchase taxes to inform vehicle choice. Once a vehicle is acquired, it will remain in circulation until old enough to be scrapped. It is therefore important to shape vehicle choice, recognising lifetime CO_2 emissions stemming from the vehicle's acquisition (LowCVP, 2006, Ferguson, 2012).

Purchase taxes/subsidies can be unique to the vehicle or the buyer. The former would not be repeated for future owners, such as the FYR of VED. The latter would be repeated for the same vehicle when acquired by another buyer, such as VAT on vehicle price). The Environmental Audit Committee (2008) reports a ratio of 3:2 for used and new vehicles respectively, which has implications for the effectiveness of different purchase taxation/subsidies.

Depending on the tax base, e.g. CO_2 emissions, price or engine size, the composition of the car fleet can be shaped accordingly (Potter *et al*., 2005; Brand *et al*., 2013). For example, Wallis (2005) compared registration taxes in five European countries with fuel economy improvements and concluded that nations with purchase taxation schemes aimed at encouraging smaller cars tended to have more fuel efficient vehicle fleets.

High purchase taxes for new vehicles may present a problem in shifting demand towards older/used vehicles. For example, in Denmark, a registration tax of 105% was charged on the first €7,653 of vehicle price inclusive of VAT, and 180% on the remainder, plus VAT of 25%. Berri *et al*. (2010) reports the majority of vehicle acquisitions under the tax regime were for second-hand vehicles. This may undermine the environmental agenda as newer vehicles are typically more fuel efficient and less polluting. Similarly, motorists may decide to delay the purchase of a new vehicle by retaining the existing vehicle for longer. New vehicles, whilst more expensive with purchase taxation, may be cleaner and safer (EC, 1997; Hayashi *et al*., 2001). Many authors therefore argue that high taxes on new vehicles should therefore be matched by higher taxes on used vehicles (Pritchard and DeBoer, 1995; Timilsina and Dulal, 2008).

A further consideration for purchase taxes/subsidies is the visibility during individuals' future vehicle purchasing decisions. Vehicle purchase price is often quoted inclusive of VED, VAT etc. Purchase taxation/subsidies are not necessarily presented as an additional cost/benefit (Giblin and McNabola, 2009). Past research argues that financial interventions should be designed to keep them separate from the purchase price (Thaler, 1985; Mueller and de Haan, 2009).

The UK previously had a car purchase tax of 10% on five-sixths of the list price of a new vehicle. In 1991, the purchase tax was reduced to 5%. In 1992, this system was replaced with a HOD increase and the introduction of the fuel duty escalator (FDE; ***Section 2.5.4.1***; Potter *et al*., 2005).

2.5.2.1 FYR of VED

From 2010, VED payments became differentiated from the time of purchasing a brand new vehicle (FYR) to the rate applicable thereafter annually or biannually (SR). The FYR was designed to *"encourage the purchase of more fuel-efficient cars by providing a strong signal to the consumer at the point of purchase"* (HM Treasury, 2010a, p.116). Ferguson (2012) notes the FYR is likely to have greater influence upon vehicle choice than the SR of VED owing to the timing. The premise of the FYR is *"cutting taxes for those who cut carbon emissions"*. Conversely, individuals purchasing a higher emitting vehicle *"should pay more... to reflect the environmental cost"* (HM Treasury, 2008a, p.19). Like the SR of VED, payment exemptions exist, e.g. for disabled drivers (Direct Government, 2010a).

The same graduated CO_2 emission scale is used for both the FYR and SR of VED. 2012/13 payments for petrol/diesel vehicles range from £0-£1,030 for 12 months, with a £10 discount available for AFVs (

Table 1-***Table 2***). Six month rates are available in tax bands E-G, calculated at 55% of the yearly rate. Six month rates are not available for tax bands H-M to avoid diluting the financial impact during individuals' future vehicle purchasing decisions (Direct Government, 2012a).

Relative to the subsequent SR of VED, financial savings are evident when purchasing a vehicle in tax bands B-D, emitting 101-130g/km of CO_2. Likewise, penalties are apparent for vehicles in tax bands H-M, emitting at least 166g/km. The rate is constant in tax band A, emitting 100g/km of CO_2 maximum, and bands E-G, emitting 131-165g/km of CO_2.

Table 1: FYR of VED (from 1 April 2012 to 31 March 2013) for petrol/diesel vehicles registered from 1 April 2010, relative to the SR of VED (DVLA, 2012)

Tax band	CO_2 emissions (g/km)	FYR of VED (2012/13[4])			
		Conventional fuelled vehicle		Comparison with SR of VED	
		12 months	6 months	12 months	6 months
A	=< 100	£0.00	-	£0.00 (same)	-
B	101-110	£0.00	-	-£20.00	-
C	111-120	£0.00	-	-£30.00	-
D	121-130	£0.00	-	-£100.00	-
E	131-140	£120.00	£66.00	£0.00 (same)	£0.00 (same)
F	141-150	£135.00	£74.25	£0.00 (same)	£0.00 (same)
G	151-165	£170.00	£93.50	£0.00 (same)	£0.00 (same)
H	166-175	£275.00	-	+£80.00	-
I	176-185	£325.00	-	+£110.00	-
J	186-200	£460.00	-	+£210.00	-
K	201-225	£600.00	-	+£330.00	-
L	226-255	£815.00	-	+£355.00	-
M	>=256	£1,030.00	-	+£555.00	-

The differential between FYR tax bands averages at £85.83 for petrol/diesel vehicles[5] (***Figure 9***) compared to £39.58 for the SR of VED (***Section 2.5.3.1***). That is, the potential saving by choosing a vehicle in a lower tax band, or additional payment from choosing a vehicle in a higher tax band. The greatest differential exists between bands K-L and L-M, where a £215 unrealised saving can occur by choosing the lower tax band. No differential exists between bands A-D, emitting 130g/km maximum as they all receive a FYR exemption. However, the SR does differentiate between bands A-D to provide incentives to choose, for example, a vehicle in tax band A over one in band D.

[4] During the write-up, the FYR of VED was subject to an inflationary increase. 2013/14 rates are shown in ***Appendix A1*** for both petrol/diesel vehicles and AFVs.
[5] Compared to an AFV, the differential is largely consistent. The only difference is between tax band D-E where the differential is £110 for AFVs and £120 for petrol/diesel vehicles.

Table 2: FYR of VED (from 1 April 2012 to 31 March 2013) for AFVs registered from 1 April 2010, relative to the SR of VED (DVLA, 2012)

Tax band	CO_2 emissions (g/km)	FYR of VED (2012/13)			
		AFV		Comparison with SR of VED	
		12 months	6 months	12 months	6 months
A	=< 100	£0.00	-	£0.00 (same)	-
B	101-110	£0.00	-	-£10.00	-
C	111-120	£0.00	-	-£20.00	-
D	121-130	£0.00	-	-£90.00	-
E	131-140	£110.00	£60.50	£0.00 (same)	£0.00 (same)
F	141-150	£125.00	£68.75	£0.00 (same)	£0.00 (same)
G	151-165	£160.00	£88.00	£0.00 (same)	£0.00 (same)
H	166-175	£265.00	-	+£80.00	-
I	176-185	£315.00	-	+£110.00	-
J	186-200	£450.00	-	+£210.00	-
K	201-225	£590.00	-	+£330.00	-
L	226-255	£805.00	-	+£355.00	-
M	>=256	£1,020.00	-	+£555.00	-

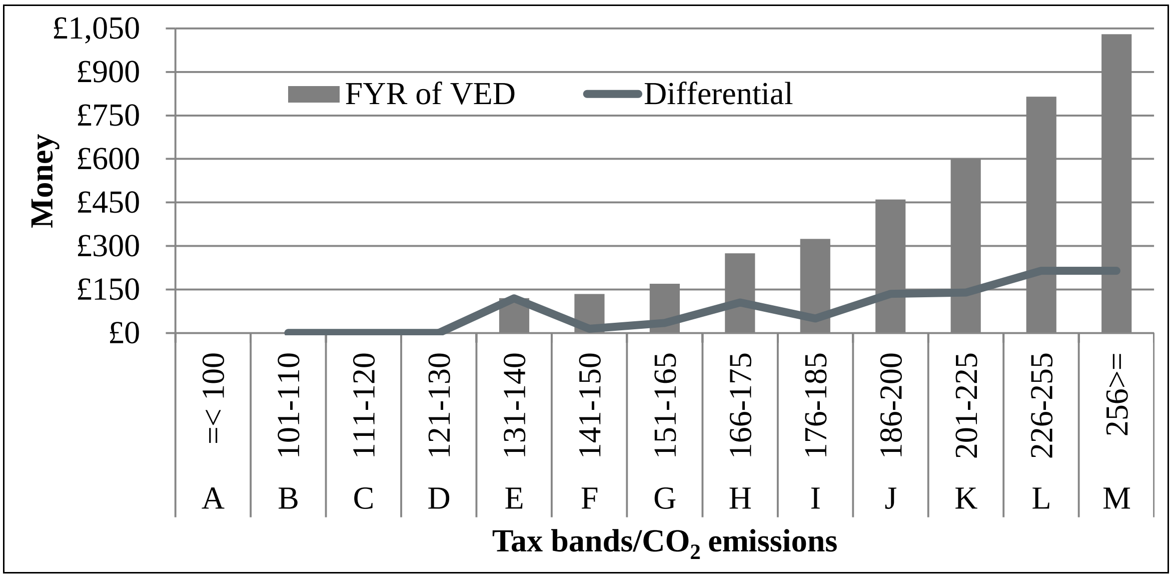

Figure 9: FYR of VED (from 1 April 2012 to 31 March 2013) for petrol/diesel vehicles registered from 1 April 2010, and the differential between tax bands

The Environmental Audit Committee (2008) was concerned about whether the differential was sufficient to encourage movements between the tax bands. The 2012/13 FYR falls short of the £300 minimum recommended by the Environmental Audit Committee (2006). However, the 'official' objective of VED is to shift purchasing behaviour for vehicles in the middle section of the CO_2 emissions scale; rather than concentrating on the most polluting vehicles. A greater environmental benefit is advocated overall if mid-range CO_2 emitting vehicles were replaced by one emitting 5g/km less (House of Commons, 2008, King, 2008). However, smaller tax differentials exist towards the middle of the CO_2 emissions scale. For example, £15 between bands E-F, £35 for bands F-G and £50 for bands H-I. As a standalone figure, these unrealised savings for choosing a lower tax band vehicle seem an insignificant enticement during individuals' future vehicle purchasing decisions.

Lehman *et al*. (2003) investigated the impact of VED differentials in encouraging the purchase of a lower CO^2 emitting vehicle. Results indicate a £50 differential was sufficient to entice 33% of motorists, whilst 72% would be influenced by a £300 differential (***Figure 10***). In context of the 2012/13 FYR of VED, these results suggest a relatively high influence upon individuals' future vehicle purchasing behaviour. The DFT (2003) asked outright for the necessary VED differential to affect purchasing behaviour, averaging £119. This figure is therefore unachievable based on the average FYR differential of only £85.83 for 2012/13. However, £119 is attainable between some tax bands, particularly at the higher end of the CO_2 emissions scale. Perhaps more worryingly, 46% of respondents declared no potential saving would influence their future vehicle purchasing behaviour (DFT, 2003). Lehman *et al*. (2003) presents a more positive perspective regarding the influence of VED. Results indicate 28% of respondents would not change their behaviour, even if the differential was over £300. In 2012/13, no differential was greater than £300. However, there is no reason to view the differentials in isolation, e.g. a £430 differential is achievable from bands K-M.

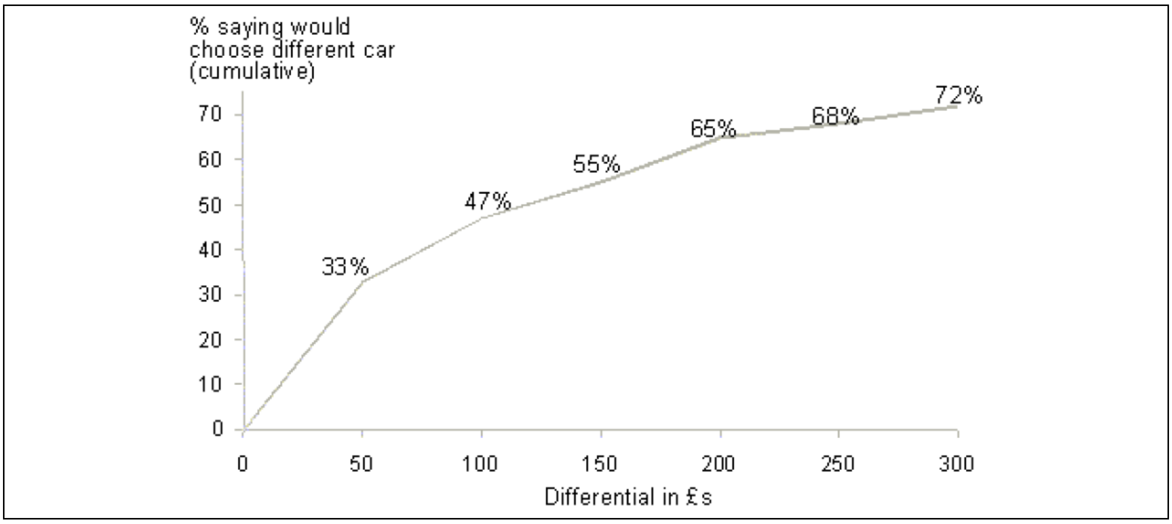

Figure 10: Reactions to raising the VED differential (Lehman et al., 2003)

Anable *et al*. (2008) unveiled a common opinion of car buyers prior to the FYR regarding the insufficiency of VED relative to vehicle prices. The FYR has gone some way towards increasing the VED-to-purchase-price ratio. However, Anable *et al*. (2008) identified much hostility towards the FYR of VED when initially proposed. Increased sensitivity was observed for VED increases at the high end of the CO_2 emission scale for the most polluting vehicles. Conversely, there was less awareness of potential savings at the opposite end of the emission scale. This corresponds to the concept of loss aversion (Kahneman and Tversky, 2000; Mueller and de Haan, 2009). Indeed, Kahneman (2011) estimates a weighting of 1.5-2.5:1 for losses and gains respectively.

Vehicle retailers have the discretion to absorb the FYR of VED into the purchase price (House of Commons, 2008). This is recognised by the Environmental Audit Committee (2008) as a potential barrier in shaping individuals' future vehicle purchasing behaviour. The physical process of taxing a new vehicle may also be undertaken on behalf of the consumer, softening the influence of the FYR of VED. A further concern is acknowledged by the Environmental Audit Committee (2008) regarding additional complexities in the vehicle purchasing decision regarding financial considerations. The FYR of VED provides another set of figures for consumers purchasing a brand new vehicle to comprehend. A final drawback for the FYR is its inapplicability to the purchase of used vehicles: the FYR would therefore have been paid when the vehicle was first registered.

2.5.2.2 VAT

VAT is chargeable on most goods/services provided by VAT-registered businesses (HMRC 2012a). The default standard VAT rate is 20%, applicable to most vehicles carrying 10 passengers maximum and with no modifications for disabled use. VAT applies to both brand new and used vehicle acquisitions (HMRC, 2011a). VAT was introduced at 8% in 1974, having replaced preceding sales taxes. VAT rates almost doubled to 15% in Geoffrey Howe's first 1979 budget. VAT increased to 17.5% in 1991 to compensate for John Major's poll tax reductions (Hennessey *et al.*, 2008). VAT was temporarily cut to 15% in 2009, to help support the economy and encourage consumer spending during the economic recession of the 2000s. VAT subsequently returned to 17.5% in 2010 (HM Treasury, 2009a), and increased by 2.5% in 2011, bringing UK VAT to a record 20% (HM Treasury, 2010b; Institute for Fiscal Studies, 2012).

Recognising VAT as derived from selling prices, it does not consider environmental credentials, such as CO_2 emissions. VAT will thus raise the price of all vehicle attributes (Potter *et al*., 2005). When AFVs are brought to market, there is often a price premium attached, reflecting the novelty of the technology. However, VAT will serve to further increase the purchase price.

Suggestions have been put forward to vary VAT by the CO_2 emissions of the vehicle (Hinnells and Potter, 2001; Lane, 2005). This would add further expense to higher emission vehicles as a deterrent, and lower the cost of low emission vehicles as an incentive (Albrecht, 2006). A comparable UK scheme covers the installation of various energy saving materials, including solar power and wind turbines with only 5% VAT (HMRC, 2012a). A similar approach was adopted in Italy, but based on engine size. 19% VAT was chargeable for petrol vehicles with an engine capacity up to 2000 cubic centimetres (CC) or diesel engines up to 2500CC. VAT doubles to 38% for vehicles with a larger engine size (Reggiani and Schintler, 2005). The scheme contributed to a 14.7% fuel economy improvement from 1970-1998 (Potter *et al*., 2005). There are no European schemes at present differentiating VAT for vehicle characteristics (Association of European Automobile Manufacturers, 2012). Recognising EU emission standards, German and Meszler (2010) anticipate all EU countries to move towards CO_2 based VAT in the future. However, the biggest weakness relates to company car purchases where VAT can be reclaimed, limiting the potential effectiveness of such a scheme. Nevertheless, private vehicle purchases are unaffected.

2.5.2.3 PICG and previous purchase subsidies

The UK PICG was confirmed alongside the Plugged-in Places scheme. From January 2011, the PICG offers a 25% purchase price reduction, subject to £5,000 maximum, for eligible electric, plug-in hybrid or hydrogen-fuelled vehicles. The scheme will run until 31 March 2014 or earlier if the £230 million funding is depleted[6]. The grant only applies to the purchase of a brand new vehicle for both private and business purposes, consequently having no impact upon the purchase of a used vehicle. Vehicles have to meet specific criteria regarding vehicle range, speed, warranty and CO_2 emissions to be eligible (***Figure 11***). When the scheme was implemented, there were nine eligible

[6] In April 2014, the Deputy Prime Minister announced additional funding of at least £200 million to continue the £5,000 PICG until 2017 or earlier depending on uptake.

vehicles, but only two were actually available to purchase (Vaughan, 2010). Vehicle availability has greatly improved since 2011 (DFT, 2012c).

Vehicle type
- New registration vehicles;
- Vehicle category M1, including pre-registration conversions:
  - Battery electric;
  - Plug-in hybrid electric;
  - Hydrogen fuel cell.

CO_2 emissions
- Maximum of 75g/km.

Range
- Minimum of 70 miles between charges for an electric vehicle;
- Minimum of 10 miles for a plug-in hybrid electric vehicle.

Speed
- Minimum speed of 60 miles per hour.

Warranty
- Vehicle – 3 years or 60,000 miles;
- Battery and electric drive train – 3 years (5 if requested by consumer).

Battery performance
- Either minimum 5 year warranty on the battery and electric drive train, or extra evidence of battery performance to show reasonable performance after 3 years of use.

Electrical safety
- Compliance with UN-ECE Reg 100.00.

Crash safety
- Either EC whole vehicle type approval (EC WVTA) or crash tested to international standards.

Figure 11: Eligibility criteria for the PICG (DFT, 2012c)

Electric, plug-in hybrid or hydrogen-fuelled vehicles are relatively novel in the UK vehicle market, resulting in a price premium at present. During the PICG launch, it was acknowledged most eligible vehicles would indeed cost over £20,000 (DFT, 2010c). As the market develops and technology becomes more extensive, the price is likely to fall (DFT, 2012c). Such vehicle technologies will then be able to compete successfully in the vehicle market without financial assistance. Government funding can then be concentrated upon the next wave of vehicle technology (Reggiani and Schintler, 2005; Potter, *et al*., 2005). Meanwhile, the PICG can help to offset part of the current price premium (Transport Committee, 2010).

In ***Section 2.3***, motorists were shown to place high importance upon vehicle purchase costs. Regarding electric, plug-in hybrid or hydrogen-fuelled vehicles, the RAC (2011) identified price as the biggest barrier to purchasing such vehicles. Lane and Banks (2010) suggest most individuals are unwilling to 'speculate to accumulate' regarding the purchase of electric, plug-in hybrid or hydrogen-fuelled vehicles. That is, a greater financial expenditure at the time of purchase can later be complemented with low running costs, forecast at approximately 1-2 pence per mile (DFT, 2010c). Given that price is said to be more important during purchasing decisions than environmental credentials (House of Commons Transport Committee, 2013), the PICG can go some way towards aligning these two considerations. Subsidies are argued by Ewing and Sarigöllü (1998) as the primary means of achieving a shift in demand towards cleaner vehicles. Indeed, the PICG was hoped to *"build a flourishing early market"* (DFT, 2012c, p.1). The Committee on Climate Change (2010, p.23) argued it would be "feasible" for up to 1.7 million electric and plug-in hybrid vehicles to be on UK roads by 2020. However, the PICG has not caused a significant number of qualifying vehicles being purchased. The £230 million funding hypothecated for the PICG would provide for 46,000 qualifying vehicles. As of 30 June 2013, the PICG had provided funds for only 4,553 eligible vehicles, equalling less than 10% of the available funds over 30 months (DFT, 2012c).

The Parliament Under Secretary for Transport, Norman Baker, part attributed the slow PICG uptake to the lack of eligible vehicles, particularly in 2011. This has since improved and PICG applications have slowly increased. The SMMT (2011b) highlighted the risk of another economic downturn as a contributory factor. Glaister (2013) recognised public uncertainty regarding the second-hand value of such vehicles and concerns over battery longevity. The incentive was also suggested as ineffective relative to the high purchase price (House of Commons Transport Committee, 2013). The current setup was consequently argued to best support more affluent households purchasing an additional secondary vehicle (House of Commons Transport Committee, 2013), which could also explain the slow uptake. Furthermore, results of a 2013 survey with UK car buyers found 35% of respondents were unaware of the PICG's existence (LowCVP, 2013).

Prior to the PICG, grants were awarded from 1998-2005 through the Powershift programme from the Energy Savings Trust. Grants were introduced to partly cover the cost of vehicle conversion to CNG or LPG, or part of the price premium for a CNG, hybrid or electric vehicle[7] (Ericson, 2005). The scheme was open to private individuals,

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[7] In addition to grants, the Powershift programme also focused on refuelling infrastructure and vehicle manufacturers to develop a sustainable market for cleaner fuelled vehicles.

car clubs, companies and public bodies. Grants were available for all types of vehicles, subject to standards set by the Energy Saving Trust and a vehicle emissions test. Grants were typically £1,000-£1,500, calculated as a percentage of the additional expense for purchasing/converting, relative to a conventional internal combustion engine. The scheme supported 4,000-7,000 conversions and new vehicles annually and was considered instrumental in the early emergence of AFVs, particularly for LPG and CNG vehicles (Lane, 2011).

Across Europe, other incentives exist regarding the purchase of an AFV. For example, a €700 premium, approximately £550, is awarded for the purchase of an electric vehicle in Cyprus (Association of European Automobile Manufacturers, 2010). Spanish incentives vary according to region and whether a hybrid or electric vehicle is purchased. As an alternative to subsidies/grants, other countries have chosen to adjust the personal taxation regime. For example, the tax system in Belgium reduces personal income tax by 30% for the purchase price of an electric vehicle, subject to a €9,000 maximum (approximately £7,000; Association of European Automobile Manufacturers, 2010).

The UK recently implemented a Voluntary Acceleration Vehicle Retirement programme. From May 2009 to March 2010, the scrappage incentive scheme (SIS) offered a £2,000 allowance for scrapping a vehicle registered before 1 March 2000 or a van registered before 1 March 2002. The vehicle/van must have previously been owned for at least one year prior to scrappage. The allowance had to be spent on a brand new vehicle, less than 3.5 tonnes and available from a participating manufacturer (Direct Government, 2010b). £300 million was initially allocated, subsequently topped up with an additional £100 million in September 2009 (BIS, 2009a), providing for 400,000 vehicles with £1,000 from the government. The remaining £1,000 subsidy was matched by the 38 manufacturers opting into the scheme (BIS, 2010).

Three main reasons are suggested for the introduction of a SIS: economic reasons to increase new vehicle sales; environmental reasons by scrapping older, more polluting vehicles; and safety reasons for the purchase of newer vehicles (EC, 2002). Economic motivations are the most common, e.g. the UK introduced a SIS responding to the economic recession of the 2000s. This was also the case with other countries across Europe and North America (International Transport Forum, 2011; Foster and Langer, 2011). The intention was to increase vehicle demand and support the car industry on a short-time basis (SMMT, 2009; BIS, 2009b). Indeed, Yamamoto *et al*. (2004) demonstrated the increased likelihood of replacing a vehicle at least 10 years old when a SIS is operational. It may also encourage individuals to retain their vehicles for longer to subsequently qualify for a scrappage incentive (Alberini *et al*., 1994; de Palma and Kilanib, 2008). An evaluation of the UK SIS indicated that 395,499 new vehicles had been registered, making up approximately 20% of all vehicle purchases (SMMT, 2010). Hence, it was successful in supporting the economy and motor industry (Holden, 2010).

The UK SIS perhaps wasted a further opportunity to support the environment by failing to cap CO_2 emissions on the replacement vehicle. For example, the French Prime à la Casse SIS imposed a 160g/km of CO_2 limit on the replacement vehicle. Indeed, the UK SIS was acknowledged to have only a *"neutral or moderately positive environmental impact"* (HM Treasury, 2009a, p.150). Nevertheless, replacement vehicles were found to emit 132.9g/km of CO_2 on average, representing a 27.1% reduction compared to the scrapped vehicle. Furthermore, vehicles bought via the SIS emitted 9.5% less CO_2 compared to all vehicles registered during the same time (SMMT, 2010). Environmental benefits were therefore achieved as an unexpected benefit. However, if the UK were to impose an emission limit on the replacement vehicle for a future SIS, past experience dictates the cut-off must be no higher than average emissions of the vehicle fleet (International Transport Forum, 2011)

The 2009 Car Allowance Rebate System in the United States of America (USA) embraced a relative approach to calculating the incentive. The fuel efficiency of both the trade-in vehicle and its replacement were used to calculate the degree of scrappage incentive (Sivak and Schoettle, 2009). A $3,500 incentive was awarded for a 4-10MPG fuel efficiency improvement, increasing to $4,500 for an improvement of more than 10MPG (Department for Transportation, 2009). The Car Allowance Rebate System also imposed restrictions on the trade-in vehicle. First, the trade-in vehicle had to achieve a maximum of 18MPG, ensuring only the least fuel efficient vehicles were replaced. The trade-in must also be 25 years old or less, ensuring older and largely unused vehicles were not traded for a new and more usable vehicle (International Transport Forum, 2011). For a future UK SIS, perhaps a CO_2 emission limit should only allow the most polluting of older vehicles to be scrapped.

However, there have been suggestions a SIS produces greater emissions. Such assertions recognise the environmental impact of vehicle production and scrappage, comprising approximately 15% of lifecycle CO_2 emissions (BIS, 2002; Kagawa *et al.*, 2011; SMMT, 2012c). To compensate, Sunderland (2009) advocates a CO_2 emissions limit of 130g/km on the replacement vehicle for receipt of a scrappage allowance. This could offset emissions from vehicle production and produce an overall environmental net gain after six years.

2.5.2.4 Initial vehicle registration fee

The Motor Car Act of 1903 introduced the requirement for registering vehicles from 1 January 1904, making it an offence to drive an unregistered vehicle on a public highway (Butcher, 2008). The process of registering a new vehicle with the Driver and Vehicle Licensing Agency requires a VAT-exempt £55 flat-fee. This is intended to cover all administration costs associated with the vehicle throughout its lifetime (Direct Government, 2012b). Some vehicles are exempt from payment, including those registered for disabled use, off-road and Crown vehicles (Direct Government, 2012b). The initial vehicle registration fee must be made as a single payment, together with the necessary FYR of VED payment. The vehicle's purchase price normally includes both payments.

The flat-fee fails to recognise the characteristics of the newly registered vehicle. Ferguson (2012) suggests the vehicle registration fee could reflect engine size or CO_2 emissions for environmental reasons. Many European countries have a more substantial system for vehicle registration taxation than the UK. CO_2 emissions are a common tax base, either in isolation or conjunction with the likes of fuel consumption, engine size and fuel type (Association of European Automobile Manufacturers, 2012). However, the initial vehicle registration fee, in whatever shape or form, is outwith the scope of used vehicles, whereby limiting its potential effectiveness in shaping individuals' future vehicle purchasing decisions.

2.5.2.5 Feebates

Feebates embraces a system of fees for highly polluting vehicles and rebates for vehicles with the opposite characteristics: hence the hybrid name (Peters *et al.*, 2008). Feebates are dependent on identification of a pivot-point, e.g. CO_2 emissions (Langer, 2005; Martin *et al.*, 2014) to determine whether money is paid or received by the buyer. For the greatest effect, the distance from the pivot-point should determine the size of the feebate, creating an incentive for all vehicles (Greene *et al*., 2005). A key weakness of feebates is their applicability to brand new vehicle purchases only, making emission reduction gradual (BenDor and Ford, 2006). Feebates must be implemented for at least 10 years to influence the whole vehicle fleet (Santos *et al*., 2010). Hence, the potential effectiveness of the two year Canadian 'Vehicle Efficiency Incentive' was somewhat limited (German and Meszler, 2010).

Feebates have the biggest impact upon vehicle manufacturers, rather than consumers (Davis *et al*., 1995; Greene *et al*., 2005). Clear pricing for CO_2 abatement via feebates allows vehicle manufacturers to plan their production strategy accordingly (Lane, 2011; Nel and du Plooy, 2013). For example, if the cost to improve vehicle CO_2 emissions is less than the change in fees/rebates, then manufacturers are financially incentivised to adopt this approach (German and Meszler, 2010).

From a consumer perspective, financial benefits arise from choosing a low emission vehicle with either a greater rebate or lesser fee (Ferguson, 2012). Research by German and Meszler (2010) suggests the level of incentive provided by feebates is often insignificant relative to current vehicle prices. This explains the relatively low impact on consumers reported by Davis *et al*. (1995) and Greene *et al*. (2005). However, the French 'Bonus/Malus' scheme was highly successful despite the low ratio of feebates to new vehicle purchase costs (D'Haultfœuille *et al*., 2010; Boutin *et al*., 2010). The LowCVP (2008) reported a surge in the 4x4 vehicle purchases between feebate announcement and subsequent introduction. Whilst belittling the intention of feebates with increased CO_2 emissions, it does suggest the impending fees would have discouraged the purchase of such vehicles (D'Haultfœuille *et al*., 2010). Past research has identified public acceptance towards feebates as fairly high (Peters *et al*., 2008; Agrawal *et al*., 2010; Martin *et al*., 2014). Musti and Kockelman (2011) argue feebates as more politically acceptable than other fiscal policy measures due to the reward component.

The administration of feebates has implications for the scheme's effectiveness. There are two administrative approaches to feebates. A consumer based approach would integrate feebates into the vehicle purchase price. Conversely, the vehicle manufacturers can temporarily pay the feebates and later be reimbursed under a manufacturers based programme. Consumer based programmes are likely to have a greater impact upon future vehicle choice than manufacturers based programmes (German and Meszler, 2010). However, consumer based feebates will cause a greater administrative burden for manufacturers.

There is a strong argument for feebates to be revenue-neutral, where the revenue generated from fees should be used to fund rebates (Johnson, 2006; Peters *et al*., 2008; Transport Committee, 2012). The design of the programme, including the pivot-point, is critical in evaluating the ability to self-fund and be sustainable (Langer, 2005; German and Meszler, 2010). Furthermore, Lyons *et al*. (2004) identified greater public acceptance for revenue-neutral policies. This can counteract initial misconceptions regarding feebates as simply another means to raise government revenue (Greene *et al*., 2005). However, the estimation of the appropriate feebates is often difficult due to uncertainties surrounding the uptake (BenDor and Ford, 2006). The initial pivot-point can be set based on existing vehicle data, e.g. average CO_2 emissions or fuel consumption. Adjustments can subsequently be made, responding to excess revenue or shortfalls. For example, the public budget for the French 'Bonus/Malus' scheme ran into a €500 million debt in 2010 due to a greater than expected uptake of rebates over fees (Boutin *et al*., 2010). This subsequently prompted a readjustment of the pivot-point. Alternatively, feebates could be designed to collect slightly more fees than rebates paid as a safeguard. The surplus could be banked and applied in later years (German and Meszler, 2010).

The pivot-point should also be adjusted to reflect improvements in vehicle emissions. This ensures the incentive to purchase a low emission vehicle is maintained (German and Meszler, 2010). For example, the French feebate scheme reduced its maximum emissions for a rebate from 130g/km to 110g/km of CO_2 from 2008 to 2011. Simultaneously, the minimum emissions for fees fell from 161 to 151g/km during the same period (Agence de l'Environnement et de la Maîtrise de l'Energie, 2012).

Feebate design can generally be split into two approaches. A per-unit approach would produce a continuous financial incentive for motorist, irrespective of the pivot-point (Greene *et al*., 2005; German and Meszler, 2010). Revising the feebate rate, such as the price of CO_2 emissions, will subsequently alter the price signal. Alternatively, a graduated approach could be adopted, which suffers a fundamental weakness regarding the universal treatment of vehicles within a band. For example, 2007 Honda Fit narrowly missed out on a rebate from the Canadian feebate scheme, but Honda was able to make some minor adjustments for the vehicle to qualify. However, no incentive exists to improve fuel efficiency beyond the feebate cut-off point (German and Meszler, 2010). For both approaches, a zero-slope range can be introduced in the mid-section of the CO_2 emissions scale. Eligible vehicles would be exempt from paying a fee or receiving a rebate (McManus, 2007; Bunch and Greene, 2010). This suffers from the same weakness as a graduated approach, but to a lesser extent. Experience of the Canadian feebate system dictates the zero-slope range should not be too large to enhance the effectiveness of feebates (German and Meszler, 2010).

A UK feebate system has been suggested (Lane, 2005; LowCVP, 2006; Environmental Audit Committee, 2008; Ferguson, 2012). Modification of the FYR of VED would perhaps most easily achieve the same outcome (Transport Committee, 2012). To aid public understandability, the LowCVP (2006) advocates the desirability of linking a feebate system to existing VED bands. The current VED set-up already provides a crude classification of 'low', 'medium' and 'high' emission vehicles. This could underpin a future feebate scheme. For example, vehicles emitting maximum 130g/km of CO_2 are currently exempt from the FYR of VED. These could, under a feebate system, be awarded a rebate instead. Vehicles emitting 166g/km of CO_2 minimum currently face a larger FYR compared to the SR. Such vehicles could continue being liable for a fee under a feebate system. Vehicles between these two pivot-points, emitting 131-165g/km of CO_2, currently pay the same rate of VED for the FYR and SR and could remain unaffected by feebates. Many of the requirements of an 'ideal' feebate system need not apply in the UK (Ferguson, 2012). For example, a UK feebate system may not have to be revenue-neutral because of the numerous taxation policies already employed. The UK's one-in-one-out rule means if feebates were introduced, simplification of existing policy would have to occur (Ferguson, 2012).

2.5.3 Circulation policy measures

Circulation taxes are effectively a registration charge on vehicle ownership. Payment reoccurs throughout the ownership cycle, typically annually or biannually. Whilst positioned away from vehicle purchasing decisions, circulation taxes tend to be based on the vehicle itself. Vehicle purchasing decisions will thus shape future circulation payments (Potter *et al*., 2005; Litman, 2009). The requirement for regular payment throughout the vehicle ownership cycle amplifies the significance of circulation taxes

(Ryan *et al*., 2009). The Environmental Audit Committee (2008) identified 13 years as the average vehicle life, which perhaps places greater importance upon circulation measures because of its wider applicability than purchase taxes. Regarding the revenue raising potential, circulation taxation tends to generate a stable revenue stream compared to purchase taxes. This arises because of a greater resistance to economic cycles (EC, 2002).

As with purchase taxes/subsidies, environmental reforms have occurred with circulation taxes across the world (Potter *et al*., 2006). For example, Denmark uses fuel consumption as a tax base, whilst Germany uses European emission standards. Circulation taxes are advocated as more influential upon CO_2 emission intensity than purchase taxes (Hayashi *et al*., 2001; Giblin and McNabola, 2009; Beck *et al*., 2011). Motorists are said to think ahead to future circulation taxes based on vehicle choice. In contrast, Ryan *et al*. (2009) suggests a combination of purchase and circulation taxes have the greatest potential for CO_2 abatement than either measure applied alone. The effectiveness of circulation taxes is advocated by Veitch and Underdown (2007) as predominantly dependent upon the amounts charged.

2.5.3.1 SR of VED

VED was introduced in 1889 as an annual tax on four-wheeled motor vehicles. An additional excise duty based on vehicle weight was introduced with the Locomotives on Highways Act 1896. This was designed to manage the use and speed of vehicles on UK roads (Butcher, 2008). From 1909, revenue from VED was hypothecated for road building and maintenance of the road network (Environmental Audit Committee, 2008). The Finance Act 1936 made VED a general revenue raising tax (Smith *et al*., 2009). VED was graduated from 1910 to recognise vehicle horsepower, but was replaced with a flat rate in 1948 (Butcher, 2008). Graduated VED was reintroduced in 1999 based on engine size, which is a crude proxy for environmental characteristics. For example, it fails to recognise different fuel types, vehicle transmission and on-board technologies such as air conditioning – all can affect CO_2 emissions. Despite its simplicity, engine size is the second most popular tax base in Europe for circulation taxation, behind CO_2 emissions (Association of European Automobile Manufacturers, 2012).

The UK was the first EU country to use a CO_2 emission tax base for circulation taxation (University College Dublin, 2009). From March 2001, tax bands A-D were created, with payment ranging from £100-£160, with discounts available for AFVs (Potter *et al*., 2005). A diesel supplement was also present to reflect particulates and other air pollutants. Additional tax bands were introduced in 2002 and 2003. Tax bands A-F required payment ranging from £55-£165 (HM Treasury, 2003). The first VED exemption materialised in 2006 for vehicles emitting 100g/km of CO_2 or less (HM Treasury, 2006). The maximum VED payment for the highest emitting vehicles gradually rose from £215 in 2006, to £300 in 2007, and £400 in 2008 to discourage their purchase (HM Treasury, 2006, 2007, 2008b). The 2007 Budget announced the alignment of VED rates for petrol/diesel vehicles to reflect air pollution improvements for diesel vehicles[8] (HM Treasury, 2007).

2008 saw the introduction of 6 new tax bands, resulting in the same 13 tax bands as present. The creation of additional tax bands allows greater exclusivity within each band, with VED payments being more closely tailored to environmental damage (HM Treasury, 2008b). For example, the 121-150g/km tax band with £120 VED was divided into: 121-130g/km with £90; 131-140g/km with £110; and 141-150g/km with £120 VED. Smaller environmental savings are now recognised which would previously have gone unrecognised. The 2012 budget announced plans to develop a direct debit system for VED (HM Treasury, 2012a). Applicable from 1 October 2014, motorists can spread the cost of VED on a monthly basis (HM Treasury, 2013a), as well as the current options for annual and biannual payment. This will dilute the potential impact of this upfront payment mechanism. For example, £10.50 per month appears more financially manageable than £120 upfront for the year. However, the setup will calculate monthly VED at 8.8% and 52.5% of the annual rate, rather than 8.3% and 50% on a straight-line basis. The surcharge was implemented to *"limit the impact on the public finances"* (Gov.uk, 2013, p.1). The effect on future vehicle purchasing behaviour, with diluted financial signals, remains to be seen.

The SR of VED must be paid when the FYR expires on a brand new vehicle or from the onset for a used vehicle. No payment is required for vehicles emitting 100g/km of CO_2 or less, argued by Lane (2011) as being of symbolic rather than financial value. Further exemption exists for vehicles registered before 1 January 1973 and those driven by

[8] Kay *et al*. (2013) estimates diesel engines offer 14% reduction in life cycle GHG emissions per vehicle km compared to the equivalent petrol engine. However, petrol engines emit less nitrous oxide and particulate emissions. Euro emission standards have helped to bridge the emissions gap between petrol and diesel engines.

disabled drivers (Direct Government, 2010a). 2012/13 payments for petrol/diesel vehicles range from £0-£475 for 12 months, with a £10 discount available for AFVs (***Table 3***). £470 million was collected in VED from Scottish vehicles in 2010/11, equating 8.1% of total UK revenue (Scottish Government, 2012e).

Table 3: SR of VED (from 1 April 2012 to 31 May 2013) for petrol/diesel vehicles and AFVs registered from 1 March 2001 (DVLA, 2012)

Tax band	CO_2 emissions (g/km)	SR of VED (2012/13[9])			
		Conventional fuelled vehicle		AFV	
		12 months	6 months	12 months	6 months
A	=< 100	£0.00	-	£0.00	-
B	101-110	£20.00	-	£10.00	-
C	111-120	£30.00	-	£20.00	-
D	121-130	£100.00	£55.00	£90.00	£49.50
E	131-140	£120.00	£66.00	£110.00	£60.50
F	141-150	£135.00	£74.25	£125.00	£68.75
G	151-165	£170.00	£93.50	£160.00	£88.00
H	166-175	£195.00	£107.25	£185.00	£101.75
I	176-185	£215.00	£118.25	£205.00	£112.75
J	186-200	£250.00	£137.50	£240.00	£132.00
K*	201-225	£270.00	£148.50	£260.00	£143.00
L*	226-255	£460.00	£253.00	£450.00	£247.50
M*	>=256	£475.00	£261.25	£465.00	£225.75

** Vehicles registered between 1 March 2001 and 23 March 2006 emitting at least 226g/km of CO_2 are classed as tax band K despite their higher emitting properties. This arose because of rising public anguish over retrospective taxing, unfairly penalising the owners of high emission vehicles for buying such a vehicle when the environmental agenda was not as prominent.*

Vehicles registered between 1 January 1973 and 1 March 2001 are subject to VED based on engine size (as per the VED system prevailing until 2001; ***Table 4***). This is due to a lack of environmental information, including CO_2 emissions, for older vehicles. Comparing VED payments based on CO_2 emissions and engine size, a financial incentive exists to choose a vehicle registered after 1 March 2001 emitting 140g/km of CO_2 or less. This results in a maximum payment of £135 annually. Conversely, if consumers wish to purchase a high emission/large engine vehicle, up to £255 can be saved by choosing one registered before 1 March 2001. This results in VED of £220, rather than up to £475 if the vehicle is registered from 1 March 2001. The SMMT (2012c) estimates 34% of the UK vehicle fleet were registered pre-2001. When combined with the 13 year average

[9] As per the FYR of VED, inflationary increases have occurred for the SR for 2013/14 (***Appendix A1***).

vehicle life (Environmental Audit Committee, 2008), this suggests a small market for engine based VED.

Table 4: SR of VED (from 1 April 2012 to 31 May 2013) for vehicles registered before 1 March 2001 (DVLA, 2012)

Engine size (CC)	SR of VED (2012/13)	
	12 months	6 months
=<1549	£135.00	£74.25
>=1550	£220.00	£121.00

The 2001 environmental reform of VED helped raise the profile of CO_2 emissions for consumers. Lehman *et al*. (2003) discovered only 17% of motorists had looked up vehicle CO_2 emissions under the engine based setup, rising to 50% after the reform. However, the relationship between VED and CO_2 emissions was revealed as *"patchy"* (DFT, 2003, p.8). Recent research still fails to present a positive picture. The RAC (2009) reported 32% of motorists with knowledge of the new tax bands and only 16% claiming to understand them. Anable *et al*. (2008) found 14% of motorists could not indicate their current vehicle's tax band or could suggest more than one possible tax band. 75% could not even provide a possible tax band, but gave a financial estimate instead. VED is often perceived as a financial expense, rather than being recognised as an environmental measure (Anable *et al*., 2008; Lane and Banks, 2010).

The VED environmental reform had a *"minor"* impact upon average UK CO_2 emissions (German and Meszler, 2010, p.17). Fleet emissions fell by 1.2% from 1995-2000 pre-reform, and a further 1.3% from 2001-2007 post-reform. This can be favourably contrasted with European reductions of 1.7% and 1% respectively. The Committee on Climate Change (2011) advocates the significance of VED contributing to this small but nevertheless valuable CO_2 emissions reduction. It is interesting to note the UK company car tax system producing greater environmental savings than private vehicles alone (Veitch and Underdown, 2007). Company car tax refers to the annual income tax charge for the provision of a company car for business and private use. A CO_2 emission scale is used in both cases, however, the company car tax scheme uses 5g/km increments from 100-220g/km (HMRC, 2011b). This approach therefore offers financial savings for CO_2 reductions of only 5g/km and can perhaps be attributed to the greater environmental savings.

Regarding the potential annual savings between the SR of VED tax bands, the biggest is £190 between bands K-L. The average differential is only £39.58 for petrol/diesel vehicles[10] (***Figure 12***). Recognising such low VED savings, Ferguson (2012) argues fuel costs savings from choosing a less emitting vehicle would be more substantial than VED savings. Recognising the majority of differentials are under £50, the findings of Lehman *et al*. (2003) indicate a relatively low influence of the SR in shaping individuals' future vehicle purchasing behaviour. Combined with the FYR of VED, the SR pricing signal will be amplified.

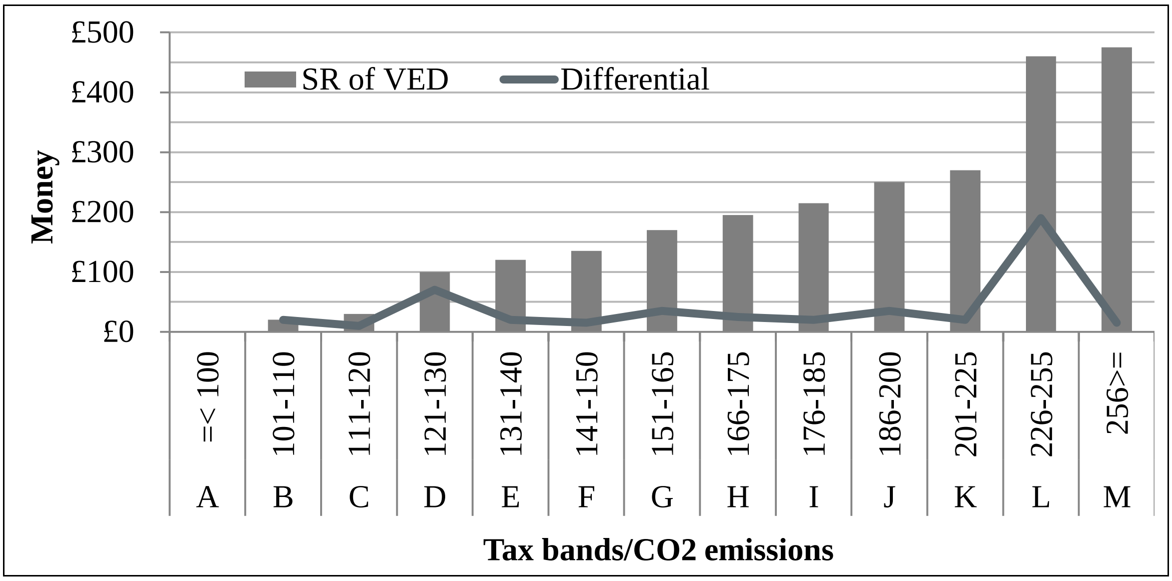

Figure 12: SR of VED (from 1 April 2012 to 31 March 2013) for petrol/diesel vehicles registered from 1 April 2010 and the differential between tax bands

Policy measures such as VED also send signals to vehicle manufacturers regarding the environmental credentials of the vehicles produced. The SMMT (2012a) highlights the change in distribution of new vehicles across the VED bands over the past decade. Results are encouraging as SMMT (2012a) report an increased number of lower CO_2 emitting vehicles available to buy. For example, only 1% of the 2000 vehicle market emitted up to 130g/km of CO_2, rising to 50% by 2011. Conversely, the share of vehicles emitting over 200g/km reduced from 23.2% in 2000 to 3.2% in 2011 (SMMT, 2012a). Despite the range of available vehicles, Anable *et al*. (2008) argues most consumers look to purchase a vehicle somewhere in the mid-range of the CO_2 emission scale. This suggests a half-hearted approach to environmental mitigation.

[10] Compared to AFVs, the differential is largely consistent. The only difference is between tax bands A-B, where the differential is £10 for AFVs and £20 for petrol/diesel vehicles.

2.5.3.2 Vehicle insurance

Insurance serves to protect risk-averse individuals/companies from the negative consequences of various acts of nature involving risk (Spence and Zeckhauser, 1971; Lloyds, 2012). Vehicle insurance is compulsory at a third party level to protect against injuries to other individuals and damage to their property. It is voluntary for more comprehensive packages covering the policy holder and their vehicle (Hickson, 2006; ABI, 2009; AA, 2012; Direct Government, 2012c).

Through the payment of a premium to an insurance company, the risk is transferred away from the individual (Lloyds, 2012). A number of factors are considered in calculating the insurance premium, including the likelihood of the risk happening and its value. This is a function of the driver and vehicle characteristics (Parry and Small, 2005; Hickson, 2006; Parry *et al*., 2007).

The notion of discounting for low CO_2 emitting vehicles as a reward does not entirely correspond with the underlying risk transfer function. Nevertheless, this type of discount is present with several UK insurance companies. For example, a 5% insurance premium reduction is offered by the Green Insurance Company for 'greener' vehicles[11]. With vehicle insurance being a reoccurring expense, typically monthly or annually, this would provide an additional way to accumulate financial savings for low emission vehicles.

2.5.4 Road-fuel policy measures

The final type of policy measure, known as road-fuel taxation/subsidies, relates to vehicle use. This policy measure is often preferable to motorists as a regular and visible expense (Goldberg, 1998). It can thus have a strong impact upon vehicle usage decisions (Potter *et al*., 2006). Hayashi *et al*. (2001) advocates the high potential influence of road-fuel taxes upon the CO_2 emitted from vehicle use. This recognises the link between the combustion of fuel and release of CO_2 emissions.

Beyond vehicle usage decisions, road-fuel taxes could be used to shape individuals' future vehicle purchasing decisions. Purchasing a lower emission vehicle will result in relatively lower fuel consumption, raising MPG and lowering road-fuel tax contributions throughout the vehicle's lifetime (Potter, 2009; AEA, 2009). Consideration of future

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[11] See http://www.greeninsurancecompany.co.uk/carInsurance.html [last accessed 9 July 2013]

running costs based on anticipated mileage may thus influence vehicle choice, providing further incentives for a lower emission vehicle purchase (Potter *et al*., 2006), although the impact is relatively small (Hayashi *et al*., 2001; Giblin and McNabola, 2009). Road-fuel taxation/subsidies can also influence vehicle manufacturers. The financial attractiveness of lower emission vehicles should encourage greater use of more fuel efficient vehicle technologies (Kirby *et al*., 2000).

However, a rebound effect regarding vehicle use may transpire from purchasing a lower emission vehicle. Such vehicles will be relatively more fuel efficient and thus have lower running costs. Ironically, this may encourage greater use, potentially offsetting the initial environmental benefit (Greene, 1992; Jones, 1993; Greene *et al*., 1999; Greening *et al*., 2000; OECD, 2001; Potter *et al*., 2004; Small and Van Dender, 2007).

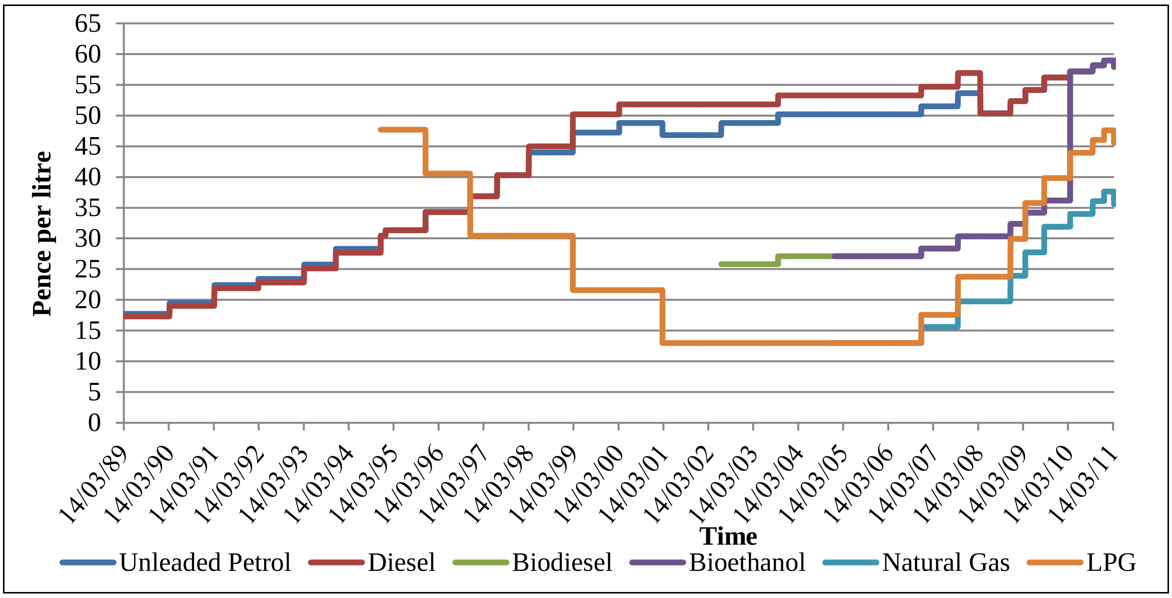
2.5.4.1 HOD and fuel taxation in general

Road-fuel is taxed via HOD and VAT[12]. HOD is a flat rate of pence per litre (PPL) or kilogram (PPKG), often rising with inflation to maintain its real value (Seely, 2011). Oil price changes also affect HOD (Smith *et al*., 2009). From a policy perspective, HOD is simple to administer, with low revenue collection costs. It is also difficult to avoid/evade and easy to modify (Royal Commission on Environmental Pollution, 1994; Potter, 2008).

HOD rates are split for different fuel types, aiming to encourage the switch towards alternative fuels with a lesser environmental impact (***Figure 13***; Knight *et al*., 2000; Hinnells and Potter, 2001; Wachs, 2003). £2.3 billion was collected in HOD in Scotland during 2010/11, equating 8.6% of total UK revenue (Scottish Government, 2012e).

Over 99% of all new Scottish vehicle registrations utilised main road-fuels, i.e. petrol and diesel (Scottish Government, 2011b). From 23 March 2011, HOD for main road-fuels was set at 57.95PPL (DECC, 2012b). A 3.02PPL increase was planned for August 2012, postponed until January 2013 to help during the economic recession (BBC News, 2012) and cancelled in December 2012 (HM Treasury, 2012b). Further planned increases of 1.89PPL for 2013/14 were also deferred to September 2013 (HM Treasury, 2012b), but later cancelled (HM Treasury, 2013b). The 2013 Autumn Statement also cancelled the

[12] Taken at 20% of the full selling price, inclusive of HOD.



Note: HOD for natural gas and LPG were initially quoted in a PPKG. These were converted into a PPL to aid comparisons, where 1PPL is equal to 1.44PPKG (HMRC, 2011d).

Figure 13: Historical HOD rates from 1989-2011 (HMRC, 2011c)

1.61PPL increase planned for September 2014 (HM Treasury, 2013a). HOD will remain frozen for the remainder of the coalition government's term in office.

Relative to retail prices, the UK takes a high tax proportion. In June 2013, approximately 42% of main road-fuel prices were taken in HOD and 58% for HOD and VAT combined (AA, 2013). Relative to the rest of Europe, the Association of European Automobile Manufacturer (2012) reports the UK holds the third highest unleaded petrol HOD, behind the Netherlands and Italy. However, the UK holds the highest rate of diesel HOD in Europe. Relative to the retail price, the UK has the highest tax proportion out of all EU member states: 60% for petrol and 58% for diesel in 2011 (Seely, 2011).

Whilst current rates could perhaps be considered substantial, over 80% of 1998 UK main road-fuel retail prices were taken in tax (DFT, 2009a). This arose under a policy to raise HOD through the FDE (Potter *et al*., 2005). Under the Conservative government's 1993 Budget, HOD was set to increase by 3% above inflation, rising 5% from November 1994 and 6% from March 1998 (Salmons, 2011). The FDE was justified as a way of raising revenue and reducing CO_2 emissions by discouraging vehicle use (Bolton *et al*., 2001; Potter *et al*., 2005). The FDE was last applied in March 1999 and abolished in the 1999 Pre-Budget (HM Treasury, 1999). The FDE brought UK fuel prices from being amongst the cheapest to the most expensive in Europe (BBC, 2000; Seely, 2011). However, fuel prices continued rising after the FDE abolishment, contributing towards the 2000 fuel protests where HOD was frozen (HM Treasury, 2000). The 1999 Pre-Budget announced future HOD increases would be decided on a budget-by-budget basis (HM Treasury, 1999).

Tax increases above inflation began reappearing towards the late 2000s (Chartered Institute of Taxation, 2009). For example, the 2009 Budget announced a 1PPL HOD increase above indexation from 2010-2013 (HMRC, 2009; HM Treasury, 2009a). The 2011 Budget announced a new package of measures to help motorists during periods of high fuel prices, known as the Fair Fuel Stabiliser. HOD would increase by inflation plus 1PPL when oil prices are greater than £45 or $75 per barrel; whilst inflationary increases will occur when oil is cheaper (HMRC, 2011d). Historical oil prices have been very volatile, particularly from 2007 (US Energy Information Administration, 2012). Crude oil has cost more than the $75 cut-off for the Fair Fuel Stabiliser since August 2010. Nevertheless, the Fair Fuel Stabiliser has been suggested as unlikely to significantly affect retail fuel prices, recognising the additional elements making up the pre-tax fuel prices (Ferguson, 2012; Bolton, 2012). Conversely, high fuel prices have been suggested as important in encouraging motorists to choose a vehicle with improved fuel economy and thus lower CO_2 emissions (Committee on Climate Change, 2011).

A UK consultation regarding discounted HOD in remote rural locations commenced in 2010 (HM Treasury, 2010b). This recognised a price premium on main road-fuels of approximately 10PPL in the Scottish Isles and 25PPL in the Scilly Isles, relative to the UK average[13] (HMRC, 2011e). From January 2012, the ‘rural fuel duty relief scheme’ was implemented. This allowed retailers to claim back 5PPL for main road-fuel purchases in the Inner and Outer Hebrides, Northern Isles, Islands in the Clyde and Isles of Scilly. Initial estimates suggest fuel consumption increases of 0.5%, whilst revenue will fall by £5 million per annum (HMRC, 2011f). The 2013 Autumn Statement announced plans to extend the current rural fuel rebate scheme to other remote UK areas (HM Treasury, 2013a).

Biofuels are derived from biological feedstock. Despite the release of CO_2 emissions during their combustion, biofuels are considered carbon-neutral due to photosynthesis when in plant form (Johnson *et al*., 2007; Sivakumar *et al*., 2010. However, Koh and Ghazoul (2008) recognise additional CO_2 emissions released during the biofuel

[13] This is mainly due to higher transport and fuel distribution costs, combined with relatively lower demand in remote rural locations.

production process, including agricultural processing, refining and delivery. Nevertheless, some researchers are positive regarding the future/next generation of biofuels (Farrell *et al*., 2006; Ragauskas *et al*., 2006).

Biofuels for transport is a relatively new but rapidly evolving industry (Bomb *et al*., 2007). A HOD saving was introduced for biodiesel from 2002 and bioethanol from 2005 relative to the main road-fuel HOD (EC, 2005c; HMRC, 2011c). The discount was initially 26PPL, reducing to 20PPL in December 2008. It was abolished in April 2010 because some biofuels were ‘greener’ than others, which was not reflected by the design of the incentive (HM Treasury, 2008b; 2009b; DFT, 2009b). This brought both biofuels and main road-fuel HOD to 57.95PPL (HMRC, 2011d).

From 2008, the RTFO is the dominant means of incentivising the uptake of ‘greener’ fuels, including biofuels (DFT, 2012d). Several other countries have adopted a similar approach, including Austria, Slovenia and the Netherlands (EU Committee, 2006). Legislation requires UK road-fuel suppliers distributing at least 450,000 litres to include a necessary minimum from renewable and sustainable sources. The target for biofuel supplies increases annually from 2.5% in 2008/09 to 5%[14] of total road transport fuels by April 2013 (DFT, 2012e). Targets were made less ambitious after the Gallagher Review was published in 2008 (Renewable Fuels Agency, 2008). If targets are not met, a buy-out price must be paid by suppliers. RTFO progress indicates a total biofuel supply of almost six billion litres. Relative to targets, progress exceeded expectations for the first two years, but fell short for the following two years (Renewable Fuels Agency, 2009, 2010; DFT, 2011b, 2013c).

In terms of shaping consumer demand, Bomb *et al*. (2007) argues the public are generally not prepared to purchase biofuels without subsidising the price. The RTFO, being a supply-orientated measure, will not provide this. Bomb *et al*. (2007) also posits the aforementioned HOD discount as the main driver triggering both the production and sale of biofuels during its reign. However, without the supply of biofuels, demand cannot occur. The EU Committee (2006) and Kampman *et al*. (2013) advocate the importance of both tax incentives and obligations to drive the future of biofuels.

[14] A government proposal has been initiated to amend the obligations targets for 2013/14 and beyond to around 4.7%. This would maintain the absolute volume of biofuel supply at current levels.

HOD incentives have existed for LPG/Autogas since 1994 and natural gas since 2004 (Johnson, 2003), measured in PPKG because of the gas structure (HMRC, 2011c). LPG has been a fuel alternative for the past 50 years (Karamangil, 2007). HOD is currently 31.61PPKG, equivalent to 45.52PPL (HMRC, 2012b). LPG causes higher fuel consumption relative to petrol, estimated at 1.5:1 (WhatGas, 2011). However, the environmental benefits justify the tax incentive of 12.43PPL compared to the main road-fuel HOD. Lifecycle LPG CO_2 emissions are approximately 14% lower than the equivalent petrol engine (Kay *et al*., 2013). In response to rising LPG demand and oil prices, LPG prices have been gradually increasing from 2005 (WhatGas, 2011). However, LPG still costs less than half the price of main road-fuels, compensating for the additional volume required. Whilst the cost of LPG vehicle conversion must be considered, a higher initial fixed cost will be offset by lower variable costs over the longer term (Rouwendal and de Vries, 1999). The 2013 Budget announced the current 12.43PPL duty differential would be reduced by 1PPL by 2015/16 (HM Treasury, 2013b). The 2013 Autumn Statement announced the 1PPL reduction will continue each year to 2024 (HM Treasury, 2013a). This will therefore be disadvantageous to current LPG drivers and discouraging for future uptake. The impact of reduced HOD incentives upon vehicle uptake and revenue raising will be reviewed at the 2018 Budget (HM Treasury, 2013a).

HOD for natural gas is slightly less than LPG, at 24.7PPKG, equivalent to 35.57PPL (HMRC, 2012b). The retail price of CNG is approximately 60% of diesel prices (Biogas, 2011). Past research have estimated CO_2 emission savings of 15-30% for CNG relative to petrol (Janssen *et al*., 2006; Frick *et al*., 2007; Kay *et al*., 2013), which justifies the 22.89PPL HOD saving relative to main road-fuel HOD.

Collectively, high fuel prices, informed by HOD, are argued as an effective mechanism for restricting vehicle use and subsequently encouraging the purchase of a more fuel-efficient vehicle (German and Meszler, 2010). Fuel taxes were not designed with the environment in mind (Sterner, 2007). However, Hayashi *et al*. (2001) advocates fuel taxation as the most successful fiscal measure to abate CO_2 emissions. For example, Gallo (2011) investigated the influence of fuel surcharges upon individuals' vehicle purchasing behaviour in Italy, reporting a clear shift towards more fuel efficient vehicles. However, price elasticities of demand indicate individuals' vehicle purchasing behaviour is more heavily influenced by rising fuel prices over the long-term. This can be contrasted with periods of up to one year (Paul, 1997; Brons *et al*., 2008; Giblin and McNabola, 2009;

Cowie, 2010). This reflects motorist's ability to choose a more economical and less CO_2 emitting vehicle when faced with rising fuel prices (Ferguson, 2012).

Fuel taxation in particular is recognised as controversial, often perceived as a *"convenient source of revenue"* (Potter *et al*., 2006, p.224). In the short-term, resistance is likely to be high towards a HOD increase (Sterner, 2007). The aforementioned fuel protests are a good illustration of negative public reaction to rising HOD/fuel prices. UK and overseas governments are very wary of this (Potter *et al*., 2006). In contrast, Sloman and Garratt (2010) argue fuel tax would have to be considerably high to significantly reduce the consumption and thus emissions. This has serious implications for a public acceptance. Nevertheless, Sterner (2007) observes relatively higher fuel taxes in Europe compared to the USA. Sterner (2007) vows that European fuel consumption would have been much greater if USA rates prevailed. Overall, the House of Commons Transport Committee (2009, p.46) concludes HOD as an effective way to *"raise revenue, to encourage fuel efficiency and reduce CO_2 emissions"*.

2.5.4.2 Road user charging (RUC)

Policy measures can be implemented locally or nationally to charge for road space. This could apply on the basis of motorists crossing set boundaries, driving within a specified area, or using a linear section of infrastructure such as a tunnel, bridge or section of motorway (DFT, 2004). The arguments for RUC are founded on the work of Pigou (1920). Recognising roads as not privately owned, a charge can be set to create a socially optimal flow of traffic within the available space (Button and Vega, 2008; Santos *et al*., 2010). Whilst RUC is not primarily concerned with environmental objectives, positive spillover effects are likely to arise from road network management (DFT, 2004; Button and Vega, 2008). For example, the London Congestion Charge was largely successful in reducing congestion and traffic levels, ultimately producing environmental savings (TFL, 2007, 2008a; Evans, 2008).

Further to managing vehicle use, RUC can offer discounts/exemptions for low emission vehicles to further incentivise and encourage the purchase of such vehicles. For example, the London Congestion Charge offers a payment exemption for electric vehicles and other 'green' vehicles emitting 75g/km of CO_2 maximum and meeting the Euro5 emission standard (TFL, 2013). Increasing numbers of 'green' vehicles qualifying for the exemptions can be partly attributed to the RUC (Potter *et al*., 2005), including almost

20,000 vehicles registered for the 'greener vehicle discount' (TFL, 2012a). Beyond the UK, analysis of different RUC schemes indicates drivers do respond to RUC pricing signals (Button and Vega, 2008).

In terms of integrating RUC schemes into UK policy, some researchers suggest a complete fiscal overhaul. This would include the abolishment of VED and HOD, and subsequent replacement with a mileage charge[15] (Ubbels *et al*., 2002; Potter *et al*., 2004). Others have simply suggested reducing VED and HOD, together with RUC (Dodgson *et al*., 2003). Indeed, the 2004 Transport Secretary envisaged future UK transport policy to include some form of RUC (DFT, 2004). The UK is, however, yet to implement a nation-wide RUC scheme, but various local schemes exist, e.g. London.

To strengthen the environmental benefit from RUC, the payment system can be structured for CO_2 emissions. This was previously considered for the London RUC scheme. The aim was to improve awareness of climate change and shape individuals' future vehicle purchasing behaviour towards low CO_2 emitting vehicles. Model simulations predicted a 4% traffic reduction for vehicles in the highest RUC band, a 3% increase for the lowest RUC band and a 2% CO_2 emission reduction (AEA, 2007). The proposal was, however, never implemented due to a change in mayorship.

A number of technical problems have been identified as a possible hindrance to future RUC successes. Button and Vega (2008) note difficulty in setting the 'optimal' charge. However, prices can be modified over time, responding to both changes in congestion/emissions and the reaction of motorists (Cowie, 2010). Various transaction costs will also be incurred during the initiation, implementation and enforcement phase. Each technological option for recording road use, including automatic number plate recognition and microwave tags, has issues surrounding their reliability and effectiveness (DFT, 2004). Privacy may be an issue, depending upon the payment and enforcement methods (Jones, 1998).

Public acceptability towards RUC is argued as the greatest barrier to implementation (Gaunt *et al*., 2007; Hensher and Bliemer, 2014). There is a consensus among motorists regarding the right to free mobility (Giuliano, 1992; Jakobsson *et al*., 2000; Harrington *et*

[15] Complete abolishment of HOD would not be possible unless a UK-wide distance-based RUC scheme was implemented.

al., 2001; DEFRA, 2002; Ryley, 2010). The DFT (2004) revealed a vast majority of individuals who were reluctant to pay more for road use. Individuals also conceptualised the negative consequences of excessive congestion as outwith their personal domain, contributing towards a reluctance to pay (Button and Vega, 2008). For example, the 2005 public referendum for RUC in Edinburgh faced an overwhelming rejection of 74% from the 69% turnout rate from Edinburgh residents (Cain and Jones, 2003; McQuaid and Grieco, 2005; Braunholtz and Cumming, 2006; Ryley, 2010). However, the proposed CO_2 based RUC scheme in London was met with 61% support (TFL, 2008b). Past research recognise increased public acceptability after a RUC scheme has been introduced (Tretvik, 2003; Ryley and Gjersoe, 2006; Schuitema and Steg, 2010; Börjesson *et al*., 2012). At this point, the public can physically see the scheme in action, perhaps explaining the high acceptance in London. When proposing and implementing a new RUC scheme, Kim *et al*. (2013) conceptualised the factors informing the acceptability of transport policy. This includes government trust, awareness of an environmental problem, perceived effectiveness and fairness. Braunholtz and Cumming (2006) emphasise the importance of communication to overcome low public acceptability.

2.5.4.3 Parking charges

Parking policy is recognised for its key impact on travel patterns and local economic development (McShane and Meyer, 1982; Kelly and Clinch, 2006; Marsden, 2006; Daunfeldt *et al*., 2009). Like RUC, parking policy is a key instrument in controlling urban road space. However, secondary environmental benefits are also recognised (McShane and Meyer, 1982; Litman, 2006a; Santos *et al*., 2010). Furthermore, Zatti (2004) argues political and public acceptability for parking fees is greater than RUC. Parking measures can be manipulated in two ways (Feeney, 1989; Litman, 2006b). First, the supply of parking spaces can be affected, e.g. peak and off-peak availability and maximum parking times. Second, changes can be made to the pricing structure, such as preferential pricing for low CO_2 emitting vehicles (Lane, 2005; Santos *et al*., 2010). The latter follows the same logic as the VED system, where payment increases as CO_2 emissions rise.

Emissions based parking charges have been highlighted in transport strategy documentation for local boroughs, including the Mayor for London’s Transport Strategy (Greater London Authority, 2010). The LowCVP (2006) suggest a number of ways preferential parking charges for low CO_2 emitting vehicles could be developed. For example, the inclusion of organisations within a city/local authority adopting a similar scheme and designated parking spaces solely for low emission vehicles.

Local authorities usually have the power to set prices for the parking spaces they own and operate. However, planning regulations or legislation may be used to influence privately owned off-street parking (Bonsall and Young, 2010). The London Borough of Camden was one of the first UK areas to implement CO_2 based parking charges due to vehicle emissions and air quality concerns (London Borough of Camden, 2012a). Other London councils have also embraced this policy measure, together with York, Brighton and Edinburgh. To further incentivise the purchase/use of low CO_2 emitting vehicles, Camden also included a 75% discount for electric vehicles (London Borough of Camden, 2012b). However, this type of policy measure fails to recognise vehicle usage/mileage, ultimately influencing total CO_2 emissions (House of Commons Transport Committee, 2009). Regarding individuals' future vehicle purchasing decisions, the incentive of free parking for AFVs was not a significant factor (Potoglou and Kanaroglou, 2007).

2.5.4.4 Low emission vehicle lanes (LEVLs)

LEVLs work on the premise of preferential road use for selected vehicles, such as those meeting a CO_2 emissions criterion. Preferential treatment could include access to specific areas of the city, such as the London Low Emission Zone (TFL, 2012b). Time savings could also arise when travelling, e.g. bus lanes or high-occupancy vehicle lanes.

In California, high-occupancy vehicle lanes for vehicles with at least two passengers have reduced travelling time by approximately 36 minutes (Hachman, 2012). This privilege has been extended to single occupancy qualifying AFVs, subject to acquisition of a Clean Air Vehicle Sticker (California Environmental Protection Agency, 2012a). 85,000 Clean Air Vehicle Stickers were available for hybrid vehicles until July 2011. This policy measure was instrumental in bringing hybrid vehicles to the Californian market (California Environmental Protection Agency, 2012b). Expiring January 2015, Clean Air Vehicle Stickers are now available for qualifying pure zero emission vehicles and CNG fuelled vehicles (California Department of Motor Vehicles, 2011; California Environmental Protection Agency, 2012c).

Whilst LEVLs are not yet an established policy measure, researchers such as Lane (2005) advocate their use. Existing high-occupancy vehicle lanes can easily be modified for low emission vehicles, providing additional non-monetary incentive for their use. Past research had reported the value of time savings (Brownstone and Small, 2005; Small and Verhoef, 2007; Small, 2012). Burris *et al*. (2012) suggested travellers were willing to pay for even a relatively small travel time saving. Satisfaction from queue jumping and the pleasure of a premium service are possible reasons for this. Regarding individuals' future vehicle purchasing decisions, the incentive of driving an AFV in high-occupancy vehicle lanes was not a significant factor (Potoglou and Kanaroglou, 2007).

2.6 Regulatory environment as a situational factor

Regulatory intervention is more direct and abrupt than the aforementioned fiscal measures. Regulation can be used to manage items produced in excess by an unregulated market, such as CO_2 emissions. Laws, permits and standards fall under the domain of regulation (Smith *et al*., 2009). Monitoring systems also need to be implemented. Regulatory infringement typically results in enforcement action, including a punishment or fine (Environmental Agency, 2007).

Regulation tends to focus more upon suppliers/vehicle manufacturers rather than consumers/motorists, whereby influencing the supply and composition of products/vehicles. There are, however, positive spillover effects upon consumers from a reduced CO_2 emitting vehicle fleet, including reduced fuel costs, less reliance on oil imports, and a lower carbon footprint (LowCVP, 2006). Consumer interest and ultimately demand in low CO_2 emitting vehicles must be supported by government intervention (Transport Committee, 2012).

Standards may be imposed on air quality or emissions. For example, European Emission Standards define the acceptable limits for exhaust emissions (EC, 1970). More stringent limits have gradually been applied from the initial Euro1 standard (EC, 2012b). Financial incentives, such as grants, loans, tax deductions are offered for vehicle manufacturers complying early with Euro5 and Euro6 standards (EC, 2010). Fundamentally, vehicles failing to comply with standards cannot be sold in Europe.

Targets also exist to reduce new vehicle CO_2 emissions as part of legal frameworks, such as the Kyoto Protocol (EC, 2007a). A 2007 European review of new vehicle CO_2 emission targets indicated limited progress (EC, 2007a; AEA, 2007). As a result, the voluntary targets became compulsory. Mandatory new vehicle fleet targets of 130g/km of CO_2 have been imposed by 2015 for car manufacturers. An additional 10g/km of CO_2 abatement should also arise from complementary measures, e.g. biofuels. By 2020, the target rises to 95g/km (EC, 2012a). An average cost of €1,500 per vehicle has been estimated for vehicle manufacturers to comply with the CO_2 emission targets (European Automobile Manufacturers' Association, 2012). Penalties are due if targets are exceeded, recognising the size of the vehicle fleet and the deviation from the target (EC, 2012a).

The provision of information to consumers has also been regulated, intending to produce more informed decision making. For example, EU member states must provide information regarding fuel economy and CO_2 emissions for new vehicles at the point of sale (EC, 2012c). Vehicle manufacturers must also produce a free guide to fuel economy and CO_2 emissions to consumers (EC, 2000a; 2003). Electric vehicles were extended into the scheme from 2013, reflecting the increasing range of available electric vehicles. Information must be displayed regarding electricity consumption, vehicle range and annual electricity costs (VCA, 2013).

Evidence exists regarding the impact of government regulation upon vehicle manufacturers. For example, 1970s USA emission targets instigated substantial research and development by General Motors and Ford, leading to the creation of the catalytic convertor in 1975 (Gerard and Lave, 2005, Ambec *et al*., 2011). In the presence of CO_2 emission targets, the UK has experienced constant reductions in new vehicle CO_2 emissions from 1997-2012 (SMMT, 2012a, 2013). The SMMT (2013) recognises vehicle manufacturers having invested heavily in advancing the internal combustion engine and AFV technology, including aerodynamics and weight savings. This has allowed manufacturers to *"remain competitive, meet consumer expectations and deliver the EU New Car CO_2 Regulation targets"* (SMMT, 2013, p.5).

Nevertheless, Smith *et al*. (2009) argues that regulation is not an economically efficient means of controlling market failures relative to taxation/subsidies. With regulation, pollution abatement costs are the same for all polluters. However, marginal costs are likely to be unique to each polluter. Direct regulation also removes many of the choices individuals/businesses have regarding their response. In contrast, taxation allows individuals/businesses to decide whether to change their behaviour to avoid the tax; or continue acting as before and pay the necessary charge. Direct regulation may therefore impose inappropriate solutions to individual situations (Smith *et al*., 2009). Regulation is argued as less effective in raising awareness of the extent of environmental damage (DFT, 1996). Furthermore, there is only the incentive to meet the required regulatory standard, e.g. the 130g/km target by 2015 in Europe. Surpassing targets will generally not produce additional savings. This can be contrasted with fiscal policy on a per-unit or graduated setup, where continuous incentives exist for environmental abatement (Sloman and Garratt, 2010).

2.7 Past behaviour and habits as situational factors

Lane and Potter (2007) recognise the influence of past behaviour and habits as the final situational factor shaping individuals' future vehicle purchasing behaviour. Individual preferences are understood to evolve due to learning and the presence of habits (Mannering and Winston, 1985). Habits arise when frequently performed behaviours become frozen and performed almost automatically (Verplanken *et al*., 1994, 1997; Bamberg and Schmidt, 2003). No premeditated intention is formed, with little or no planning beforehand (Gärling *et al*., 1998; Anable, 2005). There is a weak relationship between individuals' attitudes towards a specified behaviour and actual conduct, making habits hard to break (Jackson, 2005; Thøgersen and Ölander, 2006). Theoretically, previous behaviour must be unfrozen to allow individuals to undertake a different behaviour (Lewin, 1958; Dahlstrand and Biel, 1997).

Habits are recognised as a strong predictor of future behaviour (Aarts *et al*., 1998; Gärling *et al*., 1998; Aarts and Dijksterhuis, 2000a). Specific to individuals' future vehicle purchasing behaviour, de Haan *et al*. (2009) recognises the influence of the previous vehicle in shaping future vehicle purchases. Households can often become accustomed to a specific vehicle manufacturer/model, as informed by previous vehicle purchases (Mannering and Winston, 1985).

When habits are formed, Regina *et al*. (2010) argues individuals often fail to perceive small changes in choice circumstances and their surroundings. For example, Steg (2003) found many individuals who were unaware of past fuel price increases. Such price signals therefore had no influence on their behaviour. When decision making is similar to previous experiences, or at least perceived to be similar, individuals with strong habits tend to search for data supporting the habitual choice (Betsch *et al*., 2001). This approach would potentially overlook information challenging their habits. Individuals are said to develop certain expectations regarding an outcome, and therefore shy away from information potentially challenging the preconception (Verplanken and Wood, 2006). Fundamentally, less pre-purchase information may be sought by those with strong habits, recognising the strength of their preconceptions (Verplanken *et al*., 1997).

Regarding newly licensed motorists, past research has recognised the impact of family recommendations in shaping vehicle choice during the first year of licensure (Kindelberger and Eigen, 2003; Hellinga *et al*., 2007; Simons-Morton *et al*., 2008). The presence of the family's existing vehicle fleet is also acknowledged as a key influence (Rivara *et al*., 1998; Cammisa *et al*., 1999; Williams *et al*., 2006; Hellinga *et al*., 2007). This will, to some extent, reflect the family's previous vehicle purchasing behaviour and any established habits. This has significance upon individuals' future vehicle purchasing behaviour for new motorists.

Collectively, Stern (2000) argues the context surrounding a decision may require modification to encourage a behaviour change. For example, Verplanken and Wood (2006) acknowledge the nature and level of incentives as maintaining habits. This recognises the importance of economic measures, including taxation/subsidies, in making and breaking habitual behaviour.

2.8 Ajzen's TPB as a psychological consideration

Lane and Potter (2007) advocate Ajzen's TPB as the most important psychological model. The TPB explains the relationship between individuals' values, beliefs, attitudes and intentions to inform behaviour (Ajzen, 1985, 1991). When individuals are faced with a behavioural choice, the TPB posits that alternatives and consequences will be evaluated according to their underlying values. Schwartz (1992, p.1) defines values as *"the criteria people use to select and justify actions and to evaluate people (including self) and events"*. Values shape an individual's beliefs. Beliefs refer to a subjective assessment regarding the outcomes of various activities (MAX Success, 2007). Beliefs subsequently inform attitudes towards possible actions, i.e. a positive or negative evaluation of possible behaviour, ultimately feeding into individuals' BI to undertake a specific action. BI refers to the perceived likelihood of performing a behaviour, such as buying a lower emission vehicle (Lane and Potter, 2007).

The TPB recognises human behaviour as influenced by three main factors: attitudes, social norms; and perceived behavioural control (Max Success, 2007; ***Figure 14***). Fundamentally, the more positive the attitude and social norms and the greater the perceived behavioural control, the stronger individuals' BI should be (Caulfield, 2011).

Attitudes

- A personal appraisal of the behaviour and its consequences.

Social norms

- Perceived social pressure and expectations to perform in a certain way, e.g. the pressure of society to buy a lower emission vehicle;
- There are 2 types of social norms:
  - Descriptive norms are based on observation of other people's action;
  - Injunctive norms are based on what individuals think should be done (Cialdini *et al*., 1990).

Perceived behavioural control

- The perceived ability to actually perform a behaviour;
- This recognises the necessary skills/abilities and constraints, including time and money, to perform (Ajzen, 1991);
- Gärling *et al*. (1998) argues individuals learn from previous attempts of achieving outcomes to ascertain behavioural control.

Figure 14: Factors influencing human behaviour, according to the TPB

Figure 15 illustrates the progression from intention to actual behaviour. When the opportunity arises, individuals are expected to execute their proposed intentions (Max Success, 2007; Boston University of Public Health, 2013). The stronger the BI, the greater the likelihood of actual implementation (Dietz *et al*., 2007), although this depends on the constraints of perceived and actual behavioural control (Ajzen, 1991).

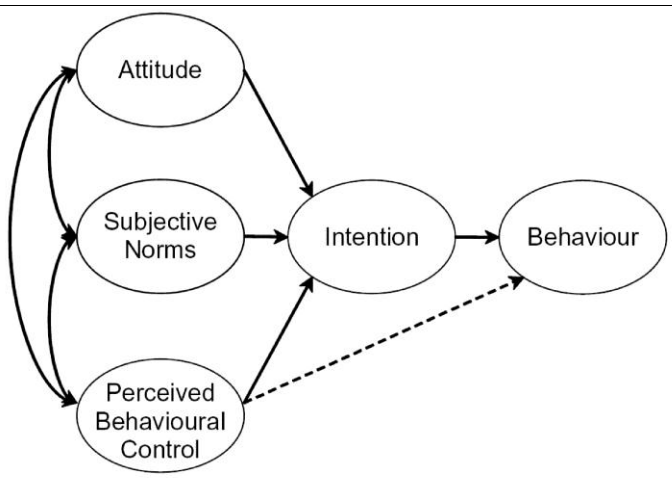


Figure 15: Ajzen's TPB model (Ajzen, 1991)

However, the attitude-action gap or value-action gap recognises the lack of 100% causality between individuals' BI and actual behaviour (Kollmuss and Agyeman, 2002;

Lane and Potter, 2007). Past research has observed concern for the environment often fails to translate into behaviour change (Golob and Hensher, 1998; Lehman *et al*., 2003; Walton *et al*., 2004). Nevertheless, perceived behavioural control can be used as a proxy for actual control and a prediction tool for behaviour (Ajzen and Madden, 1986; Ajzen, 2002).

The TPB can provide insight into the role and influence of values, beliefs, attitudes in shaping individuals' BI and ultimate execution of behaviour (Godin and Kok, 1996; Sutton, 1998; Armitage and Conner, 2001). However, Lorenzoni *et al*. (2007) recognises its overly individualistic and rational assessment of behaviour. Other important variables are also excluded from the model, e.g. habits (Aarts and Dijksterhuis (2000b). Stern (2000) recognises the influence of contextual forces such as advertising and government regulation. Past research has demonstrated the TPB to explain approximately 40% of the variance of behaviour (Ajzen, 1991; Werner, 2004). Other factors must therefore influence behaviour not recognised by the TPB.

2.9 Stern's VBN model as a psychological consideration

The VBN model expresses the relationship between values, beliefs, personal norms and actual behaviour (***Figure 16***; Stern, 1992, 2000; Stern *et al*., 1999).

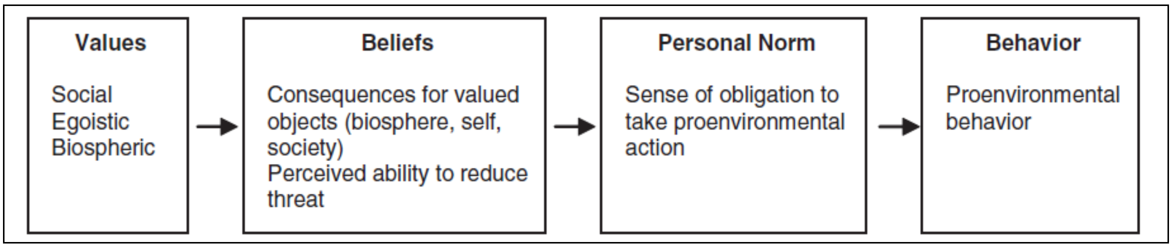


Figure 16: Stern's VBN model for pro-environmental behaviour (Collins and Chambers, 2005)

There are three types of values specific to the pro-environmental behaviour: social values; egoistic values; and biospheric values (Stern *et al*., 1999; Bamberg and Schmidt, 2003; ***Figure 17***). Values are argued by Dietz *et al*. (2007) as potentially having the greatest impact upon pro-environmental behaviour. Stern *et al*. (1995a) recognises individuals with social or biospheric values as more likely to engage in pro-environmental behaviour than those with largely egoistic values.

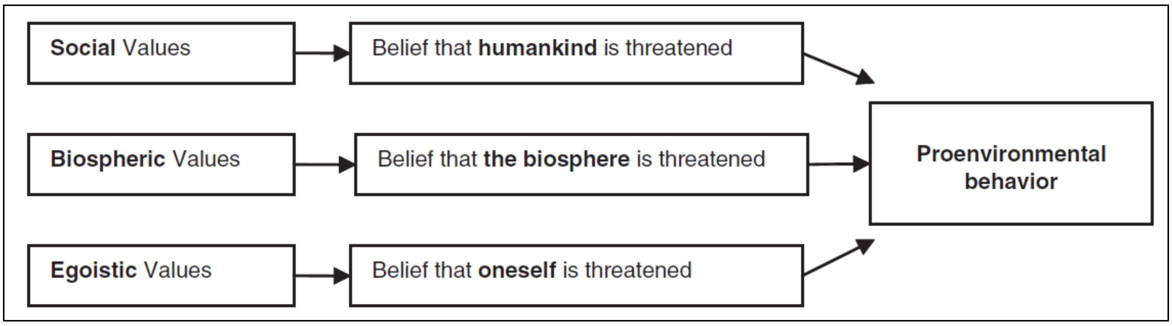


Figure 17: Values relevant to pro-environmental behaviour (Collins and Chambers, 2005)

Like the TPB, values are acknowledged to shape an individual's beliefs towards various courses of action. In contrast to the TPB, the VBN model argues that beliefs inform personal norms (Stern, 2000). Personal norms are defined as the presence of a strong moral obligation to behave in a certain way (Schwartz, 1977). Personal norms are influenced by two factors as antecedents to pro-environmental behaviour: awareness of the consequences of an action and acknowledgement of a personal responsibility towards those consequences (Graf *et al*., 2012).

The VBN model considers ecological value theory. This suggests pro-environmental behaviours occur due to pro-social, moral or altruistic values (Stern *et al*., 1999). The model also recognises the New Environmental Paradigm (Dunlap and Van Liere, 1978). This contains a set of core values directed towards *"natural limits and the importance of preserving the balance and integrity of nature"* (Jackson, 2005, p.52). Acceptance of the New Environmental Paradigm is positively correlated to biospheric and social values. It is, however, negatively correlated to egoistic values (Jackson, 2005). Acceptance is also positively associated with awareness of consequences and acknowledgement of personal responsibility.

Stern (2000, p.412) posits the VBN model to provide *"the best explanatory account to date of a variety of behavioural indicators of non-activist environmentalism"*. Similar conclusions are also reached by Stern and Oskamp (1987) and Stern *et al*. (1995b). However, reservations exist regarding the stability of values and beliefs over time (Stern *et al*., 1993). In different contexts, Jackson (2005) acknowledges changes in values and beliefs. For example, Biel (2004) observed significant differences between environmental values for individuals in professional and personal contexts. Evaluations by Stern *et al*., (1993) found the VBN explained less than 35% of the variance of behaviour. Akin to the TPB, additional factors must therefore explain behaviour outwith the scope of the VBN model. Jackson (2005) advocates the role of contextual factors to improve the explanatory power of the behaviour variance.

2.10 MAX Self Regulation Model (MaxSem) as an alternative psychological consideration

Since the Lane and Potter (2007) model, advances in understanding behaviour have occurred. The weaknesses of the TPB and VBN model were previously documented. Both models share the same fundamental flaw of a limited number of constructs to explain behaviour. At the time of this research, the most up-to-date model illustrating the behaviour change process is MaxSem[16] (***Figure 18***). MaxSem is a more integrated model, embracing more psychological constructs from behaviour theory. Existing behavioural models, including the TPB, were appraised as part of the MAX research project (MAX Success, 2009a). The process identified the *"central predictors of behaviour/behavioural change"* (MAX Success, 2007, p.10).

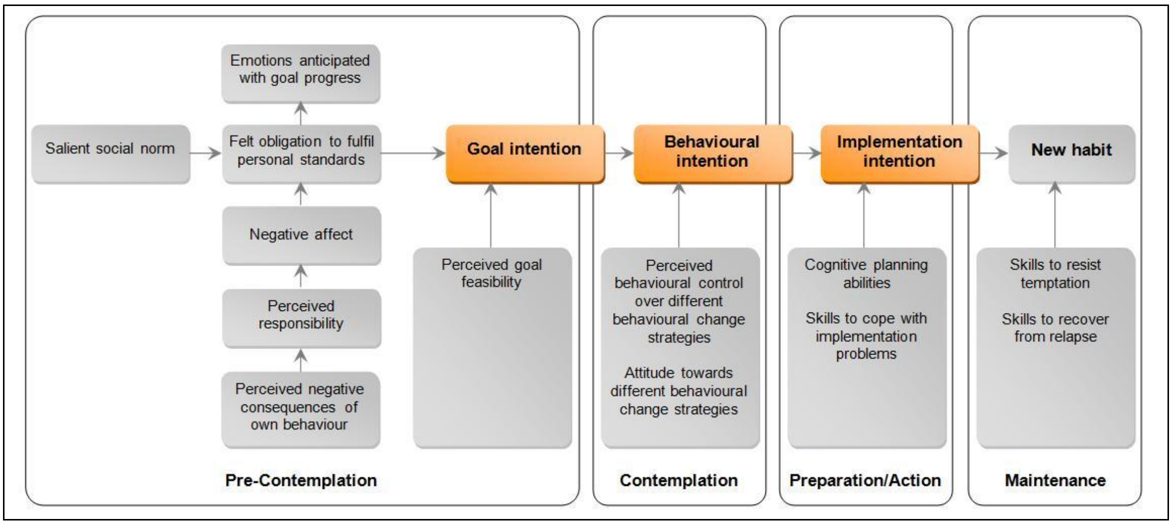


Figure 18: MaxSem constructs and stages in the behaviour change process (MAX Success, 2009a)

MaxSem assumes individuals are driven by self-regulated personal targets. This involves the setting of goals, development and enactment of strategies to achieve those goals, assessment of progress and subsequent revision of goals and strategies (MAX Success, 2009a). The model has been successfully validated through a cross-cultural survey of car

[16] Research by Bamberg (2013) has since renamed MaxSem to the 'stage model of self-regulated behavioural change'. The 4 stages of the behaviour change process have also been renamed. The new terms are pre-decisional, pre-actional, actional and post-actional stages.

drivers across seven European countries. The validation studies focussed upon behaviour change in context of car use reduction for everyday trips (MAX Success, 2009b).

