

How Private Car Drivers View Vehicle Ownership during the 'Clean Vehicles in Stockholm' Project

- An Exploratory Consumer Case Study Prepared for the City of Stockholm Environment and Health Administration

Harry M. Fisk*

Master's Thesis
Stockholm School of Economics
December 2008

Abstract

In response to concerns about climate change the City of Stockholm has set the goal of being entirely fossil fuel free by 2050. One of the ways in which they are attempting to achieve this is through the *Clean Vehicles in Stockholm* project. The Project focuses on reducing the heavy impact of car emissions by providing incentives for people, primarily companies up until now, to purchase less environmentally harmful alternative fuel vehicles (AFVs). Having made significant achievements with company uptake, the Project managers are now preparing to focus efforts towards increasing adoption by private consumers. As a precursor to targeting this new group, this thesis focuses on qualitative exploration of private consumer views and experiences of conventional and alternative fuel vehicle ownership during the Project with its predominantly company focus. The findings are used to generate recommendations for policy makers as they go forwards and to lay the foundations for further empirical research. The literature review and twelve embedded single-case interviews indicate that consumer, product, market, and information variables determine consumers' views of vehicle ownership, though they do not result in radically different views of conventional vehicle and AFV ownership. The findings suggest that for the City to meet the 2050 target will likely, amongst other things, require further wide-scale sampling as well as a reconsideration of policy to encourage more sustainable travel in general.

Keywords: Alternative fuel vehicles; Consumers; Incentives; Mobility management; Stockholm; Sustainable transport; Travel demand management.

Tutor: Associate Professor Susanne Sweet

Examiner: Professor Björn Axelsson

Defence: 9th December 2008 15.00
Room C606

Opponents: Daniel Contreras and Gustav Lange

*harryfisk@gmail.com

Contents

1. INTRODUCTION	3
1.1 GLOBAL CLIMATE CONCERN AND THE IMPACT OF ROAD TRANSPORT	4
1.2 TACKLING CLIMATE CHANGE	5
1.3 PROBLEM FORMULATION	6
1.4 PURPOSE	7
1.5 DISPOSITION	8
1.6 SCOPE AND DELIMITATIONS.....	8
1.7 DEFINITIONS.....	9
1.7.1 Vehicles.....	9
1.7.2 Incentives	10
2. METHOD	10
2.1 PRE-STUDY.....	11
2.2 STUDY DESIGN	11
2.2.1 Interview framework	12
2.2.2 Interview groups	13
2.2.3 Interview format.....	15
2.2.4 Gathering interviewees.....	15
2.3 VALIDITY AND RELIABILITY	16
3. LESSONS FROM OTHER STUDIES AND LITERATURE.....	17
3.1 TECHNOLOGICAL DIFFUSION	18
3.2 ADMINISTRATION COMMISSIONED STUDY	19
3.3 VEHICLE PURCHASING.....	20
3.4 VEHICLE USAGE	21
3.5 GREEN CONSUMERISM.....	22
3.6 PURCHASE DECISION INVOLVEMENT	23
3.7 INCENTIVE USE	24
3.7.1 Europe	25
3.7.2 Rest of the world	26
3.8 SUMMARY AND MODEL OF THE LITERATURE	27
3.9 RESEARCH QUESTIONS.....	28
4. INTERVIEW FINDINGS	29
4.1 PERSONAL AND PRODUCT VARIABLES	30
4.1.1 Family and financial situation.....	30
4.1.2 Reasons for car ownership.....	31
4.1.3 Views and experiences of vehicle attributes and availability.....	31
4.1.4 Views on AFVs	33
4.2 MARKET VARIABLES.....	33
4.2.1 Views on the government's AFV strategy.....	33
4.2.2 Views on the Clean Vehicles incentives.....	34
4.2.3 Views on the effects of the incentives on future ownership.....	35
4.2.4 Views on those most affected by the incentives.....	36
4.2.5 Views on continued conventional vehicle purchases.....	37
4.2.6 Views on alternative incentives	38
4.3 VIEWS ON INFORMATION ABOUT PRODUCT AND MARKET VARIABLES.....	39
4.4 ADDITIONAL TOPICS.....	40
4.4.1 Views on the near future of AFVs.....	40
4.4.2 Views on the causes of vehicle replacement.....	41
4.4.3 Views on the causes of vehicle abandonment.....	42
5. ANALYSIS.....	42
5.1 QUESTION 1	43
5.2 QUESTION 2	45
5.3 QUESTION 3	48
5.4 POST INVESTIGATION MODEL	50
6. CONCLUSION	51
7. DISCUSSION AND RECOMMENDATIONS	51

	2
8. FURTHER RESEARCH	55
9. REFLECTIONS ON THE STUDY	56
10. ACKNOWLEDGEMENTS.....	56
11. REFERENCES.....	56
12. APPENDICES.....	63
APPENDIX 1: IMPACTS OF DIFFERENT FUELS.....	63
APPENDIX 2: INTERVIEW FRAMEWORK.....	64
APPENDIX 3: DETAILED INTERVIEWEE DATA	65

Preface

The author would like to begin by clarifying the Project's focus and successes to date in order to place this report in the correct context.

Stockholm began, as early as in 1994, to work with various incentives to try and achieve a market breakthrough for alternative fuels and alternative fuel vehicles. Thanks to significant effort Stockholm is now the leader in Europe when it comes to the uptake of such fuels and vehicles¹.

Up until 2008 the City's efforts have logically been predominantly focused on increasing uptake amongst the largest vehicle buying group- companies². The impressive results are that in 2008 one third of all cars sold in Stockholm and a quarter of all cars sold in Sweden were alternatively fuelled vehicles. Furthermore, low-CO₂ petrol and diesel vehicles also saw record sales in Stockholm and Sweden, and the number of alternative fuel refueling facilities has also grown rapidly³.

Now that the City has made such achievements, often even surpassing their own targets, they are beginning to turn the focus towards increasing the adoption of alternative fuel vehicles amongst private consumers. This report therefore gathers evidence and makes assessments on how private consumers view vehicle ownership during the City's Clean Vehicle in Stockholm Project as it has been up until 2008, focused on companies. The report is intended to assess the then current state of play including the Project's spillover effect on consumers and to provide a baseline from which the City can move forwards as they begin to redirect their onus. Given their record with companies, they are likely to yield impressive results with their new target group.

¹ Pädam (2009).

² BEST (2008)².

³ Pädam (2009).