MaxSem identifies a series of steps in the behaviour change process. This ultimately leads to the final stage of initiating a new behaviour (MAX Success, 2009c). Whilst MaxSem was originally developed for modal choice decisions, it can be applied to other pro-environmental behaviours. This research has, for the first time, applied MaxSem to the purchase of a lower emission vehicle (***Figure 19***).

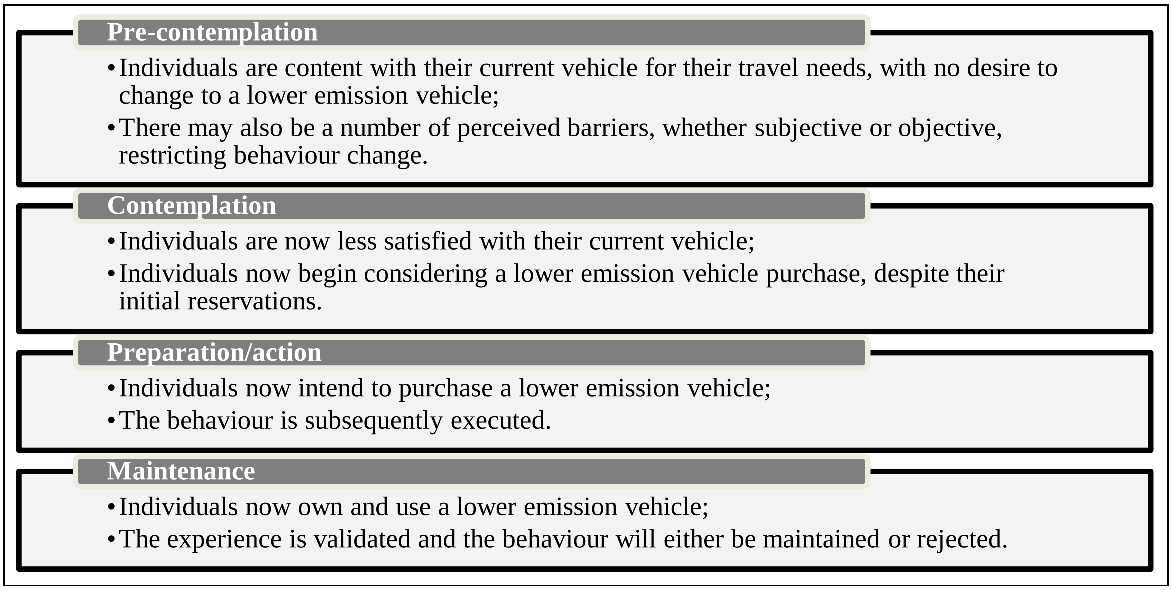


Figure 19: MaxSem model applied to a lower emission vehicle purchase

MaxSem identifies three critical threshold points to be satisfied for progression to the next stage (the orange items in ***Figure 18***). MaxSem also highlights the key psychological constructs (the grey items in ***Figure 18***) recognised as important for individuals to arrive at each threshold point. The degree of importance will vary for each individual.

The first threshold is goal intention, which is a requirement for transition from pre-contemplation to the contemplation stage. It requires individuals to recognise the problems associated with their current vehicle. The formation of a goal intention is driven by various constructs: perceived negative consequences; perceived responsibility; negative affect; personal norms; social norms; emotions; and perceived goal feasibility (***Figure 20***).

The second threshold point is BI, which allows individuals to proceed from the contemplation stage to preparation/action. A BI is formed upon identification of the most appropriate course of action, i.e. purchasing a lower emission vehicle. Attitude and perceived behavioural control lead to the formation of a BI (***Figure 21***).

Perceived negative consequences
- Highlighting environmental damage arising from their current vehicle.

Personal responsibility
- Responsibility to help reduce vehicle-related GHG emissions.

Negative affect
- Making individuals feel bad about their current vehicle's CO_2 emissions.

Personal norms
- Inherent principles and beliefs triggering an obligation to purchase a lower emission vehicle.

Social norms
- Social pressure to trigger an obligation to purchase a lower emission vehicle.

Emotions
- Such as guilt if not purchasing a lower emission vehicle.

Perceived goal feasibility
- Perceiving a lower emission vehicle purchase as a realistic option.

Figure 20: Psychological constructs towards the formation of a goal intention

Attitude
- Individuals feeling positive towards purchasing a lower emission vehicle.

Perceived behavioural control
- Confidence in an individual's ability to purchase a lower emission vehicle.

Figure 21: Psychological constructs towards the formation of a BI

The next threshold point is implementation intention, which is a requirement for progression to the maintenance stage. It involves the finalisation of definite plans to purchase a lower emission vehicle. The formation of an implementation intention is driven by cognitive planning abilities and skills to cope with implementation problems (***Figure 22***).

Cognitive planning abilities
- Regarding the implementation strategy, including the collection of relevant information about lower emission vehicles.

Skills to cope with implementation problems
- When planning and actually using a lower emission vehicle.

Figure 22: Psychological constructs towards the formation of an implementation intention

Individuals need to maintain this new behaviour, and not revert to a vehicle with higher emissions. This requires skills to resist temptation and to recover from a relapse (***Figure 23***). If these two skills are met, a new habit will be formed and a lower emission vehicle purchase becomes the norm.

Skills to resist temptation

- To return to a higher emitting vehicle.

Skills to recover from a relapse

- If a higher emission vehicle returns, skills must be present to then repurchase a lower emission vehicle.

Figure 23: Psychological constructs for individuals to maintain a new habit

Regarding policy setting, MaxSem suggests the underlying psychological constructs should be targeted via specific interventions (***Figure 24***). For example, intervention type VI seeks to change the context surrounding the behaviour. This includes the imposition of laws/regulations, infrastructure and incentives to change behaviour. These 'hard' interventions are recognised as best targeting constructs in the contemplation and preparation/action stage (Bamberg *et al*., 2011). Conversely, intervention type IV seeks to provide information regarding the pros/cons of various behaviour choices. 'Soft' interventions, such as information campaigns, are best for targeting constructs in the pre-contemplation and contemplation stage of MaxSem (Bamberg *et al*., 2011). The use of interventions at the most appropriate stages will allow individuals to progress through the behaviour change process. This ultimately leads to a behaviour change (MAX Success, 2009a).

2.11 Segmentation of the population

Behavioural models, including the TPB and VBN, apply to all individuals, adopting a one-size-fits-all approach. Segmentation recognises differences amongst the population, which can be segmented accordingly. Each segment is recognised to behave and think differently, be motivated by different needs and experience different barriers to behaviour change (Rose *et al*., 2005). Variation in the susceptibility to change behaviour will also manifest (Carreno and Welsch, 2009). This has implications regarding the allocation of resources to specific segments and for policy decisions (Anable, 2005; Anable *et al*., 2006).

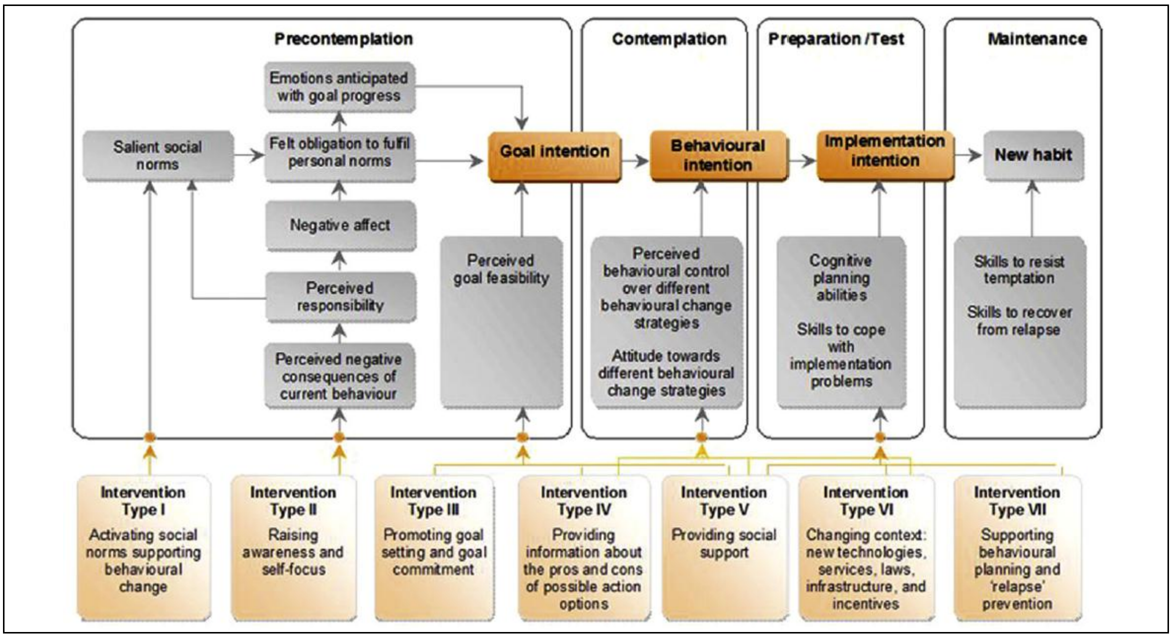


Figure 24: MaxSem constructs and stages in the behaviour change process, and the types of interventions best suited at each stage (Bamberg et al., 2011)

Approaches to segmentation can be classed as *a-priori* or *post-hoc* (Wedel and Kamakura, 1998; Darnton and Sharp, 2006). *A-priori* segmentation classifies individuals by pre-defined, broad variables deemed relevant to the study. These can be informed by tradition, past research or common sense (Dolnicar, 2004). The variables for segmentation are therefore not influenced by collected data (Chen, 2003). Alternatively, *post-hoc* segmentation goes beyond intuition. It applies statistical techniques to classify the population with similar interests, beliefs etc. The type and number of segments is driven by the data (Wedel and Kamakura, 1998; Dolnicar, 2004).

Anable *et al*. (2006) recognised the role of household characteristics for *a-priori* segmentation. However, using socio-economic criteria has been criticised for its lack of consistency in the dependent variable across the segments (Elmore-Yalch, 1998; MOTiF, 2000).

Attitudinal statements can be used for segmentation on a *post-hoc* basis. One of the most comprehensive psychological segmentation studies was Anable (2005). This derived four car driver segments based on susceptibility to use alternatives to the car, each with their own distinct profile. Whilst the Die-Hard Drivers and Aspiring Environmentalists share the same values with respect to power and status, Anable (2005) notes different motivations for turning these values into actions. Specifically, the Die-Hard Drivers see a car as a status symbol, whilst the Aspiring Environmentalists wish to set an example to other motorists. Interestingly, these four segments had no correlation to socio-demographic factors (Anable, 2005). Recognising these variables as typical foundations for *a-priori* segmentation, this finding perhaps emphasises the oversimplification of segments using an *a-priori* approach.

Thornton *et al*. (2011) used individuals' current transport behaviour and attitudes towards transport, climate change and the environment to derive six segments of car owners. Observing the profiles, Thornton *et al*. (2011) notes the 'town and rural heavy car use' were less likely to purchase a more fuel efficient vehicle. This was due to a high driving frequency and annual mileage, and importance of vehicle speed/performance. Conversely, the 'affluent empty nester' and 'educated suburban families' have a higher propensity to purchase a more fuel efficient vehicle. Akin to Anable (2005), Thornton *et al*. (2011) identified different motivations despite their shared partiality to purchase a more fuel efficient vehicle. Specifically, the 'affluent empty nester' is driven by their older age profile, regular car use and dislike of public transport. On the other hand, the 'educated suburban families' have prominent environmental concerns, higher income and little interest in vehicle performance.

Segmentation has also been conducted regarding pro-environmental behaviour in general (Abelman, 2006; DEFRA, 2008), psychological motivations towards climate change (Rose *et al.*, 2005) and AFV adoption (Rogers, 1971; Gärling and Thøgersen, 2001; Shell, 2004; Campbell *et al*., 2012). Knowledge of segment profiles can be applied in a policy context. For example, Shell (2004) identified 'Fleet Buyers' and 'Long Haulers' as more price sensitive than the 'Stars'. This has implications for the effectiveness of price signals via taxation/subsidies. Coad *et al*. (2009) conceptualised the segments of Rogers (1971) for cleaner vehicle technology adoption, including AFVs. Coad *et al*. (2009) also provided an estimation of the effectiveness of incentives/disincentives across the segments. Shell (2004) was also able to match their segments to the most appropriate type of AFV. The effectiveness of policy measures specific to AFVs can be inferred across the segments. Such insights are invaluable from a policy setting perspective and would have been overlooked by a population as a whole approach.

2.12 Significance of research

The current state of knowledge and the gaps outstanding can be inferred from assessing past research. This therefore informs the contribution of this research.

2.12.1 Literature gaps

The process of undertaking a literature review uncovered substantial research founded on the premise of reducing vehicle use to reduce CO_2 emissions (e.g. Kitamura and Fujii, 1997; Meyer, 1999; Hirota and Poot, 2005; Graham-Rowe *et al*., 2011; Bamberg *et al*., 2011). The researcher observed comparatively less past research regarding individuals' future vehicle purchasing behaviour to produce environmental savings. This research aims to contribute towards this relatively underdeveloped area.

Regarding the impact of fiscal policy, few examples can be found quantifying the incentive/disincentive necessary to influence behaviour (e.g. Lehman *et al*., 2003; DFT, 2003). However, the aforementioned past research only considered one policy measure, i.e. VED, rather than a toolkit of vehicle taxation measures. Furthermore, the value elicitation techniques employed by Lehman *et al*. (2003) and DFT (2003) were unable to provide a precise tipping-point to instigate behaviour change. This research therefore aims to fill this identified gap. That is, undertaking a comprehensive and more precise assessment of fiscal policy measures and the incentives/disincentives necessary to shape individuals' future vehicle purchasing behaviour.

Past research has successfully grouped the population by individual's current transport behaviour and attitudes towards the environment. However, the various segment profiles have been applied only generally to the influence of policy interventions, e.g. the effect of pricing signals. A breakdown for specific tax measures, or even the classification of purchase, circulation and road-fuel taxes has not been identified in past research. This research aims to add to this underdeveloped area.

At the time of this research, the Lane and Potter (2007) model stands as the most comprehensive model to date. However, it is perhaps over-simplistic in conceptualising the relationship between situational and psychological factors. Are situational factors more or less influential than psychological factors in individuals' future vehicle purchasing decisions? Which situational factor is the most/least influential? Which psychological construct is the most/least influential? Questions such as these cannot be answered by the Lane and Potter (2007) model. This research seeks to contribute towards this area of knowledge, including provision of a revised behavioural model addressing these uncertainties. This research also considers the link between situational and psychological factors. For example, the relationship between the strength of individuals'

BI to purchase a lower emission vehicle (a psychological consideration) and the influence of fiscal policy (a situational factor). Knowledge gaps, such as this, are recognised by Lane (2005).

2.12.2 Research aim and questions

As stated in ***Chapter 1***, the aim of this research is to explore individuals' future vehicle purchasing behaviour, focusing primarily upon the influence of 'green' fiscal policy in encouraging a lower emission vehicle purchase. This research will address the following research questions:

- How important are situational and psychological factors, both absolute and relative to one another, in shaping individuals' future vehicle purchasing decisions for the Scottish motoring population overall?
  - How important are situational and psychological factors, both absolute and relative to one another, in shaping individuals' future vehicle purchasing decisions, by strength of individuals' BI to purchase a lower emission vehicle in the future?
  - How important are situational and psychological factors, both absolute and relative to one another, in shaping individuals' future vehicle purchasing decisions, by 'green' segment within the Scottish motoring population, derived by the factors shaping individuals' future vehicle purchasing behaviour?
- How can current taxation measures be adapted to encourage a lower emission vehicle purchase for the Scottish motoring population overall?
  - How can current taxation measures be adapted to encourage a lower emission vehicle purchase, by strength of individuals' BI to purchase a lower emission vehicle in the future?
  - How can current taxation measures be adapted to encourage a lower emission vehicle purchase, by 'green' segment within the Scottish motoring population, derived by the factors shaping individuals' future vehicle purchasing behaviour?
- What hypothetical policy measures could potentially be introduced to encourage a lower emission vehicle purchase for the Scottish motoring population overall?

- What hypothetical policy measures could potentially be introduced to encourage a lower emission vehicle purchase, by strength of individuals' BI to purchase a lower emission vehicle in the future?
- What hypothetical policy measures could potentially be introduced to encourage a lower emission vehicle purchase, by 'green' segment within the Scottish motoring population, derived by the factors shaping individuals' future vehicle purchasing behaviour?

3 RESEARCH METHODOLOGY

3.1 Chapter overview

This chapter discusses the research strategy adopted to address three research questions. A postal questionnaire survey was adopted as the principal means of collecting primary data. This approach is discussed at length in this chapter, including the population/sampling approach, questionnaire design/content and data collection process. The chapter concludes with a consideration of the techniques for data analysis. The results of the analysis are subsequently documented throughout ***Chapters 4-7***.

3.2 Research philosophy

The philosophical assumptions of the study are dependent upon the researcher's ontological and epistemological standpoint. This will ultimately inform the research methods used (Collis and Hussey, 2003; Creswell, 2003). This research embraces the objectivist ontology, where meaning exists in objects independent of consciousness and experience (Crotty, 1998). The world is seen as being objective and capable of being measured. Crucially, the researcher does not alter the reality by collecting data, which ensures objectivity. This viewpoint underpins the positivist stance. Positivism creates 'laws' of regularity that can be used to predict natural and human behaviour. Knowledge is considered scientific and will thus be explored via scientific methods (Crotty, 1998).

With this research paradigm established, strategies of inquiry can be developed to collect and analyse the data (Hussey and Hussey, 1997; Creswell, 2003; Jankowicz, 2005). This research will be designed and interpreted primarily from a quantitative perspective. This approach aims to discover *"answers to questions through the application of scientific procedures"* (Selltiz *et al*., 1965, p.2). It is argued that quantitative data often leads to a greater assurance of relevant, reliable and unbiased collected data relative to other approaches (Selltiz *et al*., 1965). Furthermore, a large sample of data will be collected, enabling generalisations to be made relative to the population where possible.

3.3 Questionnaire survey

A questionnaire is defined by Babbie (1990) as a document containing questions and other types of information intended to acquire information for analysis. Questionnaires are best suited to research trying to identify aspects such as the characteristics, behaviour and BI, attitudes and beliefs of the population (University of South Africa, 2010). This aptly corresponds to the current research project. Indeed, questionnaires are recognised as the most popular survey instrument in social science projects, (Babbie, 1990; Burnton, 2000; Neuman, 2006).

Bachman and Schutt (2014) identify three attractive features of survey research which were desirable for this research: versatility; efficiency and generalisability (***Figure 25***). A questionnaire survey offered the greatest opportunity for data collection from a wide audience within the time and financial constraints of the research.

Versatility

- Questions can be tailored towards the needs of the research.

Efficiency

- Data can be collected at a relatively low cost, and in a relatively short period of time.

Generalisability

- Survey research presents the best opportunity to establish a representative profile of the characteristics and attitudes of the population.

Figure 25: Desirable features of survey research (Bachman and Schutt, 2014)

Accordingly, a structured, standardised set of questions was issued to the sample. Individuals would complete such questions in their own time and subsequently return completed questionnaires to the researcher. The Royal Mail postal service was used to administer the survey. This would allow a large number of individuals to be targeted, potentially over a wide geographical range, at a relatively low cost (Goode and Hatt, 1962; Moser and Kalton, 1977; Oppenheim, 1992). However, response rates for a postal survey are typically low (Philips, 1941; Robinson, 1952; Blumberg *et al*., 1974). However, measures can be taken to encourage participation, including incentives and a prepaid, self-addressed envelope for returning completed questionnaires. There is, however, the risk questions are misinterpreted by respondents and the researcher would not be present for clarification (Oppenheim, 1992). Pilot-testing would highlight potential areas for misunderstanding, allowing amendments to be made prior to initiating the survey.

3.4 Sample and population

The questionnaire was issued to a sample of Scottish individuals, currently holding a full driving-licence and actively driving a vehicle. Such individuals would therefore have some physical experience of running a private vehicle, including the financial considerations such as vehicle taxation. The means of capturing the desired sample is subsequently considered.

3.4.1 Consideration of a follow-up survey

To achieve the most representative sample of motorists possible, a follow-up survey from a larger national research project was investigated. Ex-participants selected from the established database would subsequently be issued with the researcher's own questionnaire for data collection purposes. This approach was seen to bring several advantages. Potential exists to specify required characteristics, e.g. age, gender or individuals with a certain type of driving-licence. Resources can therefore be directed towards those individuals most relevant to the research. Targeting individuals previously agreed to be recontacted for further research was expected to enhance the response rate. The strengths of the original dataset, such as national coverage, will also be carried over to the follow-up survey.

However, there is the possibility respondents may have changed address since participating in the original survey. Bias may also exist from individuals who typically agree to be recontacted for follow-up surveys. For example, Hope (2010, p.1) notes *"younger adults and those in urban areas are much less likely to agree to follow-up contact. Rural residents and older people are more likely"*. This may spillover onto the actual respondents. Nevertheless, a follow-up survey was deemed the most convenient means to acquire a sample of motorists for this research.

3.4.2 Scottish Household Survey (SHS)

Two databases were considered: the Scottish Environmental Attitudes and Behaviour Survey; and SHS. The SHS presented the best opportunity for a follow-up survey owing to its wide coverage of the adult population in private Scottish residences. There is also a dedicated section on transport, adding to the attractiveness of the survey. The SHS is a continuous cross-sectional survey, interviewing approximately 31,000 households during each 2 year cycle. Interviews are conducted in two parts: the first targets the highest income householder; whilst the second is directed towards a random adult within the household. The SHS is designed to *"provide accurate, up-to-date information about the characteristics, attitudes and behaviour of Scottish households and individuals on a range of issues"* (Scottish Government, 2009d, p.1).

During the SHS interview, respondents indicate their consent to possibly being recontacted for further research. Specifically, individuals were asked "*would you be willing to have your name, contact details and relevant answers you have given during the interview passed on to the Scottish Government or other research agencies acting on behalf of, or in collaboration with, the Scottish Government?"* (Scottish Government, 2009d, p.1). All those agreeing form the basis of a sub-sample for follow-up research.

3.4.3 Application for a follow-up survey

The application for a follow-up survey was submitted December 2009 (***Appendix A3***). Two variables were specified in the application to derive the sub-sample of ex-participants:

- **LICENCE** – Those answering *"Which of the phrases... applies to you?"* with either *"currently hold a full driving-licence (car or motorcycle)"* or *"currently hold a provisional driving-licence"*[17].
- **FREDRIV** – Those answering *"How often do you drive a car/van nowadays, for private purposes (including travelling to work, but ignoring any driving which was part of your job)?"* with either *"every day"*, *"at least three times a week"*, *"once or twice a week"*, *"at least two or three times a month"*, *"at least once a month"* or *"less than once a month"*[18].

[17] At the application stage, it was intended that this research would be split according to driving-licence type. However, two aspects hindered this plan. First, only 121 provisional driving-licence holders were acquired from the SHS. It was therefore unfeasible to specifically target such individuals in the follow-up survey. Furthermore, almost half of such individuals were interviewed up to four years prior to the data collection period. It is therefore likely many individuals would now have acquired their full driving-licence, further reducing the target audience. It was therefore decided to target all individuals in the follow-up survey as full driving-licence holders and any provisional driving-licence holders participating in the postal questionnaire survey would be removed from the dataset. Provisional driving-licence holders were targeted via a separate online questionnaire survey, documented in ***Appendix A2***. The second obstacle was the acquisition of an insufficient number of responses from the online questionnaire survey. Some preliminary findings are presented in ***Appendix A2***, but the full analysis proposed was deferred.

[18] The researcher acknowledges the overlap between the 6 response categories. For example, "at least once a month" and "at least 2 or 3 times a month" are not mutually exclusive. Despite this, the 6 response categories were adopted in this research to aid comparability with the SHS.

It was also requested for the sample to be representative of age, gender, income and particularly the urban/rural classification. Differences in household vehicle access and full driving-licence holders across the urban/rural classification were demonstrated in ***Section 1.4***. It was therefore deemed important to capture urban/rural variation in this research. No request was made for stratification by local authority, but simply to target Scotland overall. The target was to have 1,000-1,500 respondents participating in this research. Recognising the anticipated postal questionnaire response rate, access to 4,000-6,000 ex-participants of the SHS over a 4 year period was proposed.

3.4.4 Approval for a follow-up survey

The request for a follow-up survey was accepted in March 2010 (***Appendix A4***) and 4,938 individuals were selected by the SHS contractor, Ipsos-MORI. Such individuals completed the SHS between 2005-2010, with 99.3% participating between 2007-2009. The details of the sub-sample was delivered in April 2010. For each individual, the name, address and postcode, telephone number, age, gender, urban/rural classification and date of interview with the SHS was provided. A unique reference number was allocated to each individual, i.e. 1-4,938. This would be used by the researcher to derive certain information regarding respondents without specifically asking in the questionnaire. For example, the respondent’s postcode and urban/rural classification was already provided by the SHS team. This would subsequently reduce the number of questions posed to respondents.

Past research indicates the possibility of questionnaire completion by an individual other than the intended addressee, such as another family member (Scott, 1961; Moser and Kalton, 1977). Assuming such individuals also met the initial LICENCE and FREDRIV criteria, a different respondent would not be an issue. This would be determined via Section A of the questionnaire.

3.5 Design and content of the covering letter

Covering letters are a determining factor in the decision to review the questionnaire. They can also shape attitudes towards the research if recipients choose to participate (Dillman, 1978). Covering letters have also been found to improve response rates (Goode and Hatt, 1962; Cui, 2003). To achieve this, they should be kept as short as possible and written in a friendly tone.

An overview of the research and the nature of the questions were first provided. The estimated completion time, based on pilot-testing, was also given. The covering letter then indicated university sponsorship. Past research has observed this to positively impact upon response rates (Houston and Nevin, 1977; Jones and Linda, 1978; Jones and Lang, 1980). The University logo was also shown on the letterhead, which has been found to increase responses (Bruvold and Comer, 1988). Recipients were then informed of the relationship between this research and the SHS. Specifically, their prior consent to be recontacted for follow-up research, having completed the SHS. This was a stated requirement of the SHS team.

The confidentiality policy was subsequently outlined, including assurances that personal information would be kept secure and provided data would only be accessible to the researcher. Recipients were also assured no personally identifiable information would be presented. In some cases, assurance of confidentially has had a negative impact on survey participation (Yu and Cooper, 1983; Singer *et al*., 1992). However, Frey (1986) suggests no impact upon response rates. Ultimately, it was deemed good ethical practice to include a confidentiality assurance (Oppenheim, 1992). It was also a requirement of the SHS team.

The deadline for questionnaire completion was highlighted. Approximately seven weeks was made available. Fox *et al*. (1988) failed to identify a significant increase in responses from inclusion of a deadline. However, it was deemed necessary to provide closure. Furthermore, inclusion of a deadline would help reduce the number of responses received after the specified date (Nevin and Ford, 1976). Details for returning completed questionnaires were subsequently provided, including the provision of a prepaid and self-addressed envelope. Stamped reply envelopes have been found to produce higher responses than prepaid ones (Viega, 1974; Brook, 1978; Harris and Guffrey, 1978; McCrochan and Lowe, 1981. However, this would result in postage for all reply envelopes being paid regardless of use and the additional expense could not be justified.

Details of the incentive for questionnaire participation were given, i.e. a prize draw for Love2Shop gift vouchers[19]. This approach does not guarantee a financial incentive to all participants. However, prize draws have been found by Blythe (1986) to increase

[19] These are the UK's most popular gift voucher, which can be spent in over 200,000 stores. See http://www.highstreetvouchers.com/gift-vouchers/love2shop [last accessed 13 July 2013]

responses. Past research also indicates higher monetary incentives have a greater effect on response rates (Armstrong, 1975; Yu and Cooper, 1983; James and Bolstein, 1990). Therefore, a considerably greater first prize of £200 was offered to raise interest in the survey, complemented by 10 smaller prizes of £30 to increase overall chances of winning.

Finally, the researcher's contact details were provided for any queries regarding the research and/or questionnaire. The covering letter also included a mimeographed signature of the researcher to provide a personal touch for recipients. Past research into whether hand-written or mimeographed signatures increase response rates are mixed. For example, Kawash and Aleamoni (1971) suggest no difference between the two types. Conversely, Reeder (1960) suggests hand-written signatures produce more responses. However, owing to the size of the sample, hand-written signatures were not feasible.

3.6 Design and content of the questionnaire

The physical appearance of the questionnaire is likely to influence whether an individual chooses to participate (Le Vine and Gordon, 1958; Dillman, 1978). The questionnaire was printed with black ink on white 80gsm paper to offer high legibility (Paterson and Tinker, 1940). No significant differences have been observed between response rates and the colour of the paper (Sharma and Singh, 1967; Jobber and Sanderson, 1983; Greer and Lohtia, 1994). Past research dictates questions should contain simple and direct language suitable for the target audience (Payne, 1951; Freed, 1964; Moser and Kalton, 1977). This approach was adopted in this research.

The questionnaire posed 32 questions over 9 sides of A4 paper. Past research has found mixed evidence regarding questionnaire length and response rates. Brown (1965) and Leslie (1970) suggest longer questionnaires receive lesser responses. Conversely, no effect was found by Childers and Ferrell (1979) and Layne and Thompson (1981). Nevertheless, Berdie *et al*. (1986) maintains the relevance of the content as more important than length.

Clear instructions on completing the questionnaire were provided throughout for reasons of clarity (Cohen *et al*., 2000; Bryman, 2008). Instructions were to: 'tick the box', with clarification for each question whether to tick only one option or all that apply; or to 'write your answer'. Questions were grouped into logical sections to ease completion, i.e. sections A-E (Robinson, 1952; Levine and Gordon, 1958). A brief preamble was provided for each section, allowing respondents to identify with the content (Cohen *et al*., 2000).

Questions within each section were sequenced to flow logically into one another (Oppenheim, 1992). Past research has concluded question order has no effect upon answers (Clancey and Wachsler, 1971; Bishop *et al*., 1978). In contrast, Ayidiya and McClendon (1990) suggest mixed results. Nevertheless, a logical structure was not anticipated to have an adverse effect upon completion. Additional formatting, such as bold, italics and capital letters, was used to emphasise key words in each question. This approach is advocated by Berdie *et al*. (1986) and Verma and Mallick (1999). Questionnaire design, including the layout and formatting, was consistently applied throughout, allowing respondents to feel more at ease during completion.

Attitudinal questions were measured via Likert scales (Likert, 1932). Past research indicates no established criteria for the optimal number of points (Matell and Jacoby, 1971; Cox, 1980; Friedman *et al*., 1981). The size of the scale should be specific to the research and subject. Odd-numbered scales, creating a mid-way point, were adopted, recognising genuine indifferences to the presented measures. However, the mid-point was neither highlighted nor labelled to help prevent respondents simply selecting this option for convenience (Bishop, 1987). Cohen *et al*. (2000) acknowledges many individuals do not wish to appear as 'extremists' by recording answers at the outermost points of a Likert scale. A 5-point scale would allow limited choice between the 2 extremes of the scale, hence a 7-point scale was selected.

3.7 Section A of the questionnaire: Driver characteristics

Section A began with some factual, easy to answer, non-threatening questions to ease respondents into the questionnaire (Robinson, 1952; Erdos, 1957; Levine and Gordon, 1958). Questions focused upon the respondent's current driving-licence status, the number of years holding that licence and their driving frequency. Three questions were founded upon the SHS LICENCE and FREDRIV variables, including the same response categories used in the SHS, to ensure continued eligibility for questionnaire completion. Responses would be used to breakdown the sample. For example, more and less experienced drivers, frequent and infrequent drivers and high and low mileage drivers. Classification such as these can be used in context of other questions. For example, it could be investigated whether the influence of road-fuel taxation varies by annual mileage.

3.8 Section B of the questionnaire: Vehicle characteristics

Section B considered the characteristics of the vehicle driven most frequently by respondents. Questions were posed regarding the vehicle manufacturer, model, engine size, fuel type, transmission and age[20]. Some questions were presented as open-ended questions, including vehicle manufacturer and model due to space limitations. Whilst the questions in Section B were largely factual, a 'don't know' option was available. Evidence is mixed regarding the consequences of a 'don't know' category. For example, Poe *et al*. (1988) suggests greater response inaccuracies from including a 'don't know' option for factual questions. Conversely, other researchers advocate its inclusion (Payne, 1951; Jahoda *et al*., 1962; Bartholomew, 1963). Indeed, it was felt some respondents may not know, for example, the exact engine size of their vehicle, nor the vehicle model, despite driving the vehicle regularly.

Respondents were also asked who the registered owner was and whether the vehicle was acquired new or used. Oppenheim (1992) argues respondents may be unable to accurately recall past events. However, vehicle acquisitions are likely to be the second biggest financial purchase individuals make in their lifetime. This increases the likelihood of accurately recalling their last vehicle purchase.

Consideration of the respondents' vehicle prior to their current vehicle concluded this section. Respondents were asked to indicate the change in physical size, engine size and fuel consumption from their previous to current vehicle. This would therefore provide an indication of individuals' past vehicle purchasing behaviour. This is recognised by Lane and Potter (2007) as a factor informing individuals' future vehicle purchasing decisions. This question introduces the first Likert scales of the questionnaire, where 1 equals 'greatly reduced' and 7 equals 'greatly increased'.

3.9 Section C of the questionnaire: Factors of importance upon individuals' future vehicle purchasing decisions

Section C was used to evaluate the importance of situational and psychological factors upon individuals' future vehicle purchasing decisions. This therefore represents a hypothetical scenario. Oppenheim (1992) argues research focusing on policy and decision

[20] This was inferred by the researcher from the vehicle registration provided. Respondents were instructed to ignore any personalised registrations which would therefore disguise the true age of the vehicle.

making often use hypothetical scenarios. Observing the factors important during individuals' previous vehicle purchasing decisions as a guide to individuals' future vehicle purchasing behaviour was not considered particularly insightful. However, there is a risk of hypothetical bias, where predicted and actual behaviour may differ (Hensher, 2010). This would not be realised without further follow-up research.

Parts of the questionnaire may lead respondents to present themselves in a socially-acceptable' manner, known as social-desirability bias (Bradburn *et al*., 1979; Oppenheim, 1992). For example, some individuals may not wish to appear anti-environmental and not willing to purchase a lower emission vehicle. Self-completion of the questionnaire, away from the researcher, will help manage this potential issue (Sudman and Bradburn, 1982).

3.9.1 Situational factors

Respondents were asked to evaluate the importance of 32 situational factors upon future vehicle purchasing decisions. This section was founded upon past research, including Lehman *et al*. (2003), Lane (2005), Lane and Potter (2007)[21] and Anable *et al*. (2008). Aspects were grouped into: [1] vehicle attributes; [2] financial considerations; and [3] environmental considerations (***Figure 26***). Importance was measured on 7-point Likert scales, where 1 equals 'not important' and 7 equals 'very important'.

3.9.2 Psychological factors

Psychological factors were then assessed in Section C. This was founded upon current understanding of individuals' pro-environmental decision making behaviour (MAX Success, 2009d; Bamberg *et al*., 2011). The formation of a BI to purchase a lower emission vehicle is the furthest stage in the behaviour change process measurable in this research. Further follow-up research would therefore be necessary to review actual behaviour. Past research recognises BI as the best predictor of actual behaviour (Dietz *et al*., 2007; Caulfield, 2011). The MaxSem model also recognises the formation of a BI as a prerequisite for developing an implementation intention in the preparation/action stage of the behaviour change process. BI and the 10 psychological constructs recognised to influence the formation of a BI were subsequently selected.

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[21] The regulatory environment was not assessed in the questionnaire. This decision recognises that the regulatory environment primarily affects vehicle manufacturers and thus vehicle supply. The effect on consumers is thus indirect, e.g. through vehicle availability.

Vehicle attributes

- Vehicle make
- Vehicle model
- Vehicle size
- Body shape, e.g. hatchback, saloon, estate
- Style / appearance / colour
- Passenger capacity
- Luggage / storage space
- Equipment levels. e.g. Satellite-Navigation
- Entertainment system, e.g. stereo, DVD player
- Safety features, e.g. airbags
- Security features, e.g. immobiliser
- Engine type/size
- Fuel type
- Fuel consumption, i.e. MPG
- Performance / driveability
- Acceleration time
- Mileage (used vehicle only)
- Overall condition of vehicle (used vehicle only)

Financial considerations

- Vehicle price
- VAT and other purchase taxes
- Finance / credit
- Value for money
- Fuel economy
- Maintenance / repair costs
- Warranty length and coverage
- Insurance group for vehicle
- Biannual / annual VED
- Company car taxation bands
- Trade-in value

Environmental considerations

- Emissions of CO_2 & other GHGs
- Emissions of other air pollutants
- Vehicle noise

Figure 26: Situational factors assessed

Psychological constructs were assessed via attitudinal statements, presented in context of purchasing a lower emission vehicle in the future (***Figure 27***). 7-point Likert scales were used to measure the strength of each construct: 1 equals ‘strongly disagree’ and 7 equals ‘strongly agree’. Past research recognises the potential for systematic response bias in presenting numerous statements all worded in a single direction (Wong *et al*., 2003; Zikmond *et al*., 2013). To counteract this, reverse-wording was used for 6 of the 11 constructs. For example, “I feel a personal responsibility to help reduce the emissions of vehicle-related GHG emissions” became “I feel **no** personal responsibility to help reduce the emissions of vehicle-related GHG emissions”. Past research advocates the use of reverse-wording to counteract consistent and patterned responses (Nunnally, 1978; Churchill, 1979; Baumgartner and Steenkamp, 2001). Owing to the importance of the BI construct, designed to measure the strength of individuals’ BI to purchase a lower emission vehicle, two attitudinal statements were presented. One was positively worded and the other reverse-worded, and averaged during data entry prior to analysis.

BI
- I intend to buy a lower emission vehicle in the future
- Nothing would persuade me to buy a lower emission vehicle in the future*

Perceived behavioural control
- It would be very difficult for me to buy a lower emission vehicle in the future*

Perceived negative consequences
- People who drive high emission vehicles contribute significantly to GHG emissions

Goal intention
- I plan to switch to a lower emission vehicle sometime in the future

Personal norm
- Because of my own principles & beliefs, I feel no obligation to buy a lower emission vehicle in the future*

Goal feasibility
- It would cause me no problems if I were to buy a lower emission vehicle in the future

Negative affect
- Buying a lower emission vehicle would make me feel good

Social norms
- Most other people would approve of me purchasing a lower emission vehicle

Personal responsibility
- I feel no personal responsibility to help reduce the emissions of vehicle-related GHG emissions*

Attitudes
- I would not be interested in purchasing a lower emission vehicle*

Emotions
- I would feel bad about myself if I did not switch to a lower emission vehicle in the future

** These statements are reverse worded*

Figure 27: Psychological constructs assessed

All attitudinal statements in Section C included a separate ‘don't know’ option. This was for individuals who genuinely had no opinion or simply had never thought about the issue. As advocated by Grichting (1994), the ‘don’t know’ option was not located at the midpoint of the Likert scales. Evidence regarding the use of ‘don’t know’ options for non-factual questions is mixed. ‘Don't know responses are viewed by Schuman and Presser (1978) as missing data and are thus not recommended. However, others suggest ‘don't know’ responses relate more to genuine respondent uncertainty, rather than question ambiguity (Bogart, 1967; Coombs and Coombs, 1976).

3.10 Section D of the questionnaire: Potential influence of vehicle taxation and other policy measures upon individuals' future vehicle purchasing decisions

Section D questions enquired into the potential of taxation and other policy measures upon individuals' future vehicle purchasing decisions. Like Section C, questions in Section D are hypothetical, but deemed necessary given the proposed policy changes and effect on future behaviour. A dichotomous question was used to filter respondents (Cohen *et al*., 2000). Individuals with no intention of buying a vehicle in the near future were instructed to bypass section D and proceed to Section E. Remaining respondents were to complete Section D.

3.10.1 Adaption of current taxation measures

The first part of Section D enquired into the exact level of taxation increase/decrease necessary to instigate a change in vehicle purchasing behaviour. Two possible approaches were considered to measure the necessary change in taxation, which are subsequently considered.

3.10.1.1 Stated preference (SP)

SP techniques emerged in economic research (Thurstone, 1931a). They were later applied to transport studies (Hoinville, 1971; Wardman, 1987). SP refers to *"a family of techniques which use individual respondents' statements about their preferences in a set of transport options to estimate utility functions"* (Kroes and Sheldon, 1988, p.11). Techniques include rating, ranking and choice experiments (Louviere and Hensher, 1983; Sanko, 2001). Choice experiments are argued as the most common method of SP (Pearmain *et al*., 1991). SP can be used to infer a preference towards alternative attributes making up a product/service through a series of choices (Hensher, 1994; Fifer *et al*., 2014). Attributes can be considered individually, known as contingent valuation; or conjoint methods for groups (DeShazo and Fermo, 2002).

Choice experiments were deemed unsuitable for this research. A large quantity of hypothetical choice sets, each with different attributes and levels of taxation etc, would have to be presented. This would impact upon the estimated completion time and place greater demands on respondents' patience and concentration (Pearmain *et al*., 1991). Individuals may also struggle to fully process the numerous choice sets presented. Past research recognises the risk of information overload and respondent fatigue (Olshavsky, 1979; Keller and Staelin, 1987; Elrod *et al*., 1992; Timmermans, 1993; Pearce *et al*., 2002). This is therefore likely to affect the consistency and reliability of responses. Sanko (2001) argue this as the most significant disadvantage of SP. Presenting numerous scenarios on a paper questionnaire would also cause difficulties. Computer software packages, or even an online medium, would perhaps be better suited to these types of questions (Pearmain *et al*., 1991; Sanko, 2001).

Another issue with SP relates to the fundamental understanding of behaviour and decision making (Abley, 2000). SP is founded upon economic theory, including the rational choice model based on utility (Kroes and Sheldon, 1988; Louviere, 1988). However, alternative behavioural models from psychology were considered in ***Chapter 2***. Recognising different decision making strategies and the information screening process, Ampt *et al*. (1995) concluded the assumptions made by SP are invalid. Suggestions have therefore been advocated to recognise psychological considerations in SP techniques (Swanson, 1998). Abley (2000) advocates SP should only be used as a last resort, after all other options have been explored.

3.10.1.2 Value elicitation approach

As an advancement to SP, a series of value elicitation questions were used. This would be used to derive the preference for varying levels of tax increases/decreases. Psychological theory was integrated into the questions, advocated by Swanson (1998). Responses were broken-down for the tipping-point, or *"necessary minimum"* (Georgescu-Roegen, 1958, p.159) for individuals' to engage in three stages in the behaviour change process (MAX Success, 2009a; ***Figure 28***).

Start thinking about undertaking a new behaviour

- Based on the pre-contemplation stage of MaxSem.

Seriously think about undertaking a new behaviour

- Based on the contemplation and preparation/test stages of MaxSem.

Definitely undertake a new behaviour

- Based on the maintenance stage of MaxSem.

Figure 28: Three stages in the behaviour change process (MAX Success, 2009a)

This acknowledges behaviour change as not a one-stage process, akin to MAX Success (2009d). Highlighting a series of pre-purchase cognitive processes will mirror the actual processes individuals would experience (Engel *et al*., 1978; Foxall, 1983). This therefore provides contextual realism and helps counteract hypothetical bias. This approach eliminates the need for choice experiments by asking outright for the percentage increase/decrease.

The key characteristics of each taxation measure were provided first. This would aid respondent's ability to respond and enhance the context to mitigate hypothetical bias (Abley, 2000). Respondents were then asked to provide either the percentage increase/decrease in vehicle taxation, depending upon which would most influence their decision, necessary to instigate three stages in the behaviour change process. Four tax measures were explored, namely VED, VAT, HOD and the PICG. Details were provided for each measure regarding the starting point to base their response and the desired behaviour the tax increase/decrease would work towards (***Table 5***).

Investigating the tipping-point for different stages of behaviour change originates from a travel behaviour survey of Heathrow Airport employees (Carreno *et al*., 2004). The research sought to identify the level of travel plan interventions for respondents to start to think about using an alternative mode of transport, actively seek information about the alternatives, and actually stop using the car for travelling to work. Payment-card elicitation was used by Carreno *et al*. (2004). A range of potential numerical responses was presented and a tick, or equivalent, would be used to indicate the desired response (***Table 6***). However, data was collected through face-to-face interviews. This therefore offers no insight into the optimal format for self-completion.

Early versions of the questionnaire used payment-card elicitation methods, presenting a scale of percentage increases/decreases. This aimed to provide a context and reduce the chance of outliers (Pearce *et al*., 2002; ***Table 7***). However, pilot-testing of this format revealed much confusion and uncertainty for recording answers. Evaluation of other elicitation formats resulted in the adoption of an open-ended configuration. Specifically, blank space was provided for respondents to enter the necessary numerical response. This was deemed the most straightforward method of collecting responses. It would also eliminate anchoring bias, present with the payment-card format. However, Pearce *et al*. (2002) recognises the possibility of non-response, zero answers and outliers without the

Table 5: Postal questionnaire presented for VED, VAT, HOD and the PICG to extrapolate the level of taxation necessary to change individuals' future vehicle purchasing behaviour

Taxation measure	Scenario
VED[22]	Relative to the respondent's current VED, having been identified from the previous question: • The percentage increase, as a disincentive, for a vehicle with equal/greater emissions than the current one; or • The percentage decrease, as an incentive, for a lower emission vehicle necessary to initiate a lower emission vehicle purchase.
VAT[23]	Relative to the current 20% rate of VAT: • The percentage increase, as a disincentive, for a vehicle with equal/greater emissions than the current owned; or • The percentage decrease, as an incentive, for a lower emission vehicle Necessary to initiate a lower emission vehicle purchase.
HOD[24]	Relative to HOD for main road-fuels of 58.95PPL[25]: • The percentage increase, as a disincentive, for petrol/diesel; or • The percentage decrease, as an incentive, for 'greener' fuels such as LPG, CNG and biofuels Necessary to initiate the purchase of a lower emission vehicle utilising 'greener' fuels.
PICG	Relative to the average purchase price of a vehicle qualifying for the PICG, approximately £30,000: • The percentage decrease, as an incentive, in vehicle purchase price Necessary to initiate a lower emission vehicle purchase qualifying for the PICG.

presence of a scale. Nevertheless, Harrison and Rutström (2008) found insufficient evidence suggesting some elicitation formats perform better than others in reducing hypothetical bias.

Prior to completing the questions, respondents were advised to recognise their income constraints and imagine their current financial circumstances prevail when buying their next vehicle. A budget reminder was included to help counteract hypothetical bias (Pearce *et al.*, 2002; Alberini and Khan, 2009). However, other researchers suggest the effectiveness is limited (Neill, 1995; Loomis *et al.*, 1996). It was, nevertheless, deemed necessary to provide a realistic context for respondents to base their answers (Katz and Rosen, 1991).

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[22] To avoid jargon, this was referred to as 'road tax', deemed most familiar to respondents.
[23] This was measured in percentage points for simplicity. For example, if respondents indicated an increase of 5% in VAT, this would therefore represent VAT of 25% (20% + 5% = 25%).
[24] To avoid jargon, this was referred to as 'fuel duty', deemed most familiar to respondents.
[25] This was the current rate when the questionnaire was issued.

Table 6: Example of the payment-card elicitation method, including mock responses, regarding the effects of a daily cash payment on driving behaviour (Carreno et al., 2004)

Daily cash payment	Start thinking about using an alternative mode	Actively seek information on alternative modes	Would stop driving to work by car
£0.50			
£1.00	✓		
£1.50			
£2.00			
£2.50			
£3.00		✓	
£3.50			
£4.00			
£4.50			
£5.00			✓
>£5.00			

Note: in this example, the respondent would require a daily cash payment of £1 to start thinking about using an alternative mode; £3 daily to actively seek information on alternative modes; and £5 daily to stop driving to work by car.

Table 7: Example of the payment-card elicitation method, including mock responses, regarding the effects of an increase in VED upon individuals' vehicle purchasing behaviour

↓ **Current road tax**

					A		**B**													**C**
+5%	+10%	+15%	+20%	+25%	+30%	+35%	+40%	+45%	+50%	+55%	+60%	+65%	+70%	+75%	+80%	+85%	+90%	+95%	+100%	> +100%

Note: in this example, the A, B and C were used to represent the three stages of the behaviour change process. That is, the respondent would require a VED increase of 30% to start thinking about a lower emission vehicle purchase; a 40% increase to seriously think about purchasing a lower emission vehicle; and an increase of more than 100% to definitely purchase a lower emission vehicle.

To further minimise hypothetical bias, an additional calibration technique was used. An *ex-ante* statement outlining the problem of hypothetical bias, including why it occurs and how it affects responses etc, was included, known as cheap-talk. This approach has been shown to produce an insignificant difference between hypothetical and actual behaviour (Cummings and Taylor, 1999). However, the effectiveness of cheap-talk statements was found to vary among respondents (List, 2001; Murphy *et al*., 2004).

Numerous non-applicable (N/A) options were provided to enhance contextual reality (Alberini and Kahn, 2009). For example, respondents could indicate no level of taxation incentive/disincentive would influence their vehicle purchasing behaviour. Such individuals would therefore be unable to quantify a response to the value elicitation questions. N/A options were also provided for respondents who were likely to lease their future vehicle. Leasing packages often include some taxation measures, including VED, and paid by the leasing organisation. Consequently, this hampers the possible impact upon motoring behaviour. A final N/A option was provided for the PICG. Recognising the eligibility criteria of this taxation measure, respondents with no intention of buying a new vehicle could accurately indicate this.

Awareness and influence of the FYR of VED was also assessed with dichotomous questions. Value elicitation was not used for this taxation measure as the FYR was simply deemed an extension of previously assessed VED.

3.10.2 Hypothetical policy measures

11 modifications or additions to current policy were explored regarding their influence upon individuals' future vehicle purchasing decisions. Measures would provide either a time or financial saving as enticement to choose a lower emission vehicle. Policy measures were positioned across the vehicle ownership cycle (***Table 8***). The influence of policy was measured on 7-point Likert scales, where 1 equals 'not influential' and 7 equals 'very influential'. A 'don't know' option was provided for all measures as some concepts were novel and respondents may experience difficulty assessing the anticipated influence.

3.10.3 Space for comments

Space was also available for written comments on any aspect of the questionnaire. This was hoped to capture the rationale for responses and any additional thoughts on the subject[26].

[26] Recognising that only 12.6% of respondents actually left comments, a summary of the brief qualitative findings is presented in ***Appendix A5***.

Table 8: Hypothetical policy measures assessed

Policy measure	Timing during vehicle ownership cycle
Initial vehicle registration fee based on CO_2 emissions	Purchase
FYR of VED on a per-unit basis per g/km of CO_2 emitted	
Rebates for vehicles below a CO_2 emissions threshold	
Fees for vehicles above a CO_2 emissions threshold	
VAT based on CO_2 emissions	
Scrappage allowance with a CO_2 emissions limit on the replacement vehicle	
SR of VED on a per-unit basis per g/km of CO_2 emitted	Circulation
Motor insurance premiums based partly on CO_2 emissions	
Parking charges based partly on CO_2 emissions	Road-fuel/usage
Designated LEVL	
A RUC scheme with payment per mile/hour or a flat rate[27] based on CO_2 emissions	

3.11 Section E of the questionnaire: Socio-demographic factors

Section E concluded with some questions regarding socio-demographic factors, i.e. the respondent's gender, age and household income. Urban/rural classification would also be identified, but this would be inferred by the researcher, rather than asked directly. These factual, closed-questions were used to breakdown the overall sample, allowing comparisons to be made between sub-groups. The same response categories used in the SHS were adopted to aid comparability. However, household income *before* tax was adopted in this research, compared to the SHS' post-tax income. It was felt that respondents would have a greater grasp of the pre-tax figure, i.e. the 'official' figure associated with any job description.

Demographic questions were presented in the final section as a quick and easy way to conclude the questionnaire (Davies, 2007). Household income may prove to be 'sensitive' for some respondents (Bradburn *et al*., 2004). However, at this stage, respondents would have already completed 97% of the questionnaire, making response rates less likely to be affected.

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[27] Both types of RUC were assessed independently in the questionnaire. However, little difference was observed between the 2 types of RUC in shaping future vehicle purchasing behaviour. A decision was therefore made during the analysis to combine them, whereby averaging the 2 scores.

3.12 Closing section of the questionnaire

The final section relates to the prize draw mentioned in the covering letter. Respondents were asked to indicate whether they wished to be entered into the prize draw. Those opting-in were to provide their name, email address and/or telephone number. Assurance was given that personal details would only be used for the purpose of the draw. Individuals declining the prize draw invitation were to indicate this and therefore provide no personal details.

3.13 Ethical considerations

The SHS team stipulated a number of conditions for granting the follow-up survey. Conditions related to treatment of the contact details provided for the SHS ex-participants and the subsequent data collected through this research. The provided contact details were only to be used for the purpose of the project outlined in the initial application (***Appendix A3***). Respondents were informed via the covering letter that their contact details were provided because of their previous participation with the SHS and their consent to be recontacted for further research. Confidentiality was to prevail at all times. Specifically, only individuals relevant to this research at the Transport Research Institute of Edinburgh Napier University could access the data. Such individuals were informed of the conditions surrounding its provision. Furthermore, respondents are not identifiable from the results or any other research output. The contact details of the SHS ex-participants were securely stored at all times in accordance with the Data Protection Act 1988. Respondents were not asked if personal details could be retained for future research. Upon completion of this research, personal details will be deleted in a safe and responsible manner.

3.14 Consideration of reliability and validity

Reliability refers to the extent of being able to replicate the research and consistently generate the same results (Bryman, 2008). The research instrument, data and findings should be *"controllable, predictable, consistent and replicable"* (Cohen *et al.*, 2000, p.119). Robson (2002) considers four types of issues relating to reliability: participant error; participant bias; observer error; and observer bias. ***Figure 29*** documents the consideration of reliability and the steps taken to manage such risks.

Participant error

- Seeking responses to the same questions during different times of the year is likely to deliver different results;
- For consistency, all questionnaires were issued in a single sitting and completed within the same timeframe. That is, 25-27 January 2011 for questionnaire issue and up to 18 March 2011 for questionnaire completion.

Participant bias

- Respondents may give answers they believe the researcher wants to see, whereby giving inaccurate information;
- However, the absence of the researcher with a self-completion questionnaire will maintain a distance between the two parties, reducing the risk of participant bias.

Observer error

- Different interviewers may interpret the same question differently, which will have an adverse impact upon responses collected;
- A self-completion questionnaire will eliminate this risk.

Observer bias

- This relates to the interviewer, either consciously or unconsciously, recording answers not matching the true meaning intended by the respondent;
- With a self-completion questionnaire, the onus on correctly recording answers lies with the respondent, making questionnaire design absolutely crucial;
- Questions open to potential misinterpretation were highlighted during pilot-testing, allowing corrections to be made prior to full issue.

Figure 29: Consideration of reliability and the action taken in this research (Robson, 2002)

Conversely, validity refers to the integrity of the results and conclusions generated from the research. It therefore follows on from reliability. Measures cannot be valid unless they are reliable, but measures can be reliable but not valid (McCloughan, 2001). Bryman (2008) outlines four types of validity: internal validity; external validity; measurement/construct validity; and ecological validity. ***Figure 30*** documents the consideration of validity and the steps taken to manage such risks. Cohen *et al*. (2000) outlines various suggestions to minimise threats to validity. This includes the design of an appropriate methodology and research instrument. Appropriateness is gauged by a suitable level of readability, complexity and length, avoiding ambiguity and leading questions. Acquisition of an appropriate sample is also recognised by Cohen *et al*. (2000).

Internal validity

- This concerns the confidence in the cause-and-effect relationships observed between variables;
- Statistical tests can be used to indicate the significance of the findings (***section 3.19***);
- Reviewing similar studies can also help verify, to some extent, the credibility of results (***chapter 8***).

External validity

- This relates to generalisability of the results to other contexts outside the original study;
- Comparisons can be made for socio-demographic factors and current motoring behaviour relative to the SHS (***section 4.3.1***).

Measurement/construct validity

- This relates to whether the measures used in the research accurately reflect those intended. Cohen *et al*. (2000) refers to this as the articulation of the construct;
- The process of reviewing past literature (***chapter 2***) facilitated the identification of constructs and the elements recognised as suitable measures;
  - For example, attitudinal statements for psychological factors (***section 3.9.2***) were founded upon the latest pro-environmental behaviour research (MAX Success, 2009d; Bamberg *et al*., 2011). These statements are accepted as valid measures of the underlying psychological constructs.

Ecological validity

- This concerns the applicability of the findings to the social context the research aims to capture (Cicourel, 2007);
- Contextual information was provided to aid respondents in providing a response mirroring the intended contextual setting, particularly for the hypothetical questions;
- Moreover, respondents completing the questionnaire in their own ‘natural’ setting, rather than an interview room, will help with ecological validity.

Figure 30: Considerations of validity and the action taken in this research (Bryman, 2008)

During the data collection period, minimising the non-return of questionnaires and dropout rates can reduce the likelihood of invalidity (Cohen *et al*., 2000). Belson (1986) highlights the issue of volunteer/non-response bias. That is, whether those individuals not responding to the questionnaire would have answered the same as those actually participating. Belson (1986) suggests the possibility of following-up non-respondents with an interview and making comparisons with initial respondents. However, this was outwith the scope of this research. Regarding the dropout rate, questionnaire design is paramount. Pilot-testing and subsequent improvements to the questionnaire can help reduce the likelihood of respondents dropping-out.

3.15 Pilot-testing of the covering letter and questionnaire

The covering letter and questionnaire was subjected to two rounds of pilot-testing before being fully issued. ***Figure 31*** imparts the logistical issues which may be identified from pilot-testing. This includes the presentation, wording, language and phraseology of the instructions and questions – all of which can be resolved prior to the main survey.

Appraisal of the questionnaire's attractiveness and appearance
- This included the layout, length and presentation.

Assessment of wording, language and phraseology
- This includes identification of ambiguities and potential misunderstandings;
- The clarity of instructions and suitability for the target audience can also be assessed.

Feedback on question type and suitability of format
- This included the suitability of a multiple choice format, Likert scales and open-ended questions.

Assessment of the comprehensiveness of response categories
- Redundant questions and response categories can also be identified.

Provision of an estimated completion time
- This would be assessed for suitability, recognising the potential impact upon the quality of answers provided;
- Estimated completion time would also be incorporated into the covering letter for the full questionnaire survey.

Assessment of validity
- This includes whether the questionnaire allows the research questions to be answered.

Rehearsal of coding and data entry
- The intended analytical techniques can be trialled to assess ease and suitability.

Figure 31: Logistical issues which may be identified from pilot-testing (Freed, 1964; Moser and Kalton, 1977; Oppenheim, 1992; Cohen et al., 2000; Bryman, 2008)

Two pilot-tests were conducted over a three month period. Owing to the extent of changes made to the questionnaire after the first pilot-test, a second test was deemed necessary. The process and main findings are subsequently documented.

3.15.1 First pilot-test

This pilot-test was initiated in two stages, with two separate convenience samples during September 2010. The questionnaire and covering letter was first delivered by hand, post and email to various transport academics and practitioners. Such individuals were invited to review and give comments where appropriate, but not to actually complete the questionnaire. A foreword was prepared, detailing the nature of the research and requirements of the pilot-test. Three weeks were allowed for the returning of comments. 13 sets of in-depth feedback were received from individuals with a rich array of professional experience in questionnaire design. Second, the draft was issued to a sample of motorists from the public. This time, the questionnaire was to be completed by respondents and comments provided if necessary. The foreword was revised to add the conditions for participation, i.e. recipients should be a motorist and actually drive a vehicle. This would effectively mirror the LICENCE and FREDRIV variable utilised in the full questionnaire survey. Assurance of confidentiality was also documented regarding the responses provided. A separate feedback form was prepared, highlighting key areas such as the layout, clarity of instructions and ease of completion. Respondents were also encouraged to note their completion time. Three weeks was also allowed for questionnaires to be returned. A total of 24 questionnaires and feedback was collected from friends, family and friends of friends.

Pilot-testing resulted in numerous changes being made. For example, a question was added regarding annual mileage to complement the existing question regarding driving frequency. Combined, this would provide a greater indication of vehicle use. Several response formats were also changed. For example, the question regarding the current vehicle's engine size changed to an open-ended format to allow the collection of more detailed information. Questions regarding the current vehicle's MPG and CO_2 emissions were removed. Pilot-testing highlighted that respondents were largely unsure of such details and their inclusion would therefore cast doubt over the reliability of responses. Additional situational factors, not previously identified by the researcher, were added based on suggestions of respondents. This would thus develop a more comprehensive list of situational factors to be assessed. As documented earlier, value elicitation questions were overhauled. Many respondents incorrectly completed such questions under the payment-card format, which was subsequently changed to an open-ended setup. This fundamental change warranted the second pilot-test.

3.15.2 Second pilot-test

The revised questionnaire was then subjected to further pilot-testing. Multi-stage cluster sampling was used and six housing estates around Edinburgh were targeted. Locations were selected owing to the presence of good parking facilities. Recognising central Edinburgh often has limited residential parking (Rye *et al*., 2008), such locations were avoided. In total, 254 questionnaires were hand-delivered to households with a vehicle parked on the driveway[28] (***Figure 32***). The invitation to participate in the pilot-test was directed to the car owner of the household. A teabag was included with every questionnaire as a small incentive. Both Purcel *et al*. (1971) and Rose and Fogarty (2009)

[28] The addresses provided by the SHS for the 4,938 individuals for the follow-up sample were inspected prior to pilot-testing. Those residing in areas selected for pilot-testing were deliberately excluded as they would later be invited to participate in the full questionnaire survey.

reported a positive effect upon response rates through the inclusion of a cup-size packet of instant coffee and teabag respectively. Nevertheless, other researchers have identified a limited effect on responses (Gendall *et al*., 1998; Brennan *et al*., 2007; Gendall and Healey, 2008). However, both Gouldner (1960) and Dillman (2007) recognise a teabag provision as an expression of the researcher's appreciation. This can, in turn, help prevent dissonance and encourage respondents to reciprocate.

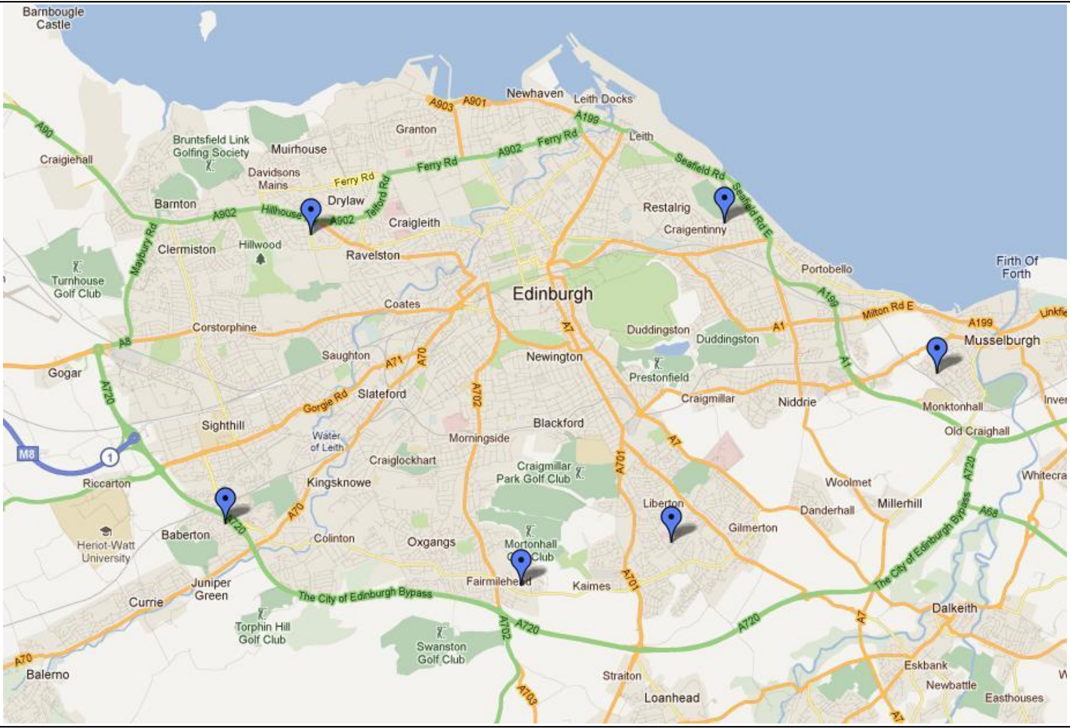


Figure 32: Location of the six housing estates around Edinburgh selected to participate in pilot-testing

The same foreword used in the first pilot-test was reissued second time round, together with the questionnaire/covering letter. A three week deadline was specified and a prepaid, self-addressed envelope was included for ease of return. A feedback sheet was also included to help shape comments. Of the 254 questionnaires issued, 42 questionnaires were completed, together with relevant feedback, equating a 16.5% response rate (***Table 9***).

Crucially, the value elicitation questions were better received under an open-ended format compared to the earlier payment-card setup. Regarding the changes made from the first pilot-test, no new issues were raised. Informed by the second pilot-test, some very minor final amendments were made. For example, the colour scheme for displaying the questions was changed from black to grey for a softer, more pleasing visual impact. After two rounds of pilot-testing, the researcher was content to finalise the covering letter and questionnaire, ready for the main survey (***Appendix A6***).

Table 9: Response rates for second pilot-test

Location	Questionnaires Issued	Questionnaires Received	Response Rate
Portobello	42	5	11.9%
Musselburgh	43	8	18.6%
Liberton	42	4	9.5%
Fairmilehead	42	5	11.9%
Baberton	43	7	16.3%
Blackhall	42	13	31.0%
TOTAL	**254**	**42**	**16.5%**

3.16 Data collection process

The revised covering letter and questionnaire was issued to the 4,938 ex-participants of the SHS. Royal Mail 2nd class postage was used to deliver questionnaires to respondents. Past research suggests only a small response rate increase from using a stamp rather than metered mail (Kernan, 1971; Dillman, 1972; Vocino, 1977). Metered mail was considered a more convenient and less time-consuming approach. No questionnaire follow-ups/reminders were utilised. This avoided the need for further financial expense, including the printing of additional questionnaires and subsequent postage costs.

3.17 Prize draw

11 winners were selected at random from those entered into the prize draw. Winners were subsequently recontacted to confirm their postal address. Prizes were sent via recorded delivery by the Royal Mail.

3.18 Data entry process

A protocol for data entry was devised based upon experience from pilot-testing. Statistical Package for the Social Sciences (SPSS) was selected for data entry and analysis. This software would be able to successfully manage both basic descriptive statistics, including frequency counts and distribution of responses, and more advanced techniques, e.g. exploring relationships between responses. Before data is entered into SPSS, variables must be created, including consideration of names/labels, measures, variable types and values (***Figure 33***).

Name and labels

- Each variable was assigned a concise yet descriptive working name;
- The name also included parts A, B, C etc of the same question to make it more obvious during data entry if any parts had been accidently omitted (Schneider and Deenan, 2004);
- Full labels were also provided to ease data analysis.

Measure

- Variables could be measured in 3 ways. Selection of the correct measure has implications for statistical analysis and techniques that should be used:
  - Nominal – the values represent categories with no ranked order, e.g. gender;
  - Ordinal – the values represent categories in a ranked order, e.g. frequency of driving;
  - Scale – the values represent ordered categories on a continuous scale, e.g. importance of situational factors.

Type

- 2 main types of data entry were most relevant to this research:
  - Numeric – this was used for closed responses, e.g. '1' for a new vehicle and '2' for a used vehicle;
  - String – this was used for open-ended responses, e.g. vehicle manufacturer and model.
- A character limit was imposed for string variables to help avoid data errors due to unintentional/extra key strokes.

Values and missing values

- Values were assigned for all possible numeric responses, e.g. '1' could represent 'not important' for situational factors assessed;
- Missing values were also recorded to allow a final check for complete entries (Findley and Stineman, 1989). 9's are typically used for missing values (Suter, 1987);
- For some questions, more than 1 missing value could be recorded. Roberts *et al*. (1997) argues all missing values should be recorded individually. Variations of 9 were used for this purpose:
  - 99 was used for N/A, with 991, 992 etc for different N/A responses within a single question;
  - 999 represented unanswered questions;
  - 0 was used for 'don't know' responses.

Figure 33: Data entry considerations

A SPSS data file was subsequently produced. The respondent's unique reference number was entered first and used to derive the urban/rural classification[29]. Data was manually entered by the researcher alone for consistent interpretation (Winkler, 2004). A nine-key number pad was used where possible, argued by Schneider and Deenan (2004) as enhancing efficiency and minimising errors. Furthermore, Microsoft Windows 'Narrator' was used to provide audio confirmation of each key stroke to further reduce the chance of unintentional/inaccurate data entry. An audio check would also be quicker than a visual

[29] However, two individuals intentionally defaced their unique reference number. This made it impossible to derive their postcode and urban/rural classification.

check of data (Winkler, 2004; Barchard and Pace, 2011). A 'coded' version of the questionnaire was produced and used for reference during data entry. This avoided excessive use of memory, often leading to errors (Schneider and Deenan, 2004).

Reverse coding and other calculations, such as averaging the variables was conducted within SPSS. This would avoid the potential for miscalculation owing to human error (Moody and McMillan, 2002). The open-ended questions in Section B, such as vehicle manufacturer/model were aggregated and recorded as a closed-response variable to facilitate data analysis. Data cleaning was also undertaken to help eliminate errors. Moser and Kalton (1977) advocate three checks to be undertaken after data entry, but before data analysis: completeness; accuracy; and uniformity (***Figure 34***). Upon completion of data entry into SPSS, frequency tables for every variable were generated. These were used to identify any 'obvious' human errors (Schneider and Deenan, 2004). For example, an 11 may have been entered instead of 1. The original questionnaire response was then looked-up to verify the accuracy of the potential error.

Completeness

- This ensures responses are provided to all questions;
- A postal questionnaire survey means respondents cannot be re-contacted to enquire into missing responses;
- However, Moser and Kalton (1977) recognise that answers can sometimes be inferred from other questionnaire responses;
  - For example, it could be easily determined that a W-registration vehicle, registered March-August 2000, was not acquired via the 2009/10 SIS.

Accuracy

- Where possible, responses were also checked for accuracy;
  - For example, it could be doubled-checked that vehicles reported as bought through the SIS had a 09, 59 or 10 vehicle registration.

Uniformity

- A final check was made that respondents had interpreted the instructions and questions in a consistent manner;
  - For example, respondents were asked to provide their current vehicle's engine size in litres. However, some responded in CCs, which therefore had to be converted by the researcher for consistency.

Figure 34: Checks during data entry (Moser and Kalton, 1977)

Based on responses to Section B, the current vehicle most often used at present was investigated in the VCA car fuel databases (VCA, 2011). The vehicle was looked-up according to the reported age, manufacturer, model, engine size, fuel type/energy source and transition. The CO_2 emissions of all potential vehicles [30] were averaged. This information was then recorded as a new variable and used in subsequent analysis.

3.19 Analytical techniques

Statistical techniques were used to analyse the data, both univariate and multivariate in nature. These are subsequently discussed.

3.19.1 Univariate analysis

Univariate analysis refers to the description of a single variable at one time. This includes response frequencies, central tendencies and data dispersion. Univariate analysis is recognised as a technique commonly employed at the early stages of a research project (Oppenheim, 1992). Whilst the technique is somewhat basic, recognising its descriptive nature and inability to show relationships between variables, it is considered the cornerstone of all statistical analysis (O'Leary, 2010). Univariate analysis was used to describe the variables for the motoring population as a whole, including both categorical and continuous data. Individual variables were also assessed relative to the population to assess the degree of similarity/difference and thus the ability to generalise the results of the research.

3.19.2 Factor analysis

Factor analysis, a type of multivariate analysis, was used to discover the underlying factors best explaining the patterns of correlation between a set of variables (Hotelling, 1933). It both screens and consolidates variables into a more concise set of measures. Furthermore, the revised measures retain a large proportion of the explanatory power (Mokhtarian and Salomon, 1997). Factor analysis works on the premise that variables demonstrating similar levels of variation are associated with the same underlying aspect. The resulting number of latent factors will therefore be less than the original dataset. Factor analysis therefore facilitates data reduction. Factor meanings, and thus their assigned label, are derived by the original variables most heavily loading upon each factor

[30] It was not possible to be 100% sure of the *exact* vehicle in ownership. Further details would have to be acquired, such as the vehicle's body shape, e.g. hatchback, saloon, estate; number of doors; and optional extras, e.g. air conditioning. The benefits to be gained by asking for all these details was deemed not to outweigh the additional demands placed on respondents when completing the questionnaire.

(Dancey and Reidy, 2007). Composite scores can be generated for each extracted factor, which can subsequently be used in further analysis (Field, 2009).

Factor analysis has nevertheless been criticised in the past. Arabie and Hubert (1994) argue many of the initial decisions made by the researcher are arbitrary. Factor analysis is reported as one of the *"more subjective and judgemental"* statistical techniques available (Howitt and Cramer, 2011, p.368). For example, preliminary decisions must be made concerning the number of factors to extract. However, statistics such as Kaiser's and Jolliffe's eigenvalue criterion, can offer guidance. Scree plots and Cronbach's Alpha can also be used to aid decision making. The type of rotation must also be decided by the researcher and SPSS offers five types. However, some are more/less suitable depending on the expected dependence of the factors (Field, 2009). This will therefore inform decisions surrounding the rotation. Green and Krieger (1995) also suggest factor analysis may breakup any underlying cluster structures, which may have an impact upon subsequent cluster analysis.

Regardless of the potential issues, the practical benefits of factor analysis mean many researchers continue to embrace the technique. The 32 situational variables were subjected to factor analysis. This would provide a more statistically sound and accurate means of grouping the variables based on actual responses received. This can be contrasted to the crude classification used in the questionnaire. Reducing the number of variables would also prove beneficial when reporting results. The application of factor analysis to this research is subsequently outlined.

3.19.2.1 Suitability of the data for factor analysis

Various suitability tests were initially carried out, including consideration of the sample size. De Vellis (1991) acknowledges the impact of sample size upon the strength of factor patterns. Specifically, the greater the number of variables entered and the larger the expected number of factors, the greatest possible number of cases should be included. Hair *et al*. (1984) suggests a ratio of at least 4-5 participants for every variable subjected to factor analysis. In contrast, Nunnally (1978) recommends having 10 times as many cases per variable. Nevertheless, both criteria are more than satisfied in this research. Additionally, Comrey (1988) classifies a sample of over 1000 respondents, as per this research, as 'excellent'. DeVellis (1991) advocates increased generalisability of conclusions from factor analysis from a large sample size. Based on these guidelines, the final sample (***Section 4.2***) was suitable for applying factor analysis.

Consideration of sample size should also recognise the treatment of missing values. These were handled on a list-wise basis, where respondents were excluded entirely if data was missing for one variable. Howell (2010) advocates this as the 'safer' option, rather than a pair-wise approach. However, a list-wise treatment of missing values will reduce the sample size more than a pair-wise approach. The final sample was indeed reduced by 23.4%. Nevertheless, a revised sample size would still be considered 'excellent' by Comrey (1988).

The structure of the correlation matrix was then assessed. Patterns of relationships between variables were studied using Pearson's correlation coefficient. Previous researchers have suggested a 0.3 cut-off for variables to be included in factor analysis (Hair *et al*., 1984; Pett *et al*., 2003). However, Field (2009) advocates the subjective nature of the cut-off rate criteria and past research has advocated other considerations. For example, Howitt and Cramer (2011) argue the variable list should be confined to those variables expected to measure a concept deemed important in the research. Additionally, Child (2006) suggests 'lonesome' variables should be eliminated from the dataset.

The original 32 variables were subsequently reviewed and only 28 variables were utilised in the final solution. The finance deals and company car tax variables had consistently low correlations with all other variables, meaning that relationships were weak. Indeed, the greatest correlation is only 0.33, barely meeting the 0.3 cut-off suggested in past research (Hair *et al*., 1984; Pett *et al*., 2003). Regarding the mileage and overall vehicle condition variables, the highest correlation was with each other (0.44). Weak relationships were observed with the remaining variables. The greatest correlation identified was only 0.31 for mileage and 0.34 for the overall condition of a used vehicle. These four variables also made heavy use of the N/A response category and therefore had greater missing values. This negatively impacts upon the valid number of cases subjected to factor analysis. There was also the risk respondents could have incorrectly used the

N/A option[31]. Hence the accuracy of such responses could be called into question, further supporting the decision to remove these 4 variables from the analysis.

The remaining 28 variables were subjected to final suitability checks. The final solution generated a determinant of the R-matrix figure of 0.00000579. The measure indicates the risk of multicollinearity. Recognising a minimum acceptable value of 0.000001 (Field, 2005), multicollinearity was therefore not an issue. The default statistic in SPSS to assess the suitability of the data is Bartlett's Test of Sphericity. For factor analysis to be appropriate, this test should yield a significant chi-squared statistic, i.e. less than 0.05 (Field, 2009). This would thus indicate the R-matrix is not an identity matrix and relationships between the variables are actually present (Dziuban and Shirkey, 1974). The output of Bartlett's Test of Sphericity for the final solution is 12213.5 where $p<0.001$. This signifies the suitability of the data for factor analysis. However, Mitchell (1993) highlights the issue of Bartlett's Test of Sphericity becoming 'sensitive' with samples greater than 300 respondents. This statistic was viewed together with other measures of suitability for corroboration. The final test lies with the Kaiser-Meyer-Olkin measure of sampling adequacy (Kaiser, 1970). This represents the ratio of the squared correlation between variables, measured from 0-1 (Field, 2009). The generally accepted criterion for this measure is a minimum of 0.5, indicating compact patterns of correlation (Kaiser, 1974). The anti-image correlation matrix displays the measure of sampling adequacy for the 28 variables. Values ranged from 0.67 to 0.95, whilst the overall figure for all variables was 0.83, whereby meeting the minimum 0.5 cut-off. Indeed, Kaiser (1974, p.35) would classify it as *"meritorious"* for being between 0.8-0.9. Collectively, the sample was considered adequate.

3.19.2.2 Type of factor analysis and rotation

SPSS offers several techniques for factor analysis and the default is principle component analysis. This approach is not strictly factor analysis (Dancey and Reidy, 2007; Field, 2009), but the results produced are often similar, especially when using large datasets. Furthermore, principle component analysis is argued to work best when the unique variance is small relative to the common variance for all variables. Data generated from

[31] For example, this was suspected with the company car tax variable. Surprisingly, almost 60% of respondents rated this as 'not important'. Perhaps some of the 60% would simply not be affected by the company car tax system. This was the intended purpose of the N/A option.

Likert scales, including those measuring situational factors, typically meets this criterion (Hair *et al*., 1984).

The factor solution was rotated to improve interpretability and help clarify the underlying structure (Tinsley and Tinsley, 1987; DeVellis, 1991). Rotation maximises the loading of each variable onto one extracted factor and minimising the loading on all other factors. During rotation, differential values remain constant and only the absolute values are transformed (Field, 2005). Varimax rotation, a type of orthogonal rotation, was used, recommended when the factors are expected to be independent of one another (Kaiser, 1958; Field, 2009). Varimax is observed as the most common choice for rotation (Costello and Osborne, 2005; Dancey and Reidy, 2007).

3.19.2.3 Deciding the number of factors to extract

In determining the optimum number of factors to extract, three main approaches were used. First, a cut-off value was assigned for the 28 components initially extracted in the analysis. As data reduction is a fundamental aim of factor analysis, it would be futile to include all 28 components initially extracted at the outset (Howitt and Cramer, 2011). Eigenvalues indicate the amount of variance explained by each factor (Dancey and Reidy, 2007). A minimum eigenvalue of 1 was adopted based on recommendations by Kaiser (1960). Specifically, only those factors explaining a greater proportion of variance than the average value for all 28 variables were included. Field (2005) highlights two conditions surrounding Kaiser's criterion. Specifically, there should be less than 30 variables and communalities after extraction should be greater than 0.7; or the sample size should exceed 250 and average communalities should be above 0.6. In this research, the communalities after extraction were only 0.61. Kaiser's eigenvalue criterion is invalid based on the first condition, but invalid for the second.

Jolliffe (1972) offers an alternative to Kaiser's eigenvalue criteria. Kaiser's cut-off point of 1 is argued as too strict, inadvertently excluding many factors. Jolliffe (1972) suggests retaining all factors where the eigenvalue is greater than 0.7. This criterion would capture an additional four factors relative to Kaiser's criterion. However, Field (2005) suggests this criterion tends to overstate the number of factors extracted. This criterion was therefore disregarded.

Owing to ambiguity in the eigenvalue criteria, a scree plot was used to provide additional clarification. Whilst this approach tends to be more subjective, Stevens (2002) advocates the reliability of the scree plot in factor selection when the sample is greater than 200 respondents. The variance is plotted against the cumulative number of factors. The optimum number of factors is determined by observing the relative importance of each factor graphically (Cattell, 1966). Having identified the point of inflection on the curve, the optimum number of factors exists at the point prior to the plateau[32]. The scree plot confirmed the suggested number of factors based on Kaiser's criteria: i.e. the extraction of seven factors.

Finally, Dancey and Reidy (2007) recommend consideration of the variance explained by the factors. Dancey and Reidy (2007) suggest an ideal variance of approximately 75%. However, the 7 extracted factors only account for 60.8%. However, Dancey and Reidy (2007) recognise the importance of explaining the greatest possible variance in the fewest number of factors. An additional 5 factors would be necessary to explain 75.6%. 12 factors were deemed excessive from a data reduction perspective. Thurstone (1931b) argues it preferable to retain too few factors, rather than too many. The original seven factors were therefore maintained.

3.19.2.4 Consideration of internal validity

An assessment of internal reliability was made using Cronbach's Alpha (α; Cronbach, 1951). Internal consistency is paramount for the variables within the identified factors. Alpha coefficients range from 0-1 and the generally accepted minimum reliability score is 0.7 (Nunnally, 1978; Kline, 1999). Field (2009) recommends conducting separate reliability analysis for all factors and the variables under each heading. Reliability scores for the seven factors ranged from 0.75 to 0.89 (***Table 25***). The extent of internal consistency was satisfactory. The results of factor analysis are shown in ***Section 5.2.2*** and the full statistical output generated by SPSS is shown in ***Appendix A7***.

3.19.3 Cluster analysis

Cluster analysis is similar to factor analysis, but the focus is towards grouping individuals based on their responses, rather than grouping variables (Field, 2000). The justification for segmenting the population was discussed earlier in ***Section 2.11***. Specific to this research, the influence of taxation and other policy measures upon individuals' future

[32] The original paper by Cattell (1966) recommends including the factor actually present at the point of inflexion. However, this practice is rarely retained according to Field (2009).

vehicle purchasing decisions is likely to vary amongst the Scottish motoring population. Segmentation was therefore considered informative. The resulting cluster profiles would provide insight into future policy decisions. Strategies can subsequently be tailored to the needs of each segment (Sullivan and O'Fallon, 2008). Targeting the 'average' motorist with a one-size-fits-all approach is increasingly recognised to have limited effectiveness, relative to individualised, targeted strategies (Ampt, 2003; Anable *et al*., 2006; Hounsham, 2006). The two approaches to segmentation are subsequently considered.

3.19.3.1 A-priori segmentation

A-priori segmentation is acknowledged as a quick and relatively easy way of segmenting the population. However, the technique has been criticised for being over-simplistic and uninformed by the data collected (Chen, 2003; Dolnicar, 2004). Implicit assumptions must be made by the researcher to decide the variables to be used for segmentation (Hanlan and Wilde, 2005). Despite the weaknesses of *a-priori* segmentation, past research provided sufficient justification for using the strength of individuals' BI to purchase a lower emission vehicle to segment the Scottish motoring population. Measuring actual behaviour, as mentioned earlier, is outwith the scope of this research. However, BI is recognised as the best predictor of actual behaviour (Dietz *et al*., 2007; Caulfield, 2011). The MaxSem model also recognises the formation of a BI as a critical threshold point in the behaviour change process. It therefore seemed pertinent to explore the motoring population by the strength of individuals' BI to purchase a lower emission vehicle in the future.

Recognising that the BI variable is measured on a continuous scale, the next decision refers to the means of classifying individuals according to their scores. This choice therefore informs the exact composition of individuals in each BI segment. This decision clearly has repercussions regarding the impending bivariate analysis conducted according to the strength of individuals' BI (documented in ***section 3.19.4***).

The universally recognised classification of 'low, medium and high' was adopted to measure the strength of individuals' BI to purchase a lower emission vehicle in the future. The 7-point Likert scale used in the questionnaire only specified the label at the two extremes to infer strength, i.e. strongly disagree and strongly agree. Discretion therefore existed for the researcher regarding the boundaries of the low, medium and high categories. The researcher first observed the full distribution of the BI variable (***Figure 35***).

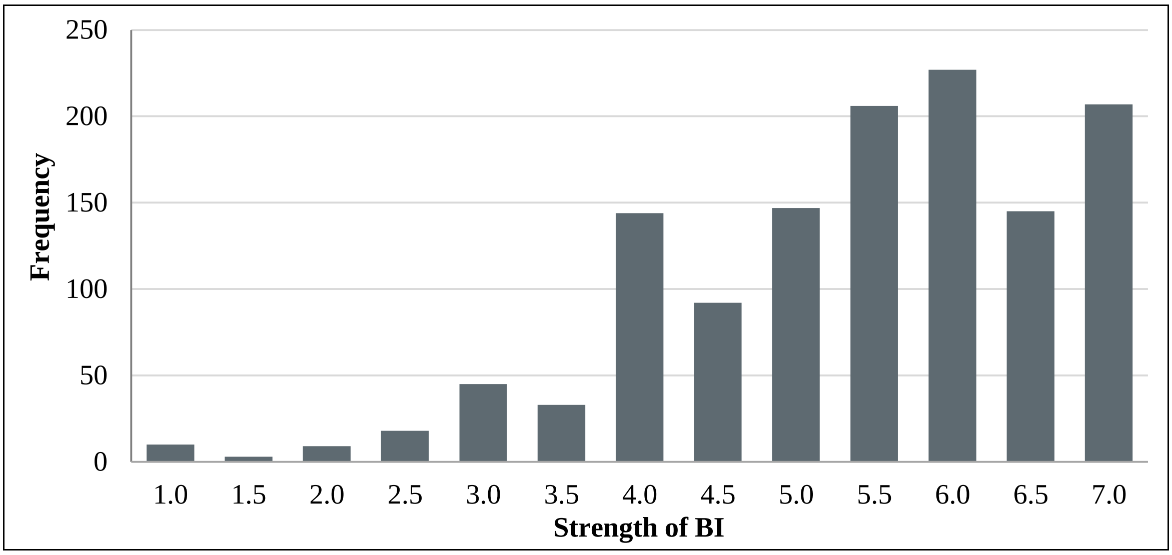


Figure 35: Distribution of Scottish motorists according to the strength of BI to purchase a lower emission vehicle in the future

The frequency is clearly skewed towards the high end of the BI intention scale. The possibility of equal sized segments was ruled out on the basis that low BI individuals could potentially score 4.5 or even 5 out of 7. This was deemed to unfairly capture the spirit of 7 representing the strongest BI. Recognising 4 as the midpoint in the 7-point scale, this was used as one of the boundaries for classifying BI strength. Individuals with a BI between 4 and 7 were split as evenly as possible. The overall classification adopted is shown in ***Figure 36***. Segment application is shown throughout ***Chapters 4-7***.

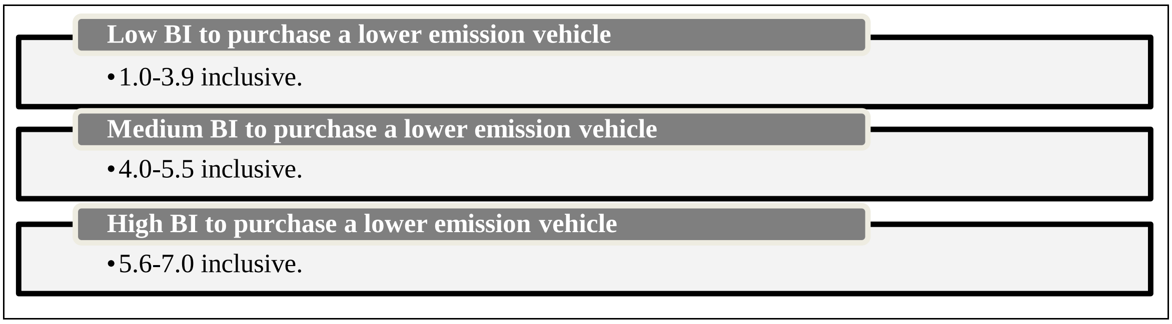


Figure 36: Low, medium and high classification of individuals' BI to purchase a lower emission vehicle in the future

3.19.3.2 Post-hoc segmentation

The most common type of *post-hoc* segmentation is k-means cluster analysis. Multivariate statistical analysis is used to identify segments (Arabie and Hubert, 1994;

Green and Krieger, 1995). Segments are derived from the data, based on respondent's similarity on multivariate profiles over a combination of variables (Anable, 2005). The goal is to maximise the distance *between* groups, whilst minimising the distance *within* groups (Mitchell, 1993; Berry and Linoff, 2004; Witten and Frank, 2005). Through an iteration process, cases are moved between clusters. Iteration is based on the distance of cases to the recalculated group centroids after each movement. This procedure is repeated until the cluster means become stable, and no further changes are made within the clusters (Hair *et al*., 1984; Myatt, 2007).

There are some potential weaknesses of k-means cluster analysis. This technique is only one of three possible methods for segmentation within SPSS. It can therefore be argued different methods produce very different results (Punj and Stewart, 1983; Aldenderfer and Blashfield, 1984). With k-means cluster analysis, the number of segments must be specified at the onset. Thus, difficulties arise in selecting the value of *k* (Punj and Stewart, 1983). However, statistical guidance is available regarding the optimal number of clusters. For example, the F-value from a one-way analysis of variance (ANOVA) can be used, together with intuition (Hair *et al*., 1984).

Despite these possible limitations, k-means cluster analysis can analyse large datasets. Key details from the SPSS output, including cluster membership, can also be saved and used in further analysis (IBM, 2011; University of North Texas, 2011). The analysis was conducted for the importance of the 7 situational factors resulting from factor analysis and the strength of 11 psychological constructs informing individuals' future vehicle purchasing behaviour. Missing values were handled on a pair-wise basis, i.e. cases with no valid scores for both variables were excluded from the analysis[33] (Gerber and Finn, 2005). All the available data was utilised for segmentation (Weiner *et al*., 2003). Hair *et al*. (1984) advocates a minimum threshold of 20 cases for every variable included in the segmentation. A ratio of 74:1 arises for the full sample and recognition of missing values is unlikely to bring the ratio below 20[33]. The data was therefore considered suitable for k-means cluster analysis.

In deciding the number of clusters, the goal was to achieve a sufficient amount of detail with the clusters, but not too many to become unmanageable or difficult to communicate

[33] It is not possible to provide an exact quantity of missing values for k-means cluster analysis. Pair-wise deletion of missing values will result in different sample sizes for each pair of variables.

(Spath, 1980; Hair *et al*., 1984; Pas and Huber, 1992). The analysis was run for 3, 4, 5, 6 and 7 segments. For each set of clusters produced, a one-way ANOVA was performed. This would provide a measure of the concentration or intensity of the clusters (Banks, 1998). The optimum solution is one with the greatest variability between the groups, relative to the variation within the groups. This is measured by the F-value, which should be as high as possible (***Table 10***). The greatest F-value generated was 3,390.8, indicating an optimum solution of three clusters. Segment application is shown throughout ***Chapters 4-7*** and the full statistical output generated from SPSS is shown in ***Appendix A7***.

Table 10: F-values for the cluster solutions

F-values	Number of clusters				
	3	4	5	6	7
Future financial considerations	146.1	95.2	80.7	63.9	48.0
Exterior design features	62.0	82.5	80.3	62.6	79.7
Interior design features	58.9	113.1	85.4	62.8	65.0
Environmental considerations	217.3	187.2	147.1	125.7	97.7
Fuel and performance	88.9	86.1	74.9	72.4	75.6
Load space	50.2	62.9	70.9	53.2	75.9
Financial considerations at purchase	52.6	36.6	32.9	28.5	35.0
BI	364.0	270.3	208.2	162.6	142.8
Perceived behavioural control	57.7	41.1	32.3	175.5	30.9
Perceived negative consequences	319.9	218.5	159.9	114.0	128.8
Goal intention	341.9	250.5	199.8	157.2	141.9
Personal norms	324.9	255.5	170.7	133.8	144.7
Goal feasibility	102.4	62.7	46.2	47.6	76.9
Negative affect	408.9	294.5	239.7	207.9	198.4
Social norm	127.6	107.6	70.8	50.9	67.6
Personal responsibility	247.6	232.8	301.0	182.2	187.8
Attitude	190.6	170.6	189.3	213.0	124.5
Emotions	229.3	228.7	189.0	121.4	158.6
TOTAL	**3390.8**	**2796.4**	**2378.9**	**2035.4**	**1879.8**

3.19.4 Bivariate analysis

Bivariate analysis can be thought of as a simplified version of multivariate analysis: i.e. examining the relationship between two variables. This can be achieved with cross-tabulations and measures of association between variables (Oppenheim, 1992). This type of analysis produces inferential statistics, allowing the researcher to draw conclusions extending beyond the data collected from the sample. This therefore allows generalisations to be made to the population (O'Leary, 2010). However, bivariate analysis may be considered over-simplistic, recognising that patterns of relationship have not been assessed using multiple variables simultaneously (Bryman, 2008). Nevertheless, relationships can be identified, whereby overcoming the weaknesses associated with univariate analysis (***Section 3.19.1***).

Bivariate analysis was primarily used to test the association between variables and the sub-groups in the motoring population derived from *a-priori* and *post-hoc* segmentation. Significance testing was employed to establish the confidence in the relationships observed, measured by probability values (p). Where p equals 0.05, this is significant at the 95% confidence interval, there is a 5% chance of the relationship occurring by chance, assuming the null-hypothesis, where no relationship between the variables in the population, is true (Dancey and Reidy, 2007). P-values therefore represents the likelihood of making a Type I error, i.e. incorrectly rejecting a true null-hypothesis (Field, 2009). Whilst there are no definitive criteria for determining the maximum p-value, 5% is most common in practice, allowing *"reasonable confidence"* in the relationships (Dancey and Reidy, 2007, p.141). Where $p<0.05$, findings are significant, whilst $p>0.05$ would be insignificant.

Chi-squared tests (χ^2) were employed for cross-tabulated, categorical information, such as frequency counts, to measure association between sub-groups. Chi-squared can evaluate whether the obtained frequency counts are significantly different from those expected if the null-hypothesis is true (Field, 2009). The larger the observed frequency compared to those expected, the larger the χ^2 and more likely the difference is significant (Dancey and Reidy, 2007).

One-way ANOVAs were used to compare mean scores between variables and sub-groups. ANOVA investigates differences between the means by calculating the grand-mean, i.e. the mean of the sub-group means. The variability for each sub-group is then reviewed relative to the grand-mean. Variation arises between and within the sub-groups. When the variation between the groups is greater than the variation within the groups, this produces a larger F-ratio. This subsequently reduces the likelihood of the result occurring by sampling error (Dancey and Reidy, 2007). However, the results of an ANOVA are general and fail to indicate which sub-group means are significantly different. *Post-hoc* tests are therefore required to explore the differences. Scheffé *post-*

hoc tests were used (Scheffé, 1953), often recognised as the most conservative test regarding Type I errors (Hair *et al*., 1984). Howell (2006) argues Scheffé *post-hoc* are the most popular type of test.

3.20 Chapter 3 summary

This chapter provided details of the research method used to address the research aim. The following key points were considered:

- A questionnaire survey was used to capture information from the Scottish motoring population;
- The questionnaire focused on individuals' future vehicle purchasing decisions and the influence of transport policy, particularly taxation/subsidies, in shaping purchasing behaviour towards a lower emission vehicle;
- A follow-up survey from the SHS was used to target the Scottish motoring population;
- Considerations of ethics, reliability and validity were used to inform the questionnaire design and collection of data;
- SPSS was used for data entry and analysis;
- Both univariate and multivatriate analytical techniques were employed for data analysis.

4 RESULTS: SAMPLE PROFILE

4.1 Chapter overview

This chapter begins with consideration of the response rate from data collection. The characteristics of the sample are then presented, including socio-demographic factors and motoring behaviour. Where possible, comparisons are made relative to the population to assess the degree of representation. Sample characteristics are subsequently presented according to the segments identified from *a-priori* and *post-hoc* segmentation.

4.2 Response rate

1,336 usable[34] questionnaire responses were collected at the deadline. 219 questionnaires were returned-to-sender unopened due to address changes since the SHS, generating a 28.3% response rate. Past research suggests self-completion mail-back surveys often fail to generate a response rate greater than 30% (Richardson *et al*., 1995; de Vaus, 1996). For example, Harzing (2000) reports mail survey response rates tend to vary between 6-16%. 28.3% was therefore considered sufficient to begin analysis.

4.3 Sample characteristics of the Scottish motoring population overall

A sample profile was prepared regarding socio-demographic factors and their motoring behaviour. This would provide insight into the composition of individuals making up the Scottish motoring population. Comparisons are made to the original 2009/10 SHS dataset and Vehicle Information Database to evaluate response bias and overall representativeness. Chi-squared tests are employed to assess the significance of the differences. Results are subsequently split for: socio-demographic factors; current motoring behaviour regarding the vehicle most often used at present; and an indication of individuals' previous vehicle purchasing behaviour.

[34] The data was cleaned prior to commencing the analysis. Respondents holding a provisional-driving licence, or those with no regular access to a vehicle were removed from the dataset. Furthermore, a minimum acceptable questionnaire completion rate of 40% was decided by the researcher. Collectively, this reduced the sample size by 16.

4.3.1 Socio-demographic factors of the Scottish motoring population overall

Socio-demographic factors are considered first, including respondents' gender, age, household income before tax and six-fold urban/rural classification.

Respondents were asked to indicate their gender. The sample consisted of more males with a full driving-licence (53.3%) than females (46.7%; ***Figure 37***). Comparisons were made relative to the percentage of the adult population with a full driving-licence, assessed by the SHS (Scottish Government, 2011c,d). The results of the chi-squared test indicates a significant difference between the gender distribution of the sample and the population ($\chi^2(1)=7.290$, $p<0.05$). In this research, males are over-represented by 3.7%, whilst females were under-represented.

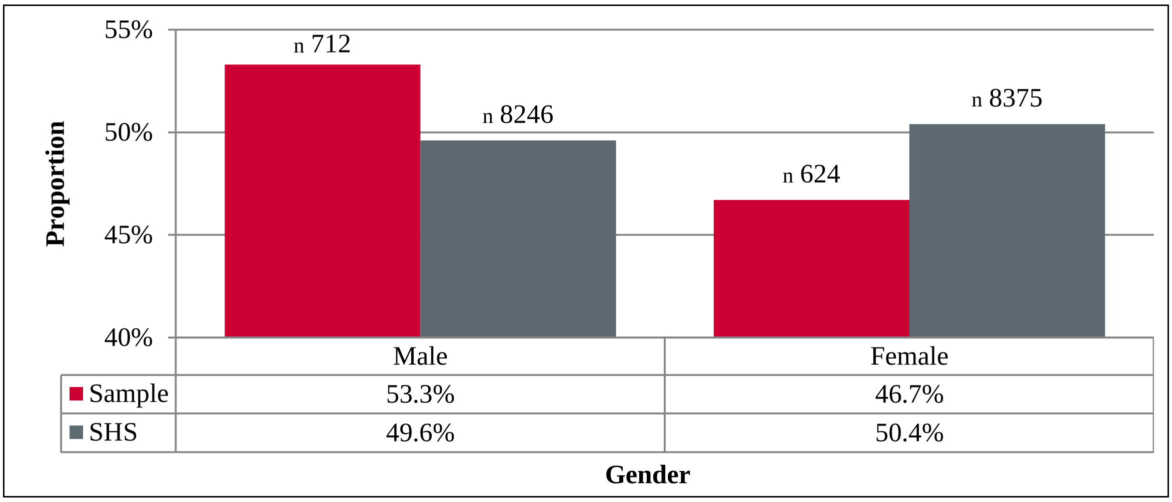
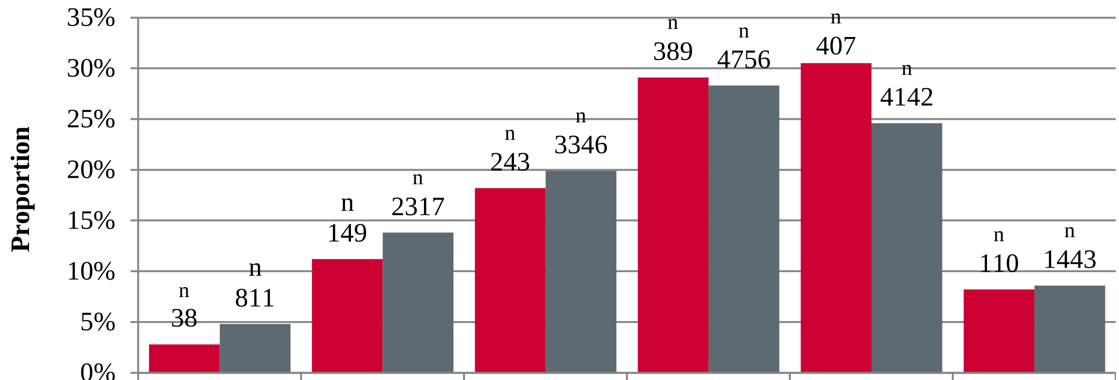


Figure 37: Composition of the final sample by gender, relative to the 2009/10 SHS

Respondents were asked to indicate their age. The sample contained a large proportion (59.6%) of individuals aged 45-74 years. Conversely, individuals aged 24 years maximum and those at least 75 years made up only a small proportion of the sample (11% collectively; ***Figure 38***). Comparisons were made relative to the percentage of the adult population with a full driving-licence, assessed by the SHS (Scottish Government, 2011c,d). The results of the chi-squared test indicates a significant difference between the age distribution of the sample and the population ($\chi^2(5)=38.595$, $p<0.05$). The biggest deviation is for individuals in the 60-74 age category, who are over-represented by 5.9%.

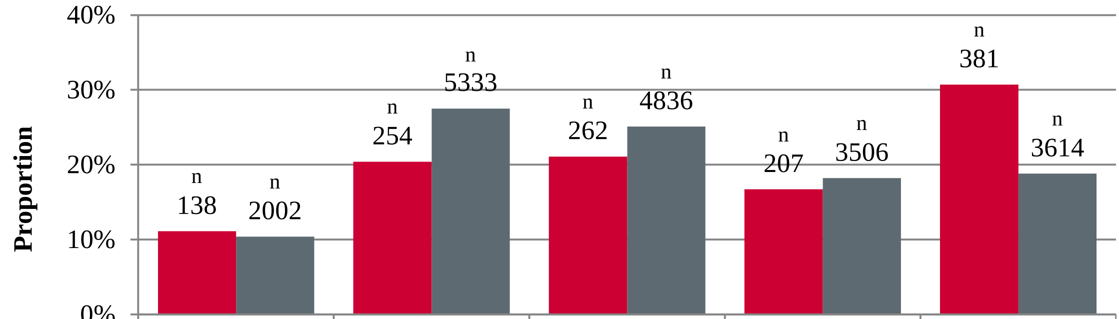


	16-24 years	25-34 years	35-44 years	45-59 years	60-74 years	75+ years
Sample	2.8%	11.2%	18.2%	29.1%	30.5%	8.2%
SHS	4.8%	13.8%	19.9%	28.3%	24.6%	8.6%

Age

Figure 38: Composition of the final sample by age, relative to the 2009/10 SHS

Respondents were asked to indicate their household income before tax. 30.7% of respondents purported to earn £40,000 per annum minimum, which was also the most frequent response. Remaining respondents largely occupied the £10,001-£30,000 income bracket (41.5% collectively; ***Figure 39***). As documented earlier, the measurement of household income used by the SHS for those households with at least one accessible vehicle was taken after tax (Scottish Government, 2011c,d). This research embraced a pre-tax approach to household income. The researcher's sample was therefore anticipated to contain a greater distribution of higher income respondents than the SHS. The results of the chi-squared test indicates a significant difference between the income distribution of the sample and the population ($\chi^2(4)=125.768$, $p<0.05$). Indeed, the biggest deviation is for individuals earning £40,001 minimum, who are over-represented by 11.9%.

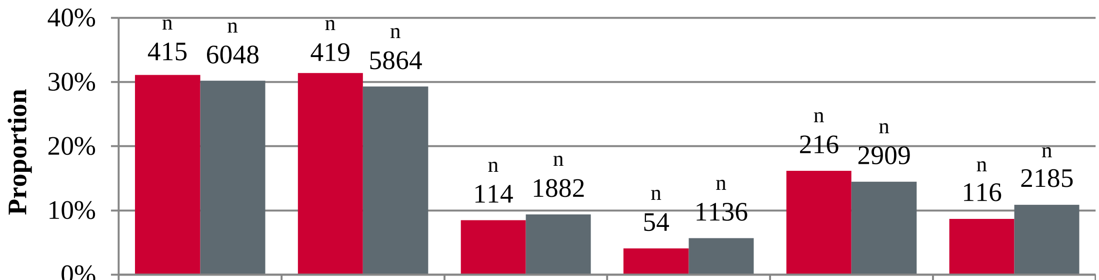


	£10,000 or less	£10,001-£20,000	£20,001-£30,000	£30,001-£40,000	£40,001+
Sample	11.1%	20.4%	21.1%	16.7%	30.7%
SHS	10.4%	27.5%	25.1%	18.2%	18.8%

Household income

Figure 39: Composition of the final sample by household income before tax, relative to the 2009/10 SHS

The six-fold urban/rural classification of respondents was inferred by the researcher. The majority of respondents (62.5%) reside in urban locations, large and other. Rural locations, accessible and remote, are the next most inhabited with 24.9%. Remaining respondents occupy accessible and remote small towns. For both rural areas and small towns, the accessible locations are more heavily populated than the remote areas with a ratio of almost 2:1 (***Figure 40***). Comparisons were made relative to the urban/rural classification for households with at least one vehicle available for private use, assessed by the SHS (Scottish Government, 2011c,d). The results of the chi-squared test indicates a significant difference between the 6-fold urban/rural distribution of the sample and the population ($\chi^2(5)=18.394$, $p<0.05$). However, the biggest deviation is for individuals residing in remote rural areas, who are over-represented by a mere 2.2%.



	Large urban area	Other urban area	Accessible small town	Remote small town	Accessible rural area	Remote rural area
Sample	31.1%	31.4%	8.5%	4.1%	16.2%	8.7%
SHS	30.2%	29.3%	9.4%	5.7%	14.5%	10.9%

Urban/rural classification

Figure 40: Composition of the final sample by urban/rural classification, relative to the 2009/10 SHS

4.3.2 Current motoring behaviour of the Scottish motoring population overall

Current motoring behaviour was also assessed, including consideration of the motorist themselves, including the number of years respondents' have held a full driving-licence, their driving frequency and annual mileage. The vehicle most often used at present was also considered, including the vehicle's engine size, fuel type/energy source, transmission, age, involvement in the SIS, purchase history, CO_2 emissions and the registered owner.

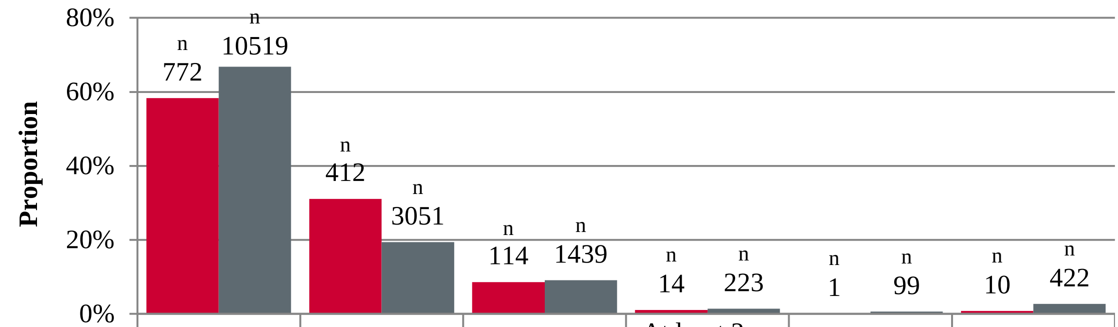
Respondents were first asked to indicate the duration of time holding a full driving-licence from the time of original acquirement. 44.9% reported a duration of 21-40 years. Similar to the age distribution, the fewest proportion of respondents held a full driving-licence for either the shortest or longest period. Specifically, 9.3% holding their driving-licence for 10 years maximum, and 10.7% holding theirs for 51 years minimum (***Table 11***).

Table 11: Composition of the final sample by the number of years driving with a full driving-licence

Number of years with a full driving-licence	n	%
10 or less years	123	9.3%
11 to 20 years	206	15.4%
21 to 30 years	307	23.2%
31 to 40 years	287	21.7%
41 to 50 years	261	19.7%
51 or more years	141	10.7%
TOTAL	**1,325**	**100.0%**

Respondents were asked to indicate their driving frequency in terms of usage per week or month. The sample is heavily populated with individuals driving frequently. Specifically, 58.3% drive daily and a further 31.1% drive 3 times a week minimum. Only 2% could measure their driving frequency in months (***Figure 41***). Comparisons were made relative to the percentage of the adult population with a full driving-licence, assessed by the SHS (Scottish Government, 2011c,d). The results of the chi-squared test indicates a significant difference between the driving frequency distribution of the sample and the population ($\chi^2(5)=134.176$, $p<0.05$). Indeed, the biggest deviation lies with frequent motorists, where those driving daily are under-represented by 8.5% and those driving three times a week minimum are over-represented by 11.7%. However, recognising some response categories as not mutually exclusive, the combined deviation for the two response categories is only 3.2%.

Respondents were asked to indicate their annual mileage to measure the distance travelled. The sample largely comprises of motorists driving 10,000 miles a year maximum (71.1%). Beyond the 10,000 mile threshold, 26.7% of motorists drive 20,000 miles maximum and a further 2.2% drive at least 20,001 miles (***Table 12***),



	Every day	At least 3 times/ week	Once or twice/ week	At least 2 or 3 times/ month	At least once/ month	Less than once/ month
Sample	58.3%	31.1%	8.6%	1.1%	0.1%	0.8%
SHS	66.8%	19.4%	9.1%	1.4%	0.6%	2.7%

Frequency of driving

Figure 41: Composition of the final sample by the frequency of driving, relative to the 2009/10 SHS

Table 12: Composition of the final sample by annual mileage

Annual mileage for private purposes	n	%
2,500 miles or less	123	9.3%
2,501 to 5,000 miles	253	19.2%
5,001 to 7,500 miles	276	20.9%
7,501 to 10,000 miles	287	21.7%
10,001 to 15,000 miles	286	21.6%
15,001 to 20,000 miles	67	5.1%
20,001 or more	29	2.2%
TOTAL	**1,321**	**100.0%**

Regarding the vehicle most often used at present, respondents were asked to indicate the vehicle's engine size in litres. The majority of respondents have a 1.3-2 litre engine vehicle (74.7%). Indeed, the average engine size was 1.7 litres. The smallest engine size recorded was only 1 litre, whilst the biggest engine size was 4.5 litres. 10% of respondents drive a vehicle with at least a 2.1 litre engine (***Figure 42***). Comparisons were made relative to private and light goods vehicles licensed in the Vehicle Information Database (Scottish Government, 2010). The results of the chi-squared test indicates a significant difference between the engine size distribution of the sample and the population ($\chi^2(7)=64.993$, $p<0.05$). The biggest variation is for 2.1-2.5 litre engines which are under-represented by 4.9%; whilst smaller engines between 1.1-1.2 litres are over-represented by 3.5%.

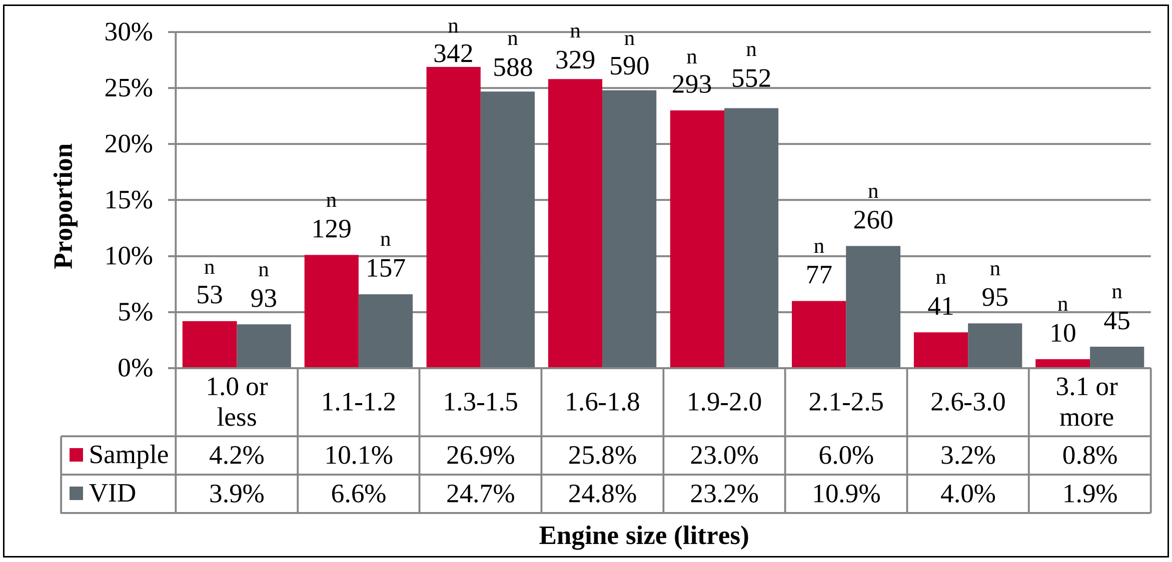


Figure 42: Composition of the final sample's current vehicle by engine size, relative to the 2009 Vehicle Information Database

Respondents were then asked to document the fuel type/energy source for the vehicle most often used at present. There was approximately a ratio of 2:1 for petrol and diesel fuelled vehicles. Beyond main road-fuels, only two vehicles were plug-in hybrids utilising petrol and electricity, and one utilising diesel and biofuels (***Table 13***).

Table 13: Composition of the final sample's current vehicle by fuel type/energy source

Fuel type/energy source	n	%
Petrol	881	66.2%
Diesel	446	33.5%
Petrol & electricity	2	0.2%
Diesel & biofuel	1	0.1%
TOTAL	**1,330**	**100.0%**

Respondents were asked to indicate the transmission of the vehicle most often used at present. 88.9% of vehicles embraced a manual system, whilst 10.9% were automatic. The remaining three vehicles have a semi-automatic vehicle transmission (***Table 14***).

Table 14: Composition of the final sample's current vehicle by transmission

Transmission	n	%
Manual	1,180	88.9%
Automatic	145	10.9%
Semi-automatic	3	0.2%
TOTAL	**1,328**	**100.0%**

Respondents were asked to provide part of the registration number of the vehicle most often used at present. The researcher would subsequently infer the age of the vehicle. 59.8% of vehicles were 6 years old maximum. The newest of those vehicles, up to 1 year old, made up the smallest proportion with 8.7%. Vehicles at least 6 years old made up the remaining 40.2% and the oldest vehicle recorded was registered between August 1985 and July 1986 (***Table 15***).

Table 15: Composition of the final sample's current vehicle by age/vehicle registration

Period of initial registration	n	%
28/2/99 & earlier	89	7.0%
1/3/99 to 28/2/01	83	6.6%
1/3/01-28/2/02	70	5.5%
1/3/02-28/2/03	88	7.0%
1/3/03-29/2/04	98	7.7%
1/3/04-28/2/05	81	6.4%
1/3/05-28/2/06	115	9.1%
1/3/06-28/2/07	128	10.1%
1/3/07-29/2/08	133	10.5%
1/3/08-28/2/09	129	10.2%
1/3/09-28/2/10	142	11.2%
1/3/10-28/2/11	110	8.7%
TOTAL	**1,266**	**100.0%**

Respondents were asked to indicate whether the current vehicle most often used at present was acquired new or used. A greater proportion of used vehicles exist in the sample, with a ratio of almost 3:2 relative to new vehicles (***Table 16***).

Table 16: Composition of the final sample's current vehicle by its purchase history

Purchase history	n	%
New vehicle	560	42.2%
Used vehicle	768	57.8%
TOTAL	**1,328**	**100.0%**

Respondents were asked to indicate whether the vehicle most often used at present was acquired via the UK SIS from May 2009 to March 2010. Only 27 vehicles (2%) were acquired through the scheme.

The researcher inferred the CO_2 emissions of the vehicle most often used at present through the information provided in the questionnaire and VCA (2011) databases. The majority of vehicles (24%) emit 151-165g/km of CO_2. Indeed, the average CO_2 emissions overall was 164g/km. The proportion of vehicles above and below this CO_2 emissions threshold is almost equal. 38.7% of vehicles emit 150g/km maximum; whilst 37.3% emit 166g/km minimum. The lowest emission vehicle was a mere 89g/km and only 3 vehicles emit less than 100g/km of CO_2 (0.2%). Conversely, the highest emission vehicle was 341g/km of CO_2, plus another 28 fell into the highest tax band, emitting 256g/km of CO_2 minimum (2.2%; ***Table 17***).

Table 17: Composition of the final sample's current vehicle by CO_2 emissions

VED tax band	g/km of CO_2	n	%
A	Up to 100	3	0.2%
B	101 to 110	22	1.7%
C	111 to 120	52	3.9%
D	121 to 130	75	5.7%
E	131 to 140	136	10.4%
F	141 to 150	220	16.8%
G	151 to 165	314	24.0%
H	166 to 175	115	8.8%
I	176 to 185	126	9.6%
J	186 to 200	93	7.1%
K	201 to 225	90	6.9%
L	226 to 255	35	2.7%
M	256 or greater	29	2.2%
TOTAL		**1,310**	**100.0%**
$\bar{X}$		163.6	-
σ		33.5	-

Finally, respondents were asked to indicate the registered owner of the vehicle most often used at present. The majority of respondents purported to be the registered owner (79%), with a further 13.8% owned by the respondent's spouse/partner. Remaining vehicles were split between a leasing organisation (2.6%); employer (2.3%); parents (2%); other family member (0.2%) or a friend (0.1%; ***Table 18***).

Table 18: Composition of the final sample's current vehicle by registered owner

Owner	n	%
Myself	1052	79.0%
My spouse/partner	184	13.8%
My parents	26	2.0%
Other family member	3	0.2%
Friend	2	0.1%
My employer	30	2.3%
Leasing organisation	34	2.6%
TOTAL	**1,331**	**100.0%**

4.3.3 Previous vehicle purchasing behaviour of the Scottish motoring population overall

Respondents were asked to indicate the change in engine size, physical size and fuel consumption from the vehicle prior to the current one driven most often and the current one. This would provide an indication of individuals' previous vehicle purchasing behaviour and previous transitions. 37 respondents indicated their current vehicle was their first and only vehicle. Such individuals therefore have no purchase history. For remaining respondents, the majority indicated their current vehicle was of very similar proportions as their previous one. Specifically, respondents currently drive a vehicle with a slightly smaller engine (3.9), in a slightly smaller sized car (3.9), consuming slightly less fuel (3.9; ***Table 19***).

Table 19: Change in vehicle characteristics for the vehicle most often used at present, relative to the previous vehicle

Degree of change*	Engine size	Vehicle size	Fuel consumption
$\bar{X}$	3.9	3.9	3.9
σ	1.5	1.4	1.6
n	1,274	1,259	1,234

** Where 1 = greatly reduced; 4 = the same; and 7 = greatly increased*

4.4 Sample characteristics, by strength of individuals' BI to purchase a lower emission vehicle in the future

The rationale and process for *a-priori* segmentation of the Scottish motoring population based on the strength of individuals' BI to purchase a lower emission vehicle in the future was considered in ***Section 3.19.3.1***. Results are shown in ***Figure 43***. Significance testing was used to explore the differences between the segments regarding socio-demographic factors and motoring behaviour. Chi-squared tests were used for categorical data and one-way ANOVAs were performed on continuous data.

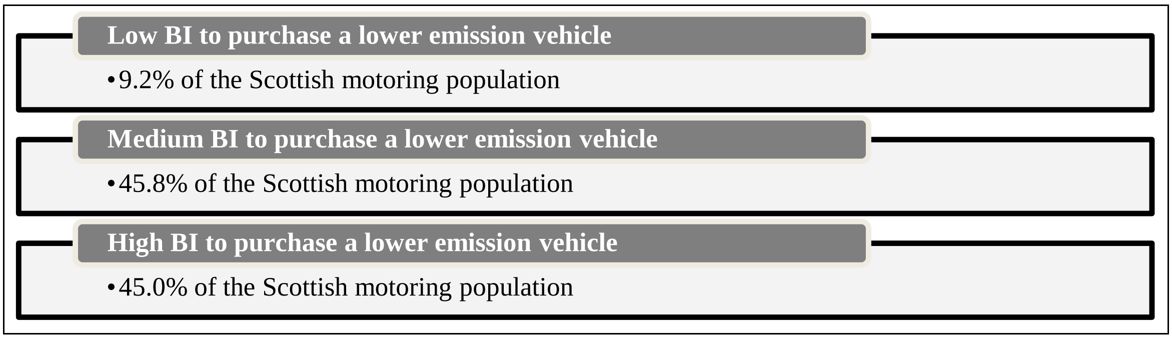
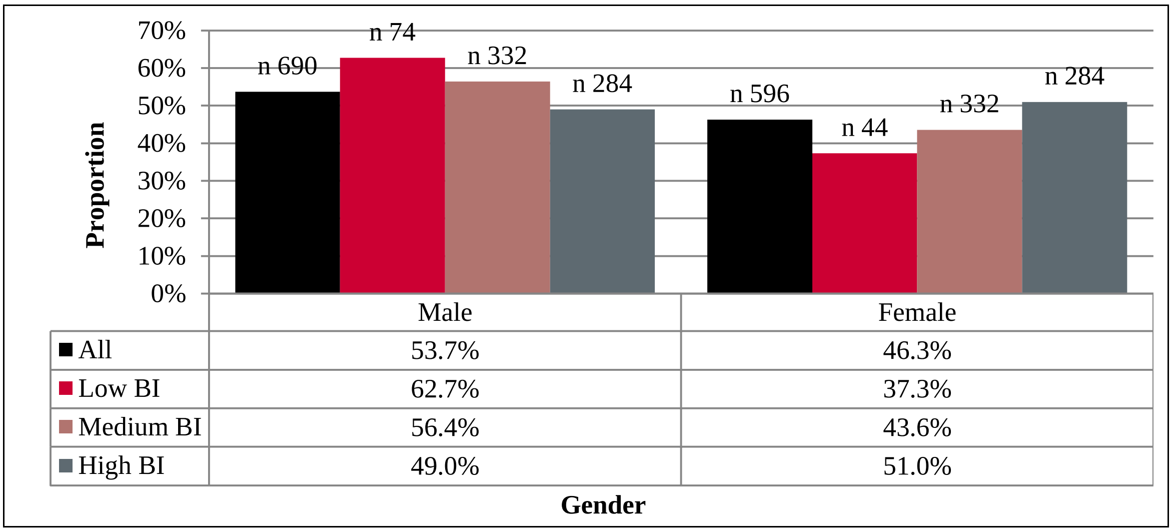


Figure 43: BI segments resulting from a-priori segmentation

4.4.1 Socio-demographic factors, by strength of individuals' BI to purchase a lower emission vehicle in the future

Socio-demographic factors are considered by strength of individuals' BI to purchase a lower emission vehicle in the future, including respondents' gender, age, household income before tax and six-fold urban/rural classification. This section will illustrate whether these underlying socio-demographic factors ultimately inform the strength of individuals' BI to purchase a lower emission vehicle in the future.

The results of the chi-squared test indicates a significant association between gender and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(2)=10.572$, $p<0.05$). A greater proportion of males had either a Low (+9%) or Medium BI (+2.7%). Conversely, more females have a High BI (+4.7%; ***Figure 44***).

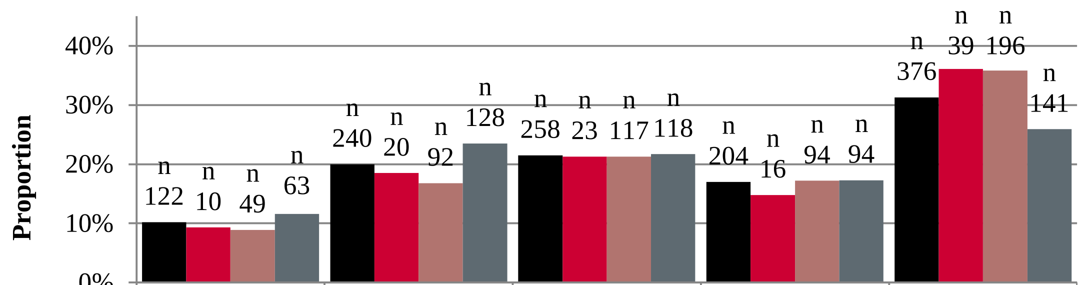


	Male	Female
All	53.7%	46.3%
Low BI	62.7%	37.3%
Medium BI	56.4%	43.6%
High BI	49.0%	51.0%

Figure 44: Gender distribution, by strength of individuals' BI to purchase a lower emission vehicle in the future

The result of the chi-squared test indicates no significant association between age and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(10)=16.630$, $p>0.05$). There was an increased proportion of Low BI individuals aged 25-34 years (+0.3%) and at least 60 years (+4.8%). For Medium BI individuals, there was a 0.2% greater share of those aged 24 years or less, a 4.1% larger proportion aged 35-44 years and a slightly bigger share aged at least 75 years (+0.2%). In contrast, High BI individuals have an increased share of motorists aged 34 years maximum (+0.7%), and 45-74 years (+3.8%)

The results of the chi-squared test indicates a significant association between household income before tax and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(8)=17.966$, $p<0.05$). Low BI individuals have a 4.8% larger share of motorists earning £40,001 minimum. For Medium BI individuals, there is a larger share of those earning £30,001 minimum (+4.7% collectively). In contrast, High BI individuals have a greater share of motorists earning £40,000 maximum (+5.4% collectively; ***Figure 45***).



	£10,000 or less	£10,001-£20,000	£20,001-£30,000	£30,001-£40,000	£40,001 or more
All	10.2%	20.0%	21.5%	17.0%	31.3%
Low BI	9.3%	18.5%	21.3%	14.8%	36.1%
Medium BI	8.9%	16.8%	21.3%	17.2%	35.8%
High BI	11.6%	23.5%	21.7%	17.3%	25.9%

Household income

Figure 45: Household income before tax, by strength of individuals' BI to purchase a lower emission vehicle in the future

The result of the chi-squared test indicates no significant association between the six-fold urban/rural classification and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(10)=8.966$, $p>0.05$). There is a greater share of Low BI individuals residing in urban and rural locations (+1.8% and +3.3% respectively). More

Medium BI individuals live in small towns and rural areas (+1.1% and 0.7% respectively). Conversely, High BI individuals more heavily populate urban locations (1.5%).

4.4.2 Current motoring behaviour, by strength of individuals' BI to purchase a lower emission vehicle in the future

Current motoring behaviour was also assessed by the strength of individuals' BI to purchase a lower emission vehicle in the future. This section includes consideration of the motorist themselves and the vehicle most often used at present. Relative to individuals' future vehicle purchasing decisions, this section will illustrate the influence of previous motoring behaviour upon the formation of individuals' BI to purchase a lower emission vehicle.

The result of the chi-squared test indicates no significant association between the number of years with a full driving-licence and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(10)=17.974$, $p>0.05$). Low BI individuals have a greater proportion of motorists holding their full driving-licence for 41 years minimum (+6.3%). Conversely, Medium BI individuals have a larger share of those possessing a full driving-licence for 11-30 years (3.1%) or 50 years minimum (+1.3%). However, High BI individuals have a greater share of motorists holding their full driving-licence for 10 years maximum (+0.9%) or 31-50 years (+4%).

The result of the chi-squared test indicates no significant association between the driving frequency and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(10)=12.647$, $p>0.05$). There is a greater proportion of Low BI individuals who drive daily (+6.9%) or less than once a month (+0.1%). There is a 1.1% larger share of those driving daily with a Medium BI, and those driving more than twice a week but at least once a month (+1.4%). In contrast, High BI individuals have a greater share of those driving three times a week minimum (+3.4%) or less than once a month (+0.2%).

The result of the chi-squared test indicates no significant association between annual mileage and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(12)=17.037$, $p>0.05$). There is a greater proportion of Low BI individuals driving 2,501-5,000 miles (+3.5%), 10,001-15,000 miles (+2.8%), and 20,001 minimum (+3.7%). Medium BI individuals have a greater share of those driving 2,501-5,000 miles (+1.4%) and 10,001-20,000 miles (+0.9%). Conversely, High BI individuals drive the least miles per year, specifically, 2,500 miles or less (+1.1%). Furthermore, High BI individuals have a 1.9% larger share of those driving 2,500 miles maximum (+1.1%), 5,001-10,000 miles (+1.9%), and 15,001-20,000 (+0.1%).

A one-way ANOVA was used to test the relationship between the engine size of the vehicle most often used at present and the strength of individuals' BI to purchase a lower emission vehicle in the future. A main effect was observed ($F(2,1230)=13.671$, $p<0.05$). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 20***). Low BI individuals currently drive a vehicle with an average 1.8 litre engine. This size of engine was identified as significantly greater than the Medium and High BI segments. In contrast, High BI individuals drive a vehicle with a significantly lower engine size (1.6 litres) than the Low and Medium BI segments. Medium BI individuals are thus mid-way between the other BI segments, with an average engine size of 1.7 litres.

Table 20: Engine size of the vehicle most often used at present, by strength of individuals' BI to purchase a lower emission vehicle in the future

	All		Strength of individuals' BI					
			Low BI (1)		Medium BI (2)		High BI (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
Engine size in litres	1,233	1.7 (0.5)	114	$1.8^{+2,+3}$ (0.6)	566	$1.2^{-1,+3}$ (0.5)	553	$1.6^{-1,-2}$ (0.4)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments (p<0.05) derived from Scheffé post-hoc tests.

The assumptions surrounding the chi-squared test were not satisfied to test the relationship between the fuel type/energy source of the vehicle most often used at present and the strength of individuals' BI to purchase a lower emission vehicle in the future. Low (+1.4%) or Medium BI individuals (+2.9%) have a greater share of vehicles fuelled by diesel. In contrast, High BI individuals have a larger proportion of vehicles utilising petrol (+2.9%) and other non-conventional energy sources. Specifically, 'petrol and electricity' and 'diesel and biofuel' (+0.1% for both).

The assumptions surrounding the chi-squared test were not satisfied to test the relationship between the transmission of the vehicle most often used at present and the strength of individuals' BI to purchase a lower emission vehicle in the future. There is an increased proportion of vehicles driven by Low (+3.7%) and Medium BI individuals (+1.2%) with an automatic transmission. There is also a 0.1% increased share of vehicles driven by Medium BI individuals with a semi-automatic transmission. In contrast, High BI individuals have a 2.2% greater proportion of vehicles with a manual transmission.

The result of the chi-squared test indicates no significant association between the age of the vehicle most often used at present and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(22)=30.318$, $p>0.05$). For Low BI individuals, there is a greater share of vehicles registered between March 2001 and February 2002 (+3.7%), March 2003 to February 2004 (+2.2%), March 2005 to February 2006 (+1.8%), and March 2008 to February 2010 (+4.8%). Medium BI individuals have a larger proportion of current vehicles registered between March 1999 and February 2001 (+1.2%), March 2006 to February 2009 (+4.1%) and March 2010 to February 2011 (+0.3%). Conversely, there was an increased proportion of High BI individuals currently driving a vehicle registered before March 1999 (+0.9%), between March 2001 and February 2003 (+2%), March 2004 to February 2006 (+0.9%) and March 2009 to February 2011 (+1.9%).

The result of the chi-squared test indicates no significant association between whether the vehicle most often used at present was acquired new or used and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(2)=5.044$, $p>0.05$). Results show an increased proportion of Low (2.4%) or Medium BI individuals who currently drive a used vehicle (+2.9%). In contrast, there is a greater share of High BI individuals currently driving a vehicle acquired new (+3.4%)[35].

A one-way ANOVA was used to test the relationship between the CO_2 emissions of the vehicle most often used at present and the strength of individuals' BI to purchase a lower emission vehicle in the future. A main effect was observed ($F(2,1259)=10.119$, $p<0.05$). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 21***). The average CO_2 emissions of the vehicle most often used by High BI individuals is 159.4g/km. This is significantly less than the CO_2 emitted by the vehicle most often used by Low or Medium BI individuals. On the other hand, Low BI individuals drive a significantly higher emitting vehicle than the other BI segments. The average CO_2 emissions of the vehicle most often used by Low BI individuals is 172.6g/km. Medium

[35] ***Section 4.3.2*** reported only 27 vehicles acquired through the UK SIS. Analysis of this figure according to strength of individuals' BI to purchase a LEV, and later by 'green' segment, was not undertaken due to insufficient numbers of applicable individuals.

BI individuals are thus mid-way between the other BI segments, with 165.6g/km of CO_2 emitted on average .

Table 21: CO_2 emissions of the vehicle most often used at present, by strength of individuals' BI to purchase a lower emission vehicle in the future

Grams of CO_2 emitted per vehicle kilometre	All		Strength of individuals' BI					
			Low BI (1)		Medium BI (2)		High BI (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
	1,262	163.5 (33.2)	117	172.7^{+3} (41.3)	577	165.6^{+3} (33.8)	568	$159.4^{-1,-2}$ (30.2)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments (p<0.05) derived from Scheffé post-hoc tests.

The assumptions surrounding the chi-squared test were not satisfied to test the relationship between the registered owner of the vehicle most often used at present and the strength of individuals' BI to purchase a lower emission vehicle in the future. There is a greater share of Low BI individuals using a vehicle owned by a leasing organisation (+3.3%), the respondent or their spouse/partner (+0.7% each). For Medium BI individuals, there is a larger proportion of vehicles owned by their spouse/partner (+1%), another family member excluding parent (+0.3%), a friend (+0.1%) or employer (+0.8%). For High BI individuals, there is a greater proportion of vehicles owned by the respondent (+1.1%) or their parents (+1%).

4.4.3 Previous vehicle purchasing behaviour, by strength of individuals' BI to purchase a lower emission vehicle in the future

Individuals' previous vehicle purchasing behaviour was also assessed by the strength of individuals' BI to purchase a lower emission vehicle in the future. That is, the change in engine size, physical size and fuel consumption from the vehicle prior to the current one driven most often and the current one. Akin to ***Section 4.4.2***, this section will illustrate the influence of previous motoring behaviour upon the formation of individuals' BI to purchase a lower emission vehicle.

A one-way ANOVA was used to test the relationship between individuals' previous vehicle purchasing behaviour and the strength of individuals' BI to purchase a lower emission vehicle in the future. No main effect was observed ($F(2,1227)=0.511$, $p>0.05$ for the change in engine size; $F(2,1213)=0.188$, $p>0.05$ for the change in vehicle size; and $F(2,1188)=0.660$, $p>0.05$ for the change in fuel consumption). Of those individuals who are currently driving their first vehicle, 1 has a Low BI, 20 have a Medium BI and 14 have a High BI to purchase a lower emission vehicle in the future. Of the remaining individuals with a purchase history, Medium BI individuals have experienced the greatest engine size (3.9; σ=1.5) and fuel consumption reduction (3.8; σ=1.5) relative to their previous vehicle most often used. Conversely, Low BI individuals underwent the smallest reduction for both vehicle attributes (4.0; σ=1.6 and 1.5 respectively). High BI individuals underwent an engine size and fuel consumption reduction mid-way between the other BI segments (3.9 for engine size and 3.9 for fuel consumption; σ=1.5 and 1.6 respectively). Regarding the change in vehicle size, High BI individuals have undergone the biggest reduction (3.9; σ=1.4). On the other hand, Medium BI individuals have down-sized the least (3.9; σ=1.4). Low BI individuals are thus mid-way between the other BI segments in terms of reducing their vehicle size from their previous to current vehicle (3.9; σ=1.4).

4.5 Sample characteristics, by 'green' segment within the Scottish motoring population

The justification and process for *post-hoc* segmentation of the Scottish motoring population by the situational and psychological factors informing individuals' future vehicle purchasing behaviour was considered in ***Section 3.19.3.2***. The results of cluster analysis were profiled for: socio-demographic factors; motoring behaviour, both past and present; situational factors of importance in individuals' future vehicle purchasing decisions; and psychological constructs regarding a future lower emission vehicle purchase. Significant differences between the three segments is shown in ***Figure 46***. Whilst cluster members share the same broad characteristics, all members are not necessarily identical.

Recognising the environmental underpinnings of this research, a 'green' theme was adopted in the naming process. Segments one and three appear to embody the two extremes on a 'green' scale, essentially representing opposites of one another. On that basis, segment one was named the No-Greens and segment three was named the Go-Greens. This was intended to represent their limited and plentiful environmental inclinations towards purchasing a lower emission vehicle in the future, plus a reflection of their existing motoring behaviour. The final segment, number two, appears to lie someway between the No-Greens and Go-Greens, for example regarding CO_2 emissions of their current vehicle and the majority of psychological constructs regarding a lower emission vehicle purchase. The main exception relates to situational factors, where the majority of factors are significantly more influential to segment two than both other segments. Nevertheless, environmental considerations are still most influential to the Go-Greens and thereby retain the previously assigned label. Recognising the characteristics of segment two, they were subsequently named the Maybe-Greens. Segment labels and their respective percentage membership is shown in ***Figure 47***.

Segment one

- More males and individuals earning at least £30,001 per year
- More individuals driving 2,501-5,000 miles or at least 7,500 miles per year in their current vehicle, which has greater CO_2 emissions and a larger engine than both other segments
- All situational factors are deemed less important in future vehicle purchasing decisions than segment two, whilst financial considerations (both at the time of purchase and in the future), fuel/performance, interior design features and environmental considerations are considered less important than segment three
- All psychological constructs are weaker than segment two, except for perceived behavioural control which is stronger for this segment. All psychological constructs are weaker relative to segment three.

Segment two

- More females and individuals earning a maximum of £10,000 or £20,001-30,000 per year
- More individuals driving a maximum of 5,000 miles per year in their current vehicle, which has CO_2 emissions and an engine greater in size than segment three, but less than segment one
- All situational factors are deemed more important in future vehicle purchasing decisions than segment one. Relative to segment three, future financial considerations, fuel/performance, load space, interior and exterior design features are deemed more important in their future vehicle purchasing decisions, whilst environmental considerations are less important
- All psychological constructs are stronger than segment one, except for perceived behavioural control which is weaker for this segment. All psychological constructs are weaker relative to segment three

Segment three

- More females and individuals earning a maximum of £20,000 per year
- More individuals driving a maximum of 2,501 miles or 5,001-10,000 miles per year in their current vehicle, which has lower CO_2 emissions and a smaller engine than both other segments
- Financial considerations (both at the time of purchase and in the future), fuel/performance, interior design features and environmental considerations are deemed more important in future vehicle purchasing decisions than segment one. Relative to segment two, future financial considerations, fuel/performance, load space, interior and exterior design features are less important, whilst environmental considerations are more important
- All psychological constructs are stronger than segments one and two

Figure 46: Significant differences in socio-demographic factors, current motoring behaviour and the influence of situational and psychological factors informing future vehicle purchasing behaviour across the segments identified from post-hoc segmentation

Significance testing was used to explore the differences between the segments regarding socio-demographic factors and motoring behaviour. Chi-squared tests were used for categorical data and one-way ANOVAs were performed on continuous data.

No-Greens (NG)
- 26.7% of the Scottish motoring population.

Maybe-Greens (MG)
- 33.7% of the Scottish motoring population.

Go-Greens (GG)
- 39.6% of the Scottish motoring population.

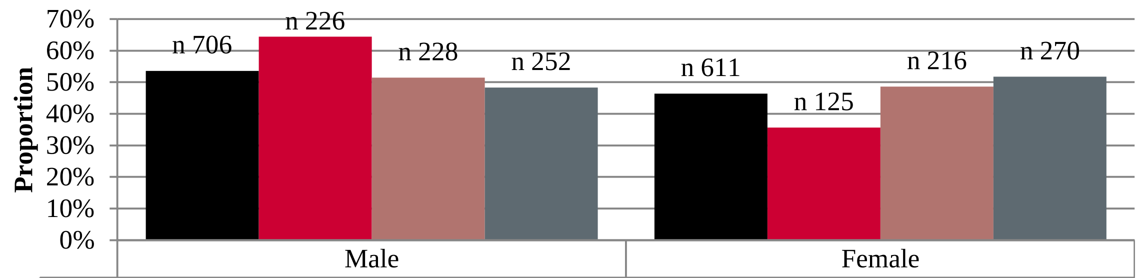
Note: The segments are abbreviated in subsequent tables and figures.

Figure 47: 'Green' segments resulting from post-hoc segmentation

4.5.1 Socio-demographic factors, by 'green' segment within the Scottish motoring population

The 'green' segments were first investigated regarding socio-demographic factors, including respondents' gender, age, household income before tax and six-fold urban/rural classification. This section will illustrate the influence of socio-demographic factors upon 'green' segment membership.

The results of the chi-squared test indicates a significant association between gender and the 'green' segments ($\chi^2(8)=17.966$, $p<0.05$). The No-Greens segment has a 10.8% greater share of males. Conversely, the Maybe-Greens (+2.2%) and the Go-Greens (+5.3%) have a greater proportion of females (***Figure 48***).



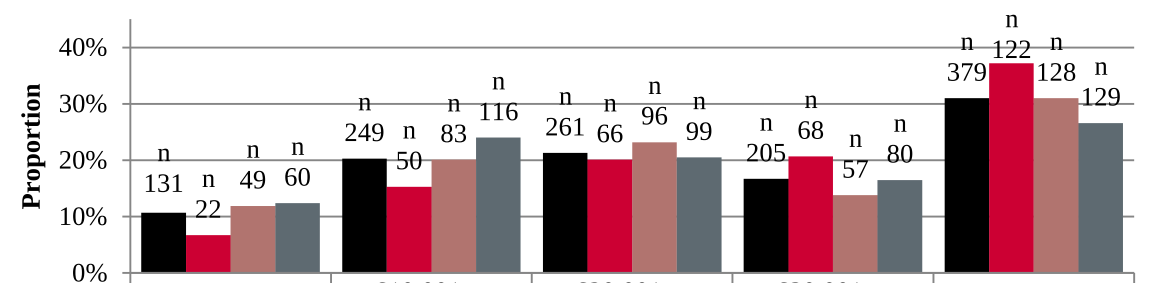
	Male	Female
All	53.6%	46.4%
NG	64.4%	35.6%
MG	51.4%	48.6%
GG	48.3%	51.7%

Gender

Figure 48: Gender distribution, by 'green' segment

The result of the chi-squared test indicates no significant association between age and the 'green' segments ($\chi^2(10)=9.457$, $p>0.05$). The No-Greens have a greater proportion of individuals aged 35-59 years of age (+6%). In contrast, the Maybe-Greens have a greater share of individuals in all age groups except those aged 45-59 years. Particularly, there is a 1.1% greater share of the Maybe-Greens aged 35-44 years. Finally, the Go-Greens have a greater proportion of individuals aged 34 years maximum (+1.2%) and those aged 60-74 years (+1.8%).

The results of the chi-squared test indicates a significant association between household income before tax and the ‘green’ segments ($\chi^2(8)=27.450$, $p<0.05$). The No-Greens have a larger proportion of individuals with annual household income before tax of £30,001 minimum (+10.2%). In contrast, the Go-Greens segment has a 5.4% bigger share of individuals with earnings of £20,000 maximum. Moreover, the Maybe-Greens have a greater proportion of individuals earning £10,000 maximum (+1.2%) and those earning £20,001-£30,000 (+1.9%; ***Figure 49***).



	£10,000 or less	£10,001 to £20,000	£20,001 to £30,000	£30,001 to £40,000	£40,001 or more
All	10.7%	20.3%	21.3%	16.7%	31.0%
NG	6.7%	15.3%	20.1%	20.7%	37.2%
MG	11.9%	20.1%	23.2%	13.8%	31.0%
GG	12.4%	24.0%	20.5%	16.5%	26.6%

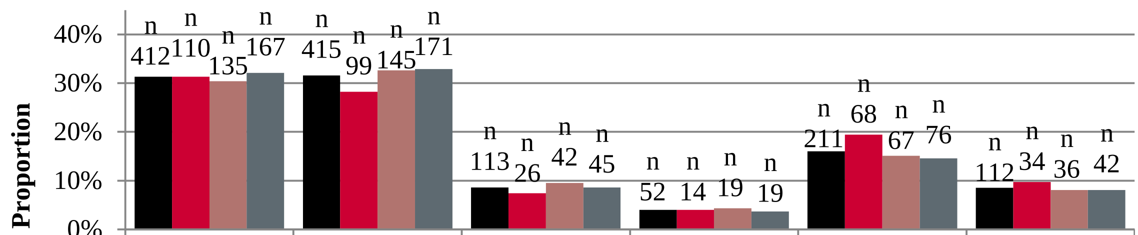
Household income

Figure 49: Household income before tax, by ‘green’ segment

The result of the chi-squared test indicates no significant association between the six-fold urban/rural classification and the ‘green’ segments[36] ($\chi^2(10)=7.244$, $p>0.05$). The No-

[36] The statistics presented in ***Chapter 1*** identified differences in vehicle ownership, accessibility and full driving-licence holdership according to urban/rural locations across Scotland. It could thus be anticipated that differences would be observed between the ‘green’ segments regarding the urban/rural classification. The qualitative findings documented in ***Appendix A5.6*** verify the greater need for a vehicle in rural locations. Whilst past research focusing upon car ownership in Scotland indicates a greater concentration of vehicles in rural areas (Farrington, 1995; Farrington *et al.*, 1998; Gray *et al.*, 2001), their findings do not indicate vehicle characteristics such as CO_2 emissions. It is thus interesting to note that significant differences were not visible in the quantitative results between the ‘green’ segments and geography. The wide range of vehicles potentially qualifying as a lower emission vehicle can perhaps explain this observation. As documented in ***Chapter 1***, any vehicle emitting even one gram of CO_2 less than their current vehicle used most often meets the definition. The ability for Scottish individuals to purchase such a vehicle should therefore not be impeded by location. The only potential issue lies with AFVs, recognising the lack of supporting infrastructure especially in rural locations. This limitation is indeed recognised in the qualitative findings (***Appendix A5.6***). Recognising that conventional internal combustion engines are expected to remain the dominant powertrain until at least 2030 (Kay *et al.*, 2013), the potential for lower emission vehicle uptake in rural locations should not be inhibited to a large extent.

Greens have a greater proportion of individuals residing in rural locations, both accessible (+3.4%) and remote (+1.2%). Conversely, the Go-Greens have an increased share of individuals in urban areas, including large (+0.8%) and other urban locations (+1.3%). Finally, there is a larger share of Maybe-Greens inhabiting small towns, both accessible (+0.9%) and remote (+0.3%) and living in other urban areas (+1%; ***Figure 50***).



	Large urban area	Other urban area	Accessible small town	Remote small town	Accessible rural area	Remote rural area
■ All	31.3%	31.6%	8.6%	4.0%	16.0%	8.5%
■ NG	31.3%	28.2%	7.4%	4.0%	19.4%	9.7%
■ MG	30.4%	32.6%	9.5%	4.3%	15.1%	8.1%
■ GG	32.1%	32.9%	8.6%	3.7%	14.6%	8.1%

Urban/rural classification

Figure 50: Urban/rural classification, by 'green' segment

4.5.2 Current motoring behaviour, by 'green' segment within the Scottish motoring population

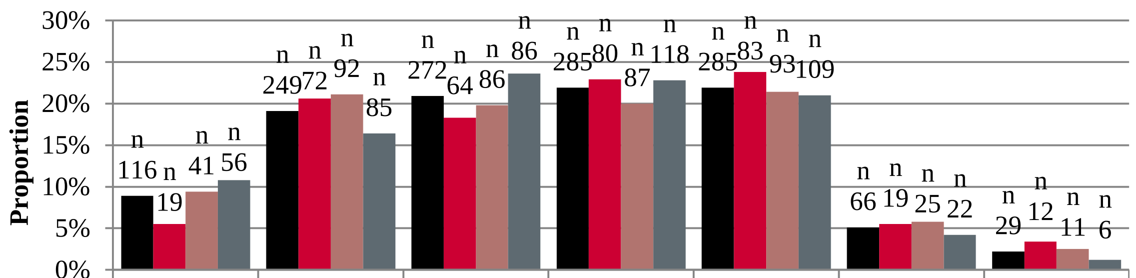
Current motoring behaviour was also assessed for the 'green' segments. This section considers both the motorist and the vehicle most often used at present. This section will evaluate the influence of previous motoring behaviour, relative to individuals' future vehicle purchasing decisions, upon 'green' segment membership.

The result of the chi-squared test indicates no significant association between the number of years with a full driving-licence and the 'green' segments ($\chi^2(10)=13.265$, $p>0.05$). The No Greens have an increased proportion of individuals holding their full driving-licence 21-30 years (+2.1%) or 50 years minimum (+2.5%). The Maybe-Greens have an increased share of those holding a driving-licence 11-20 years (+1.6%), 31-40 years (+0.1%), and 50 years minimum (+1.2%). In contrast, the Go-Greens have a greater proportion of individuals holding their driving-licence for 10 years maximum (+1.6%), 21-30 years (+0.3%) and 41-50 years (+1.8%).

The result of the chi-squared test indicates no significant association between the driving frequency and the 'green' segments ($\chi^2(10)=11.112$, $p>0.05$). A greater share of the No-

Greens drive every day (+3.3%), once or twice a week (+1%) or once a week minimum (+0.2%). Conversely, the Maybe-Greens have an increased proportion who drive daily (+1.7%) or less than once a month (+0.1%). Finally, the Go-Greens have a greater share who drive at least two or three times a month, but less than seven days a week (+3.6%) and a 0.2% larger proportion of individuals driving less than once a month.

The result of the chi-squared test indicates a significant association between the extent of annual mileage and the ‘green’ segments ($\chi^2(12)=21.561$, $p<0.05$). The No-Greens have a larger proportion of motorists driving 2,501-5,000 miles per year (+1.5%) and at least 7,500 miles (+4.5%). In contrast, the Maybe-Greens have an increased share of individuals driving 5,000 miles maximum per year (+2.5%) and driving 15,001 miles minimum (+1%). The Go-Greens have a 1.9% greater proportion of motorists driving 2,500 miles per annum maximum, but also a bigger share driving 5,001-10,000 miles (+3.6%; ***Figure 51***).



	2500 or less	2501-5000	5001-7500	7501-10000	10001-15000	15001-20000	20001+
■ All	8.9%	19.1%	20.9%	21.9%	21.9%	5.1%	2.2%
■ NG	5.5%	20.6%	18.3%	22.9%	23.8%	5.5%	3.4%
■ MG	9.4%	21.1%	19.8%	20.0%	21.4%	5.8%	2.5%
■ GG	10.8%	16.4%	23.6%	22.8%	21.0%	4.2%	1.2%

Annual mileage

Figure 51: Annual mileage for private purposes, by ‘green’ segment

A one-way ANOVA was used to test the relationship between the engine size of the vehicle most often used at present and the ‘green’ segments. A main effect was observed ($F(2,1257)=30.449$, $p<0.05$). Scheffé *post-hoc* tests were used to explore the differences between the ‘green’ segments (***Table 22***). The No-Greens currently drive a vehicle with an average 1.8 litre engine, which is significantly greater than the vehicle driven by the other two segments. Conversely, the Go-Greens typically drive a vehicle with a significantly lower engine size than both other ‘green’ segments, averaging 1.6 litres. The Maybe-Greens are therefore mid-way between the other ‘green’ segments, with an average engine size of 1.7 litres.

Table 22: Engine size of the vehicle most often used at present, by 'green' segment

Engine size in litres	All		'Green' segments					
			NG (1)		MG (2)		GG (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
	1,260	1.7 (0.5)	340	1.8 $^{+2,+3}$ (0.6)	424	1.7 $^{-1,+3}$ (0.4)	496	1.6 $^{-1,-2}$ (0.4)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other 'green' segments (p<0.05) derived from Scheffé post-hoc tests.

The assumptions surrounding the chi-squared test were not satisfied to test the relationship between the fuel type/energy source of the vehicle most often used at present and the 'green' segments. A greater proportion of the No-Greens (+6.1%) and the Maybe-Greens (+0.3%) currently drive a vehicle fuelled by diesel. In contrast, the Go-Greens have an increased share of individuals driving a vehicle fuelled by petrol (+3.9%) or an alternative fuel source, i.e. petrol and electricity (+0.3%) or diesel and biofuels (+0.1%).

The assumptions surrounding the chi-squared test were not satisfied to test the relationship between the transmission of the vehicle most often used at present and the 'green' segments. There is an increased share of the No-Greens and the Maybe-Greens who drive a vehicle with either an automatic (+4.0% and +0.4% respectively) or semi-automatic (+0.1% and +0.3% respectively) transmission. Conversely, there is a 3.2% greater proportion of the Go-Greens who drive a manual vehicle.

The result of the chi-squared test indicates no significant association between the age of the vehicle most often used at present and the 'green' segments ($\chi^2(22)=28.181$, $p>0.05$). The No-Greens have a greater share of vehicles registered February 2001 or earlier (+3.8%), between March 2003 and February 2005 (+2.8%), and March 2010 to February 2011 (+0.1%). The Maybe-Greens have a greater concentration of vehicles registered between March 2005 and February 2009 (+4.6%) and March 2010 to February 2011 (+1.4%). Finally, the Go-Greens have an increased proportion of vehicles registered between March 2001 and February 2003 (+1.8%), March 2004 to February 2007 (+2.5%), and March 2009 to February 2010 (+1.3%).

The result of the chi-squared test indicates no significant association between whether the vehicle most often used at present was acquired new or used and the 'green' segments ($\chi^2(2)=4.444$, >0.05). The No-Greens have a 4.7% greater share of individuals currently driving a used vehicle. In contrast, the Maybe-Greens (+1.8%) and Go-Greens (+1.7%) have a greater proportion of new vehicles.

A one-way ANOVA was used to test the relationship between the CO_2 emissions of the vehicle most often used at present and the 'green' segments. A main effect was observed ($F(2,1289)=21.890$, $p<0.05$). Scheffé *post-hoc* tests were used to explore the differences between the 'green' segments (***Table 23***). The average CO_2 emissions of the vehicle most often used by the No-Greens is 172.3g/km. This was found to be significantly higher than the vehicle driven by both other 'green' segments. Conversely, the Go-Greens most often drive a significantly lower emitting vehicle than the other 'green' segments. The average CO_2 emissions of the vehicle most often used by the Go-Greens is 157.3g/km. The Maybe-Greens are thus mid-way between the other 'green' segments, with 164.2g/km of CO_2 emitted on average.

Table 23: CO_2 emissions of the vehicle most often used at present, by 'green' segment

Grams of CO_2 emitted per vehicle kilometre	All		'Green' segments					
			NG (1)		MG (2)		GG (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
	1292	163.7 (33.5)	346	172.3 $^{+2,+3}$ (40.1)	434	164.2 $^{-1,+3}$ (30.6)	512	157.3 $^{-1,-2}$ (29.6)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other 'green' segments (p<0.05) derived from Scheffé post-hoc tests.

The assumptions surrounding the chi-squared test were not satisfied to test the relationship between the registered owner of the vehicle most often used at present and the 'green' segments. The No-Greens have a greater proportion of vehicles owned by the respondent (+2.3%), another family member excluding their spouse/partner or parents (+0.3%), or a lessor (+0.6%). In contrast, the Maybe-Greens have an increased share of vehicles owned by their employer (+1.1%), a friend (+0.4%) or their spouse/partner (+2.1%). The Go-Greens have a larger proportion of vehicles where the registered owner is the respondent (+1.3%) or their parents (+0.9%).

4.5.3 Previous vehicle purchasing behaviour, by 'green' segment within the Scottish motoring population

Individuals' previous vehicle purchasing behaviour was also assessed for the 'green' segments. Specifically, the change in engine size, physical size and fuel consumption from the vehicle prior to the current one driven most often and the current one. This section will illustrate the influence of previous motoring behaviour upon 'green' segment membership.

A one-way ANOVA was used to test the relationship between individuals' past vehicle purchasing behaviour and the 'green' segments. No main effect was observed ($F(2,1255)=0.736$, $p>0.05$ for the change in engine size; $F(2,1240)=2.887$, $p>0.05$ for the change in vehicle size; and $F(2,1215)=1.436$, $p>0.05$ for the change in fuel consumption). Of the motorists currently driving their first vehicle: 6 were members of the No-Greens segment; 9 were Maybe-Greens; and 22 were Go-Greens. Of the remaining individuals with a purchase history, the Go-Greens have undergone the greatest reduction in engine size (3.9; $\sigma=1.5$), vehicle size (3.8; $\sigma=1.4$) and fuel consumption (3.8; $\sigma=1.6$). Conversely, the smallest reduction was undertaken by the Maybe-Greens for engine size (4.0; $\sigma=1.5$) and vehicle size (4.0; $\sigma=1.4$). The No-Greens and the Maybe-Greens underwent an identical fuel consumption reduction (3.9; $\sigma=1.5$ and 1.6 respectively). The No-Greens are therefore mid-way between the other 2 segments regarding the engine (3.9; $\sigma=1.5$) and vehicle size reduction (3.9; $\sigma=1.4$).

4.6 Chapter 4 summary

This chapter presented a profile of socio-demographic factors and motoring behaviour of the sample of Scottish motorists acquired for data collection. The following key points were considered:

- A sample of 1,336 Scottish motorists was acquired from the researcher's questionnaire survey, equating a response rate of almost 30%;
- The sample contains slightly more males, with more individuals aged 45-74 years, earning over £40,000 per annum, residing in urban Scottish locations;
- The majority of motorists drive frequently, both in terms of regularity and distance travelled. The average vehicle most often used at present has a 1.7 litre engine, emitting 164g/km of CO_2, fuelled by petrol, which was acquired used;
- *A-priori* segmentation resulted in the motoring population being grouped according to individuals with a Low, Medium and High BI to purchase a lower emission vehicle in the future. *Post-hoc* segmentation resulted in the classification of No-Greens, Maybe-Greens and Go-Greens;
- Across the segments, differences were observed regarding socio-demographic factors and motoring behaviour. For example, Low BI individuals and the No-Greens were found to have significantly higher household income than High BI individuals and the Go-Greens. Furthermore, the vehicle used most often at present

by Low BI individuals and the No-Greens has significantly higher CO_2 emissions than High BI individuals and the Go-Greens.

5 RESULTS: THE IMPORTANCE OF SITUATIONAL AND PSYCHOLOGICAL FACTORS INFORMING INDIVIDUALS' FUTURE VEHICLE PURCHASING DECISIONS

5.1 Chapter overview

This chapter presents the results of the questionnaire survey necessary to address the first research question. Specifically, the importance of situational and psychological factors in individuals' future vehicle purchasing decisions. A revised behavioural model demonstrating individuals' future vehicle purchasing decisions for the Scottish motoring population is also presented. Results are documented for the Scottish motoring population overall, and split according to the strength of individuals' BI to purchase a lower emission vehicle in the future and the 'green' segments derived by the factors shaping individuals' future vehicle purchasing behaviour.

5.2 Importance of situational and psychological factors in individuals' future vehicle purchasing decisions for the Scottish motoring population overall

Respondents were asked to indicate, measured on 7-point Likert scales, the importance of situational and psychological factors in their future vehicle purchasing decisions. This section will provide an understanding of future vehicle purchasing behaviour and the factors shaping vehicle choice.

5.2.1 Situational factors of importance in individuals' future vehicle purchasing decisions for the Scottish motoring population overall

Financial considerations appear twice in the top three factors of most importance. Specifically, value for money (6.3), condition of a used vehicle (6.3) and vehicle price (6.2). Aspects relating to fuel consumption (6.1) are also important, including the financial implications (fuel economy; 6.2). Vehicle safety features and anticipated maintenance/repair costs are considered important (both 6.0). Further financial considerations are recognised, including: vehicle insurance group (5.8); taxation (purchase taxes had slightly more weighting with 5.8 compared to circulation taxes at 5.6); and warranty (5.6). Considerations of vehicle performance/driveability (5.8), mileage for used vehicles (5.7) and security features (5.5) are also prominent. All three environmental considerations were reported of equal importance, i.e. vehicle noise, CO_2

and other GHG emissions and air pollution (5.3). Remaining factors scoring greater than 5 relate to vehicle attributes. Namely, engine type and size (5.2); fuel type (5.2); luggage and storage space (5.1); vehicle body shape (5.1); vehicle size (5.1); and passenger capacity (5.0). The remaining 9 factors scored less than 5. Namely: future anticipated trade-in value (4.9); style/appearance/colour (4.7); vehicle model (4.7); manufacturer (4.6); finance deals (4.5); entertainment system (4.2); and acceleration time (4.0). Recognising 4 as the mid-point of the 7-point scale, only 2 situational factors are under this threshold, i.e. vehicle equipment levels (3.8) and the company car tax system (2.7; ***Table 24***).

5.2.2 Factor analysis of situational factors of importance in individuals' future vehicle purchasing decisions

Details of the factor analysis conducted were documented in ***Section 3.19.2***. The process resulted in 7 situational factors, compared to the original 32 variables. Factor profiles were derived by the variables loading most heavily onto each factor. A cut-off rate for each component was decided to eliminate those variables with an insufficient weighting upon the factors. The criterion is somewhat arbitrary, potentially ranging from 0.3-0.5 (Dancey and Reidy, 2007). Recognised as one of the most common approaches, a threshold of 0.4 was adopted (Hair *et al*., 1984; Stevens, 2002). When a variable loaded onto more than one factor, it was assigned to the one with the heaviest loading (advocated by Dancey and Reidy (2007). After consideration of communality between the variables, the seven factors were subsequently named (***Table 25***).

Based on composite scores for the extracted factors, financial considerations at the time of purchase are of greatest importance in individuals' future vehicle purchasing decisions (6.1). Considerations relating to fuel and performance are the second most important (5.7), followed by future financial considerations (5.6). Environmental considerations are ranked fourth most important (5.3), followed by vehicle load space for passengers and cargo (5.2). The two least important factors relate to the vehicle's design, both external (4.8) and internal (4.7; ***Table 26***).

Table 24: Ranked importance of 32 situational factors in individuals' future vehicle purchasing decisions

Rank	Situational factors	n	$\bar{X}$*	σ
1	Value for money	1,314	6.3	0.9
2	Overall vehicle condition (used vehicle only)	1,176	6.3	1.0
3	Vehicle price	1,322	6.2	1.1
4	Fuel economy	1,321	6.2	1.1
5	Fuel consumption/MPG	1,316	6.1	1.2
6	Safety features	1,314	6.0	1.3
7	Maintenance/repair costs	1,308	6.0	1.2
8	Insurance group for the vehicle	1,309	5.8	1.3
9	Performance/driveability	1,305	5.8	1.3
10	VAT and other purchase taxes	1,286	5.8	1.5
11	Vehicle mileage (used vehicle only)	1,172	5.7	1.4
12	Biannual/annual VED	1,300	5.6	1.5
13	Vehicle warranty	1,303	5.6	1.5
14	Security features	1,304	5.5	1.5
15	Vehicle noise	1,301	5.3	1.5
16	Vehicle emissions of CO_2 & other GHGs	1,299	5.3	1.5
17	Vehicle emissions of other air pollutants	1,290	5.3	1.5
18	Engine type/size	1,296	5.2	1.5
19	Fuel type	1,309	5.2	1.7
20	Luggage/storage space	1,307	5.1	1.5
21	Vehicle body shape	1,301	5.1	1.6
22	Vehicle size	1,299	5.1	1.5
23	Passenger capacity	1,304	5.0	1.5
24	Trade-in value	1,231	4.9	1.8
25	Style/appearance/colour	1,303	4.7	1.7
26	Vehicle model	1,305	4.7	1.8
27	Vehicle make	1,304	4.6	1.9
28	Finance deals	1,210	4.5	2.3
29	Entertainment levels	1,305	4.2	1.7
30	Acceleration time	1,295	4.0	1.7
31	Equipment levels	1,297	3.8	1.7
32	Company car tax bands	761[37]	2.7	2.3

** Where 1 = not important; and 7 = very important*

[37] The number of missing values for 'company car tax bands' is notably high at 575. As a crude comparator, only 30 current vehicles are owned by an employer (***Table 18***). The quantity of individuals selecting N/A was expected by the researcher to be somewhat higher. That is, unless an exceptionally large number of individuals are expecting their next vehicle to come from their employer. Instead, almost 60% of valid responses awarded a score of 1, whereby indicating the company car tax system was of no importance. This is abnormally high relative to other factors. This therefore pulled the mean score down to only 2.7 (***Table 24***). This leads to the suggestion that perhaps the N/A option was under-utilised and the mean score has unjustly been brought down.

Table 25: Results of factor analysis

Factor label and components	Factor loading	Variance explained	Cronbach's alpha*
Future financial considerations: financial implications for the motorist, occurring away from the time of vehicle purchase		10.6%	0.8
• Insurance group for the vehicle;	0.7		
• Maintenance/repair costs;	0.7		
• Vehicle warranty;	0.7		
• Biannual/annual road tax;	0.7		
• Trade-in value.	0.5		
Exterior design features: concerned with the physical characteristics of the vehicle, but only those specific to the exterior		10.2%	0.8
• Vehicle model;	0.9		
• Vehicle make;	0.9		
• Vehicle size;	0.5		
• Style/appearance/colour.	0.5		
Interior design features: interior aspects of the vehicle		9.8%	0.7
• Security features;	0.7		
• Equipment levels;	0.7		
• Safety features;	0.7		
• Entertainment levels;	0.6		
• Acceleration time.	0.5		
Environmental considerations: environmental performance of the vehicle		9.0%	0.9
• Vehicle emissions of other air pollutants;	0.9		
• Vehicle emissions of CO_2 & other GHGs;	0.9		
• Vehicle noise.	0.7		
Fuel and performance: the physical running of the vehicle		7.7%	0.8
• Fuel consumption/MPG;	0.8		
• Fuel type;	0.6		
• Fuel economy;	0.5		
• Performance/driveability;	0.5		
• Engine type/size.	0.5		
Load space: size and capacity of the vehicle for both occupants and their personal belongings/luggage		7.6%	0.8
• Luggage/storage space;	0.8		
• Passenger capacity;	0.8		
• Vehicle body shape.	0.6		
Financial considerations at purchase: financial considerations at the time of vehicle purchase		5.9%	0.7
• Vehicle price;	0.8		
• Value for money;	0.7		
• VAT and other purchase taxes.	0.6		

* *Cronbach's alpha was discussed earlier in* **section 3.19.2.4**.

Table 26: Ranked importance of seven situational factors in individuals' future vehicle purchasing decisions

Rank	Situational factors	n	$\bar{X}$*	σ
1	Financial considerations at purchase	1,024	6.1	1.0
2	Fuel and performance		5.7	0.9
3	Future financial considerations		5.6	1.1
4	Environmental considerations		5.3	1.4
5	Load space		5.2	1.2
6	Exterior design features		4.8	1.4
7	Interior design features		4.7	1.1

** Where 1 = not important; and 7 = very important*

5.2.3 Psychological constructs informing individuals' future vehicle purchasing decisions for the Scottish motoring population overall

When considering the psychological factors informing individuals' future vehicle purchasing decisions, the BI construct was isolated from the ranking (***Table 27***). This decision recognises the MaxSem model, where all preceding constructs ultimately contribute towards the formation of individuals' BI (***Figure 18***; MAX Success, 2009d; Bamberg *et al*., 2011).

Table 27: Ranked strength of psychological constructs in individuals' future vehicle purchasing decisions

Rank	Psychological constructs	n	$\bar{X}$*	σ
-	BI	1,286	5.4	1.2
	↓			
1	Attitude	1,254	5.6	1.7
2	Perceived goal feasibility	1,226	5.4	1.5
3	Perceived responsibility	1,271	5.3	1.7
4	Perceived negative consequences	1,249	5.2	1.7
5	Personal norms	1,236	5.1	1.7
6	Negative affect	1,252	4.7	1.7
7	Perceived behavioural control	1,163	4.7	1.7
8	Goal intention	1,165	4.7	1.6
9	Social norms	1109	4.4	1.6
10	Emotions	1243	3.8	1.8

** Where 1 is 'weak' and 7 is 'strong'*

Results show individuals' BI to purchase a lower emission vehicle is relatively strong (5.4 out of 7.0). Regarding the strength of the informing psychological constructs, attitudes are the strongest influence of individuals' future vehicle purchasing decisions (5.6). Perceived goal feasibility (5.4) and perceived responsibility (5.3) are the next most influential, followed by perceived negative consequences (5.2) and personal norms (5.1). Remaining constructs scored less than 5.0, specifically: negative affect (4.7); perceived behavioural control (4.7); goal intention (4.7); social norms (4.4); and the weakest construct of emotions (3.8).

5.2.4 Situational factors and psychological constructs of importance/influence in individuals' future vehicle purchasing decisions for the Scottish motoring population overall

Lane and Potter (2007) recognise both situational and psychological factors as informing individuals' vehicle purchasing behaviour. The revised ranking (***Table 28***) indicates the dominance of situational factors in the top three most influential factors. Specifically, financial considerations at purchase (6.1), fuel/vehicle performance (5.7) and anticipated future financial costs (5.6). The next three ranked factors are psychological in nature, i.e. attitudes (5.6), perceived goal feasibility (5.4) and perceived responsibility (5.3). There is a greater integration of situational and psychological factors in the rest of the ranking. That is, environmental properties (5.3); perceived negative consequences (5.2); load space (5.2); personal norms (5.1); exterior design features (4.8); perceived behavioural control (4.7); goal intention (4.7); negative affect (4.7); interior design features (4.7); social norms (4.4); and finally emotions (3.8).

5.2.5 Revised behavioural model capturing the factors of importance/influence in individuals' future vehicle purchasing decisions for the Scottish motoring population overall

A revised conceptualisation of individuals' vehicle purchasing behaviour was produced based on the results of this research. This aimed to develop upon the weaknesses of the Lane and Potter (2007) model. The revised model seeks to capture the inherent ranking of situational and psychological factors, missing from the Lane and Potter (2007) model. A new classification of situational factors arose from this research to be incorporated in a revised behavioural model. Furthermore, the psychological constructs identified by the MaxSem model can also be integrated. The revised model included all factors except BI. Recognising the MaxSem model, BI would be classed as the dependent variable, where all the other factors ultimately inform the strength of individuals' BI to purchase a lower emission vehicle.

Table 28: Ranked importance of situational and psychological factors in individuals' future vehicle purchasing decisions

Rank	Type	Factors	n	$\bar{X}$*	σ
-	Psychological	BI	1,286	5.4	1.2
		↓			
1	Situational	Financial considerations at purchase	1,024	6.1	1.0
2	Situational	Fuel and performance	1,024	5.7	0.9
3	Situational	Future financial considerations	1,024	5.6	1.1
4	Psychological	Attitude	1,254	5.6	1.7
5	Psychological	Perceived goal feasibility	1,226	5.4	1.5
6	Psychological	Perceived responsibility	1,271	5.3	1.7
7	Situational	Environmental considerations	1,024	5.3	1.4
8	Psychological	Perceived negative consequences	1,249	5.2	1.7
9	Situational	Load space	1,024	5.2	1.2
10	Psychological	Personal norms	1,236	5.1	1.7
11	Situational	Exterior design features	1,024	4.8	1.4
12	Psychological	Perceived behavioural control	1,163	4.7	1.7
13	Psychological	Goal intention	1,165	4.7	1.6
14	Psychological	Negative affect	1,252	4.7	1.7
15	Situational	Interior design features	1,024	4.7	1.1
16	Psychological	Social norms	1,109	4.4	1.6
17	Psychological	Emotions	1,243	3.8	1.8

** Where 1 is 'weak/not important' and 7 is 'strong/very important'*

To illustrate the relative importance/influence of situational and psychological factors, the length of the arrows feeding into individuals' vehicle purchasing behaviour was used. Specifically: the smaller the arrow, the less important/influential the construct is towards individuals' vehicle purchasing behaviour; and the longer the arrow, the more important/influential. Furthermore, average scores for situational and psychological constructs were classified for 'low', 'medium' and 'high' importance/influence. This taxonomy was colour co-ordinated for ease of understanding. The same logic as the earlier classification of individuals' BI to purchase a lower emission vehicle was applied for the revised behavioural model (***Figure 52***).

The Borthwick 'wheel' demonstrating individuals' future vehicle purchasing behaviour is shown in ***Figure 53***. The black inner circle represents individuals' vehicle purchasing behaviour. The three black rings mark the boundaries for the 'low', 'medium' and 'high' classification measured on a 7-point Likert scale. Situational and psychological factors are presented in descending order from financial considerations at purchase at the top, clockwise to emotions. Green coloured constructs reaching the outer circle were of high importance/influence. Grey constructs reaching the middle circle were of medium importance/influence. Constructs located entirely in the inner circle in dark red were of low importance/influence. To enhance the model, the distinction between situational and psychological factors was included towards the centre of the model, denoted by 'S' and 'P' respectively.

Low importance/influence
- 1.0-3.9 inclusive.

Medium importance/influence
- 4.0-5.5 inclusive.

High importance/influence
- 5.6-7.0 inclusive.

Figure 52: Low, medium and high classification of individuals' BI to purchase a lower emission vehicle in the future for the revised behavioural model

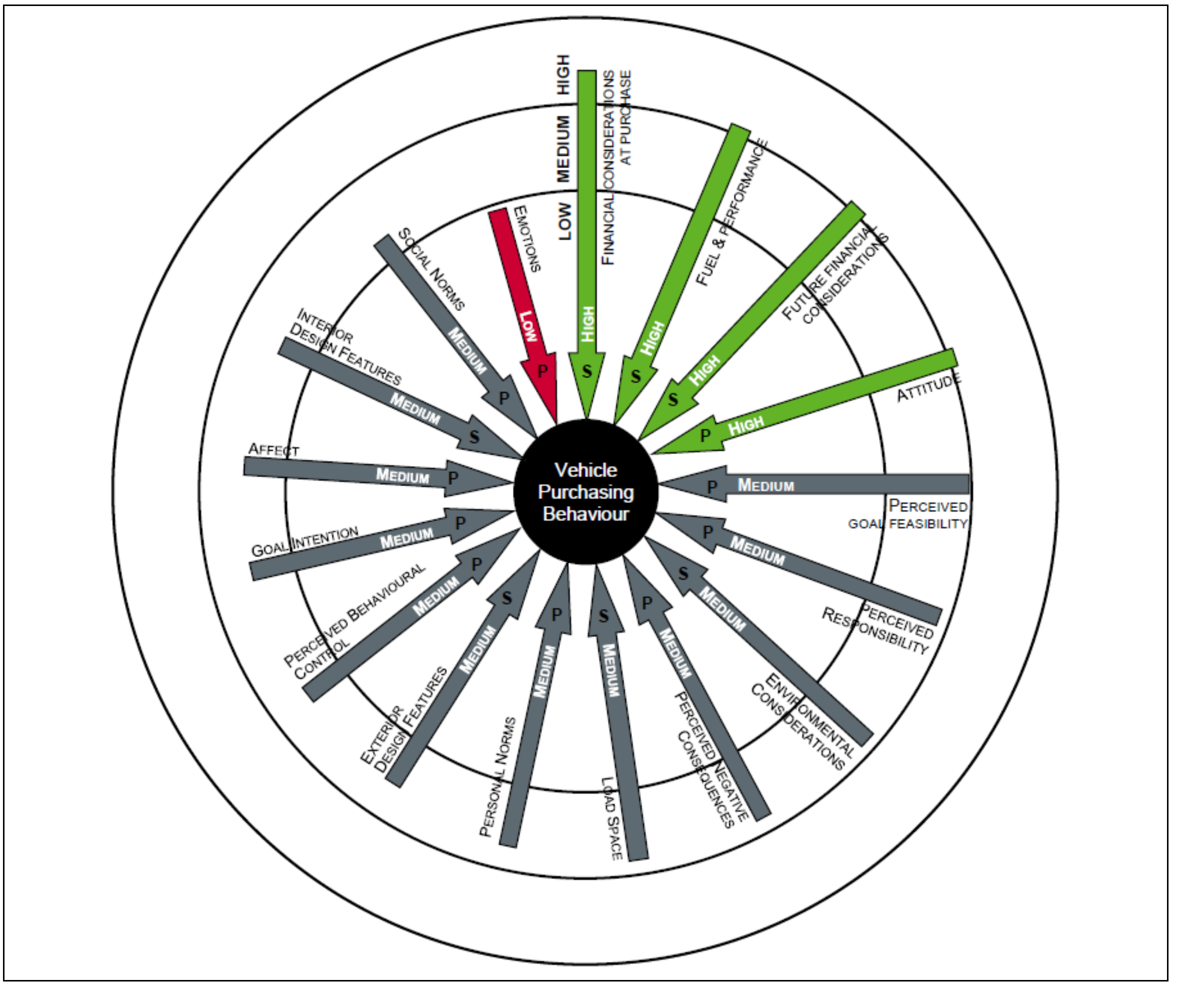


Figure 53: The Borthwick 'wheel', demonstrating individuals' future vehicle purchasing decisions for the Scottish motoring population overall

5.3 Importance of situational and psychological factors in individuals' future vehicle purchasing decisions by strength of individuals' BI to purchase a lower emission vehicle in the future

The importance/influence of situational and psychological factors in individuals' future vehicle purchasing decisions was subsequently evaluated for each BI segment. This section will illustrate whether the strength of individuals' BI to purchase a lower emission vehicle impacts upon the factors shaping future vehicle purchasing behaviour.

A one-way ANOVA was used to test the relationship between the situational and psychological factors and the strength of individuals' BI to purchase a lower emission vehicle in the future. A main effect was observed for all situational and psychological factors excluding interior and exterior design features (***Table 29***). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 30***).

Table 29: Results of the one-way ANOVAs for the situational and psychological factors of importance in individuals' future vehicle purchasing decisions, by strength of individuals' BI to purchase a lower emission vehicle in the future

Situational and psychological factors	One-way ANOVA
Financial considerations at purchase	$F(2,1000)=19.751$, $p<0.05$
Fuel & performance	$F(2,1000)=15.888$, $p<0.05$
Future financial considerations	$F(2,1000)=19.751$, $p<0.05$
Attitude	$F(2,1243)=171.428$, $p<0.05$
Perceived goal feasibility	$F(2,1214)=72.241$, $p<0.05$
Perceived responsibility	$F(2,1000)=96.258$, $p<0.05$
Environmental considerations	$F(2,1000)=106.480$, $p<0.05$
Perceived negative consequences	$F(2,1229)=86.875$, $p<0.05$
Load space	$F(2,1000)=4.309$, $p<0.05$
Personal norms	$F(2,1226)=297.976$, $p<0.05$
Exterior design features	$F(2,1000)=0.487$, $p>0.05$
Perceived behavioural control	$F(2,1155)=30.422$, $p<0.05$
Goal intention	$F(2,1158)=254.743$, $p<0.05$
Negative affect	$F(2,1236)=181.780$, $p<0.05$
Interior design features	$F(2,1000)=0.983$, $p>0.05$
Social norms	$F(2,1099)=54.885$, $p<0.05$
Emotions	$F(2,1227)=66.205$, $p<0.05$

Table 30: Ranked importance of situational and psychological factors in individuals' future vehicle purchasing decisions, by strength of individuals' BI to purchase a lower emission vehicle in the future

Rank	All		Strength of individuals' BI*					
			Low BI (1)		Medium BI (2)		High BI (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	N	$\bar{X}$ (σ)
1	Financial considerations at purchase		Financial considerations at purchase		Financial considerations at purchase		Financial considerations at purchase	
	1,003	6.1 (1.0)	87	$5.9^{-2,-3}$ (1.2)	471	$6.0^{+1,-3}$ (1.0)	445	$6.3^{+1,+2}$ (0.9)
2	Fuel and performance		Fuel and performance		Fuel and performance		Attitude	
	1,003	5.7 (0.9)	87	5.5^{-3} (1.2)	471	5.6^{-3} (0.9)	563	$6.3^{+1,+2}$ (1.4)
3	Future financial considerations		Future financial considerations		Future financial considerations		Perceived responsibility	
	1,003	5.6 (1.1)	87	5.1^{-3} (1.5)	471	5.5^{-3} (1.1)	569	$6.0^{+1,+2}$ (1.6)
4	Attitude		Load space		Attitude		Perceived goal feasibility	
	1,246	5.6 (1.7)	87	5.0 (1.3)	570	$5.2^{+1,-3}$ (1.5)	552	$5.9^{+1,+2}$ (1.5)
5	Perceived goal feasibility		Exterior design features		Perceived goal feasibility		Fuel and performance	
	1,217	5.4 (1.5)	87	4.8 (1.6)	553	$5.1^{+1,-3}$ (1.4)	445	$5.9^{+1,+2}$ (0.9)
6	Perceived responsibility		Interior design features		Load space		Environmental considerations	
	1,260	5.4 (1.7)	87	4.8 (1.3)	471	5.1^{-3} (1.2)	445	$5.9^{+1,+2}$ (1.0)
7	Environmental considerations		Perceived goal feasibility		Perceived responsibility		Personal norms	
	1,003	5.3 (1.4)	112	$4.4^{-2,-3}$ (1.8)	577	$5.0^{+1,-3}$ (1.6)	553	$5.8^{+1,+2}$ (1.6)
8	Perceived negative consequences		Perceived behavioural control		Perceived negative consequences		Perceived negative consequences	
	1,232	5.2 (1.7)	115	4.4^{-3} (1.9)	561	$4.9^{+1,-3}$ (1.6)	558	$5.8^{+1,+2}$ (1.5)
9	Load space		Environmental considerations		Environmental considerations		Future financial considerations	
	1,003	5.2 (1.2)	87	$4.3^{-2,-3}$ (1.8)	471	$4.9^{+1,-3}$ (1.3)	445	$5.8^{+1,+2}$ (1.0)
10	Personal norms		Perceived responsibility		Exterior design features		Goal intention	
	1,229	5.1 (1.7)	114	$4.1^{-2,-3}$ (1.8)	471	4.8 (1.4)	517	$5.7^{+1,+2}$ (1.3)
11	Exterior design features		Perceived negative consequences		Personal norms		Negative affect	
	1,003	4.8 (1.4)	113	$4.0^{-2,-3}$ (2.0)	562	$4.7^{+1,-3}$ (1.4)	560	$5.5^{+1,+2}$ (1.5)
12	Perceived behavioural control		Personal norms		Interior design features		Load space	
	1,158	4.7 (1.7)	114	$3.7^{-2,-3}$ (1.8)	471	4.7 (1.1)	445	5.3^{+2} (1.2)
13	Goal intention		Attitude		Perceived behavioural control		Perceived behavioural control	
	1,161	4.7 (1.6)	113	$3.7^{-2,-3}$ (1.8)	534	4.4^{-3} (1.4)	509	$5.2^{+1,+2}$ (1.8)
14	Negative affect		Social norms		Negative affect		Social norms	
	1,239	4.7 (1.7)	98	$3.6^{-2,-3}$ (1.7)	563	$4.3^{+1,-3}$ (1.5)	504	$4.9^{+1,+2}$ (1.6)
15	Interior design features		Goal intention		Goal intention		Interior design features	
	1,003	4.7 (1.1)	108	$3.1^{-2,-3}$ (1.7)	536	$4.2^{+1,-3}$ (1.2)	445	4.8 (1.1)
16	Social norms		Negative affect		Social norms		Exterior design features	
	1,102	4.4 (1.6)	116	$3.0^{-2,-3}$ (1.6)	500	$4.1^{+1,-3}$ (1.4)	445	4.8 (1.4)
17	Emotions		Emotions		Emotions		Emotions	
	1,230	3.8 (1.8)	113	$2.9^{-2,-3}$ (1.7)	573	$3.4^{+1,-3}$ (1.5)	544	$4.4^{+1,+2}$ (1.9)

* *Where 1 is 'weak/not important' and 7 is 'strong/very important'*

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments ($p<0.05$) derived from Scheffé post-hoc tests.