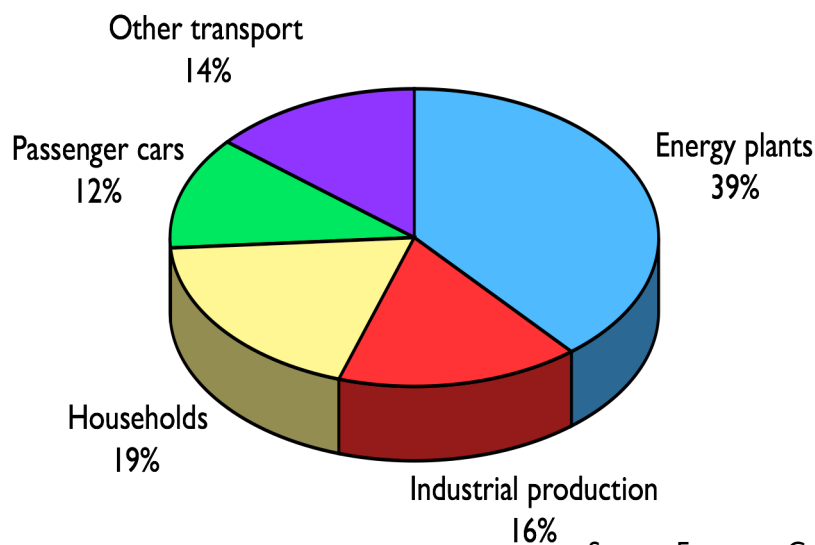
I. Introduction

1.1 Global climate concern and the impact of road transport

It is typical for environmental management papers to start with quotations from the Brundtland Report⁴ or calls for actors to acknowledge the ‘new’ challenges of climate change. Global warming is no longer the preserve of climate scientists and the average reader cannot have failed to notice the increased activity surrounding the issue in recent years. So instead of following suit and reiterating the familiar, this poignant quote is given in summary of the situation mankind currently faces: “Today, the time for doubt has passed. The IPCC has unequivocally affirmed the warming of our climate system, and linked it directly to human activity”⁵. The effects of climate change are almost universally undesirable⁶.

Life on earth depends on the warmth of the sun being trapped by a layer of gases that surround the earth. We now produce so much of these heat-trapping gases, especially carbon dioxide (CO₂), that the layer is getting thicker, which changes our climate⁷.

Figure 1: **Sources of EU CO₂ emissions**



Source: European Commission and IPCC (2007).

As can be seen in *Figure 1*, transport generates approximately one quarter of total carbon dioxide emissions and is thus one of the main forms of human activity in the European Union linked to climate change. Passenger cars are responsible for almost half this amount (12%) and despite the significant improvements in vehicle technology in recent years, it has not been enough to counter the effects of increases in traffic and car size⁸. In Sweden, the car represents 64% of the total daily personal transport kilometres travelled, with the population travelling four times further by car

⁴ “Our Common Future: Report of the World Commission on Environment and Development”, more commonly known as The Brundtland Report, was published in 1987 and is commonly referred to for the definition of sustainable development amongst other things.

⁵ Ban Ki-Moon, UN Secretary General (2007) as cited by Dr R.K. Pachauri, chairman of the IPCC in 2007.

⁶ A few of the impacts are more extreme weather events, loss of plant and animal species, and increased prevalence of diseases such as malaria (DirectGov UK, 2005).

⁷ DirectGov UK (2005)¹.

⁸ European Environment Agency (2008).

than by public transport (though in Stockholm it is 2.4 times as far)⁹. As well as climate impacting carbon dioxide, conventional petrol and diesel cars also produce emissions of particulate matter (PM), nitrogen dioxide (NO₂), volatile organic compounds (VOCs), and carbon monoxide (CO) that can damage human health¹⁰. In addition, nitrogen oxides (NO_x) and sulphur dioxide (SO₂) contribute to acidification of buildings; and traffic noise has been shown to disturb communication, concentration and sleep, and to cause negative human emotional reactions¹¹.

1.2 Tackling climate change

The negative impacts these pollutants have on the natural and built environments mean that many private, public, non-governmental, charitable bodies, and individual citizens, have an interest in tackling climate change. In the European Union two of the major tools used to do so are legislation¹² and targeted initiatives (see below). Many of the measures that begin at the European Commission subsequently need to be implemented by national governments.

Sweden performs relatively well when it comes to taking responsibility for implementing European resolutions and acting on climate change and currently tops the Germanwatch Climate Change Performance index of the top 56 CO₂ emitting nations¹³. Rather than resting on their laurels however, the central government continues to drive the issue. “The Swedish Parliament has endorsed the goal of reducing national emissions of greenhouse gases [to a level] at least four per cent [...] below 1990 levels by 2008 - 2010. Moreover, the environmental quality objective of reduced climate impact implies that Swedish emissions of greenhouse gases should decline by up to 50 per cent from present levels by 2050 or emissions below 4.5 tonnes of carbon dioxide equivalents per person per year.”¹⁴ In order to achieve these goals the government must identify key areas for action such as the heavily impacting road transport sector.

As the largest city and political and economic centre of Sweden, Stockholm has led many of the efforts to achieve the national climate goals, even setting their own transport specific targets to be fulfilled by 2010¹⁵:

- 35 percent of the total number of new car sales in the region will be ‘clean vehicles’;
- 100 percent of the municipality’s cars will be ‘clean vehicles’ (excluding special vehicles and emergency services vehicles); and
- those ‘clean vehicles’ will be fuelled with at least 85 percent ‘clean fuels’ (for those ‘dual-fuel’ vehicles which can run on traditional petrol/ diesel or a more environmentally-friendly alternative);
- 8 percent of vehicle fuel that is sold in the region will be renewable.

⁹ SIKA (2007).

¹⁰ Eriksson (2008).

¹¹ Ibid.

¹² Dimas (2008).

¹³ For an explanation of the thorough calculations on which the rankings are based, see <http://www.germanwatch.org/klima/ccpi2008.pdf>

¹⁴ Ministry of the Environment, Sweden (2004).

¹⁵ Stockholms Stad (2008)².

To achieve these goals and to try and free the municipality from fossil fuels entirely by 2050¹⁶ the City of Stockholm Environment and Health Administration¹⁷ (the *Administration*) work with different vehicle technologies and a number of EU initiatives:

- i. *Biogasmax*- A public-private partnership (PPP) concentrating on seven cities with the aim of spreading the municipal and public use of biomethane as vehicle fuel (biogas). Biogas can eliminate smog in the atmosphere and significantly reduce noise pollution. In addition, the most environmentally harmful compounds (particles, non-methane hydrocarbons) are absent when biogas is used as vehicle fuel¹⁸.
- ii. *BEST*- The goal of Bioethanol for Sustainable Transport (BEST) is to have bioethanol penetrate the vehicle fuel market as a replacement to fossil fuels. The nine public participating regions extend as far as Sao Palo, Brazil and Nanyang in China¹⁹.
- iii. *CATALIST*- A third programme which began in 2007, with the aim of validating, exploiting and disseminating the results of the CIVITAS Initiative (for cleaner and better transport in cities) and, more importantly, of stimulating new cities in the adoption of sustainable, clean and energy efficient urban transport. Stockholm is one of the 36 member cities driving the programme²⁰.