Regardless of the strength of individuals' BI to purchase a lower emission vehicle, financial considerations at the time of purchase are of greatest importance in individuals' future vehicle purchasing decisions. Furthermore, emotions are consistently ranked the least influential factor. Beyond these two variables, the ranked order does vary by strength of individuals' BI to purchase a lower emission vehicle in the future. The results for each BI segment are subsequently presented.

Low BI: Such individuals generally place greater importance upon situational factors than psychological ones in individuals' future vehicle purchasing decisions. Financial considerations at the time of purchase are the highest ranked situational factor (5.9). Such considerations are significantly less important to Low BI individuals than those with a Medium or High BI. The next most important factor ranked is fuel/performance (5.5), followed by future financial considerations (5.1). Both factors are less important to Low BI individuals than other BI segments, and significantly more important than High BI individuals. Considerations of load space are ranked next (5.0), of less importance to Low BI individuals than both other segments. This is followed by exterior design features (4.8) of less importance to Low BI individuals than those with a Medium BI, but more important than High BI individuals. Interior design features are next (4.8), of less importance to Low BI individuals than the High BI segment, but more important than Medium BI individuals. Finally, environmental considerations are the least important situational factor (4.3), of significantly less importance to Low BI individuals than both other BI segments.

In contrast, psychological factors are ranked lower in importance for Low BI individuals. The most important psychological construct is perceived goal feasibility (4.4). However, this factor is significantly less important to Low BI individuals than the other BI segments. Perceived behavioural control was ranked next (4.4). This factor is less important to Low BI individuals than the other BI segments, but significant relative to only High BI individuals. All remaining constructs scored significantly less than both Medium and High BI individuals. Namely: perceived responsibility (4.1); perceived negative consequences (4.0); attitude (3.7); social norms (3.6); goal intention (3.1); negative affect (3.0); and emotions (2.9).

Medium BI: The most important situational factor is financial considerations at the time of purchase (6.0). This factor is significantly more important for Medium BI individuals than those with a Low BI, but significantly less than the High BI segment. Considerations of fuel/performance (5.6), future financial expenditure (5.5) and load space (5.1) are ranked next. These three factors are all more important to Medium BI individuals than the Low BI segment, but significantly less important than High BI individuals. Environmental considerations are ranked next (4.9). This factor is significantly more important to the Medium BI segment than those with a Low BI, but significantly less than High BI individuals. This is followed by exterior design features (4.8), of more importance to Medium BI individuals than the other BI segments. Of least importance is interior design features (4.7), of less importance to the Medium BI segment than other individuals.

Psychological factors for the Medium BI segment are more important than the Low BI segment, but less important than High BI individuals. This is significant in all instances except for perceived behavioural control relative to the Low BI segment. The most important psychological constructs are attitudes (5.2) and perceived goal feasibility (5.1). Remaining constructs scored less than 5 on a 7-point Likert scale. Namely: perceived responsibility (5.0); perceived negative consequences (4.9); personal norms (4.7); perceived behavioural control (4.4); negative affect (4.3); goal intention (4.2); social norms (4.1) and finally emotions (3.4).

High BI: Concerning situational factors, High BI individuals place greatest importance upon financial considerations at purchase (6.3), considerations of fuel/performance (5.9), environmental factors (5.9) and future financial considerations (5.8). These are significantly more important to High BI individuals relative to the Low or Medium BI segments. Load space is ranked next (5.3), being more important to High BI individuals than both other segments, but significant relative to the Medium BI segment. This is followed by interior design features (4.8), of more importance to this BI segment than both Low and Medium BI individuals. Finally, exterior design features are ranked last (4.8), of less importance to High BI individuals relative to the other segments.

In contrast to Low BI individuals, situational and psychological factors are more integrated in the ranking for the High BI segment. All psychological factors are significantly more influential to High BI individuals relative to those with Medium or Low BI. Attitudes (6.3) are the strongest construct, followed by perceived responsibility (6.0) and perceived goal feasibility (5.9). Personal norms (5.8) are the next most influential, then perceived negative consequences (5.8), goal intention (5.7), negative affect (5.5), perceived behavioural control (5.2), social norms (4.9) and finally emotions (4.4).

5.4 Importance of situational and psychological factors in individuals' future vehicle purchasing decisions, by 'green' segment within the Scottish motoring population

The importance/influence of situational and psychological factors was evaluated for each 'green' segment, concerning their importance in individuals' future vehicle purchasing decisions. This section will illustrate whether 'green' segment membership impacts upon the factors shaping future vehicle purchasing behaviour.

A one-way ANOVA was used to test the relationship between the situational and psychological factors and the 'green' segments. A main effect was observed for all situational and psychological factors (***Table 31***). Scheffé *post-hoc* tests were used to explore the differences between the 'green' segments (***Table 32***).

Table 31: Results of the one-way ANOVAs for the situational and psychological factors of importance in individuals' future vehicle purchasing decisions, by 'green' segment

Situational and psychological factors	One-way ANOVA
BI	$F(2,1283)=373.012$, $p<0.05$
Financial considerations at purchase	$F(2,1021)=60.578$, $p<0.05$
Fuel/performance	$F(2,1021)=98.236$, $p<0.05$
Future financial considerations	$F(2,1021)=143.749$, $p<0.05$
Attitude	$F(2,1251)=194.204$, $p<0.05$
Perceived goal feasibility	$F(2,1223)=112.800$, $p<0.05$
Perceived responsibility	$F(2,1268)=255.119$, $p<0.05$
Environmental considerations	$F(2,1021)=249.397$, $p<0.05$
Perceived negative consequences	$F(2,1246)=330.006$, $p<0.05$
Load space	$F(2,1021)=44.332$, $p<0.05$
Personal norms	$F(2,1233)=314.219$, $p<0.05$
Exterior design features	$F(2,1021)=53.359$, $p<0.05$
Negative affect	$F(2,1249)=416.384$, $p<0.05$
Perceived behavioural control	$F(2,1160)=55.000$, $p<0.05$
Goal intention	$F(2,1162)=320.791$, $p<0.05$
Interior design features	$F(2,1021)=53.883$, $p<0.05$
Social norms	$F(2,1106)=132.128$, $p<0.05$
Emotions	$F(2,1240)=234.498$, $p<0.05$

Table 32: Ranked importance of situational and psychological factors in individuals' future vehicle purchasing decisions, by 'green' segment

Rank	All		'Green' segments*					
			NG (1)		MG (2)		GG (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
-	BI		BI		BI		BI	
	1286	5.4 (1.3)	343	4.3 $^{-2,-3}$ (1.2)	432	5.3 $^{+1,-3}$ (1.0)	511	6.2 $^{+1,+2}$ (0.8)
	↓		↓		↓		↓	
1	Financial considerations at purchase		Financial considerations at purchase		Financial considerations at purchase		Attitude	
	1,024	6.1 (1.0)	286	5.6 $^{-2,-3}$ (1.1)	334	6.4 $^{+1}$ (0.8)	498	6.5 $^{+1,+2}$ (1.1)
2	Fuel/performance		Fuel/performance		Fuel/performance		Perceived responsibility	
	1,024	5.7 (0.9)	286	5.2 $^{-2,-3}$ (1.1)	334	6.1 $^{+1,+3}$ (0.6)	504	6.5 $^{+1,+2}$ (1.1)
3	Future financial considerations		Load space		Future financial considerations		Personal norms	
	1,024	5.6 (1.1)	286	4.8 $^{-2}$ (1.2)	334	6.1 $^{+1,+3}$ (0.8)	490	6.3 $^{+1,+2}$ (1.1)
4	Attitude		Perceived goal feasibility		Load space		Financial considerations at purchase	
	1,254	5.6 (1.7)	330	4.8 $^{-2,-3}$ (1.5)	334	5.7 $^{+1,+3}$ (1.0)	404	6.3 $^{+1}$ (0.8)
5	Perceived goal feasibility		Future financial considerations		Environmental considerations		Perceived goal feasibility	
	1,226	5.4 (1.5)	286	4.8 $^{-2,-3}$ (1.2)	334	5.5 $^{+1,-3}$ (1.1)	484	6.2 $^{+1,+2}$ (1.2)
6	Perceived responsibility		Attitude		Perceived negative consequences		Perceived negative consequence	
	1,271	5.3 (1.7)	337	4.6 $^{-2,-3}$ (1.6)	414	5.4 $^{+1,-3}$ (1.3)	499	6.1 $^{+1,+2}$ (1.1)
7	Environmental considerations		Perceived behavioural control		Exterior design features		Environmental considerations	
	1,024	5.3 (1.4)	319	4.6 $^{+2,-3}$ (1.6)	334	5.4 $^{+1,+3}$ (1.2)	404	5.9 $^{+1,+2}$ (0.9)
8	Perceived negative consequences		Exterior design features		Interior design features		Negative affect	
	1,249	5.2 (1.7)	286	4.5 $^{-2}$ (1.4)	334	5.2 $^{+1,+3}$ (0.9)	500	5.9 $^{+1,+2}$ (1.2)
9	Load space		Interior design features		Attitude		Goal intention	
	1,024	5.2 (1.2)	286	4.4 $^{-2,-3}$ (1.1)	419	5.2 $^{+1,-3}$ (1.7)	460	5.8 $^{+1,+2}$ (1.2)
10	Personal norms		Perceived responsibility		Perceived goal feasibility		Fuel/performance	
	1,236	5.1 (1.7)	339	4.3 $^{-2,-3}$ (1.5)	412	5.1 $^{+1,-3}$ (1.6)	404	5.8 $^{+1,-2}$ (0.9)
11	Exterior design features		Personal norms		Perceived responsibility		Future financial considerations	
	1,024	4.8 (1.4)	334	4.1 $^{-2,-3}$ (1.5)	428	4.9 $^{+1,-3}$ (1.8)	404	5.7 $^{+1,-2}$ (1.0)
12	Negative affect		Environmental considerations		Negative affect		Perceived behavioural control	
	1,252	4.7 (1.7)	286	4.0 $^{-2,-3}$ (1.4)	414	4.6 $^{+1,-3}$ (1.4)	461	5.3 $^{+1,+2}$ (1.7)
13	Perceived behavioural control		Perceived negative consequences		Goal intention		Social norms	
	1,163	4.7 (1.7)	336	3.7 $^{-2,-3}$ (1.6)	391	4.6 $^{+1,-3}$ (1.3)	452	5.2 $^{+1,+2}$ (1.5)
14	Goal intention		Social norms		Personal norms		Load space	
	1,165	4.7 (1.6)	293	3.4 $^{-2,-3}$ (1.5)	412	4.5 $^{+1,-3}$ (1.6)	404	5.0 $^{-2}$ (1.3)
15	Interior design features		Goal intention		Social norms		Emotions	
	1,024	4.7 (1.1)	314	3.4 $^{-2,-3}$ (1.3)	364	4.3 $^{+1,-3}$ (1.4)	490	4.9 $^{+1,+2}$ (1.7)
16	Social norms		Negative affect		Perceived behavioural control		Interior design features	
	1,109	4.4 (1.6)	338	3.2 $^{-2,-3}$ (1.4)	383	4.2 $^{-1,-3}$ (1.6)	404	4.6 $^{+1,-2}$ (1.1)
17	Emotions		Emotions		Emotions		Exterior design features	
	1,243	3.8 (1.8)	337	2.6 $^{-2,-3}$ (1.3)	416	3.6 $^{+1,-3}$ (1.6)	404	4.5 $^{-2}$ (1.4)

** Where 1 is 'weak/not important' and 7 is 'strong/very important'*

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other 'green' segments ($p<0.05$) derived from Scheffé post-hoc tests.

Concerning the strength of individuals' BI to purchase a lower emission vehicle in the future, the No-Greens have the weakest BI (4.3). The BI to purchase a lower emission vehicle in the future is stronger for the Maybe-Greens (5.3), and strongest for the Go-Greens (6.2). Differences between the 'green' segments were identified as significant.

Regardless of 'green' segment membership, financial considerations at the time of purchase are of greatest importance in individuals' future vehicle purchasing decisions and emotions are of least importance. Despite this initial consensus, the ranked order varies across the 'green' segments. The results for each 'green' segment are subsequently presented.

No-Greens: Future vehicle purchasing behaviour for this segment is more influenced by situational factors than psychological ones. The highest ranked situational factor is financial considerations at purchase (5.6), followed by fuel/performance considerations (5.2). Both factors are significantly less important to the No-Greens than the other 'green' segments. Load space was ranked next (4.8), of less importance to the No-Greens than the Go-Greens and significantly less than the Maybe-Greens. Future financial considerations are ranked next (4.8), being significantly less important to the No-Greens relative to both other segments. This is followed by exterior design features (4.5), of more importance to the No-Greens than the Go-Greens, but significantly less important than the Maybe-Greens. The remaining two least important factors to the No-Greens are interior design features (4.4) and environmental considerations (4.0). Both factors are significantly less important to the No-Greens relative to the other 'green' segments.

Regarding psychological factors, the No-Greens are the least psychologically prepared to purchase a lower emission vehicle in the future. They score significantly lower for all psychological constructs than both other segments, except for perceived behavioural control. This psychological construct is significantly more important to the No-Greens than the Maybe-Greens, but still significantly less important than the Go-Greens. Specifically, the No-Greens rank perceived goal feasibility the most important (4.8), followed by attitudes (4.6), perceived behavioural control (4.6), perceived responsibility (4.3), personal norms (4.1), perceived negative consequences (3.7), social norms (3.4), goal intention (3.4), negative affect (3.2) and emotions (2.6).

Maybe-Greens: Situational factors have much greater prominence in individuals' future vehicle purchasing decisions for the Maybe-Greens compared to psychological factors.

All situational factors except one are significantly more influential to the Maybe-Greens than the other 'green' segments. The exception, financial considerations at purchase, is more important to the Maybe-Greens than the Go-Greens, but not significantly more. Concerning the ranked order, financial considerations at purchase are considered most important to the Maybe-Greens (6.4). This is followed by fuel/performance (6.1), future financial considerations (6.1), load space (5.7), environmental considerations (5.5), exterior design features (5.4) and interior design features (5.2).

The Maybe-Greens are significantly less prepared psychologically to purchase a lower emission vehicle than the Go-Greens, but significantly more than the No-Greens. There is one exception to this statement, where perceived behavioural control is significantly less important to this segment than the No-Greens. The ranked order dictates perceived negative consequences as the most dominant construct (5.4). This is followed by attitudes (5.2), perceived goal feasibility (5.1), perceived responsibility (4.9), negative affect (4.6), goal intention (4.7), personal norms (4.5), social norms (4.3), perceived behavioural control (4.2) and finally emotions (3.6).

Go-Greens: This segment ranks financial considerations at purchase as the most important (6.3). This factor is significantly less important to the Go-Greens than the Maybe-Greens, but significantly more than the No-Greens. The next most important consideration relates to the environment (5.9), of significantly more importance to the Go-Greens than both other segments. Considerations of fuel/performance (5.8) and future financial costs (5.7) were ranked next. Both factors are significantly more important to the Go-Greens than the No-Greens, but significantly less than the Maybe-Greens. Load space is ranked next (5.0), of more importance to the Go-Greens than the No-Greens, but significantly less than the Maybe-Greens. This is followed by interior design features (4.6), of significantly more importance to the Go-Greens than the No-Greens, but less than the Maybe-Greens. Of least importance are exterior design features (4.5), of less importance for the Go-Greens relative to both other segments, but significant relative to only the Maybe-Greens.

Furthermore, the Go-Greens segment are significantly more prepared psychologically to purchase a lower emission vehicle than the other 'green' segments. Psychological constructs predominantly drive the Go-Greens' future vehicle purchasing behaviour. Attitudes are the strongest construct for the Go-Greens (6.5), followed by perceived responsibility (6.5), personal norms (6.3), perceived goal feasibility (6.2) and perceived negative consequences (6.1), negative affect (5.9), goal intention (5.8), perceived behavioural control (5.3), social norms (5.2) and emotions (4.9).

5.4.1 Revised behavioural model capturing the factors of importance/influence in individuals' future vehicle purchasing decisions, by 'green' segment within the Scottish motoring population

A revised model of individuals' future vehicle purchasing behaviour was produced for all 'green' segments. The Lane and Potter (2007) model was recognised earlier as being a one-size-fits-all conceptualisation of individuals' future vehicle purchasing behaviour. However, differences were uncovered for each of the 'green' segments regarding the factors informing their future vehicle purchasing behaviour. Each segment thus warranted their own behavioural model (***Figure 54-Figure 56***). The original location of situational and psychological factors was maintained from the initial conceptualisation to enable comparisons relative to the population overall. Fundamentally, the models for each 'green' segment are not shown in descending order of importance/influence. However, the 'low', 'medium' and 'high' classification remains.

5.5 Chapter 5 summary

This chapter presented the results necessary to address the first research question regarding the importance of situational and psychological factors in shaping individuals' future vehicle purchasing decisions. The following key points were considered:

- For the Scottish motoring population overall, situational factors were generally more influential than psychological factors in individuals' future vehicle purchasing decisions;
- Across the segments, differences were observed regarding the most important/influential factors in individuals' future vehicle purchasing decisions. For example, the Go-Greens are more driven by psychological factors than situational factors, whilst the opposite is true for the No-Greens;
- Revised behavioural models conceptualising individuals' future vehicle purchasing behaviour were successfully produced for the Scottish motoring population as a whole and the 'green' segments therein.

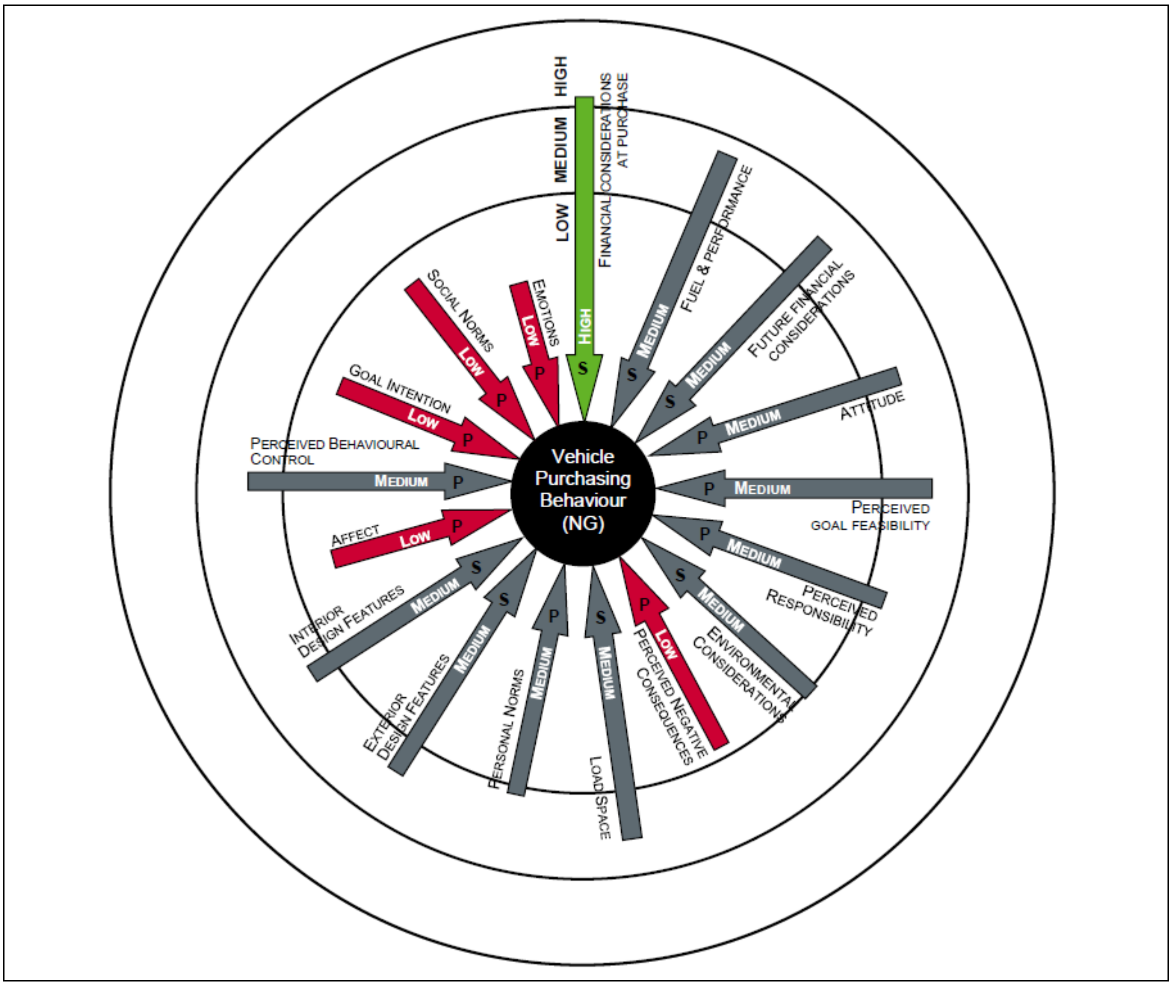


Figure 54: The Borthwick 'wheel', demonstrating individuals' future vehicle purchasing decisions for the No-Greens segment of the Scottish motoring population

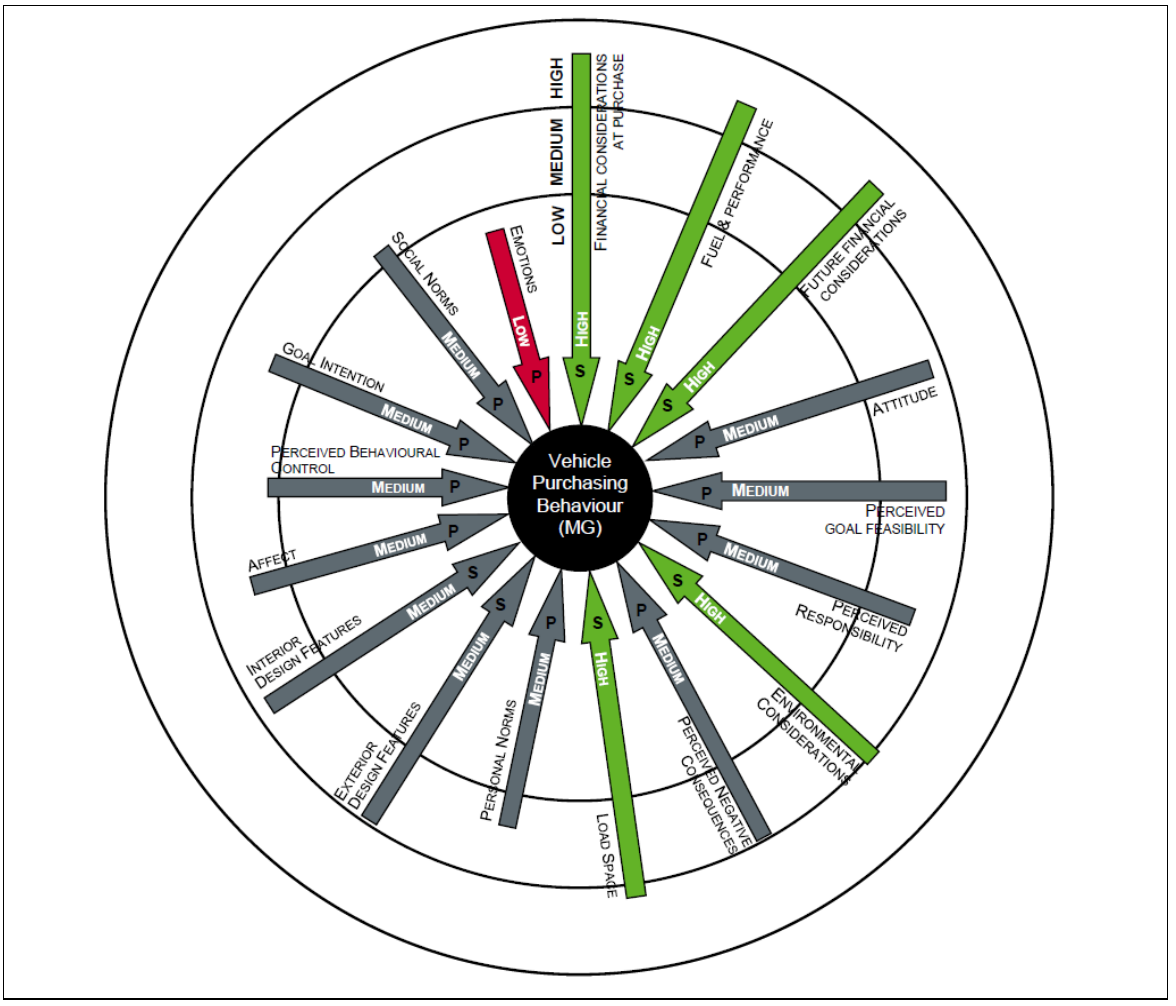


Figure 55: The Borthwick 'wheel', demonstrating individuals' future vehicle purchasing decisions for the Maybe-Greens segment of the Scottish motoring population

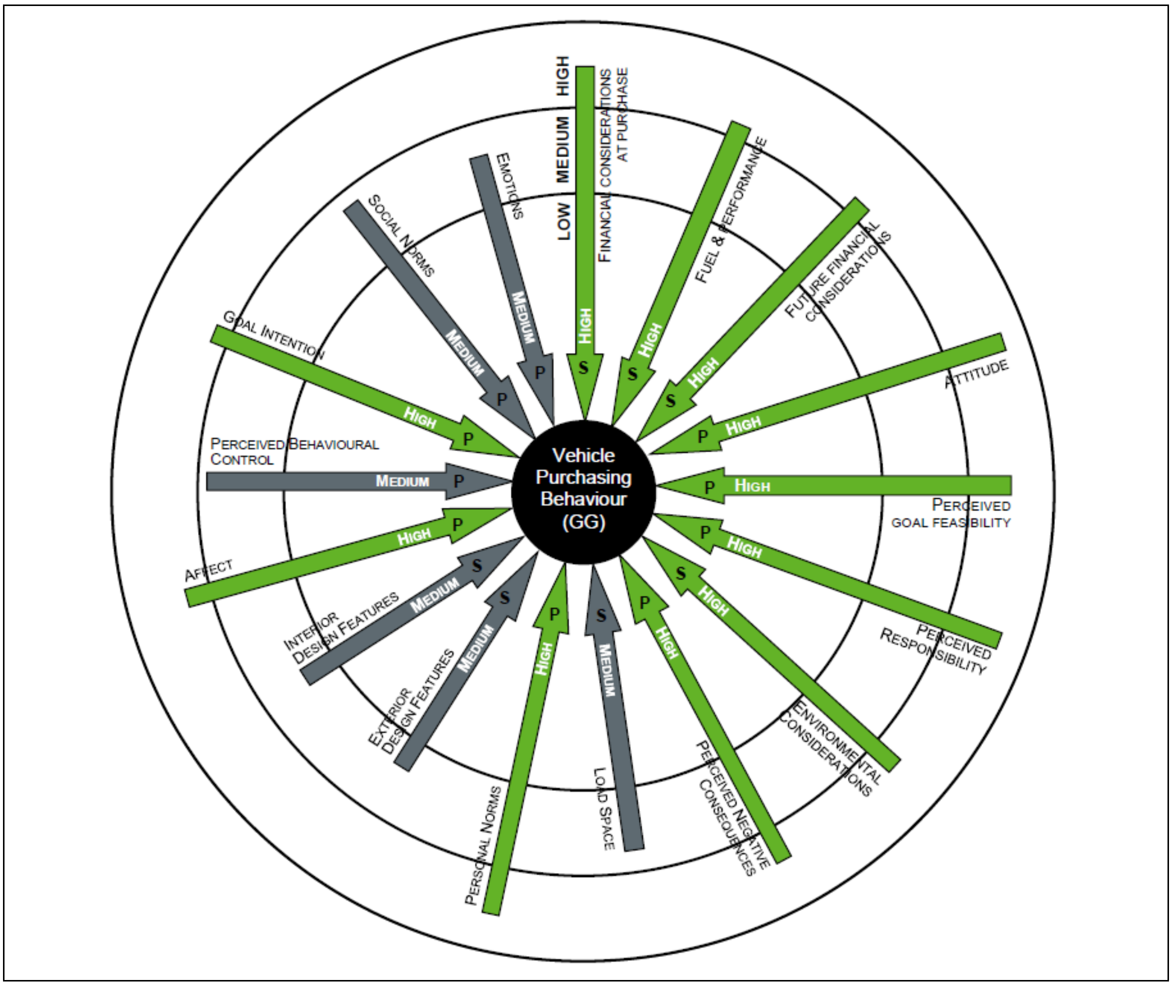


Figure 56: The Borthwick 'wheel', demonstrating individuals' future vehicle purchasing decisions for the Go-Greens segment of the Scottish motoring population

6 RESULTS: THE ADAPTATION OF CURRENT TAXATION POLICY TO ENCOURAGE A LOWER EMISSION VEHICLE PURCHASE

6.1 Chapter overview

This chapter presents the results of the questionnaire survey necessary to address the second research question. That is, the adaptation of VED, VAT, HOD and the PICG necessary to encourage a lower emission vehicle purchase. The potential influence of each taxation measure in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle is considered first. The type of price signal most influential and the exact level of tax necessary to instigate the vehicle purchasing decision towards a lower emission vehicle are then considered. Results are presented for the Scottish motoring population overall, and split according to the strength of individuals' BI to purchase a lower emission vehicle in the future and the 'green' segments derived by the factors shaping individuals' future vehicle purchasing behaviour.

6.2 Adaptation of current taxation policy to encourage the purchase of a lower emission vehicle for the Scottish motoring population overall

Respondents were asked to indicate the changes to current taxation policy required to encourage a lower emission vehicle purchase. This section will provide an indication of the changes to current taxation policy, that is, VED, VAT, HOD and the PICG, necessary to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle.

6.2.1 VED

Respondents were asked to indicate whether VED would potentially inform their future vehicle purchasing decisions towards a lower emission vehicle. The majority of future vehicle purchasing decisions (92.5%) could indeed be influenced by a VED change. In contrast, 1.8% stated their future vehicle was likely to be leased, thus rendering VED as N/A. A further 5.7% indicated no level of VED increase/decrease would influence their future vehicle purchasing behaviour (***Table 33***).

Table 33: The potential influence of VED in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle

Influence of VED	n	%
Yes	533	92.5%
No – my vehicle is likely to be leased	10	1.8%
No level of VED increase/decrease would influence my motoring behaviour	33	5.7%
TOTAL	**576**	**100.0%**

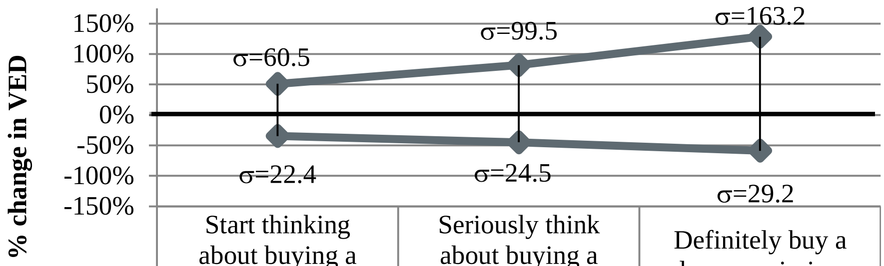
Respondents were asked to indicate whether a VED increase/decrease would be most influential in their future vehicle purchasing decisions to purchase a lower emission vehicle. The majority of respondents would be more influenced by a VED reduction (56.9%). Conversely, 43.1% would find a VED increase more influential in shaping their future vehicle purchasing behaviour towards a lower emission vehicle (***Table 34***).

Table 34: Change in VED with the greatest influence in individuals' future vehicle purchasing decisions for a lower emission vehicle

Change in VED with the greatest influence	n	%
Tax increase (disincentive)	223	43.1%
Tax decrease (incentive)	295	56.9%
TOTAL	**518**	**100.0%**

Respondents were asked to indicate the level of VED necessary to start thinking about, seriously think about and definitely buy a lower emission vehicle. A 51.0% increase, relative to their current VED, for a new vehicle with equal/greater emissions would be required to start thinking about purchasing a lower emission vehicle in the future. A VED increase of 81.9% would be necessary to seriously think about purchasing a lower emission vehicle; rising to 128.6% for individuals to definitely buy such a vehicle in the future. In contrast, a 34.6% VED decrease would be necessary for a lower emission vehicle, relative to current VED, for individuals to start thinking about buying such a vehicle. A VED reduction of 44.9% would be required to seriously think about purchasing a lower emission vehicle; whilst a 58.7% decrease would be necessary to definitely buy such a vehicle in the future (***Figure 57***).

The exact level of VED increase/decrease necessary to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase was further examined. The ratio of losses-to-gains is 1.5:1 for individuals to start thinking about buying a lower emission vehicle, 1.8:1 to seriously think about buying such a vehicle, and 2.2:1 to definitely purchase a lower emission vehicle.



	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle
Increase in VED for a new vehicle with equal or greater emissions than my current vehicle	51.0%	81.9%	128.6%
Decrease in VED for a new vehicle with lower emissions than my current vehicle	-34.6%	-44.9%	-58.7%

Stages of behaviour change

Figure 57: Average VED increases/decreases necessary for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle

These results can be converted into financial terms. This is based on the CO_2 emissions of the vehicle most often used at present by the sample and the 2012/13[38] VED payment structure (***Table 35***). For example, 10.4% of the Scottish motoring population most often drive a vehicle emitting 131-140g/km of CO_2. Such individuals would require £180.20 VED for a vehicle emitting at least 141g/km of CO_2 to start thinking about buying a lower emission vehicle. £218.28 VED would be required to seriously think about buying such a vehicle, whilst £274.32 VED would be necessary to definitely purchase a lower emission vehicle. Likewise, the reported VED reductions can be presented into financial terms based on the 2012/13 VED payment structure (***Table 36***). For example, 16.8% of the Scottish motoring population, who currently drive a vehicle emitting 141-150g/km of CO_2, would require £88.29 VED for a vehicle emitting 140g/km of CO_2 maximum to start thinking about buying a lower emission vehicle. £74.39 VED would be required by such individuals to seriously think about buying a lower emission vehicle, whilst £55.76 VED would be necessary to definitely buy such a vehicle.

[38] 2012/13 rates of taxation are used throughout this chapter when converting the results of this research from percentages into financial terms. Whilst 2010/11 rates were relevant when collecting data for this research, 2012/13 rates were most pertinent when writing-up this thesis. ***Chapter 8*** provides a discussion of the changes in taxation rates from 2010/11 to 2012/13, where applicable.

Table 35: VED necessary, after a tax increase and based on the 2012/13 VED payment structure, for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle

Tax Band	CO_2 emissions	2012/13 VED payment	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of drivers currently in each tax band
			+51.0%	+81.9%	+128.6%	
A	=< 100	£0.00	£0.00	£0.00	£0.00	0.2%
B	101-110	£20.00	£30.20	£36.38	£45.72	1.7%
C	111-120	£30.00	£45.30	£54.57	£68.58	4.0%
D	121-130	£100.00	£151.00	£181.90	£228.60	5.7%
E	131-140	£120.00	£181.20	£218.28	£274.32	10.4%
F	141-150	£135.00	£203.85	£245.57	£308.61	16.8%
G	151-165	£170.00	£256.70	£309.23	£388.62	24.0%
H	166-175	£195.00	£294.45	£354.71	£445.77	8.8%
I	176-185	£215.00	£324.65	£391.09	£491.49*	9.6%
J	186-200	£250.00	£377.50	£454.75	£571.50*	7.1%
K	201-225	£270.00	£407.70	£491.13*	£617.22*	6.9%
L	226-255	£460.00	£694.60*	£836.74*	£1,051.56*	2.7%
M	>=256	£475.00	£717.25*	£864.03*	£1,085.85*	2.2%

* *These entries are not achievable with the 2012/13 VED payment structure, going beyond £475 per annum.*

Table 36: VED necessary, after a tax decrease and based on the 2012/13 VED payment structure, for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle

Tax Band	CO_2 emissions	2012/13 VED payment	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of drivers currently in each tax band
			- 34.6%	- 44.9%	- 58.7%	
A	=< 100	£0.00	£0.00	£0.00	£0.00	0.2%
B	101-110	£20.00	£13.08	£11.02	£8.26	1.7%
C	111-120	£30.00	£19.62	£16.53	£12.39	4.0%
D	121-130	£100.00	£65.40	£55.10	£41.30	5.7%
E	131-140	£120.00	£78.48	£66.12	£49.56	10.4%
F	141-150	£135.00	£88.29	£74.39	£55.76	16.8%
G	151-165	£170.00	£111.18	£93.67	£70.21	24.0%
H	166-175	£195.00	£127.53	£107.45	£80.54	8.8%
I	176-185	£215.00	£140.61	£118.47	£88.80	9.6%
J	186-200	£250.00	£163.50	£137.75	£103.25	7.1%
K	201-225	£270.00	£176.58	£148.77	£111.51	6.9%
L	226-255	£460.00	£300.84	£253.46	£189.98	2.7%
M	>=256	£475.00	£310.65	£261.73	£196.18	2.2%

Respondents were asked to indicate their awareness of the FYR of VED, prior to completing the questionnaire. Only 39.2% of respondents were aware of the SR and FYR differentiation, whereas 60.8% were oblivious to its introduction (***Table 37***). Respondents were asked to indicate whether the FYR of VED would potentially inform their future vehicle purchasing behaviour towards an eligible lower emission vehicle. 41.3% of individuals' future vehicle purchasing decisions could be influenced by the FYR of VED. Conversely, a further 38.9% of respondents would not be influenced by the FYR. The remaining 19.8% indicated the FYR of VED was N/A due to their future vehicle likely being leased (2.3%) or acquired used (17.5%; ***Table 37***).

Table 37: Initial awareness and influence of the FYR of VED

	Awareness of the FYR of VED		Influence of the FYR of VED	
	n	%	n	%
Yes	242	39.2%	257	41.3%
No	375	60.8%	242	38.9%
N/A – my vehicle is likely to be leased	-	-	14	2.3%
N/A – I have no intention of buying a newly registered vehicle	-	-	109	17.5%
TOTAL	**617**	**100.0%**	**622**	**100.0%**

The results of the chi-squared test indicates a significant association between initial awareness of the FYR and its influence upon individuals' future vehicle purchasing behaviour ($\chi^2(3)=13.996$, $p<0.05$). There is a larger share of individuals who could be influenced by the FYR, who were previously aware of its existence (+8.3%). In contrast, there were a greater proportion of individuals who would not be influenced by the FYR, who were previously unaware of its existence (+4.5%; ***Figure 58***).

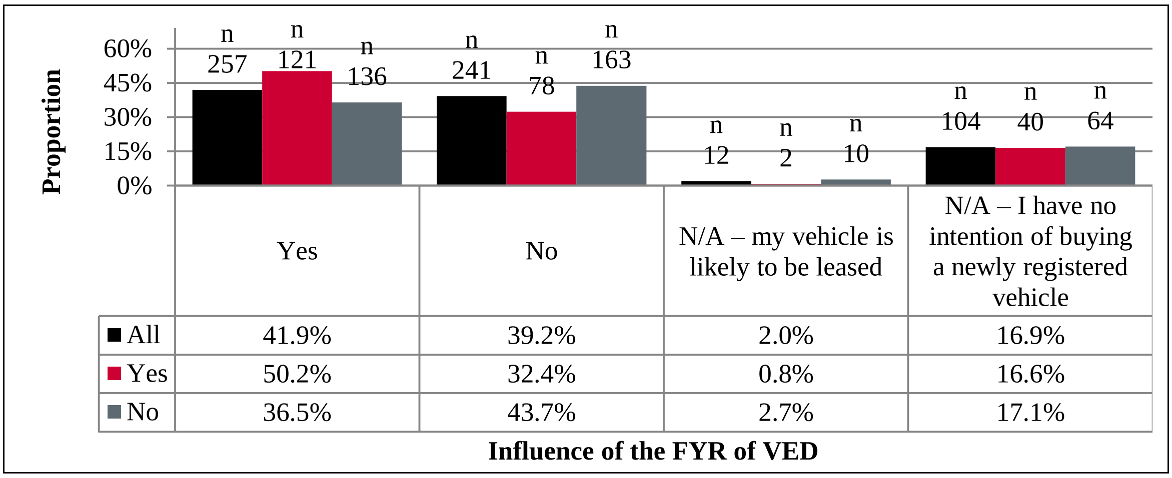


Figure 58: Influence of the FYR of VED in individuals' future vehicle purchasing decisions, according to initial awareness of the FYR of VED

6.2.2 VAT

Respondents were asked to indicate whether VAT could potentially inform their future vehicle purchasing decisions towards a lower emission vehicle. 88.8% of future vehicle purchasing decisions could be influenced by VAT. By contrast, 1.5% stated their future vehicle was likely to be leased and 3.4% expected to purchase their future vehicle privately. Both considerations render VAT as N/A to future vehicle purchasing decisions. A final 6.3% declared no VAT increase/decrease would affect their future vehicle purchasing decisions to purchase a lower emission vehicle (***Table 38***).

Table 38: The potential influence of VAT in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle

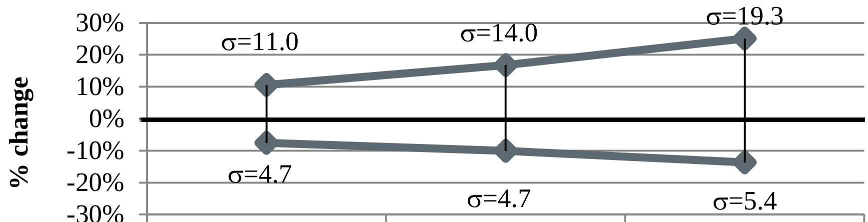
Influence of VAT	n	%
Yes	521	88.8%
No – my vehicle is likely to be leased	9	1.5%
No – I would be involved in a private vehicle sale	20	3.4%
No level of VAT increase/decrease would influence my motoring behaviour	37	6.3%
TOTAL	**587**	**100.0%**

Respondents were asked to indicate whether a VAT increase/decrease would be most influential in their future vehicle purchasing decisions to purchase a lower emission vehicle. A VAT reduction was found to be more influential to the majority of respondents (64.6%). Conversely, a VAT increase was deemed more influential for only 35.4% of respondents (***Table 39***).

Table 39: Change in VAT with the greatest influence in individuals' future vehicle purchasing decisions for a lower emission vehicle

Change in VAT with the greatest influence	n	%
Tax increase (disincentive)	175	35.4%
Tax decrease (incentive)	320	64.6%
TOTAL	**495**	**100.0%**

Respondents were asked to indicate the level of VAT necessary to start thinking about, seriously think about and definitely buy a lower emission vehicle. An average increase of 10.6% would be necessary to start thinking about buying a lower emission vehicle. A VAT increase of 16.8% would be required to seriously think about making such a purchase, and a 25.1% increase would be necessary to definitely buy a lower emission vehicle. In contrast, a VAT reduction of 7.6% would be required to start thinking about a future lower emission vehicle purchase. A 10.1% VAT reduction would be necessary to seriously think about buying a lower emission vehicle, and a 13.7% reduction would be required to definitely buy such a vehicle (***Figure 59***).



	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle
Increase in VAT for a new vehicle with equal or greater emissions than my current vehicle	10.6%	16.8%	25.1%
Decrease in VAT for a new vehicle with lower emissions than my current vehicle	-7.6%	-10.1%	-13.7%

Stages of behaviour change

Figure 59: Average VAT increases/decreases necessary for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle

The exact level of VAT increase/decrease necessary to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase can be examined. The ratio of losses-to-gains is 1.4:1 to start thinking about buying a lower emission vehicle, 1.7:1 to seriously think about buying such a vehicle and 1.8:1 to definitely buy a lower emission vehicle.

The necessary VAT increases/decreases can be presented based on the 2012/13 rate of 20%. That is, the absolute VAT rate necessary to engage in the behaviour change process towards a lower emission vehicle purchase. Results indicate VAT would have to rise to 30.6% for a higher emitting vehicle for individuals to start thinking about buying a lower emission vehicle. VAT of 36.8% would be necessary for individuals to seriously think about buying a lower emission vehicle, whilst 45.1% VAT would be required to definitely purchase such a vehicle. In terms of reducing VAT, results indicate 12.4% VAT on a lower emission vehicle would be required for individuals to start thinking about purchasing such a vehicle. 9.9% VAT would be necessary for individuals to seriously think about buying a lower emission vehicle, whilst 6.3% VAT would be required to definitely buy such a vehicle.

6.2.3 HOD

Respondents were asked to indicate whether HOD could potentially inform their future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuels. The majority of individuals’ future vehicle purchasing decisions could be influenced towards a lower emission vehicle through a change in HOD (90.4%). In contrast, the remaining 9.6% stated no HOD increase/decrease would influence their future vehicle purchasing decisions (***Table 40***).

Table 40: The potential influence of HOD in shaping individuals’ future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuels

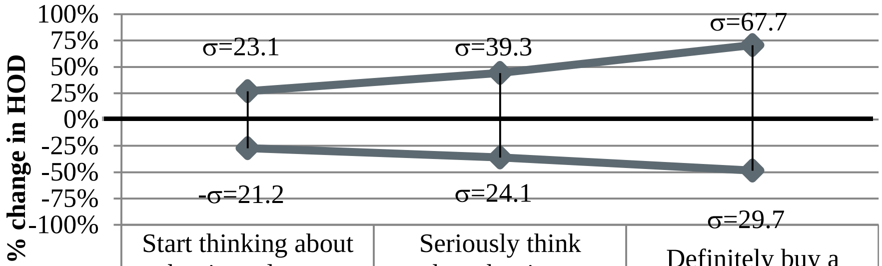
Influence of HOD	n	%
Yes	516	90.4%
No level of HOD increase/decrease would influence my motoring behaviour	55	9.6%
TOTAL	**571**	**100.0%**

Respondents were asked to indicate whether a HOD increase/decrease would be most influential in their future vehicle purchasing decisions to purchase a lower emission vehicle utilising ‘greener’ fuels. A HOD reduction would be more influential for the majority of respondents (63.2%). Conversely, only 36.8% would find a HOD increase more influential in shaping their future vehicle purchasing behaviour (***Table 41***).

Table 41: Change in HOD with the greatest influence in individuals’ future vehicle purchasing decisions for a lower emission vehicle utilising ‘greener’ fuels

Change in HOD with the greatest influence	n	%
Tax increase (disincentive)	185	36.8%
Tax decrease (incentive)	318	63.2%
TOTAL	**503**	**100.0%**

Respondents were asked to indicate the level of HOD necessary to start thinking about, seriously think about and definitely buy a lower emission vehicle utilising ‘greener’ fuels. A 26.9% main road-fuel HOD increase would be necessary for individuals to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels in the future. An increase of 44.2% would be necessary to seriously think about making the purchase; whilst an increase of 70.6% would be required to definitely buy a lower emission vehicle utilising ‘greener’ fuels. In contrast, a 27.2% HOD decrease for ‘greener’ fuels, relative to the main road-fuel HOD, would be necessary to start thinking about purchasing a lower emission vehicle utilising such fuels. A 36.1% reduction would be required for individuals to seriously think about purchasing a lower emission vehicle utilising ‘greener’ fuels; whilst a 48.5% HOD reduction would be necessary to definitely buy such a vehicle (***Figure 60***).



	Start thinking about buying a lower emission vehicle running on 'greener' fuels	Seriously think about buying a lower emission vehicle running on 'greener' fuels	Definitely buy a lower emission vehicle running on 'greener' fuels
Increase in HOD for petrol and diesel	26.8%	44.2%	70.6%
Decrease in HOD for 'greener' fuels	-27.2%	-36.1%	-48.5%

Stages of behaviour change

Figure 60: Average HOD increases/decreases necessary for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle utilising ‘greener’ fuels

The exact level of HOD increase/decrease necessary to instigate the same progress in the behaviour change process towards the purchase of a lower emission vehicle utilising ‘greener’ fuels is subsequently considered. The ratio of losses-to-gains is 1:1 for individuals to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. The ratio rises to 1.2:1 to seriously think about buying such a vehicle, and 1.5:1 to definitely buy a lower emission vehicle utilising ‘greener’ fuels.

The necessary HOD percentage increases/decreases for main road-fuels and ‘greener’ fuels can be presented in financial terms based on 2012/13 HOD rates. Results indicate 73.54 PPL HOD for petrol/diesel would be necessary to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. Main road-fuel HOD of 83.56PPL would be required to seriously think about buying such a vehicle, whilst 98.86PPL would be necessary to definitely buy a lower emission vehicle utilising ‘greener’ fuels. In contrast, HOD of 42.19PPL for ‘greener’ fuels would be necessary for individuals to start thinking about buying a lower emission vehicle utilising such fuels. 37.03PPL HOD would be required to seriously think about purchasing such a vehicle, whilst 29.84PPL would be necessary to definitely purchase a lower emission vehicle utilising ‘greener’ fuels.

6.2.4 PICG

Respondents were asked to indicate whether the PICG could potentially inform their future vehicle purchasing behaviour towards an eligible lower emission vehicle. The majority of individuals’ future vehicle purchasing decisions could be influenced towards a lower emission vehicle through the PICG (79%). 1.2% indicated their future vehicle would be leased, thus rendering the PICG as N/A. A further 10.5% did not intend to purchase a newly registered vehicle. This is a requirement of the PICG scheme, also rendering this taxation measure inapplicable in future vehicle purchasing decisions. 3.4% of respondents indicated no interest in PICG vehicle technologies, irrespective of potential subsidies. A final 5.9% indicated no level of PICG would influence their future vehicle purchasing behaviour (***Table 42***).

Table 42: The potential influence of the PICG in shaping individuals’ future vehicle purchasing behaviour towards a PICG qualifying lower emission vehicle

Influence of PICG	n	%
Yes	466	79.0%
No – my vehicle is likely to be leased	7	1.2%
No – I have no intention of buying a newly registered vehicle	62	10.5%
No – I have no interest in PICG vehicle technologies	20	3.4%
No level of PICG would influence my motoring behaviour	35	5.9%
TOTAL	**590**	**100.0%**

Respondents were asked to indicate the level of PICG necessary to start thinking about, seriously think about and definitely buy an eligible lower emission vehicle. A 30.7% purchase price reduction of a PICG qualifying vehicle would be necessary for individuals to start thinking about buying such a vehicle. A subsidy of 39.6% would be required to seriously think about purchasing an eligible vehicle, whilst a 51.3% subsidy would be necessary to definitely purchase such a vehicle (***Figure 61***).

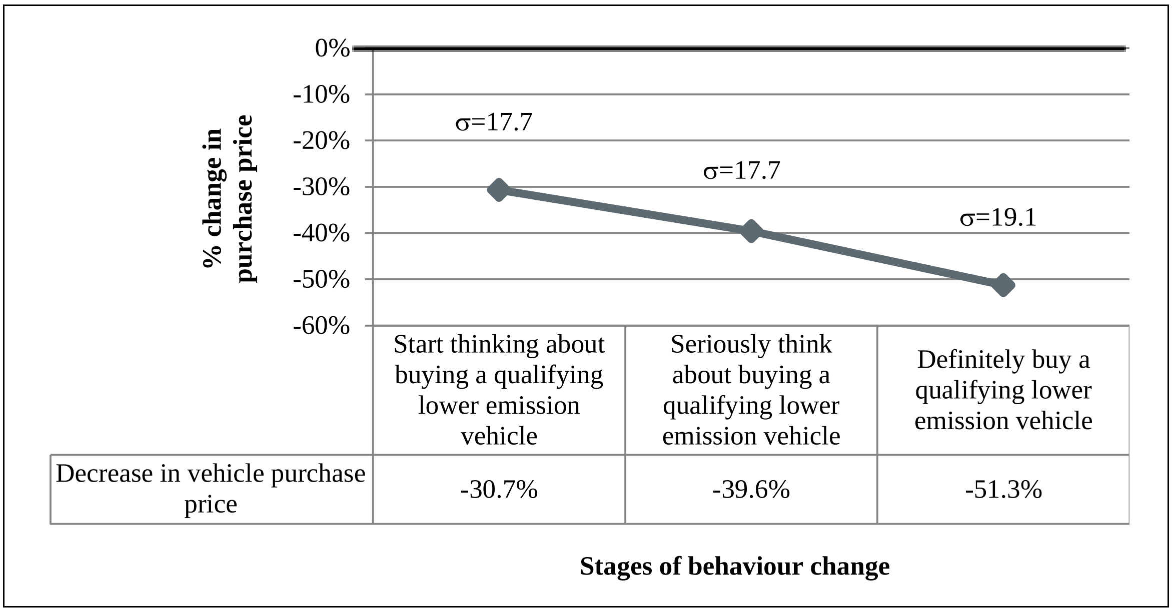


Figure 61: Average purchase price reductions of a PICG qualifying vehicle necessary for individuals to start thinking about, seriously think about and definitely buy a PICG qualifying lower emission vehicle

The average starting price[39] of a vehicle qualifying for the PICG, calculated by the researcher in January 2013 is £30,262. Indeed, the DFT (2012c) estimate a figure of £25,000-£30,000. The reported level of PICG can be converted from percentages into financial terms using the average price of a PICG qualifying vehicle. Results indicate £9,291 PICG would be required to start thinking about buying a qualifying lower emission vehicle. A £11,984 PICG incentive would be necessary to seriously think about buying such a vehicle, whilst a £15,525 PICG would be required to definitely buy a qualifying lower emission vehicle.

6.3 Adaptation of current taxation policy to encourage a lower emission vehicle purchase, by strength of individuals' BI to purchase a lower emission vehicle in the future

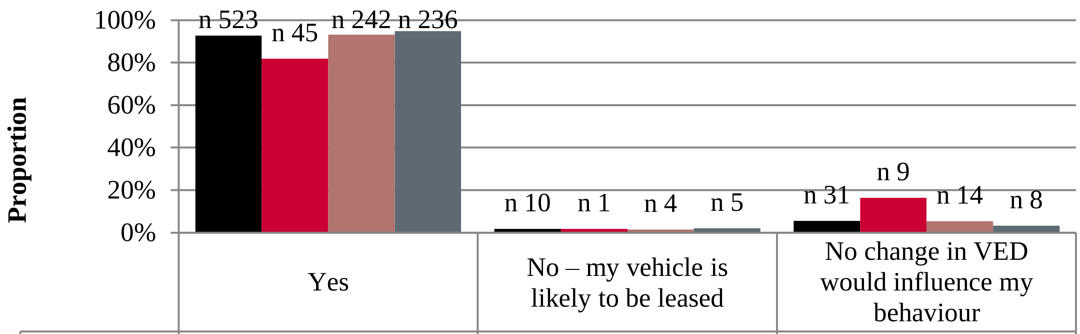
The changes to current taxation policy required to encourage a lower emission vehicle purchase were explored for the three strengths of individuals' BI to purchase a lower

[39] Where: the Renault Fluence ZE starts at £22,495 (http://www.renault-ze.com/en-gb/z.e.-range/fluence-z.e./fluence-z.e.-1935.html); Peugeot iOn at £26,216 (http://www.peugeot.co.uk/media/peugeot-ion-prices-and-specifications-brochure.pdf); Mitsubishi i-MiEV at £28,900 (http://www.mitsubishi-cars.co.uk/imiev/); Nissan Leaf at £30,990 (http://www.nissan.co.uk/vehicles/electric-vehicles/electric-leaf/leaf.html#vehicles/electric-vehicles/electric-leaf/leaf); Toyota Prius plug-in hybrid at £33,245 (http://www.toyota.co.uk/cgi-bin/toyota/bv/frame_start.jsp?id=CC2-Prius-Plug-landing); and the Vauxhall Ampera and Chevrolet Volt at £34,995 (http://www.vauxhall.co.uk/vehicles/vauxhall-range/cars/ampera/index.html and https://www.chevrolet.co.uk/cars/volt/). No pricing details were available in January 2013 for the Citroen Czero, Mia, and the Smart fortwo electric drive.

emission vehicle in the future. This section will illustrate whether the strength of individuals' BI to purchase a lower emission vehicle impacts upon changes necessary to current taxation policy, that is VED, VAT, HOD and the PICG, to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle.

6.3.1 VED

The result of the chi-squared test indicates a significant association between the potential influence of VED in individuals' future vehicle purchasing decisions towards a lower emission vehicle and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(10)=13.265$, $p>0.05$). A greater proportion of Low BI individuals' future vehicle purchasing decisions would not be influenced towards a lower emission vehicle by a VED increase/decrease (10.9%). Conversely, a greater share of Medium (+0.4%) and High BI individuals (+2.1%) could be influenced by VED in their future vehicle purchasing decisions. Furthermore, there is a 0.2% greater proportion of High BI individuals envisaging their next vehicle as leased. This therefore renders VED as N/A in their future vehicle purchasing decisions (***Figure 62***).

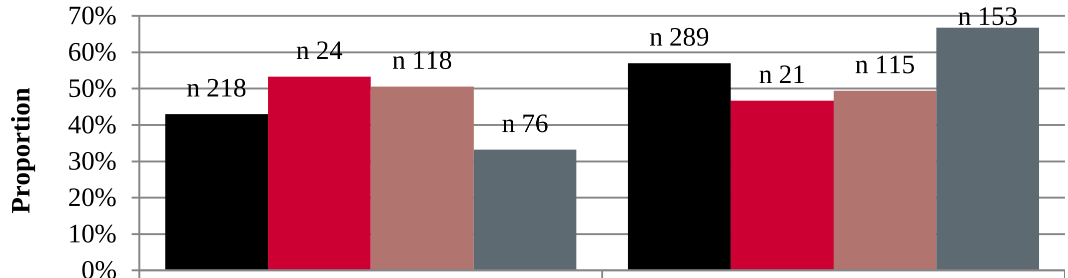


	Yes	No – my vehicle is likely to be leased	No change in VED would influence my behaviour
All	92.7%	1.8%	5.5%
Low BI	81.8%	1.8%	16.4%
Medium BI	93.1%	1.5%	5.4%
High BI	94.8%	2.0%	3.2%

Influence of VED

Figure 62: The potential influence of VED in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

The result of the chi-squared test indicates a significant association between the type of VED price signal most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(2)=16.510$, $p<0.05$). There is a 10.3% and 7.6% greater proportion of Low and Medium BI individuals respectively who would be most influenced by a VED increase. In contrast, there is a 9.8% larger share of High BI individuals who would be more influenced by a VED decrease (***Figure 63***).



	Tax increase (disincentive)	Tax decrease (incentive)
All	43.0%	57.0%
Low BI	53.3%	46.7%
Medium BI	50.6%	49.4%
High BI	33.2%	66.8%

Change in VED with the greatest influence

Figure 63: Change in VED with the greatest influence in individuals' future vehicle purchasing decisions for a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

A one-way ANOVA was used to test the relationship between the level of VED necessary to instigate individuals' future vehicle purchasing decisions towards a lower emission vehicle and the strength of individuals' BI to purchase a lower emission vehicle in the future. A main effect was observed for the level of VED reduction to start thinking about buying a lower emission vehicle (***Table 43***). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 44***). No main effect was observed for the other stages in the behaviour change process. The results for each BI segment are subsequently presented.

Table 43: Results of the one-way ANOVAs for the level of VED to instigate the vehicle purchasing decision towards a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

Stages in the behaviour change process		One-way ANOVA
VED increase for a new vehicle with equal/greater emissions than my current vehicle	Start thinking about buying a lower emission vehicle	$F(2,261)=2.891$, $p>0.05$
	Seriously think about buying a lower emission vehicle	$F(2,261)=2.430$, $p>0.05$
	Definitely buy a lower emission vehicle	$F(2,261)=3.027$, $p>0.05$
VED decrease for a new vehicle with lesser emissions than my current vehicle	Start thinking about buying a lower emission vehicle	$F(2,311)=3.997$, $p<0.05$
	Seriously think about buying a lower emission vehicle	$F(2,311)=2.248$, $p>0.05$
	Definitely buy a lower emission vehicle	$F(2,311)=0.971$, $p>0.05$

Table 44: Average range of increases/decreases of VED necessary for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle, by the strength of individuals' BI to purchase a lower emission vehicle in the future

VED		All		Strength of individuals' BI					
				Low BI (1)		Medium BI (2)		High BI (3)	
		n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
Increase for a new vehicle with equal/greater emissions than my current vehicle	Start thinking about buying a lower emission vehicle	264	+51.4% (60.9)	27	+58.7% (43.3)	141	+58.1% (73.4)	96	+39.6% (39.9)
	Seriously think about buying a lower emission vehicle	264	+82.1% (99.4)	27	+98.5% (103.4)	141	+90.9% (116.4)	96	+64.6% (62.7)
	Definitely buy a lower emission vehicle	264	+129.0% (162.9)	27	+172.0% (216.9)	141	+141.2% (182.2)	96	+98.9% (100.1)
Decrease for a new vehicle with lesser emissions than my current vehicle	Start thinking about buying a lower emission vehicle	314	-34.7% (22.4)	21	-38.8% (20.6)	131	-38.3%$^{+3}$ (24.9)	162	-31.2%$^{-2}$ (20.1)
	Seriously think about buying a lower emission vehicle	314	-45.0% (24.4)	21	-47.9% (22.8)	131	-48.1% (26.3)	162	-42.2% (22.9)
	Definitely buy a lower emission vehicle	314	-58.8% (29.1)	21	-60.2% (26.2)	131	-61.3% (29.5)	162	-56.6% (29.2)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments (p<0.05) derived from Scheffé post-hoc tests.

Low BI: The biggest VED increase would be required by Low BI individuals to encourage a lower emission vehicle purchase. Specifically, a VED increase of 58.7% to start thinking about buying a lower emission vehicle; a 98.5% increase to seriously think about making such a purchase; and a 172.0% increase to definitely buy a lower emission vehicle. To incentivise a lower emission vehicle purchase through a VED saving, Low BI individuals would need the biggest VED reduction to start thinking about buying a lower emission vehicle (-38.8%). The necessary VED reduction to seriously think about (-48.9%) and definitely buy a lower emission vehicle (-60.2%) is greater than High BI individuals, but less than Medium BI individuals.

Medium BI: This segment would need a VED increase for all three stages in the behaviour change process greater than High BI individuals, but lower than Low BI individuals. That is, a 58.1% increase would be required to start thinking about buying a lower emission vehicle; increasing to 90.9% to seriously think about making such a purchase; and further increasing to 141.2% to definitely purchase a lower emission vehicle. To incentivise a lower emission vehicle purchase, Scheffé post-hoc tests indicate the Medium BI segment would need a significantly greater VED reduction of 38.3% than High BI individuals. However, the 38.3% reduction is less than the level required by Low BI individuals. For the remaining stages of behaviour change, the VED reduction required by Medium BI individuals is greater than both other BI segments. Specifically, a 48.1% decrease to seriously think about and 61.3% to definitely purchase a lower emission vehicle.

High BI: The necessary VED increase/decrease to instigate all three stages in the behaviour change process is smaller than both other BI segments. Scheffé post-hoc tests indicate the VED reduction for High BI individuals to start thinking about buying a lower emission vehicle is significantly less than that required by Medium BI individuals. Specifically, High BI individuals would need a 39.6% VED increase or 31.3% decrease to start thinking about buying a lower emission vehicle. A 64.6% increase or 42.2% decrease would be necessary to seriously think about buying such a vehicle. Finally, a 98.9% increase or 56.6% decrease would be required to definitely buy a lower emission vehicle in the future.

The level of VED increase/decrease required to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase was subsequently evaluated. The ratio of losses-to-gains for Low BI individuals is 1.5:1 to start thinking about buying a lower emission vehicle, 2.1:1 to seriously think about purchasing such a vehicle and 2.9:1 to definitely purchase a lower emission vehicle. The ratio of losses-to-gains is 1.5:1 for Medium BI individuals to start thinking about buying a lower emission vehicle, 1.9:1 to seriously think about buying such a vehicle and 2.3:1 to definitely buy a lower emission vehicle. Finally, High BI individuals have intimated a losses-to-gains ratio of 1.3:1 to start thinking about buying a lower emission vehicle. This rises to 1.5:1 to seriously think about buying such a vehicle and 1.8:1 to definitely purchase a lower emission vehicle.

The reported VED percentage increases can be converted into financial terms. This is based on the CO_2 emissions of the vehicle most often used by the BI segments and the 2012/13 VED payment structure (***Table 45***). For example, 11.1% of Low BI individuals most often use a vehicle emitting 176-185g/km of CO_2 at present. £341.21 VED would be required by such individuals for a vehicle emitting 186g/km minimum to start thinking about buying a lower emission vehicle. £426.82 VED would be necessary to seriously think about purchasing such a vehicle, whilst £584.89 would be required to definitely buy a lower emission vehicle. Likewise, the reported VED reductions for Low, Medium and High BI individuals can be converted into financial terms, based on the 2012/13 VED payment structure (***Table 46***). For example, the 25.8% of Medium BI individuals most often drive a vehicle emitting 151-165g/km of CO_2 at present. Such individuals would require £104.98 VED to start thinking about buying a lower emission vehicle. £88.32 VED would be necessary to seriously think about buying such a vehicle, whilst £65.72 VED would be required to definitely buy a lower emission vehicle.

The result of the chi-squared test indicates no significant association between the initial awareness of the FYR of VED and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(2)=2.159$, $p>0.05$). There is a greater share of individuals who were previously unaware of the FYR of VED who had either a Low (+4.4%) or Medium BI (+2.1%). Conversely, a larger proportion of High BI individuals were previously aware of the FYR of VED (+3.2%).

The result of the chi-squared test indicates a significant association between the influence of the FYR of VED and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(6)=20.052$, $p<0.05$). A greater proportion of Low (+14.3%) and Medium BI individuals (+5.0%) would not be influenced by the FYR of VED in their future vehicle purchasing decisions. In contrast, there is a 7.8% greater share of High BI individuals who could be influenced by the FYR. There is also a 0.6% greater share of High BI individuals who foresee their future vehicle as being leased. Furthermore, there is a greater proportion of Low (+2.4%) and High BI (+0.1%) individuals who do not intend to purchase a brand new vehicle. Both considerations render the FYR of VED as irrelevant in their future vehicle purchasing decisions (***Figure 64***).

6.3.2 VAT

The result of the chi-squared test indicates no significant association between the potential influence of VAT and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(6)=8.864$, $p>0.05$). A greater proportion of Low (+4.6%) or Medium BI (+0.8%) individuals' future vehicle purchasing decisions would not be influenced towards a lower emission vehicle by a VAT increase/decrease. Conversely, a greater

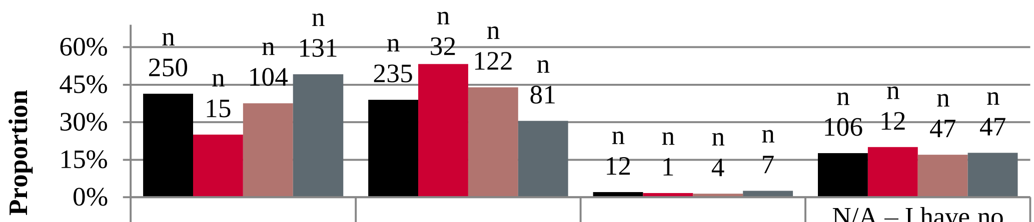
Table 45: VED necessary, after a tax increase and based on the 2012/13 VED payment structure, for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle, by the strength of individuals' BI to purchase a lower emission vehicle in the future

Tax Band (CO_2 emissions)	Low BI				Medium BI				High BI			
	% of Low BI individuals in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of Medium BI individuals in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of High BI individuals in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle
		+58.7%	+98.5%	+172.0%		+58.1%	+90.9%	+141.2%		+39.6%	+64.6%	+98.9%
A (=< 100)	0.0%	£0.00	£0.00	£0.00	0.0%	£0.00	£0.00	£0.00	0.5%	£0.00	£0.00	£0.00
B 101-110)	0.0%	£31.74	£39.70	£54.41	0.9%	£31.62	£38.18	£48.24	2.8%	£27.92	£32.93	£39.77
C (111-120)	5.1%	£47.61	£59.56	£81.61	4.2%	£47.42	£57.27	£72.37	3.4%	£41.87	£49.39	£59.66
D (121-130)	2.6%	£158.70	£198.52	£272.04	4.9%	£158.08	£190.90	£241.22	7.4%	£139.58	£164.64	£198.86
E (131-140)	7.7%	£190.44	£238.22	£326.45	9.5%	£189.70	£229.08	£289.46	12.0%	£167.50	£197.57	£238.63
F (141-150)	11.1%	£214.25	£268.00	£367.25	17.3%	£213.41	£257.72	£325.65	17.1%	£188.43	£222.26	£268.46
G (151-165)	30.8%	£269.79	£337.48	£462.47	25.8%	£268.74	£324.53	£410.07	21.8%	£237.29	£279.89	£338.06
H (166-175)	9.4%	£309.47	£387.11	£530.48*	6.1%	£308.26	£372.26	£470.38	8.8%	£272.18	£321.05	£387.78
I (176-185)	11.1%	£341.21	£426.82	£584.89*	9.7%	£339.87	£410.44	£518.62*	11.3%	£300.10	£353.98	£427.55
J (186-200)	6.0%	£396.75	£496.30*	£680.10*	8.5%	£395.20	£477.25*	£603.05*	5.8%	£348.95	£411.60	£497.15*
K (201-225)	4.3%	£428.49	£536.00*	£734.51*	8.3%	£426.82	£515.43*	£651.29*	6.0%	£376.87	£444.53	£536.92*
L (226-255)	6.0%	£730.02*	£913.19*	£1,251.38*	2.3%	£727.17*	£878.14*	£1,109.61*	2.3%	£642.07*	£757.34*	£914.76*
M (>=256)	6.0%	£753.83*	£942.97*	£1,292.19*	2.6%	£750.88*	£906.78*	£1,145.80*	0.9%	£663.01*	£782.04*	£944.59*

** These entries are not achievable with the 2012/13 VED payment structure, going beyond £475 per annum.*

Table 46: VED necessary, after a tax decrease and based on the 2012/13 VED payment structure, for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle, by the strength of individuals' BI to purchase a lower emission vehicle in the future

Tax Band (CO_2 emissions)	Low BI				Medium BI				High BI			
	% of Low BI individuals in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of Medium BI individuals in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of High BI individuals in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle
		- 38.8%	- 47.9%	- 60.2%		- 38.3%	- 48.1%	- 61.3%		- 31.2%	- 42.2%	- 56.6%
A (=< 100)	0.0%	£0.00	£0.00	£0.00	0.0%	£0.00	£0.00	£0.00	0.5%	£0.00	£0.00	£0.00
B 101-110)	0.0%	£12.24	£10.43	£7.95	0.9%	£12.35	£10.39	£7.73	2.8%	£13.75	£11.56	£8.67
C (111-120)	5.1%	£18.36	£15.64	£11.93	4.2%	£18.53	£15.59	£11.60	3.4%	£20.63	£17.34	£13.01
D (121-130)	2.6%	£61.19	£52.14	£39.76	4.9%	£61.75	£51.95	£38.66	7.4%	£68.76	£57.81	£43.36
E (131-140)	7.7%	£73.43	£62.57	£47.71	9.5%	£74.10	£62.34	£46.39	12.0%	£82.51	£69.37	£52.03
F (141-150)	11.1%	£82.61	£70.39	£53.68	17.3%	£83.36	£70.13	£52.19	17.1%	£92.83	£78.04	£58.54
G (151-165)	30.8%	£104.02	£88.64	£67.59	25.8%	£104.98	£88.32	£65.72	21.8%	£116.89	£98.28	£73.71
H (166-175)	9.4%	£119.32	£101.67	£77.53	6.1%	£120.41	£101.30	£75.39	8.8%	£134.08	£112.73	£84.55
I (176-185)	11.1%	£131.56	£112.10	£85.48	9.7%	£132.76	£111.69	£83.12	11.3%	£147.83	£124.29	£93.22
J (186-200)	6.0%	£152.98	£130.35	£99.40	8.5%	£154.38	£129.88	£96.65	5.8%	£171.90	£144.53	£108.40
K (201-225)	4.3%	£165.21	£140.78	£107.35	8.3%	£166.73	£140.27	£104.38	6.0%	£185.65	£156.09	£117.07
L (226-255)	6.0%	£281.47	£239.84	£182.90	2.3%	£284.05	£238.97	£177.84	2.3%	£316.30	£265.93	£199.46
M (>=256)	6.0%	£290.65	£247.67	£188.86	2.6%	£293.31	£246.76	£183.64	0.9%	£326.61	£274.60	£205.96



	Yes	No	N/A – my vehicle is likely to be leased	N/A – I have no intention of buying a newly registered vehicle
■ All	41.4%	39.0%	2.0%	17.6%
■ Low BI	25.0%	53.3%	1.7%	20.0%
■ Medium BI	37.6%	44.0%	1.4%	17.0%
■ High BI	49.2%	30.5%	2.6%	17.7%

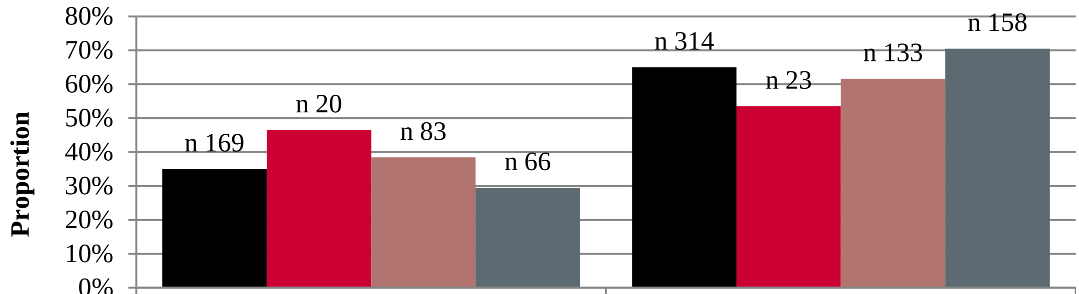
Influence of FYR of VED

Figure 64: Influence of the FYR of VED in individuals' future vehicle purchasing decisions, by strength of individuals' BI to purchase a lower emission vehicle in the future

share of High BI individuals' could be influenced by VAT in shaping their future vehicle purchasing decisions (+3.3%). Regarding the non-applicability of VAT, there is a greater proportion of individuals anticipating their next vehicle as leased in the Low (+0.3%) and High BI segment (+0.1%). Furthermore, there is a greater share of individuals who foresee a private vehicle purchase in the Low BI (+3.6%) or Medium BI segment (+0.7%).

The result of the chi-squared test indicates a significant association between the type of VAT price signal most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(2)=6.637$, $p<0.05$). There is a larger proportion of individuals with either a Low (+11.5%) or Medium BI (+3.4%) who would be more influenced by a VAT increase in their future vehicle purchasing decisions to acquire a lower emission vehicle. In contrast, there is a 5.5% larger share of High BI individuals who would be more influenced by a VAT decrease (***Figure 65***).

A one-way ANOVA was used to test the relationship between the level of VAT necessary to instigate the vehicle purchasing decision towards a lower emission vehicle and the strength of individuals' BI to purchase a lower emission vehicle in the future. No main effect was observed (***Table 47***). The results for each BI segment are subsequently presented.



	Tax increase (disincentive)	Tax decrease (incentive)
■ All	35.0%	65.0%
■ Low BI	46.5%	53.5%
■ Medium BI	38.4%	61.6%
■ High BI	29.5%	70.5%

Change in VAT with the greatest influence

Figure 65: Change in VAT with the greatest influence in individuals' future vehicle purchasing decisions for a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

Table 47: Results of the one-way ANOVAs for the level of VAT to instigate individuals' future vehicle purchasing decisions towards a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

Stages in the behaviour change process		One-way ANOVA
VAT increase for a new vehicle with equal/greater emissions than my current vehicle	Start thinking about buying a lower emission vehicle	F(2,212)=1.083, p>0.05
	Seriously think about buying a lower emission vehicle	F(2,212)=1.562, p>0.05
	Definitely buy a lower emission vehicle	F(2,212)=2.844, p>0.05
VAT decrease for a new vehicle with lesser emissions than my current vehicle	Start thinking about buying a lower emission vehicle	F(2,343)=3.071, p>0.05
	Seriously think about buying a lower emission vehicle	F(2,343)=1.975, p>0.05
	Definitely buy a lower emission vehicle	F(2,343)=0.971, p>0.05

Low BI: The necessary VAT increase to instigate all three stages in the behaviour change process is larger for Low BI individuals than the increase required by Medium and High BI individuals. Specifically, a 13.7% VAT increase (σ=13.5) would be necessary for Low BI individuals to start thinking about buying a lower emission vehicle. A 21.4% increase (σ=14.9) would be required to seriously think about making such a purchase. Ultimately, a 32.7% increase (σ=18.2) would be necessary to definitely purchase a lower emission vehicle in the future. Low BI individuals also require the largest VAT reduction to start thinking about and seriously think about purchasing a lower emission vehicle, i.e. a 9.1% (σ=5.8) and 11.0% reduction respectively (σ=5.4). However, for Low BI individuals to definitely buy a lower emission vehicle, the lowest VAT reduction of all BI segments would be required in their future vehicle purchasing decisions, i.e. a 13.3% reduction (σ=5.5).

Medium BI: This segment would need a VAT increase greater than High BI individuals, but less than Low BI individuals to instigate all three stages in the behaviour change process. Namely, an increase of 10.6% (σ=9.7) would be necessary to start thinking about buying a lower emission vehicle in the future. An increase of 17.0% (σ=13.6) would be required to seriously think about making such a purchase, whilst a 25.8% increase (σ=19.6) would be necessary to definitely purchase a lower emission vehicle. Medium BI individuals also require a VAT decrease greater than High BI individuals, but less than those with a Low BI to start thinking about and seriously think about buying a lower emission vehicle. Specifically a VAT reduction of 8.0% (σ=4.5) and 10.6% respectively (σ=4.6). However, Medium BI individuals would require the greatest VAT reduction of all segments to definitely purchase a lower emission vehicle, i.e. a VAT decrease of 14.2% (σ=5.3).

High BI: The VAT increase necessary to instigate all three stages of the behaviour change process is lowest for High BI individuals. Namely, an increase of 9.0% (σ=12.1) would be required to start thinking about buying a lower emission vehicle. An increase of 15.5% (σ=14.4) would be necessary to seriously think about making such a purchase, whilst a 22.1% increase (σ=19.0) would be required to definitely purchase a lower emission vehicle. The VAT decrease required to start thinking about and seriously think about buying a lower emission vehicle is also lowest for High BI individuals, i.e. a 7.0% (σ=4.7) and 9.7% decrease respectively (σ=4.6). However, the VAT reduction necessary for High BI individuals is higher than the Low BI segment, but lower than Medium BI individuals, i.e. a 13.4% decrease (σ=5.4).

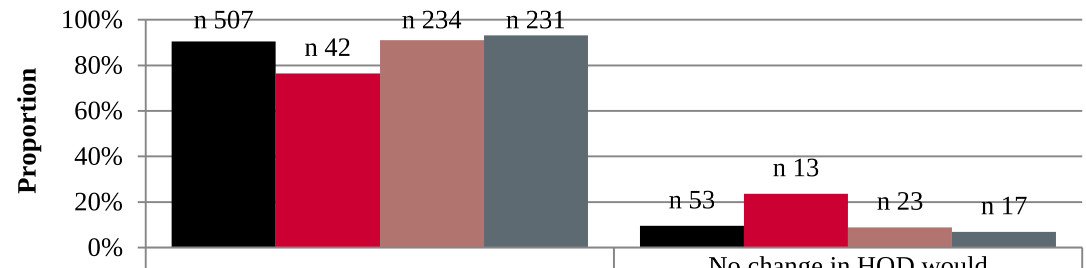
The level of VAT increase/decrease required to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase was considered. The ratio of losses-to-gains for Low BI individuals is 1.5:1 to start thinking about buying a lower emission vehicle, 1.9:1 to seriously think about purchasing such a vehicle, and 2.5:1 to definitely purchase a lower emission vehicle. The ratio of losses-to-gains for Medium BI individuals is 1.3:1 to start thinking about buying a lower emission vehicle, 1.6:1 to seriously think about buying such a vehicle and 1.8:1 to definitely purchase a lower emission vehicle. Finally, High BI individuals have a losses-to-gains ratio of 1.4:1 to start thinking about buying a lower emission vehicle. This rises to 1.6:1 to seriously think about buying such a vehicle and 1.7:1 to definitely purchase a lower emission vehicle.

The necessary VAT increases/decreases can be presented based on the 2012/13 rate of 20% VAT. Namely, the rate of VAT necessary to engage in the behaviour change process towards a lower emission vehicle purchase. Results indicate Low BI individuals would require 33.7% VAT for a higher emitting vehicle to start thinking about buying a lower emission vehicle. VAT would have to further increase to 41.4% to seriously think about buying such a vehicle, whilst VAT of 52.7% would be necessary to definitely buy a lower emission vehicle. Medium BI individuals would need VAT of 30.6% to start thinking about buying a lower emission vehicle. 37.0% would be required for such individuals to seriously think about buying a lower emission vehicle, whilst 45.8% would be necessary to definitely purchase such a vehicle. High BI individuals would need VAT to rise to 29.8% to start thinking about buying a lower emission vehicle, 35.5% to seriously think about, and 42.1% to definitely buy such a vehicle.

To incentivise a lower emission vehicle purchase with VAT, Low BI individuals would need VAT to fall to 10.9% to start thinking about buying a lower emission vehicle. VAT of 9.0% would be required to seriously think about buying such a vehicle, whilst 6.7% would be necessary to definitely purchase a lower emission vehicle. Medium BI individuals would need VAT of 12.0% to start thinking about buying a lower emission vehicle. This would have to fall to 9.4% to seriously think about purchasing such a vehicle. Finally, 5.8% VAT would be required to definitely buy a lower emission vehicle. High BI individuals would need VAT of 13.0% to start thinking about buying a lower emission vehicle and 10.3% to seriously think about purchasing such a vehicle. To definitely buy a lower emission vehicle, High BI individuals would need VAT to fall to 6.6%.

6.3.3 HOD

The result of the chi-squared test indicates a significant association between the potential influence of HOD in individuals’ future vehicle purchasing decisions towards a lower emission vehicle utilising ‘greener’ fuels and the strength of individuals’ BI to purchase a lower emission vehicle in the future ($\chi^2(2)=14.942$, $p<0.05$). There is a 14.1% greater share of Low BI individuals who would not be influenced by a HOD increase/decrease in their future vehicle purchasing decisions. In contrast, there is a larger proportion of Medium (+0.6%) and High BI individuals (+2.6%) who could be influenced by HOD (***Figure 66***).



	Yes	No change in HOD would influence my behaviour
All	90.5%	9.5%
Low BI	76.4%	23.6%
Medium BI	91.1%	8.9%
High BI	93.1%	6.9%

Influence of HOD

Figure 66: The potential influence of HOD in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising 'greener' fuels, by strength of individuals' BI to purchase a lower emission vehicle in the future

The result of the chi-squared test indicates no significant association between the type of HOD price signal most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle utilising 'greener' fuels and the strength of individuals' BI to purchase a lower emission vehicle in the future ($\chi^2(2)=0.794$, $p>0.05$). There is a larger proportion of Low BI individuals (+6.3%) who are more influenced by a HOD increase. Conversely, a larger share of Medium (0.3%) and High BI individuals would be more influenced by a VAT reduction (0.9%).

A one-way ANOVA was used to test the relationship between the level of HOD necessary to instigate the vehicle purchasing decision towards a lower emission vehicle utilising 'greener' fuels and the strength of individuals' BI to purchase a lower emission vehicle. A main effect was observed between the levels of HOD increase necessary to instigate all three stages in the behaviour change process towards the purchase of a lower emission vehicle utilising 'greener' fuels (***Table 48***). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 49***). No main effect was observed for the equivalent HOD reduction. The results for each BI segment are subsequently presented.

Table 48: Results of the one-way ANOVAs for the level of HOD to instigate individuals' future vehicle purchasing decisions towards a lower emission vehicle utilising 'greener' fuels, by strength of individuals' BI to purchase a lower emission vehicle in the future

Stages in the behaviour change process		One-way ANOVA
HOD increase for petrol and/or diesel	Start thinking about buying a lower emission vehicle utilising 'greener' fuels	F(2,218)=4.927, p<0.05
	Seriously think about buying a lower emission vehicle utilising 'greener' fuels	F(2,218)=4.084, p<0.05
	Definitely buy a lower emission vehicle utilising 'greener' fuels	F(2,218)=4.163, p<0.05
Decrease in HOD for 'greener' fuels	Start thinking about buying a lower emission vehicle utilising 'greener' fuels	F(2,331)=0.285, p>0.05
	Seriously think about buying a lower emission vehicle utilising 'greener' fuels	F(2,331)=0.011, p>0.05
	Definitely buy a lower emission vehicle utilising 'greener' fuels	F(2,331)=0.001, p>0.05

Table 49: Average range of increases/decreases of HOD necessary for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle utilising 'greener' fuels, by strength of individuals' BI to purchase a lower emission vehicle in the future

HOD		All		Strength of individuals' BI					
				Low BI (1)		Medium BI (2)		High BI (3)	
		n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
HOD increase for petrol and/or diesel	Start thinking about buying a lower emission vehicle utilising 'greener' fuels	221	+27.3% (23.2)	20	+40.0%$^{+3}$ (29.7)	102	+28.8% (23.9)	99	+23.2%$^{-1}$ (20.1)
	Seriously think about buying a lower emission vehicle utilising 'greener' fuels	221	+44.8% (39.5)	20	+65.8%$^{+3}$ (55.9)	102	+46.4% (39.9)	99	+39.0%$^{-1}$ (33.8)
	Definitely buy a lower emission vehicle utilising 'greener' fuels	221	+71.5% (68.1)	20	+104.3%$^{+3}$ (98.1)	102	+76.5% (65.7)	99	+59.8%$^{-1}$ (60.9)
Decrease in HOD for 'greener' fuels	Start thinking about buying a lower emission vehicle utilising 'greener' fuels	334	-27.1% (21.2)	25	-29.2% (20.7)	157	-27.6% (22.5)	152	-26.3% (20.0)
	Seriously think about buying a lower emission vehicle utilising 'greener' fuels	334	-35.9% (24.2)	25	-36.6% (24.2)	157	-35.9% (24.1)	152	-35.8% (24.3)
	Definitely buy a lower emission vehicle utilising 'greener' fuels	334	-48.3% (29.7)	25	-48.2% (29.7)	157	-48.3% (28.2)	152	-48.2% (31.3)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments (p<0.05) derived from Scheffé post-hoc tests.

Low BI: The biggest HOD increase for main road-fuels would be required for Low BI individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle utilising 'greener' fuels. That is, HOD increases of 40.0%, 65.8% and 104.3% respectively, which are significant relative to High BI individuals. Low BI individuals also require the highest HOD decrease for 'greener' fuels to instigate the first two stages in the behaviour change process. Specifically, a 29.2% decrease would be required by Low BI individuals to start thinking about buying a lower emission vehicle utilising 'greener' fuel. A 36.6% decrease would be necessary to seriously think about making such a purchase. However, Low BI individuals require a HOD decrease greater than High BI individuals but less than Medium BI individuals to definitely buy a lower emission vehicle utilising 'greener' fuels. Namely, a 48.2% decrease in main road-fuel HOD.

Medium BI: This segment would need a HOD increase greater than High BI individuals, but less than Low BI individuals, to instigate all three stages in the behaviour change process towards the purchase of a lower emission vehicle utilising 'greener' fuels. Specifically: an increase of 28.8% to start thinking about, 46.4% increase to seriously think about and a 76.5% increase to definitely purchase such a vehicle. For the first two stages in the behaviour change process, Medium BI individuals would need a greater HOD reduction for 'greener' fuels than High BI individuals, but less than the Low BI segment. That is, a reduction of 27.6% to start thinking about buying a lower emission vehicle utilising 'greener' fuels, and a 35.9% reduction to seriously think about buying such a vehicle. The HOD reduction is, however, largest for Medium BI individuals to definitely buy a 'greener' fuelled vehicle, i.e. a 48.3% HOD reduction.

High BI: The HOD increase for main road-fuels necessary to instigate all three stages of the behaviour change process towards the purchase of a lower emission vehicle utilising 'greener' fuels is lowest for High BI individuals. The difference is significant relative to Low BI individuals. Likewise, High BI individuals also require the lowest HOD decrease for 'greener' fuels for all three stages in the behaviour change process. For High BI individuals to start thinking about buying a lower emission vehicle utilising 'greener' fuels, they would require a 23.2% increase or 26.3% decrease in HOD. A 39.0% increase or 35.8% decrease would be required to seriously think about making such a purchase. Finally, a 59.8% increase or 48.2% decrease would be necessary to definitely purchase a lower emission vehicle utilising 'greener' fuels.

The ratio of losses-to-gains regarding the level of HOD necessary by the BI segments was subsequently considered. Low BI individuals have intimated a ratio of 1.4:1 to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. This rises to 1.8:1 to seriously think about buying such a vehicle and 2.2:1 to definitely buy a lower emission vehicle utilising ‘greener’ fuels. The losses-to-gains ratio for Medium BI individuals is 1.0:1 to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. This increases to 1.3:1 to seriously think about it and 1.6:1 to definitely buy a lower emission vehicle utilising ‘greener’ fuels. Finally, High BI individuals have a losses-to-gains ratio of only 0.9:1 to start thinking about buying a lower emission vehicle. This increases to 1.1:1 to seriously think about purchasing such a vehicle and 1.2:1 to definitely buy a lower emission vehicle utilising ‘greener’ fuels.

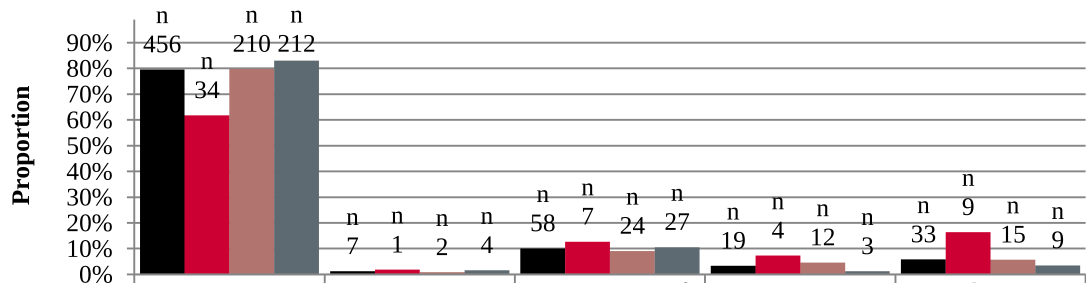
The range of HOD percentage increases/decreases necessary to instigate the behaviour change process towards the purchase of a lower emission vehicle utilising ‘greener’ fuels can be presented in financial terms based on 2012/13 HOD rates. Results indicate petrol/diesel HOD would have to increase to 81.13PPL for Low BI individuals to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. HOD would have to increase to 96.08PPL to seriously think about buying such a vehicle, whilst 118.39PPL would be necessary to definitely purchase a lower emission vehicle utilising ‘greener’ fuels. Medium BI individuals would require HOD to increase to 74.64PPL to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. This would have to increase to 84.84PPL to seriously think about buying a lower emission vehicle utilising ‘greener’ fuels, but 102.28PPL to definitely purchase such a vehicle. High BI individuals would require HOD of 71.39PPL to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels, 80.55PPL to seriously think about it, and 92.6PPL to definitely buy such a vehicle.

Regarding the level of HOD reduction for ‘greener’ fuels, Low BI individuals would require HOD to fall to 41.03PPL to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. It would have to fall further to 36.74PPL to seriously think about buying such a vehicle, whilst 30.02PPL would be required to definitely purchase a lower emission vehicle utilising ‘greener’ fuels. Medium BI individuals would require HOD to reduce to 41.96PPL to start thinking about buying a lower emission vehicle, and 37.15PPL to seriously think about making the purchase. However, to definitely buy a lower emission vehicle utilising ‘greener’ fuels, HOD would have to reduce to 29.96PPL.

High BI individuals would require HOD of 42.71PPL to start thinking about, 37.2PPL to seriously think about and 30.02PPL to definitely buy a lower emission vehicle utilising ‘greener’ fuels.

6.3.4 PICG

The result of the chi-squared test indicates a significant association between the potential influence of the PICG in individuals’ future vehicle purchasing decisions towards a qualifying lower emission vehicle and the strength of individuals’ BI to purchase a lower emission vehicle in the future ($\chi^2(8)=24.431$, $p<0.05$). A greater proportion of Low BI individuals’ future vehicle purchasing decisions would not be influenced towards a qualifying lower emission vehicle by any level of PICG (+10.6%). In contrast, there is a greater share of the Medium (0.2%) and High BI individuals (3.5%) who could be influenced by the PICG in their future vehicle purchasing decisions. There is a greater proportion of Low (+0.6%) and High BI individuals (+0.4%) who anticipate their next vehicle to be leased. There is also a greater proportion of Low (+2.6%) or High BI individuals (+0.5%) who foresee their next vehicle to be acquired used. Both considerations render the PICG as N/A. Furthermore, there is a greater share of Low (+4%) or Medium BI individuals (+1.3%) who have no interest in PICG vehicle technologies (***Figure 67***).



	Yes	No – my vehicle is likely to be leased	No intention of buying a newly registered vehicle	No interest in PICG vehicle technologies	No change in PICG would influence my behaviour
All	79.6%	1.2%	10.1%	3.3%	5.8%
Low BI	61.8%	1.8%	12.7%	7.3%	16.4%
Medium BI	79.8%	0.8%	9.1%	4.6%	5.7%
High BI	83.1%	1.6%	10.6%	1.2%	3.5%

Influence of PICG

Figure 67: The potential influence of the PICG in shaping individuals’ future vehicle purchasing behaviour towards a PICG qualifying lower emission vehicle, by strength of individuals’ BI to purchase a lower emission vehicle in the future

A one-way ANOVA was used to test the relationship between the level of PICG necessary to instigate the vehicle purchasing decision towards a qualifying lower emission vehicle and the strength of individuals' BI to purchase a lower emission vehicle in the future. No main effect was observed for any of the stages in the behaviour change process ($F(2,453)=1.211$, $p>0.05$ for the level of PICG to start thinking about buying an eligible lower emission vehicle; $F(2,453)=1.271$, $p>0.05$ to seriously think about; and $F(2,453)=1.825$, $p>0.05$ to definitely purchase such a vehicle). The results for each BI segment are subsequently presented.

Low BI: The necessary purchase price reduction of eligible lower emission vehicles is highest for Low BI individuals for all three stages in the behaviour change process. Specifically, a PICG of 35.0% ($\sigma=15.6$) would be necessary to start thinking about buying a qualifying lower emission vehicle. A PICG of 44.0% ($\sigma=13.9$) would be required to seriously think about buying such a vehicle, whilst a 57.1% PICG ($\sigma=15.0$) would be necessary to definitely buy an eligible lower emission vehicle.

Medium BI: To start thinking about buying a qualifying lower emission vehicle and definitely buy such a vehicle, Medium BI individuals would need a PICG incentive greater than High BI individuals, but lower than the Low BI segment. That is, a 30.4% ($\sigma=18.3$) and 50.9% purchase price reduction of eligible lower emission vehicles respectively ($\sigma=20.5$). Medium BI individuals requires the lowest incentive of all BI segments, i.e. a 39.0% purchase price reduction ($\sigma=18.4$) for eligible lower emission vehicles, to seriously think about buying such a vehicle.

High BI: The lowest PICG incentive would be required by High BI individuals to start thinking about buying a qualifying lower emission vehicle, i.e. a 30.0% vehicle purchase price reduction ($\sigma=17.2$). The PICG would have to rise to 39.1% ($\sigma=17.2$) for this segment to seriously think about buying such a vehicle. This PICG is higher than the equivalent tax incentive required by Medium BI individuals, but lower than the level necessary for Low BI individuals. To definitely buy a qualifying lower emission vehicle, the PICG for High BI individuals would need to be 50.4% ($\sigma=18.0$), which is the lowest incentive of all BI segments.

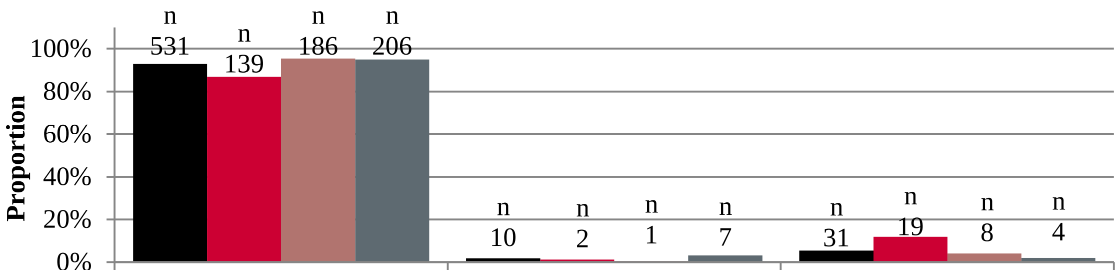
The reported level of the PICG can be converted from percentages into financial terms, based on the average price of a PICG qualifying vehicle. Results indicate Low BI individuals would require a £10,592 PICG to start thinking about buying a lower emission vehicle qualifying for the grant. The incentive would have to increase to £13,315 to seriously think about making the purchase, whilst a £17,280 PICG would be required to definitely buy a qualifying lower emission vehicle. Medium BI individuals would require a £9,200 PICG to start thinking about buying a qualifying lower emission vehicle. The incentive would have to rise to £11,802 to seriously think about buying such a vehicle and £15,403 to definitely purchase an eligible lower emission vehicle. High BI individuals would require a £9,079 PICG to start thinking about buying a qualifying lower emission vehicle. The incentive would need to increase to £11,832 to seriously think about buying such a vehicle. However, to definitely buy a qualifying lower emission vehicle, High BI individuals would require a £15,252 PICG.

6.4 Adaptation of current taxation policy to encourage a lower emission vehicle purchase by 'green' segment within the Scottish motoring population

The changes to current taxation policy necessary to encourage a lower emission vehicle purchase were explored for the 'green' segments. This section will illustrate whether 'green' segment membership impacts upon changes necessary to current taxation policy, that is VED, VAT, HOD and the PICG, to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle.

6.4.1 VED

The result of the chi-squared test indicates a significant association between the potential influence of VED in individuals' future vehicle purchasing decisions towards a lower emission vehicle and the 'green' segments ($\chi^2(4)=23.539$, $p<0.05$). A greater proportion of the No-Greens' future vehicle purchasing decisions would not be influenced towards a lower emission vehicle by a VED change (+6.5%). In contrast, there is a greater share of the Maybe-Greens (+2.6%) and Go-Greens (+2.1%) who could be influenced by VED in their future vehicle purchasing decisions to buy a lower emission vehicle. Furthermore, there is a 1.4% increased proportion of the Go-Greens who anticipate their next vehicle to be leased. This therefore renders VED as N/A in their future vehicle purchasing decisions (***Figure 68***).

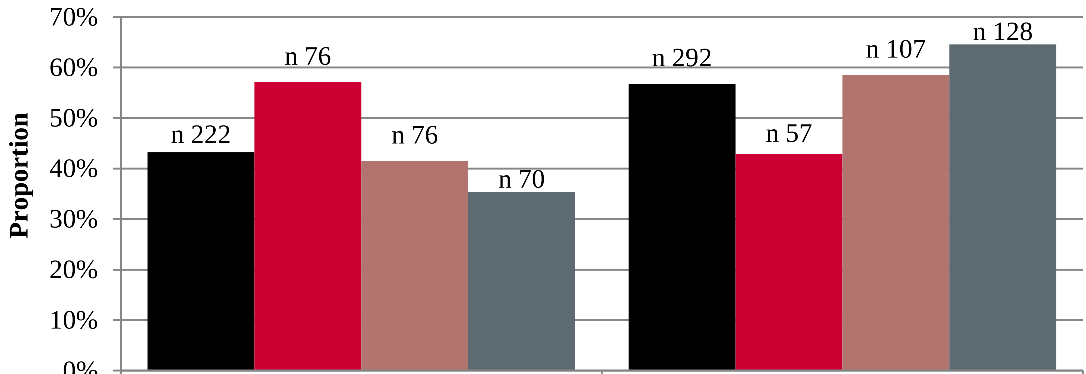


	Yes	No – my vehicle is likely to be leased	No change in VED would influence my behaviour
All	92.8%	1.8%	5.4%
NG	86.9%	1.2%	11.9%
MG	95.4%	0.5%	4.1%
GG	94.9%	3.2%	1.9%

Influence of VED

Figure 68: The potential influence of VED in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle, by 'green' segment

The result of the chi-squared test indicates a significant association between the type of VED price signal most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle and the 'green' segments ($\chi^2(6)=47.807$, $p<0.05$). A 13.9% larger proportion of the No-Greens would be most influenced by a VED increase in their future vehicle purchasing decisions for a lower emission vehicle. Conversely, a greater share of the Maybe-Greens (+1.7%) and Go-Greens (+7.8%) would be most influenced by a VED decrease in shaping their future vehicle purchasing behaviour towards a lower emission vehicle (***Figure 69***).



	Tax increase (disincentive)	Tax decrease (incentive)
All	43.2%	56.8%
NG	57.1%	42.9%
MG	41.5%	58.5%
GG	35.4%	64.6%

Change in VED with the greatest influence

Figure 69: Change in VED with the greatest influence in individuals' future vehicle purchasing decisions, by 'green' segment

A one-way ANOVA was used to test the relationship between the level of VED necessary to instigate the vehicle purchasing decision towards a lower emission vehicle and the 'green' segments. A main effect was observed for the level of VED increase to seriously think about and definitely purchase a lower emission vehicle, and the VED decrease to start thinking about a lower emission vehicle purchase (***Table 50***). Scheffé *post-hoc* tests were used to explore the differences between the 'green' segments (***Table 51***). No main effect was observed for the other stages in the behaviour change process. The results for each 'green' segment are subsequently presented.

Table 50: Results of the one-way ANOVAs for the level of VED to instigate individuals' future vehicle purchasing decisions towards a lower emission vehicle, by 'green' segment

Stages in the behaviour change process		One-way ANOVA
VED increase for a new vehicle with equal/greater emissions than my current vehicle	Start thinking about buying a lower emission vehicle	$F(2,266)=2.646$, $p>0.05$
	Seriously think about buying a lower emission vehicle	$F(2,266)=3.524$, $p<0.05$
	Definitely buy a lower emission vehicle	$F(2,266)=4.358$, $p<0.05$
Decrease in VED for a new vehicle with lesser emissions than my current vehicle	Start thinking about buying a lower emission vehicle	$F(2,315)=4.018$, $p<0.05$
	Seriously think about buying a lower emission vehicle	$F(2,315)=2.871$, $p>0.05$
	Definitely buy a lower emission vehicle	$F(2,315)=1.972$, $p>0.05$

Table 51: Average range of increases/decreases of VED necessary for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle, by 'green' segment

VED		All		'Green' segments					
				NG (1)		MG (2)		GG (3)	
		n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
Increase for a new vehicle with equal / greater emissions than my current vehicle	Start thinking about buying a lower emission vehicle	269	+51.0% (60.6)	89	+61.2% (67.4)	92	+51.4% (70.3)	88	+40.4% (36.4)
	Seriously think about buying a lower emission vehicle	269	+82.0% (99.6)	89	+102.3%$^{+3}$ (134.3)	92	+80.6% (92.2)	88	+63.0%$^{-1}$ (51.6)
	Definitely buy a lower emission vehicle	269	+128.9% (163.4)	89	+168.3%$^{+3}$ (231.4)	92	+119.8% (127.6)	88	+98.5%$^{-1}$ (92.0)
Decrease for a new vehicle with lesser emissions than my current vehicle	Start thinking about buying a lower emission vehicle	318	-34.6% (22.4)	66	-38.0% (21.3)	114	-37.6%$^{+3}$ (25.2)	138	-30.6%$^{-2}$ (19.9)
	Seriously think about buying a lower emission vehicle	318	-44.9% (24.5)	66	-49.5% (23.9)	114	-46.6% (26.4)	138	-41.4% (22.8)
	Definitely buy a lower emission vehicle	318	-58.7% (29.2)	66	-63.2% (27.7)	114	-60.4% (31.2)	138	-55.2% (28.0)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments ($p<0.05$) derived from Scheffé post-hoc tests.

No-Greens: This segment would need the greatest VED increase/decrease to initiate all three stages in the behaviour change process to purchase a lower emission vehicle in the future. The No-Greens would require a 61.2% VED increase for a vehicle with equal or greater emissions, relative to their current vehicle to even start thinking about buying a lower emission vehicle. A VED increase of 102.3% would be necessary to seriously think about making the purchase, whilst a 168.3% increase would be required to definitely purchase a lower emission vehicle. Both VED increases are significantly greater for the No-Greens relative to the Go-Greens. The No-Greens also require the biggest VED reduction to incentivise the behaviour change process towards a lower emission vehicle. Specifically, a 38.0% reduction would be required to start thinking about a lower emission vehicle purchase. A decrease of 49.5% would be necessary to seriously think about buying such a vehicle, whilst a reduction of 63.2% would be required to definitely buy a lower emission vehicle.

Maybe-Greens: This segment would need a VED increase/decrease greater than the Go-Greens, but less than the No-Greens to initiate all three stages in the behaviour change process towards a lower emission vehicle purchase. Specifically, a VED increase of 51.4% would be necessary to start thinking about purchasing a lower emission vehicle. An increase of 80.6% would be required to seriously think about buying such a vehicle; whilst a 119.8% increase would be necessary to definitely purchase a lower emission vehicle. Regarding the level of VED reduction, the Maybe-Greens would need a decrease of 37.6% to start thinking about buying a lower emission vehicle. This level of reduction is significantly greater than the level required by the Go-Greens. A 46.6% reduction in VED would be necessary for the Maybe-Greens to seriously think about buying a lower emission vehicle, whilst a 60.4% VED reduction would be required to definitely purchase such a vehicle.

Go-Greens: The lowest VED increase/decrease would be required by the Go-Greens to instigate all three stages of the behaviour change process to ultimately purchase a lower emission vehicle in the future. VED would have to increase by 40.4% for the Go-Greens to start thinking about buying a lower emission vehicle. A VED increase of 63.0% would be necessary to seriously think about making such a purchase, whilst an increase of 98.5% would be necessary to definitely purchase a lower emission vehicle. The level of increase required for the latter two stages in the behaviour change process are significantly lower for the Go-Greens than the rate required by the No-Greens. To incentivise individuals' future vehicle purchasing behaviour, the Go-Greens would need a VED reduction of 30.6% to start thinking about buying a lower emission vehicle. This VED reduction is significantly lower than the level required by the Maybe-Greens. A 41.4% decrease would be required to seriously think about making such a purchase, whilst a 55.2% reduction would be necessary to definitely purchase a lower emission vehicle in the future.

The level of VED increase/decrease necessary to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase was subsequently considered. The ratio of losses-to-gains for the No-Greens to start thinking about buying a lower emission vehicle is 1.6:1. This rises to 2.1:1 to seriously think about buying such a vehicle and 2.7:1 to definitely buy a lower emission vehicle. The ratio of losses-to-gains is 1.4:1 for the Maybe-Greens to start thinking about buying a lower emission vehicle, 1.7:1 to seriously think about it and 1.5:1 to definitely buy such a vehicle. Finally, the Go-Greens have implied a losses-to-gains ratio of 1.3:1 to start thinking about buying a lower emission vehicle. This increases to 1.5:1 to seriously think about buying such a vehicle and 1.8:1 to definitely buy a lower emission vehicle.

The reported VED percentage increases for the 'green' segments can be converted into financial terms using the 2012/13 payment structure. The proportion of each 'green' segment driving a vehicle falling into each tax band was also calculated (***Table 52***). For example, 4.9% of the No-Greens most often drive a vehicle emitting 111-120g/km of CO_2 at present. Such individuals would need VED to increase from £30 to £48.36 for a vehicle emitting at least 121g/km to start thinking about buying a lower emission vehicle. VED would have to further increase to £60.69 to seriously think about buying such a vehicle, and £80.49 to definitely buy a lower emission vehicle. Furthermore, the reported VED reductions for the 'green' segments can be converted into financial terms based on the 2012/13 VED payment structure (***Table 53***). For example, 10.0% of the Go-Greens most often drive a vehicle emitting 176-185g/km of CO_2 at present. Such individuals would require VED to reduce from £215 for their current vehicle to £149.23 to start thinking about buying a lower emission vehicle. VED would have to further reduce to £125.99 to seriously think about buying such a vehicle, whilst £96.28 VED would be required to definitely buy a lower emission vehicle.

Table 52: VED necessary, after a tax increase and based on the 2012/13 VED payment structure, for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle, by 'green' segment

Tax Band (CO_2 emissions)	No-Greens				Maybe-Greens				Go-Greens			
	% of No-Greens in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of Maybe-Greens in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of Go-Greens in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle
		+61.2%	+102.3%	+168.3%		+51.4%	+80.6%	+119.8%		+40.4%	+63%	+98.5%
A (=< 100)	0.0%	£0.00	£0.00	£0.00	0.0%	£0.00	£0.00	£0.00	0.6%	£0.00	£0.00	£0.00
B 101-110)	1.2%	£32.24	£40.46	£53.66	0.9%	£30.28	£36.12	£43.96	2.5%	£28.08	£32.60	£39.70
C (111-120)	4.9%	£48.36	£60.69	£80.49	2.1%	£45.42	£54.18	£65.94	4.9%	£42.12	£48.90	£59.55
D (121-130)	2.9%	£161.20	£202.30	£268.30	5.3%	£151.40	£180.60	£219.80	8.0%	£140.40	£163.00	£198.50
E (131-140)	8.7%	£193.44	£242.76	£321.96	11.3%	£181.68	£216.72	£263.76	10.7%	£168.48	£195.60	£238.20
F (141-150)	11.6%	£217.62	£273.11	£362.21	19.4%	£204.39	£243.81	£296.73	18.2%	£189.54	£220.05	£267.98
G (151-165)	26.3%	£274.04	£343.91	£456.11	23.3%	£257.38	£307.02	£373.66	23.6%	£238.68	£277.10	£337.45
H (166-175)	8.7%	£314.34	£394.49	£523.19*	7.8%	£295.23	£352.17	£428.61	9.2%	£273.78	£317.85	£387.08
I (176-185)	8.7%	£346.58	£434.95	£576.85*	9.9%	£325.51	£388.29	£472.57	10.0%	£301.86	£350.45	£426.78
J (186-200)	9.0%	£403.00	£505.75*	£670.75*	7.4%	£378.50	£451.50	£549.50*	5.5%	£351.00	£407.50	£496.25*
K (201-225)	8.4%	£435.24	£546.21*	£724.41*	9.2%	£408.78	£487.62*	£593.46*	4.1%	£379.08	£440.10	£535.95*
L (226-255)	5.5%	£741.52*	£930.58*	£1,234.18*	1.6%	£696.44*	£830.76*	£1,011.08*	1.6%	£645.84*	£749.80*	£913.10*
M (>=256)	4.3%	£765.70*	£960.93*	£1,274.43*	1.8%	£719.15*	£857.85*	£1,044.05*	1.2%	£666.90*	£774.25*	£942.88*

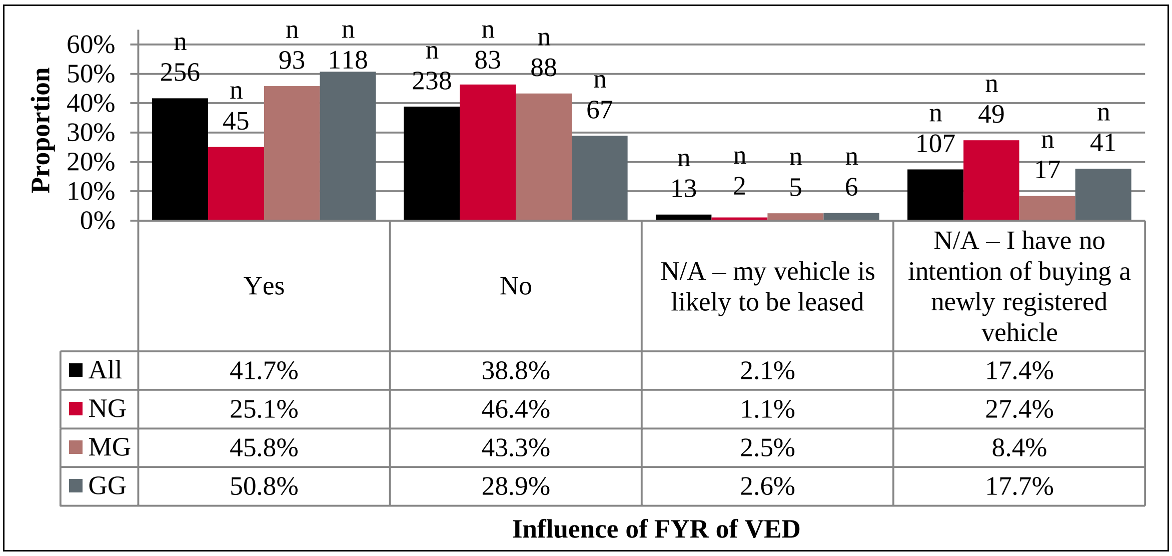
** These entries are not achievable with the 2012/13 VED payment structure, going beyond £475 per annum.*

Table 53: VED necessary, after a tax decrease and based on the 2012/13 VED payment structure, for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle, by 'green' segment

Tax Band (CO_2 emissions)	No-Greens				Maybe-Greens				Go-Greens			
	% No-Greens in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of Maybe-Greens in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle	% of Go-Greens in each tax band	Start thinking about buying a lower emission vehicle	Seriously think about buying a lower emission vehicle	Definitely buy a lower emission vehicle
		- 38.0%	- 49.5%	- 63.2%		- 37.6%	- 46.6%	- 60.4%		- 30.6%	- 41.4%	- 55.2%
A (=< 100)	0.0%	£0.00	£0.00	£0.00	0.0%	£0.00	£0.00	£0.00	0.6%	£0.00	£0.00	£0.00
B 101-110)	1.2%	£12.41	£10.10	£7.36	0.9%	£12.49	£10.68	£7.91	2.5%	£13.88	£11.72	£8.96
C (111-120)	4.9%	£18.61	£15.15	£11.05	2.1%	£18.74	£16.03	£11.87	4.9%	£20.82	£17.58	£13.43
D (121-130)	2.9%	£62.04	£50.50	£36.82	5.3%	£62.45	£53.42	£39.56	8.0%	£69.41	£58.60	£44.78
E (131-140)	8.7%	£74.45	£60.60	£44.18	11.3%	£74.94	£64.10	£47.47	10.7%	£83.29	£70.32	£53.74
F (141-150)	11.6%	£83.75	£68.18	£49.71	19.4%	£84.31	£72.12	£53.41	18.2%	£93.70	£79.11	£60.45
G (151-165)	26.3%	£105.47	£85.85	£62.59	23.3%	£106.17	£90.81	£67.25	23.6%	£118.00	£99.62	£76.13
H (166-175)	8.7%	£120.98	£98.48	£71.80	7.8%	£121.78	£104.17	£77.14	9.2%	£135.35	£114.27	£87.32
I (176-185)	8.7%	£133.39	£108.58	£79.16	9.9%	£134.27	£114.85	£85.05	10.0%	£149.23	£125.99	£96.28
J (186-200)	9.0%	£155.10	£126.25	£92.05	7.4%	£156.13	£133.55	£98.90	5.5%	£173.53	£146.50	£111.95
K (201-225)	8.4%	£167.51	£136.35	£99.41	9.2%	£168.62	£144.23	£106.81	4.1%	£187.41	£158.22	£120.91
L (226-255)	5.5%	£285.38	£232.30	£169.37	1.6%	£287.27	£245.73	£181.98	1.6%	£319.29	£269.56	£205.99
M (>=256)	4.3%	£294.69	£239.88	£174.90	1.8%	£296.64	£253.75	£187.91	1.2%	£329.70	£278.35	£212.71

The result of the chi-squared test indicates no significant association between the initial awareness of the FYR of VED and the ‘green’ segments ($\chi^2(2)=1.745$, $p>0.05$). There is a proportionately greater share of the No-Greens (+2.8%) and the Maybe-Greens (+1.3%) who were previously unaware of the FYR of VED. Conversely, there is a 3.3% greater share of the Go-Greens who knew of its existence prior to this research.

The result of the chi-squared test indicates a significant association between the influence of the FYR of VED and the ‘green’ segments ($\chi^2(6)=47.807$, $p<0.05$). A greater proportion of the Go-Greens (+9.1) and the Maybe-Greens (+4.1%) would be influenced by the FYR of VED in their future vehicle purchasing decisions.There is also a greater share of the No-Greens (+7.6%) and the Maybe-Greens (+4.5%) who would not be influenced by the FYR. Furthermore, there is a larger proportion of the Maybe-Greens (+0.4%) and Go-Greens (+0.5%) who foresee their future vehicle as leased. There is also a greater share of the No-Greens (+10%) and Go-Greens (+0.3%) who do not intend to purchase a brand new vehicle. Both factors render the FYR of VED as inapplicable to their future vehicle purchasing decisions (***Figure 70***).



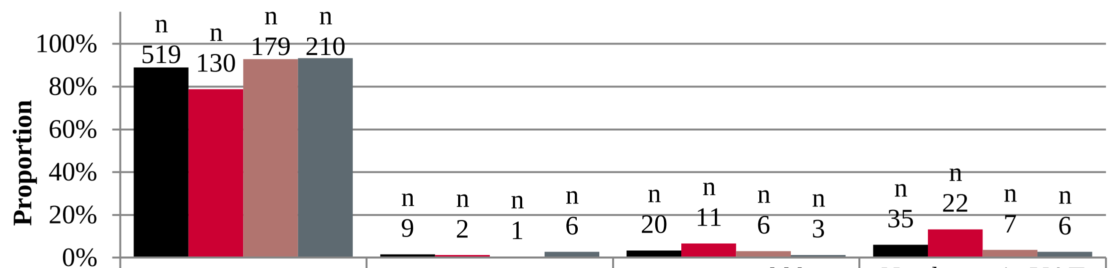
	Yes	No	N/A – my vehicle is likely to be leased	N/A – I have no intention of buying a newly registered vehicle
All	41.7%	38.8%	2.1%	17.4%
NG	25.1%	46.4%	1.1%	27.4%
MG	45.8%	43.3%	2.5%	8.4%
GG	50.8%	28.9%	2.6%	17.7%

Figure 70: Influence of the FYR of VED in individuals’ future vehicle purchasing decisions, by ‘green’ segment

6.4.2 VAT

The result of the chi-squared test indicates a significant association between the influence of VAT and the ‘green’ segments ($\chi^2(6)=34.717$, $p<0.05$). A greater proportion of the No-Greens’ future vehicle purchasing decisions would not be influenced towards a lower emission vehicle by a VAT change (+7.3%). In contrast, a larger proportion of the Maybe-

Greens (+3.8%) and the Go-Greens (+4.3%) could be influenced by VAT. Furthermore, there is a 3.3% greater proportion of the No-Greens who intend to purchase their next vehicle privately and a 1.1% increased proportion of the Go-Greens who intend to lease their next vehicle. Both considerations render VAT as N/A in their future vehicle purchasing decisions (***Figure 71***).



	Yes	No – my vehicle is likely to be leased	No – I would be involved in a private vehicle sale	No change in VAT would influence my behaviour
■ All	89.0%	1.6%	3.4%	6.0%
■ NG	78.8%	1.2%	6.7%	13.3%
■ MG	92.8%	0.5%	3.1%	3.6%
■ GG	93.3%	2.7%	1.3%	2.7%

Influence of VAT

Figure 71: The potential influence of VAT in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle, by 'green' segment

The result of the chi-squared test indicates no significant association between the type of VAT price signal most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle and the 'green' segments ($\chi^2(2)=1.928$, $p>0.05$). A larger proportion of both the No-Greens (+2.7%) and the Maybe-Greens segment (+2.4%) would be more influenced by a VAT increase in their future vehicle purchasing decisions to acquire a lower emission vehicle. In contrast, a larger share of the Go-Greens would be more influenced by a VAT reduction (+3.6%).

A one-way ANOVA was used to test the relationship between the level of VAT necessary to instigate the vehicle purchasing decision towards a lower emission vehicle and the 'green' segments. No main effect was observed (***Table 54***). The results for each 'green' segment are subsequently presented.

No-Greens: This segment would require a VAT increase of 12.0% ($\sigma=13.3$) to start thinking about buying a lower emission vehicle, which is the largest increase required by the three 'green segments. For the No-Greens to seriously think about purchasing a lower emission vehicle, VAT would have to rise by 18.3% ($\sigma=15.7$). This increase is larger than

Table 54: Results of the one-way ANOVAs for the level of VAT to instigate the vehicle purchasing decision towards a lower emission vehicle, by 'green' segment

Stages in the behaviour change process		One-way ANOVA
VAT increase for a new vehicle with equal/greater emissions than my current vehicle	Start thinking about buying a lower emission vehicle	$F(2,217)=1.554, p>0.05$
	Seriously think about buying a lower emission vehicle	$F(2,217)=2.338, p>0.05$
	Definitely buy a lower emission vehicle	$F(2,217)=3.003, p>0.05$
Decrease in VAT for a new vehicle with lesser emissions than my current vehicle	Start thinking about buying a lower emission vehicle	$F(2,346)=1.900, p>0.05$
	Seriously think about buying a lower emission vehicle	$F(2,346)=1.127, p>0.05$
	Definitely buy a lower emission vehicle	$F(2,346)=0.247, p>0.05$

the Go-Greens but lower than the Maybe-Greens to bring about the same stage in the behaviour change process. Finally, VAT would need to increase by 27.6% (σ=21.2) for the No-Greens to definitely purchase a lower emission vehicle. This is the highest VAT increase required of all the 'green' segments. Concerning a VAT reduction, the No-Greens would need a 7.8% reduction (σ=4.9) to start thinking about purchasing a lower emission vehicle. This level of decrease is greater than that required by the Go-Greens, but less than the Maybe-Greens. The No-Greens would require a VAT decrease of 10.5% (σ=4.9) to seriously think about purchasing a lower emission vehicle, which is the biggest decrease required of the three segments. Ultimately, a decrease of 13.6% (σ=5.3) would be necessary for the No-Greens to definitely purchase a lower emission vehicle. This VAT reduction is greater for the No-Greens relative to the Go-Greens, but lower than the Maybe-Greens.

Maybe-Greens: This segment would require a VAT increase of 11.1% (σ=12.7) to start thinking about buying a lower emission vehicle. This level of increase is greater for this segment compared to the Go-Greens, but less than the level required by the No-Greens. An increase of 18.5% (σ=16.9) would be necessary for the Maybe-Greens to seriously think about purchasing a lower emission vehicle. This is the highest VAT increase required of all 'green' segments to bring about the same stage in the behaviour change process. Finally, an increase of 27.4% (σ=23.5) would be necessary for this segment to definitely purchase a lower emission vehicle. This VAT increase is greater than the level required by the Go-Greens, but less than the No-Greens. To incentivise individuals' future vehicle purchasing behaviour, the Maybe-Greens would require the greatest VAT decrease of the 'green' segments to start thinking about buying a lower emission vehicle, i.e. a reduction of 8.2% (σ=4.8). A decrease of 10.4% (σ=4.7) would be required by the Maybe-Greens to seriously think about purchasing a lower emission vehicle. This decrease is larger than the level required by the Go-Greens, but less than the No-Greens. An overall reduction of 13.9% (σ=5.5) would be necessary for this segment to definitely buy a lower emission vehicle. This is the largest decrease stipulated of all 'green' segments to definitely purchase a lower emission vehicle.

Go-Greens: The smallest level of VAT increase/decrease is required by the Go-Greens to instigate all three stages in the behaviour change process. Specifically, an increase of 8.9% (σ=6.1) would be necessary to start thinking about buying a lower emission vehicle. An increase of 14.2% (σ=7.7) would be required to seriously think about making such a purchase. Ultimately, an increase of 20.9% (σ=10.9) would be necessary for the Go-Greens to definitely purchase a lower emission vehicle in the future. VAT would have to be reduced by 7.0% (σ=4.5) for the Go-Greens to start thinking about purchasing a lower emission vehicle. A decrease of 9.7% (σ=4.6) would be necessary to seriously think about making such a purchase. However, a decrease of 13.5% (σ=5.3) would be required to definitely purchase a lower emission vehicle.

The magnitude of the VAT increase/decrease necessary to initiate the behaviour change process towards a lower emission vehicle purchase was considered. The No-Greens have intimated a losses-to-gains ratio of 1.5:1 to start thinking about buying a lower emission vehicle. This ratio increases to 1.8:1 to seriously think about buying such a vehicle and 2.0:1 to definitely buy a lower emission vehicle. The ratio of losses-to-gains for the Maybe-Greens is 1.4:1 to start thinking about buying a lower emission vehicle, 1.8:1 to seriously think about purchasing such a vehicle, and 2.0:1 to definitely buy a lower emission vehicle. Finally, the Go-Greens have a losses-to-gains ratio of 1.3:1 to start think about buying a lower emission vehicle. This rises to 1.5:1 to seriously think about buying such a vehicle and 1.6:1 to definitely buy a lower emission vehicle.

The necessary VAT increases/decreases can be presented based on the 2012/13 VAT rate of 20%. Specifically, the rate of VAT required to engage in the behaviour change process towards a lower emission vehicle purchase. Results indicate the No-Greens would require

VAT to increase to 32% to start thinking about buying a lower emission vehicle. VAT would have to increase to 38.3% to seriously think about buying such a vehicle, whilst 47.6% would be necessary to definitely purchase a lower emission vehicle. The Maybe-Greens would require VAT to increase from 20% to 31.1% to start thinking about buying a lower emission vehicle. 38.5% VAT would be required to seriously think about buying such a vehicle. VAT would have to further rise to 47.4% for the Maybe-Greens to definitely buy a lower emission vehicle. The Go-Greens would need VAT to increase to 28.9% to start thinking about buying a lower emission vehicle, 34.2% to seriously think about and 40.9% to definitely buy such a vehicle.

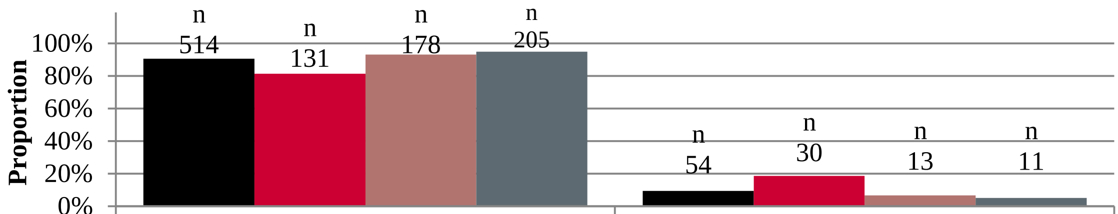
In contrast, VAT would have to fall from 20% to 12.2% for the No-Greens to start thinking about buying a lower emission vehicle. This segment would require VAT to further reduce to 9.5% to seriously think about buying such a vehicle, whilst 6.4% VAT would be necessary to definitely buy a lower emission vehicle. The Maybe-Greens would require VAT of 11.8% to start thinking about buying a lower emission vehicle, whilst 9.6% VAT would be necessary to seriously think about making the purchase. However, VAT of 6.1% would be required by the Maybe-Greens to definitely purchase a lower emission vehicle. Finally, VAT would have to fall from 20% to 13% for the Go-Greens to start thinking about buying a lower emission vehicle. VAT would have to further reduce to 10.3% to seriously think about buying such a vehicle, whilst 6.5% VAT would be necessary for the Go-Greens to definitely purchase a lower emission vehicle.

6.4.3 HOD

The result of the chi-squared test indicates a significant association between the potential influence of HOD in individuals' future vehicle purchasing decisions towards a lower emission vehicle utilising 'greener' fuels and the 'green' segments ($\chi^2(2)=22.099$, $p<0.05$). A 9.1% greater proportion of the No-Greens would not be influenced by a HOD change in their future vehicle purchasing decisions to acquire a lower emission vehicle utilising 'greener' fuel. Conversely, a larger share of Maybe-Greens (+2.7%) and Go-Greens (+4.4%) could be influenced by a HOD change (***Figure 72***).

The result of the chi-squared test indicates no significant association between the type of HOD price signal most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle utilising 'greener' fuels and the 'green' segments ($\chi^2(2)=3.853$, $p>0.05$). A greater proportion of the No-Greens (+4.0%) and the Maybe-

Greens (+2.9%) would be more influenced by a HOD increase in their future vehicle purchasing decisions towards a lower emission vehicle utilising ‘greener’ fuels. In contrast, there is a 5.3% larger share of the Go-Greens who would be more influenced by a HOD reduction in informing their future vehicle purchasing behaviour.



	Yes	No change in HOD would influence my behaviour
■ All	90.5%	9.5%
■ NG	81.4%	18.6%
■ MG	93.2%	6.8%
■ GG	94.9%	5.1%

Influence of HOD

Figure 72: The potential influence of HOD in shaping individuals’ future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuels, by ‘green’ segment

A one-way ANOVA was used to test the relationship between the level of HOD necessary to instigate the vehicle purchasing decision towards a lower emission vehicle utilising ‘greener’ fuels and the ‘green’ segments. No main effect was observed (***Table 55***). The results for each ‘green’ segment are subsequently presented.

Table 55: Results of the one-way ANOVAs for the level of HOD to instigate the vehicle purchasing decision towards a lower emission vehicle utilising ‘greener’ fuels, by ‘green’ segment

Stages in the behaviour change process		One-way ANOVA
HOD increase for petrol and/or diesel	Start thinking about buying a lower emission vehicle utilising ‘greener’ fuels	F(2,222)=2.831, p>0.05
	Seriously think about buying a lower emission vehicle utilising ‘greener’ fuels	F(2,222)=2.464, p>0.05
	Definitely buy a lower emission vehicle utilising ‘greener’ fuels	F(2,222)=2.223, p>0.05
Decrease in HOD for ‘greener’ fuels	Start thinking about buying a lower emission vehicle utilising ‘greener’ fuels	F(2,334)=0.289, p>0.05
	Seriously think about buying a lower emission vehicle utilising ‘greener’ fuels	F(2,334)=0.228, p>0.05
	Definitely buy a lower emission vehicle utilising ‘greener’ fuels	F(2,334)=0.330, p>0.05

No-Greens: This segment would require the highest HOD increase for main road-fuels to start thinking about buying a lower emission vehicle utilising 'greener' fuels, i.e. an increase of 30.1% (σ=26.2). For the No-Greens to seriously think about and definitely purchase such a vehicle, HOD would have to rise by 47.1% (σ=42.0) and 74.1% respectively (σ=71.6). Both increases are greater than the level required by the Go-Greens, but less than the Maybe-Greens. In terms of reducing HOD to incentivise the purchase of a lower emission vehicle utilising 'greener' fuels, the No-Greens would require the greatest decrease for all three stages in the behaviour change process, relative to the other segments. Specifically, a reduction of 28.1% (σ=22.8) would be necessary to start thinking about buying a lower emission vehicle utilising 'greener' fuels. A HOD decrease of 37.6% (σ=21.1) would be required to seriously think about such a purchase, whilst a 50.5% decrease (σ=28.9) would be necessary for the No-Greens to definitely purchase a lower emission vehicle utilising 'greener' fuels.

Maybe-Greens: The necessary HOD increase for the Maybe-Greens to start thinking about buying a lower emission vehicle utilising 'greener' fuels is 29.4% (σ=26.3). This increase is greater than the level required by the Go-Greens, but less than the No-Greens. The Maybe-Greens would, however, require the highest HOD increase compared to the other two segments to seriously think about and definitely purchase a lower emission vehicle. Specifically, an increase of 49.7% (σ=47.0) and 80.3% respectively (σ=80.3). The Maybe-Greens would need a HOD reduction greater than the Go-Greens, but less than the No-Greens to initiate the first two stages in the behaviour change process towards the purchase of a lower emission vehicle utilising 'greener' fuels. That is, a 27.8% HOD reduction (σ=21.4) to start thinking about buying such a vehicle and a 35.5% decrease (σ=24.6) to seriously think about making the purchase. Finally, the Maybe-Greens would need the lowest HOD decrease to definitely purchase a lower emission vehicle utilising 'greener' fuels, i.e. a decrease of 46.8% (σ=28.8).

Go-Greens: This segment would need the lowest HOD increase to initiate all three stages in the behaviour change process towards the purchase of a lower emission vehicle utilising 'greener' fuels. Namely, an increase of 22.1% (σ=15.4) would be necessary to start thinking about buying such a vehicle. An increase of 36.7% (σ=25.5) would be required to seriously think about making the purchase, whilst a 58.5% increase (σ=46.3) would be necessary to definitely purchase a lower emission vehicle utilising 'greener' fuels. The Go-Greens also require the lowest HOD decrease to instigate the first two stages in the behaviour change process. Specifically, a 26.1% (σ=20.1) and 35.4% HOD decrease (σ=23.8) to start thinking about and seriously think about buying a lower emission vehicle utilising ‘greener’ fuels. Finally, a reduction of 48.5% (σ=30.7) would be necessary for the Go-Greens to definitely purchase a lower emission vehicle utilising ‘greener’ fuels. This decrease is larger than the level required by the Maybe-Greens, but less than the No-Greens segment.

The relationship between the required levels of HOD increase/decrease necessary for the ‘green’ segments to engage in the behaviour change process was subsequently considered. The No-Greens have intimated a ratio of losses-to-gains of 1.1:1 to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. This increases to 1.3:1 to seriously think about buying such a vehicle, and further rises to 1.5:1 to definitely purchase a lower emission vehicle utilising ‘greener’ fuels. The ratio of losses-to-gains for the Maybe-Greens is 1.1:1 to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. This rises to 1.4:1 to seriously think about, and 1.7:1 to definitely buy such a vehicle. Finally, the Go-Greens have a losses-to-gains ratio of 0.9:1 regarding the level of HOD necessary to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. The ratio increases to 1.0:1 to seriously think about buying such a vehicle, and 1.2:1 to definitely buy a lower emission vehicle utilising ‘greener’ fuels.

The reported HOD percentage increases/decreases to engage in the behaviour change process towards the purchase of a lower emission vehicle utilising ‘greener’ fuels can be considered in terms of 2012/13 rates. Results indicate HOD for petrol/diesel would have to increase from 57.99PPL to 75.39PPL for the No-Greens to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. HOD would have to further increase to 85.24PPL to seriously think about purchasing such a vehicle, whilst HOD of 100.89PPL would be required for the No-Greens to definitely buy a lower emission vehicle utilising ‘greener’ fuels. The Maybe-Greens would require HOD for main road-fuels to increase to 74.99PPL to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. 86.75PPL HOD would be required to seriously think about buying such a vehicle, whilst 104.48PPL would be suffice for the Maybe-Greens to definitely buy a lower emission vehicle. Finally, Go-Greens would require HOD to increase to 70.76PPL to start thinking about, 79.22PPL to seriously think about and 91.85PPL to definitely purchase a lower emission vehicle utilising 'greener' fuels.

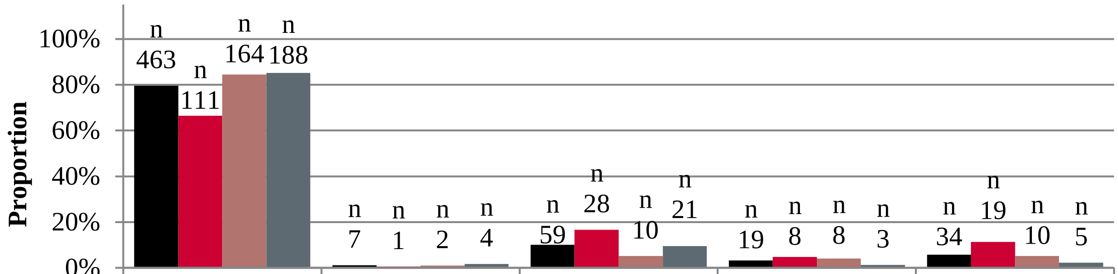
Concerning the equivalent HOD reduction for 'greener' fuels for the purchase of a lower emission vehicle utilising 'greener' fuels, HOD would have to fall to 41.67PPL for the No-Greens to start thinking about buying such a vehicle. 36.16PPL HOD would be required to seriously think about buying a lower emission vehicle utilising 'greener' fuel, whilst 28.8PPL would be necessary to definitely purchase such a vehicle. The Maybe-Greens would require HOD for 'greener' fuels to reduce to 41.84PPL to start thinking about buying a lower emission vehicle utilising such fuels. 37.38PPL HOD would be necessary for the Maybe-Greens to seriously think about buying a lower emission vehicle utilising 'greener' fuels, whilst HOD of 30.83PPL would be required to definitely buy such a vehicle. Finally, HOD would have to fall to 42.83PPL for the Go-Greens to start thinking about, 37.44PPL to seriously think about, and 29.84PPL to definitely purchase a lower emission vehicle utilising 'greener' fuels.

6.4.4 PICG

The result of the chi-squared test indicates a significant association between the potential influence of the PICG in individuals' future vehicle purchasing decisions towards a qualifying lower emission vehicle and the 'green' segments ($\chi^2(8)=36.210$, $p<0.05$). There is a 5.6% greater proportion of the No-Greens who would not be influenced by the PICG in their future vehicle purchasing decisions towards an eligible lower emission vehicle. In contrast, a greater share of Maybe-Greens (+4.9%) and Go-Greens (+5.5%) could be influenced by a change in the PICG. There is a larger share of individuals anticipating their next vehicle to be leased in the Go-Greens (+0.6%), or acquired used in the No-Greens (+6.6%). This therefore renders the PICG as N/A in their future vehicle purchasing decisions. Furthermore, there is a greater share of the No-Greens (+1.5%) and the Maybe-Greens (+0.8%) who have no interest in PICG vehicle technologies (***Figure 73***).

A one-way ANOVA was used to test the relationship between the level of PICG necessary to instigate the vehicle purchasing decision towards a qualifying lower emission vehicle and the 'green' segments. A main effect was observed for the level of PICG to start thinking about buying an eligible lower emission vehicle ($F(2,460)=3.788$, $p<0.05$). Scheffé *post-hoc* tests were used to explore the differences between the 'green' segments

(***Table 56***). No main effect was observed for the other stages in the behaviour change process (F(2,460)=2.987, p>0.05 for the level of PICG to seriously think about buying an eligible lower emission vehicle; and F(2,460)=2.102, p>0.05 to definitely buy such a vehicle). The results for each 'green' segment are subsequently presented.



	Yes	No – my vehicle is likely to be leased	No intention of buying a newly registered vehicle	No interest in PICG vehicle technologies	No change in PICG would influence my behaviour
All	79.6%	1.2%	10.1%	3.3%	5.8%
NG	66.5%	0.6%	16.7%	4.8%	11.4%
MG	84.5%	1.0%	5.2%	4.1%	5.2%
GG	85.1%	1.8%	9.5%	1.3%	2.3%

Influence of PICG

Figure 73: The potential influence of the PICG in shaping individuals' future vehicle purchasing behaviour towards a PICG qualifying lower emission vehicle, by 'green' segment

Table 56: Average purchase price reduction of a PICG qualifying lower emission vehicle necessary for individuals to start thinking about, seriously think about and definitely buy a PICG qualifying lower emission vehicle, by 'green' segment

PICG		All		'Green' segments					
				NG (1)		MG (2)		GG (3)	
		n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
Decrease in purchase price for a qualifying lower emission vehicle	Start thinking about buying a qualifying lower emission vehicle	463	-30.7% (17.8)	111	-31.7% (19.9)	164	$-33.1\%^{+3}$ (18.0)	188	$-28.1\%^{-2}$ (15.9)
	Seriously think about buying a qualifying lower emission vehicle	463	-39.6% (17.7)	111	-39.9% (19.7)	164	-41.9% (17.4)	188	-37.3% (16.4)
	Definitely buy a qualifying lower emission vehicle	463	-51.2% (19.1)	111	-51.6% (21.5)	164	-53.3% (18.3)	188	-49.2% (18.2)

Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments (p<0.05) derived from Scheffé post-hoc tests.

No-Greens: This segment would require a decrease greater than the Go-Greens, but less than the Maybe-Greens to instigate all three stages in the behaviour change process towards the acquisition of a qualifying lower emission vehicle. Specifically, a purchase price reduction of 31.7% would be necessary to start thinking about buying such a vehicle. A decrease of 39.9% would be required to seriously think about buying a qualifying lower emission vehicle, but a 51.6% reduction would be necessary to definitely purchase such a vehicle.

Maybe-Greens: The greatest vehicle purchase price reduction would be necessary for the Maybe-Greens to instigate all stages towards the purchase of a qualifying lower emission vehicle. A reduction of 33.1% would be required for this segment to start thinking about buying a qualifying lower emission vehicle. This level of decrease is significantly greater than the level required by the Go-Greens. A 41.9% reduction would be required to seriously think about such a purchase, whilst a 53.3% reduction would be necessary for this segment to definitely purchase a qualifying lower emission vehicle.

Go-Greens: This segment would require a lesser purchase price reduction of a qualifying lower emission vehicle compared to the other 'green' segments for all three stages in the behaviour change process. A price reduction of 28.1% would be required for the Go-Greens to start thinking about purchasing a qualifying lower emission vehicle. This decrease is significantly lower than the level required by the Maybe-Greens. A 37.3% reduction would be necessary to seriously think about purchasing a qualifying lower emission vehicle, whilst a 49.2% saving on the purchase price would be required to definitely purchase such a vehicle.

The level of PICG required by the 'green' segments can be converted into financial terms, using the average price of a PICG qualifying vehicle. The No-Greens would require a £9,593 PICG to start thinking about buying a qualifying lower emission vehicle. The incentive would have to increase to £12,075 to seriously think about buying a qualifying lower emission vehicle, whereas a £15,615 PICG would be required for this segment to definitely buy such a vehicle. The Maybe-Greens would require a £10,017 PICG to start thinking about buying a lower emission vehicle qualifying for the grant. This segment would require a £12,680 PICG to seriously think about buying such a vehicle. A £16,130 PICG would ultimately be required by the Maybe-Greens to definitely buy a vehicle qualifying for the PICG. The Go-Greens would require a £8,504 PICG to start thinking about buying a qualifying lower emission vehicle, whilst an incentive of £11,288 would be necessary to seriously think about buying such a vehicle. The PICG would have to rise to £14,889 to definitely purchase a lower emission vehicle qualifying for the PICG.

6.5 Chapter 6 summary

This chapter presented the results necessary to address the second research question regarding the adaptation of current taxation measures to encourage a lower emission vehicle purchase. The following key points were considered:

- Results indicate a sizeable potential for using VED, VAT, HOD and the PICG to shape individuals' future vehicle purchasing decisions towards a lower emission vehicle for the Scottish motoring population overall;
- Differences were observed between the segments regarding the potential influence of vehicle taxation in individuals' future vehicle purchasing decisions towards a lower emission vehicle. For example, the reported influence was generally found to increase as the BI to purchase a lower emission vehicle in the future strengthens.
- A VED, VAT and HOD reduction was found to be more influential for the Scottish motoring population overall in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle;
- The aforementioned is largely consistent across the segments, although the influence of a tax decrease increases as individuals become more prepared to purchase a lower emission vehicle in the future. For example, around half of Low BI individuals would be more influenced by a VAT reduction to change their future vehicle purchasing decisions. However, over two thirds of High BI individuals feel the same way, which is significantly greater than the proportion of Low BI individuals;
- Results indicate the Scottish motoring population require a greater increase/decrease to advance through the behaviour change process towards the purchase of a lower emission vehicle, one utilising 'greener' fuels or qualifying for the PICG;
- Across the segments, individuals who are most prepared to purchase a lower emission vehicle generally require the lowest increase/decrease to change their future vehicle purchasing behaviour towards a lower emission vehicle. For example, VED would have to more than double for the No-Greens to definitely buy a lower emission vehicle; whilst the equivalent figure for the Go-Greens is an increase of just over 60%, which is significantly less than the No-Greens.

7 RESULTS: HYPOTHETICAL POLICY MEASURES TO POTENTIALLY BE INTRODUCED TO ENCOURAGE A LOWER EMISSION VEHICLE PURCHASE

7.1 Chapter overview

This chapter presents the results of the questionnaire survey necessary to address the third research question. Specifically, the influence of hypothetical policy measures in encouraging a lower emission vehicle purchase. Influence is considered according to the timing of policy measures in the vehicle ownership cycle and for each individual policy measure. Results are presented for the Scottish motoring population overall, and split according to the strength of individuals' BI to purchase a lower emission vehicle in the future and the 'green' segments derived by the factors shaping individuals' future vehicle purchasing behaviour.

7.2 Hypothetical policy measures to potentially be introduced to encourage a lower emission vehicle purchase for the Scottish motoring population overall

Respondents were asked to indicate the potential influence of hypothetical policy measures which modify or add to current policy to encourage a lower emission vehicle purchase. Results are first presented regarding the timing of hypothetical policy measures in the vehicle ownership cycle, followed by the influence of each hypothetical policy measure. This section will provide an indication of the direction of future policy to encourage a lower emission vehicle purchase.

7.2.1 Influence of hypothetical policy measures, by timing in the vehicle ownership cycle, in individuals' future vehicle purchasing decisions towards a lower emission vehicle for the Scottish motoring population overall

Hypothetical policy measures were classified by their timing during the vehicle ownership cycle. Averages were subsequently calculated for purchase, circulation and road-fuel policy measures. Circulation policy measures would have the greatest influence in individuals' future vehicle purchasing decisions (4.7). This reported influence is closely followed by purchase policy measures (4.6). Road-fuel measures would be least influential in shaping individuals' future vehicle purchasing behaviour (3.8; ***Table 57***).

Table 57: Ranked influence of hypothetical policy measures in individuals' future vehicle purchasing decisions, based on timing in the vehicle ownership cycle

Rank	Timing	n	$\bar{X}$*	σ
1	Circulation – periodic after vehicle acquisition	585	4.7	1.4
2	Purchase – during vehicle purchasing decision	592	4.6	1.4
3	Road-fuel – based on usage	584	3.8	1.5

** Where 1 = not influential; and 7 = very influential*

7.2.2 Influence of each hypothetical policy measure in individuals' future vehicle purchasing decisions towards a lower emission vehicle for the Scottish motoring population overall

Additional insight can be gained by examining the individual policy measures. Rebates for vehicles below a CO_2 emissions threshold would be most influential in individuals' future vehicle purchasing decisions towards a lower emission vehicle (5.0). This is followed by fees for vehicles above a CO_2 emissions threshold (4.9) and adjusting VAT to reflect CO_2 emissions (4.8). The next most influential policy measure would be per-unit SR of VED based on CO_2 emissions (4.7) and CO_2 based motor insurance premiums (4.6). This is followed by per-unit FYR of VED based on CO_2 emissions (4.4) and CO_2 based RUC (4.2). A SIS with a CO_2 emissions limit on the replacement vehicle would be the next most influential policy measure (4.2), followed by a CO_2 based initial vehicle registration fee (4.1). Remaining measures scored less than 4.0 for influence. Namely, CO_2 based parking charges (3.7) and designated LEVLs (3.5; ***Table 58***).

Table 58: Ranked influence of hypothetical policy measures in individuals' future vehicle purchasing decisions towards a lower emission vehicle

Rank	Future policy measures	n	$\bar{X}$*	σ
1	Rebates for vehicles below a CO_2 emissions threshold	576	5.0	1.6
2	Fees for vehicles above a CO_2 emissions threshold	563	4.9	1.6
3	VAT based on CO_2 emissions	560	4.8	1.7
4	SR of VED on a per-unit basis per g/km of CO_2 emitted	568	4.7	1.6
5	Motor insurance premiums based partly on CO_2 emissions	567	4.6	1.8
6	FYR of VED on a per-unit basis per g/km of CO_2 emitted	559	4.4	1.7
7	RUC scheme with payment per mile/hour or a flat rate based on CO_2 emissions	570	4.2	1.8
8	Scrappage allowance with a CO_2 emissions limit on the replacement vehicle	556	4.2	1.8
9	Initial vehicle registration fee based on CO_2 emissions	560	4.1	1.9
10	Parking charges based partly on CO_2 emissions	565	3.7	1.9
11	Designated LEVL	555	3.5	1.9

** Where 1 = not influential; and 7 = very influential*

7.3 Hypothetical policy measures to potentially be introduced to encourage a lower emission vehicle purchase, by strength of individuals' BI to purchase a lower emission vehicle in the future

The influence of hypothetical policy measures upon individuals' future vehicle purchasing decisions towards a lower emission vehicle were evaluated for the three strengths of individuals' BI to purchase a lower emission vehicle in the future. This includes consideration of the reported influence of each hypothetical policy measure and the timing in the vehicle ownership cycle. This section will illustrate whether the strength of individuals' BI to purchase a lower emission vehicle impacts upon the influence of hypothetical policy measures in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle.

7.3.1 Influence of hypothetical policy measures, by timing in the vehicle ownership cycle, in individuals' future vehicle purchasing decisions towards a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

A one-way ANOVA was used to test the relationship between the influence of purchase, circulation and road-fuel policy measures in individuals' future vehicle purchasing decisions and the strength of individuals' BI to purchase a lower emission vehicle in the future. A main effect was observed ($F(2,569)=27.069$, $p<0.05$ for circulation policy measures; $F(2,576)=31.096$, $p<0.05$ for purchase policy measures; and $F(2,558)=9.083$, $p<0.05$ for road-fuel policy measures). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 59***). The results for each BI segment are subsequently presented.

Low BI: Low BI individuals would be most influenced by circulation policy measures, followed closely by purchase policy measures (both 3.7). Road-fuel policy measures would be least influential in individuals' future vehicle purchasing decisions (3.0). This BI segment is significantly less influenced by purchase, circulation and road-fuel hypothetical policy measures relative to Medium or High BI individuals.

Medium BI: This segment would be most influenced by circulation policy measures (4.5), followed by purchase policy measures (4.4). Both types of policy measures would be significantly more influential to this BI segment than Low BI individuals, but significantly less than the High BI segment. Road-fuel policy measures are ranked lowest for influence for Medium BI individuals (3.8). This type of policy measure is less influential to Medium BI individuals than those with a High BI, but significantly more influential than Low BI individuals.

High BI: Circulation policy measures are ranked highest for potential influence for High BI individuals in their future vehicle purchasing decisions (5.1). This is closely followed by purchase policy measures (5.0). Both types of policy measures are significantly more influential to High BI individuals than those with either Low or a Medium BI. Road-fuel policy measures are ranked last for High BI individuals (4.0). This type of policy measure is more influential to High BI individuals than the Medium BI segment, and significantly more than Low BI individuals.

Table 59: Ranked influence of hypothetical policy measures in individuals' future vehicle purchasing decisions, based on timing in the vehicle ownership cycle, by strength of individuals' BI to purchase a lower emission vehicle in the future

Rank	All		Strength of individuals' BI*					
			Low BI (1)		Medium BI (2)		High BI (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
1	Circulation		Circulation		Circulation		Circulation	
	572	4.7 (1.4)	58	3.7 $^{-2,-3}$ (1.6)	261	4.5 $^{+1,-3}$ (1.3)	253	5.1 $^{+1,+2}$ (1.3)
2	Purchase		Purchase		Purchase		Purchase	
	579	4.6 (1.4)	58	3.7 $^{-2,-3}$ (1.8)	266	4.4 $^{+1,-3}$ (1.2)	255	5.0 $^{+1,+2}$ (1.2)
3	Road-fuel		Road-fuel		Road-fuel		Road-fuel	
	571	3.8 (1.5)	56	3.0 $^{-2,-3}$ (1.5)	262	3.8 $^{+1}$ (1.5)	253	4.0 $^{+1}$ (1.5)

** Where 1 is 'not influential' and 7 is 'very influential'*
Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments ($p<0.05$) derived from Scheffé post-hoc tests.

7.3.2 Influence of each hypothetical policy measure in individuals' future vehicle purchasing decisions towards a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future

A one-way ANOVA was used to test the relationship between the influence of hypothetical policy measures in individuals' future vehicle purchasing decisions and the strength of individuals' BI to purchase a lower emission vehicle in the future. A main effect was observed for all policy measures (***Table 60***). Scheffé *post-hoc* tests were used to explore the differences between the BI segments (***Table 61***).

Table 60: Results of the one-way ANOVAs for the influence of hypothetical policy measures, by strength of individuals' BI to purchase a lower emission vehicle in the future

Timing of hypothetical policy measures	One-way ANOVA
Rebates for vehicles below a CO_2 emissions threshold (REB)	$F(2,560)=34.403$, $p<0.05$
Fees for vehicles above a CO_2 emissions threshold (FEES)	$F(2,548)=321.883$, $p<0.05$
VAT based on CO_2 emissions (VAT)	$F(2,545)=26.017$, $p<0.05$
SR of VED on a per-unit basis per g/km of CO_2 emitted (VED)	$F(2,553)=32.302$, $p<0.05$
Motor insurance premiums based partly on CO_2 emissions (INS)	$F(2,552)=10.135$, $p<0.05$
FYR of VED on a per-unit basis per g/km of CO_2 emitted (FYR VED)	$F(2,544)=23.828$, $p<0.05$
A RUC scheme with payment per mile/hour or a flat rate based on CO_2 emissions (RUC)	$F(2,554)=5.031$, $p<0.05$
Scrappage allowance with a CO_2 emissions limit on the replacement vehicle (SCRAP)	$F(2,543)=6.330$, $p<0.05$
Initial vehicle registration fee based on CO_2 emissions (VRF)	$F(2,547)=14.212$, $p<0.05$
Parking charges based partly on CO_2 emissions (PARK)	$F(2,549)=6.306$, $p<0.05$
Designated LEVL (LEVL)	$F(2,540)=9.342$, $p<0.05$

Note: Abbreviations are used in ***Table 61***

Regardless of the strength of individuals' BI to purchase a lower emission vehicle, CO_2 based VAT is consistently ranked the third most influential policy measure in individuals' future vehicle purchasing decisions towards a lower emission vehicle. Beyond this, variation does exist in the ranked order by strength of individuals' BI to purchase a lower emission vehicle in the future. The results for each BI segment are subsequently presented.

Low BI: Of all hypothetical policy measures, individuals in this segment would be most influenced by CO_2 based motor insurance premiums (3.9). This is followed by rebates for lower emission vehicles (3.8), CO_2 based VAT (3.7) and fees for vehicles above a CO_2 emissions threshold (3.6). Per-unit SR of VED based on CO_2 emissions would be the next most influential policy measure (3.6). This is followed by CO_2 based RUC (3.5), per-unit FYR of VED based on CO_2 emissions (3.4) and a SIS with a CO_2 emissions limit on the replacement vehicle (3.4). All of the aforementioned hypothetical policy measures are significantly less influential to the Low BI segment than either Medium or High BI individuals. The next most influential hypothetical policy measure for Low BI individuals would be a CO_2 based initial vehicle registration fee (3.3), followed by CO_2 based parking charges (3.0). Both hypothetical policy measures are less influential to this BI segment than Medium and High BI individuals. The difference is significant relative to only High BI individuals. Designated LEVLs would be the least influential policy measure for Low

BI individuals (2.5). This policy measure is significantly less influential to this segment than Medium or High BI individuals.

Medium BI: Rebates for vehicles below a CO_2 emissions threshold (4.8) would be the most influential hypothetical policy measure for Medium BI individuals. This is followed by fees for vehicles above a CO_2 emissions threshold (4.7) and VAT designed to reflect CO_2 emissions (4.6). Per-unit SR of VED based on CO_2 emissions would be the next most influential policy measure (4.6), and then CO_2 based motor insurance (4.5). All of the abovementioned hypothetical policy measures are significantly more influential to Medium BI individuals than those with a Low BI, but significantly less influential than High BI individuals. CO_2 based RUC was ranked next (4.2), followed by a SIS with a CO_2 emissions limit on the replacement vehicle (4.2). Both hypothetical policy measures would be less influential to this BI segment than High BI individuals, but significantly more influential than Low BI individuals. Per-unit FYR of VED based on CO_2 emissions would be the next most influential policy measure for Medium BI individuals (4.1). This policy measure would be significantly more influential to this segment than those with a Low BI, but significantly less influential than High BI individuals. The next most influential policy measure for Medium BI individuals would be a CO_2 based initial vehicle registration fee (3.9). This policy measure would be more influential to this segment than Low BI individuals, but significantly less influential than High BI individuals. The second least influential hypothetical policy measure would be designated LEVLs (3.7), which would be more influential to this BI segment than Low or High BI individuals. The difference is significant relative to Low BI individuals. The least influential measure for Medium BI individuals would be CO_2 based parking charges (3.6). This would be more influential to Medium BI individuals than the Low BI segment, but less than High BI individuals.

High BI: This segment would be most influenced by rebates for vehicles below a CO_2 emissions threshold (5.5), followed by fees for higher emitting vehicles (5.4) and CO_2 based VAT (5.3). Per-unit SR of VED based on CO_2 emissions would be the next most influential policy measure (5.2), followed by motor insurance reflecting CO_2 emissions (4.9). Per-unit FYR of VED based on CO_2 emissions (4.9) and CO_2 based initial vehicle registration fee (4.6) were ranked next. All of the aforementioned policy measures would be significantly more influential to High BI individuals relative to Low or Medium BI individuals. The next most influential policy measure is CO_2 based RUC (4.4), followed by a SIS with a CO_2 emissions limit on the replacement vehicle (4.4) and CO_2 based parking charges (4.0). These three policy measures are more influential to High BI individuals than those with a Medium BI, but significantly more influential than Low BI individuals. The lowest ranked policy measure is designated LEVLs (3.6), which would be less influential to this BI segment than Medium BI individuals, but significantly more than Low BI individuals.

Table 61: Ranked influence of hypothetical policy measures in individuals' future vehicle purchasing decisions, by strength of individuals' BI to purchase a lower emission vehicle in the future

Rank	All		Strength of individuals' BI*					
			Low BI (1)		Medium BI (2)		High BI (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
1	REB		INS		REB		REB	
	563	5.0 (1.6)	55	3.9 $^{-2,-3}$ (2.0)	256	4.8 $^{+1,-3}$ (1.4)	251	5.5 $^{+1,+2}$ (1.4)
2	FEES		REB		FEES		FEES	
	551	4.9 (1.6)	56	3.8 $^{-2,-3}$ (2.1)	253	4.7 $^{+1,-3}$ (1.5)	245	5.4 $^{+1,+2}$ (1.5)
3	VAT		VAT		VAT		VAT	
	548	4.8 (1.7)	54	3.7 $^{-2,-3}$ (2.1)	255	4.6 $^{+1,-3}$ (1.6)	239	5.3 $^{+1,+2}$ (1.5)
4	VED		FEES		VED		VED	
	556	4.8 (1.6)	53	3.6 $^{-2,-3}$ (2.0)	252	4.6 $^{+1,-3}$ (1.4)	248	5.2 $^{+1,+2}$ (1.5)
5	INS		VED		INS		INS	
	555	4.6 (1.8)	56	3.6 $^{-2,-3}$ (1.9)	251	4.5 $^{+1,-3}$ (1.7)	249	4.9 $^{+1,+2}$ (1.7)
6	FYR VED		RUC		RUC		FYR VED	
	547	4.4 (1.7)	55	3.5 $^{-2,-3}$ (1.9)	256	4.2 $^{+1}$ (1.8)	242	4.9 $^{+1,+2}$ (1.7)
7	RUC		FYR VED		SCRAP		VRF	
	557	4.2 (1.8)	55	3.4 $^{-2,-3}$ (1.9)	249	4.2 $^{+1}$ (1.7)	246	4.6 $^{+1,+2}$ (1.9)
8	SCRAP		SCRAP		FYR VED		RUC	
	546	4.2 (1.8)	55	3.4 $^{-2,-3}$ (1.9)	250	4.1 $^{+1,-3}$ (1.6)	246	4.4 $^{+1}$ (1.8)
9	VRF		VRF		VRF		SCRAP	
	550	4.2 (1.9)	57	3.3 $^{-3}$ (1.9)	247	3.9 $^{-3}$ (1.7)	242	4.4 $^{+1}$ (1.8)
10	PARK		PARK		LEVL		PARK	
	552	3.7 (1.9)	51	3.0 $^{-3}$ (1.8)	250	3.7 $^{+1}$ (1.8)	246	4.0 $^{+1}$ (1.9)
11	LEVL		LEVL		PARK		LEVL	
	543	3.5 (1.9)	55	2.5 $^{-2,-3}$ (1.7)	255	3.6 (1.8)	238	3.6 $^{+1}$ (1.9)

** Where 1 is 'not influential' and 7 is 'very influential'*
Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments ($p<0.05$) derived from Scheffé post-hoc tests.

7.4 Hypothetical policy measures to potentially be introduced to encourage a lower emission vehicle purchase, by 'green' segment within the Scottish motoring population

The influence of hypothetical policy measures upon individuals' future vehicle purchasing decisions towards a lower emission vehicle were considered for the 'green' segments within the population. This includes consideration of the reported influence of each hypothetical policy measure and the timing in the vehicle ownership cycle. This section will illustrate whether 'green' segment membership impacts upon the influence of hypothetical policy measures in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle.

7.4.1 Influence of hypothetical policy measures, by timing in the vehicle ownership cycle, in individuals' future vehicle purchasing decisions towards a lower emission vehicle, by 'green' segment within the Scottish motoring population

A one-way ANOVA was used to test the relationship between the influence of purchase, circulation and road-fuel policy measures in individuals' future vehicle purchasing decisions and the 'green' segments. A main effect was observed ($F(2,578)=43.282$, $p<0.05$ for circulation policy measures; $F(2,585)=61.831$, $p<0.05$ for purchase circulation measures; and $F(2,577)=21.055$, $p<0.05$ for road-fuel policy measures). Scheffé *post-hoc* tests were used to explore the differences between the 'green' segments (***Table 62***). The results for each 'green' segment are subsequently presented.

Table 62: Ranked influence of hypothetical policy measures in individuals' future vehicle purchasing decisions, based on timing in the vehicle ownership cycle, by 'green' segment

Rank	All		'Green' segments*					
			NG (1)		MG (2)		GG (3)	
	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)	n	$\bar{X}$ (σ)
1	Circulation		Circulation		Circulation		Circulation	
	581	4.7 (1.4)	167	$3.9^{-2,-3}$ (1.4)	200	4.9^{+1} (1.3)	214	5.1^{+1} (1.3)
2	Purchase		Purchase		Purchase		Purchase	
	588	4.6 (1.4)	168	$3.7^{-2,-3}$ (1.4)	201	$4.8^{+1,-3}$ (1.2)	219	$5.1^{+1,+2}$ (1.2)
3	Road-fuel		Road-fuel		Road-fuel		Road-fuel	
	580	3.8 (1.5)	164	$3.2^{-2,-3}$ (1.5)	199	4.0^{+1} (1.5)	217	4.1^{+1} (1.4)

* *Where 1 is 'not influential' and 7 is 'very influential'*
Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments (p<0.05) derived from Scheffé post-hoc tests.

No-Greens: This segment would be significantly more influenced by all types of policy measures in their future vehicle purchasing decisions towards a lower emission vehicle than both other 'green' segments. In the ranking, the No-Greens would be most influenced by circulation policy measures (3.9), followed by purchase policy measures (3.7). Road-fuel policy measures (3.2) would be least influential in their future vehicle purchasing decisions.

Maybe-Greens: This segment would be less influenced by all three types of policy than the Go-Greens in their future vehicle purchasing decisions towards a lower emission vehicle. The difference is significant for hypothetical purchase policy measures. The Maybe-Greens would also be significantly more influenced than the No-Greens for all three types of policy measures. The ranking indicates circulation policy measures would be most influential (4.9), followed by purchase based policy measures (4.8). Road-fuel policy measures would be least influential in their future vehicle purchasing decisions (4.0).

Go-Greens: Hypothetical purchase, circulation and road-fuel policy measures would be more influential to the Go-Greens than the Maybe-Greens. The difference is significant for purchase policy measures. Furthermore, the Go-Greens are significantly more influenced by all three types of policy measures than the No-Greens. Purchase policy measures are ranked the most influential (5.1), followed by circulation policy measures (5.1). Road-fuel policy measures are ranked lowest in terms of influence in their future vehicle purchasing decisions (4.1).

7.4.2 Influence of each hypothetical policy measure in individuals' future vehicle purchasing decisions towards a lower emission vehicle, by 'green' segment within the Scottish motoring population

A one-way ANOVA was used to test the relationship between the influence of hypothetical policy measures in individuals' future vehicle purchasing decisions and the 'green' segments. A main effect was observed for all policy measures (***Table 63***). Scheffé *post-hoc* tests were used to explore the differences between the 'green' segments (***Table 64***).

Table 63: Results of the one-way ANOVAs for the influence of hypothetical policy measures, by 'green' segment

Timing of hypothetical policy measures	One-way ANOVA
Rebates for vehicles below a CO_2 emissions threshold (REB)	$F(2,569)=48.734$, $p<0.05$
Fees for vehicles above a CO_2 emissions threshold (FEES)	$F(2,556)=41.361$, $p<0.05$
VAT based on CO_2 emissions (VAT)	$F(2,553)=45.281$, $p<0.05$
SR of VED on a per-unit basis per g/km of CO_2 emitted (VED)	$F(2,561)=46.229$, $p<0.05$
Motor insurance premiums based partly on CO_2 emissions (INS)	$F(2,561)=19.705$, $p<0.05$
FYR of VED on a per-unit basis per g/km of CO_2 emitted (FYR VED)	$F(2,552)=32.654$, $p<0.05$
A RUC scheme with payment per mile/hour or a flat rate based on CO_2 emissions (RUC)	$F(2,563)=15.082$, $p<0.05$
Scrappage allowance with a CO_2 emissions limit on the replacement vehicle (SCRAP)	$F(2,550)=18.167$, $p<0.05$
Initial vehicle registration fee based on CO_2 emissions (VRF)	$F(2,553)=33.976$, $p<0.05$
Parking charges based partly on CO_2 emissions (PARK)	$F(2,558)=16.010$, $p<0.05$
Designated LEVL (LEVL)	$F(2,548)=10.911$, $p<0.05$

Note: Abbreviations are used in ***Table 64***

Some consistencies exist in the ranked order of future policy measures across the 'green' segments. Rebates for vehicles below a CO_2 emissions threshold are consistently ranked the most influential policy measure in individuals' future vehicle purchasing decisions towards a lower emission vehicle. Conversely, CO_2 based parking charges are consistently ranked the second least influential, whilst designated LEVLs are ranked the least influential policy measure across the 'green' segments. Beyond this, the ranked order for the 'green' segments vary. The results for each 'green' segment are subsequently presented.

No-Greens: All 11 hypothetical policy measures would be significantly less influential to the No-Greens relative to both other 'green' segments. The No-Greens would be most influenced by rebates for lower emission vehicles (4.1), followed by fees for vehicles above a CO_2 emissions threshold (4.0). CO_2 based motor insurance premiums (3.9) were ranked next, then CO_2 based VAT (3.9). The next most influential policy measure would be per-unit SR of VED based on CO_2 emissions (3.8), followed by CO_2 based RUC (3.6). Per-unit FYR of VED based on CO_2 emissions (3.6) was ranked next, then a SIS scheme with a CO_2 emissions limit on the replacement vehicle (3.5). This is followed by a CO_2 based initial vehicle registration fee (3.2) and CO_2 based parking charges (3.0). Finally, designated LEVLs would be the least influential policy measure in their future vehicle purchasing decisions (2.9).

Maybe-Greens: This segment would be most influenced by rebates for vehicles below a CO_2 emissions limit (5.3) in their future vehicle purchasing decisions towards a lower emission vehicle. This is followed by CO_2 based VAT (5.1) and fees for vehicles above a CO_2 emissions threshold (5.1). Per-unit SR of VED based on CO_2 emissions was ranked next (5.0), and then CO_2 based insurance premiums (4.8). All of the aforementioned hypothetical policy measures would be less influential to this segment than the Go-Greens, but significantly more influential than the No-Greens. Per-unit FYR of VED based on CO_2 emissions (4.5) was ranked next. This policy measure is significantly less influential to the Maybe-Greens than the Go-Greens, but significantly more influential than the No-Greens. A SIS with a CO_2 emissions limit on the replacement vehicle (4.4) was ranked next, followed by a CO_2 based initial vehicle registration fee (4.4). CO_2 based RUC (4.3) appears next, and then CO_2 based parking charges (4.0). These 4 hypothetical policy measures would be less influential to this segment than the Go-Greens, but significantly more influential than the No-Greens. The lowest ranked policy measure for the Maybe-Greens is designated LEVLs (3.7). This policy measure would be most influential to this segment compared to the other 'green' segments. However, the difference is significant relative to only the No-Greens.

Go-Greens: All hypothetical policy measures, excluding LEVLs, would be more influential to the Go-Greens than the other 'green' segments. Differences are significant relative to only the No-Greens. Regarding the ranked order, the Go-Greens are most influenced by rebates (5.5), followed by fees for vehicles above a CO_2 emission threshold (5.4) and CO_2 based VAT (5.3). Per-unit SR of VED based on CO_2 emissions was ranked next (5.3), then CO_2 based insurance premiums (5.0). The next most influential policy measure of the Go-Greens would be per-unit FYR of VED based on CO_2 emissions (4.9). Further to this policy measure being significantly more influential to the Go-Greens relative to the No-Greens, it is also significantly more influential than the Maybe-Greens. The ranking continues with the initial vehicle registration fee recognising CO_2 emissions (4.7), RUC founded on CO_2 emissions (4.6), a SIS with a CO_2 emissions limit on the replacement vehicle (4.5) and CO_2 based parking charges (4.0). Designated LEVLs would have the lowest influence upon the future vehicle purchasing decisions of the Go-Greens (3.7). This policy measure would be less influential to this segment than the Maybe-Greens, but significantly more influential than the No-Greens.

Table 64: Ranked influence of hypothetical policy measures in individuals' future vehicle purchasing decisions, by 'green' segment

Rank	**All**		**'Green' segments***					
			NG (1)		**MG (2)**		**GG (3)**	
	n	**$\bar{X}$ (σ)**	**n**	**$\bar{X}$ (σ)**	**n**	**$\bar{X}$ (σ)**	**n**	**$\bar{X}$ (σ)**
1	REB		REB		REB		REB	
	572	5.0 (1.6)	163	4.1 $^{-2,-3}$ (1.7)	193	5.3 $^{+1}$ (1.3)	216	5.5 $^{+1}$ (1.4)
2	FEES		FEES		VAT		FEES	
	559	4.9 (1.6)	157	4.0 $^{-2,-3}$ (1.6)	193	5.1 $^{+1}$ (1.6)	211	5.4 $^{+1}$ (1.4)
3	VAT		INS		FEES		VAT	
	556	4.8 (1.7)	160	3.9 $^{-2,-3}$ (1.8)	191	5.1 $^{+1}$ (1.5)	206	5.3 $^{+1}$ (1.4)
4	VED		VAT		VED		VED	
	564	4.8 (1.6)	157	3.9 $^{-2,-3}$ (1.7)	194	5.0 $^{+1}$ (1.4)	208	5.3 $^{+1}$ (1.4)
5	INS		VED		INS		INS	
	564	4.6 (1.8)	162	3.8 $^{-2,-3}$ (1.6)	194	4.8 $^{+1}$ (1.7)	210	5.0 $^{+1}$ (1.7)
6	FYR VED		RUC		FYR VED		FYR VED	
	555	4.4 (1.7)	160	3.6 $^{-2,-3}$ (1.8)	190	4.5 $^{+1,-3}$ (1.6)	205	4.9 $^{+1,+2}$ (1.6)
7	RUC		FYR VED		SCRAP		VRF	
	566	4.2 (1.8)	160	3.6 $^{-2,-3}$ (1.7)	187	4.4 $^{+1}$ (1.7)	204	4.7 $^{+1}$ (1.7)
8	SCRAP		SCRAP		VRF		RUC	
	553	4.2 (1.8)	159	3.5 $^{-2,-3}$ (1.8)	191	4.4 $^{+1}$ (1.8)	211	4.6 $^{+1}$ (1.8)
9	VRF		VRF		RUC		SCRAP	
	556	4.2 (1.9)	161	3.2 $^{-2,-3}$ (1.7)	195	4.3 $^{+1}$ (1.8)	207	4.5 $^{+1}$ (1.7)
10	PARK		PARK		PARK		PARK	
	561	3.7 (1.9)	155	3.0 $^{-2,-3}$ (1.7)	195	4.0 $^{+1}$ (1.9)	211	4.0 $^{+1}$ (1.9)
11	LEVL		LEVL		LEVL		LEVL	
	551	3.5 (1.9)	159	2.9 $^{-2,-3}$ (1.7)	193	3.7 $^{+1}$ (1.9)	199	3.7 $^{+1}$ (1.8)

** Where 1 is 'not influential' and 7 is 'very influential'*
Note: Superscript items indicate those significantly greater (+) or smaller (-), relative to the other BI segments ($p<0.05$) derived from Scheffé post-hoc tests.

7.5 Chapter 7 summary

This chapter presented the results necessary to address the third research question regarding the influence of hypothetical policy measures to encourage a lower emission vehicle purchase. The following key points were considered:

- Circulation and purchase based hypothetical policy measures founded upon CO_2 emissions present the greatest opportunity to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Road-fuel based policy measures would be less influential in facilitating a future lower emission vehicle purchase;

- The ranked order of hypothetical policy measures split by timing in the vehicle ownership cycle is consistent across the segments, but the reported influence does vary. For example, Low BI individuals would be significantly less influenced by purchase, circulation and road-fuel based policy measures in their future vehicle purchasing decisions than Medium or High BI individuals;
- The Scottish motoring population would be most influenced by a feebate system in their future vehicle purchasing decisions. CO_2 based VAT would also be influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle;
- Largely similar findings were observed across the segments, however the reported influence does vary. For example, the No-Greens would be significantly less influenced by all hypothetical policy measures than the Maybe-Greens and Go-Greens.

8 DISCUSSION OF THE RESULTS

8.1 Chapter overview

This chapter discusses the results of the questionnaire survey presented across ***Chapters 4-7***. This chapter is structured around three research questions concerning the importance of situational and psychological factors in future vehicle purchasing behaviour, the adaptation of current taxation measures and potential influence of hypothetical policy measures in encouraging a lower emission vehicle purchase. Results are discussed in context of past research and the consequences for current transport policy.

8.2 Addressing research question one

This research question concerns the importance of situational and psychological factors, both absolute and relative to one another, in shaping individuals' future vehicle purchasing decisions. Results are split for the Scottish motoring population overall, the strength of individuals' BI to purchase a lower emission vehicle and the 'green' segments derived from k-means cluster analysis[40].

8.2.1 How important are situational and psychological factors, both absolute and relative to one another, in shaping individuals' future vehicle purchasing decisions for the Scottish motoring population overall?

The Lane and Potter (2007) model was discussed in considerable depth in ***Chapter 2***. The importance of situational and psychological factors in individuals' future vehicle purchasing decisions was investigated in this research. 32 situational factors were considered during data collection. Factor analysis resulted in the extraction of seven situational factors.

For the motoring population as a whole, results verify the importance of financial considerations. This is particularly true for those considerations present at the time of purchase, including vehicle price; but also for future running costs, including maintenance/repair costs. Considerations of fuel and performance were also identified as important. This is confirmatory of previous research (Boardman *et al.*, 2000; Lehman *et*

[40] As a general point regarding segmentation, differences were indeed present between both the BI and 'green' segments. This supports the idea of segmentation as these differences would have been otherwise overlooked (Smith, 1956). Results also confirm the impracticalities of a one-size-fits-all approach to policy making (Ampt, 2003; Lorenzoni and Pidgeon, 2005; Anable *et al.*, 2006; Hounsham, 2006).

al., 2003; DFT, 2003; Anable *et al*., 2008; Lane and Banks, 2010). The precedence of financial considerations in individuals' future vehicle purchasing decisions has positive implications for pricing signals to shape behaviour. Focusing on taxation, this research has confirmed the greater importance of purchase taxation over circulation measures during individuals' future vehicle purchasing decisions (Potter *et al*., 2005; Litman, 2009; Lane, 2011). Vehicle taxation overall was identified as being relatively important, which is somewhat contradictory to past research. For example, VED has been observed as a relatively unimportant factor in individuals' future vehicle purchasing behaviour by Lehman *et al*. (2003), the DFT (2003) and Lane and Banks (2010).

Considerations of fuel consumption/economy was also of relatively high importance. This is perhaps unsurprising given the sample is largely populated with motorists driving 3-7 days a week, accumulating up to 20,000 miles per year. Recognising the positive relationship between CO_2 emissions and fuel consumption, this result has positive implications for lower emission vehicles. Further to environmental benefits, financial savings, including reduced fuel costs, would also manifest for a lower emission vehicle. The importance of fuel consumption/MPG has been previously illustrated in past research (Lehman *et al*., 2003; DFT, 2003), and confirmed in this research.

Environmental considerations were identified as relatively important in individuals' future vehicle purchasing decisions. This contrasts with past studies by Lehman *et al*. (2003), DFT (2003), Anable *et al*. (2008) and Lane and Banks (2010) who have observed environmental considerations as being ranked comparatively lower. However, the DFT (2011a) revealed a relatively greater importance attached to environmental factors in shaping future vehicle purchases, which complements the findings of this research. Furthermore, other researchers have acknowledged environmental factors as gaining precedence in shaping future vehicle choice (Sasu and Ariton, 2011; Wallis, 2011; Ahmed *et al.*, 2013). This perhaps substantiates the results presented in this research. A further explanatory factor could be the relationship between financial considerations and environmental factors. Past research has suggested the financial savings associated with a lower emission vehicle often compels their purchase, rather than environmental benefits (DFT, 2003; Lehman *et al*., 2003; Gärtner, 2005; RAC, 2011). Perhaps the precedence of financial considerations documented earlier is helping to raise the importance of environmental factors.

Load space, external and internal vehicle design features were of lesser importance in individuals' future vehicle purchasing decisions. This is somewhat contradictory to past research (Lehman *et al*., 2003; Anable *et al*., 2008; Lane and Banks, 2010). Whilst vehicle performance would be important in individuals' future vehicle purchasing decisions, the aesthetic and design features would not be of great consequence.

Results indicate the Lane and Potter (2007) model was on the right lines with the identified constructs. However, there is an overwhelming dominance of financial considerations, not made explicit by Lane and Potter (2007). This research has also broken-down the term 'vehicle attributes' used by Lane and Potter (2007). Results indicate differences between the range of attributes. For example, fuel and performance considerations were very important, whilst those relating to vehicle design, both internal and external, were considerably less important.

The psychological constructs adopted in this research were applied for the first time to a lower emission vehicle purchase. Hence, past research offers no insight to rationalise the results. It is encouraging to note that Scottish individuals have a relatively strong BI to purchase a lower emission vehicle in the future. However, before actual behaviour change manifests, additional psychological constructs and threshold points must be satisfied. This includes formation of an implementation intention, which is beyond the scope of this research. Whilst BI is a good indicator of future behaviour, it is not 100% guaranteed (Ajzen, 1991; Dietz *et al*., 2007; Darnton, 2008b).

Concerning the psychological constructs leading to a BI formation to purchase a lower emission vehicle, individuals expressed a positive attitude towards purchasing such a vehicle. There are also realistic perceptions of individuals' ability to actually purchase a lower emission vehicle. Motorists also perceived a responsibility to lower their vehicle-related GHG emissions. There was also an awareness of the negative environmental consequences of driving a higher emission vehicle. Inherent principles and beliefs also lead to an obligation to buy a lower emission vehicle in the future. On the other hand, individuals do not feel too bad regarding their current vehicle's CO_2 emissions to compel a lower emission vehicle purchase and some degree of difficulty is anticipated to actually buy such a vehicle. Plans to switch to a lower emission vehicle are also limited and perceived social pressure to buy such a vehicle is minimal. The weakest construct is emotions, translating as restrained feelings of guilt if not purchasing a lower emission vehicle. These constructs appear to hinder a lower emission vehicle purchase.

Interventions can be designed to target these weaker constructs to help enable progression in the behaviour change process (Bamberg *et al*., 2011). For example, Gollwitzer (1999) and Gollwitzer and Sheeran (2006) recognise the role of mental and physical preparation regarding the ‘when?’, ‘where?’ and ‘how?’ individuals plan to initiate a new behaviour to strengthen goal intention.

Regarding the Lane and Potter (2007) model, results indicate a greater number of psychological constructs informing individuals’ future vehicle purchasing decisions. For example, perceived goal feasibility and perceived responsibility are outwith the scope of the TPB and VBN models. However, both constructs were identified as relatively influential in shaping individuals’ future vehicle purchasing behaviour.

Observing situational and psychological factors together, the top three factors informing individual’s future vehicle purchasing behaviour are situational. Conversely, the five lowest factors are psychological. Overall, situational factors are ranked higher in importance in shaping individuals’ future vehicle purchasing decisions than psychological factors.

Regarding past vehicle purchasing behaviour, results indicate a slight reduction in engine size, vehicle size and fuel consumption from their previous vehicle to the current one. In the context of lower emission vehicles, this is a very small step in the right direction.

8.2.2 How important are situational and psychological factors, both absolute and relative to one another, in shaping individuals’ future vehicle purchasing decisions, by strength of individuals’ BI to purchase a lower emission vehicle in the future?

Regarding the strength of individuals’ BI to purchase a lower emission vehicle, less than one in ten motorists reported a Low BI. This is encouraging given the small size of the segment and is consistent with past research. For example, the DFT (2012b, p.26) identified only 13% of individuals who either disagreed or strongly disagreed with the statement *“I am willing to buy a car with lower* CO_2 *emissions”*. Less than half of motorists alluded to having a Medium BI to purchase a lower emission vehicle in the future. Low and Medium BI individuals together, making up 55% of the Scottish motoring population, are therefore some way from engaging in the decision making process towards a lower emission vehicle purchase. 45% of the Scottish motoring population reported a High BI to purchase a lower emission vehicle in the future. This is promising, albeit with less than half of the population. This finding is confirmatory of past research. For example, the RAC (2009) identified 46% of motorists would actively seek a car with lower CO_2 emissions.

Results indicate all BI segments regard financial considerations at purchase as the most important factor. This has positive implications for purchase taxation seeking to financially reward a lower emission vehicle acquisition. Future financial considerations are also rated highly, having been ranked third in importance for either Low or Medium BI individuals, and fourth for High BI individuals. This result highlights the potential influence of circulation taxes financially rewarding the drivers of lower emission vehicles.

Beyond the ranking, the differences between the segments can be considered in terms of household income and the environmental properties of the vehicle most often used at present. Low BI individuals are significantly more affluent than the other BI segments. Such individuals are thus most able to absorb the financial repercussions of buying a higher emitting vehicle. This will therefore hamper the potential influence of fiscal policy measures using pricing signals, such as taxation. Indeed, Low BI individuals currently drive the highest emitting vehicle of the BI segments (differences are significant relative to High BI individuals). Greater environmental benefits could, of course, be realised if this segment were to acquire a lower emission vehicle. On the other hand, High BI individuals have significantly less household income than the other BI segments. This presents a greater need to be financially prudent in their future vehicle purchasing decisions. Financial rewards for purchasing a lower emission vehicle are likely to be better received. Indeed, High BI individuals currently drive a significantly lower CO_2 emitting vehicle than the other segments. Such individuals may have already benefitted from tax incentives for lower emission vehicles to shape their previous vehicle purchasing decisions. Medium BI individuals rest mid-way between the other BI segments regarding the influence of financial considerations, household income and their current vehicle's CO_2 emissions.