In addition to the above, Stockholm has been involved in a number of other sustainable transport projects such as *Trendsetter* (EU PPP), *Moses* (EU PPP), *ZEUS* (EU public project) and *CUTE* (Swedish public project)²¹, which have now concluded.

1.3 Problem formulation

Many municipalities in Europe have implemented measures to reduce the pollution their urban transport systems produce, especially from their public transport fleets²². Established in 1994 the Clean Vehicles in Stockholm²³ project (the *Project*) collectively administers all of the above programmes with the declared purpose of “increasing the number of clean vehicles”²⁴ in order to “keep Stockholm as the leading clean vehicle city”²⁵ (though the project does not specify in which context). To try and achieve the aims of the individual programmes and to help meet the 2010 and 2050 targets, the Administration has been using a variety of incentives to try and attract public and

¹⁶ Biogasmax (2008)¹.

¹⁷ Stockholms Stad Miljöförvaltningen.

¹⁸ Biogasmax (2008)².

¹⁹ BEST (2008)¹.

²⁰ CIVITAS (2005).

²¹ See <http://www.stockholm.se/Fristaende-webbplatser/Fackforvaltningssajter/Miljoforvaltningen/Miljobilar/Om-Miljobilar-i-Stockholm/Avslutade-projekt/> [last accessed on 10 October 2008] for more on these projects.

²² The CIVITAS website (<http://civitas-initiative.net>) presents the measures taken by 36 European cities.

²³ ‘Miljöbilar i Stockholm’ is a sub-section of the Environment and Health Administration (<http://www.stockholm.se/KlimatMiljo/>).

²⁴ Stockholms Stad (2008).

²⁵ BEST (2008)².

private organisations to ownership of ‘clean vehicles’. In a European context Stockholm stand out in their ambition to clean up the County’s *private* vehicle fleet²⁶ and have been very successful in doing so. In accordance with their company focus, the Administration calculates that around 90 percent of ‘clean vehicle’ ownership is by companies²⁷. Furthermore, whilst AFV sales have been growing almost continuously year on year since 2001²⁸, fossil fuelled passenger cars are continuing to outsell their alternatively fuelled counterparts²⁹.

1.4 Purpose

The continued popularity of conventional vehicles and the dominance of companies in ‘clean vehicle’ purchases mean the Administration is now turning to investigating municipal and individual ownership. As a civic authority themselves, the Environment and Health Administration are able to relatively easily investigate the impact of the Project with regards sister City departments. It could take considerably more time and effort for the Administration to gain access to individual consumers and to investigate their views and experiences of vehicle ownership during the Project. Furthermore, the Clean Vehicles Project Managers have recognised that they possess only a basic comprehension of the interaction between consumers and the Project in theoretical terms³⁰. Now that the Administration is focusing more on private consumers they declared their interest in co-operating on this research investigating consumer perspectives from a theoretical and empirical angle and in receiving any resulting recommendations. The purpose of this thesis is thus:

To explore subjective consumer views and experiences of conventional and ‘clean vehicle’ ownership during the Clean Vehicles in Stockholm project in order to generate recommendations for policy makers and to lay the foundations for further empirical research.

To address the predominant component of the purpose, exploring consumer views and experiences, three more distinct research questions have been generated³¹:

1. *Do private vehicle owners view AFV ownership as different from conventional vehicle ownership?*
2. *Do private vehicle owners view the Clean Vehicles in Stockholm project as catalysing the sale of AFVs?*
3. *Do private vehicle owners view themselves as having the necessary information to consider buying an AFV?*

²⁶ Stockholm has implemented more measures aimed at private consumers than the other cities in the CIVITAS project (<http://civitas-initiative.net>).

²⁷ BEST (2008)².

²⁸ VSP (2008). See Figure 7.

²⁹ The mean average of AFVs sales as percentage of total new vehicle sales is 28.4% for January- August 2008 (Swedish Road Administration, 2008)^{1&2}.

³⁰ “När det gäller teori för marknadsgenombrott [för miljöbilar] kan vi väldigt lite”. (Sunnerstedt, 2008).

³¹ Further detail can be found in Section 3.9.

1.5 Disposition

Chapter 1 has so far provided a background to the issues at hand as well as providing the purpose of the thesis. This section concludes with the scope and delimitations, and the definitions to be used. The methodological approach is described in *Chapter 2*, with attention given to the pre-study, the approach and design of the study as well as the aspects of reliability and validity. *Chapter 3* begins with abbreviated versions of previous studies, theoretical constructions and practical examples in the field, the useful findings from which are tabulated and then encapsulated in a model. The model leads onto the three research questions that are then investigated in *Chapter 4*, the findings. The outcomes of the case studies are analysed in *Chapter 5* in accordance with the research questions and the model from the third chapter, and then concluded briefly in *Chapter 6*. *Chapter 7* then reopens the dialogue to look at the Clean Vehicles project from a more macro perspective that in turn leads to the second part of the purpose, recommendations for the Project Managers. *Chapter 8* summarises the third part of the purpose, implications for further research. *Chapters 9-12* deal with reflections on the study; acknowledgements; references; and appendices.

1.6 Scope and delimitations

This thesis focuses on subjective consumer views and experiences of vehicle ownership in the County of Stockholm during the Clean Vehicles in Stockholm project. The case studies herein performed provide the means for explorative qualitative investigation in a certain geographical setting with the accompanying implications for low absolute validity and reliability. The interviewees were asked for their views and experiences surrounding their currently owned vehicle(s), which are passenger cars not light-, or heavy-goods vehicles. In addition, for those who own a 'clean vehicle', it is their first. The interviewees are taken as both decision maker and end-user unless some other indication is offered. The sample group is regrettably bereft of any first time vehicle buyers who chose a 'clean vehicle', and any owners who are students, unemployed, drivers of high-performance vehicles or car enthusiasts - minority consumer groups that may have quite different views and experiences of vehicle ownership. The research is analysed from the perspectives of technology diffusion, vehicle purchase and use behaviour, green consumerism, purchase decision involvement, and incentive strategies and is done so under the definitions provided in the following section. There are other theoretical and practical interpretations that could have been applied with more time and space. One of the many alternative angles would be to go more in-depth into one of these aspects such as purchase decision-making (other further research is discussed in *Chapter 8*). Analysis of the information channels is restricted to items mentioned by the interviewees and websites that are easy to access and typically remain available even after use has concluded (unlike print media). The implications of the research are largely limited to policy makers.