Consensus also exists between the BI segments regarding fuel and performance, ranked as the second most important factor in individuals' future vehicle purchasing behaviour. Given the wide range of vehicles potentially classified as a lower emission vehicle, the potential therefore exists for all lower emission vehicles to offer comparable performance to the current vehicle. High BI individuals place significantly more importance upon this factor. They currently drive a vehicle with a significantly lower engine size than the other segments, which appears logical. Fuel and performance issues, including fuel consumption/MPG, also have implications for future financial considerations, such as road-fuel taxes. Perhaps the income constraints of this segment reflect the greater importance placed on such considerations. Fuel consumption also has implications for CO_2 emissions. Fundamentally, the less fuel burned, the less CO_2 emitted (AEA, 2009). In contrast, individuals with either a Medium and particularly those with a Low BI place significantly less importance upon fuel and vehicle performance. As the strength of individuals' BI to purchase a lower emission vehicle weakens, the current vehicle's engine size and household income increases significantly. This is consistent with the segment profile accumulated so far.

Environmental considerations are ranked higher as individuals' BI to purchase a lower emission vehicle strengthens. This has implications for the successful application of vehicle taxation founded on vehicle environmental properties. This finding relates to the environmental properties of the current vehicle most often used at present. Specifically, High BI individuals currently drive the lowest emitting vehicle and have the highest regard for environmental considerations in their future vehicle purchasing decisions. In contrast, Low BI individuals currently drive the highest emitting vehicle and place less importance on environmental considerations. Lane and Potter (2007) recognise past vehicle purchasing behaviour as a contributory factor to future vehicle purchasing behaviour. The results of this research appear to verify this idea.

Considerations relating to the physical characteristics of a vehicle appear in the lower half of the ranking. Specifically, considerations of load space, interior and exterior design features. Regarding lower emission vehicles, other non-aesthetic characteristics largely take dominance, such as the vehicle's fuel and performance.

Regarding the psychological constructs leading to the formation of a BI, High BI individuals would be significantly more driven by all 10 psychological constructs than Low or Medium BI individuals. There is, however, an inherent ranking of the factors. High BI individuals have a more positive outlook towards purchasing a lower emission vehicle and feel more responsibility to lower their vehicle-related GHG emissions. Greater perceptions exist regarding the realism of purchasing a lower emission vehicle, perhaps informed by stronger inherent principles and beliefs. Greater awareness of the negative consequences of driving a higher emission vehicle also exists, together with greater plans to actually purchase a lower emission vehicle. This segment also feels worse regarding their current vehicle's CO_2 emissions, and perceives fewer difficulties in purchasing a lower emission vehicle. Greater perceptions of social pressure to change individuals' future vehicle purchasing behaviour towards a lower emission vehicle also exist, and they would feel most guilty if choosing not to purchase such a vehicle. In contrast, Medium BI individuals would be significantly less stimulated by all the aforementioned psychological constructs. Such individuals would also be more driven by psychological factors relative to Low BI individuals (differences are significant for all constructs except perceived behavioural control). Specifically, Low BI individuals would be less influenced by psychological factors in their future vehicle purchasing decisions than both other BI segments. Overall, it can be surmised the stronger individuals' BI, the more psychologically prepared individuals are to purchase a lower emission vehicle in the future (differences are significant in most cases). This is consistent with the MaxSem model, recognising various constructs and threshold points to be satisfied for progression towards the formation of individuals' BI (MAX Success, 2009d).

Looking at the ranked and relative importance of situational and psychological factors together, a final assessment can be made regarding individuals' future vehicle purchasing behaviour. Situational factors were generally more influential than psychological factors for Low BI individuals. This indicates less progress has been made in the psychological transition towards a lower emission vehicle purchase. Hence, it could be argued 'softer' interventions may be more relevant to this segment. For example, awareness raising and information campaigns could be implemented to help promote individuals' awareness and self-focus (Bamberg *et al*., 2011). These could aim to highlight, for example, the negative effects of car use and promote the environmental benefits of lower emission vehicles. The weaker psychological constructs appear to be hindering the formation of a stronger BI to purchase a lower emission vehicle. For Medium BI individuals, and more so for the High BI segment, psychological and situational factors are more integrated in the ranking. As individuals' BI strengthens, psychological factors are promoted in the overall ranking. Situational factors are therefore demoted, signifying the importance of psychological factors in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. High BI individuals have made greater progress in the psychological transition towards a lower emission vehicle purchase. 'Harder' contextual interventions are likely to be most effective in shaping their future vehicle purchasing decisions, including fiscal policy providing tax incentives/disincentives (Bamberg *et al*., 2011).

8.2.3 How important are situational and psychological factors, both absolute and relative to one another, in shaping individuals' future vehicle purchasing decisions, by 'green' segment within the Scottish motoring population, derived by the factors shaping individuals' future vehicle purchasing behaviour?

Post-hoc segmentation, based on situational and psychological factors of importance in individuals' future vehicle purchasing decisions, indicates the Scottish motoring population can be classified into three distinct groups. Approximately a quarter of motorists were classified as the No-Greens. One third were the Maybe-Greens and almost 40% of motorists made up the Go-Greens. Fundamentally, the Go-Greens are most prepared to purchase a lower emission vehicle in the future, which is encouraging given its larger size. Collectively, it could be said that over 70% of the Scottish motoring population have 'green' tendencies, some albeit stronger than others. This corresponds to the high level of importance placed on environmental considerations in a future vehicle purchasing decision reported earlier. Additionally, past research by Lehman (2003), the Scottish Executive (2005) and DFT (2011a) have suggested that 65-83% of motorists are concerned about climate change. Indeed, the DFT (2011a, 2012b) estimate 70-80% of motorists sampled would be willing to purchase a lower emission vehicle to mitigate the effects of climate change. The 'green' inclinations identified in this research are thus aligned to previous studies.

Financial considerations at purchase are consistently ranked the most important factor for all 'green' segments. This signifies the importance of taxation measures at the point of sale in shaping individuals' future vehicle purchasing decisions. Future financial considerations also appear within the top four situational factors for all 'green' segments. This also has positive implications for using CO_2 based circulation taxes to encourage a lower emission vehicle purchase.

Regarding household income, the No-Greens were significantly more affluent. This segment would be most able to absorb the financial repercussions of buying a higher emitting vehicle. The potential effectiveness of purchase and circulation taxes aimed at encouraging a lower emission vehicle purchase is therefore likely to be hampered. Indeed, the No-Greens currently drive a significantly higher emitting vehicle than the other 'green' segments. In contrast, the Maybe-Greens and the Go-Greens have significantly less income than the No-Greens. This perhaps indicates a greater need to be financially prudent in their future vehicle purchasing decisions. Pricing signals from taxation are likely to be more effective. This is perhaps reflected in their previous vehicle purchasing behaviour. That is, the Maybe-Greens and the Go-Greens currently drive a vehicle with significantly lower CO_2 emissions than the No-Greens. However, it is interesting to note the Maybe-Greens place most importance on financial considerations. This perhaps indicates this segment is not fully aware of the link between CO_2 emissions and saving money.

Fuel and vehicle performance considerations are also ranked highly across the 'green' segments. The No-Greens place significantly less importance upon fuel and vehicle performance than both other 'green' segments. It follows logically that this segment currently drive a vehicle with a significantly higher engine size than the other 'green' segments. In contrast, the Go-Greens and the Maybe-Greens place significantly more importance upon fuel and vehicle performance. This is reflected in these segments driving a vehicle with a significantly lower size of engine. Furthermore, the Maybe-Greens place significantly more importance upon fuel and vehicle performance than the Go-Greens, but currently drive a vehicle with a significantly greater size of engine. This indicates scope for this segment to improve their future vehicle's performance, particularly within the wide lower emission vehicle definition. Akin to the earlier comment regarding CO_2 emissions, perhaps this segment is not fully aware of the various vehicle options impacting upon fuel consumption.

Environmental considerations gain relative importance in the ranking from the No-Greens to the Maybe-Greens and the Go-Greens. This has repercussions regarding the successful application of environmental based fiscal measures. The CO_2 emissions of the vehicle most often used at present across the 'green' segments correlates to the importance of environmental considerations in individuals' future vehicle purchasing decisions. Specifically, the Go-Greens place significantly more importance on this factor than the other 'green' segments. This is consistent with the Go-Greens driving a significantly lower CO_2 emitting vehicle at present than the other 'green' segments. Indeed, past vehicle purchasing behaviour is recognised by Lane and Potter (2007) as shaping individuals' future vehicle purchasing behaviour. Conversely, as the importance of environmental considerations reduces, the CO_2 emissions of the vehicle most often used at present increases. Likewise, past vehicle purchasing behaviour appears to be shaping future considerations.

Vehicle characteristics lose importance from the No-Greens to the Maybe-Greens and the Go-Greens. This includes considerations of load space and exterior and interior design features. Vehicle design features appear to have little bearing upon future vehicle purchasing decisions for any of the ‘green’ segments.

The BI to purchase a lower emission vehicle in the future is weakest for the No-Greens. It becomes significantly stronger for the Maybe-Greens and even more so for the Go-Greens. This concurs with the current vehicles’ CO_2 emissions and the importance of environmental considerations in individuals’ future vehicle purchasing decisions. Specifically, the weaker individuals’ BI to purchase a lower emission vehicle, the lower the importance placed on environmental considerations and the higher the CO_2 emissions of the current vehicle, and *vice versa*.

Regarding the psychological constructs informing the strength of individual’s BI to purchase a lower emission vehicle, the Go-Greens would be significantly more driven by all 10 constructs than the other ‘green’ segments. However, inherent differences exist in the ranked order. The Go-Greens have a more positive attitude towards purchasing a lower emission vehicle, with a greater perceived responsibility to reduce their vehicle-related GHG emissions. Stronger intrinsic principles and beliefs are present, subsequently informing an obligation to purchase a lower emission vehicle. There are also more realistic perceptions of individuals’ ability to change their future vehicle purchasing behaviour towards a lower emission vehicle, and a greater awareness of the negative environmental consequences of driving a higher emitting vehicle. The Go-Greens also feel worse regarding their current vehicle’s CO_2 emissions, and have greater plans to actually purchase a lower emission vehicle. Fewer difficulties are perceived if they were to purchase a lower emission vehicle, and greater perceptions of social pressure exist to change their future vehicle purchasing behaviour towards such a vehicle. Furthermore, there is a greater sense of guilt perceived if choosing not to purchase a lower emission vehicle. In contrast, the Maybe-Greens are significantly less influenced by all psychological constructs than the Go-Greens. Relative to the No-Greens, the Maybe-Greens are significantly more motivated by all psychological constructs, except for perceived behavioural control. This psychological construct is significantly stronger for the No-Greens than the Maybe-Greens. The Maybe-Greens therefore anticipate the greatest difficulty in buying a lower emission vehicle in the future.

Observing situational and psychological factors together, the No-Greens are more influenced by situational factors. They also have a significantly lower BI relative to both other 'green' segments. Collectively, the No-Greens are less psychologically prepared to purchase a lower emission vehicle in the future. 'Softer' interventions targeting the weaker psychological constructs would be most pertinent. For example, Bamberg *et al*. (2011) identifies the potential for interventions providing information regarding the pros/cons of various behaviour choices as pertinent for strengthening constructs in the pre-contemplation stage of MaxSem. This could take the form of psychologically-based information campaigns, aiming to highlight the environmental consequences of high emission vehicles and the benefits of purchasing a lower emission vehicle. Fundamentally, more progress must be made psychologically for the No-Greens to further engage in the behaviour change process towards a lower emission vehicle purchase.

The Maybe-Greens are in a similar position to the No-Greens. However, situational factors are more concentrated in the top half of the ranking and the BI to purchase a lower emission vehicle is significantly stronger than the No-Greens. The aforementioned 'softer' interventions will be useful to strengthen their psychological standing (Bamberg *et al*., 2011). Ultimately, this will help to strengthen individuals' BI to purchase a lower emission vehicle in the future. However, recognising the dominance of situational factors, contextual interventions will also be relatively influential. For example, the provision of incentives/disincentives through taxation is recognised by Bamberg *et al*., (2011) as pertinent in strengthening the constructs in the preparation/test phase of MaxSem. Financial considerations were also found to be of great importance to the Maybe-Greens. This further reinforces the use of fiscal price signals for this segment.

Conversely, the Go-Greens are predominantly driven by psychological factors in their future vehicle purchasing decisions. Relative to the No-Greens, the ranked order of situational and psychological factors for the Go-Greens is almost completely reversed. Specifically, there is a greater concentration of situational factors in the lower half of the ranking. The psychological mindset of the Go-Greens will largely drive their future vehicle purchasing behaviour. Based on advanced progress in the behaviour change process, the aforementioned contextual interventions, including vehicle taxation, would be most effective (Bamberg *et al*., 2011).

8.3 Addressing research question two

This research question concerns the adaptation of current taxation measures, that is, VED, VAT, HOD and the PICG, to encourage a lower emission vehicle purchase. The potential influence of each taxation measure and the type of price signal most influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle is considered. The exact level of tax necessary to instigate the vehicle purchasing decision towards a lower emission vehicle is also considered. Results are split for the Scottish motoring population overall, the strength of individuals' BI to purchase a lower emission vehicle and 'green' segments derived from k-means cluster analysis.

8.3.1 How can current taxation measures be adapted to encourage the purchase of a lower emission vehicle for the Scottish motoring population overall?

This section considers the adaption of VED, VAT, HOD and the PICG to encourage a lower emission vehicle purchase for the Scottish motoring population overall.

8.3.1.1 VED

The majority of future vehicle purchasing decisions could be influenced towards a lower emission vehicle by VED, which was the most influential taxation measure evaluated. This can perhaps be explained by the regularity of payment, reinforcing the financial signal (Ryan *et al*., 2009). This finding is somewhat contradictory with past research, e.g. the DFT (2003). However, it is nevertheless encouraging from an environmental perspective, supporting the use of fiscal policy to shape individuals' future vehicle purchasing decisions.

A VED reduction was identified as being more influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. This finding correlates to the loss aversion concept, where individuals would be more sensitive to losses from a tax increase, rather than a gain from a tax decrease (Kahneman and Tversky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009). Furthermore, past research has revealed a greater preference for 'carrots' rather than 'sticks' (DEFRA, 2002; Avery, 2009). The greater influence of a VED reduction has confirmed the precedence of pull-measures to best shape individuals' future vehicle purchasing behaviour. Whilst reducing VED would have positive implications upon individuals' future vehicle purchasing behaviour, there are negative consequences for government revenue. Revenue generation has been noted as one of the main functions of taxation (Reggiani and Schintler, 2005; Santos *et al*., 2010).

From 2010/11, VED rates have increased by £10-£40 for vehicles emitting at least 120g/km of CO_2 in 2012/13, whilst no tax bands underwent a reduction. Acknowledging the influence of a VED reduction, limited progress has therefore been made towards encouraging a lower emission vehicle purchase.

The required VED increases/decreases for individuals to start thinking about, seriously think about and definitely buy a lower emission vehicle can be considered in terms of the 2012/13 payment structure[41]. Based on the CO_2 emissions of the average vehicle driven, 2012/13 rates have VED payments sufficiently high for individuals to engage in the behaviour change process towards a lower emission vehicle purchase. Recognising the range of vehicles most often used by motorists, some drivers would not find the required VED disincentive within 2012/13 rates to engage in the behaviour change process towards a lower emission vehicle purchase. The majority (95%, 88% and 72% for the respective stages in the behaviour change process) would, however, be financially deterred. Results indicate success in the government's aim of targeting mid-range CO_2 emitting vehicles (House of Commons, 2008). Whilst the FYR of VED would clearly provide a more substantial deterrent, this does rely on a future vehicle being acquired brand new.

In terms of VED as an incentive, owners of an average CO_2 emitting vehicle would find sufficient incentives within 2012/13 VED rates to engage in the behaviour change process towards a lower emission vehicle purchase. Recognising the range of CO_2 emitting vehicles driven by Scottish motorists, all required VED incentives would be obtainable within the 2012/13 payment structure. This recognises an exemption from payment awarded to motorists choosing a vehicle emitting 100g/km of CO_2 maximum. This equates to a 100% reduction from existing levels of VED. Potential therefore exists for all individuals to be financially incentivised to engage in the behaviour change process towards a lower emission vehicle purchase.

[41] This analysis is, however, dependent upon *how* much higher the proposed future vehicle's CO_2 emissions are relative to the current vehicle. For example, whether the future vehicle is 10g/km higher, perhaps falling into the next tax band; or 100g/km higher, perhaps moving up 10 tax bands. This was not specifically assessed in this research. The analysis provides a general indication of the potential influence of VED. However, exceptions will arise depending upon exact circumstances.

Results indicate individuals require a VED disincentive greater than the equivalent incentive to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase. This finding has positive implications from a government perspective regarding revenue raising. This observation is similar to past research regarding loss aversion (Kahneman and Tversky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009). The results of this research are largely within the remit of past research by Kahneman (2011), who estimated a losses-to-gains ratio of 1.5-2.5:1.

Regarding the FYR of VED, results indicate a poor awareness of its existence and a limited potential influence. However, this policy measure only applies to brand new vehicle purchases, perhaps explaining the limited awareness. This research did, however, identify a significant association between initial awareness of the FYR and influence in shaping individuals' future vehicle purchasing behaviour. This suggests the focus should be upon increasing public knowledge to promote its effectiveness. For example, an information campaign could be used to raise awareness of the FYR of VED.

8.3.1.2 VAT

Akin to VED, the potential influence of VAT in shaping individuals' future vehicle purchasing behaviour is high. Whilst the UK has yet to implement CO_2 based VAT, the results of this research are encouraging for its future adoption. This has also been advocated by Hinnells and Potter (2001), Lane (2005) and Albrecht (2006).

A VAT incentive was identified as most influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Akin to VED, this corresponds to the concept of loss aversion (Kahneman and Tversky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009). Furthermore, this demonstrates a greater preference of 'carrots' over 'sticks' (DEFRA, 2002; Avery, 2009).

Comparing 2010/11, VAT rates have remained unchanged in 2012/13. Recognising a greater reported influence of a VAT reduction to change individuals' future vehicle purchasing behaviour, no progress has therefore been made by policy makers to make VAT more influential.

The 2012/13 flat rate of 20% VAT does not incentivise/disincentivise individuals' future vehicle purchasing behaviour towards a lower emission vehicle. The required VAT rates indicate substantial changes are necessary to shape individuals' future vehicle purchasing decisions. Historically, VAT has typically changed by only 2.5% at one time. The VAT increases identified in this research to instigate behaviour change seem somewhat extreme and perhaps unrealistic. Nevertheless, the proposed VAT rates are similar to the Italian system, resulting in a positive impact upon fuel economy (Potter *et al*., 2005; Reggiani and Schintler, 2005). Concerning the elicited VAT reduction, the proposed rates would aptly correspond to the current UK system of 5% VAT for energy efficient materials. Indeed, results indicate 5% VAT would be enough for the Scottish motoring population to definitely purchase a lower emission vehicle.

Results indicate a greater VAT disincentive would be required to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase than the equivalent VAT incentive. The results of this research are similar to previous studies regarding loss aversion (Kahneman and Tvserky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009; Kahneman, 2011).

8.3.1.3 HOD

HOD was also found to be influential for 90% of motorists in shaping their future vehicle purchasing behaviour towards a lower emission vehicle utilising 'greener' fuels. This can perhaps be attributed to the visible nature of fuel costs (Goldberg, 1998; Potter *et al*., 2006).

A HOD incentive for 'greener' fuels was found to be more influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising such fuels. As per the results for VED and VAT, this corresponds to the idea of loss aversion (Kahneman and Tvsersky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009) and the preference for 'carrots' to shape individuals' behaviour (DEFRA, 2002; Avery, 2009).

From the time of data collection, the main road-fuel HOD fell by 1PPL to 57.95PPL. If petrol/diesel fuelled vehicles are cheaper to run, this will not encourage a lower emission vehicle purchase for fuel savings. Biodiesel and bioethanol are still taxed at the same rate as main road-fuels (57.95PPL), having undergone the same 1PPL reduction as petrol/diesel. HOD for CNG fell by 1.45PPKG to 24.70PPKG, whilst HOD for LPG fell by 1.43PPKG to 31.61PPKG. The HOD reduction for CNG and LPG was proportionate to the HOD reduction for main road-fuels (HMRC, 2011d). Based on results of this research, 2012/13 HOD rates for 'greener' fuels do not provide sufficient incentive relative to main road-fuel HOD to purchase a lower emission vehicle. Moreover, plans exist for the LPG differential to be further reduced (HM Treasury, 2013a). This research identified the need for greater incentives for 'greener' fuels and the planned reductions will not help to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising LPG.

Results indicate that current HOD rates for petrol/diesel would have to increase substantially for individuals' to engage in the behaviour change process towards the purchase of a lower emission vehicle utilising 'greener' fuels. The reported HOD increases have the potential to provoke public anguish via fuel protests. The UK government are wary of a negative public reaction to raising fuel prices (Potter *et al*., 2006). For example, the 2013 Budget cancelled the proposed 1.89PPL HOD increase amidst *"recognition of the impact that persistently high pump prices have on the cost of living"* (HM Treasury, 2013b, p.53). Furthermore, the UK already holds some of the highest HOD rates in Europe (Seely, 2011; Association of European Automobile Manufacturers, 2012). The HOD increases identified in this research have greater implications for approximately a quarter of motorists residing in rural areas. The rural fuel duty relief scheme would help to some extent, but this is applicable in only some parts of Scotland. VAT is also chargeable on the resource price of fuel plus HOD, further increasing the overall retail price.

However, such a drastic disincentive is perhaps necessary to instigate a change in individuals' future vehicle purchasing behaviour. Indeed, the Committee on Climate Change (2011) supports the use of high fuel prices to encourage motorists to choose a 'greener' vehicle. Motorists could potentially avoid the high main road-fuel HOD and instead pay the relatively lower HOD for 'greener' fuels. Compared to the fuel protests of 2000, there is greater choice and improved availability of 'greener' fuels, aiding the transition towards a 'greener' fuelled vehicle.

Concerning a HOD reduction for 'greener' fuels, results indicate HOD would need to be subsidised by at least 15.8PPL for individuals to engage in the behaviour change process towards the purchase of a lower emission vehicle utilising such fuel. Recognising the 2012/13 HOD rate for biofuels as identical to main road-fuels, there is no tax incentive to change individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising biofuels. The previous 20PPL differential would have been suffice for individuals to seriously think about buying a lower emission vehicle utilising biofuels.

The earlier 26PPL differential would have been just 2PPL short of the HOD necessary for individuals to definitely buy a lower emission vehicle utilising biofuels. Historical HOD rates would therefore be far more influential in shaping individuals' future vehicle purchasing behaviour.

For LPG, 2012/13 HOD rates narrowly miss the incentive necessary for individuals to start thinking about purchasing a lower emission vehicle utilising LPG. However, 2012/13 rates would be completely inadequate for individuals to even seriously think about purchasing such a vehicle. The future LPG differential reductions will certainly not encourage motorists to engage in the behaviour change process towards the purchase of a lower emission vehicle utilising LPG. Regarding CNG, 2012/13 HOD rates would be suffice for individuals to seriously think about purchasing a lower emission vehicle utilising CNG. However, such rates would be insufficient for individuals to actually purchase such a vehicle.

Collectively, the 2012/13 HOD tax system would be able to rouse some interest in lower emission vehicles utilising 'greener' fuels. However, further incentives/disincentives would be necessary for individuals to advance through the behaviour change process towards the purchase of such a vehicle.

Results indicate an equal HOD incentive would be necessary relative to the equivalent HOD disincentive necessary for individuals to start thinking about buying a lower emission vehicle utilising 'greener' fuels. This contrasts with past research regarding loss aversion (Kahneman and Tvserky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009; Kahneman, 2011). For the remaining two stages in the behaviour change process, a greater HOD disincentive would be required for individuals to seriously think about and definitely buy a lower emission vehicle utilising 'greener' fuels, relative to the equivalent HOD incentive. This is confirmatory of past research (Kahneman and Tvserky, 2000; Peters *et al*., 2008; Mueller and de Haan, 2009; Kahneman, 2011).

8.3.1.4 PICG

The PICG was found to potentially inform future vehicle purchasing decisions of almost 80% of motorists. This policy measure was the least influential of the four measures assessed, perhaps explained by the eligibility criteria and the need for the vehicle to be acquired new.

From 2010/11 rates, the PICG has remained constant at £5,000. Therefore no additional incentive has been provided to encourage individuals to engage in the behaviour change process towards the purchase of a PICG qualifying vehicle.

Based on the average starting price of a PICG qualifying lower emission vehicle (£30,262), the £5,000 grant equals a 16.5% purchase price reduction. According to this research, a 16.5% incentive would be insufficient for individuals to even start thinking about buying a qualifying lower emission vehicle. Ignoring the £5,000 cap, a 25% purchase price reduction would still be inadequate for individuals to start even thinking about buying a qualifying lower emission vehicle. A far greater incentive of around 50% would be necessary for individuals to definitely purchase such a vehicle.

In financial terms, results indicate the current £5,000 PICG would be insufficient to even stimulate interest in buying a qualifying lower emission vehicle. The slow uptake of the PICG from 2011 may substantiate this argument. Past research has identified high purchase prices as a key barrier to the future uptake of AFVs, such as those qualifying for the PICG (Karplus *et al.*, 2010; RAC, 2011; OLEV, 2013e). Purchase prices are negatively affected by the requirement for PICG qualifying vehicles to be acquired new. Lane and Banks (2010) identified an £11,000-£15,000 average car purchase price for new/nearly-new vehicle purchases. Compared to £30,262 for PICG qualifying vehicles, the grant needs to make such vehicles more financially attractive and competitive in the market. Motorists have also demonstrated a preference towards the purchase of used vehicles, both in this research and past research (Environmental Audit Committee, 2008; SMMT, 2012c). Andersz (2012) estimates the average asking price of Scottish used cars at £8,914-£9,627. Whether vehicles are acquired new/used, PICG-qualifying vehicles require a substantially greater financial investment.

Gallagher and Muehlegger (2011) advocate a positive relationship between the generosity of a tax incentive and the effect on consumer behaviour. Even if the PICG trebled to £15,000 (identified as necessary for individuals to definitely purchase a qualifying lower emission vehicle), this would have utilised only 30% of the £230 million funding available. However, PICG uptake could be assumed to be higher owing to a more attractive incentive. Nevertheless, over £160 million would have been available for this purpose.

A final consideration is the flat rate of PICG. The £5,000 maximum has been recognised by the DFT (2010c) as applicable, recognising most PICG eligible vehicles cost over £20,000. The flat-rate incentive fails to recognise the greater investment required for some vehicles. For example, the Renault Fluence ZE starts at £22,495, whilst the Vauxhall Ampera and Chevrolet Volt start at £34,995. A relative price reduction may perhaps better serve future buyers to keep the cost reduction relative to the upfront investment, advocated by the House of Commons Transport Committee (2013).

8.3.1.5 Final considerations regarding vehicle taxation

Across all four taxation measures, a pattern emerges regarding the tax incentive/disincentive necessary for individuals to progress through the behaviour change process towards purchasing a lower emission vehicle, one utilising ‘greener’ fuels or qualifying for the PICG. Specifically, the required tax incentive/disincentive progressively intensifies for individuals to advance from only thinking about buying a lower emission vehicle, to seriously thinking about it, and definitely buying one. Individuals will not progress to the next stage in the behaviour change process until the tax level specified has been satisfied. This acknowledges past research where behaviour change manifests over a series of stages, rather than one simple transition (MAX Success, 2009d; Bamberg *et al*., 2011).

Furthermore, whilst a physical change in individuals’ future vehicle purchasing behaviour is the ultimate goal, the preceding stages in the behaviour change process are equally important. For example, the 2012/13 HOD subsidy for CNG would be suffice for individuals to seriously think about purchasing a lower emission vehicle utilising CNG (discussed in ***Section 8.3.1.3***). These subtle psychological changes in individuals’ attitudes and perceptions towards a lower emission vehicle are important prerequisites to definitely purchasing a lower emission vehicle and should not be disregarded (Carreno and Welsch, 2009).

8.3.2 How can current taxation measures be adapted to encourage a lower emission vehicle purchase, by strength of individuals’ BI to purchase a lower emission vehicle in the future?

This section considers the adaption of VED, VAT, HOD and the PICG to encourage a lower emission vehicle purchase by the strength of individuals’ BI to purchase a lower emission vehicle.

8.3.2.1 VED

The reported influence of VED increases significantly as individuals' BI to purchase a lower emission vehicle strengthens. This finding appears logical, where individuals with a greater propensity to purchase a lower emission vehicle would be more influenced by VED financially rewarding such behaviour, and *vice versa*. This result also corresponds to the earlier observation regarding the increased importance of financial considerations, including taxation, as individuals' BI to purchase a lower emission vehicle strengthens. VED will be highly influential in shaping future vehicle purchasing behaviour when individuals' BI to purchase a lower emission vehicle becomes sufficiently strong. Psychological factors have a key role to play in strengthening individuals' BI to purchase a lower emission vehicle and interventions can be used to target the significantly weaker constructs.

The preference for a VED incentive increases significantly as individuals' BI to purchase a lower emission vehicle strengthens. Relatively more Medium or High BI individuals would be more influenced by a VED incentive in their future vehicle purchasing decisions. This perhaps recognises their significantly smaller household income relative to the Low BI segment. Medium and High BI individuals therefore respond more to 'carrots', financially rewarding a lower emission vehicle purchase. In contrast, relatively more Low BI individuals need to be out-priced with VED to change their future vehicle purchasing behaviour towards a lower emission vehicle. This also reflects their significantly higher household income than Medium and High BI individuals. Hence, Low BI individuals respond more to 'sticks', financially penalising a higher emitting vehicle purchase.

The VED disincentive required to instigate the behaviour change process towards purchasing a lower emission vehicle reflects the psychological progress made by the segments. For example, High BI individuals are psychologically more prepared to purchase a lower emission vehicle than the other two segments. Accordingly, such individuals would require a lower disincentive to engage in the behaviour change process towards a lower emission vehicle purchase. Household income could also be a contributory factor, where High BI individuals have significantly less income than other BI segments and would therefore be out-priced quicker. Fundamentally, a negative correlation was observed between the strength of individuals' BI to purchase a lower emission vehicle in the future and the disincentive required to engage in the behaviour change process towards purchasing a lower emission vehicle.

The VED increase necessary for Low, Medium or High BI individuals to engage in the behaviour change process towards a lower emission vehicle purchase can be considered in terms of the 2012/13 VED payment structure. Based on the CO_2 emissions of the average vehicle driven, 2012/13 rates have sufficiently high VED payments for Medium and High BI individuals to engage in the behaviour change process towards a lower emission vehicle purchase. However, 2012/13 rates would be sufficient for Low BI individuals to only seriously think about buying a lower emission vehicle. Recognising the range of CO_2 emitting vehicles driven by the BI segments, not all motorists will find a sufficiently high VED disincentive within 2012/13 rates to engage in the behaviour change process towards a lower emission vehicle purchase. However, as individuals' BI to purchase a lower emission vehicle strengthens, a greater proportion of motorists would be financially satisfied by 2012/13 VED rates to engage in the behaviour change process towards a lower emission vehicle purchase.

Concerning the necessary VED reduction, results indicate High BI individuals consistently require the lowest incentive for engagement in the behaviour change process towards a lower emission vehicle purchase. Akin to the required VED increase, this perhaps recognises the greater preparedness of such individuals to purchase a lower emission vehicle, whereby requiring a lower incentive to instigate the behaviour change process.

Regarding the average CO_2 emitting vehicle driven by the BI segments, results indicate the 2012/13 VED payment structure would provide sufficient incentives for all individuals to engage in the behaviour change process towards a lower emission vehicle purchase. Considering the range of vehicles most often used by motorists, results indicate all required VED reductions for a lower emission vehicle would be achievable within the 2012/13 payment structure. Potential therefore exists for all Scottish motorists to be sufficiently incentivised to engage in the behaviour change process towards purchasing a lower emission vehicle.

Across the BI segments, the required VED disincentive to instigate all three stages in the behaviour change process towards a lower emission vehicle purchase is greater than the equivalent VED incentive. Specifically, High BI individuals have the lowest losses-to-gains ratio to start thinking about, seriously think about and definitely buy a lower emission vehicle. This correlates to such individuals being the most prepared to purchase a lower emission vehicle and thus requiring a less intense pricing signal to engage in the behaviour change process. This could also reflect their relatively lower household income, and thus their limited ability to absorb the financial repercussions of a VED increase. Low and Medium BI individuals require a similar losses-to-gains ratio to start thinking about buying a lower emission vehicle. However, a greater losses-to-gains ratio is evident for Low BI individuals to seriously think about and definitely buy a lower emission vehicle. This perhaps reflects their limited penchant for purchasing a lower emission vehicle, and their relatively greater household income.

Regarding the FYR of VED, results indicate the lowest initial awareness of this policy measure for Low BI individuals. This perhaps reflects such individuals being less predisposed to purchase a lower emission vehicle, meaning they have not sought information regarding fiscal policy measures founded on CO_2 emissions. Initial awareness subsequently increases as individuals' BI to purchase a lower emission vehicle strengthens. Furthermore, the reported influence of the FYR increases significantly as individuals' BI to purchase a lower emission vehicle strengthens. Akin to earlier observation regarding the SR of VED, this highlights the importance of strengthening individuals' BI to purchase a lower emission vehicle to increase the potential influence of taxation measures.

8.3.2.2 VAT

The reported influence of VAT increases as individuals' BI to purchase a lower emission vehicle strengthens. Akin to VED, this reflects how prepared individuals' are to purchase a lower emission vehicle.

Regarding the type of pricing signal most influential in individuals' future vehicle purchasing decisions, results indicate a significantly greater preference for a VAT incentive as individuals' BI to purchase a lower emission vehicle strengthens. Results also reflect the household income of the BI segments, i.e. as household income increases, VAT disincentives become more influential. 'Sticks' would therefore be more influential for Low or Medium BI individuals, whilst 'carrots' would be more influential for High BI individuals.

The VAT increase necessary for all individuals to engage in the behaviour change process towards a lower emission vehicle purchase is smallest for High BI individuals, and largest for Low BI individuals. This reflects the propensity of each BI segment to purchase a lower emission vehicle in the future. Akin to VED, household income could also be a contributory factor. Regarding the necessary VAT decrease, the aforementioned pattern of responses is evident for the BI segments to start thinking about and definitely buy a lower emission vehicle. That is, the higher individuals' BI to purchase a lower emission vehicle, the lower the required VAT incentive. However, such observations are contrary to the VAT decrease necessary to definitely purchase a lower emission vehicle. Nevertheless, the differences between the segments are not significant.

Recognising historical VAT rates, the required increases appear somewhat drastic and perhaps unrealistic, particularly for Low BI individuals who would need 52.7% VAT to definitely buy a lower emission vehicle. Reducing VAT may be the more favourable and realistic option. Whilst differences were observed across the BI segments, a consensus was reached regarding the greater influence of a VAT reduction to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Extending the current VAT subsidy for energy efficient material to include vehicles would, according to this research, be sufficient for all BI segments to definitely purchase a lower emission vehicle.

Regardless of the strength of individuals' BI to purchase a lower emission vehicle, the required VAT increase to instigate the behaviour change process towards a lower emission vehicle purchase is greater than the equivalent VAT reduction. For all three stages in the behaviour change process, Low BI individuals have the greatest losses-to-gains ratio. Such individuals would require a relatively stronger VAT disincentive to change their future vehicle purchasing behaviour. This reflects their limited BI to purchase a lower emission vehicle and the need for a greater VAT increase to change their future vehicle purchasing behaviour. They also have higher household income, which is perhaps reflected in the losses-to-gains ratio. Medium and High BI individuals have similar losses-to-gains ratios. Relative to Low BI individuals, they display a greater penchant for purchasing a lower emission vehicle and thus require a less intense VAT disincentive to change their future vehicle purchasing behaviour. They would also be less able to absorb the financial repercussions of a VAT increase given their relatively lower household income.

8.3.2.3 HOD

The reported influence of HOD in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle utilising 'greener' fuels increases significantly as individuals' BI to purchase a lower emission vehicle strengthens. This reflects the progress made by the BI segments towards a lower emission vehicle purchase and thus the potential receptiveness of taxation policy aimed at encouraging such behaviour.

The reported influence of a HOD reduction for 'greener' fuels was found to increase as individuals' BI to purchase a lower emission vehicle strengthens. 'Carrots' would therefore be more influential for High BI individuals, whereas 'sticks' would be relatively more effective for Low BI individuals. This also reflects the financial affluence of the BI segments and their ability to absorb the financial repercussions of a tax increase.

The required HOD disincentive for main road-fuels was found to reduce as individuals' BI to purchase a lower emission vehicle strengthens. This reflects the progress made by each segment regarding a lower emission vehicle purchase. For example, Low BI individuals would need the largest disincentive to engage in the behaviour change process towards purchasing a lower emission vehicle utilising 'greener' fuels. Concerning the equivalent HOD reduction for 'greener fuels, there is little variation across the BI segments. However, in all instances, High BI individuals require the lowest incentive to engage in all three stages in the behaviour change process.

Results indicate that 2012/13 HOD for main road-fuels would have to rise substantially for all individuals, irrespective of the strength of individuals BI to purchase a lower emission vehicle, to engage in the behaviour change process to purchase a lower emission vehicle utilising 'greener' fuels. However, if all required HOD rates were implemented by policy makers, there is likely to be some public anguish. Since the coalition government came into power, HOD has remained static and pump prices are 13PPL cheaper than intended under the previous government (BBC, 2013). If this 13PPL increase had gone ahead, this would have been suffice for High BI individuals to start thinking about buying a lower emission vehicle utilising 'greener' fuels. Given the anguish over a 1.89PPL increase, the required HOD increases identified by this research are likely to be politically unpopular. Such rates would, however, have the potential to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising 'greener' fuels.

Under 2012/13 HOD rates, no tax incentives are available for biofuels. However, this research indicates a considerable HOD reduction in main road-fuels as necessary to shape future vehicle purchasing decisions across all BI segments. Interestingly, the previous 20PPL subsidy would have been suffice for all individuals, regardless of the strength of individuals' BI to purchase a lower emission vehicle, to seriously think about buying a lower emission vehicle utilising biofuels. The initial 26PPL subsidy slightly falls short of the incentive necessary for all BI segments to definitely buy a lower emission vehicle utilising biofuels. Hence, previous HOD rates were more influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising biofuels, compared to the current lack of tax incentives.

The 2012/13 HOD incentive for LPG would be marginally insufficient for all BI segments to start thinking about buying a lower emission vehicle utilising LPG. The current subsidy of 12.43PPL would thus be completely inadequate for all individuals to engage in the behaviour change process towards purchasing a lower emission vehicle utilising LPG. Regarding CNG, all three strengths of BI would, according to this research, be financially incentivised by the current HOD incentive to seriously think about buying a lower emission vehicle utilising CNG. However, an additional incentive would be required for all individuals to definitely purchase a lower emission vehicle, making the current incentive insufficient to produce a physical change in future vehicle purchasing behaviour.

The current range of HOD incentives for 'greener' fuels would therefore be suffice for some progress to be made in the behaviour change process towards the purchase of a CNG fuelled vehicle. However, additional incentives would be necessary for LPG and biofuels for all BI segments to engage in the behaviour change process towards the purchase of a lower emission vehicle utilising such fuels.

The required HOD increase for the BI segments to engage in the behaviour change process towards purchasing a lower emission vehicle utilising 'greener' fuels was greater than the equivalent HOD decrease in all instances but one. However, the difference between the HOD increase/decrease for the one exception is only 3.1%. For all three stages in the behaviour change process, Low BI individuals have the greatest losses-to-gains ratio. Such individuals are less prepared to purchase a lower emission vehicle in the future and thus require a relatively greater tax disincentive to instigate progress in the behaviour change process towards purchasing a lower emission vehicle utilising ‘greener’ fuels. Low BI individuals also have relatively more household income, which may be a further contributory factor. Conversely, the losses-to-gains ratio lessens as individuals’ BI to purchase a lower emission vehicle strengthens. This reflects their advanced progress in the transition to purchase a lower emission vehicle in the future, and perhaps their relatively lesser household income to absorb the financial repercussions of a HOD increase.

8.3.2.4 PICG

As individuals’ BI to purchase a lower emission vehicle strengthens, the reported influence of the PICG in shaping individuals’ future vehicle purchasing decisions towards a qualifying lower emission vehicle becomes greater. This reflects how prepared individuals are to purchase a lower emission vehicle in the future.

Low BI individuals would require a greater tax incentive than the other BI segments to engage in all three stages of the behaviour change process towards purchasing a qualifying lower emission vehicle. Such individuals are less prepared to purchase a lower emission vehicle and thus require a bigger incentive to change their behaviour. Individuals with a stronger BI to purchase a lower emission vehicle thus require a lower PICG to instigate the behaviour change process towards purchasing a qualifying lower emission vehicle. Such individuals are relatively more prepared to purchase a lower emission vehicle and consequently require a lesser incentive to change their future vehicle purchasing behaviour towards said vehicles.

Recognising the current 16.5% purchase price reduction for an average PICG qualifying vehicle, this incentive would be inadequate for all BI segments to even start thinking about buying a qualifying lower emission vehicle. The incentive would have to roughly double for all individuals to engage in the behaviour change process towards purchasing a qualifying lower emission vehicle. Even without the £5,000 limit on the PICG, a 25% saving would still prove ineffective for all BI segments to start thinking about buying a qualifying lower emission vehicle.

In financial terms, the current £5,000 incentive would be insufficient for all BI segments to even start thinking about buying a qualifying lower emission vehicle. This validates the slow uptake of the PICG. The £5,000 PICG would have to at least treble for all BI segments to definitely purchase a qualifying lower emission vehicle.

8.3.3 How can current taxation measures be adapted to encourage a lower emission vehicle purchase, by 'green' segment within the Scottish motoring population, derived by the factors shaping individuals' future vehicle purchasing behaviour?

This section considers the adaption of VED, VAT, HOD and the PICG to encourage a lower emission vehicle purchase by 'green' segment.

8.3.3.1 VED

The Go-Greens and the Maybe-Greens would be significantly more influenced by VED in their future vehicle purchasing behaviour towards a lower emission vehicle than the No-Greens. The influence of VED appears to reflect the progress made by the 'green' segments in the behaviour change process and confirms past research. For example, findings by Bamberg *et al*. (2011) would suggest contextual interventions, such as taxation, would not be as effective to the No-Greens given their weaker predisposition to purchase a lower emission vehicle. This was anticipated earlier in ***Section 8.2.3***, recognising the range of situational and psychological factors shaping the segments' future vehicle purchasing behaviour. Likewise, taxation was anticipated, based on Bamberg *et al*. (2011), to be more influential to the Go-Greens and the Maybe-Greens. This recognises their advanced progress in the behaviour change process towards purchasing a lower emission vehicle, as confirmed by this research. Furthermore, the No-Greens place significantly less importance upon environmental considerations in their future vehicle purchasing decisions than both other 'green' segments. This perhaps corresponds to the No-Greens' limited reported influence of a taxation measure founded upon CO_2 emissions. Conversely, the relatively greater importance placed upon environmental considerations by the Go-Greens and the Maybe-Greens is perhaps reflected in their greater influence of VED with an environmental tax base.

Results indicate the preference for a VED incentive increases significantly from the No-Greens to the Maybe-Greens to the Go-Greens. Relatively more of the No-Greens would need to be out-priced via 'sticks' to change their future vehicle purchasing behaviour towards a lower emission vehicle. This is perhaps reflective of their significantly greater household income and thus their ability to absorb the financial repercussions of a VED increase. The possibility of saving money via a VED incentive is perhaps less appealing for this reason. On the other hand, relatively more of the Go-Greens would be influenced by more rewarding 'carrots'. Again, this could be reflective of their significantly lower household income.

Regarding the required VED increases, the No-Greens require the biggest disincentive relative to the other 'green' segments to start thinking about, seriously think about and actually purchase a lower emission vehicle. The necessary disincentive subsequently decreases for the Maybe-Greens, further reducing for the Go-Greens. This is perhaps reflective of the psychological process made by each 'green' segment towards a lower emission vehicle purchase. For example, the Go-Greens are more psychologically prepared to purchase a lower emission vehicle (***Section 8.2.3***). Such individuals therefore require a lower disincentive to make the transition towards a lower emission vehicle purchase. On the other hand, the No-Greens have made less progress in the behaviour change process, and thus require a more substantial deterrent to start thinking about, seriously think about and definitely buy a lower emission vehicle.

The required VED increase necessary for the 'green' segments to engage in the behaviour change process towards a lower emission vehicle purchase can be considered in terms of 2012/13 VED rates. Based on the average CO_2 emissions of the average vehicle most often used, 2012/13 rates have VED payments high enough for the Maybe-Greens and the Go-Greens to engage in the behaviour change process towards purchasing a lower emission vehicle. However, 2012/13 VED rates would be suffice for the No-Greens to only seriously think about buying a lower emission vehicle. Recognising the range of vehicles currently driven by the 'green' segments, some motorists would not find a sufficiently high VED disincentive in 2012/13 rates to engage in the behaviour change process towards a lower emission vehicle purchase. Overall, the ability of 2012/13 VED rates to instigate the behaviour change process towards a lower emission vehicle purchase is weakest for the No-Greens, improving for the Maybe-Greens, and most successful for the Go-Greens.

The range of VED decreases required by the 'green' segments follows a similar pattern as the aforementioned VED increases. Namely, the No-Greens consistently require the biggest incentive compared to the Maybe-Greens and particularly the Go-Greens to instigate all three stages in the behaviour change process towards a lower emission vehicle purchase. This also reflects the psychological process made by the ‘green’ segments towards a lower emission vehicle purchase.

Regarding the average CO_2 emitting vehicle driven by the ‘green’ segments, results indicate that 2012/13 rates would provide sufficient incentive for all segments to engage in the behaviour change process towards a lower emission vehicle purchase. Observing the range of vehicles driven by motorists, results indicate all required VED reductions for the ‘green’ segments would be achievable within the 2012/13 payment structure. Potential therefore exists for all motorists, irrespective of their ‘green’ segment membership, to be incentivised by 2012/13 rates to engage in the behaviour change process towards a lower emission vehicle purchase.

Observing the VED incentive/disincentive for each ‘green’ segment to instigate the same progress in the behaviour change process towards a lower emission vehicle purchase, results indicate the need for a greater disincentive than the equivalent incentive. Furthermore, the No-Greens were found to require the greatest losses-to-gains ratio to start thinking about, seriously think about and definitely buy a lower emission vehicle, relative to the other ‘green’ segments. This perhaps reflects their limited preparedness to purchase a lower emission vehicle and their need for a greater price signal to engage in the behaviour change process. Moreover, the No-Greens have comparatively greater household income and can absorb a tax increase better than other ‘green’ segments. Hence a relatively greater VED disincentive would be necessary to instigate progress in the behaviour change process towards a lower emission vehicle purchase. The losses-to-gains ratio is smaller for the Maybe-Greens, and even more so for the Go-Greens. This would appear to reflect their greater penchant for purchasing a lower emission vehicle and their comparatively lower household income.

Regarding the FYR of VED, initial awareness was lowest for the No-Greens. Awareness is greater for the Maybe-Greens and particularly the Go-Greens. Recognising the predisposition of each segment to purchase a lower emission vehicle, this result reflects their knowledge of fiscal policy measures founded upon CO_2 emissions. For example, the Go-Greens’ greater awareness of the FYR of VED, financially rewarding a lower emission vehicle purchase, correlates to their greater penchant to purchase such a vehicle in the future. The reported influence of the FYR of VED increases from the No-Greens to the Maybe-Greens and the Go-Greens. Similar to earlier comments regarding the SR of VED, this finding appears to recognise the progress made by the 'green' segments in the behaviour change process towards a lower emission vehicle purchase.

8.3.3.2 VAT

The No-Greens were identified as significantly less influenced by VAT in shaping their future vehicle purchasing behaviour towards a lower emission vehicle than the other 'green' segments. Similar to VED, this finding reflects the progress made by the 'green' segments in the transition towards a lower emission vehicle purchase.

The Go-Greens would be relatively more influenced by a VAT incentive to change their future vehicle purchasing behaviour towards a lower emission vehicle. This is perhaps reflective of their comparatively lower household income, and thus the greater influence of a tax saving. 'Carrots' would therefore be most influential to this segment. In contrast, Maybe-Greens and No-Greens would be relatively less influenced by a VAT reduction. This recognises the greater affluence of these segments and thus their greater ability to absorb the financial repercussions of a tax increase. 'Sticks' would thus be more influential to the Maybe-Greens and No-Greens.

Regarding the necessary VAT increase for higher emitting vehicles, the No-Greens would require the biggest disincentive relative to the other 'green' segments to instigate all three stages in the behaviour change process towards a lower emission vehicle purchase. The required VAT increase lessens for the Maybe-Greens and further reduces for the Go-Greens. The Go-Greens therefore require the lowest incentive to change their behaviour. This finding reflects the propensity of each 'green' segment to purchase a lower emission vehicle in the future. Specifically, the greater the preparedness to purchase a lower emission vehicle, the lower the tax disincentive necessary to make the transition, and *vice versa*.

The Go-Greens require the lowest VAT decrease to instigate all three stages of the behaviour change process. This is consistent with the aforementioned observation regarding their preparedness to purchase a lower emission vehicle in the future. The Maybe-Greens and No-Greens require a comparatively greater VAT incentive to engage in the behaviour change process towards a lower emission vehicle purchase. The Maybe-Greens would require the greatest VAT reduction to start thinking about and definitely buy a lower emission vehicle, whilst the No-Greens require the greatest incentive to seriously think about buying a lower emission vehicle. However, the differences between the segments are not significant.

Recognising historical VAT rates, the required increases across the ‘green’ segments are perhaps unrealistic from a policy setting perspective. This is particularly so for the No-Greens, who would require VAT to increase to 47.6% to definitely buy a lower emission vehicle. A VAT reduction, to incentivise a lower emission vehicle purchase, may be the more realistic option for policy makers. Indeed, a VAT reduction was reported as more influential in shaping future vehicle purchasing behaviour towards a lower emission vehicle across all ‘green’ segments. According to this research, extending the 5% VAT subsidy for energy efficient material to include vehicles would be suffice for all individuals to definitely purchase a lower emission vehicle.

Regarding the ratio of losses-to-gains, all ‘green’ segments would require a greater VAT disincentive to instigate all three stages in the behaviour change process towards a lower emission vehicle purchase, than the equivalent VAT incentive. The Go-Greens consistently require the lowest losses-to-gains-ratio to start thinking about, seriously think about and definitely buy a lower emission vehicle. The Go-Greens were also found to be most predisposed to purchase a lower emission vehicle in the future and this is perhaps reflected in the weaker price signal. Furthermore, the Go-Greens have less household income than the other ‘green’ segments and are perhaps less able to absorb a VAT increase. Conversely, the Maybe-Greens and No-Greens intimated relatively greater losses-to-gains ratios for all three stages in the behaviour change process towards a lower emission vehicle purchase. This is reflective of their comparatively greater household income and reduced penchant to purchase a lower emission vehicle in the future.

8.3.3.3 HOD

The reported influence of HOD in shaping future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuel is weakest for the No-Greens. HOD becomes more influential for the other ‘green’ segments. This reflects the progress made by each ‘green’ segment towards a lower emission vehicle purchase, and thus the receptiveness of a tax measure designed to encourage such behaviour.

The No-Greens and Maybe-Greens would be less influenced by a HOD reduction for ‘greener’ fuels relative to the Go-Greens. The Go-Greens would thus be more influenced by ‘carrots’, also reflecting their comparatively lower household income. In contrast, the

No-Greens and Maybe-Greens would be more influenced by ‘sticks’ to change their future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuels. Such individuals have relatively more household income, corresponding to a greater reported influence of a HOD increase for main road-fuels to shape their future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuels.

The Go-Greens require the lowest HOD increase for main road-fuels to instigate all three stages in the behaviour change process towards purchasing a lower emission vehicle utilising ‘greener’ fuels. This is reflective of their greater penchant for purchasing a lower emission vehicle and thus the requirement for a smaller disincentive to engage in the behaviour change process. On the other hand, the necessary HOD incentive for ‘greener’ fuels is relatively greater for the No-Greens and Maybe-Greens. Similar observations were made regarding the required HOD reduction for ‘greener’ fuels. Specifically, the No-Greens would need the largest incentive relative to other ‘green’ segments to engage in the behaviour change process towards the purchase of a lower emission vehicle utilising ‘greener’ fuels. This is also confirmatory of the psychological progress made by the segments towards a lower emission vehicle purchase.

Recognising 2012/13 rates, HOD for main road-fuels would have to rise substantially for all ‘green’ segments to engage in the behaviour change process towards purchasing a lower emission vehicle utilising ‘greener’ fuels. From a policy setting perspective, the HOD disincentives identified in this research would be politically unpopular. Historically, the government have recognised the political sensitivity of smaller HOD increases, such as the 1.89PPL increase planned but later cancelled for 2013/14. The 13PPL HOD increase proposed prior to the coalition government coming into power would have been suffice for the Go-Greens to start thinking about buying a lower emission vehicle utilising ‘greener’ fuels. Whilst this research identified a HOD increase as a means of shaping individuals’ future vehicle purchasing behaviour towards a lower emission vehicle utilising ‘greener’ fuels, policy setters have previously shown a reluctance to embrace the full potential of this policy measure.

Recognising the HOD reductions identified for the ‘green’ segments in this research, 2012/13 HOD rates would therefore not instigate the behaviour change process towards purchasing a lower emission vehicle utilising such fuel. The previous 20PPL HOD subsidy would have been sufficient for all ‘green’ segments to start thinking about buying a lower emission vehicle utilising biofuels. The original 26PPL HOD incentive would be adequate for all ‘green’ segments to seriously think about buying such a vehicle. Pre-existing HOD incentives were therefore more influential in shaping individuals’ vehicle purchasing behaviour towards a lower emission vehicle utilising biofuels compared to current rates.

The 2012/13 LPG HOD incentive of 12.43PPL would be marginally insufficient for all ‘green’ segments to even start thinking about buying a LPG fuelled lower emission vehicle. To definitely purchase a lower emission vehicle utilising LPG, the current incentive would have to become 2½ times greater for all ‘green’ segments. Regarding CNG, the 2012/13 HOD incentive would be sufficient for all ‘green’ segments to seriously think about purchasing a CNG fuelled lower emission vehicle. Additional HOD incentives would be required for the ‘green’ segments to definitely purchase a CNG fuelled lower emission vehicle.

Collectively, this research indicates the HOD incentive for CNG would result in the greatest progress in the behaviour change process towards purchasing a lower emission vehicle utilising ‘greener’ fuel. However, additional incentives for all assessed ‘greener’ fuels would be required to make greater progress towards purchasing such a vehicle.

The HOD increase necessary for the ‘green’ segments to engage in the behaviour change process towards purchasing a lower emission vehicle utilising ‘greener’ fuels was observed as greater than the equivalent HOD decrease in all instances but one. Regarding the one exception, the difference between the HOD increase/decrease is only 4%. Across all three stages in the behaviour change process, the Go-Greens have the weakest losses-to-gains ratio. This segment has made greater progress in the behaviour change process towards a lower emission vehicle purchase, perhaps accounting for the relatively weaker disincentive advocated. This segment also has relatively less household income than the other ‘green’ segments, perhaps further contributing to the lower losses-to-gains ratio. To start thinking about buying a lower emission vehicle utilising ‘greener’ fuels, the No-Greens require a greater losses-to-gains ratio than the Maybe-Greens. The opposite is true to seriously think about and definitely buy a lower emission vehicle utilising ‘greener’ fuels. Collectively, these two ‘green’ segments are less prepared to purchase a lower emission vehicle in the future, perhaps explaining why a stronger tax incentive would be necessary compared to the Go-Greens. Furthermore, the No-Greens and Maybe-Greens are more affluent and would thus require a greater disincentive to instigate advancement in the behaviour change process towards purchasing a lower emission vehicle utilising 'greener' fuels.

8.3.3.4 PICG

The PICG would be least influential for the No-Greens in shaping their future vehicle purchasing decisions towards a lower emission vehicle qualifying for the grant. The reported influence of the PICG is significantly greater for the other 'green' segments. This is reflective of how prepared the 'green' segments are to purchase a lower emission vehicle in the future.

The Go-Greens consistently require the lowest PICG incentive of all 'green' segments to engage in the behaviour change process towards purchasing a lower emission vehicle qualifying for the grant. The Go-Greens are more prepared psychologically to purchase a lower emission vehicle than the other 'green' segments, corresponding to a lower incentive to change their future vehicle purchasing behaviour. Their comparatively greater income constraints could also be a contributory factor to the lower PICG incentive. The Maybe-Greens would require the greatest incentive to engage in the behaviour change process towards purchasing a lower emission vehicle qualifying for the grant. Whilst the No-Greens are less prepared to purchase a lower emission vehicle, this segment would require a smaller PICG incentive than the Maybe-Greens. This perhaps suggests a greater resistance from the Maybe-Greens to purchase a PICG qualifying vehicle, such as one with an electric battery, than a conventionally-fuelled lower emission vehicle. A greater incentive would therefore be required to change their future vehicle purchasing behaviour towards qualifying vehicles.

Relative to the average 16.5% purchase price reduction for a qualifying vehicle currently offered by the PICG, all 'green' segments would require a much greater incentive to start thinking about buying such a vehicle. The PICG incentive would have to approximately double for all 'green' segments to start thinking about buying a PICG qualifying lower emission vehicle. Even if the £5,000 maximum was revoked, a 25% purchase price reduction would still be insufficient for all 'green' segments to start thinking about buying a PICG qualifying lower emission vehicle.

In financial terms, the £5,000 PICG incentive would be inadequate for all 'green' segments to even start thinking about buying a qualifying lower emission vehicle. This partly explains the slow uptake of the PICG from January 2011. The current incentive would have to at least treble for all 'green' segments to definitely buy a qualifying lower emission vehicle.

8.4 Addressing research question three

This research question concerns the potential influential of hypothetical policy measures to encourage a lower emission vehicle purchase. Hypothetical policy measures are considered according to their timing in the vehicle ownership cycle and for each individual policy measure. Results are presented for the Scottish motoring population overall and split for the strength of individuals' BI to purchase a lower emission vehicle and 'green' segments derived from k-means cluster analysis.

8.4.1 What hypothetical policy measures could potentially be introduced to encourage the purchase of a lower emission vehicle for the Scottish motoring population overall?

Based on the results of this research, Scottish motorists would be most influenced by hypothetical circulation policy measures in shaping their future vehicle purchasing behaviour towards a lower emission vehicle. This is confirmatory of past research (Hayashi *et al*., 2001; Giblin and McNabola, 2009; Beck *et al*., 2011). Hypothetical purchase policy measures would be the next most influential, where individuals can easily choose between vehicle models at the point of sale (Potter *et al*., 2005; Litman, 2009; Lane, 2011). Collectively, hypothetical circulation and purchase policy measures were clearly dominant in influencing individuals' future vehicle purchasing behaviour, corresponding to past research by Ryan *et al*. (2009). Finally, hypothetical road-fuel policy measures would have the lowest influence in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle. This is perhaps not surprising given usage decisions and vehicle purchasing decisions tend not to share the same tax base. This result is confirmatory of past research (Hayashi *et al*., 2001; Giblin and McNabola, 2009).

Regarding specific policy measures, results indicate a high potential influence of rebates for vehicles below a CO_2 emissions threshold. This corroborates past research by de Haan *et al*. (2007). Whilst the uptake of the PICG, a type of rebate, has been slow, results of this research indicate the specific design of the PICG must be a contributory factor. Fees for vehicles above a CO_2 emissions threshold would also be influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle.

Recognising rebates as being more influential than fees, this corresponds to earlier findings regarding the influence of 'carrots' and 'sticks'. This also corroborates past research by DEFRA (2002) and Avery (2009). The closest UK policy measure issuing fees would be the FYR of VED, with fees for new vehicles emitting at least 131g/km of CO_2. Results indicate a potentially high influence through the imposition of fees.

Fees and rebates together would become feebates, which can be inferred as highly influential to the Scottish motoring populations' future vehicle purchasing decisions. This substantiates previous suggestions for a UK feebate scheme (Lane, 2005; Environmental Audit Committee, 2008; Ferguson, 2012; Brand *et al*., 2013). The main weakness of feebates is their applicability to new vehicles only (BenDor and Ford, 2006). Recognising the proportion of used vehicles currently driven by motorists, this may impede the success of a future feebate system. However, the implementation of a long-term scheme lasting at least 10 years is advocated by Santos *et al*. (2010) to aid emission abatement.

CO_2 based VAT would also be highly influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. This is similar to the Italian VAT scheme based on engine size (Potter *et al*., 2005). This research also quantified the VAT levels necessary to instigate the behaviour change process towards a lower emission vehicle purchase (discussed in ***Chapter 6***). Combined, the results of this research can inform UK policy decisions.

Both the FYR and particularly the SR of VED derived on a per-unit basis founded on CO_2 emissions would be relatively influential in shaping individuals' future vehicle purchasing behaviour[42]. Recognising a greater reported influence for per-unit SR of VED than the FYR, this corresponds to the earlier observation regarding the greater influence of circulation policy measures over purchase based measures (Ryan *et al*., 2009). The Scottish motoring populations' penchant for used vehicles, rendering the FYR as inapplicable, may also be a contributory factor to this finding. Compared to the current graduated VED system, a per-unit approach would provide a continuous financial incentive for motorists to reduce their CO_2 emissions (Gordon and Levenson, 1989; Greene *et al*., 2005). This defining characteristic may be an explanatory factor to the reported influence. Nevertheless, the complexity of a per-unit system is recognised by

[42] The current graduated system was not investigated to provide a comparison to the proposed per-unit setup. It is therefore not possible to ascertain whether this approach would be more or less influential compared to current practice.

Bunch *et al*. (2011) as a weakness of this approach. However, this would depend on the exact setup of a future UK feebate system.

CO_2 based motor insurance would be the next most influential policy measure in shaping individuals' vehicle purchasing behaviour. This would strengthen the financial signal to purchase a lower emission vehicle. Furthermore, extending the CO_2 emissions tax base to motor insurance would provide additional continuity across various policy measures.

CO_2 based RUC was ranked the next most influential policy measure. Recognising almost 60% of motorists drive daily, the potential influence of RUC appears substantiated. Whilst proposals to integrate CO_2 emissions into the London Congestion Charge were halted, this research indicates this policy measure as relatively effective in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Past research has recognised the influence of pricing signals from RUC (Button and Vega, 2008), as confirmed in this research. Suggestions have been made by previous researchers to abolish/reduce VED and HOD in favour of RUC (Ubbels *et al*., 2002; Dodgson *et al*., 2003; Potter *et al*., 2004). However, the results of this research indicate greater success in shaping individuals' future vehicle purchasing behaviour through VED[43].

Reintroducing a SIS, but with a CO_2 emissions limit on the replacement vehicle would be the next most influential policy measure. Whilst a 27.1% emission reduction was achieved from the 2009/10 SIS without an emissions limit, environmental savings could undoubtedly have been greater (SMMT, 2010). Suggestions of increasing lifecycle emissions from vehicle production and scrappage would be compensated by the imposition of a CO_2 emissions cap (Sunderland, 2009). However, the main drawback of a SIS is the vehicle eligibility criteria. For example, the 2009/10 scheme insisted the scrapped vehicle must be owned for at least one year. Indeed, only 2% of motorists sampled acquired their current vehicle via the 2009/10 SIS. This may explain why seven other hypothetical policy measures were ranked more influential.

CO_2 based initial vehicle registration fee was the third least influential policy measure. Modifying the current £55 fee to reflect CO_2 emissions is unlikely to produce a substantial maximum deterrent. Furthermore, the initial vehicle registration fee is only applicable to a brand new vehicle acquisition, whereby limiting its potential effectiveness. If both the

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[43] HOD was not directly assessed in the questionnaire for a similar comparison.

FYR of VED and initial vehicle registration fee were founded on CO_2 emissions, they would present two similar payments at the same stage in the vehicle ownership cycle (Ferguson, 2012). However, this research indicates a greater influence of the FYR of VED over the initial vehicle registration fee in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. The FYR should therefore be prioritised from a policy setting perspective.

CO_2 based parking charges would be the second least influential policy measure in shaping individuals' future vehicle purchasing decisions. Recognising the fundamental objective of parking policy as managing vehicle use/travel patterns (Kelly and Clinch, 2006), the limited effectiveness of this policy measure in shaping vehicle purchasing behaviour is perhaps not unexpected. This is supportive of past research by Potoglou and Kanaroglou (2007), where a free parking incentive did not affect preferences towards purchasing an AFV.

The least influential policy measure in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle would be LEVLs. This is the only policy measure offering time savings for owning/using a lower emission vehicle, rather than financial incentives/disincentives. Recognising the importance of financial considerations during individuals' future vehicle purchasing decisions observed in ***Section 5.1***, this result is perhaps unsurprising. However, real-world experience in California highlights the role LEVLs played in bringing AFVs to market (California Environmental Protection Agency, 2012b). Whilst financial incentives/disincentives would appear most suited as the primary motivation for purchasing a lower emission vehicle, time savings could perhaps be used as a secondary incentive.

8.4.2 What hypothetical policy measures could potentially be introduced to encourage the purchase of a lower emission vehicle, by strength of individuals' BI to purchase a lower emission vehicle in the future?

The influence of hypothetical purchase, circulation and road-fuel policy measures increases as individuals' BI to purchase a lower emission vehicle strengthens. This reflects how prepared each BI segment is to purchase a lower emission vehicle in the future, and thus their receptiveness to hypothetical policy measures encouraging such behaviour. Across the BI segments, hypothetical circulation policy measures would be most influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. This is followed by hypothetical purchase policy measures, whilst hypothetical road-fuel policy measures would have the least influence. The ranked order is consistent with past research (Hayashi *et al*., 2001; Giblin and McNabola, 2009; Ryan *et al*., 2009; Beck *et al*., 2011).

All policy measures except LEVLs become more influential as individuals' BI to purchase a lower emission vehicle strengthens. Low BI individuals are significantly less influenced by all future policy measures than High BI individuals. This is reflective of the psychological progress made by the BI segments towards a future lower emission vehicle purchase.

Hypothetical policy measures applicable to the purchase of a brand new vehicle would be significantly more influential for High BI individuals than those with a weaker BI to purchase a lower emission vehicle. There are a greater proportion of High BI individuals driving a brand new vehicle most often at present. This perhaps explains the higher reported influence of hypothetical policy measures targeting such vehicles.

The influence of CO_2 based VAT was also assessed as part of research question two. Both sets of results indicate CO_2 based VAT would be more influential as individuals' BI to purchase a lower emission vehicle strengthens. This finding, together with the earlier quantification of required VAT rates to instigate the behaviour change process towards a lower emission vehicle purchase are useful from a policy setting perspective for designing future policy.

Recognising CO_2 emissions as the foundation for all hypothetical policy measures, a pattern emerges regarding the CO_2 emissions of the vehicle most often used at present by the BI segments. Namely, Low BI individuals currently drive a significantly greater CO_2 emitting vehicle than the other BI segments. Such individuals have previously ignored policy measures offering incentives to choose a lower emission vehicle, such as VED. This outlook appears to continue with regards to their future vehicle purchasing decisions, with the lowest reported influence of all hypothetical policy measures. The stronger individuals' BI to purchase a lower emission vehicle, the lower the CO_2 emissions of the current vehicle most often used at present. Medium and High BI individuals appear to have benefitted more from previous policy measures rewarding a lower emission vehicle purchase. This is perhaps reflected in their relatively greater receptiveness, relative to Low BI individuals, to the presented hypothetical policy measures continuing to reward such behaviour in the future.

For 10 of the 11 policy measures, financial incentives/disincentives were presented to encourage a lower emission vehicle purchase. Such measures would be significantly more influential for High BI individuals relative to Low BI individuals. This perhaps recognises the financial affluence of the BI segments. For example, High BI individuals have significantly lower household income than those with a Low BI. This corresponds to the less affluent BI segment being more influenced by financial signals than the wealthier BI segment.

Across the BI segments, the only policy measure offering time savings was ranked either the least or second least influential policy measure in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Financial incentives/disincentives clearly have more influence in shaping individuals' future vehicle purchasing behaviour, regardless of the strength of individuals' BI to purchase a lower emission vehicle.

Despite differences between the segments, there is some similarity in the ranked influence of hypothetical policy measures in shaping individuals' future vehicle purchasing decisions. Regardless of the strength of individuals' BI to purchase a lower emission vehicle, rebates, fees, per-unit SR of VED, CO_2 based VAT and vehicle insurance consistently appear in the top five most influential hypothetical policy measures. The exact order of influence does vary slightly depending on the strength of individuals' BI to purchase a lower emission vehicle. These five hypothetical policy measures would therefore have a universal effect on individuals' future vehicle purchasing behaviour. However, the extent of influence will vary by strength of individuals' BI to purchase a lower emission vehicle in the future.

Consensus also exists across the BI segments regarding the two least influential hypothetical policy measures: CO_2 based parking charges and designated LEVLs. The order of influence does vary slightly depending on the strength of individuals' BI to purchase a lower emission vehicle. Implementing such policy measures would have little impact upon individuals' future vehicle purchasing decisions across the BI segments.

The influence of contextual interventions prescribed by Bamberg *et al*. (2011) is reflected in the results of this research. For example, High BI individuals have made the most progress psychologically towards changing their future vehicle purchasing behaviour towards a lower emission vehicle. Such individuals would, according to Bamberg *et al*.

(2011), be more receptive to contextual interventions such as incentives. This is confirmed by the reported influence of hypothetical policy measures in this research. Conversely, Low BI individuals are less prepared to purchase a lower emission vehicle. According to Bamberg *et al*. (2011), and confirmed in this research, contextual interventions would not be best suited for Low BI individuals.

Fundamentally, the psychological constructs leading to the formation of individuals' BI would have to become stronger before contextual interventions become more influential. Other types of interventions would be more pertinent in strengthening the weaker constructs in the pre-contemplation stage of the MaxSem model (Bamberg *et al*., 2011). This could include psychologically-based awareness raising and information campaigns designed to change attitudes towards lower emission vehicle.

8.4.3 What hypothetical policy measures could potentially be introduced to encourage the purchase of a lower emission vehicle, by 'green' segment within the Scottish motoring population, derived by the factors shaping individuals' future vehicle purchasing behaviour?

Hypothetical purchase, circulation and road-fuel policy measures would be least influential for the No-Greens. All types of hypothetical policy measures would be more influential for the Maybe-Greens and even more so for the Go-Greens. This is reflective of the willingness of each 'green' segment to purchase a lower emission vehicle in the future, and thus the influence of hypothetical policy measures designed to encourage such behaviour. Hypothetical circulation policy measures would be most influential in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle across all 'green' segments. This is followed by hypothetical purchase policy measures, whilst hypothetical road-fuel policy measures would be least influential in shaping future vehicle purchasing behaviour across the 'green' segments. This finding is consistent with past research (Hayashi *et al*., 2001; Giblin and McNabola, 2009; Ryan *et al*., 2009; Beck *et al*., 2011). The No-Greens would be least influenced by all hypothetical policy measures in their future vehicle purchasing decisions towards a lower emission vehicle. This is consistent with the limited propensity of this 'green' segment to purchase a lower emission vehicle in the future. The influence of hypothetical policy measures is greater for the other 'green' segments. Such individuals are relatively more prepared psychologically to purchase a lower emission vehicle in the future, aptly corresponding to a greater reported influence of hypothetical policy measures.

Hypothetical policy measures targeting the purchase of a brand new vehicle would be significantly more influential for the Maybe-Greens and Go-Greens, relative to the No-Greens. A greater proportion of the Maybe-Greens and Go-Greens currently drive a vehicle acquired brand new. This perhaps corresponds to the greater reported influence of hypothetical policy measures targeting such vehicles.

The influence of CO_2 based VAT was assessed earlier for research question two. Both sets of findings confirm the relatively high influence of this hypothetical policy measure for the Maybe-Greens and Go-Greens, but significantly lower influence for the No-Greens. The reported influence of this hypothetical policy measure and the level of VAT required to instigate the behaviour change process towards a lower emission vehicle purchase will be invaluable from a policy setting perspective when designing future policy.

Acknowledging CO_2 emissions as the foundation for all hypothetical policy measures, the reported influence of such measures corresponds to the CO_2 emissions of the vehicle most often used at present by the 'green' segments. Specifically, the No-Greens most frequently drive a significantly higher emitting vehicle than both other segments. The No-Greens appear to have previously overlooked policy measures rewarding a lower emission vehicle purchase. This previous outlook appears to continue in the future, with the lowest reported influence for all hypothetical policy measures. Conversely, the Maybe-Greens and the Go-Greens currently drive a significantly less emitting vehicle than the No-Greens. This perhaps suggests a previous acknowledgment of policy measures incentivising lower emission vehicles. This appears to be maintained for their future vehicle purchasing decisions, with a relatively higher reported influence of all hypothetical policy measures.

Financial incentives/disincentives were present in 10 of the 11 hypothetical policy measures. The influence of such policy measures perhaps recognises the affluence of each 'green' segment. Specifically, the Go-Greens and the Maybe-Greens have significantly less household income than the No-Greens. Accordingly, financial signals could be anticipated as more influential to the Go-Greens and the Maybe-Greens, corresponding to a higher reported influence of the 10 financial based hypothetical policy measures. On the other hand, the No-Greens have significantly higher household income than the other 'green' segments. Such individuals can therefore more easily absorb the financial repercussions of purchasing a higher emission vehicle, reflected by a lower reported influence of hypothetical policy measures bestowing financial incentives/disincentives.

LEVLs are consistently ranked the least influential policy measure for all 'green' segments. This is the only policy measure offering a time incentive to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Monetary based policy measures would clearly be more influential in shaping individuals' future vehicle purchasing behaviour, regardless of 'green' segment membership.

Further consensus exists regarding the influence of hypothetical policy measures across the 'green' segments. Rebates for vehicles below a CO_2 emissions threshold would be the most influential hypothetical policy measure regardless of 'green' segment membership. Rebates, together with fees, per-unit SR of VED, CO_2 based VAT and vehicle insurance populate the top five most influential hypothetical policy measures across the 'green' segments, although the exact order of influence does vary slightly. These five hypothetical policy measures, particularly rebates, would have the greatest widespread influence upon all 'green' segments.

In addition to the aforementioned low influence of LEVLs, there is consensus among the 'green' segments regarding the relative ineffectiveness of CO_2 based parking charges in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. This hypothetical policy measure is consistently ranked second lowest for potential influence. Both CO_2 based parking and LEVLs would therefore have little impact upon individuals' future vehicle purchasing behaviour across all 'green' segments.

The influence of contextual interventions stipulated by Bamberg *et al*. (2011) is reflected in the results of this research. Specifically, the No-Greens have made the least progress psychologically to change their future vehicle purchasing behaviour towards a lower emission vehicle. Such individuals would, according to Bamberg *et al*. (2011), be less influenced by contextual interventions such as incentives. This has been confirmed by a significantly lower reported influence of hypothetical policy measures relative to the other 'green' segments. Different types of interventions would be necessary to strengthen the weaker psychological constructs in the pre-contemplation stage of the behaviour change process (Bamberg *et al*., 2011) to ultimately increase the influence of hypothetical policy measures. For example, psychologically-based information campaigns to raise awareness regarding the environmental consequences of car use and the benefits of purchasing a lower emission vehicle would be pertinent to the No-Greens.

The Maybe-Greens have made relatively more progress psychologically to purchase a lower emission vehicle in the future. Furthermore, situational factors were identified as dominant in informing their future vehicle purchasing decisions. Recognising research by Bamberg *et al*. (2011), contextual interventions such as the hypothetical policy measures assessed would be expected and were indeed significantly more influential to this segment compared to the No-Greens. Finally, the Go-Greens have made most progress psychologically towards changing their future vehicle purchasing behaviour towards a lower emission vehicle. According to Bamberg *et al*. (2011), and confirmed in this research, contextual interventions would be more influential to this ‘green’ segment.

8.5 Chapter 8 summary

This chapter provided a discussion of the results presented in ***Chapters 4-7***. Three research questions were addressed, including consideration of the Scottish motoring population overall, and the various segments within.

The following key points were considered for research question one:

- The importance of situational factors in shaping individuals’ future vehicle purchasing decisions was largely confirmatory of past research;
- Psychological constructs would be less dominant in shaping Low BI individuals and the No-Greens’ future vehicle purchasing decisions. In this case, psychologically-based interventions can be implemented to target the weaker constructs. As psychological constructs become stronger, as per High BI individuals and the Go-Greens, contextual interventions including vehicle taxation become more influential in engaging behaviour change.

The following key points were considered for research question two:

- The reported influence of VED, VAT, HOD, the PICG and FYR of VED was identified as reflecting individuals’ engagement in the behaviour change process towards a lower emission vehicle purchase. Namely, the more prepared individuals are to purchase a lower emission vehicle in the future, policy measures rewarding such behaviour are more influential. This is confirmatory of earlier discussions regarding the influence of contextual interventions based on situational/psychological factors informing individuals' future vehicle purchasing decisions;

- The greater influence of a VED, VAT and HOD reduction in shaping individuals' future vehicle purchasing behaviour is confirmatory of past research regarding loss aversion. Across the segments, the influence of a tax disincentive was found to reflect financial affluence and thus the segments' ability to absorb the financial repercussions of buying a higher emitting vehicle;
- The required level of tax increase/decrease to instigate the behaviour change process towards purchasing a lower emission vehicle was confirmatory of past research advocating a multi-stage process to change behaviour. Subtle attitudinal changes were recognised as necessary for individuals to move closer to actually changing their future vehicle purchasing behaviour;
- Across the segments, the level of tax incentive/disincentive necessary to instigate the behaviour change process towards purchasing a lower emission vehicle was largely reflective of their preparedness to purchase such a vehicle in the future. Specifically, the required level of tax incentive/disincentive lessens as individuals' willingness to purchase a lower emission vehicle strengthens;
- Results indicate current taxation policy to be largely ineffective in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. This includes the range of HOD incentives for 'greener' fuels and the PICG.

The following key points were considered for research question three:

- The ranked influence of purchase, circulation and road-fuel based hypothetical policy measures in facilitating a lower emission vehicle purchase is confirmatory of past research;
- Across the segments, the reported influence of hypothetical policy measures increases as individuals' propensity to purchase a lower emission vehicle in the future strengthens. This is further confirmatory of earlier assertions regarding the influence of contextual interventions for each segment;
- For the greatest impact upon individuals' future vehicle purchasing behaviour across the segments, feebates, CO_2 based VAT and vehicle insurance should be considered for introduction by policy makers.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Chapter overview

Individuals' future vehicle purchasing behaviour and the influence of 'green' fiscal policy in shaping such behaviour has been considered throughout the thesis. This included an examination of existing literature (***Chapter 2***) and the presentation and subsequent discussion of the results collected from the researcher's questionnaire survey (***Chapters 4-8***). This chapter collates the research findings, including a final overview of the research questions and a summary of the main findings. The limitations of the research and implications on the results are subsequently considered. The chapter concludes with recommendations for both policy makers and future research.

9.2 Summary of research

This research aimed to examine the influence of situational and psychological factors, both absolute and relative to one another, in individuals' future vehicle purchasing decisions. Particular focus was given towards the role of 'green' fiscal policy measures in shaping purchasing behaviour towards lower emission vehicles. Lane and Potter (2007) and their model of factors influencing individuals' future vehicle purchasing behaviour provided the theoretical and conceptual underpinnings of this research.

Chapter 1 highlighted the importance of this research. The environmental consequences of private motoring were discussed, recognising government targets to reduce vehicle-related GHG emissions. Research into the potential influence of policy interventions to shape individuals' future vehicle purchasing behaviour towards a lower emission vehicle, to reduce CO_2 emissions, is therefore justified. A questionnaire survey (***Chapter 3***), was initiated to the Scottish motoring population. This was designed to explore individuals' future vehicle purchasing behaviour and the influence of fiscal and other policy measures to shape individuals' future vehicle purchasing decisions towards a lower emission vehicle. The survey data collected was used to address three research questions subsequently considered.

9.2.1 Final consideration of research question one

This research considered how important situational and psychological factors, both absolute and relative to one another, are in shaping individuals' future vehicle purchasing decisions. For the Scottish motoring population overall, situational factors were generally more influential than psychological factors in individuals' future vehicle purchasing decisions.

Financial considerations are the most important situational factor for the Scottish motoring population overall in their future vehicle purchasing decisions for a lower emission vehicle. This includes costs at the time of purchase, reoccurring during the vehicle ownership cycle, and those relating to fuel and vehicle performance. This has positive implications for the influence of policy measures embracing price signals.

For the Scottish motoring population overall, attitudes are the strongest psychological construct informing the strength of individuals' BI to purchase a lower emission vehicle. This is followed by individuals' perceived ability and apparent responsibility to change their future vehicle purchasing behaviour towards a lower emission vehicle. Knowledge of each psychological constructs' strength can inform the type of interventions most likely to be successful in shaping individuals' future vehicle purchasing behaviour (Bamberg *et al*., 2011). Regarding the segments forming the Scottish motoring population, situational factors would be relatively more influential for Low BI individuals to purchase a lower emission vehicle and members of the No-Greens and Maybe-Greens. Psychologically-based interventions would be most relevant to such individuals to help strengthen the weaker psychological constructs. Psychological constructs gain precedence in the ranked factors informing future vehicle purchasing behaviour towards a lower emission vehicle for Medium or High BI individuals and members of the Go-Greens. Contextual interventions, including vehicle taxation, would be relatively more influential to such individuals to aid the transition towards purchasing a lower emission vehicle.

A revised behavioural model conceptualising individuals' future vehicle purchasing behaviour was produced for the Scottish motoring population overall and the 'green' segments. The Borthwick 'wheel' indicates the relative importance/influence of situational and psychological factors to one another. Advances from psychology regarding the behaviour change process were also reflected, together with the researcher's interpretation of situational factors informing individuals' future vehicle purchasing behaviour.

9.2.2 Final consideration of research question two

The research then considered how current taxation measures could be adapted to encourage a lower emission vehicle purchase. Over three quarter of future vehicle purchasing decisions by Scottish motorists could be influenced by the SR of VED, CO_2 based VAT, HOD and the PICG. Unarguably, this is encouraging in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Vehicle taxation becomes more influential as individuals' BI to purchase a lower emission vehicle strengthens. This is also evident across the 'green' segments. These observations reflect the progress made by the BI and 'green' segments in the behaviour change process towards a future lower emission vehicle purchase. It also confirms the earlier discussion of research question one, where the influence of contextual interventions was asserted to increase as individuals advance through the behaviour change process. Collectively, this finding signifies the importance of psychological constructs, ultimately informing the strength of individuals' BI to purchase a lower emission vehicle, in promoting the successful application of taxation.

Across the Scottish motoring population overall, a VED, VAT and HOD incentive would be more influential than a disincentive to encourage a lower emission vehicle purchase. This corresponds to individuals being loss-averse and more responsive to 'carrots' to change their future vehicle purchasing behaviour. From a government perspective, however, negative implications arise for raising revenue. VED, VAT and HOD incentives become more influential in shaping future vehicle purchasing behaviour towards a lower emission vehicle as individuals' BI to purchase such a vehicle strengthens. The influence of tax incentives is weakest for the No-Greens, subsequently strengthening for the Maybe-Greens and even more so for the Go-Greens. This finding reflects the financial affluence of each BI and 'green' segment and thus their ability to absorb a tax increase.

Disaggregating the behaviour change process, the required tax incentive/disincentive would have to intensify for individuals to progress from only starting to think about buying a lower emission vehicle, to seriously think about, and definitely buy such a vehicle. This recognises and confirms the multi-stage approach to the behaviour change process (MAX Success, 2009d). Subtle attitudinal changes would be necessary for individual progression towards an actual change in their future vehicle purchasing behaviour towards a lower emission vehicle. Regarding the BI and 'green' segments, individuals most prepared to purchase a lower emission vehicle in the future generally require the lowest incentive/disincentive to change their future vehicle purchasing behaviour towards a lower emission vehicle, and *vice versa*. This reflects how prepared each segment is to purchase a lower emission vehicle in the future and the level of price signal required to engage in the behaviour change process towards a lower emission vehicle purchase. Results suggest current taxation policy would be largely ineffective in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle, including the range of HOD incentives for 'greener' fuels and PICG.

9.2.3 Final consideration of research question three

The research considered hypothetical policy measures to potentially be introduced to encourage a lower emission vehicle purchase. Results indicate circulation and purchase based policy measures would be most influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Concerning specific hypothetical policy measures, feebates, CO_2 based VAT and vehicle insurance reflecting CO_2 emissions would have the greatest effect across the identified segments in aiding a lower emission vehicle purchase. Across the BI and 'green' segments, purchase, circulation and road-fuel policy measures become more influential as individuals become more prepared to purchase a lower emission vehicle in the future. Similar findings were identified regarding the influence of individual hypothetical policy measures. This reflects how prepared individuals' are to purchase a lower emission vehicle in the future and thus the receptiveness of policy measures encouraging this type of behaviour. The finding also confirms earlier assertions regarding the greater influence of contextual interventions according to the factors informing individuals' future vehicle purchasing behaviour.

9.3 Contribution to knowledge

This research set out to address the gaps in knowledge identified from reviewing existing literature (***Chapter 2***). The actual contribution and advances made are subsequently considered.

This research sought to integrate psychological theory of behaviour change to vehicle purchasing behaviour. Results confirm individuals go through various mindsets, leading to the actual purchase of a vehicle. Furthermore, this research was able to elicit the exact levels of vehicle taxation (VED, HOD, VAT and the PICG) necessary to instigate each of the stages observed in the behaviour change process. Results support the use of taxation/price signals to stimulate changes in psychological constructs towards purchasing a lower emission vehicle. These subtle changes in aspects such as attitudes and norms are prerequisites for individuals to advance towards changing their vehicle purchasing behaviour. The research was also able to classify the above according to the different segments making up the Scottish motoring population. Specific details of vehicle purchasing behaviour and the role of taxation in encouraging the purchase of a lower emission vehicle across sub-groups in the population represents a further contribution to knowledge. Collectively, the detail accumulated provides insight into fiscal policy design, such as the use of tax incentives versus disincentives, particularly in a Scottish context. This feeds into the recommendations in ***section 9.5.1***.

Whilst the Lane and Potter (2007) model of factors influencing individuals' future vehicle purchasing behaviour (***Figure 3***) was the most recent and comprehensive conceptualisation available, various weaknesses were identified and addressed in this research. First, the Lane and Potter (2007) model assumes an equal weighting of situational and psychological factors informing vehicle purchasing behaviour. Results of the research have shown this not to be the case and the revised Borthwick 'wheel' (***Figure 53***) indicates the relative and absolute importance of each factor in an inherent ranking. Second, the Lane and Potter (2007) model incorporates only a limited number of psychological factors, stemming from the TPB and VBN models. Since 2007, the MaxSem model recognised a number of additional constructs as important predictors of behaviour/behaviour change (MAX Success, 2009a) and the Borthwick 'wheel' incorporates these extra factors. Third, the Lane and Potter (2007) model exists as a one-size-fits-all conceptualisation of vehicle purchasing behaviour. However, the results of this research identified differences between the 'green' segments regarding the factors informing their future vehicle purchasing behaviour. These important differences across the motoring population were shown in segment-specific 'wheels' (***Figure 54-Figure 56***). The extensions made to the Lane and Potter model is shown in ***Figure 74***.

9.4 Research limitations

The value elicitation technique for deriving the tax increase/decrease required to start thinking about, seriously think about and definitely buy a lower emission vehicle was not without fault during data collection. Given the earlier application of this technique in a face-to-face manner (Carreno *et al*., 2004), some issues were anticipated in designing a format suitable for self-completion. Despite two rounds of pilot-testing, there were still

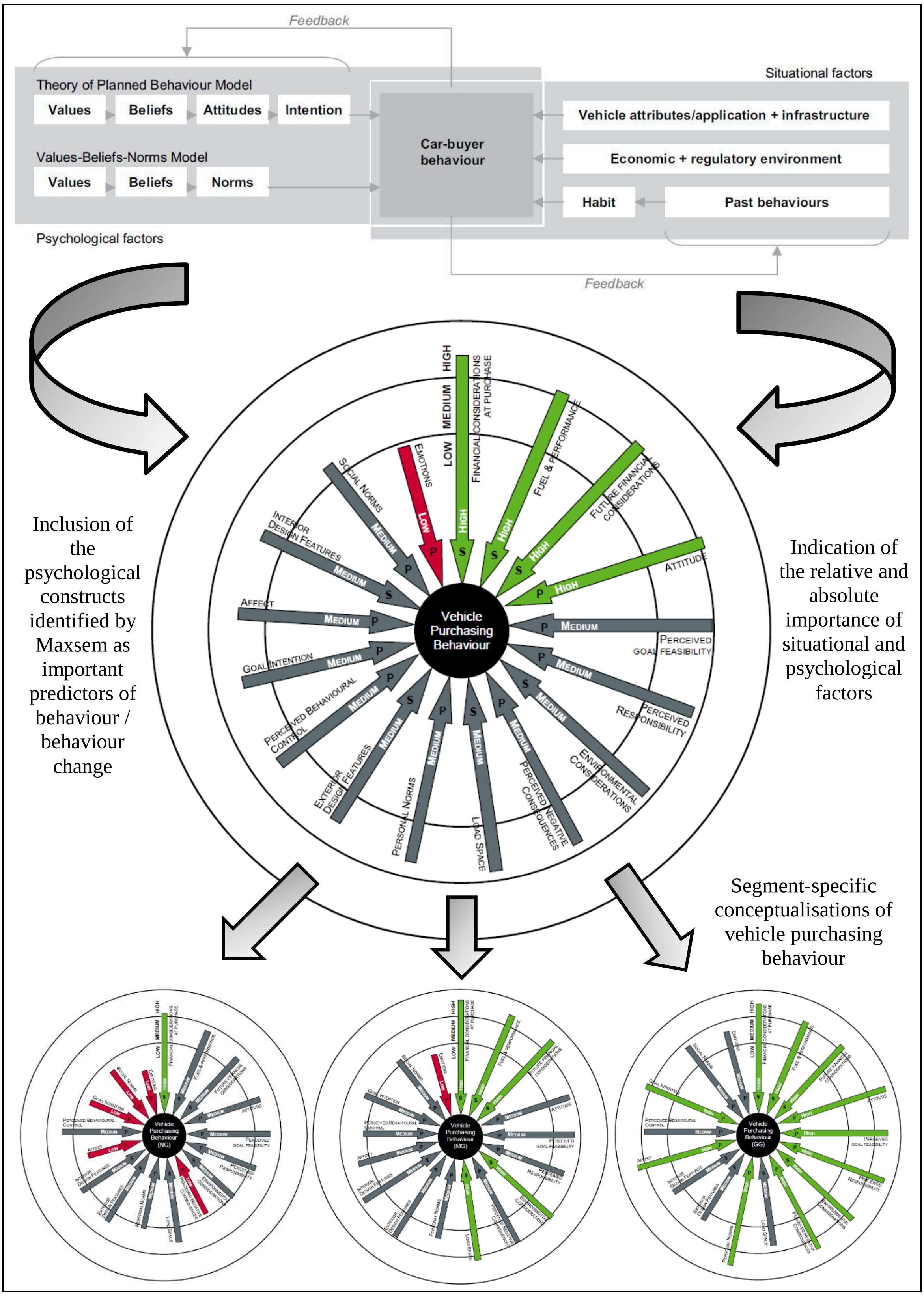

Figure 74: Extensions made to the Lane and Potter (2007) model via the Borthwick 'wheel'

some individuals who could not comprehend the question. For example, 105 individuals reported the same VED percentage increase/decrease as necessary to start thinking about, seriously think about and definitely buy a lower emission vehicle. Such individuals failed to recognise the significance of the behaviour change process that the question was trying to represent. Duplicate responses were nevertheless included in the analysis as they do provide a measure of the incentive/disincentive necessary to influence individuals' future vehicle purchasing behaviour towards a lower emission vehicle.