1.7 Definitions

1.7.1 Vehicles

It is important to be clear about the vehicles being discussed in this thesis. The first vehicle category will be referred to as, 'conventional vehicles'. These cars³² are fuelled by petrol or diesel and do not match the criteria used in this thesis for the second vehicle category 'alternative fuel vehicles'. Thus far, this category has been referred to as 'clean vehicles', which is the Administration's chosen translation of the Swedish 'miljöbilar' (literally meaning 'environment-cars'). Readers may find the further use of any of these terms unsatisfactory as they convey that the vehicle being described is non-polluting or even environmentally friendly, which even in the best performing cases, a car is unlikely to be. Instead, the term 'alternative fuel vehicle', or simply 'AFV' will be used henceforth. Different authors favour different terms but AFV has been adopted from Cao³³ simply because it is somewhat self-explanatory and all encompassing.

When it comes to defining what an AFV is in practice, there is little consistency. Even on the website run by the Stockholm, Malmö and Gothenburg municipalities dedicated to AFVs (www.miljofordon.se), there are three separate definitions for AFVs in Stockholm, the most comprehensive of which is that for the AFV purchase rebate (which will be discussed later). It states that AFVs must have low carbon dioxide emissions, be energy efficient and have low emissions of harmful particulate matter. Fuel consumption must be low regardless of whether the vehicle is run on alternative or fossil fuels. More specifically³⁴:

- An alternative fuel vehicle (flexible fuel, dual-fuel and/or electric) shall have fuel consumption below the energy equivalent of 9.2 litres of petrol; 9.7 cubic metres of natural gas (CNG); or 37 kilowatt hours electric energy per 100 km. AFVs must also run predominantly (at least 85% of the time) on alternative fuels as opposed to fossil fuels.
- A vehicle run on fossil fuels can be called an AFV if the carbon dioxide emissions are below 120 grams/km and the fuel consumption is below 4.5 litres diesel or 5.0 litres petrol per 100 km.
- For vehicles with diesel engines, emissions of particulate matter must be below 5 mg/km. In practice this means that vehicles run on diesel must be equipped with particulate filters.

The most common AFVs (as a percentage of all cars) by far in Sweden are those running on ethanol, 1.78% (typically with the possibility to use petrol as well); followed by applicable petrol/

³² The terms "vehicle" and "car" are used interchangeably without meaningful distinction.

³³ Cao (2004).

³⁴ These definitions are taken from the Swedish Road Administration (Vägverket, 2007).

diesel vehicles, 0.44%; natural/ biogas cars, 0.28%; and electric hybrids, 0.21%³⁵. More information on the range of alternative fuel sources currently available in Sweden and how their environmental impacts compare with conventional vehicles can be found in *Appendix I*. AFVs started appearing on the Swedish market in the 1990s and in accordance with the definition of an AFV used here, there are currently 203 models of passenger car available in Sweden for purchase.

1.7.2 Incentives

Incentives or “positive motivational influences”³⁶ for ‘cleaner’ driving can take many forms such as pay-as-you-drive insurance and fuel tax increases³⁷. *Table I* details the Clean Vehicles in Stockholm incentives aiming to directly and positively influence private consumers to purchase new alternative fuel vehicles.

Table I: Incentives for private consumers

Name	Description	Inception	Original end date (new end date)
Information spreading	Newsletters and website	1994	Ongoing
Tax exemption for biofuels	Exemption from (CO ₂ and energy) taxation for biogas and ethanol as part of an EU ruling. It was initially introduced and renewed on a yearly short-term basis and then extended twice on a long-term basis	1995 (short-term) 2003 (long-term)	Dec 2008 (Dec 2012)
Exemption from vehicle tax	All electric and hybrid vehicles have exemption from the vehicle tax for a five-year period from their purchase	1995	Oct 2006 (Dec 2012)
Free city residents' parking	AFV owners who live in the city are able to park their registered car(s) in the area of their registered residence (on the street) without charge	May 2005	May 2008 (Dec 2008)
Exemption from the congestion charge	Registered AFV owners can travel in and out of the Stockholm congestion charge zone at any time without charge	Jan- Jul 2006 (test period) Permanent inception Aug 2007	Jul 2012
Lower vehicle tax	Both light and heavy AFVs are subject to a lower tax as calculated on their CO ₂ emissions	Oct 2006	Light vehicles: ongoing Heavy vehicles: TBA
Purchase rebate	Private purchasers of a new AFV automatically receive 10,000SEK automatically from the government	Apr 2007	Dec 2009 (Jun 2009)

N.B. The months of inception and end were not available in some cases.

Source: WSP (2008).

2. Method

This section details the methodological approach to the research. It begins with the pre-study and then moves on to details of the study design and ends with a discussion of the aspects of validity and reliability.

³⁵ Based on 2007 data (<http://www.miljofordon.se/fordon/antal-fordon--mangd-bransle.aspx> Last accessed on 5 November 2008).

³⁶ Princeton University WordNet (2008).

³⁷ Litman (2003).

2.1 Pre-study

In order to develop a research plan that would hopefully yield original findings, a large body of material, generated by a number of sources was digested. Initial conversations were carried out face-to-face, on the telephone, and via email with the Project Managers for Clean Vehicles in Stockholm. They provided reports and primary data on Stockholm's experience with alternative fuel vehicles hitherto and also clarify the existing knowledge gaps. Journal articles as well as master's and doctoral theses aided understanding of the research to date and provided examples of cases in other areas and a wealth of contrasting theoretical offerings on the subject. The thesis supervisor also helped by suggesting relevant publications and by offering advice on the thesis structure.

2.2 Study design

The pre-study hinted that there are many relevant and interesting theoretical offerings and practical cases in this field. As such, the next stage of the research was to perform a more thorough review of this body of work to gain a solid comprehension of the suggested variables which effect consumer views and experiences of vehicle ownership. These findings were then used to form the foundations for the empirical investigation. The results of the investigation, when analysed in light of the literature findings should lead to recommendations and a deeper understanding for policy makers, as well as identification of hypotheses and research themes which could develop this field further.

The Administration ultimately wants to understand how effective the Stockholm incentives have been and will continue to be in increasing the adoption of alternative fuel vehicles by consumers. To gain a reliable picture, quantitative investigation will be necessary. Quantitative consumer studies, like those reviewed in *Chapter 3*, typically use closed questions (as they expedite data processing and quantitative analysis) to which respondents select or rank (on e.g. a Likert scale) the limited answer options in accordance with their actions or opinions e.g. "how influential was the 10,000SEK rebate on your choice of vehicle?" If the survey is poorly constructed, the results may be misconstrued. Preparatory qualitative research therefore, is useful "to better understand our researched problem [and then] use these insights for quantitative descriptive or testing purposes"³⁸ i.e. to help avoid asking unsuitable questions and providing ill-suited answer options. Yin³⁹ also sees case studies as applicable for exploring situations in which the intervention being evaluated has no clear set of outcomes

³⁸ Cited from advice given by Professor Richard Wahlund on the interview questions (2008).

³⁹ (1994) as cited by Tellis (1997).

Deep interviews were selected as the best case-study method with which to make these in-depth explorations as they “let us dive into individual consumers’ attitudes and preferences”⁴⁰. Phenomena can be explored from multiple angles as more open methods of investigation mean researchers can get closer to respondents, constantly reacting to the respondents and steering the investigation to gain a more in-depth understanding (on which to base quantitative research). To help “maximize what can be learned in the period of time available for the study”⁴¹, attention was turned to accepted publications on qualitative research design⁴² and consultation with an experienced expert in research framework design⁴³.

2.2.1 Interview framework

A simple approach to interviewing is to formulate a list of questions and then work through them with the interviewee in an orderly fashion. If the interviewer is aiming to gain a deep understanding by exploring a topic from an original angle, answers to their questions ought to have low predictability; otherwise they might be more efficiently answered via a questionnaire. For instance, if you ask, “What is your favourite car brand?” there are a finite number of responses the interviewee can give. With the overarching goal of the interviews being to explore consumers’ views and experiences of car ownership at a depth not achievable by surveying, the following principles were kept in mind when preparing the interview framework:

- With the exception of the background information, the question answers should not be predictable (including predictable within a range of answers e.g. Ford, Opel, Peugeot etc.);
- The questions should not be answerable with a monosyllabic response;
- The questions should not entice the interviewee to provide a certain response (other than to answer the question honestly) but to state their view(s) or experience(s);
- The questions should act as a framework to remind the interviewer to cover certain areas of discussion rather than to provide a rigid order;
- The questions should encourage the interviewee to think about their responses; and
- The questions should not make the interviewee feel uncomfortable.

In relation to this final point, it was decided that asking interviewees about their financial situation (a relevant variable discussed later) was too personal and could serve to make them feel uneasy during the interviews. It was hoped that occupation and other indications given during the interviews (such as property) would serve as sufficient proxies for their economic situation instead. It would also be possible to pay for one of the online services available in Sweden⁴⁴ to find

⁴⁰ Ek and Klingspor (2001:8).

⁴¹ Tellis (1997:1).

⁴² For example, Kvale (1996) and Yin (2003).

⁴³ Richard Wahlund, Professor in Marketing and Strategy at the Stockholm School of Economics.

⁴⁴ E.g. <http://www.extrakoll.se>.

out the interviewees' earnings though this could be considered an unreasonable breach of the interviewees' trust.

The result of the research design process was a single semi-structured interview framework for use with all interviewees. The first section focused on background information; followed by consumer and product variables; market variables; information variables; and some additional explorative questions about views on the future of the AFV market, causes of vehicle replacement and abandonment, and views on AFV ownership/ sightings. The one inconsistency in the framework came in this final section when if the subject was an AFV owner they were asked, "How do you view owning an AFV?" and conventional vehicle owners "What are your views when you see an AFV?" These questions were posed in order to gain more insight into the interviewees' views about 'green' products. This was thought to be a more subtle yet directly applicable approach than asking about other ecologically-friendly goods like recycled paper products⁴⁵, which may also have required a stated preference⁴⁶. The full framework can be seen in *Appendix 2*.

2.2.2 Interview groups

The need to interview private drivers has already been established. However, private drivers per se, are far from a homogenous group and require further fragmentation. It was logically reasoned that there are two groups of primary interest to mine for nuggets of knowledge⁴⁷:

Conventional vehicle owners

At some point (before or during the Clean Vehicles project) these owners decided to purchase a conventional car instead of an alternatively fuelled choice. It is important to explore these owners' views and experiences of vehicle ownership during the Project as they are the primary group whose ownership the Project is aimed at changing.

AFV owners

This group consists of those people who bought an alternatively fuelled vehicle at points when different incentives⁴⁸ were present. Rather than purchase a conventional car, or go without a vehicle, they made the decision to buy an AFV. It could well be that they made this decision irrespective of the Clean Vehicles project and were fuelled by ulterior motives; research will help find this out. Furthermore, these owners are perhaps those with the strongest opinions on the Project as they are the most likely to be aware of, and affected by it.

⁴⁵ As investigated by Wong, Turner and Stoneman (1996).

⁴⁶ The drawbacks of which are illustrated in the sections on *Vehicle usage* and *Green consumerism*.

⁴⁷ To paraphrase Kvale (1996).

⁴⁸ "Incentives" as used here, exclusively refers to the package of Administration-launched measures as described in the section *Incentives*.

Discarded groups

The originally planned approach was to divide the second interview group into two: those who made their purchases before the Project started and those who did so during, to see how it affected their views and experiences of ownership differently. This proved troublesome as different parts of the Project (the incentives) were launched at different times. Even if you take 1st January 2006 as the start of the current government strategy (with the trial launch of the congestion charge exemption), other elements of the Project were launched at later dates. A possible way around this would be to interview AFV owners who made purchases between (i) 1996 and May 2005 and then those (ii) who did so after April 2007 (see *Table 1*). Because of the difficulty in finding sufficient subjects for group (i)⁴⁹ this structure was dropped in favour of a single group of owners who made purchases between 1995 and the present day. This observation was not made until the interviews had commenced at which point it was decided to include all eight interviews for this group rather than sacrifice learning opportunities simply because the separate groups were not possible. If time constraints had allowed, it would have been desirable to interview an additional four conventional vehicle owners. The distribution of vehicle purchases can be seen at the start of *Chapter 4*.

Interviewing vehicle non-owners was also considered during the research design phase. Whilst access to both those considering a vehicle purchase and those who had given up owning a vehicle (in some cases on environmental grounds), had been assured, the decision to exclude them was taken none-the-less. There are a number of reasons for this, firstly, that there is research supporting the notion that consumers often display inconsistency between their stated preferences and their actual purchases⁵⁰. Pearce et al.⁵¹ likened sustainable development to motherhood and apple pie, in that they sound so good everyone agrees with them whatever their own interpretation. This suggests that most consumers would attribute significant weight in their decision making to the environmental performance of a forthcoming purchase. However, “there is a gap between consumers’ environmental attitudes and purchasing behaviour”⁵² with consumers going on to purchase conventional cars despite their original intentions- ‘talking the talk’ but not ‘walking the walk’ so to say. It could well be that consumers try to gain social acceptance by seeming to be fashionably green or, that they have genuine intent to make a ‘greener’ choice at the consideration point but then when it comes to the crunch of actually making a purchase, the taste of the apple pie fades away in favour of other (AFV-inconsistent) vehicle attributes. The value of interviewing such consumers is therefore diminished. Roger L. Mackett⁵³ commented on the distinct lack of investigations taking a real set of trips and asking the drivers “Why do you use a

⁴⁹ The number of AFVs privately purchased in the Stockholm County by 1995 is unknown. Based on the author’s familiarity with AFV development in Stockholm it is estimated that there were no more than a few hundred, only a small proportion of which are likely to still be on the road.