Some of the potential issues recognised by Pearce *et al*. (2002) regarding an open-ended value elicitation format did manifest. For example, there was some unexpectedly high tax increases/decreases reported as necessary to instigate the behaviour change process towards a lower emission vehicle purchase. However, prior conceptions of the researcher regarding a 'reasonable' answer should not influence the results/analysis. In fact, respondents providing typically high responses were members of the No-Greens, who were generally found to require a greater incentive/disincentive to change their future vehicle purchasing behaviour towards a lower emission vehicle than other 'green' segments.

Recognised as a possibility by Pearce *et al*. (2002), non-response for open-ended value elicitation questions was indeed high, perhaps reflecting the complexity of the question. Questionnaire length is perhaps a further contributory factor. Indeed, past research highlighted the risk of respondents breaking off mid-way through a large questionnaire (Sheatsley, 1983) or simply missing out some questions (Anderson *et al*., 1983). Section D participation was optional, depending on the intention to purchase a vehicle in the near future. Almost a third of individuals indicated such an intention, whereby completing this section. Relative to the earlier self-reported BI to purchase a lower emission vehicle in the future, where almost half of individuals had a High BI, section D participation could have been expectedly higher.

Both value elicitation techniques and SP have limitations, which should be discussed further. The first issue is hypothetical bias, where the level of taxation indicated in this research may be insufficient when the hypothetical situation *actually* occurs. Wallis and Friedman (1942, p.180) have suggested responses to hypothetical questions are *"valueless because the subject cannot know how he would react"*. However, other researchers have concluded that hypothetical scenarios can successfully capture individuals' preferences and judgements (Rousseas and Hart, 1951; Mosteller and Nogee, 1951). Various counteractive measures were utilised in the questionnaire, including budget reminders and cheap-talk.

A further area of potential bias is the possibility of respondents trying to control future policy through their responses, regardless of their true feelings (Sanko, 2001). For example, a tax incentive was found to be generally more influential in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle than a tax disincentive. Perhaps this was an attempt, either consciously or subconsciously, to sway future policy towards reducing taxation. This may be possible given the unpopularity of 'green' taxation (Chartered Institute of Taxation, 2009). Both types of bias may or may not be present in this research – the possibility should, however, be recognised.

Another consideration is the ever changing levels of fiscal policy. 2010/11 tax rates were presented in section D of the questionnaire as a starting point for the value elicitation questions. By 2012/13, some of the tax rates had changed, perhaps resulting in different responses. However, ***Chapter 8*** did provide an assessment of the changes to taxation policy reported by Scottish motorists and the actual changes implemented by government from 2010/11 to 2012/13.

Oppenheim (1992, p.284) argues that most surveys are *"never 'analysed-out' completely"*. Limitations therefore exist according to the cut-off for data analysis determined by the researcher. The strengths and weaknesses of the analytical techniques employed in this research were discussed earlier in ***Section 3.19***. Perhaps the biggest limitation to reiterate in this final chapter is the dominance of bivariate analysis to test the relationship between variables and the sub-groups in the motoring population. That is, the examination of two variables at one time. This technique is therefore not as strong as multivariate analysis, but nevertheless an advancement upon univariate analysis.

A final caveat exists regarding the representativeness of the sample. The biggest deviation is for household income, although the comparison to the population differs regarding income tax. Past research has identified income as highly influential in shaping individuals' future vehicle purchasing decisions (Lave and Train, 1979; Mannering and Winston, 1985; Choo and Mokhtarian, 2004). There are also implications given the importance of financial considerations, including vehicle taxation, in shaping individuals' future vehicle purchasing decisions (Boardman *et al*., 2000; DFT, 2003; Lehman *et al.*, 2003; Anable *et al*., 2008; Lane and Banks, 2010). This potential limitation should be recognised regarding the generalisations proposed.

9.5 Recommendations from the research

The aforementioned results/discussion provides a greater understanding of individuals' future vehicle purchasing behaviour and the role of transport policy, particularly taxation, in achieving environmental objectives. Recommendations can therefore be advocated for policy makers and future research.

9.5.1 Recommendations for policy makers

This research focused upon the influence of UK transport policy upon Scottish motorists. Presently, Scotland does not have the autonomy to implement changes to transport policy. This responsibility is 'reserved' for the UK Parliament to legislate. However, the possibility of Scottish independence, decided after the 18 September 2014 referendum, should be considered. If independence is granted, responsibility for setting national taxation policy is likely to transfer to the Scottish Parliament. Taxation measures could thus be tailored towards Scotland's needs (Scottish Government, 2009b). Policy recommendations of this research are perhaps best suited to an independent Scottish Parliament, with full power to implement the suggested changes. However, with the current devolved scenario, the recommendations are nonetheless insightful to Scottish policy makers[44].

Results indicate 2012/13 VED rates would be largely effective in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle. Policy setters' intention of targeting mid-range CO_2 emitting vehicles was identified as successful. However, drivers of higher CO_2 emitting vehicles will not be financially discouraged by 2012/13 VED rates to change their future vehicle purchasing behaviour towards a lower emission vehicle. Nevertheless, such individuals are few in number and the FYR of VED will go towards providing a sufficient disincentive, assuming future vehicles would be acquired brand new. No major changes would therefore be recommended for VED. The

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[44] In response to the question "should Scotland be an independent country?", 55.3% of the 3.6 million votes cast said no. Whilst full devolution of power will not occur, the Better Together campaign were keen to advocate that a no vote does not mean no change. In light of the referendum result, the Prime Minister David Cameron issued a statement advocating full delivery of further devolution promised for the Scottish Parliament, including the powers agreed in the Scotland Act 2012. Lord Smith of Kelvin has been appointed to oversee the devolution process, with powers over tax, spending and welfare to be agreed by November 2014 and draft legislation published by January 2015. In terms of this research, the range of fiscal policy measures assessed and subsequent recommendations to policy makers, it is perhaps disheartening that the exact mix of powers to be devolved to the Scottish Parliament is not entirely clear at this stage. This will nevertheless become clearer in due course.

effectiveness of a per-unit VED system was also investigated. Results indicate this policy measure as relatively influential in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle. Perhaps additional consideration, beyond the remit of this research, should be given by policy makers towards a per-unit VED system.

The potential influence of CO_2 based VAT was also explored. Recognising the reported high influence, policy makers should seriously consider this policy measure. The recommendation would be to reduce VAT to 5% for lower emission vehicles, achievable by extending the 5% rate for energy saving material.

Based on the results of this research, 2012/13 HOD rates would appear largely ineffective in shaping individuals' future vehicle purchasing behaviour towards a lower emission vehicle utilising 'greener' fuels. Regarding biofuels, a HOD subsidy would be required, currently missing, to incentivise the purchase of a lower emission vehicle utilising such fuel. HOD subsidies for biofuels are thus recommended for reintroduction. Whilst a HOD incentive is available for LPG, the subsidy was identified as too small for individuals to engage in the behaviour change process towards purchasing a lower emission vehicle utilising LPG. An increase in the 2012/13 HOD subsidy for LPG would therefore be recommended. The current HOD incentive for CNG was identified as suffice for Scottish motorists to change their attitudes towards purchasing a lower emission vehicle utilising CNG. However, no actual change in individuals' future vehicle purchasing behaviour towards such a vehicle would occur with the current incentive. The HOD subsidy for CNG is thus recommended for future increase. This research quantified the necessary minimum for all 'green' segments to definitely purchase a lower emission vehicle utilising 'greener' fuels at 29.15PPL, which is thus the recommendation.

Concerning the PICG, results indicate the £5,000 subsidy would be insufficient for the Scottish motoring population to even start thinking about buying a qualifying lower emission vehicle. The slow uptake of the PICG across the UK confirms its inadequacy. Recognising a £30,262 average price for qualifying lower emission vehicles, the necessary minimum incentive for all 'green' segments to definitely purchase a qualifying lower emission vehicle was quantified at £16,130. It is therefore recommended the PICG should at least treble for the Scottish motoring population to definitely change their future vehicle purchasing behaviour towards a qualifying lower emission vehicle. An alternative recommendation would be a relative percentage reduction in qualifying lower emission vehicle prices to reflect the exact financial investment incurred by motorists. The necessary minimum percentage reduction for all ‘green’ segments to definitely purchase a qualifying lower emission vehicle was quantified as 53.3%. This would therefore be the alternative recommendation.

Lesser changes than the aforementioned recommendations will instigate some engagement in the behaviour change process. Whilst these subtle changes are necessary, they will not cause actual changes in individuals’ future vehicle purchasing behaviour.

Feebates were rated highly influential across all ‘green’ segments of the Scottish motoring population in shaping individuals’ future vehicle purchasing behaviour towards a lower emission vehicle. The future adoption of feebates is thus recommended. Recognising the UK’s one-in-one-out rule, a simplification of existing policy measures would be necessary if feebates were introduced.

Results also indicate CO_2 based vehicle insurance would be relatively influential in shaping individuals’ future vehicle purchasing decisions towards a lower emission vehicle, particularly for the No-Greens. Some UK and overseas insurers already offer insurance discounts for ‘greener’ vehicles. This type of arrangement, perhaps on a larger scale and with government backing, is recommended for consideration by policy makers.

9.5.2 Recommendations for future research

Specific to the methodology, self-completion of the value elicitation questions was not entirely successful, despite pilot-testing. As documented earlier, value elicitation questions were previously applied in a face-to-face manner. Responses were thus recorded by the interviewer and any issues/misunderstandings could be clarified during data collection. Further research would thus be recommended regarding aspects such as the format and presentation of value elicitation questions under different data collection methods.

Concerning data analysis, other techniques could perhaps have been utilised going beyond bivariate analysis. Additional multivariate analysis such as regression or structural equation modelling could have been used to identify predictors of the dependent variable. This would have recognised the effect of multiple variables simultaneously rather than each being viewed separately. Where possible, these techniques would be recommended for future analysis.

Avenues for further research were highlighted as part of the recommendations for policy makers. For example, this research identified feebates to be highly influential in individuals' future vehicle purchasing decisions. However, it is unclear where the tipping point for awarding fees or paying rebates should be, or whether the scheme should be revenue-neutral. Past research has identified such aspects as affecting the successful application of feebates (German and Meszler, 2010). Further research would therefore be recommended regarding the setup and administration of a per-unit VED system, CO_2 based motor insurance and feebates in Scotland/UK.

A further recommendation would be to replicate this study in other geographical locations. England, Wales and Northern Ireland would be the obvious starting point given the universal application of UK transport policy. It would be interesting to ascertain whether the influence of vehicle taxation varies with geography and whether the 'green' cluster structure is valid across the UK.

Comparative studies beyond the UK would also be possible, despite the policy measure differences. For example, the online questionnaire survey targeting future motorists (***Appendix A2***) has been modified for Chinese, Slovenian and Thai individuals. The future motoring population is worthy of further research for several reasons. Such individuals currently have limited but impending exposure to fiscal policy and the process of buying/running a vehicle. Future motorists are effectively a 'blank canvas'. Policy measures can be designed, informed by the type of research advocated, to instil environmentally conscious vehicle purchasing decisions from the onset. Furthermore, 103,000 theory tests and 130,000 practical driving tests were conducted in Scotland during 2011. This represents an increase of 5% and 14% respectively since 2002 (Scottish Government, 2012b), further signifying the importance of studying such individuals.

Verification of MaxSem's application to purchasing a lower emission vehicle is also recommended. MaxSem was originally applied to travel behaviour and mobility management. This research is thought to be the first to take the constructs of MaxSem in context of individuals' future vehicle purchasing behaviour. Future research should therefore aspire to verify the findings of this research.

This research sought to capture the process leading to the formation of individuals' BI to purchase a lower emission vehicle in the future. This embraced the pre-contemplation and contemplation stages of the MaxSem model. However, there are two stages of MaxSem occurring after the formation of individuals' BI to purchase a lower emission vehicle. It would be interesting to observe individuals' *actual* vehicle purchasing behaviour and thus capture the whole behaviour change process. This should be strived for in future research.

A final recommendation involves consideration of whether the strength of individuals' BI to purchase a lower emission vehicle varies for the vehicle's position in the household fleet. Specifically, whether the lower emission vehicle would be the dominant primary vehicle, or an additional secondary vehicle. Conventionally fuelled vehicles are often classified as the primary household vehicle, whilst AFVs are often conceptualised as a secondary vehicle (Kurani *et al*., 1994, 1995; Gärling and Thøgersen, 2001; Grahame-Rowe *et al*., 2012). Regarding taxation, the House of Commons Transport Committee (2013) suggested the PICG was more supportive for purchasing a secondary vehicle rather than the dominant household vehicle. This complexity would have been an interesting angle in this research, and is thus recommended for future studies.

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APPENDICES

A1 2013/14 VED RATES

As documented in ***Chapter 2***, inflationary increases in the SR and FYR of VED occurred during the write-up of this thesis. The revised rates are subsequently provided.

The FYR of VED for petrol/diesel vehicles (***Table 65***) and AFVs (***Table 66***) in 2012/13 and 2013/14 is presented. Incentives for lower emission vehicles and disincentives for higher emission vehicles have intensified relative to the SR. For example, vehicles in tax band E, emitting 131-140g/km, face an additional £5 at the time of purchase in 2013/14. Conversely, tax band M vehicles, emitting 256g/km minimum, must pay a further £35. Vehicles emitting 130g/km of CO_2 or less continue to gain an exemption to VED in the first year.

Table 65: FYR of VED (from 1 April 2013 to 31 March 2014) for petrol/diesel vehicles registered from 1 April 2010, relative to 2012/13 rates (DVLA, 2013)

Tax band	CO_2 emissions (g/km)	2012/13	2013/14	Difference
A	=< 100	£0.00	£0.00	£0.00 (same)
B	101-110	£0.00	£0.00	£0.00 (same)
C	111-120	£0.00	£0.00	£0.00 (same)
D	121-130	£0.00	£0.00	£0.00 (same)
E	131-140	£120.00	£125.00	£5.00
F	141-150	£135.00	£140.00	£5.00
G	151-165	£170.00	£175.00	£5.00
H	166-175	£275.00	£285.00	£10.00
I	176-185	£325.00	£335.00	£10.00
J	186-200	£460.00	£475.00	£15.00
K	201-225	£600.00	£620.00	£20.00
L	226-255	£815.00	£840.00	£25.00
M	>=256	£1,030.00	£1,065.00	£35.00

The SR of VED for petrol/diesel vehicles (***Table 67*** and ***Table 69***) and AFVs (***Table 68***) in 2012/13 and 2013/14 is presented. The incentive for purchasing a lower emission vehicle appears to have strengthened. Vehicles at the upper end of the CO_2 emissions scale are charged up to an additional £15. On the other hand, vehicles emitting up to 120g/km continue to be charged at 2012/13 rates. Inflationary increases have also resulted in an additional £5 chargeable on all engine based VED for 2013/14. Potential savings of £85 therefore still exist to choose a vehicle with an engine size of 1549CC or less.

Table 66: FYR of VED (from 1 April 2013-31 March 2014) for AFVs registered from 1 April 2010, relative to 2012/13 rates (DVLA, 2013)

Tax band	CO_2 emissions (g/km)	2012/13	2013/14	Difference
A	=< 100	£0.00	£0.00	£0.00 (same)
B	101-110	£0.00	£0.00	£0.00 (same)
C	111-120	£0.00	£0.00	£0.00 (same)
D	121-130	£0.00	£0.00	£0.00 (same)
E	131-140	£110.00	£115.00	£5.00
F	141-150	£125.00	£130.00	£5.00
G	151-165	£160.00	£165.00	£5.00
H	166-175	£265.00	£275.00	£10.00
I	176-185	£315.00	£325.00	£10.00
J	186-200	£450.00	£465.00	£15.00
K	201-225	£590.00	£610.00	£20.00
L	226-255	£805.00	£830.00	£25.00
M	>=256	£1,020.00	£1,055.00	£35.00

Table 67: SR of VED (from 1 April 2013 to 31 March 2014) for petrol/diesel vehicles registered from 1 March 2001, relative to 2012/13 rates (DVLA, 2013)

Tax band	CO_2 emissions (g/km)	2012/13	2013/14	Difference
A	=< 100	£0.00	£0.00	£0.00 (same)
B	101-110	£20.00	£20.00	£0.00 (same)
C	111-120	£30.00	£30.00	£0.00 (same)
D	121-130	£100.00	£105.00	£5.00
E	131-140	£120.00	£125.00	£5.00
F	141-150	£135.00	£140.00	£5.00
G	151-165	£170.00	£175.00	£5.00
H	166-175	£195.00	£200.00	£5.00
I	176-185	£215.00	£220.00	£5.00
J	186-200	£250.00	£260.00	£10.00
K	201-225	£270.00	£280.00	£10.00
L	226-255	£460.00	£475.00	£15.00
M	>=256	£475.00	£490.00	£15.00

Table 68: SR of VED (from 1 April 2013 to 31 March 2014) for AFVs registered from 1 March 2001, relative to 2012/13 rates (DVLA, 2013)

Tax band	CO_2 emissions (g/km)	2012/13	2013/14	Difference
A	=< 100	£0.00	£0.00	£0.00
B	101-110	£10.00	£10.00	£0.00
C	111-120	£20.00	£20.00	£0.00
D	121-130	£90.00	£95.00	£5.00
E	131-140	£110.00	£115.00	£5.00
F	141-150	£125.00	£130.00	£5.00
G	151-165	£160.00	£165.00	£5.00
H	166-175	£185.00	£190.00	£5.00
I	176-185	£205.00	£210.00	£5.00
J	186-200	£240.00	£250.00	£10.00
K	201-225	£260.00	£270.00	£10.00
L	226-255	£450.00	£465.00	£15.00
M	>=256	£465.00	£480.00	£15.00

Table 69: SR of VED (from 1 April 2013 to 31 March 2014) for vehicles registered before 1 March 2001, relative to 2012/13 rates (DVLA, 2013)

Engine size (CC)	2012/13	2013/14	Difference
=<1549	£135.00	£140.00	£5.00
>=1550	£220.00	£225.00	£5.00

A2 ONLINE QUESTIONNAIRE SURVEY

To supplement the postal questionnaire survey documented in ***Chapter 3***, a secondary online questionnaire survey was implemented. The postal questionnaire was subsequently modified and responses were collected from a different population. The strategy adopted is discussed in this appendix. This includes consideration of the population/sampling approach, questionnaire design/content and data collection process. Some preliminary findings are presented.

A2.1 Nature of an online questionnaire survey

The same benefits of a questionnaire survey documented in ***Section 3.3*** are pertinent to the online survey. That is, a wide range of individuals can be targeted within a relatively small period of time and at a minimum cost to the researcher. Respondents are also free to participate in the research at a time most convenient to them.

However, specific to the online medium, various features should be recognised (Evans and Mathur, 2005). Online questionnaires can be issued at a lower cost than a postal equivalent, with no paper/printing or postage costs (Bachmann *et al*., 1996; Witmer *et al*., 1999; Yun and Trumbo, 2000; Llieva *et al*., 2002). The online questionnaire can also be deployed and returned in relatively less time (Bachmann *et al*., 1996; Garton *et al*., 1999; Couper, 2000). An additional advantage is automatic data entry (Yun and Trumbo, 2000; Wright, 2005). Moreover, household internet access has increased over the past decade. At the end of 2010, 70% of Scottish households reported household internet access (Scottish Government, 2011c). This signifies a potentially wide population to target and a small chance of sample bias. Due to long periods spent on the internet, Couper (2000) argues individuals are becoming increasingly comfortable completing online questionnaires. An online approach to questionnaire surveys would allow for more flexible questionnaire design. Skip patterns and logic can be used, depending upon the exact answers provided (Stanton, 1998; Zhang, 1999). Consequently, Bryman (2008) maintains online questionnaires tend to have fewer missing responses than the equivalent in a paper format. Pilot-testing before initiating the online survey will also help to identify questions/wording open to misinterpretation.

Previous research provides little consensus regarding typical response rates from online surveys. For example, Manfreda *et al*. (2008) suggest an 11% lower response rate compared to other methods; whereas Krantz and Dalal (2000) suggest no major differences between online and traditional survey methods. Nevertheless, responses can be encouraged through incentives, akin to the postal survey.

SurveyMonkey was used as the platform to host the online questionnaire and collect responses. SurveyMonkey was able to meet the needs of the online survey, with features such as various question types, enforced responses, skip logic and automatic data entry (***Figure 75***).

15 types of questions
- Questions can thus be presented in the most appropriate format.

Inclusion of a survey completion bar
- Giving respondents a perspective of their progress.

Enforcement of required responses
- Reducing missing responses for critical questions.

Inclusion of skip logic
- Aiding respondents' journey through the questionnaire by skipping non-applicable questions.

Range of presentation options
- Including colour schemes and inclusion of logos to add some degree of professionalism to the questionnaire.

Collection of responses via a uniform resource locator (URL)
- To be distributed by, for example email or social networking.

Automatic data entry
- Reducing the likelihood of data entry errors.

Ability or download the data
- Presenting time benefits for the researcher.

Figure 75: Features of SurveyMonkey (SurveyMonkey, 2011)

A2.2 Sample and population

The questionnaire was issued to a sample of Scottish individuals holding a provisional driving-licence and actively learning to drive. Such individuals would therefore be most likely to purchase a vehicle in the near future, upon acquiring their full driving-licence. The sample would thus offer insight into the behaviour of the future Scottish motoring generation. The means of capturing the desired sample is subsequently considered.

Obtaining a sampling frame of eligible individuals was faced with some difficulty. Contact was initially made with the Driving Standards Agency to explore the possibility of obtaining a sampling frame of individuals due to take their theory and/or practical driving test across Scotland. Unfortunately, this endeavour was unsuccessful. Owing to the difficulties in obtaining a sufficient sampling frame, snowball sampling was used. This is argued by Babbie (2010) and O'Leary (2010) as a commonly used strategy when the population is not easily identifiable. The sample was created through a process of referrals (Atkinson and Flint, 2001). Initial contact was made with a small group of relevant people, who then made contact with other individuals meeting the sampling criteria (Cohen *et al*., 2000; Bryman, 2008). Specifically, three avenues were used to compile the sample, which are subsequently detailed.

A2.2.1 Connections with driving schools

Contact was made with numerous driving schools throughout Scotland. The possibility of advertising the online questionnaire survey to the learner drivers in each establishment was investigated. 15 schools agreed to participate, allowing a collective access to approximately 1,200 students throughout Scotland (***Figure 76***).

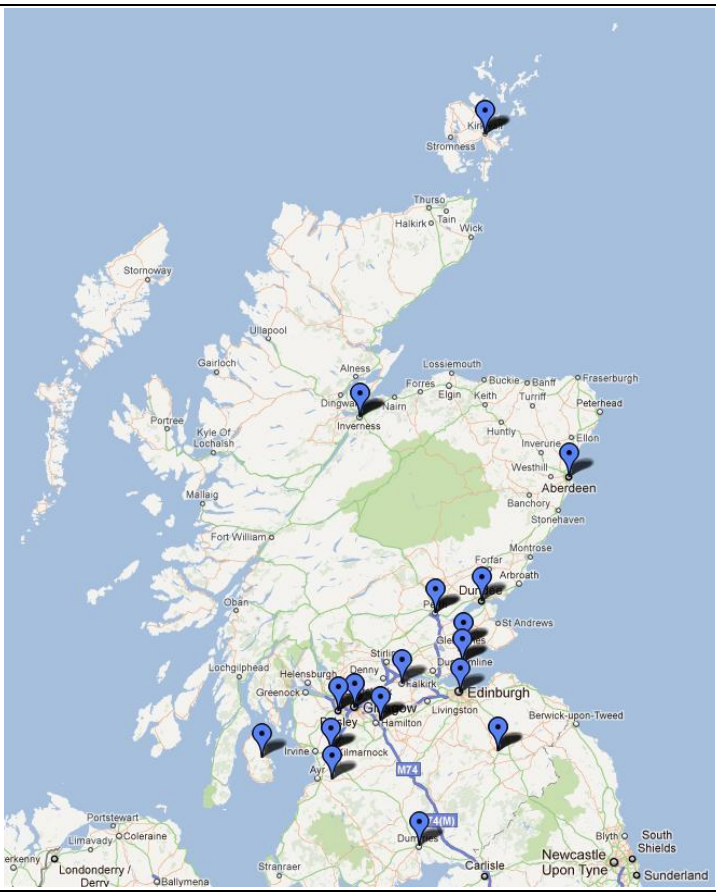

Figure 76: Areas covered by the 15 driving schools participating in the online survey

A2.2.2 Connections with universities and colleges

Recognising the minimum age of 17 to acquire a provisional driving-licence, universities and colleges were expected to have a high proportion of eligible individuals. As a benchmark, a quarter of Edinburgh Napier University students were aged 18-20 years during 2010/11, with a further one third aged 21-24 (Edinburgh Napier University, 2012). Indeed, the student population has been recognised in past research as having a strong desire to own a car in the future (Zhu *et al*., 2012).

The potential for distributing details of the online questionnaire survey to students across Scottish Higher Education institutions was investigated. Personal emails were sent to academic contacts in 9 Higher Education institutions. 'Cold-calling' emails were sent to a representative in the remaining 53 institutions where no personal contact could be established. Collectively, 62 universities/colleges were contacted and 8 institutions confirmed their involvement. Together with the researcher's own university, 9 student populations throughout Scotland were targeted (***Figure 77***).

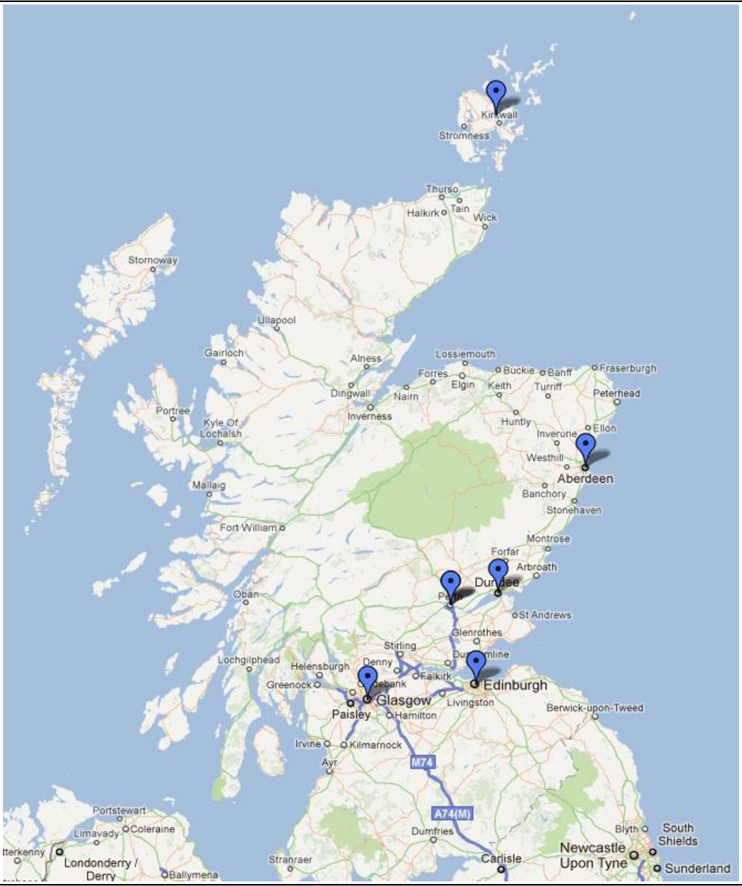

Figure 77: Location of the universities and colleges participating in the online survey

A2.2.3 Connections via social networking

Facebook was used to recruit participants for the online survey. The potential for sample recruitment was huge, with more than 800,000 active users and over 50% logging on daily (Facebook, 2011). Furthermore, Facebook is the most popular UK social network (Nielson, 2009). Brickman-Bhutta (2009) and Baltar and Brunet (2012) argue social networking sites are an efficient tool for snowball sampling.

Details of the online questionnaire survey was publicised to the researcher's own contacts, who were encouraged to share the details with their friends. On average, Facebook users have 130 friends (Facebook, 2011). Facebook was also used to target a much wider set of individuals not personally known to the researcher. The online questionnaire survey was publicised on community pages. The average Facebook user is connected to 80 community pages (Facebook, 2011). This further emphasises the potential for marketing the online survey and enhancing sample recruitment.

Collectively, the final sample was anticipated to be 1,000-1,500 respondents. This was planned to coincide with the projected sample from the postal questionnaire survey. O'Leary (2010) argues the largest possible sample size should be sought for quantitative data.

A2.2.4 Potential issues with sampling

Non-random sampling strategies are not without problems. For example, Cohen *et al*. (2000) argues some individuals in the population are more likely to be selected than others. The sampling strategy therefore does not guarantee representation. However, a population profile can be compiled and compared with the final sample to assess areas of over/under representation.

O'Leary (2010) outlines two types of bias specific to non-random sampling. Unwitting bias occurs when individuals are purposely selected to provide the type of responses already anticipated by the researcher. However, three different approaches were used to compile the sample to help reduce this risk. The second type of bias is based on erroneous assumptions regarding the characteristics of individuals in the sampling frame. This could lead to an ill-informed selection of individuals. Consequently, the eligibility criteria was clearly emphasised prior to questionnaire commencement. This would filter out individuals ineligible for participating in the research, despite receiving the initial invitation.

A2.3 Design and content of the welcome screen

The foreword to the online questionnaire served the same purpose as the covering letter for the postal questionnaire. Furthermore, Dillman *et al.* (1999) highlights the importance of respondents knowing they have arrived at the correct webpage, having followed a hyperlink or manually entered the uniform resource locator (URL) into their web browser. Similar to the postal questionnaire covering letter, the online foreword used the same type of basic language and friendly tone to fully inform recipients regarding the survey. This was used to encourage recipients to participate (Goode and Hatt, 1962; Dillman, 1978; Cui, 2003).

An overview of the research, including University sponsorship, was first provided. The foreword used identical phrasing to the postal questionnaire covering letter. The focus of the questionnaire upon the decision making process when respondents acquire their full driving-licence and ultimately purchase a vehicle was subsequently documented. An estimated completion time was also provided based on pilot-testing. Nixon (1954) argues response rates can be increased by highlighting a completion time of under 15 minutes, as per the online questionnaire. The eligibility criterion for questionnaire completion was specified. Namely, respondents had to live in Scotland, hold a provisional driving-licence and be learning to drive. Whilst this was outlined in the initial invitation, it was reiterated to ensure the final sample met the necessary criteria. Assurances of confidentiality and discretion in handling responses were subsequently outlined. A guarantee that respondents would not be personally identifiable from the research output was also provided. Details of the prize draw incentive to encourage participation were also provided. The same prize draw incentive was used for respondents of both the online and postal questionnaire survey. That is, a first prize of £200 and 10 smaller prizes of £30 in Love2Shop gift vouchers. The contact details of the researcher were subsequently provided. This was to be used if respondents had any queries regarding the research or questionnaire. The logic and merits for including the aforementioned pieces of information were documented earlier in ***Section 3.5***.

In contrast to the paper questionnaire, a deadline for online questionnaire completion was not specified. Owing to the various means of distributing the survey, it would have been difficult to determine the timescale for all individuals to receive the questionnaire. Furthermore, past research has failed to identify a significant increase in responses due to a stated deadline (Nevin and Ford, 1976; Fox *et al*., 1988).

A2.4 Design and content of the questionnaire

The online questionnaire was largely founded upon the postal survey version. Similar presentation was adopted, including titling, numbering and layout. However, designing the online version posed a number of challenges regarding formatting. Additional modifications were thus required to maximise compatibility for online hosting.

Prior to entering questions into SurveyMonkey, a number of design options were considered. This includes the background colour scheme, titles, questions and responses. A theme was established mimicking the researcher's University's colours. For additional professionalism, the logo from the researcher's institution was displayed in the survey header (advocated by Cialdini, 1984; Bruvold and Comer, 1988). Displaying a logo can establish and reinforce trust between respondents and the researcher (Dillman, 2007).

An adequately sized and legible font was used, with suitable use of bold for aspects such as headings. Relative to the paper questionnaire, SurveyMonkey was unable to provide additional formatting for specific words or key phrases within a question, such as bold or italicised font. Instead, capital letters were used to maintain the emphasis (Berdie *et al*., 1986; Verma and Mallick, 1999). Bryman (2008) argues online questionnaires tend to be more attractive than paper questionnaires in terms of style and presentation. The aim was to present a relatively simple user-interface, argued by Dillman *et al*. (1999) to have a positive impact upon response rates.

Page and question numbers were also selected, plus titles for both the survey and various sections. This is argued by Berdie *et al*. (1986) to add credibility to a questionnaire. A survey completion progress bar was also displayed on every page to indicate the percentage of the questionnaire already completed. Respondents can observe the questionnaire drawing to a close with every question completed. This is argued by Dillman *et al*. (1999) to help sustain motivation. Subsequently, Couper *et al*. (2001) and Heerwegh (2004) suggests the inclusion of a progress indicator can increase completion rates and reduce the occurrence of missing data. However, Crawford *et al*. (2001) identify a negative impact upon survey completion rates. Nevertheless, Yan *et al*. (2011) suggest respondent's expectations of survey length are an important consideration. Research by

Boltz (1993) found individuals tended to over-estimate the duration of a task when it takes longer than expected; and *vice versa*.

To direct the focus towards the new sample of provisional driving-licence holders, several modifications were undertaken to the questions. That is, questions now focused upon the respondent's decision to purchase a vehicle upon passing their driving test and thus acquiring their full driving-licence. However, akin to the paper questionnaire, the online version used simple wording, language and phraseology deemed appropriate for the sample (advocated by Payne, 1951; Freed, 1964; Moser and Kalton, 1977). This was subsequently verified during pilot-testing.

The online questionnaire contained 29 questions. However, skip-logic was used in several places and respondents could potentially evade up to 13 questions. Skip-logic is argued to provide a more interactive experience (Fricker and Schonlau, 2002). From the respondent's point of view, skip-logic simplifies questionnaire completion (Stanton, 1998; Zhang, 1999). When questions were 'skipped', SurveyMonkey simply renumbered remaining questions and updated the survey progress bar. The order of the online questionnaire was largely similar to the postal version. Questions were logically grouped into five sections, A to E. There was also a closing section regarding prize draw entry. Explanations were also provided prior to each question/section to provide a context for respondents (advocated by Cohen *et al*., 2000).

Consideration was given to the question format best suited to each question. This would thus guide respondents towards the correct type of response. For example, selecting a multiple choice format requiring only one answer would subsequently prohibit participants from selecting a greater number of responses. Five types of questions were utilised in SurveyMonkey: multiple choice with one answer only; multiple choice with multiple answers; matrix of choices with only one answer per row; a matrix of dropdown menus; and a single textbox.

Furthermore, some questions were programmed to necessitate an answer from respondents before displaying the next set of questions. However, this technique was not overused. Dillman *et al*. (1999) stresses the risk of respondents dropping out of the questionnaire if unable, or unwilling to provide a response. Forcing a response was used primarily with the five skip-logic questions, where a response was necessary to determine the next question to be displayed. It was also used for the socio-demographic factors assessed.

SurveyMonkey was able to provide small comment boxes after various questions. This was expected to allow for more constructive comments and supplementary information relative to each question (advocated by Berdie *et al*., 1986; Cohen *et al*., 2000). This can be contrasted to the large space available for comments at the end of the paper questionnaire. The decision with the postal survey arose due to space limitations and the sheer length of the questionnaire when printed. Recognising the limited degree of comments received, it was anticipated that some respondents perhaps had difficulty recalling their thoughts on earlier questions. It was therefore decided to split the comment boxes in the online questionnaire. Comley (1996) and Bryman (2008) advocate open-ended questions as more likely to be answered online. This can result in more detailed responses than, for example, a paper format.

A2.5 Section A of the questionnaire: Driver characteristics

Relative to the paper questionnaire, it was deemed unnecessary with the online version to dedicate a whole section to the sample's motoring characteristics. For example, enquiring into the annual mileage of provisional driving-licence holders seemed futile. One question was retained but modified, asking respondents to indicate whether they had access to a vehicle for private motoring, besides the vehicle provided by a driving school[45]. Skip-logic was employed based on responses. Respondents answering 'yes' were taken to the start of Section B to elicit vehicle details. Respondents answering 'no' were taken directly to Section C as there was no vehicle to detail in Section B.

A2.6 Section B of the questionnaire: Vehicle characteristics

As stated above, respondents were directed to Section B to give details of the vehicle used for private motoring. Relative to the paper questionnaire, the following aspects were also solicited with the online version: vehicle manufacturer and model; engine size; fuel type; transmission; the vehicle's age; purchase history; and the registered owner. Age was derived according to the vehicle's registration number, ignoring any personalised

[45] It was assumed that provisional-licence holders would not have sufficient knowledge of the vehicle provided for use by a driving school. This would have included details such as the vehicle's engine size, fuel type and date of registration. Such individuals would thus be unable to complete Section B satisfactorily.

registrations. Regarding the registered owner, the response category ‘my employer’ was removed as company cars are highly unlikely to be issued to employees holding a provisional driving-licence. In contrast to the paper questionnaire, questions focusing upon individuals’ previous vehicle purchasing behaviour were excluded from the online questionnaire. It was deemed unlikely provisional driving-licence holders would have a vehicle history greater than the current vehicle.

Nevertheless, a further question was added to the online questionnaire. It was deemed important to establish the respondent’s involvement in the decision to acquire the vehicle. For example, the degree of influence in deciding the vehicle make, model and other features. Individuals’ previous vehicle purchasing behaviour is recognised by Lane and Potter (2007) as a factor informing future vehicle purchasing decisions.

A2.7 Section C of the questionnaire: Factors of importance upon individuals’ future vehicle purchasing decisions

Akin to the paper questionnaire, the importance of situational and psychological factors upon individuals’ future vehicle purchasing decisions were evaluated.

A2.7.1 Situational factors

Akin to the paper questionnaire, 32 identical situational factors were presented in the online version, i.e. 18 vehicle attributes, 11 financial considerations and 3 environmental considerations. These were measured on the same 7-point Likert scales as the paper questionnaire (Likert, 1932). A matrix of choices with only one answer per row was selected for such questions. This would prohibit multiple, and incorrect, responses for each consideration due to human error. Question order bias, i.e. the potential influence of question positioning, was considered (Ferber, 1952; Perreault, 1975; Oppenheim, 1992). To counteract this, the order of 32 factors was randomised to reduce the order-effect. Space was available for comments after the three types of situational factors for respondents to elaborate on the provided responses.

A2.7.2 Psychological factors

Regarding psychological factors, difficulty arose in defining a lower emission vehicle for respondents without a vehicle for private motoring. Consequently, UK average new car CO_2 emissions were used. The most recent figure during questionnaire design was

144.2g/km of CO_2 for 2010 (SMMT, 2011a). Three exemplary vehicles were identified with average CO_2 emissions of 142.3-146.3g/km. Namely, the Ford Focus, Fiat Bravo and Renault Scenic (VCA, 2010)[46]. Images of each vehicle was provided in the online questionnaire as a visual illustration. This was deemed necessary recognising provisional driving-licence holders as unlikely to have an accurate perception of vehicle CO_2 emissions whilst still learning to drive.

The same wording was used in both the paper and online questionnaire for the 12 attitudinal statements, measuring 11 psychological constructs. The same 7-point Likert scales were also used. Akin to the situational factors, attitudinal statements were shown in a random order (Ferber, 1952; Perreault, 1975; Oppenheim, 1992) and space for comments was provided.

A2.8 Section D of the questionnaire: Potential influence of vehicle taxation and other policy measures upon individuals' future vehicle purchasing decisions

As per the paper questionnaire, Section D enquired into the potential adaption of current taxation measures and introduction of hypothetical policy measures to shape individuals' future vehicle purchasing decisions towards a lower emission vehicle.

A2.8.1 Adaption of current taxation measures

In contrast to the paper questionnaire, no preliminary question was present to filter respondents by their intention to purchase a vehicle in the near future. The online questionnaire itself was founded upon the principle that respondents would purchase a car upon passing their driving test and acquiring their full driving-licence.

A preface to Section D was provided, highlighting the relationship between vehicle taxation and CO_2 emissions. That is, the notion of greater taxation and/or lesser subsidies for high emission vehicles as a deterrent ('sticks'); and the opposite for lower emission vehicles as an incentive ('carrots'). This therefore provided a context for respondents, helping to mitigate hypothetical bias (Abley, 2000). The key characteristics of VED, VAT, HOD and the PICG were provided prior to relevant questions. A compulsory dichotomous question was then used to identify whether a change in each taxation

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[46] Selection was based on all vehicle specifications, such as engine size, fuel type and transmission, under Euro 4 emission standards and available from May 2010.

measure would be able to alter future vehicle choice. Skip-logic was employed based on responses. Respondents answering 'yes' were directed to a follow-up, value elicitation question to quantify the exact level increase/decrease required. Respondents answering 'no' [47] were diverted to the next taxation measure and presented with a further dichotomous question concerning its potential influence. A comment box was also provided for respondents, particularly those indicating 'no' to the aforementioned question, to explain their choice.

The same value elicitation approach was adopted in both the paper and online questionnaire. Respondents were instructed to consider the level of incentive/disincentive required for each taxation measure to purchase a vehicle with 'lower than average' emissions. The 'average' emission vehicle was previously defined in Section C of the questionnaire. The behaviour change process was broken down for the tipping-point necessary for individuals to start thinking about, seriously think about and definitely undertake a new behaviour (MAX Success, 2009a).

Respondents were asked to provide *either* the percentage increase/decrease in vehicle taxation, depending on which would most influence their future vehicle purchasing behaviour. Details were provided for each measure regarding the starting point to base their response and the desired behaviour the tax increase/decrease would work towards (***Table 70***). As per the paper questionnaire, a cheap talk statement was provided to help counteract hypothetical bias (Cummings and Taylor, 1999; List, 2001; Murphy *et al*., 2004). A reminder for respondents to recognise their financial constraints was also included (Katz and Rosen, 1991; Pearce *et al*., 2002; Alberini and Kahn, 2009).

Given the pros/cons of an online medium, a different elicitation method was selected for the online questionnaire. As documented in ***Section 3.10.1.2***, a payment-card elicitation method was used in early drafts of the paper questionnaire. Due to space limitations and a negative visual impact, the tipping point for all three stages in the behaviour change process were recorded on the same payment scale. This was recognised as a contributory factor to the confusion identified during pilot-testing. However, SurveyMonkey has the ability to host a matrix of dropdown menus, used to display a range of percentage changes

[47] Various options were presented under the heading 'no' to establish the reason behind the response, including the non-applicable responses used in the postal survey (***Section 3.10.1.2***).

Table 70: Scenarios presented in the online questionnaire for VED, VAT, HOD and the PICG to extrapolate the level of taxation necessary to change individuals' future vehicle purchasing behaviour

Taxation measure	Scenario
VED	Relative to the VED chargeable on the average CO_2 emitting vehicle, that is £130 for 12 months: • The percentage increase, as a deterrent, for a vehicle with equal/greater emissions than the average emitting vehicle; or • The percentage decrease, as an incentive, for a lower emission vehicle necessary to initiate a lower emission vehicle purchase.
VAT	Relative to the current 20% rate of VAT: • The percentage increase, as a deterrent, for a vehicle with equal/greater emissions than the average emitting vehicle; or • The percentage decrease, as an incentive, for a lower emission vehicle necessary to initiate a lower emission vehicle purchase.
HOD	Relative to HOD for main road-fuels of 58.95PPL: • The percentage increase, as a deterrent, for petrol/diesel; or • The percentage decrease, as an incentive, for 'greener' fuels such as LPG, CNG and biofuels Necessary to initiate the purchase of a lower emission vehicle utilising 'greener' fuels.
PICG	Relative to the average purchase price of a vehicle qualifying for the PICG, approximately £30,000: • The percentage decrease, as an incentive, in the vehicle purchase price Necessary to initiate a lower emission vehicle purchase qualifying for the PICG.

for the three scenarios. That is, six drop-down menus: three for the increase and three for decrease for VED, VAT and HOD. Recognising the incentivising nature of the PICG, only three drop down menus were displayed to measure the vehicle purchase price decrease. Drop-down menus have an advantage in terms of presentation and visual impact for respondents (Bryman, 2008).

The scales for VED and HOD progressed in 5% steps, up to a 100% increase/decrease. 5% increments were anticipated to provide sufficient detail for the researcher, but not present an excessively long list of options for respondents. In past research, the latter has been shown to deter respondents from reviewing all possible answers before selecting (Couper *et al.*, 2004). Respondents could indicate an increase greater than 100%, i.e. current rates would have to more than double to instigate stages in the behaviour change process towards purchasing a lower emission vehicle. However, a decrease greater than 100% was not presented as this would essentially represent a rebate and be in conflict with the current structure of VED and HOD. A 2.5% increment was used for VAT, recognising historic rates of 17.5%, 15%, 12.5% and 10% VAT prior to January 2011.

An increase/decrease of 20% was chosen to reflect the current 'starting' rate of VAT. Respondents were also given the option of indicating an increase greater than 20%, akin to VED and HOD. As per the paper questionnaire, the necessary VAT movement was measured in percentage points. To remind respondents of this, the resulting rate of VAT was also shown. For example, a 2.5% VAT increase would result in 22.5% VAT. The PICG scale used increments of 5%, up to a 60% limit. Recognising the current incentive of only 25%, a subsidy greater than 60% seemed unrealistic. A comment box was also provided for each taxation measure, allowing respondents to elaborate on their valuations.

Unfortunately, the matrix of dropdown menus in SurveyMonkey was unable to restrict responses to only the increase or decrease column. Respondents were instructed to select *either* the incentive or disincentive, depending on which would influence their future vehicle purchasing behaviour the most. However, clear instructions were provided to guide respondents towards completing the three 'correct' percentages.

As per the paper questionnaire, awareness and potential influence of the FYR of VED upon future purchasing decisions was also assessed in the online version. A brief description of the policy measure, including a hyperlink to a website with additional detail, was given prior to the question being posed.

A2.8.2 Hypothetical policy measures

The final part of Section D focused upon the same 11 future policy measures assessed in the paper questionnaire and the potential influence in individuals' future vehicle purchasing decisions. The same 7-point Likert scales were used. The list of measures were displayed in a random order to help counteract question order bias (Ferber, 1952; Perreault, 1975; Oppenheim, 1992). As with previous questions, a comment box was provided if respondents wished to elaborate on their responses.

A2.9 Section E of the questionnaire: Socio-demographic factors

A socio-demographic profile was compiled for the sample of provisional driving-licence holders. As mentioned earlier, responses to gender, age and postcode[48] were made compulsory to enable a basic profile to be created. Respondents were also invited to

[48] In contrast to the paper questionnaire, the respondent's postcode had to be directly asked in the online version to derive the urban/rural classification.

indicate their household income before tax. Based on responses to the postal questionnaire, income was a sensitive topic for some respondents. This socio-demographic factor was therefore presented as optional in the online questionnaire.

A2.10 Closing section of the questionnaire

Finally, respondents were to indicate whether they wanted to be entered into the prize draw. Skip-logic was employed based on responses. Respondents answering 'yes' were directed to provide their contact details, i.e. name, email address and/or phone number. Respondents answering 'no' were directed to a final page, thanking them for their contribution and wishing them luck with their driver training.

A2.11 Pilot-testing of the welcome screen and questionnaire

As with the paper questionnaire, the online version was pilot-tested with a small sample of individuals prior to its full application. The benefits of pilot-testing were discussed earlier in ***Section 3.15***. In March 2011, a group of individuals were acquired with the same characteristics as the full sample. The secondary school of the researcher, located in Midlothian outside Edinburgh, were approached. With the aid of past teachers, a sample of 11 young adults, aged 17 or 18 years, currently learning to drive with their provisional driving-licence were exposed to the online questionnaire.

A large proportion of the online questionnaire was based upon the paper version, which was previously assessed during two rounds of pilot-testing in 2010. Particular attention was thus given to the online format, including the design, practicality and suitability of the format. The process of pilot-testing resulted in a minimal number of changes. The online questionnaire was subsequently finalised and ready to be fully issued.

A2.12 Ethical considerations

Many of the ethical considerations prevailing for the postal questionnaire survey remain pertinent for the online version. For example, the welcome screen stipulated all personal information collected would be kept strictly confidential. Collected data was stored in a safe manner, only accessible by the researcher. Akin to the paper questionnaire, respondents were not asked if personal details could be retained for future research. Such information will therefore be deleted in a safe and responsible manner upon completion of this research. Respondents were also assured they would not be personally identifiable in the results or other research output.

SurveyMonkey itself has its own privacy policy: *"Our [SurveyMonkey] privacy policy states that we will not use your data for our own purposes. The data you collect is kept private and confidential. You are the owner of all data collected or uploaded into the survey"* (SurveyMonkey, 2011, p.68). Efforts made by both the researcher and the online medium will help ensure ethical standards are maintained.

A2.13 Considerations of reliability and validity

Reliability and validity were defined earlier in ***Section 3.14***. Given the similarity in the paper and online questionnaire, many of the considerations outlined earlier remain pertinent. ***Figure 78*** and ***Figure 79*** recapitulates the main points affecting reliability and validity respectively.

Participant error

- The online questionnaire was issued over a 2 month period from March-April 2011 to aid consistent responses due to timing.

Participant bias

- A self-completion questionnaire, maintaining a distance between the researcher and the respondent, will minimise the risk of respondents giving answers they deem desirable to the researcher.

Observer error

- A self-completion questionnaire will avoid the risk of different interviewers interpreting the same question differently.

Observer bias

- The online questionnaire was subject to pilot-testing to identify questions/sections open to misinterpretation prior to the full survey being launched.

Figure 78: Consideration of reliability and the action taken in this research

A2.14 Data collection process

Upon completion of the questionnaire, a web-link collector was established in SurveyMonkey. A tailored URL was created, relevant to the survey. This was designed to make it easier for respondents having to manually enter the URL into a web browser: http://www.surveymonkey.com/s/learnerdriversurvey. The three methods for data collection are subsequently discussed.

Internal validity

- Akin to the paper questionnaire, statistical tests can be employed to assess the significance of the findings and validate the cause-and-effect relationship between the variables (***Section 3.19***).

External validity

- Comparisons can be made relative to the population which the sample aims to capture;
- The SHS annual report provides socio-demographic data for Scottish provisional driving-licence holders to evaluate the generalisability of the results;
- The online questionnaire was distributed in three different ways to try capturing a representative sample of individuals;
- A limited response rate is a threat to external validity. The same measures used in the postal questionnaire survey to enhance response rates were adopted in the online survey.

Measurement/construct validity

- As per the paper questionnaire, the review of past literature (***chapter 2***) aided the identification of variables suitable for measuring underlying constructs.

Ecological validity

- Contextual information was provided in both the paper and online questionnaire to aid a response mirroring the intended social context;
- Respondents completing the survey in their own natural environment will also enhance the ecological validity.

Figure 79: Considerations of validity and the action taken in this research

A2.14.1 Data collection from driving schools

As documented earlier, 15 driving schools agreed to distribute details of the survey to their learner drivers, for example, at the end of a driving lesson. A small postcard-style advertisement was prepared with details of the research and the URL link to the survey. This was sent by Royal Mail to the driving schools in March 2011.

A2.14.2 Data collection from universities and colleges

Targeting the student population was documented in ***Appendix A2.2.2***. An email was prepared, effectively acting as a covering letter to the online survey. Much of the information presented on the welcome screen was simply reiterated in the email. Details include: an overview of the research; the eligibility criteria for questionnaire completion; the URL link to the online survey; an estimated completion time; assurances of ethical practices; details of the prize draw incentive; and the contact details of the researcher. This information was emailed to all students in the researcher's own university in March 2011. A foreword was added to the message when contacting the other Higher Education institutes. The foreword explained the context for distributing the survey and was to be deleted prior to forwarding the email to students.

A reminder email was issued to Edinburgh Napier University students one week after the initial invitation. Past research advocates a short time period between the initial email and the reminder (Jones and Pitt, 1999; Truell *et al*., 2002). Kittleson (1997) recommends a lag of 4-7 days from the initial survey distribution. However, reminders were not distributed at the other Higher Education institutions as it was unclear which institutions had actually distributed details of the survey from the initial email. It would also involve further imposition upon the other parties involved.

A2.14.3 Data collection via social networking

The means of recruiting a sample via Facebook was documented earlier in ***Appendix A2.2.3***. An ‘event’ was created and the researcher’s friends were invited to ‘attend’. The same message used in the student email was provided for the ‘event’. This would allow recipients to decide if they were interested or indeed eligible to complete the questionnaire. The event was also ‘shared’ by some friends and thus forwarded to their own circle of contacts to help increase awareness.

Details of the survey were also communicated through ‘liked’ pages of common interest to provisional driving-licence holders. Such individuals were directed to the questionnaire on SurveyMonkey, rather than the event on Facebook. Survey details were posted on pages relating to learning to drive, Scottish universities and colleges, information services for university and college admission, and sites regarding surveys and research. Reminder messages were posted approximately one week after the initial invitation (Kittleson, 1997; Jones and Pitt, 1999; Truell *et al*., 2002).

A2.15 Prize draw

The prize draw process for respondents from both the postal and online survey wishing to be entered was documented earlier in ***Section 3.17***.

A2.16 Data entry process

Responses were automatically entered into SurveyMonkey. This therefore eliminated the possibility of transcription errors by the researcher (Fricker and Schonlau, 2002). It was intended the collected data would be exported from SurveyMonkey into Microsoft Excel and then into SPSS for analysis. Analysis would therefore mirror the postal questionnaire survey.

A2.17 Response rate

The collection of responses was more challenging than originally anticipated. Despite best efforts, the survey was closed after two months with 338 responses. Recognising the nature of data collection, it was difficult to establish exactly how many individuals had seen the invitation to participate in the survey and how many were indeed eligible. The calculation of a response rate is therefore unfeasible. Relative to the postal questionnaire survey, where 1,336 responses were collected, the online survey failed to match up. It was therefore decided the full analysis of the online survey should be deferred until further data collection could occur and further responses collected.

A2.18 Preliminary findings

Some preliminary findings can be presented. The results are, however, descriptive and exist purely as a taster for future development. The most obvious differences between the sample of full-driving and provisional driving-licence holders are highlighted, but no significance testing was employed.

A2.18.1 Preliminary findings from section A of the questionnaire: Driver characteristics

Respondents were asked to indicate whether there was a vehicle available for private motoring, besides the vehicle provided by an elected driving school. The majority of provisional driving-licence holders (51.5%) reported no access to a vehicle for private motoring, whilst 48.5% reported access to such a vehicle.

A2.18.2 Preliminary findings from section B of the questionnaire: Vehicle characteristics

This section addressed the vehicle available for private motoring by provisional driving-licence holders. This included the vehicle’s registered owner, engine size, fuel type/energy source, transmission, age, purchase history and CO_2 emissions.

Respondents were asked to indicate the involvement in the vehicle purchasing decision to acquire the vehicle identified in Section A of the questionnaire. The majority of provisional driving-licence holders (39%) reported no involvement in the vehicle purchasing decision. 19.8% said they had some involvement, whilst a further 19.2% had a fair amount of involvement. Only 22.1% of provisional driving-licence holders made all the decisions surrounding vehicle choice.

Respondents were asked to indicate the registered owner of the vehicle available for private motoring. The majority of provisional driving-licence holders (44.2%) reported their parents as the registered owner. 29.7% of respondents said they themselves were the registered owner of the vehicle available for private motoring, whilst the respondent's spouse/partner was the registered owner for a further 18.6%. Remaining vehicles were split between another family member (3.5%), a friend (3.5%) or their employer (0.6%).

Respondents were asked to indicate the engine size of the vehicle available for private motoring. The majority of provisional-licence holders reported an engine size of 1.3-1.5 litres (34.6%) – indeed, the average engine size was 1.4 litres. The smallest engine size recorded was 0.7 litres whilst the biggest engine size was 4.0 litres.

Respondents were asked to indicate the fuel type or energy source of the vehicle available for private motoring. The majority of provisional driving-licence holders reported access to a petrol fuelled vehicle (78.1%), whilst a further 21.3% said the vehicle was fuelled by diesel. Only 0.6% reported a LPG fuelled vehicle for private motoring.

Respondents were asked to indicate the transmission of the vehicle available for private motoring. 88.3% of vehicles had a manual transmission, whilst 11.7% were automatic.

Respondents were asked to provide some information regarding the vehicle's registration number. The researcher was then able to infer the time-period when the vehicle was registered. The majority of vehicles (15.9%) were registered before March 1999. The newest of vehicles, up to 1 year old, made up the smallest proportion with 2.7%. There is a relatively even spread of vehicles registered between those two extremes.

Respondents were asked to indicate whether the vehicle available for private motoring was acquired new or used. The majority of vehicles (77.8%) were acquired brand new, whilst 22.2% were used.

The researcher was able to infer the average CO_2 emissions of the vehicle available for private motoring. The majority of vehicles (36.9%) emit 151-165g/km of CO_2 – indeed, the average CO_2 emissions overall was 159.5g/km. 42.3% of vehicles emit less than 151g/km, whilst a further 20.7% emit more than 165g/km. The lowest emitting vehicle reported was 106g/km, whilst the highest emission vehicle was 340g/km.

A2.18.2.1 Summary of the differences between full and provisional driving-licence holders regarding the primary vehicle used

Relative to the sample of full driving-licence holders, the vehicle available for private motoring by provisional driving-licence holders was found to have:

- More spouses/partners, parents or other family members as the registered owners;
- More engines with a 1.5 litre capacity or less;
- More petrol fuelled vehicles;
- More vehicles registered before March 2003, or between March 2004 and February 2005;
- More vehicles acquired used;
- More vehicles emitting 101-110g/km of CO_2 emissions or 121-165g/km.

A2.18.3 Preliminary findings from section C of the questionnaire: Factors of importance upon individuals' future vehicle purchasing decisions

The strength of both situational and psychological factors in shaping individuals' future vehicle purchasing decisions was investigated for provisional driving-licence holders. Respondents were asked to indicate the importance of situational factors in shaping their future vehicle purchasing behaviour. The two most important factors are both financial in nature. That is, value for money (6.2) and vehicle price (6.1). Considerations relating to fuel consumption (5.9) appear next in the ranking, followed by fuel economy (5.9). The vehicle's insurance group is considered important (5.8), together with safety features and the overall condition of a used vehicle (both 5.7). Maintenance/repair costs (5.7) and performance/driveability (5.5) are also prominent. Taxation measures are next in the ranking, where circulation taxes (5.4) are slightly more important than purchase taxes (5.2). This is followed by vehicle warranty (5.2), mileage of a used vehicle (5.2) and security features (5.0). Vehicle emissions of CO_2 and other GHGs (4.7) were ranked higher than the emission of other pollutants (4.6) and noise pollution (4.4). Beyond environmental considerations, the vehicle's style/appearance/colour (4.9), fuel type (4.8) and finance deals (4.7) are considered relatively important. This is followed by further factors relating to vehicle attributes. This includes: vehicle size (4.7); passenger capacity

(4.7); vehicle body shape (4.7); luggage/storage space (4.6); engine type/size (4.6); vehicle manufacturer (4.5) and model (4.4). The future trade-in value was next in the ranking (4.4), followed by company car tax (4.3) and entertainment levels (4.0). Recognising 4 as the mid-point of the 7-point scale, only 2 situational factors are under this threshold, i.e. the vehicle's acceleration time (3.9) and equipment levels (3.7).

Respondents were asked to indicate the strength of psychological constructs informing their future vehicle purchasing behaviour. Results indicate a relatively strong BI for provisional driving-licence holders to purchase a lower emission vehicle in the future (5.2). Regarding the strength of psychological constructs informing the BI, attitudes are strongest (5.3). Perceived responsibility (5.1) and personal norms (4.9) are the next most influential, followed by perceived behavioural control and perceived goal feasibility (both 4.9). Negative affect is next in the ranking (4.8), then perceived negative consequences (4.8) and social norms (4.8). The two weakest constructs are goal intention (4.7) and finally emotions (4.0).

Situational and psychological factors can be considered together, showing a collective representation of the factors shaping provisional driving-licence holders' future vehicle purchasing decisions. Future vehicle purchasing decisions of provisional driving-licence holders are clearly dominated by situational factors. The top 10 factors are all situational in nature. Psychological factors largely appear in the middle of the ranked order of factors, whilst goal intention and particularly emotions are towards the lower end of the ranking.

A2.18.3.1 Summary of the differences between full and provisional driving-licence holders regarding the factors informing individuals' future vehicle purchasing behaviour

Relative to the sample of full driving-licence holders, provisional driving-licence holders were found to:

- Place more importance upon a future vehicles' style/appearance/colour, the finance deals available and the company car tax system in their future vehicle purchasing decisions;
- Place vehicle price, fuel consumption/MPG, the vehicle's insurance group, annual/biannual VED, vehicle warranty, style/appearance/colour, fuel type, finance deals, vehicle size, passenger capacity, vehicle manufacturer and the company car

tax system higher in the ranking of situational factors in their future vehicle purchasing decisions;

- Be more driven by their perceived behaviour control, negative affect, social norms and emotions in their future vehicle purchasing decisions;
- Place perceived responsibility, personal norms, perceived behavioural control and social norms higher in the ranking of psychological factors in their future vehicle purchasing decisions.

A2.18.4 Preliminary findings from section D of the questionnaire: Potential influence of vehicle taxation and other policy measures upon individuals' future vehicle purchasing decisions

Respondents were asked to indicate the changes to current taxation policy required to encourage a lower emission vehicle purchase. The potential influence of hypothetical policy measures to encourage a lower emission vehicle purchase was also considered.

A2.18.4.1 VED

Respondents were asked to consider the potential influence of VED in shaping their future vehicle purchasing decisions towards a lower emission vehicle. The majority of future vehicle purchasing decisions of provisional driving-licence holders could be influenced by a VED change (78.1%). 5% of respondents indicated that their future vehicle was likely to be leased, whilst a further 16.9% reported that no level of VED would influence their future vehicle purchasing behaviour.

Respondents were asked to indicate the type of VED pricing signal most influential in shaping their future vehicle purchasing behaviour towards a lower emission vehicle. The majority of provisional driving-licence holders would be more influenced by a VED reduction (65.6%). Only 34.4% would find a VED increase more influential in shaping their future vehicle purchasing behaviour towards a lower emission vehicle.

Respondents were asked to indicate the tipping-point of VED necessary to start thinking about, seriously think about and definitely purchase a lower emission vehicle. A 23.4% increase, relative to the VED chargeable on the average CO_2 emitting vehicle, would be required by provisional driving-licence holders to start thinking about buying a lower emission vehicle in the future. VED would have to increase by 37.3% to seriously think about buying such a vehicle; further rising by 55.1% to definitely purchase a lower emission vehicle. Conversely, a VED decrease of 27.7% would be necessary for provisional driving-licence holders to start thinking about buying a lower emission vehicle in the future. A 41.5% decrease would be required to seriously think about such a purchase; whilst a 60.1% decrease would be needed to definitely purchase such a vehicle.

Respondents were asked to indicate their knowledge of the FYR of VED. The majority of provisional driving-licence holders (81.5%) were unaware of the SR and FYR differentiation. Only 18.5% knew of the FYR of VED. Respondents were then asked to indicate the potential influence of the FYR of VED upon their future vehicle purchasing decisions towards an eligible lower emission vehicle. The majority of provisional driving-licence holders (51.5%) said their future vehicle purchasing behaviour could be influenced by the FYR of VED. 18.2% of respondents would not be influenced by the FYR. The remaining 30.4% indicated the inapplicability of the FYR of VED due to their future vehicle being leased (2.7%) or acquired used (27.7%).

A2.18.4.2 VAT

The potential influence of VAT in shaping individuals' future vehicle purchasing decisions towards a lower emission vehicle was considered. The majority of provisional driving-licence holders (69.5%) reported that their future vehicle purchasing decisions could be influenced by VAT. Conversely, 5% of respondents indicated that their future vehicle was likely to be leased, and a further 15.1% expected their future vehicle to be acquired privately. Only 10.4% said that no level of VAT increase/decrease would influence their future vehicle purchasing behaviour towards a lower emission vehicle.

Respondents were asked to indicate the type of VAT pricing signal most influential in shaping their future vehicle purchasing behaviour towards a lower emission vehicle. The majority of provisional driving-licence holders (65.7%) would be more influenced by a VAT reduction. In contrast, 34.3% of respondents would be more influenced by an increase in VAT.

Respondents were asked to indicate the tipping-point in VAT necessary to start thinking about, seriously think about and definitely purchase a lower emission vehicle. A VAT increase of 5.9% would be required for provisional driving-licence holders to start thinking about buying a lower emission vehicle. A 9.5% VAT increase would be necessary to seriously think about buying such a vehicle; but to definitely buy a lower emission vehicle, VAT would have to increase by 13.6%. Conversely, a VAT reduction of 6.2% would be necessary for provisional driving-licence holders to start thinking about a future lower emission vehicle purchase. A 9.9% VAT reduction would be required to seriously think about buying such a vehicle; whilst a 14.4% decrease would be necessary to definitely buy a lower emission vehicle.

A2.18.4.3 HOD

Respondents were asked to indicate the potential influence of HOD in shaping their future vehicle purchasing behaviour towards a lower emission vehicle utilising 'greener' fuels. The majority of provisional driving-licence holders (74.3%) reported that their future vehicle purchasing decisions could be influenced by HOD. Conversely, 25.7% of respondents indicated that no level of HOD increase/decrease would influence their future vehicle purchasing decision towards a 'greener' fuelled lower emission vehicle.

Respondents were asked to indicate the HOD pricing signal most influential in shaping their future vehicle purchasing behaviour towards a lower emission vehicle utilising 'greener' fuels. The majority of provisional-licence holders (65.8%) would be more influenced by a HOD decrease. On the other hand, only 34.2% would find a HOD increase more influential in shaping their future vehicle purchasing behaviour towards a 'greener' fuelled lower emission vehicle.

Respondents were asked to indicate the tipping-point in HOD necessary to start thinking about, seriously think about and definitely purchase a lower emission vehicle utilising 'greener' fuels. A main road-fuel HOD increase of 20.2% would be necessary for provisional driving-licence holders to start thinking about buying a 'greener' fuelled lower emission vehicle in the future. An increase of 32.0% would be required to seriously think about making such a purchase; whilst a 46.7% increase would be necessary to definitely buy a lower emission vehicle utilising 'greener' fuels. Conversely, a 25.8% reduction in HOD for 'greener' fuels relative to the main road-fuel rate of HOD would be necessary for provisional driving-licence holders to start thinking about buying a 'greener' fuelled lower emission vehicle. A 37.5% reduction in HOD would be required to seriously consider such a purchase; whilst a 52.6% reduction would be necessary to definitely purchase a lower emission vehicle utilising 'greener' fuels.

A2.18.4.4 PICG

Respondents were asked to indicate the potential influence of the PICG in shaping their future vehicle purchasing behaviour towards a lower emission vehicle qualifying for the grant. The majority of provisional driving-licence holders (68%) reported that their future vehicle purchasing decisions could be influenced by the PICG. 4.7% of respondents indicated that their future vehicle is likely to be leased and 16.3% anticipated buying a used vehicle – rendering the PICG as N/A. Regardless of the degree of incentive, 4.4% of provisional driving-licence holders have no interest in PICG vehicle technologies. A final 6.5% of respondents indicated that no level of PICG increase/decrease would influence their future vehicle purchasing decision towards a qualifying lower emission vehicle.

Respondents were asked to indicate the tipping-point in PICG necessary to start thinking about, seriously think about and definitely purchase a qualifying lower emission vehicle. A 20.4% purchase price reduction in a PICG qualifying vehicle would be necessary for provisional driving-licence holders to start thinking about buying such a vehicle. A subsidy of 31.1% would be required to seriously think about purchasing a eligible vehicle; whilst a 43.1% PICG incentive would be necessary to definitely purchase a qualifying lower emission vehicle.

A2.18.4.5 Hypothetical policy measures

The influence of purchase, circulation and road-fuel based hypothetical policy measures in shaping respondents' future vehicle purchasing decisions towards a lower emission vehicle was considered. Circulation policy measures would have the greatest influence for provisional driving-licence holders in their future vehicle purchasing decisions (4.9). This reported influence is closely followed by purchase policy measures (4.8); whilst road-fuel measures would be least influential in shaping provisional driving-licence holders' future vehicle purchasing behaviour (4.5).

Regarding the influence of individual hypothetical policy measures, rebates for vehicles below a CO_2 emissions threshold would be most influential in provisional driving-licence holders' future vehicle purchasing decisions towards a lower emission vehicle (5.1). This is followed by CO_2 based VAT and motor insurance (both 5.0) and per-unit SR of VED based on CO_2 emissions (4.9). The next most influential measure would be fees for vehicles above a CO_2 emissions threshold (4.9), followed by per-unit FYR of VED based on CO_2 emissions (4.7) and a SIS with a CO_2 emissions limit on the replacement vehicle (4.6). CO_2 based initial registration fee (4.5) appears next in the ranking, then CO_2 based RUC (4.5), designated LEVLs (4.4) and CO_2 based parking charges (4.2).

A2.18.4.6 Summary of the differences between full and provisional driving-licence holders regarding the potential influence of vehicle taxation and other policy measures

Relative to the sample of full driving-licence holders, provisional driving-licence holders were found to:

- Be less influenced by VED, VAT, HOD and the PICG in shaping their future vehicle purchasing behaviour towards a lower emission vehicle. In turn, there are more vehicles anticipated to be leased, acquired privately or purchased used;
- Have more respondents previously unaware of the FYR of VED, but open to the influence of this policy measure;
- Be more influenced by a VED, VAT, HOD reduction, as an incentive, to shape future vehicle purchasing behaviour towards a lower emission vehicle;
- Require a lesser VED, VAT and HOD disincentive to instigate all stages in the behaviour change process towards purchasing a lower emission vehicle. Typically, but not always, a lesser VED, VAT, HOD and the PICG incentive was reported as necessary;
- Have a lower ratio of losses-to-gains for the VED, VAT and HOD required to instigate all stages in the behaviour change process towards a lower emission vehicle purchase. In all cases, a greater level of tax decrease, as an incentive, was required relative to the level of tax increase as a disincentive;
- Be more influenced by hypothetical circulation, purchase and road-fuel policy measures in their future vehicle purchasing decisions;
- Be more influenced by rebates for vehicles below a CO_2 emissions threshold, CO_2 based VAT, motor insurance, initial vehicle registration fee and parking charges, per-unit SR and FYR of VED, a scrappage allowance with a CO_2 emissions limit on the replacement vehicle, CO_2 based RUC and LEVLs;
- Place a scrappage allowance with a CO_2 emissions limit on the replacement vehicle, LEVLs and CO_2 based VAT, motor insurance and initial vehicle registration fee

higher in the ranked influence of hypothetical policy measures, relative to the sample of full driving-licence holders.

A2.18.5 Preliminary findings from section E of the questionnaire: Socio-demographic factors

Respondents were asked to provide some basic socio-demographic data, including their gender, age, household income and urban/rural classification.

Respondents were asked to indicate their gender. The majority of provisional driving-licence holders are female (60.9%), whilst only 39.1% are male.

Respondents were asked to indicate their age. The majority of provisional driving-licence holders are aged 24 years or less (68%). A further 21% were aged 25-34 years; 6.8% aged 35-44 years; 3.8% aged 45-59 years and only 0.3% aged 60 years or greater.

Respondents were asked to indicate their household income before tax. The majority of provisional driving-licence holders earn £10,000 or less per year (39.9%). Almost a quarter of respondents earn £10,001-£20,000 per annum (23.6%), and a further 10.1% earning £20,001-£30,000. 8.9% of respondents purported to earn between £30,001-£40,000 and a further 17.5% earning at least £40,001 per annum.

Respondents were asked to provide their postcode. The researcher was then able to infer their urban/rural classification. The majority of provisional driving-licence holders reside in urban locations, both large (65.1%) or other (21.1%). There is an almost even split between small towns and rural areas. That is, 4.3% and 2.1% for accessible and remote small towns; and 4.9% and 2.4% for accessible and remote rural areas respectively.

A2.18.5.1 Summary of the differences between full and provisional driving-licence holders regarding socio-demographic factors

Relative to the sample of full driving-licence holders, provisional driving-licence holders were found to have:

- More female respondents;
- More respondents aged 34 years or younger;
- More respondents earning £20,000 or less per annum before tax;
- More respondents living in large urban areas, relative to the sample of full driving-licence holders.

A3 APPLICATION FOR A FOLLOW-UP SURVEY FROM THE SHS

SHS Follow-up Surveys Pro-forma and Guidelines	Scottish Household Survey

Overview

The Scottish Household Survey (SHS) is designed to provide accurate, up-to-date information about the characteristics, attitudes and behaviour of Scottish households and individuals on a range of issues. The survey is specifically designed to support the work of the Scottish government's transport, communities and local government policy areas.

Organised in two-year cycles, it interviews around 14,500 households per annum and can provide data disaggregated at local authority level at the end of each cycle. The survey is conducted as a two-part interview. The first is the "Household" element, asked of a householder (typically the Highest Income Householder) or their spouse/partner. The second is an "Adult" element, asked of a random adult within the household.

One of the stated aims of the SHS is to provide a basis from which to undertake detailed follow-up surveys of particular sub-groups from the main survey. The purpose of this paper is to set out advice and guidance in using the SHS for such research. In particular, a pro-forma is included which sets out the range of information required by the SHS team in granting approval for such follow-up research.

What is a follow-up survey?

A follow-up survey provides opportunities to researchers to use the SHS to identify a sample for follow-up research. This may allow more detailed probing of certain sub-groups or variables of interest, and to examine under-lying issues within the data.

At the end of each interview, respondents are asked whether they are willing to be re-contacted for further research. The wording of the consent they are asked to give is as follows:

> *In the future, the Scottish Government may want to commission follow-up research among particular groups of the public to improve public policies and services. Please be assured that any information you provide for this purpose will only be released for bone fide social research carried out by reputable research organisations and that your confidentiality will be protected in the publication of any results given.*
>
> *Would you be willing to have your name, contact details and relevant answers you have given during the interview passed on to the Scottish Government or other research agencies acting on behalf of, or in collaboration with, the Scottish Government for this purpose?*

Both the household respondent and random adult respondent are asked for their consent.

How do I request a follow-up survey?

Those wishing to conduct follow-up research from the SHS should submit a written proposal providing details on the following key issues:

- Purpose of research, including aims and objectives
- Expected timescale
- Methodology
- Planned sample size
- Population sub-groups to be targeted, including list of variables required to draw the sample
- Additional variables required on respondents who participate
- Justification for the use of the SHS (as opposed to others alternatives) as a sampling frame

A pro-forma is available in the Annex of this document to aide researchers in setting this information out.

How can I use an SHS sample?

After submitting your research proposal, the SHS Project Team will review the rationale and determine whether this is feasible or not. Advice will be sought from senior management responsible for the SHS. Approval for releasing such information from the SHS will then need to be granted by the Scottish government's Chief Statistician.

If approved, the SHS Project Team will contact you to outline the conditions of use in using the SHS contact details as your research's sample frame. You will be asked to sign a declaration form noting your agreement.

There would be a cost for drawing the sampling which would be payable to Ipsos MORI, our lead contractor. Project costs must be considered by anyone planning to undertake follow-up research as the costs for drawing a sample from the SHS, undertaking the follow-up research and the dissemination of findings must be met from outside the SHS budget.

Conditions of use

If your research proposal is successful, the SHS respondent contact details will be supplied to you by the Scottish government under the following conditions:

- Only details of those respondents who have given their permission to be re-contacted will be supplied;
- The contact details are to be used only for the purposes of this project;
- The details provided must be treated as confidential and their storage and use must not contravene the Data Protection Act 1998;
- Only people working for *Edinburgh Napier University* should have access to the data, and any staff given access to the data must be aware of conditions of use;
- Respondents must be informed that their contact details were provided via the Scottish Household Survey and following their consent to be re-contacted;
- Individuals must not be identified in the results or any outputs produced using the SHS dataset;

- All contact details should be deleted on completion of the project unless respondents agree to their retention;
- The SHS Project Manager should be kept informed of any outputs arising from the follow-up research;
- Any costs for drawing the sampling and mailing this out should be fully met by the research proposer.

SHS Project Team
February 2009

shs@scotland.gsi.gov.uk | www.scotland.gov.uk/shs

SHS Follow-up Surveys **Pro-forma**	Scottish Household Survey

Your details
Please provide the following basic details about yourself.

✓ **Name**	*Miss Sarah Borthwick*
✓ **Job Title**	*PhD Research Student*
✓ **Organisation**	*Transport Research Institute, Edinburgh Napier University*
✓ **Address**	*Merchiston Campus, 10 Colinton Road, Edinburgh, EH10 5DT, Scotland*
✓ **e-mail**	*s.borthwick@napier.ac.uk*
✓ **Telephone**	*0131-455-2951*

Research description
Provide a brief overview of your research, in particular your key aims and objectives.

✓ **Title**	*The Potential for 'Green' Fiscal Measures to Lessen the Environmental Impact of Private Car Use in Scotland.*
✓ **Purpose**	*The research focuses upon the potential for 'green' fiscal policy to alter driver behaviour: gauged by changes in vehicle ownership and usage. Centring on private passenger vehicles and their associated carbon-footprint, the main focus will be on taxation instruments and their potential to promote behaviour with a lesser environmental impact.* *Disaggregating this, the objectives of this research are:* *The research will first of all assess current views and opinions, from a representative sample of current and future Scottish motorists, on the potential for 'green' fiscal measures to shape motoring behaviour. Identification of where a range of fiscal instruments sit in the initial vehicle purchasing decision and in shaping the degree of usage will provide a useful insight into driver behaviour.*

	An exploration of the rationale and motivations behind the behaviour previously identified will follow. An understanding of the required level of incentive/disincentive to instigate pro-environmental behaviour will aid a better understanding of the relationship between motoring behaviour and fiscal policy. *The acquired knowledge can also be applied to current fiscal measures to assess their level of effectiveness in shaping driver pro-environmental behaviour.* *The literature review for the project has recently commenced; the process of which will help clarify the above areas and exact focus of the research.*
✓ **Sponsor**	*The research will be conducted as part of a PhD programme, funded by the Transport Research Institute, Edinburgh Napier University.*

Methodology
Outline your research requirements, including how you plan on conducting your research and the timescales involved.

✓ **Methodology**	*Matching up with previously identified objectives, the proposed methodology will include a questionnaire survey and subsequent focus groups:* *Based upon the sample criteria from the SHS (specified later), the selected respondents will be re-contacted and asked if they would be willing to complete a further questionnaire. Acknowledging the questions already asked by the SHS, the questionnaire will enable concentration on areas specific to the research and thus left unanswered by the SHS. Analysis will be split according to respondent's current vehicle in possession, the previous car owned and the future vehicle to be bought – highlighting the influences to transition (past, present and future), the types of policy having the most effect; plus the influences to usage in each case. An environmental theme will run throughout, where the end product relates to the resulting carbon footprint.* *As part of the questionnaire, respondents will also be asked to indicate if they would be happy to participate in a subsequent focus group. The planned focus groups will provide the opportunity and scope for further discussion with a cross-section of the initial sample on responses to questions in the initial survey.*
✓ **Timescale**	*The physical research for the project is scheduled to take place during a twelve month period from mid-2010. From receipt of potential follow-up respondent's details, it is anticipated that recruitment to the follow-up survey will take approximately 4 to 6 weeks. Delivery and return of questionnaires for 1 to 2 months; where early analysis of results, drawing out the preliminary findings will take place for approximately 2 months, leading up to the planned focus groups occurring in the final few months.*
✓ **Contractors**	*None.*

Sample
Identify the required sample size, and the number of cases that need to be drawn to meet the required sample number.

✓ **Sample Size**	*A representative sample of between 1,000 and 1,500 respondents is the initial target (taking into account urban/rural considerations and other relevant socio-demographic factors) – of which a much smaller sub-section of the initial sample will be targeted for the focus groups.*
✓ **Records**	*In order to achieve the above sample size, it is likely that between 4,000 and 6,000 records will have to be accessed from the SHS dataset – although advice will be sought from the SHS team on previous similar follow-up surveys on the exact number likely to be required. In terms of the datasets, sample selection from at least three years of records is necessary – ideally from 2005-2009 (if available), otherwise 2004-2008.*

Variable Requirements
You should also identify which population sub-groups you wish target, by including a list of variables required to draw the sample. Further information on the variables available within the SHS are contained in our Topic List and Questionnaire publications – both of these are available through the Scottish Household Survey website.

✓ **Sub-group**	*The overall aim will be to focus on current Scottish car drivers. Within this sub-group, the sample is to be representative of Scottish individuals through criteria such as age, gender, income – and particularly through the six-fold urban rural classification.*
✓ **Variables**	*In order to meet the above requirement, the key variable to be used is:* *FREDRIV: How often do you drive a car/van nowadays, for private purposes (including travelling to work, but ignoring any driving which was part of your job)? → 1 (every day), 2 (at least three times a week), 3 (once or twice a week), 4 (at least two or three times a month), 5 (at least once a month) and 6 (less than once a month) → ≠ 7. The variable is selected from the 'random adult' section of the SHS.* *If feasible, it would be useful to identify an additional sample of imminent car drivers, i.e. those indicating via:* *LICENCE: Which of the phrases applies to you? → 2 (currently hold a provisional licence)*

Please note, we will only supply the contact details for the households, and not any supplementary information.

Justification and Outcomes
Please provide justification for the use of the SHS (as opposed to other alternatives) as a means to identify your sampling frame, and how you propose using the resultant analysis.

✓ **Use of SHS**	*The SHS provides the opportunity for a representative sample of Scottish individuals to be targeted. Owing to the range of topics covered (with a whole section devoted to 'Travel and Transport'), the respondents selected will meet the exact needs of the research. Compared with other datasets (e.g. National Travel Survey), the SHS brings the advantage of improved concentration of resources towards the Scottish population. In terms of the response rate, the SHS brings the advantage that potential respondents have already agreed to be re-contacted for further research. In line with the Scottish Government's current transport and environmental policy aims and objectives, the outcome of the research will provide an invaluable insight into an as yet under researched area and ultimately help inform future policy.*
✓ **Outcomes**	*The data is to be used for the purpose of a PhD with the Transport Research Institute within Edinburgh Napier University, and will therefore be contained in the completed thesis. It is also anticipated that the results of the research will be presented at selected conferences and published in academic journals. Following discussions with members of the Scottish Government Transport directorate, I have agreed to make available the results of various aspects of the research in the form of face-to-face presentations and/or written reports.*

Signed declaration
Please sign and date this request, acknowledging you have provided as much information as possible in support of the recommendations as set out in the SHS Follow-up Surveys - Pro-forma and Guidelines (February 2009) document.

✓ Name	*Sarah Borthwick*
✓ Date	*7 December 2009*

A4 ACCEPTANCE LETTER FOR A FOLLOW-UP SURVEY FROM THE SHS

Housing and Regeneration Directorate
Communities Analytical Services Division

T: 0131-244 0824 F: 0131-244 7573
E: shs@scotland.gsi.gov.uk

Sarah Borthwick
Transport Research Institute
Edinburgh Napier University

By e-mail

Our ref: B3487064

1 March 2010

Dear Sarah

SCOTTISH HOUSEHOLD SURVEY FOLLOW-UP SURVEY REQUEST THE POTENTIAL FOR 'GREEN' FISCAL MEASURES TO LESSEN THE ENVIRONMENTAL IMPACT OF PRIVATE CAR USE IN SCOTLAND

Thank you for your request to use the Scottish Household Survey (SHS) follow-up survey facility, in support of your above noted project.

I am pleased to say that this project has been approved. This letter provides a summary of the information we will provide to you based on the requirements you specified.

Sample Requirements

You will be provided with the following data:

Year:	Most up-to-date information available – currently up to 2009 Quarter 3
Geography:	Scotland, no requirement to stratify by local authority
Sample selection:	Focus on current Scottish car drivers, so sample frame to be drawn on specification FREDRIV in (1,2,3,4,5,6) or LICENCE in (1,2)
Sample size:	5,000
Variables:	As default, we will provide the following information:

- Name of respondent
- Address and postcode
- Telephone number
- Date of interview (for confirmation of interview if queried)

In addition, the following variables will also be provided:

- Age (HA5)
- Gender (HA6)
- Urban Rural classification (SHS_6CLA)

Conditions of Use

The SHS respondent contact details will be supplied to you under the following conditions:

- Only details of those respondents who have given their permission to be re-contacted will be supplied;
- The contact details are to be used only for the purposes of this project;
- The details provided must be treated as confidential and their storage and use must not contravene the Data Protection Act 1998;
- Only people working for your organisation should have access to the data, and any staff given access to the data must be aware of conditions of use;
- Respondents must be informed that their contact details were provided via the Scottish Household Survey and following their consent to be re-contacted;
- Individuals must not be identified in the results or any outputs produced using the SHS dataset;
- All contact details should be deleted on completion of the project unless respondents agree to their retention;
- The SHS Project Manager should be kept informed of any outputs arising from the follow-up research;
- Any costs for drawing the sampling and mailing this out should be fully met by the research proposer.

I would be grateful if you could review the data specifications along with the terms and conditions under which the data will be provided. If content, could you sign two copies of the attached declaration form and return one copy to the SHS Project Team.

Upon receipt of your signed declaration form, the SHS contractors will be informed that approval has been given and that the agreed contact details can be supplied.

If you wish to discuss this then please feel free to contact myself.

Yours sincerely

Nic Krzyzanowski
(SHS Project Manager)

A5 QUALITATIVE FINDINGS

Within the limited qualitative data collected (***Section 3.10.3***), a summary of the qualitative results is presented for the key themes of this research.

A5.1 Climate change and the relationship with transport

Members of the No-Greens were keen to question whether climate change was actually happening. For example, a respondent advocated global warming as a *"natural process"*. The relationship between "*CO_2 emissions and their alleged effect on the climate"* was also questioned by the No-Greens. Another respondent preferred *"the scientific view that the earth's rotation is the cause of global warming"*. This perspective has been identified in past research (Lorenzoni and Pidgeon, 2005; Lowe *et al*., 2006; Whitmarsh *et al*., 2011) and clearly weakens the foundation for 'green' taxation.

Furthermore, a lack of confidence was present regarding the relationship between road transport and CO_2 emissions/climate change. One of the No-Greens argued *"this link is unproven"*. This perhaps explains the relatively lower influence of VED, HOD, VAT and the PICG in encouraging a lower emission vehicle purchase for the No-Greens identified in ***Chapter 6***.

Attempts were also made by the No-Greens to highlight environmental damage by other sectors. For example, air travel was noted to *"use far more fuel and discharge far more CO_2 emissions"*. The carbon footprint of other countries was also remarked upon. For example, it was argued to *"be far better to concentrate on the USA, China and India as well as other European countries as we [the UK] cause less than 2% of the world's total emissions"*. This is perhaps an attempt to evade a personal responsibility to reduce emissions due to bigger players in the market (Lowe *et al*., 2006).

A5.2 The government and transport policy for climate change mitigation

Negativity was expressed towards the government and fiscal policies targeting the motorist. Akin to the previous section, the overwhelming majority of pessimism came from the No-Greens. For example, the *"war on motorists"* was highlighted, advocating them as *"an easy and large target"*. Similar findings have been identified by past researchers (Potter *et al*. 2005; Smith *et al*., 2009). The revenue raising aspect of motoring taxation was also highlighted. For example, one of the No-Greens argued the government's focus was *"about how much money can be squeezed out of the motorist and the CO_2 argument is the front for that argument"*. The No-Greens were noted earlier in ***Chapter 6*** to be less responsive to vehicle taxation founded on environmental measures, which may partly explain the findings.

A5.3 Importance of situational factors in individuals' future vehicle purchasing decisions

The dominance of financial considerations in individuals' future vehicle purchasing decisions was evident throughout the qualitative results (akin to the quantitative findings discussed in ***Chapter 5***). For example, one of the Go-Greens acknowledged *"the price on the forecourt and the price at the pumps"* as the two primary considerations upon future vehicle purchasing decisions. On the other hand, one of the No-Greens advocated *"their financial means"* as driving their future vehicle purchases. This concurs with past research by Lehman *et al*. (2003), DFT (2003), King (2007) and Lane and Banks (2010). The importance of taxation and a range of vehicle attributes were also acknowledged several times by all 'green' segments. One of the Go-Greens summarised this, suggesting *"buyers look for the whole package"* when purchasing a vehicle.

The relationship between tax and environmental consideration was identified as unclear. One of the Go-Greens indicated they *"would base any future car purchases on road tax cost and petrol consumption, as opposed to how environmentally-friendly it was"*. This was also recognised quantitatively in ***Chapter 5*** and past research Anable *et al*. (2008) and Lane and Banks (2010).

A5.4 CO_2 emissions from vehicle production

Members of the Maybe-Greens and No-Greens were keen to recognise the CO_2 emissions generated from vehicle production – not just vehicle use. For example, one of the No-Greens advocated the *"need to build in the level of pollution in the manufacturing process and not get so hung up on a few grams of CO_2 per kilometre"*. However, the SMMT (2012c) note only 10% of the vehicle's carbon footprint arising from production, whilst 85% stems from vehicle use. This is perhaps an attempt to deflect attention away from the environmental damage they are responsible for, previously recognised by Lehman *et al*. (2003), Poortinga *et al*. (2006) and Spence *et al*. (2010). Furthermore, this perhaps recognises the Maybe-Greens and No-Greens driving relatively more miles per year (***Chapter 4***).

A5.5 Purchase of a new or used vehicle

Various comments were made, particularly by the Go-Greens, regarding the difficulties in buying a used 'green' vehicle. Used vehicles were identified as more popular in this research across all 'green' segments (***Chapter 4***) and also in past research by the Environmental Audit Committee (2008). Specific to the Go-Greens, this perhaps recognises their relatively lower income compared to other 'green' segments (***Chapter 4***). For example, one of the Go-Greens was quoted as saying *"for a person on a low income, and there are great many of us, new cars are an impossible dream, but those are the cars with the lower emissions"*. This difficulty is faced despite such individuals wanting *"to be 'greener' in [their] vehicle choice"*.

A5.6 Rural considerations

The impact of location was discussed considerably across all 'green' segments in the qualitative results. The limited transport options available to rural inhabitants were highlighted by many. For example, a member of the Maybe-Greens argued *"a vehicle is a necessity as [they] live in the country and have limited public transport"*. Another Maybe-Green recognised *"geographical discrepancies in vehicle or transport reliance"*, advocating *"driving for many is not an optional extra in life"*. This confirms statistics by the Scottish Government (2012b).

The availability of fuel was also considered. For example, one of the Go-Greens declared *"alternative fuel is not available in Shetland – petrol/diesel only as far as I know"*. Difficulties were also noted by one of the Maybe-Greens *"for the island to even get conventional fuel"*. The weak refuelling infrastructure in rural Scotland is likely to negatively impact upon individuals' future vehicle purchasing decisions regarding AFVs.

A5.7 PICG qualifying vehicles

Respondents from all 'green' segments indicated dissatisfaction with the price of PICG qualifying vehicles, particularly the Go-Greens. This perhaps reflects their relatively lower household income (***Chapter 4***). For example, one of the Go-Greens notes *"low carbon vehicles have too high a price-point just now to make them a serious option"*. A Maybe-Green advocates the purchase price to be *"a major stumbling block"*. One of the No-Greens questions how the price can *"be justified against the cost of today's super minis at £10-15k?"*. This coincides with the level of PICG elicited in ***Chapter 6***. This issue of high vehicle purchase prices and a comparatively low PICG incentive have been recognised by the House of Commons Transport Committee (2013).

A5.8 Infrastructure to support the purchase of electric vehicles

The limited infrastructure to support the application of electric vehicles was noted by respondents, particularly the Go-Greens and Maybe-Greens. This perhaps reflects their greater progress in the behaviour change process towards a lower emission vehicle purchase perhaps utilising alternative fuels (***Chapter 8***). For example, one of the Maybe-Greens noted *"hybrid/electrical based drive systems require more infrastructure and support to make them more attractive to purchase"*. Indeed, past research by Kollmuss and Agyeman (2002) and Darnton (2004) have identified the importance of infrastructure provision and availability in stimulating the purchase of AFVs. The same respondent also argued *"if an employer, for instance, had recharging facilities at a place of work, then that would be a very good incentive"*. Workplace charge points have been identified by OLEV (2011) as part of the UK's vision for charging infrastructure.