⁵⁰ Solomon (1999) as cited by Ek and Klingspor (2001).

⁵¹ Pearce et al. (1989) as cited by Giddings, Hopwood and O’Brien (2002).

⁵² Wong et al. (1996:264).

⁵³ (2003).

car for that trip?” and “What would make you switch to an alternative?” etc. This much more direct approach (versus stated preference research) is more closely aligned with the technique employed in this study.

The second significant reason for excluding this group from the study, is that whilst it would surely be interesting to interview people who had forfeited the right to vehicle ownership (especially those who had done so on environmental grounds), and to engage them in discussion about the Clean Vehicles project, they are not the focal group for the Project. The intention of the Project is to convince those who are considering the purchase of a new car to make it an alternatively-, rather than a conventionally, fuelled one and not to give up ownership completely.

2.2.3 Interview format

On the basis of the thesis supervisor’s advice, the time constraints of writing a thesis, the aim of the interviews, and related previous studies⁵⁴, it was decided that 12 cases would be performed with the consumer as the unit of analysis. Whilst the aim would always be to meet in person and discuss for a duration of two hours, in practise this turned out to not always be possible due to the interviewees’ time constraints. It also meant that in some cases the interviews were performed on the telephone. In order to be consistent with the language of the report, permission was requested to perform the interviews in English though in some cases the interviewee preferred Swedish and so that was used instead. The author carried out all the interviews and also took notes and made digital recordings (used to later confirm the interview notes, with two exceptions when the recording device failed).

2.2.4 Gathering interviewees

Interview subjects were sought simply via the author’s personal network. This meant asking friends and colleagues to ask their friends and colleagues who live within the Stockholm County⁵⁵ and own conventional vehicles and AFVs if they would be willing to be interviewed. Whilst on the surface this may appear to be a rather haphazard method of selection, in reality it proved fruitful. As emails, phone calls and conversations spread further afield, a reasonably diverse group of potential subjects presented itself. Whilst heterogeneity with regards views and experiences of ownership was desired, it could not be guaranteed by ensuring demographic variety. Despite earlier research, it has now been shown that environmentally conscious consumer behaviour cannot be attributed to a particular demographic group or groups⁵⁶ and thus, different reactions to

⁵⁴ Heffner, et al. (2005) in analysing purchase decisions of hybrid-electric vehicles in Northern California conducted detailed two-hour interviews with 10 households (as cited by Diamond, 2003).

⁵⁵ *Stockholms län* in Swedish, is the area bordering the counties of Uppsala and Södermanland, Mälaren and the Baltic Sea.

⁵⁶ Newholm and Shaw (2007); Diamantopoulos, Schlegelmilch, Sinkovics, and Bohlen (2003); Straughton and Roberts (1999); Manieri, Barnett, Valdero, Unipan and Oskamp (1997).

the Project should not follow demographic boundaries⁵⁷. An additional advantage of identifying interview subjects via personal connections was that many of them felt as though they were performing a personal favour rather than if a stranger had approached them. This resulted in several of the interviews being conducted in the interviewees' homes (where they felt relaxed) and for more extended periods of time than may have been possible if they had been contacted by cold-calling.

13 people (including one couple interviewed together) gave informed consent for an interview. Eight of them are women and four of them men. Their ages range from 25- 76 and they have a variety of family situations, live in a range of Stockholm neighbourhoods, work in different professional fields, and drive various vehicle models motored by four different engine types. More detailed information about the subjects and the interviews can be found in *Appendix 3*.

2.3 Validity and reliability

The stated aims of this study are to explore how car drivers view and experience vehicle ownership and then construct informative indicators for others to go on and test based on this empirical evidence, as well as providing recommendations to policy makers. Yin⁵⁸ identifies the criteria for judging the quality of embedded single-case exploratory studies like this one, as based on *construct validity*; *external validity*; and *reliability*. Several strategies have been employed to ensure that the results of this study can be understood and relied upon.

To minimise the risk of construct invalidity and to provide theory triangulation⁵⁹, multiple sources of evidence have been used. In addition to the two groups of interview cases, secondary data has been sought from academia (peer-reviewed journals such as *Energy Policy* and the *Journal of Public Policy & Marketing*); the press (e.g. BBC); public bodies (e.g. Stockholm City); and private organisations (e.g. WSP Group). Furthermore, guidance has been gratefully received on topics such as question construction from experts within Stockholm School of Economics, the Economic Research Institute (EFI)⁶⁰ and other bodies. All sources can be found in the reference list.

“[A]nalysts fall into the trap of trying to select a “representative” case or set of cases. Yet no set of cases, no matter how large is likely to deal satisfactorily with the complaint [that it is difficult to generalise from one case to another]”⁶¹. This quote summarises the important aspect of external validity in case studies. It should be clear that the interviews are not intended to represent all car

⁵⁷ In addition to this research's impact on this thesis, it is also reinsuring to know that we no longer have to think of environmentally conscious consumers as a niche group.

⁵⁸ Yin (1994).

⁵⁹ Which improves the validity of the research (Mathison, 1988).

⁶⁰ The Economic Research Institute (www.hhs.se/EFI/), where the author is employed, is home to a number of distinguished researchers and assistants, several of whom were kind enough to give their opinions on the research design.

⁶¹ Yin (1994:37).

owners in Stockholm, nor dupe the reader into believing so, but rather to explore an issue (and generate ideas to be investigated with a representative sample). It is certainly the case that the study is quite specific to Stockholm but that does not mean that many of the findings cannot be used as departure points for research in other domestic and international settings.

“Qualitative research, in contrast [to quantitative research], is comparatively weak on reliability and precision due to its phenomenological fecundity”⁶². That is to say that if the same people were interviewed a second time (or more) then the outcomes may not be consistent with the first time. This is due to the semi-structured nature of the interviews, but also other uncontrollable variables which could impact their views on vehicles e.g. if the respondent got stuck in a traffic jam on the way to the interview or, how their Volvo shares are currently performing. Asking more specific questions in a more structured format may go some way to improving the reliability, though this would have been done so at the sacrifice of discovering other, less prompted, valuable pieces of information. Reliability does not have to be a large concern as the aim, as has already been stated, is to use the findings as the basis for quantitative research which can be reliable. The format also impacts on the reporting of the findings in that not everything will be interesting for developing this particular topic, for example, “the Indian government should be investing heavily in alternative fuel research”, and so the researcher must be careful when separating such complementary data from that which pertains to the research purpose. To help future researchers, and external observers, all procedures have been well documented. It is believed that conducting a further number of cases and extending the additional ones would serve to possibly uncover additional information but in no way nullify the current findings.

3. Lessons from other studies and literature

This section reviews both theoretical and experimental studies in the field. A number of different approaches from consumer behaviour to transport economics have been considered in order to identify the strengths and limitations of the approach taken for this study⁶³. The aim is to identify the factors and phenomena most likely to be impacting on views and experiences of private vehicle ownership and to use these findings to design a model and research questions to guide the empirical investigation. The review begins with the more macro aspects impacting individual behaviour and then focuses in to the central research interest at the consumer level.

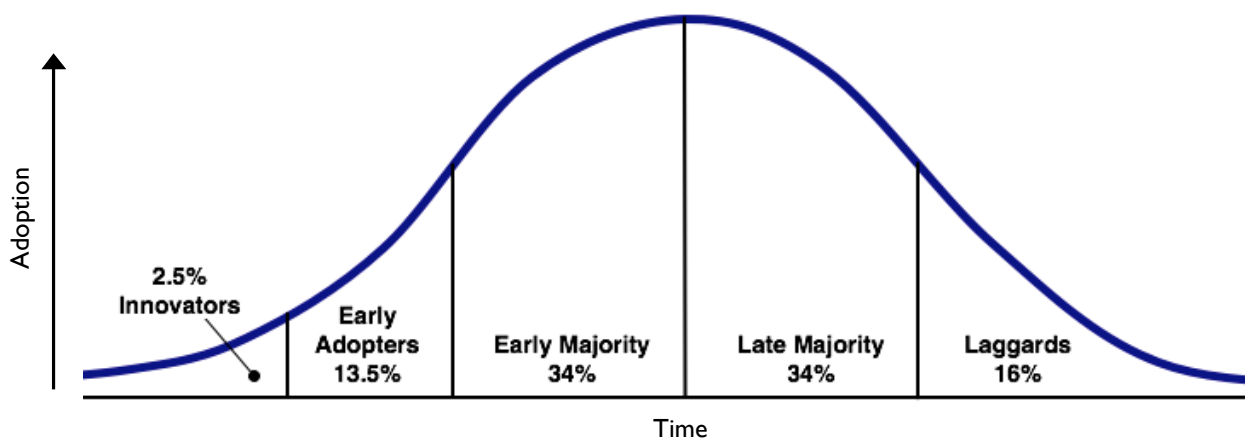
⁶² Tadajewski and Wagner-Tsukamoto (2006:10).

⁶³ The strength of a case study is improved by interpreting the investigated phenomenon through a variety of theoretical schemes (Denzin, 1984 as cited by Tellis, 1997).

3.1 Technological diffusion

Sweden is no stranger to alternative vehicle fuels. Following the Suez Crisis in 1956⁶⁴ and the 1973 oil price shocks, oil alternatives were sought and Swedes began using various methanol/ petrol blends in their cars⁶⁵. However, by the mid-1980s there was an oversupply of oil and alternatives were left by the wayside. Ever since, petrol and diesel have clearly been the dominating fuels for passenger cars. So whilst Sweden has some past history with different fuels, the current alternative fuel types and technologies are not the same as they were thirty odd years ago. By turning to the first seminal work on the adoption of innovations we can begin to see if theorising the current, much more comprehensive breed of AFVs as being innovative⁶⁶, leads to a better understanding of consumer views and experiences of vehicle ownership. In 1962 Everett Rogers⁶⁷ divided adopters into five categories that are commonly displayed as a bell-shaped curve:

Figure 2: **Diffusion of innovation curve**



Source: http://vmmba.com/images/111658-104310/DiffusionOfInnovation_2.png

“Sometimes it seems to take an amazingly long period of time for new technologies to be adopted by those who seem most likely to benefit from their use.”⁶⁸ i.e. for the innovation to be viewed by consumers as beneficial and to move from the *innovators/ early adopters* and tip to the *majority*. Rather than getting sidetracked into a long discussion of innovation and diffusion theory⁶⁹, it suffices to say that there are typically two ways to explain the time it takes for a technology to diffuse.

In *epidemic* models it is the diffusion of information about an innovation that drives its adoption⁷⁰. Geroski⁷¹ suggests thinking of this phenomenon in the terms used by Rogers⁷² where “hardware” represents the physical embodiment of the car and “software” which is the required accompanying information. Furthermore, Geroski proposes it is more astute to consider software “as a process

⁶⁴ The event also known as the Tripartite Aggression, which resulted in oil having to be shipped around the African continent from the Middle East, drastically increasing its cost.

⁶⁵ Grahn (2004).

⁶⁶ There is much debate on what constitutes an innovation, however, this is not the place for that discussion.

⁶⁷ Rogers (1962).

⁶⁸ Geroski (2000:604)

⁶⁹ The reader is directed to Rogers (1995) for a popular review of the technological diffusion literature.

⁷⁰ Geroski (2000).

⁷¹ Geroski (2000).

⁷² (1995:12).

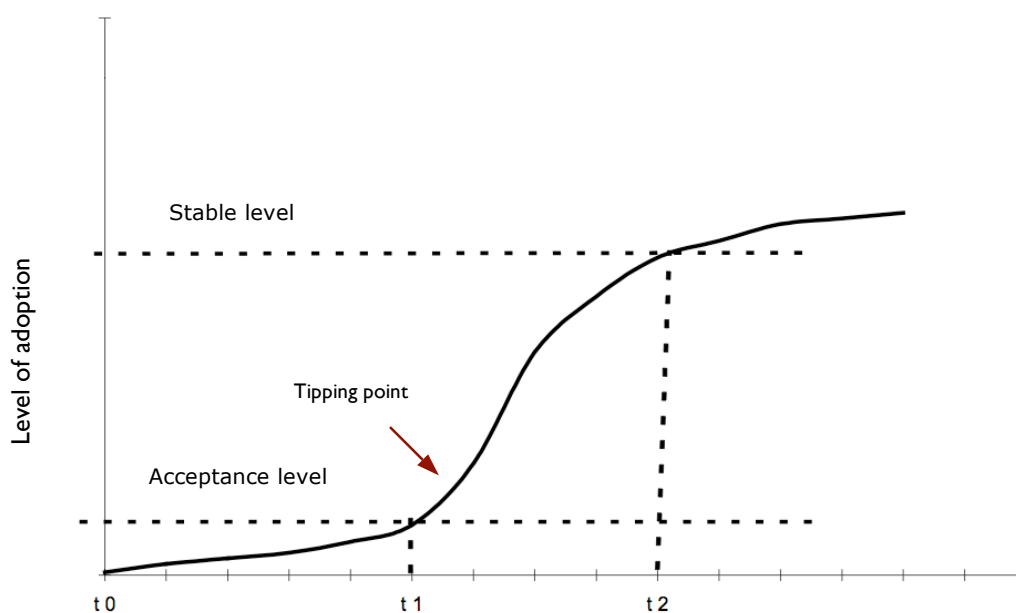
of persuasion rather than simply as a process of spreading news”⁷³. The repercussion for the Project therefore, is that as well as the availability of the *hardware*, how drivers view vehicle ownership and the Project is influenced by *software transfer costs* (time and effort searching for information etc.) and *risk aversion* (“how they react to the uncertainty which they experience when their learning is incomplete”⁷⁴).

Rivalling the epidemic explanation are the *probit* models. Here the focus lies with the individual actor and the role played by differences between people⁷⁵. Put simply, personal preferences and characteristics play the central role in probit models of explaining diffusion. In Geroski’s exploration of *Models of technology diffusion* he identifies *supplier responsibility for information flow facilitation*; *technological expectations*; *learning and search costs*; and *switching costs*. In the epidemic model information was seen as important to everyone, whereas the probit models say people have different tastes for information. Both models are considered in this investigation, as both appear to offer valuable contributions to the understanding of vehicle diffusion and how different drivers view and experience vehicle ownership.

3.2 Administration commissioned study

In 1998 a consultancy group applied the *technological diffusion* theory in a study commissioned by the Administration. The study looked at the purchases of alternative fuel vehicles at the macro level in Stockholm. The investigation concluded that the adoption of AFVs would follow an S-shaped notional diffusion curve.

Figure 3: **Consultancy proposed AFV adoption curve**



Source: Inregia (1999).

The adoption of new technologies, in this case the early AFVs, is often seen as a function of a number of factors that vary across space and time. As changes in price, information, and other

⁷³ Geroski (2000:609).

⁷⁴ Ibid (p610).

⁷⁵ Geroski (2000).

factors occur, the average individual's utility for the technology is said to increase⁷⁶. This results in the acceptance curve increasing slowly over time, before reaching a tipping point⁷⁷ (indicated in Figure 3) at which adoption accelerates before reaching a stable market share, often in the S-shaped pattern⁷⁸ (from which the diffusion of innovation curve is derived). Such a diffusion pattern has been shown to hold true for the American adoption of hybrid vehicles⁷⁹. It is perhaps worth adding, "that one rarely encounters symmetric S-curves in the actual diffusion of new technology. In almost all cases, the later stages of diffusion occur much more slowly than would be predicted by a symmetric S-curve."⁸⁰ On the basis of the consultancy investigation, the Administration concluded that intervention mechanisms⁸¹ that influence any of these factors should help lower the individual adoption threshold, the tipping point, and speed up the diffusion process and/or increase the final equilibrium market share⁸². Accordingly, as early as 1994 the Administration began the Clean Vehicles in Stockholm project to encourage the uptake of AFVs.

3.3 Vehicle purchasing

The previous sections looked at the huge category of 'innovations' of which vehicles are just one type. The focus is now narrowed to looking at more specific studies on vehicles, beginning with vehicle purchasing. Previous work in this sphere is helpful for creating a general understanding of vehicle purchasing and ownership before taking another step forwards in investigating consumer views of such behaviour in the specific setting of the Clean Vehicles project.

In his doctoral research, Cao⁸³, performed a significant review of the many quantitative studies focusing on automobile demand and ownership conducted since 1940. Each of these studies can be classified according to its employment of an *aggregate* model or a *disaggregate* one. *Aggregate* models take a macro perspective in analysing regional or national ownership demand. As aggregate studies use the wider population as the unit of analysis, vehicle owners in a certain geographical area (country or county etc.) are taken as a homogeneous group. "[A] variety of variables were found to significantly affect aggregate automobile demand or ownership, in expected ways"⁸⁴, these groups are: *income-related* (e.g. gross national product); *cost-related* (e.g. cost index of motoring); *land-use* (e.g. population density); *demographics* (e.g. household size); and *other* (e.g. vehicle stock levels). This research is predominantly concerned with investigating different driver views and experiences and develops from the foregone conclusion that drivers are not a homogenous group. Because it is fundamentally not possible to investigate individual consumers at the macro level,

⁷⁶ Diamond (2008).

⁷⁷ The definition of a tipping point varies according to the field of discussion. Here, it is sufficient to say that a tipping point is the moment in time when a slow gradual change gathers momentum and begins to accelerate at a much faster rate.

⁷⁸ Diamond (2008).

⁷⁹ Gallagher and Muehlegger (2008).

⁸⁰ Geroski (2000:609).

⁸¹ At the point of, what in the diffusion literature is referred to as, the *persuasion* stage (Rogers, 1995).

⁸² Diamond (2008).

⁸³ (2004).

⁸⁴ Ibid (p12).

such aggregate factors are not being investigated further. However, it is important to have a holistic background understanding of the entire system in which consumer views and experiences are formed.

The other studies reviewed all use *disaggregate* models which focus on random utility theory to predict consumer decision-making about vehicle purchases. It is these findings that are most relevant to the microanalysis being conducted here. Cao⁸⁵ finds several utility variables commonly impacting conventional vehicle choice. Commonsensically, *higher prices* negatively impact on demand, as do *vehicle-operating costs*. *Brand loyalty* also appears as a typically positive factor. Additionally, the attributes *engine power* and *number of seats* suggest households favour powerful, spacious cars.

A number of more specific studies using disaggregate models have also been carried out specifically on AFVs. Here the reviewer again finds *purchase and operating costs* as most significant (the lower the better), but then also unique AFV performance variables: *cruising range*, *fuel availability* and *fuel flexibility* which are positively correlated with popularity; and *emissions* where less is viewed more positively. Other reviews have also identified *refuelling time* (lower is more popular) and *acceleration* (faster is more popular) as important⁸⁶. It should be noted that whilst these studies are not so old, the market for AFVs is far from static and some of these considerations will as such reflect the state of play at the time. Byrne and Polonsky⁸⁷ summarise the necessities for adoption of AFVs into four broad categories: satisfaction with *vehicle characteristics* such as those provided above; supportive *regulatory barriers* such as emissions standards; sufficient *resources* to bring an AFV to market (i.e. commitment by manufacturers and the government etc.); and sufficient *infrastructure* (availability of AFVs, fuels, refuelling stations and maintenance services).

3.4 Vehicle usage

The Swedish National Travel Survey (SNTS) 2005- 2006 showed that 46% of all day-to-day journeys are made for business, work, or school-related purposes; 30% for leisure; 18% for service and shopping; and 5% for other reasons. How people use their vehicles will obviously influence how they view and experience them. The SNTS figures are useful background information (especially for the discussion in *Chapter 7* about alternative travel methods), but they do not tell us the specific reasons for these journeys nor, which of them are made by car. Although this data is lacking for Sweden, more specific work has been performed in the United Kingdom.