A5.9 Considerations of vehicle use and the impact on taxation

Some of the Go-Greens and Maybe-Greens were keen to advocate their relatively low vehicle mileage (***Chapter 4***), whereby reducing their motoring carbon footprint. For example, one of the Maybe-Greens argues *"I drive 8,000 miles per year in my 4x4. Am I polluting more than the company rep in his saloon car driving 30,000 miles per year?"*. This, in turn, lead to discontent with flat rate taxation measures. For example, a member of the Go-Greens is reported to *"strongly object to road tax [VED] based on CO_2 emissions as I do a low mileage... A driver covering say 5,000 miles per year pays the same [VED] as someone covering 20,000"*. However, road-fuel policy measures, such as HOD, would recognise the degree of vehicle mileage.

Following on from this, many respondents from all 'green' segments were keen to suggest VED should be integrated into HOD. This would necessitate *"the more fuel used, either by MPG or miles driven, the more [motorists] would pay"* (Maybe-Green). A similar system has been advocated by Ubbels *et al*. (2002) and Potter *et al*. (2004). The relatively high level of HOD currently levied, combined with payment of VED, was seen as *"unjust"* (Go-Green) and *"unfair"* to motorists (No-Green).

A5.10 Tax incentives/disincentives

Agreement was present across all 'green' segments regarding a preference for tax incentives, rather than disincentives (akin to the results in ***Chapter 6***). For example, one of the Go-Greens advocated a greater inclination *"to make the switch if prices were reduced as an incentive, rather than punishing people for driving cars with higher CO_2 emission"*. One of the No-Greens summarised the consensus as *"carrots, not sticks"*. Similar observations have been made by DEFRA (2002) and Avery (2009).

A5.11 Hypothecating taxation revenue

All 'green' segments were keen to recognise the attraction of hypothecating taxation revenue. For example, one of the No-Greens suggests *"the public would be more incentivised if a greater proportion of motoring taxes were spent on road maintenance and transport improvement"*. VED, for example, has not been hypothecated for road building and maintenance of the road network since the Finance Act 1936. This may be a contributory factor towards the acceptance of 'green' transport taxation measures, previously recognised by Harrington *et al*. (2001), Schuitema and Steg (2008) and Sælen and Kallbekken (2011).

A5.12 Information campaigns

The Maybe-Greens and particularly the Go-Greens were keen to advocate the need for greater information regarding 'green' vehicles. For example, one of the Go-Greens argues for more information to be *"available for easy comparison of costs (initial cost, running costs etc) between high and low emissions"*. The same respondent also called for *"easily understood information regarding the damage to the environment by different cars"*. Insufficient information regarding *"the incentives already in operation"* was also noted by another member of the Go-Greens. This was suggested *"to help 'tip the balance' in favour of purchasing a lower emission vehicle"*. For example, limited awareness of the PICG has been identified by the LowCVP (2013).

It is interesting to note a member of the Go-Greens segment advocating the researcher's questionnaire provided *"interesting insight for me and highlighted a few things I was not aware of"*. The role of awareness raising and information campaigns for the 'green' segments, considered earlier in ***Chapter 8***, appear to coincide with qualitative findings.

A6 QUESTIONNAIRE AND COVERING LETTER

Dear Sir or Madam,

Please find enclosed a questionnaire forming part of a research project undertaken by myself at the Transport Research Institute of Edinburgh Napier University. My research focuses upon the decision to buy a vehicle and the factors influencing this choice – particularly vehicle taxation – which could be used to help inform and shape future policy.

My questionnaire asks for your views as a motorist, the car/van you drive and the decision making process for the next vehicle you might consider buying. It should take you approximately 20 minutes to complete.

You have been sent a questionnaire as you have already kindly completed the Scottish Household Survey and indicated your agreement to be involved with follow-up research. Your help at this time would be very much appreciated.

Personal information will be kept **strictly confidential and secure** and only the researcher will have access to the data you provide. No details which can identify you will be presented in the research output.

Please return your completed questionnaire in the prepaid envelope, to arrive by 18 March 2011.

As a thank you, all completed questionnaires received by the deadline will be entered into an optional prize draw for **Love2Shop High Street Gift Vouchers**: a **first prize of £200** and **ten runner-up prizes of £30** (see *http://tinyurl.com/love2shop-redeemers*).

If you have any queries about my questionnaire, please feel free to contact myself at *s.borthwick@napier.ac.uk* or telephone *0131-455-2951*. Or, if you would like more information about my research, please go to *http://tinyurl.com/napier-tri-sborthwick*.

Thank you very much, in advance, for your time and effort in this important piece of research.

Yours faithfully,

Sarah Borthwick, BA (Hons)
PhD Research Student
Transport Research Institute, Edinburgh Napier University,
Merchiston Campus, 10 Colinton Road, Edinburgh, EH10 5DT

SECTION A – ABOUT YOU AS A DRIVER:

Q1 What is your current licence status? (PLEASE TICK ALL THAT APPLY)

Provisional EU/UK car licence .... ☐
Provisional car licence from outside EU.. ☐
Full EU/UK car driving licence .... ☐
Full car licence from outside EU .... ☐

Q2 How many years have you held this licence? Please think back to when you originally acquired this. (PLEASE TICK ONE)

5 or less years...................................... ☐
6 to 10 years... ☐
11 to 15 years...................................... ☐
16 to 20 years...................................... ☐
21 to 30 years...................................... ☐
31 to 40 years...................................... ☐
41 to 50 years...................................... ☐
51 to 60 years...................................... ☐
61 to 70 years...................................... ☐
71 or more years.................................. ☐

Q3 Do you have regular access to a vehicle (car or van) for private motoring? (PLEASE TICK ONE)

REGULAR ACCESS IS HAVING A VEHICLE AT HAND, AS AND WHEN REQUIRED.

Yes .... ☐
No... ☐

Q4 How often do you drive for private purposes? (PLEASE TICK ONE)

Include all journeys for social, domestic & pleasure purposes, including the travel to and from your place of work – but excluding driving for the purpose of your employment or education

Every day .... ☐
At least three times a week .... ☐
Once or twice a week............................ ☐
At least two or three times a month........ ☐
At least once a month............................ ☐
Less than once a month .... ☐

Q5 On average, how many miles per year do you drive for private purposes? (PLEASE TICK ONE)

2,500 miles or less .... ☐
2,501 to 5,000 miles .... ☐
5,001 to 7,500 miles .... ☐
7,501 to 10,000 miles .... ☐
10,001 to 15,000 miles.......................... ☐
15,001 to 20,000 miles.......................... ☐
20,001 to 30,000 miles.......................... ☐
30,001 to 40,000 miles.......................... ☐
40,001 to 50,000 miles.......................... ☐
50,001 miles or more............................. ☐

SECTION B – IDENTIFY THE **CAR OR VAN** THAT YOU **DRIVE MOST OFTEN** (IN TERMS OF **MILEAGE**) FOR **PRIVATE PURPOSES**:

Q6 What is the make of the vehicle you drive most often? (PLEASE WRITE YOUR ANSWER)

Make ....
Don't know .... ☐

Q7 What is the model of this vehicle? (PLEASE WRITE YOUR ANSWER)

Model...
Don't know .... ☐

Q8 What is the size of engine for this vehicle, measured in litres? (PLEASE WRITE YOUR ANSWER) *E.g. 1.3 litres, or 3.0 litres.*

....litres
Don't know .... ☐
N/A .... ☐

Q9 What is the fuel type, or energy source for this vehicle? (PLEASE TICK ALL THAT APPLY, MORE THAN ONE IF A HYBRID)

Petrol .... ☐
Diesel .... ☐
Electricity .... ☐
Compressed natural gas (CNG) .... ☐
Liquid petroleum gas (LPG) .... ☐
Biofuel *(e.g. E85)* .... ☐
Hydrogen .... ☐
Don't know .... ☐

Q10 What is the transmission, or gearbox for this vehicle? (PLEASE TICK ONE)

Manual .... ☐
Automatic .... ☐
Semi-automatic .... ☐
Don't know .... ☐

Q11 If your vehicle was registered on or before 31 August 2001, what is the FIRST LETTER of the registration number, ignoring any personalised registrations? (PLEASE WRITE YOUR ANSWER)

Letter .... *E.g. (A)123 BCD*

OR If your vehicle was registered on or after 1 September 2001, what is the NUMBER component of the registration number, ignoring any personalised registrations? (PLEASE WRITE YOUR ANSWER)

Number .... *E.g. AB(51)CDE*
Don't know either .... ☐

Q12 **Who is the registered owner of this vehicle?** (PLEASE TICK ALL THAT APPLY, MORE THAN ONE IF JOINTLY OWNED)

Myself .... ☐
My spouse/partner .... ☐
My parents .... ☐
Other family member (e.g. sibling) .... ☐
Friend .... ☐
My employer .... ☐
Leasing organisation .... ☐
Don't know .... ☐

Q13 When you acquired the use of this vehicle, was it new or used? (PLEASE TICK ONE)

New vehicle .... ☐
Used vehicle .... ☐
Don't know .... ☐

Q14 Was this vehicle bought as part of the scrappage scheme? (PLEASE TICK ONE)

THIS WOULD HAVE TAKEN PLACE BETWEEN 18 MAY 2009 AND 31 MARCH 2010, SCRAPPING A VEHICLE OF 10 OR MORE YEARS AND BUYING A NEW REPLACEMENT VEHICLE WITH A £2,000 SCRAPPAGE ALLOWANCE

Yes .... ☐
No .... ☐
Don't know .... ☐

THINK BACK TO THE VEHICLE YOU DROVE MOST OFTEN BEFORE THE CURRENT VEHICLE, AND COMPARE THE TWO:

Q15 How does the current vehicle compare with the previous one you drove most often, measured on a scale from 'greatly reduced' to 'greatly increased'? (PLEASE TICK ONE FROM EACH ROW; OR N/A)

AS AN EXAMPLE: MY CURRENT VEHICLE HAS ... COMPARED WITH MY PREVIOUS VEHICLE.

	Greatly Reduced		..........**The Same**..........				**Greatly Increased**	***Don't know***
Engine size	☐	☐	☐	☐	☐	☐	☐	☐
Vehicle size	☐	☐	☐	☐	☐	☐	☐	☐
Fuel consumption	☐	☐	☐	☐	☐	☐	☐	☐

N/A, there is no previous vehicle .... ☐

SECTION C – THINK ABOUT THE **NEXT VEHICLE** YOU MIGHT CONSIDER BUYING IN THE FUTURE:

Q16 How important would the following VEHICLE considerations be in a FUTURE decision to buy a vehicle measured on a scale from 'not important' to 'very important'? (PLEASE TICK ONE FROM EACH ROW)

	Not Important			**.................**			**Very Important**	***Don't know***	***N/A***
Make of vehicle	☐	☐	☐	☐	☐	☐	☐	☐	☐
Model of vehicle	☐	☐	☐	☐	☐	☐	☐	☐	☐
Vehicle size *(exterior)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Body shape *(e.g. hatchback, saloon, estate)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Style/appearance/colour	☐	☐	☐	☐	☐	☐	☐	☐	☐
Vehicle capacity *(seating)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Luggage/storage space	☐	☐	☐	☐	☐	☐	☐	☐	☐
Equipment levels *(e.g. Sat-Nav)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Entertainment system *(e.g. stereo, DVD)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Safety features *(e.g. airbags)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Security features *(e.g. immobiliser)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Engine type/size *(power)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fuel type	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fuel consumption (miles per gallon)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Performance/driveability *(handling)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Acceleration time	☐	☐	☐	☐	☐	☐	☐	☐	☐
Mileage *(used vehicle)*	☐	☐	☐	☐	☐	☐	☐	☐	☐
Overall condition of vehicle *(used vehicle)*	☐	☐	☐	☐	☐	☐	☐	☐	☐

Q17 How important would the following FINANCIAL considerations be in a FUTURE decision to buy a vehicle, measured on a scale from 'not important' to 'very important'? (PLEASE TICK ONE FROM EACH ROW)

	Not Important			**.................**			**Very Important**	***Don't know***	***N/A***
Vehicle price	☐	☐	☐	☐	☐	☐	☐	☐	☐
VAT & other purchase taxes	☐	☐	☐	☐	☐	☐	☐	☐	☐
Finance deals (credit options)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Value for money	☐	☐	☐	☐	☐	☐	☐	☐	☐
Fuel economy	☐	☐	☐	☐	☐	☐	☐	☐	☐
Maintenance/repair costs	☐	☐	☐	☐	☐	☐	☐	☐	☐
Warranty (length & coverage)	☐	☐	☐	☐	☐	☐	☐	☐	☐
Insurance group for vehicle	☐	☐	☐	☐	☐	☐	☐	☐	☐
Annual/biannual road tax	☐	☐	☐	☐	☐	☐	☐	☐	☐
Company car tax bands	☐	☐	☐	☐	☐	☐	☐	☐	☐
Trade-in value	☐	☐	☐	☐	☐	☐	☐	☐	☐

Q18 How important would the following ENVIRONMENTAL considerations be in a FUTURE decision to buy a vehicle, measured on a scale from 'not important' to 'very important'? (PLEASE TICK ONE FROM EACH ROW)

	Not Important			**...........................**			**Very Important**	**Don't know**
Emissions of CO_2 & other greenhouse gases	☐	☐	☐	☐	☐	☐	☐	☐
Emissions of other air pollutants	☐	☐	☐	☐	☐	☐	☐	☐
Vehicle noise	☐	☐	☐	☐	☐	☐	☐	☐

Q19 How much do you agree or disagree, measured on the scale below, with the following statements regarding the future decision to buy a lower emission vehicle? (PLEASE TICK ONE FROM EACH ROW)

LOWER EMISSION VEHICLES DO NOT NECESSARILY RUN ON 'GREENER' FUELS NOR ALTERNATIVE TECHNOLOGIES (E.G. ELECTRICITY) – BUT SIMPLY HAVE LOWER EMISSIONS THAN THE CURRENT VEHICLE YOU DRIVE

	Strongly Disagree			**......................**			**Strongly Agree**	**Don't know**
I intend to buy a lower emission vehicle in the future	☐	☐	☐	☐	☐	☐	☐	☐
It would be very difficult for me to buy a lower emission vehicle in the future	☐	☐	☐	☐	☐	☐	☐	☐
People who drive high emission vehicles contribute significantly to greenhouse gas emissions	☐	☐	☐	☐	☐	☐	☐	☐
I plan to switch to a lower-emission vehicle sometime in the future	☐	☐	☐	☐	☐	☐	☐	☐
Because of my own principles & beliefs, I feel no obligation to buy a lower emission vehicle in the future	☐	☐	☐	☐	☐	☐	☐	☐
It would cause me no problems if I were to buy a lower emission vehicle in the future	☐	☐	☐	☐	☐	☐	☐	☐
Buying a lower emission vehicle would make me feel good	☐	☐	☐	☐	☐	☐	☐	☐
Nothing would persuade me to buy a lower emission vehicle in the future	☐	☐	☐	☐	☐	☐	☐	☐
Most other people would approve of me buying a lower-emission vehicle	☐	☐	☐	☐	☐	☐	☐	☐
I feel no personal responsibility to help reduce the emissions of vehicle-related greenhouse gas emissions	☐	☐	☐	☐	☐	☐	☐	☐
I would not be interested in buying a lower emission vehicle	☐	☐	☐	☐	☐	☐	☐	☐
I would feel bad about myself if I did not switch to a lower emission vehicle in the future	☐	☐	☐	☐	☐	☐	☐	☐

SECTION D – CONSIDER THE LEVEL OF **INCENTIVE/DISINCENTIVE** YOU WOULD NEED IN EACH TAX MEASURE TO **BUY A LOWER EMISSION VEHICLE** THAN THE ONE YOU CURRENTLY DRIVE MOST OFTEN. *IF YOUR VEHICLE IS LIKELY TO BE **LEASED**, PLEASE MARK **N/A** FOR THE IRRELEVANT TAX MEASURES (THOSE INCLUDED IN THE LEASING CONTRACT):*

ROAD TAX: THE PAYMENT OF ROAD TAX IS NOW BASED UPON THE CO_2 EMISSIONS OF THE VEHICLE:

Q20 What is the current road tax payment for the vehicle outlined in Section B – the vehicle driven most often? (IF UNSURE, PLEASE PROVIDE A BEST ESTIMATE, AND TICK ONE)

£100 or less.. ☐ £301 to £400 .... ☐
£101 to £150.. ☐ £401 to £500 .... ☐
£151 to £200.. ☐ £501 to £600 .... ☐
£201 to £250.. ☐ £601 to £800 .... ☐
£251 to £300.. ☐ £801 to £950 .... ☐

Q21 What was the renewal period for this road tax? (PLEASE TICK ONE)

6 months .... ☐ Don't know.. ☐
12 months .... ☐

Q22 Do you have any intention of buying a vehicle in the near future, either as a replacement or an additional vehicle? (PLEASE TICK ONE)

Yes.. ☐ No .... ☐

If 'YES', please go to the <u>next question</u> **If 'NO', please go straight to <u>Section E</u> (page 9)**

IMAGINE WHEN YOU BUY YOUR NEXT VEHICLE THAT YOUR INCOME IS THE SAME AS YOUR **CURRENT FINANCIAL CIRCUMSTANCES**.
PAST STUDIES HAVE SHOWN THAT **PEOPLE TEND TO RESPOND TO SURVEYS DIFFERENTLY THAN THEY WOULD ACT IN REAL LIFE SITUATIONS** (E.G. **UNDER- OR OVER-STATING** THE AMOUNTS THEY WOULD PAY OR THEIR WILLINGNESS TO BUY GOODS). PLEASE BE AWARE OF THIS AND ANSWER AS **REALISTICALLY** AS POSSIBLE:

Q23 Looking into the future and the next vehicle you may buy, please indicate either the increase OR decrease in the amount of road tax you currently pay that would make you:

A: ***Start thinking about buying a lower emission vehicle:***
If my current level of road tax (Q20) was
Raised by _____________% for a new vehicle with equal or greater emissions.
OR
Reduced by _____________% for a new vehicle with lower emissions.
(ANSWER <u>EITHER</u> THE INCREASE <u>OR</u> DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

B: ***Seriously think about buying a lower emission vehicle:***
If my current level of road tax (Q20) was
Raised by _____________% for a new vehicle with equal or greater emissions.
OR
Reduced by _____________% for a new vehicle with lower emissions.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

C: ***Definitely buy a lower emission vehicle:***
If my current level of road tax (Q20) was
Raised by _____________% for a new vehicle with equal or greater emissions.
OR
Reduced by _____________% for a new vehicle with lower emissions.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

N/A
My vehicle is likely to be leased and I would not have to pay road tax .... ☐
No level of road tax increase/decrease would influence my motoring behaviour .... ☐

VAT (VALUE ADDED TAX): AT THE MOMENT, THE LEVEL OF VAT TO BE CHARGED UPON THE PRICE OF A VEHICLE IS 20% – REGARDLESS OF THE CO_2 EMISSIONS OF THE VEHICLE:

Q24 Looking into the future and the next vehicle you may buy, imagining that the level of VAT was altered to reflect the CO_2 emissions of a vehicle, please indicate either the increase OR decrease in the amount of VAT you currently pay that would make you:

E.G. FOR SIMPLICITY, A 5% INCREASE WILL BRING 20% UP TO 25%; & A 5% DECREASE WILL BRING 20% DOWN TO 15%

A: ***Start thinking about buying a lower emission vehicle:***
If the level of VAT (currently 20%) was
Raised by _____________% for a new vehicle with equal or greater emissions.
OR
Reduced by _____________% for a new vehicle with lower emissions.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

B: ***Seriously think about buying a lower emission vehicle:***
If the level of VAT (currently 20%) was
Raised by _____________% for a new vehicle with equal or greater emissions.
OR
Reduced by _____________% for a new vehicle with lower emissions.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

C: ***Definitely buy a lower emission vehicle:***
If the level of VAT (currently 20%) was
Raised by _____________% for a new vehicle with equal or greater emissions.
OR
Reduced by _____________% for a new vehicle with lower emissions.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

N/A
My vehicle is likely to be leased and I would not have to pay VAT.............................. ☐
I deal in private vehicle sales and VAT is irrelevant.. ☐
No level of VAT increase/decrease would influence my motoring behaviour.......................... ☐

FUEL DUTY: AROUND 50% OF THE AVERAGE COST OF FUEL (ULTRA-LOW & SULPHUR-FREE PETROL & DIESEL) ARE TAKEN IN FUEL DUTY. THIS RATE IS REDUCED IN SOME CASES FOR ‘GREENER’ FUELS SUCH AS LIQUID PETROLEUM GAS AND BIOFUELS AS AN INCENTIVE FOR THEIR USE:

Q25 Looking into the future and the next vehicle you may buy (and assuming any issues of availability for ‘greener’ fuel have been resolved), please indicate either the increase OR decrease in the amount of fuel duty you currently pay for petrol or diesel that would make you:

A: ***Start thinking about buying a new vehicle utilising ‘greener’ fuels:***
If the level of fuel duty (58.95 pence per litre) was
Raised by _____________% for petrol and diesel.
OR
Reduced by _____________% for ‘greener’ fuels.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

B: ***Seriously think about buying a new vehicle utilising ‘greener’ fuels:***
If the level of fuel duty (58.95 pence per litre) was
Raised by _____________% for petrol and diesel.
OR
Reduced by _____________% for ‘greener’ fuels.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

C: ***Definitely buy a new vehicle utilising ‘greener’ fuels:***
If the level of fuel duty (58.95 pence per litre) was
Raised by _____________% for petrol and diesel.
OR
Reduced by _____________% for ‘greener’ fuels.
(ANSWER EITHER THE INCREASE OR DECREASE, DEPENDING ON WHICH WOULD INFLUENCE YOUR DECISION THE MOST)

N/A *No level of fuel duty increase/decrease would influence my motoring behaviour*..☐

PLUG-IN CAR GRANT: THIS ALLOWS UP TO £5,000 OFF THE PRICE OF QUALIFYING NEW ELECTRIC, PLUG-IN HYBRID AND HYDROGEN FUELLED VEHICLES – KNOWN AS ‘ULTRA-LOW EMISSION VEHICLES’. EXAMPLES AND STARTING PRICES (EXCLUDING THE GRANT) CAN BE SHOWN BELOW:

Nissan Leaf – around £29,000 starting price

Tata Vista EV – around £29,000 starting price

Vauxhall Ampera – around £34,000 starting price

Q26 Looking to the future and the next vehicle you may buy (and assuming any issues of e.g. vehicle range have been resolved), please indicate the decrease in the price to buy a new ‘ultra-low emission vehicle’ that would make you:

A: ***Start thinking about buying a new ‘ultra-low emission vehicle’:***
If the price to buy was
Reduced by _____________% for a new ‘ultra-low emission vehicle’.

B: ***Seriously think about buying a new 'ultra-low emission vehicle':***
If the price to buy was
Reduced by _____________% for a new 'ultra-low emission vehicle'.

C: ***Definitely buy a new 'ultra-low emission vehicle':***
If the price to buy was
Reduced by _____________% for a new 'ultra-low emission vehicle'.

N/A
My vehicle is likely to be leased and I wouldn't have to pay the plug-in car grant .... ☐
I have no intention of buying a newly registered vehicle .... ☐
I have no interest in ''ultra-low emission vehicle' technologies & would not buy one .... ☐
No level of plug-in car grant would influence my motoring behaviour .... ☐

FIRST YEAR RATE OF ROAD TAX: AT THE TIME OF BUYING A NEWLY REGISTERED VEHICLE, A DIFFERENT RATE OF ROAD TAX MUST INITIALLY BE PAID. THIS PROVIDES A STRONGER FINANCIAL SIGNAL AT THE POINT OF SALE, WITH A LESSER PAYMENT FOR LOWER EMISSION VEHICLES, AND GREATER PAYMENT FOR THOSE WITH HIGHER EMISSIONS:

Q27 Were you aware of the new first year rate prior to this questionnaire? (PLEASE TICK ONE)

Yes........ ☐ No .... ☐

Q28 Would it influence the choice of vehicle you would buy? (PLEASE TICK ONE)

Yes........ ☐ No .... ☐

N/A
– My vehicle is likely to be leased and I would not have to pay this........ ☐
– I have no intention of buying a newly registered vehicle........ ☐

NEW POLICY MEASURES: TO HELP ENCOURAGE THE BUYING OF LOWER EMISSION VEHICLES, CHANGES TO POLICY CAN RESULT IN TIME OR FINANCIAL SAVINGS FOR SUCH VEHICLES:

Q29 How influential would each of the following measures be in a future decision to buy a vehicle, either as a modification or an addition to current policy? (PLEASE TICK ONE FROM EACH ROW)

	Not Influential			....			**Very Influential**	**Don't know**
First vehicle registration fee based on CO_2 emissions	☐	☐	☐	☐	☐	☐	☐	☐
Annual/biannual road tax derived by a fixed monetary amount (£) per gram of CO_2	☐	☐	☐	☐	☐	☐	☐	☐
First year rate of road tax derived by a fixed monetary amount (£) per gram of CO_2	☐	☐	☐	☐	☐	☐	☐	☐
Rebates for vehicles below a CO_2 emissions threshold	☐	☐	☐	☐	☐	☐	☐	☐
Fees for vehicles above a CO_2 emissions threshold	☐	☐	☐	☐	☐	☐	☐	☐
VAT based on CO_2 emissions	☐	☐	☐	☐	☐	☐	☐	☐
Vehicle scrappage scheme with a CO_2 emissions limit on the replacement vehicle	☐	☐	☐	☐	☐	☐	☐	☐

[Continued overleaf]

	Not Influential			**......................**			**Very Influential**	**Don't know**
Parking charges partly based on CO_2 emissions	☐	☐	☐	☐	☐	☐	☐	☐
Motor insurance premiums partly based on CO_2 emissions	☐	☐	☐	☐	☐	☐	☐	☐
Designated 'low emission vehicle lane' *(similar to bus-lanes)*	☐	☐	☐	☐	☐	☐	☐	☐
A road user charging scheme with payment (per mile/hour) based on CO_2 emissions	☐	☐	☐	☐	☐	☐	☐	☐
A road user charging scheme with payment (a flat rate) based on CO_2 emissions	☐	☐	☐	☐	☐	☐	☐	☐

DO YOU HAVE ANY FURTHER THOUGHTS RELATING TO TAX (INCENTIVES/DISINCENTIVES) OR ANY OTHER POLICY MEASURES? ARE THERE ANY OTHER ISSUES OF IMPORTANCE IN A FUTURE DECISION TO BUY A VEHICLE THAT YOU WISH TO ADD?

SECTION E – ABOUT YOU PERSONALLY:

Q30 What is your gender? (PLEASE TICK ONE)

Male... ☐ Female...☐

Q31 What is your age? (PLEASE TICK ONE)

16 to 24 years... ☐ 45 to 59 years..☐
25 to 34 years... ☐ 60 to 74 years..☐
35 to 44 years... ☐ 75 years or greater ....☐

Q32 What is your household annual income before tax? (PLEASE TICK ONE)

Include earnings from all sources of employment/self-employment (before deductions for tax, national insurance etc) and including overtime, bonuses, commission or tips

£10,000 or less.. ☐ £40,001 to £50,000 ....☐
£10,001 to £20,000.................................. ☐ £50,001 to £60,000 ....☐
£20,001 to £30,000.................................. ☐ £60,001 to £70,000 ....☐
£30,001 to £40,000.................................. ☐ £70,001 or more....................................☐

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

Finally, please indicate your preference with regards to the prize draw (details can be found on the covering letter):

I wish to be entered into the prize draw ....☐
I do not wish to be entered into the prize draw ....☐

Please provide your contact details for the purpose of the draw: *Your details will not be passed onto any other parties for marketing activities or otherwise*

Name ....
Email address ....
Contact telephone number (home/mobile)...

The draw will take place in May.
All winners will be notified shortly after and prizes issued within 6 weeks of the draw.

A7 SPSS OUTPUT FROM FACTOR ANALYSIS AND K-MEANS CLUSTER ANALYSIS

The full statistical output generated by SPSS from the factor analysis and k-means cluster analysis is presented below.

A7.1 Factor analysis

Table 71: Communalities

Situational factors	Initial	Extraction
Vehicle make	1.000	.769
Vehicle model	1.000	.801
Vehicle size	1.000	.535
Vehicle body shape	1.000	.517
Style/appearance/colour	1.000	.519
Passenger capacity	1.000	.692
Luggage/storage space	1.000	.676
Equipment levels	1.000	.561
Entertainment levels	1.000	.516
Safety features	1.000	.582
Security features	1.000	.618
Engine type/size	1.000	.531
Fuel type	1.000	.491
Fuel consumption/MPG	1.000	.682
Performance/driveability	1.000	.508
Acceleration time	1.000	.457
Vehicle price	1.000	.703
VAT and other purchase taxes	1.000	.568
Value for money	1.000	.572
Fuel economy	1.000	.553
Maintenance/repair costs	1.000	.618
Vehicle warranty	1.000	.551
Insurance group for the vehicle	1.000	.601
Biannual/annual VED	1.000	.538
Trade-in value	1.000	.478
Vehicle emissions of CO_2 and other GHGs	1.000	.887
Vehicle emissions of other air pollutants	1.000	.893
Vehicle noise	1.000	.609

Extraction Method: Principal Component Analysis

Table 72: Correlation matrix

	Make	Model	Size	Body shape	Style	Capacity	Storage	Equip-ment	Entertain-ment	Safety	Security	Engine	Fuel	Fuel Consume	Perform-ance	Acc time	Price	VAT/ Purch tax	Value for money	Fuel economy	Mainten-ance	Warranty	Insurance	Road tax	Trade in	CO_2 & GHG	Air pollutants	Noise
Vehicle make	1.000	.838	.439	.343	.457	.284	.236	.261	.265	.161	.185	.344	.318	.161	.266	.321	.025	.008	.015	.035	-.002	.048	.042	.014	.124	-.009	-.020	.023
Vehicle model	.838	1.000	.461	.402	.429	.276	.209	.270	.275	.153	.199	.391	.324	.144	.276	.326	.019	-.016	.009	.004	-.032	.046	.003	-.012	.131	-.004	-.004	.036
Vehicle size	.439	.461	1.000	.503	.331	.412	.310	.224	.249	.222	.209	.388	.275	.228	.202	.249	.128	.086	.047	.131	.096	.127	.124	.112	.145	.061	.056	.112
Body shape	.343	.402	.503	1.000	.398	.387	.403	.212	.254	.218	.241	.348	.325	.208	.287	.260	.106	.054	.041	.122	.051	.128	.091	.056	.105	.057	.049	.072
Vehicle style	.457	.429	.331	.398	1.000	.400	.235	.448	.383	.235	.272	.328	.245	.119	.247	.338	.068	.006	.021	.013	-.042	.137	.075	.002	.153	.040	.026	.090
Capacity	.284	.276	.412	.387	.400	1.000	.566	.251	.231	.247	.218	.340	.340	.247	.252	.203	.103	.076	.059	.152	.054	.116	.130	.086	.076	.111	.116	.122
Luggage/storage	.236	.209	.310	.403	.235	.566	1.000	.243	.225	.237	.242	.239	.295	.169	.216	.194	.049	.103	.092	.099	.096	.105	.125	.121	.093	.081	.075	.103
Equipment levels	.261	.270	.224	.212	.448	.251	.243	1.000	.574	.237	.319	.284	.193	.032	.210	.363	.052	.016	.028	-.007	-.023	.130	.047	.034	.140	-.025	-.040	.045
Entertainment	.265	.275	.249	.254	.383	.231	.225	.574	1.000	.314	.325	.295	.219	.081	.197	.341	.073	.067	.088	.090	.062	.148	.098	.102	.180	.019	.013	.080
Safety features	.161	.153	.222	.218	.235	.247	.237	.237	.314	1.000	.645	.228	.183	.273	.337	.198	.119	.166	.109	.180	.123	.280	.198	.195	.243	.174	.174	.169
Security features	.185	.199	.209	.241	.272	.218	.242	.319	.325	.645	1.000	.309	.236	.197	.321	.270	.142	.153	.104	.107	.098	.244	.224	.226	.257	.181	.178	.230
Engine type/size	.344	.391	.388	.348	.328	.340	.239	.284	.295	.228	.309	1.000	.501	.316	.378	.377	.126	.070	.085	.130	.147	.110	.108	.154	.134	.064	.053	.072
Fuel type	.318	.324	.275	.325	.245	.340	.295	.193	.219	.183	.236	.501	1.000	.390	.310	.291	.105	.090	.094	.191	.139	.124	.150	.184	.115	.118	.136	.111
Fuel consume	.161	.144	.228	.208	.119	.247	.169	.032	.081	.273	.197	.316	.390	1.000	.373	.170	.167	.180	.156	.535	.280	.240	.256	.223	.170	.273	.265	.171
Performance	.266	.276	.202	.287	.247	.252	.216	.210	.197	.337	.321	.378	.310	.373	1.000	.355	.127	.117	.104	.130	.129	.164	.110	.145	.222	.179	.173	.190
Acc time	.321	.326	.249	.260	.338	.203	.194	.363	.341	.198	.270	.377	.291	.170	.355	1.000	.000	.079	.005	.074	.062	.132	.092	.078	.216	.046	.025	.101
Vehicle price	.025	.019	.128	.106	.068	.103	.049	.052	.073	.119	.142	.126	.105	.167	.127	.000	1.000	.404	.364	.181	.171	.171	.216	.217	.168	.159	.160	.162
VAT/purch taxes	.008	-.016	.086	.054	.006	.076	.103	.016	.067	.166	.153	.070	.090	.180	.117	.079	.404	1.000	.334	.258	.333	.330	.342	.424	.319	.197	.194	.201
Value for money	.015	.009	.047	.041	.021	.059	.092	.028	.088	.109	.104	.085	.094	.156	.104	.005	.364	.334	1.000	.258	.265	.210	.205	.211	.163	.075	.071	.078
Fuel economy	.035	.004	.131	.122	.013	.152	.099	-.007	.090	.180	.107	.130	.191	.535	.130	.074	.181	.258	.258	1.000	.472	.323	.302	.282	.161	.282	.282	.193
Maintenance	-.002	-.032	.096	.051	-.042	.054	.096	-.023	.062	.123	.098	.147	.139	.280	.129	.062	.171	.333	.265	.472	1.000	.467	.415	.403	.218	.177	.186	.115
Vehicle warranty	.048	.046	.127	.128	.137	.116	.105	.130	.148	.280	.244	.110	.124	.240	.164	.132	.171	.330	.210	.323	.467	1.000	.419	.347	.410	.242	.227	.197
Insurance group	.042	.003	.124	.091	.075	.130	.125	.047	.098	.198	.224	.108	.150	.256	.110	.092	.216	.342	.205	.302	.415	.419	1.000	.579	.354	.273	.268	.266
VED	.014	-.012	.112	.056	.002	.086	.121	.034	.102	.195	.226	.154	.184	.223	.145	.078	.217	.424	.211	.282	.403	.347	.579	1.000	.324	.283	.272	.261
Trade-in value	.124	.131	.145	.105	.153	.076	.093	.140	.180	.243	.257	.134	.115	.170	.222	.216	.168	.319	.163	.161	.218	.410	.354	.324	1.000	.219	.223	.249
CO_2 & GHG	-.009	-.004	.061	.057	.040	.111	.081	-.025	.019	.174	.181	.064	.118	.273	.179	.046	.159	.197	.075	.282	.177	.242	.273	.283	.219	1.000	.950	.568
Air pollution	-.020	-.004	.056	.049	.026	.116	.075	-.040	.013	.174	.178	.053	.136	.265	.173	.025	.160	.194	.071	.282	.186	.227	.268	.272	.223	.950	1.000	.573
Vehicle noise	.023	.036	.112	.072	.090	.122	.103	.045	.080	.169	.230	.072	.111	.171	.190	.101	.162	.201	.078	.193	.115	.197	.266	.261	.249	.568	.573	1.000

Table 73: Significance of the correlations (one-tailed)

	Make	Model	Size	Body shape	Style	Capacity	Storage	Equip-ment	Entertain-ment	Safety	Security	Engine	Fuel	Fuel Consume	Perform-ance	Acc time	Price	VAT/ Purch tax	Value for money	Fuel economy	Mainten-ance	Warranty	Insurance	Road tax	Trade in	CO_2 & GHG	Air pollutants	Noise
Vehicle make		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.213	.398	.320	.131	.479	.063	.090	.325	.000	.386	.256	.229
Vehicle model	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.275	.302	.386	.453	.151	.071	.461	.351	.000	.454	.449	.122
Vehicle size	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.003	.066	.000	.001	.000	.000	.000	.000	.025	.036	.000
Body shape	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.043	.096	.000	.053	.000	.002	.037	.000	.034	.059	.011
Vehicle style	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.015	.427	.254	.339	.089	.000	.008	.474	.000	.102	.202	.002
Capacity	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.007	.029	.000	.041	.000	.000	.003	.007	.000	.000	.000
Luggage/storage	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.058	.000	.002	.001	.001	.000	.000	.000	.002	.005	.008	.000
Equipment levels	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.151	.000	.000	.047	.310	.187	.409	.234	.000	.065	.136	.000	.212	.101	.073
Entertainment	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.005	.000	.000	.010	.017	.002	.002	.023	.000	.001	.001	.000	.275	.340	.005
Safety features	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Security features	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000
Engine type/size	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.012	.003	.000	.000	.000	.000	.000	.000	.020	.044	.011
Fuel type	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.002	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000
Fuel consume	.000	.000	.000	.000	.000	.000	.000	.151	.005	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Performance	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Acc time	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.500	.006	.439	.009	.024	.000	.002	.006	.000	.070	.209	.001
Vehicle price	.213	.275	.000	.000	.015	.000	.058	.047	.010	.000	.000	.000	.000	.000	.000	.500		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
VAT/purch taxes	.398	.302	.003	.043	.427	.007	.000	.310	.017	.000	.000	.012	.002	.000	.000	.006	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Value for money	.320	.386	.066	.096	.254	.029	.002	.187	.002	.000	.000	.003	.001	.000	.000	.439	.000	.000		.000	.000	.000	.000	.000	.000	.008	.012	.006
Fuel economy	.131	.453	.000	.000	.339	.000	.001	.409	.002	.000	.000	.000	.000	.000	.000	.009	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000
Maintenance	.479	.151	.001	.053	.089	.041	.001	.234	.023	.000	.001	.000	.000	.000	.000	.024	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000
Vehicle warranty	.063	.071	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000
Insurance group	.090	.461	.000	.002	.008	.000	.000	.065	.001	.000	.000	.000	.000	.000	.000	.002	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000
VED	.325	.351	.000	.037	.474	.003	.000	.136	.001	.000	.000	.000	.000	.000	.000	.006	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000
Trade-in value	.000	.000	.000	.000	.000	.007	.002	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000
CO_2 & GHG	.386	.454	.025	.034	.102	.000	.005	.212	.275	.000	.000	.020	.000	.000	.000	.070	.000	.000	.008	.000	.000	.000	.000	.000	.000		.000	.000
Air pollution	.256	.449	.036	.059	.202	.000	.008	.101	.340	.000	.000	.044	.000	.000	.000	.209	.000	.000	.012	.000	.000	.000	.000	.000	.000	.000		.000
Vehicle noise	.229	.122	.000	.011	.002	.000	.000	.073	.005	.000	.000	.011	.000	.000	.000	.001	.000	.000	.006	.000	.000	.000	.000	.000	.000	.000	.000	

Table 74: Anti-image covariance

	Make	Model	Size	Body shape	Style	Capacity	Storage	Equip-ment	Entertain-ment	Safety	Security	Engine	Fuel	Fuel Consume	Perform-ance	Acc time	Price	VAT/ Purch tax	Value for money	Fuel economy	Mainten-ance	Warranty	Insurance	Road tax	Trade in	CO_2 & GHG	Air pollutants	Noise
Vehicle make	.273	-.204	-.037	.045	-.075	.008	-.034	.011	-.001	-.007	.009	.025	-.026	-.004	-.016	-.017	.000	-.008	.009	-.012	-.009	.020	-.017	-.001	.003	-.008	.011	.014
Vehicle model	-.204	.263	-.041	-.058	.007	.002	.029	-.007	-.010	.015	-.010	-.044	-.010	.006	-.011	-.008	.013	.010	-.012	.017	.017	-.011	.020	.011	-.019	.009	-.010	-.005
Vehicle size	-.037	-.041	.588	-.175	.020	-.099	.002	-.011	-.009	-.033	.021	-.079	.038	-.033	.065	-.010	-.038	.001	.021	.004	-.022	.003	.000	-.019	-.020	.002	.002	-.038
Body shape	.045	-.058	-.175	.589	-.108	.003	-.134	.050	-.024	.009	-.019	-.010	-.050	.011	-.065	-.009	-.032	.005	.025	-.037	.021	-.024	-.010	.022	.021	-.005	.006	.023
Vehicle style	-.075	.007	.020	-.108	.568	-.127	.067	-.123	-.046	-.008	-.013	-.025	.017	.002	.006	-.044	-.012	.020	-.005	.026	.037	-.043	-.020	.034	-.021	-.004	.004	-.019
Capacity	.008	.002	-.099	.003	-.127	.538	-.256	-.005	.011	-.027	.027	-.046	-.046	-.016	-.024	.026	-.019	-.003	.017	-.034	.036	-.007	-.025	.018	.039	.009	-.012	-.002
Luggage/storage	-.034	.029	.002	-.134	.067	-.256	.597	-.053	-.009	-.018	-.028	.033	-.047	.008	-.001	-.009	.052	-.024	-.043	.030	-.036	.024	.002	-.014	-.001	-.007	.007	-.013
Equipment levels	.011	-.007	-.011	.050	-.123	-.005	-.053	.564	-.245	.023	-.059	-.019	-.001	.031	-.023	-.078	-.021	.014	.012	.005	.030	-.041	.006	.005	.003	-.003	.008	.007
Entertainment	-.001	-.010	-.009	-.024	-.046	.011	-.009	-.245	.594	-.075	-.008	-.028	-.016	.039	.028	-.059	.002	.009	-.031	-.038	-.013	.013	.007	-.017	-.026	.004	-.002	-.008
Safety features	-.007	.015	-.033	.009	-.008	-.027	-.018	.023	-.075	.518	-.279	.024	.032	-.055	-.077	.028	.017	-.018	.001	-.017	.023	-.059	.008	.001	-.015	.005	-.007	.027
Security features	.009	-.010	.021	-.019	-.013	.027	-.028	-.059	-.008	-.279	.505	-.059	-.018	.020	-.017	-.030	-.024	.009	-.005	.022	.017	-.009	-.028	-.028	-.019	.000	-.001	-.052
Engine type/size	.025	-.044	-.079	-.010	-.025	-.046	.033	-.019	-.028	.024	-.059	.568	-.171	-.049	-.076	-.081	-.032	.023	-.006	.026	-.061	.035	.025	-.035	.010	-.010	.012	.023
Fuel type	-.026	-.010	.038	-.050	.017	-.046	-.047	-.001	-.016	.032	-.018	-.171	.623	-.124	-.005	-.045	-.002	.012	-.014	.012	.003	-.001	.001	-.047	.022	.024	-.026	.000
Fuel consume	-.004	.006	-.033	.011	.002	-.016	.008	.031	.039	-.055	.020	-.049	-.124	.542	-.139	.006	-.015	.003	.013	-.236	.016	-.005	-.039	.017	-.001	-.014	.006	.027
Performance	-.016	-.011	.065	-.065	.006	-.024	-.001	-.023	.028	-.077	-.017	-.076	-.005	-.139	.658	-.118	-.024	.010	-.028	.071	-.036	.009	.048	-.014	-.050	-.001	-.003	-.046
Acc time	-.017	-.008	-.010	-.009	-.044	.026	-.009	-.078	-.059	.028	-.030	-.081	-.045	.006	-.118	.686	.067	-.041	.041	-.016	-.001	.000	-.008	.024	-.067	-.012	.016	-.021
Vehicle price	.000	.013	-.038	-.032	-.012	-.019	.052	-.021	.002	.017	-.024	-.032	-.002	-.015	-.024	.067	.741	-.194	-.193	.000	.017	.014	-.027	.008	-.001	.000	-.005	-.022
VAT/purch taxes	-.008	.010	.001	.005	.020	-.003	-.024	.014	.009	-.018	.009	.023	.012	.003	.010	-.041	-.194	.645	-.099	-.014	-.048	-.049	-.002	-.126	-.086	.001	.000	-.021
Value for money	.009	-.012	.021	.025	-.005	.017	-.043	.012	-.031	.001	-.005	-.006	-.014	.013	-.028	.041	-.193	-.099	.776	-.079	-.051	-.017	-.011	.000	-.019	-.002	.009	.009
Fuel economy	-.012	.017	.004	-.037	.026	-.034	.030	.005	-.038	-.017	.022	.026	.012	-.236	.071	-.016	.000	-.014	-.079	.555	-.165	-.029	-.001	-.008	.020	-.002	-.006	-.022
Maintenance	-.009	.017	-.022	.021	.037	.036	-.036	.030	-.013	.023	.017	-.061	.003	.016	-.036	-.001	.017	-.048	-.051	-.165	.577	-.176	-.080	-.068	.027	.016	-.016	.039
Vehicle warranty	.020	-.011	.003	-.024	-.043	-.007	.024	-.041	.013	-.059	-.009	.035	-.001	-.005	.009	.000	.014	-.049	-.017	-.029	-.176	.609	-.077	.000	-.151	-.019	.014	.004
Insurance group	-.017	.020	.000	-.010	-.020	-.025	.002	.006	.007	.008	-.028	.025	.001	-.039	.048	-.008	-.027	-.002	-.011	-.001	-.080	-.077	.561	-.222	-.075	.000	-.002	-.039
VED	-.001	.011	-.019	.022	.034	.018	-.014	.005	-.017	.001	-.028	-.035	-.047	.017	-.014	.024	.008	-.126	.000	-.008	-.068	.000	-.222	.558	-.043	-.014	.009	-.023
Trade-in value	.003	-.019	-.020	.021	-.021	.039	-.001	.003	-.026	-.015	-.019	.010	.022	-.001	-.050	-.067	-.001	-.086	-.019	.020	.027	-.151	-.075	-.043	.704	.011	-.014	-.044
CO_2 & GHG	-.008	.009	.002	-.005	-.004	.009	-.007	-.003	.004	.005	.000	-.010	.024	-.014	-.001	-.012	.000	.001	-.002	-.002	.016	-.019	.000	-.014	.011	.093	-.086	-.018
Air pollution	.011	-.010	.002	.006	.004	-.012	.007	.008	-.002	-.007	-.001	.012	-.026	.006	-.003	.016	-.005	.000	.009	-.006	-.016	.014	-.002	.009	-.014	-.086	.092	-.030
Vehicle noise	.014	-.005	-.038	.023	-.019	-.002	-.013	.007	-.008	.027	-.052	.023	.000	.027	-.046	-.021	-.022	-.021	.009	-.022	.039	.004	-.039	-.023	-.044	-.018	-.030	.621

Table 75: Anti-image correlation

	Make	Model	Size	Body shape	Style	Capacity	Storage	Equip-ment	Entertain-ment	Safety	Security	Engine	Fuel	Fuel Consume	Perform-ance	Acc time	Price	VAT/ Purch tax	Value for money	Fuel economy	Mainten-ance	Warranty	Insurance	Road tax	Trade in	CO_2 & GHG	Air pollutants	Noise
Vehicle make	.749[a]	-.760	-.093	.111	-.189	.022	-.083	.029	-.002	-.019	.025	.064	-.063	-.011	-.038	-.039	.001	-.018	.020	-.032	-.023	.049	-.042	-.002	.007	-.053	.068	.033
Vehicle model	-.760	.760[a]	-.104	-.149	.018	.005	.073	-.019	-.025	.040	-.027	-.113	-.024	.016	-.026	-.019	.030	.023	-.027	.044	.044	-.026	.051	.028	-.044	.055	-.065	-.012
Vehicle size	-.093	-.104	.900[a]	-.297	.034	-.177	.003	-.020	-.015	-.060	.039	-.138	.063	-.059	.105	-.016	-.058	.001	.031	.006	-.037	.006	.000	-.032	-.030	.007	.008	-.062
Body shape	.111	-.149	-.297	.871[a]	-.187	.006	-.227	.087	-.040	.016	-.035	-.018	-.083	.020	-.104	-.014	-.048	.008	.037	-.065	.036	-.040	-.017	.039	.033	-.020	.024	.037
Vehicle style	-.189	.018	.034	-.187	.889[a]	-.229	.116	-.218	-.080	-.015	-.024	-.044	.028	.004	.010	-.070	-.019	.032	-.008	.046	.065	-.073	-.035	.061	-.033	-.018	.016	-.032
Capacity	.022	.005	-.177	.006	-.229	.837[a]	-.452	-.010	.019	-.052	.052	-.082	-.079	-.030	-.039	.043	-.030	-.006	.026	-.063	.064	-.013	-.045	.033	.063	.040	-.053	-.003
Luggage/storage	-.083	.073	.003	-.227	.116	-.452	.803[a]	-.091	-.016	-.033	-.050	.057	-.078	.014	-.002	-.014	.078	-.039	-.063	.051	-.061	.039	.003	-.025	-.001	-.030	.032	-.022
Equipment levels	.029	-.019	-.020	.087	-.218	-.010	-.091	.827[a]	-.423	.043	-.111	-.033	-.002	.056	-.038	-.126	-.032	.024	.019	.009	.052	-.069	.011	.009	.004	-.013	.035	.012
Entertainment	-.002	-.025	-.015	-.040	-.080	.019	-.016	-.423	.861[a]	-.135	-.014	-.048	-.026	.069	.045	-.093	.003	.014	-.045	-.066	-.022	.021	.011	-.030	-.040	.017	-.007	-.014
Safety features	-.019	.040	-.060	.016	-.015	-.052	-.033	.043	-.135	.807[a]	-.546	.045	.056	-.103	-.133	.047	.028	-.031	.002	-.031	.043	-.105	.016	.001	-.024	.021	-.030	.048
Security features	.025	-.027	.039	-.035	-.024	.052	-.050	-.111	-.014	-.546	.831[a]	-.109	-.032	.038	-.029	-.052	-.039	.016	-.008	.042	.031	-.016	-.053	-.052	-.032	.000	-.006	-.093
Engine type/size	.064	-.113	-.138	-.018	-.044	-.082	.057	-.033	-.048	.045	-.109	.896[a]	-.288	-.088	-.124	-.129	-.049	.038	-.009	.046	-.107	.059	.044	-.062	.015	-.042	.054	.039
Fuel type	-.063	-.024	.063	-.083	.028	-.079	-.078	-.002	-.026	.056	-.032	-.288	.892[a]	-.214	-.008	-.068	-.003	.019	-.020	.020	.005	-.001	.002	-.079	.033	.098	-.107	.000
Fuel consume	-.011	.016	-.059	.020	.004	-.030	.014	.056	.069	-.103	.038	-.088	-.214	.829[a]	-.233	.009	-.024	.005	.019	-.430	.028	-.008	-.070	.031	-.002	-.063	.028	.047
Performance	-.038	-.026	.105	-.104	.010	-.039	-.002	-.038	.045	-.133	-.029	-.124	-.008	-.233	.891[a]	-.176	-.034	.015	-.039	.117	-.058	.014	.079	-.022	-.074	-.005	-.011	-.072
Acc time	-.039	-.019	-.016	-.014	-.070	.043	-.014	-.126	-.093	.047	-.052	-.129	-.068	.009	-.176	.917[a]	.094	-.062	.056	-.026	-.002	.000	-.013	.039	-.096	-.048	.064	-.032
Vehicle price	.001	.030	-.058	-.048	-.019	-.030	.078	-.032	.003	.028	-.039	-.049	-.003	-.024	-.034	.094	.807[a]	-.280	-.255	.001	.026	.021	-.042	.012	-.001	.002	-.017	-.032
VAT/purch taxes	-.018	.023	.001	.008	.032	-.006	-.039	.024	.014	-.031	.016	.038	.019	.005	.015	-.062	-.280	.869[a]	-.140	-.023	-.079	-.079	-.003	-.210	-.128	.002	.000	-.034
Value for money	.020	-.027	.031	.037	-.008	.026	-.063	.019	-.045	.002	-.008	-.009	-.020	.019	-.039	.056	-.255	-.140	.841[a]	-.120	-.077	-.024	-.016	.000	-.026	-.009	.033	.013
Fuel economy	-.032	.044	.006	-.065	.046	-.063	.051	.009	-.066	-.031	.042	.046	.020	-.430	.117	-.026	.001	-.023	-.120	.805[a]	-.291	-.049	-.001	-.014	.032	-.011	-.028	-.038
Maintenance	-.023	.044	-.037	.036	.065	.064	-.061	.052	-.022	.043	.031	-.107	.005	.028	-.058	-.002	.026	-.079	-.077	-.291	.827[a]	-.297	-.141	-.119	.043	.071	-.069	.065
Vehicle warranty	.049	-.026	.006	-.040	-.073	-.013	.039	-.069	.021	-.105	-.016	.059	-.001	-.008	.014	.000	.021	-.079	-.024	-.049	-.297	.877[a]	-.131	.000	-.231	-.079	.058	.006
Insurance group	-.042	.051	.000	-.017	-.035	-.045	.003	.011	.011	.016	-.053	.044	.002	-.070	.079	-.013	-.042	-.003	-.016	-.001	-.141	-.131	.871[a]	-.396	-.119	-.002	-.007	-.065
VED	-.002	.028	-.032	.039	.061	.033	-.025	.009	-.030	.001	-.052	-.062	-.079	.031	-.022	.039	.012	-.210	.000	-.014	-.119	.000	-.396	.861[a]	-.069	-.063	.037	-.040
Trade-in value	.007	-.044	-.030	.033	-.033	.063	-.001	.004	-.040	-.024	-.032	.015	.033	-.002	-.074	-.096	-.001	-.128	-.026	.032	.043	-.231	-.119	-.069	.904[a]	.042	-.056	-.066
CO_2 & GHG	-.053	.055	.007	-.020	-.018	.040	-.030	-.013	.017	.021	.000	-.042	.098	-.063	-.005	-.048	.002	.002	-.009	-.011	.071	-.079	-.002	-.063	.042	.677[a]	-.920	-.076
Air pollution	.068	-.065	.008	.024	.016	-.053	.032	.035	-.007	-.030	-.006	.054	-.107	.028	-.011	.064	-.017	.000	.033	-.028	-.069	.058	-.007	.037	-.056	-.920	.672[a]	-.124
Vehicle noise	.033	-.012	-.062	.037	-.032	-.003	-.022	.012	-.014	.048	-.093	.039	.000	.047	-.072	-.032	-.032	-.034	.013	-.038	.065	.006	-.065	-.040	-.066	-.076	-.124	.948[a]

Table 76: Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.367	22.738	22.738	6.367	22.738	22.738	2.955	10.554	10.554
2	3.645	13.019	35.758	3.645	13.019	35.758	2.862	10.220	20.774
3	1.819	6.496	42.253	1.819	6.496	42.253	2.748	9.813	30.587
4	1.586	5.665	47.919	1.586	5.665	47.919	2.508	8.957	39.544
5	1.269	4.531	52.450	1.269	4.531	52.450	2.167	7.738	47.281
6	1.222	4.365	56.815	1.222	4.365	56.815	2.133	7.617	54.899
7	1.119	3.995	60.810	1.119	3.995	60.810	1.655	5.912	60.810
8	.998	3.563	64.373						
9	.930	3.322	67.695						
10	.805	2.875	70.570						
11	.733	2.617	73.187						
12	.671	2.396	75.583						
13	.655	2.340	77.922						
14	.626	2.235	80.158						
15	.607	2.166	82.324						
16	.570	2.036	84.360						
17	.554	1.980	86.341						
18	.512	1.828	88.169						
19	.503	1.797	89.965						
20	.461	1.648	91.613						
21	.420	1.499	93.112						
22	.394	1.406	94.518						
23	.381	1.360	95.878						
24	.354	1.263	97.140						
25	.307	1.095	98.236						
26	.296	1.058	99.294						
27	.150	.534	99.828						
28	.048	.172	100.000						

Extraction Method: Principal Component Analysis

Table 77: KMO and Bartlett's test results

Tests		Result
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.830
Bartlett's Test of Sphericity	Approx. Chi-Square	12213.522
	df	378
	Sig.	.000

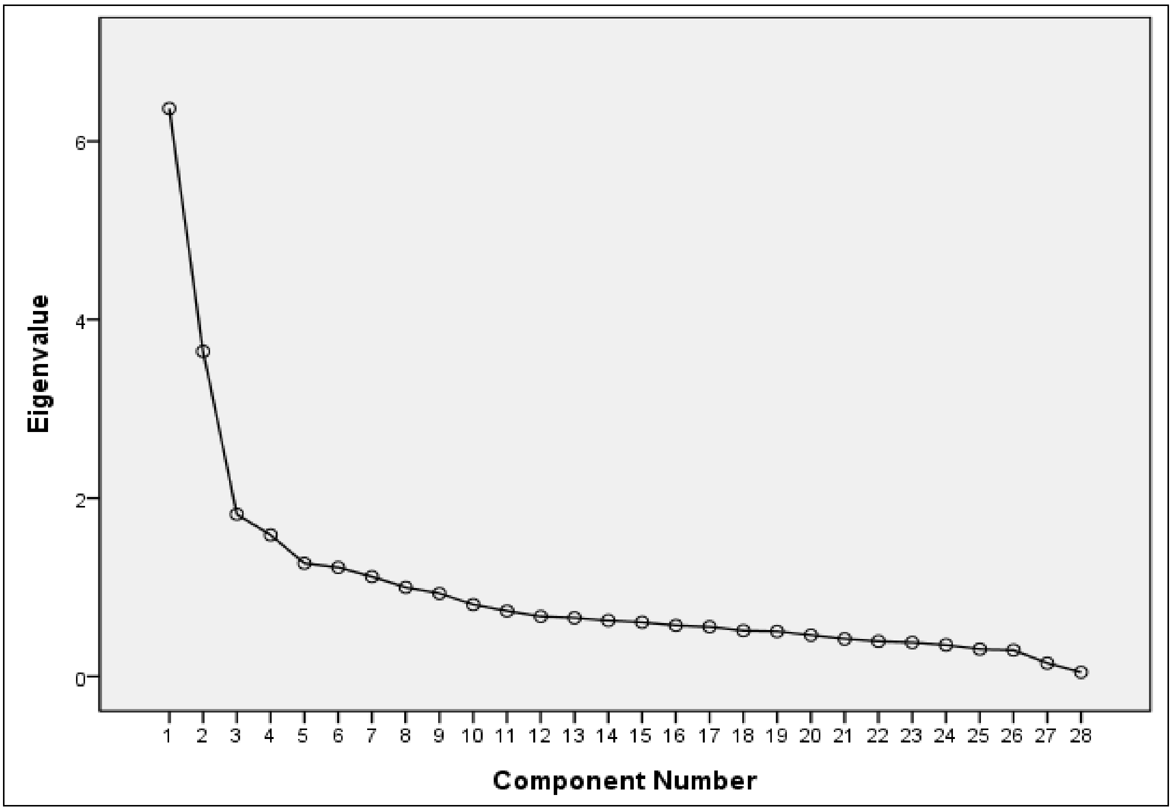

Figure 80: Scree plot

Table 78: Component transformation matrix

Component	1	2	3	4	5	6	7
1	.412	.428	.472	.277	.404	.378	.202
2	.566	-.522	-.254	.448	.060	-.249	.276
3	.422	-.041	.037	-.820	-.011	-.049	.379
4	.062	-.185	.773	.076	-.512	-.305	-.053
5	.191	.696	-.295	.160	-.459	-.351	.179
6	-.154	-.151	-.085	.113	-.518	.660	.479
7	-.517	.016	.138	.076	.302	-.375	.690

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Table 79: Component matrix

Situational factors	Component						
	1	2	3	4	5	6	7
Engine type/size	.588						
Security features	.572			.439			
Fuel type	.554						
Vehicle size	.552						
Performance/driveability	.550						
Safety features	.546						
Passenger capacity	.545					.411	
Vehicle body shape	.540						
Fuel consumption/MPG	.532			-.400			
Style/appearance/colour	.519	-.433					
Vehicle make	.501	-.500			.468		
Acceleration time	.490						
Entertainment levels	.488			.423			
Luggage/storage	.484					.455	
Vehicle warranty	.475						
Trade-in value	.458						
Fuel economy/MPG	.421	.415					
Vehicle model	.502	-.526			.470		
Biannual/annual VED	.444	.489					
Insurance group	.460	.472					
Maintenance/repair costs		.470					
VAT and other purchase taxes		.453					
Vehicle emissions of other air pollutants		.531	-.670				
Vehicle emission of CO_2 and other GHGs		.526	-.665				
Vehicle noise			-.510				
Equipment levels	.436			.466			
Vehicle price							.539
Value for money							.426

Extraction method: principal component analysis

Table 80: Rotated component matrix

	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Insurance group for the vehicle	.739						
Maintenance/repair costs	.709						
Vehicle warranty	.701						
Biannual/annual VED	.681						
Trade-in value	.524						
Vehicle model		.871					
Vehicle make		.855					
Vehicle size		.516				.480	
Style/appearance/colour		.510	.415				
Security features			.719				
Equipment levels			.673				
Safety features			.663				
Entertainment levels			.647				
Acceleration time		.410	.459				
Vehicle emission of other air pollutants				.916			
Vehicle emission of CO_2 and other GHGs				.913			
Vehicle noise				.746			
Fuel consumption/MPG					.768		
Fuel type					.560		
Fuel economy	.453				.541		
Performance/driveability					.525		
Engine type/size					.502		
Luggage/storage space						.790	
Passenger capacity						.777	
Vehicle body shape						.557	
Vehicle price							.819
Value for money							.715
VAT & other purchase taxes	.465						.580

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 7 iterations.

A7.2 K-means cluster analysis

Table 81: Number of cases in each cluster

		n
Cluster	1	351
	2	444
	3	522
Valid		1317
Missing		19

Table 82: Initial cluster centres

Situational and psychological factors	Cluster		
	1	2	3
Future financial considerations	1	3	3
Exterior design features	1	3	1
Interior design features	1	3	1
Environmental considerations	1	3	3
Fuel and performance	1	3	2
Load space	1	3	2
Financial considerations at purchase	1	3	3
BI	1	2	3
Perceived behavioural control	1	3	3
Perceived negative consequences	1	1	3
Goal intention	1	1	3
Personal norms	1	1	3
Goal feasibility	1	1	3
Negative affect	1	1	3
Social norm	1	1	3
Personal responsibility	1	3	3
Attitude	1	3	1
Emotion	1	1	3

Table 83: Iteration history

Iteration	Change in Cluster Centers		
	1	2	3
1	3.130	2.954	2.818
2	.434	.180	.301
3	.193	.119	.092
4	.079	.088	.043
5	.095	.097	.040
6	.050	.079	.046
7	.058	.068	.031
8	.087	.082	.023
9	.078	.075	.s023
10	.061	.069	.033
11	.055	.048	.015
12	.046	.039	.013
13	.052	.038	.000
14	.040	.040	.024
15	.022	.047	.027
16	.019	.026	.014
17	.005	.010	.007
18	.000	.000	.000

Convergence achieved due to no or small change in cluster centers. The maximum absolute coordinate change for any center is .000. The current iteration is 18. The minimum distance between initial centers is 6.403.

Table 84: Distances between the final cluster centres

Cluster	1	2	3
1		2.029	3.164
2	2.029		1.995
3	3.164	1.995	

Table 85: Cluster membership

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
1	2	1.229	37	3	2.818	73	1	2.737
2	3	2.687	38	2	2.440	74	2	3.156
3	1	2.170	39	3	1.739	75	3	2.559
4	3	2.758	40	3	1.778	76	1	1.506
5	2	2.558	41	2	2.975	77	3	1.064
6	3	1.385	42	3	2.220	78	2	2.076
7	3	2.926	43	2	2.803	79	3	2.561
8	1	1.577	44	2	1.865	80	.	.
9	1	2.611	45	1	2.504	81	3	2.320
10	3	2.607	46	.	.	82	1	1.899
11	3	1.557	47	1	2.619	83	3	2.666
12	3	2.744	48	2	.609	84	2	1.346
13	2	2.999	49	1	2.964	85	2	3.804
14	1	3.232	50	3	2.198	86	2	2.929
15	1	1.889	51	1	2.909	87	2	2.258
16	3	2.157	52	3	2.912	88	2	1.854
17	2	1.992	53	1	3.211	89	2	2.372
18	1	2.897	54	3	2.779	90	3	1.671
19	2	2.411	55	2	2.698	91	1	1.478
20	3	1.417	56	2	1.738	92	1	1.708
21	2	1.900	57	1	1.369	93	3	2.581
22	1	2.584	58	3	2.347	94	2	.844
23	2	3.181	59	2	2.291	95	2	2.520
24	3	2.643	60	1	2.712	96	1	3.485
25	1	3.507	61	3	1.666	97	3	3.668
26	1	3.233	62	3	1.621	98	3	2.226
27	2	2.233	63	1	2.136	99	1	1.785
28	1	2.702	64	3	1.287	100	2	2.628
29	1	2.612	65	2	2.338	101	1	2.510
30	3	1.593	66	3	2.109	102	1	2.209
31	3	2.256	67	2	3.379	103	3	1.324
32	3	2.909	68	3	1.901	104	1	2.094
33	3	2.405	69	3	1.627	105	3	1.483
34	1	2.660	70	3	1.980	106	3	1.570
35	3	1.640	71	3	2.612	107	2	2.909
36	2	1.946	72	2	2.443	108	3	1.894

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
109	2	2.443	147	3	1.688	185	3	.572
110	1	2.465	148	3	3.072	186	2	2.069
111	1	2.664	149	3	.942	187	3	1.700
112	3	2.649	150	3	2.232	188	3	2.904
113	2	3.062	151	2	3.388	189	1	1.792
114	2	2.957	152	1	1.958	190	3	2.927
115	3	1.907	153	3	2.794	191	2	2.806
116	2	2.657	154	2	.954	192	1	2.083
117	1	3.035	155	3	1.929	193	3	2.124
118	3	2.604	156	2	2.415	194	2	1.935
119	3	1.656	157	1	1.715	195	2	2.023
120	2	1.601	158	1	2.184	196	3	1.301
121	1	3.289	159	2	2.945	197	3	2.469
122	2	3.116	160	1	2.651	198	3	1.464
123	3	2.262	161	3	2.167	199	1	1.807
124	.	.	162	3	2.757	200	2	2.411
125	3	1.775	163	3	1.706	201	3	3.057
126	2	1.845	164	3	2.377	202	3	2.420
127	1	3.445	165	1	2.817	203	3	2.323
128	3	2.349	166	.	.	204	3	2.138
129	3	1.651	167	1	3.275	205	3	1.301
130	2	2.919	168	1	2.991	206	3	2.472
131	2	1.843	169	3	2.262	207	1	2.717
132	3	2.493	170	3	1.525	208	1	1.321
133	3	1.746	171	3	2.530	209	3	2.418
134	1	3.344	172	2	2.262	210	3	2.239
135	1	2.917	173	3	3.005	211	2	1.889
136	2	2.469	174	3	.749	212	3	2.209
137	3	2.038	175	1	2.595	213	2	1.560
138	2	2.846	176	2	2.143	214	1	2.461
139	3	1.653	177	2	2.480	215	2	2.762
140	1	3.631	178	2	3.321	216	1	2.444
141	3	3.057	179	2	2.400	217	1	2.237
142	.	.	180	2	1.670	218	1	.304
143	2	3.425	181	3	1.937	219	3	2.299
144	1	2.600	182	1	2.859	220	1	1.689
145	1	1.908	183	2	1.936	221	3	3.224
146	3	2.052	184	3	2.909	222	2	1.782

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
223	3	1.225	261	3	2.026	299	3	2.175
224	3	1.944	262	1	2.348	300	3	2.093
225	3	3.041	263	3	2.260	301	2	2.703
226	1	2.614	264	3	1.743	302	3	3.072
227	3	2.834	265	2	2.395	303	1	2.106
228	3	2.133	266	3	1.777	304	2	2.114
229	2	3.109	267	1	2.806	305	2	2.303
230	2	2.179	268	2	1.560	306	3	3.341
231	1	2.437	269	2	2.270	307	3	2.573
232	2	1.694	270	3	2.262	308	2	2.292
233	3	2.283	271	2	2.145	309	2	2.035
234	3	2.089	272	3	1.502	310	1	1.813
235	2	2.129	273	3	1.982	311	3	1.767
236	2	1.954	274	3	1.967	312	2	2.837
237	1	1.968	275	1	1.789	313	3	2.523
238	3	1.523	276	3	2.718	314	3	.401
239	2	2.133	277	2	3.409	315	2	3.058
240	3	2.689	278	2	2.550	316	1	2.559
241	3	2.316	279	2	2.923	317	3	2.903
242	3	1.520	280	1	2.320	318	2	2.039
243	3	2.686	281	1	3.089	319	2	1.822
244	2	3.152	282	3	1.704	320	2	2.002
245	1	3.977	283	2	3.159	321	3	2.234
246	3	2.229	284	3	2.155	322	1	3.195
247	3	1.601	285	3	2.311	323	1	1.613
248	3	1.945	286	1	3.248	324	3	1.846
249	2	1.993	287	2	2.306	325	3	1.653
250	3	1.490	288	3	1.949	326	3	1.527
251	1	2.851	289	1	2.650	327	3	2.151
252	2	1.583	290	3	1.967	328	2	3.188
253	2	2.396	291	2	2.260	329	1	3.150
254	2	1.010	292	2	2.000	330	2	1.701
255	3	1.098	293	2	2.202	331	2	2.004
256	1	2.158	294	3	2.693	332	3	2.773
257	2	1.225	295	3	2.037	333	3	1.279
258	3	1.656	296	3	2.481	334	3	.961
259	1	2.780	297	1	2.557	335	2	2.400
260	3	2.595	298	3	2.310	336	3	2.068

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
337	2	2.957	375	2	3.055	413	2	2.139
338	1	3.535	376	1	2.642	414	3	2.958
339	2	1.927	377	3	2.956	415	3	2.137
340	3	2.259	378	1	2.527	416	3	2.986
341	2	2.726	379	3	2.524	417	1	2.815
342	1	2.206	380	1	2.433	418	1	2.330
343	3	1.218	381	1	3.110	419	2	1.617
344	2	3.896	382	3	2.432	420	1	1.843
345	2	2.772	383	1	2.606	421	2	2.708
346	1	2.630	384	3	2.426	422	3	2.050
347	3	2.064	385	2	2.125	423	1	1.819
348	2	1.167	386	3	1.577	424	2	.849
349	2	2.261	387	2	2.169	425	1	2.871
350	3	2.642	388	3	1.741	426	2	1.882
351	2	3.652	389	3	1.421	427	2	1.067
352	3	1.666	390	2	3.195	428	1	3.399
353	2	1.216	391	2	2.519	429	3	1.301
354	3	.432	392	1	3.127	430	3	1.973
355	3	2.871	393	3	2.171	431	3	1.597
356	1	1.626	394	3	1.562	432	2	2.489
357	3	2.411	395	1	2.865	433	2	3.013
358	1	2.978	396	1	3.482	434	2	3.114
359	2	2.643	397	1	3.327	435	3	1.476
360	2	2.570	398	1	3.154	436	1	1.370
361	1	3.143	399	2	2.071	437	1	2.272
362	2	2.254	400	2	2.384	438	3	1.666
363	1	3.170	401	1	2.537	439	1	3.102
364	2	2.479	402	1	3.429	440	2	2.550
365	2	3.016	403	1	2.509	441	3	2.197
366	2	1.418	404	3	2.146	442	3	1.562
367	1	2.615	405	1	2.770	443	2	1.847
368	2	2.899	406	2	2.470	444	1	2.853
369	3	1.801	407	2	2.712	445	1	3.205
370	1	2.462	408	1	2.762	446	2	1.868
371	3	2.493	409	3	1.038	447	2	3.446
372	2	2.423	410	3	1.301	448	3	2.738
373	1	2.168	411	1	2.768	449	1	2.621
374	2	1.564	412	3	2.054	450	2	2.110

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
451	2	2.064	489	1	2.707	527	2	1.889
452	2	2.008	490	2	2.957	528	3	2.089
453	3	.269	491	2	1.812	529	3	1.945
454	1	3.302	492	3	1.758	530	3	2.976
455	1	2.101	493	2	2.749	531	3	2.431
456	3	1.301	494	3	2.702	532	1	1.300
457	3	2.188	495	2	1.402	533	3	2.389
458	3	2.689	496	1	2.815	534	3	1.597
459	2	2.623	497	1	3.289	535	2	1.462
460	3	2.256	498	3	2.951	536	2	2.332
461	3	1.475	499	3	1.672	537	2	2.931
462	1	1.786	500	3	1.284	538	2	2.161
463	3	1.666	501	3	3.189	539	2	2.603
464	3	3.177	502	2	1.505	540	3	1.900
465	2	1.560	503	1	2.626	541	1	3.296
466	3	1.109	504	3	1.929	542	3	2.416
467	1	2.225	505	2	2.716	543	1	3.083
468	1	2.630	506	1	2.291	544	3	1.603
469	3	2.280	507	3	2.355	545	3	2.344
470	1	2.354	508	2	2.361	546	2	1.819
471	3	1.896	509	3	2.644	547	3	2.906
472	3	2.083	510	2	2.415	548	1	3.429
473	1	2.713	511	2	2.188	549	2	2.862
474	2	3.035	512	2	2.603	550	2	2.771
475	3	2.247	513	2	2.262	551	3	1.911
476	2	2.895	514	2	3.027	552	1	2.514
477	3	3.032	515	3	2.905	553	2	2.944
478	3	1.544	516	2	3.321	554	3	1.496
479	3	2.461	517	2	2.333	555	2	3.017
480	.	.	518	2	2.427	556	1	3.343
481	.	.	519	3	.572	557	.	.
482	1	2.590	520	1	2.595	558	3	1.673
483	2	2.649	521	2	2.132	559	1	1.910
484	3	1.627	522	3	2.126	560	3	2.775
485	3	1.588	523	3	3.258	561	3	3.321
486	3	3.069	524	3	2.328	562	3	2.009
487	3	1.385	525	3	1.301	563	1	2.541
488	3	2.463	526	1	2.717	564	3	2.702

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
565	3	2.102	603	1	2.991	641	2	1.939
566	2	1.740	604	2	2.440	642	2	3.043
567	2	2.280	605	2	1.267	643	1	2.586
568	1	2.666	606	2	2.648	644	1	2.039
569	2	.849	607	2	2.560	645	3	1.739
570	2	2.797	608	1	1.380	646	1	2.477
571	3	2.231	609	1	2.087	647	3	2.723
572	3	2.784	610	2	1.770	648	1	1.763
573	3	3.172	611	1	2.473	649	2	2.849
574	2	2.152	612	3	4.067	650	3	1.860
575	1	3.785	613	3	2.797	651	1	2.157
576	2	3.180	614	3	1.070	652	1	3.274
577	1	1.844	615	1	1.851	653	1	2.014
578	.	.	616	3	1.503	654	2	3.052
579	1	1.074	617	2	2.280	655	1	1.857
580	1	2.809	618	3	2.657	656	3	2.926
581	1	3.132	619	3	1.923	657	3	1.439
582	2	2.566	620	1	2.526	658	3	2.158
583	1	3.209	621	3	.712	659	2	2.398
584	1	2.266	622	1	3.210	660	3	1.759
585	2	1.955	623	3	3.444	661	2	1.775
586	3	1.683	624	3	1.964	662	3	1.592
587	2	2.150	625	3	1.771	663	2	1.430
588	3	2.256	626	3	2.608	664	3	2.253
589	3	1.833	627	2	2.571	665	2	1.202
590	3	1.783	628	1	2.418	666	3	2.388
591	2	2.847	629	2	2.083	667	1	3.277
592	2	1.225	630	2	2.334	668	2	2.780
593	2	1.816	631	2	3.448	669	1	3.155
594	3	2.492	632	2	2.296	670	1	2.661
595	3	2.490	633	3	2.183	671	3	1.429
596	3	2.497	634	2	2.481	672	2	2.989
597	2	2.893	635	3	2.370	673	3	.910
598	1	2.448	636	2	2.148	674	3	2.740
599	3	3.320	637	3	1.226	675	1	1.905
600	2	2.657	638	.	.	676	3	2.445
601	1	2.613	639	2	1.208	677	2	2.289
602	.	.	640	1	2.029	678	2	2.366

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
679	3	2.227	717	3	2.348	755	2	2.932
680	2	2.218	718	3	3.816	756	2	3.515
681	3	2.361	719	3	2.269	757	3	1.897
682	2	1.873	720	2	2.096	758	1	2.623
683	2	2.925	721	3	1.292	759	1	2.987
684	2	2.398	722	2	1.760	760	2	2.535
685	2	1.927	723	2	3.353	761	2	1.819
686	3	1.981	724	3	2.477	762	2	2.425
687	3	3.259	725	2	1.822	763	1	2.324
688	2	2.113	726	1	.477	764	3	1.827
689	3	1.861	727	1	2.625	765	2	2.628
690	3	2.643	728	3	1.468	766	3	1.565
691	2	2.225	729	2	2.436	767	3	2.359
692	3	1.898	730	2	1.001	768	3	2.408
693	2	2.158	731	2	1.705	769	2	2.092
694	2	2.560	732	2	1.990	770	2	.849
695	1	1.337	733	2	2.305	771	2	2.364
696	2	1.777	734	3	2.829	772	3	2.426
697	3	2.544	735	1	1.989	773	1	2.516
698	1	2.018	736	3	1.966	774	1	2.642
699	3	1.755	737	2	2.238	775	3	1.713
700	2	2.383	738	2	2.380	776	1	1.631
701	2	2.574	739	3	1.490	777	3	2.575
702	1	3.720	740	1	2.963	778	3	2.418
703	3	1.249	741	2	2.100	779	3	2.559
704	2	2.194	742	3	2.703	780	2	3.232
705	1	1.787	743	1	2.119	781	3	2.587
706	3	1.717	744	2	1.890	782	2	2.627
707	2	3.007	745	1	2.478	783	1	2.497
708	2	2.076	746	2	3.059	784	2	2.393
709	3	2.374	747	3	.883	785	3	3.141
710	3	2.068	748	3	1.296	786	1	2.680
711	3	1.921	749	1	2.800	787	3	1.300
712	1	2.632	750	2	3.089	788	2	2.296
713	3	2.256	751	.	.	789	3	1.909
714	3	2.256	752	1	1.964	790	3	2.618
715	1	3.029	753	2	1.667	791	3	1.798
716	2	1.989	754	1	2.597	792	.	.

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
793	3	1.975	831	3	1.806	869	2	2.286
794	2	2.201	832	2	2.780	870	3	1.744
795	3	2.189	833	3	1.873	871	3	2.409
796	3	2.187	834	1	2.669	872	2	2.048
797	1	2.970	835	3	2.594	873	2	1.992
798	1	2.593	836	2	1.098	874	2	1.720
799	2	2.489	837	2	2.966	875	1	2.401
800	3	1.544	838	2	2.608	876	1	2.679
801	1	2.583	839	3	2.344	877	3	2.093
802	2	1.669	840	1	3.472	878	3	1.948
803	2	.898	841	3	1.504	879	1	1.850
804	2	1.473	842	3	2.447	880	.	.
805	3	1.394	843	3	2.528	881	3	2.007
806	1	1.662	844	3	.812	882	3	2.747
807	3	2.083	845	3	3.147	883	2	2.461
808	2	2.820	846	3	1.920	884	1	1.695
809	1	3.314	847	3	1.848	885	3	1.302
810	2	1.997	848	2	1.892	886	2	1.370
811	2	2.070	849	3	1.728	887	3	2.367
812	1	2.909	850	1	2.731	888	2	3.308
813	2	2.197	851	3	2.976	889	3	2.592
814	1	2.169	852	2	2.105	890	3	3.032
815	3	2.102	853	3	1.850	891	.	.
816	3	2.501	854	3	2.380	892	2	2.313
817	2	1.231	855	2	2.593	893	2	3.575
818	3	1.849	856	2	3.512	894	3	1.821
819	3	1.242	857	2	2.309	895	3	2.851
820	1	2.011	858	2	2.865	896	3	1.367
821	3	2.154	859	2	2.221	897	2	2.593
822	3	1.892	860	1	1.813	898	3	2.605
823	3	1.798	861	3	2.310	899	3	2.184
824	3	2.731	862	1	2.360	900	2	2.269
825	1	3.091	863	3	2.247	901	2	2.199
826	2	2.352	864	1	1.960	902	1	1.226
827	2	3.173	865	1	2.821	903	3	1.551
828	3	1.708	866	1	2.744	904	2	3.082
829	1	3.196	867	2	2.447	905	2	3.072
830	1	2.492	868	2	2.490	906	3	2.432

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
907	2	2.554	945	2	1.600	983	2	1.473
908	3	2.565	946	3	1.821	984	1	3.185
909	3	2.765	947	2	2.915	985	2	2.279
910	1	3.395	948	3	3.031	986	3	2.594
911	3	2.319	949	1	4.080	987	1	3.014
912	1	2.969	950	3	2.021	988	3	1.301
913	2	2.746	951	3	1.923	989	1	2.170
914	1	2.677	952	1	4.053	990	3	3.662
915	2	1.840	953	2	2.009	991	2	2.893
916	2	2.750	954	3	1.676	992	1	3.261
917	3	2.418	955	1	2.874	993	3	2.843
918	3	2.104	956	2	2.144	994	3	1.237
919	3	1.666	957	2	2.670	995	2	3.390
920	3	2.678	958	3	2.857	996	2	1.632
921	2	2.448	959	3	2.310	997	2	3.326
922	3	2.699	960	2	1.640	998	3	2.353
923	2	2.173	961	2	1.472	999	1	1.068
924	3	2.700	962	3	2.744	1000	1	2.310
925	3	1.318	963	3	2.346	1001	1	2.492
926	3	1.520	964	3	2.120	1002	2	1.620
927	3	2.056	965	2	2.020	1003	3	2.162
928	2	2.011	966	1	2.036	1004	2	2.623
929	1	2.323	967	1	3.181	1005	3	2.632
930	3	2.635	968	2	1.580	1006	2	2.831
931	3	3.098	969	2	2.578	1007	1	3.029
932	3	1.806	970	2	2.252	1008	1	1.942
933	3	2.735	971	1	2.471	1009	2	1.547
934	3	2.194	972	1	2.623	1010	2	2.653
935	3	2.235	973	1	1.820	1011	3	.998
936	1	1.445	974	2	2.401	1012	2	2.142
937	1	2.781	975	1	2.744	1013	2	2.250
938	3	1.523	976	3	2.843	1014	1	2.395
939	1	3.048	977	3	.749	1015	1	2.678
940	2	3.121	978	2	2.392	1016	2	2.467
941	3	1.636	979	3	2.572	1017	3	1.864
942	2	1.965	980	2	2.539	1018	3	2.068
943	1	2.426	981	2	3.114	1019	.	.
944	3	2.608	982	3	3.003	1020	1	1.684

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
1021	2	3.492	1059	1	2.800	1097	2	2.188
1022	2	2.856	1060	2	3.284	1098	2	2.317
1023	1	1.300	1061	2	2.637	1099	2	2.504
1024	2	2.011	1062	1	2.656	1100	2	2.318
1025	2	1.759	1063	3	2.273	1101	3	2.139
1026	2	2.821	1064	1	2.315	1102	3	2.891
1027	2	3.013	1065	2	1.472	1103	2	2.133
1028	1	3.946	1066	3	2.199	1104	3	2.005
1029	2	1.912	1067	1	2.503	1105	1	2.833
1030	1	1.787	1068	3	2.570	1106	1	2.165
1031	1	2.273	1069	3	2.358	1107	3	1.944
1032	3	2.831	1070	1	2.235	1108	3	1.983
1033	3	1.978	1071	1	3.177	1109	3	2.107
1034	1	.608	1072	2	.773	1110	1	1.807
1035	3	2.875	1073	3	2.029	1111	1	2.934
1036	3	2.372	1074	3	1.900	1112	3	2.428
1037	3	2.118	1075	2	1.475	1113	3	2.322
1038	2	3.273	1076	1	2.862	1114	3	2.213
1039	1	2.467	1077	1	2.986	1115	3	1.485
1040	1	1.894	1078	2	2.160	1116	2	1.340
1041	2	1.489	1079	1	2.669	1117	3	2.335
1042	3	2.683	1080	2	2.456	1118	1	3.707
1043	3	2.073	1081	2	2.916	1119	3	2.305
1044	3	2.042	1082	3	2.712	1120	2	2.303
1045	2	3.375	1083	3	2.019	1121	2	2.612
1046	1	3.288	1084	3	2.018	1122	2	1.575
1047	2	2.461	1085	3	2.671	1123	2	2.641
1048	3	1.911	1086	1	1.300	1124	3	1.195
1049	1	.694	1087	2	2.746	1125	3	3.214
1050	3	2.485	1088	3	1.822	1126	1	.979
1051	3	1.358	1089	2	1.953	1127	1	2.125
1052	1	2.030	1090	2	2.575	1128	2	1.375
1053	1	1.829	1091	2	2.333	1129	1	2.237
1054	1	3.377	1092	2	2.903	1130	2	2.099
1055	1	2.820	1093	1	2.125	1131	1	2.777
1056	3	2.258	1094	2	2.255	1132	1	1.572
1057	2	1.764	1095	3	2.098	1133	2	2.824
1058	1	2.461	1096	3	3.341	1134	3	1.854

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
1135	2	1.514	1173	3	2.784	1211	3	2.319
1136	3	2.095	1174	1	3.668	1212	3	1.718
1137	2	2.619	1175	1	1.822	1213	2	1.673
1138	1	2.867	1176	.	.	1214	1	2.619
1139	3	2.519	1177	.	.	1215	3	2.847
1140	2	2.825	1178	3	2.190	1216	1	1.706
1141	2	2.907	1179	1	1.286	1217	3	1.439
1142	1	2.309	1180	2	2.768	1218	1	3.052
1143	1	2.382	1181	2	2.373	1219	2	2.347
1144	1	3.012	1182	2	2.360	1220	2	2.221
1145	3	1.763	1183	2	1.814	1221	3	1.496
1146	1	2.393	1184	3	1.891	1222	1	1.759
1147	3	1.975	1185	3	1.827	1223	3	1.620
1148	2	2.977	1186	2	2.490	1224	1	2.445
1149	2	3.199	1187	2	2.096	1225	2	1.497
1150	2	1.667	1188	1	3.400	1226	1	1.750
1151	3	1.777	1189	2	2.626	1227	3	2.652
1152	1	2.423	1190	2	1.548	1228	3	1.848
1153	3	.942	1191	2	1.860	1229	2	3.053
1154	2	3.150	1192	1	2.510	1230	1	1.601
1155	2	2.116	1193	1	.980	1231	1	2.588
1156	2	2.783	1194	3	1.963	1232	2	1.882
1157	1	1.880	1195	2	2.287	1233	3	2.569
1158	1	3.562	1196	2	3.085	1234	3	3.086
1159	3	1.739	1197	3	1.505	1235	3	2.120
1160	1	2.627	1198	3	1.333	1236	1	2.811
1161	2	1.562	1199	1	2.757	1237	1	2.641
1162	2	2.143	1200	3	1.424	1238	2	2.246
1163	1	1.748	1201	3	2.227	1239	1	2.612
1164	1	2.495	1202	1	2.338	1240	2	2.975
1165	3	.821	1203	3	2.213	1241	2	3.518
1166	3	1.785	1204	3	1.764	1242	3	1.986
1167	.	.	1205	2	3.290	1243	2	.849
1168	1	2.416	1206	1	1.316	1244	1	1.300
1169	3	1.725	1207	3	2.110	1245	2	1.860
1170	1	3.139	1208	1	3.133	1246	2	.609
1171	3	2.152	1209	3	1.935	1247	2	2.326
1172	1	2.478	1210	2	3.160	1248	3	1.991

Case number	Cluster	Distance	Case number	Cluster	Distance	Case number	Cluster	Distance
1249	1	2.336	1287	2	3.901	1325	3	2.771
1250	2	1.654	1288	1	2.775	1326	1	2.371
1251	3	2.962	1289	1	2.395	1327	1	1.398
1252	1	3.211	1290	3	2.600	1328	2	2.792
1253	3	2.022	1291	3	2.030	1329	2	2.354
1254	3	2.259	1292	2	1.767	1330	1	2.595
1255	3	3.825	1293	2	1.472	1331	1	2.973
1256	3	1.666	1294	1	2.232	1332	2	1.977
1257	2	2.443	1295	3	1.078	1333	3	1.433
1258	1	1.899	1296	2	3.444	1334	2	2.720
1259	3	1.687	1297	2	2.846	1335	3	2.389
1260	1	2.263	1298	2	2.148	1336	3	2.505
1261	3	1.780	1299	1	1.440			
1262	1	1.876	1300	2	2.624			
1263	1	2.040	1301	1	2.422			
1264	3	2.273	1302	2	2.007			
1265	1	2.461	1303	2	2.938			
1266	1	3.017	1304	1	2.278			
1267	2	2.581	1305	1	2.654			
1268	2	1.822	1306	2	1.872			
1269	3	1.944	1307	1	2.132			
1270	2	1.820	1308	1	3.105			
1271	2	3.120	1309	3	2.414			
1272	2	2.059	1310	2	1.839			
1273	1	2.913	1311	3	2.238			
1274	3	2.575	1312	1	3.347			
1275	1	2.909	1313	2	1.357			
1276	1	3.140	1314	2	1.521			
1277	1	2.102	1315	2	2.129			
1278	3	3.235	1316	3	2.140			
1279	2	2.155	1317	3	2.128			
1280	3	1.825	1318	3	2.453			
1281	2	2.567	1319	2	1.365			
1282	1	1.758	1320	1	2.885			
1283	3	2.393	1321	3	2.502			
1284	1	2.037	1322	3	1.301			
1285	1	1.452	1323	1	3.039			
1286	1	2.579	1324	3	1.841			

Table 86: Final cluster centres

Situational and psychological factors	Cluster		
	1	2	3
Future financial considerations	2	3	3
Exterior design features	2	2	2
Interior design features	2	2	2
Environmental considerations	2	3	3
Fuel and performance	2	3	3
Load space	2	3	2
Financial considerations at purchase	3	3	3
BI	2	2	3
Perceived behavioural control	2	2	2
Perceived negative consequences	2	2	3
Goal intention	2	2	3
Personal norms	2	2	3
Goal feasibility	2	2	3
Negative affect	2	2	3
Social norm	2	2	2
Personal responsibility	2	2	3
Attitude	2	2	3
Emotion	1	2	2

Table 87: ANOVA

Situational and psychological factors	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Future financial considerations	47.613	2	.326	1021	146.084	.000
Exterior design features	29.183	2	.470	1021	62.041	.000
Interior design features	24.261	2	.412	1021	58.894	.000
Environmental considerations	71.160	2	.327	1021	217.340	.000
Fuel and performance	23.700	2	.267	1021	88.848	.000
Load space	20.474	2	.408	1021	50.209	.000
Financial considerations at purchase	11.286	2	.214	1021	52.638	.000
BI	96.244	2	.264	1283	363.978	.000
Perceived behavioural control	29.908	2	.518	1160	57.712	.000
Perceived negative consequences	110.328	2	.345	1246	319.868	.000
Goal intention	107.750	2	.315	1162	341.939	.000
Personal norms	112.620	2	.347	1233	324.898	.000
Goal feasibility	40.026	2	.391	1223	102.407	.000
Negative affect	131.386	2	.321	1249	408.915	.000
Social norm	51.635	2	.405	1106	127.565	.000
Personal responsibility	96.156	2	.388	1268	247.560	.000
Attitude	67.900	2	.356	1251	190.618	.000
Emotion	95.620	2	.417	1240	229.306	.000

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal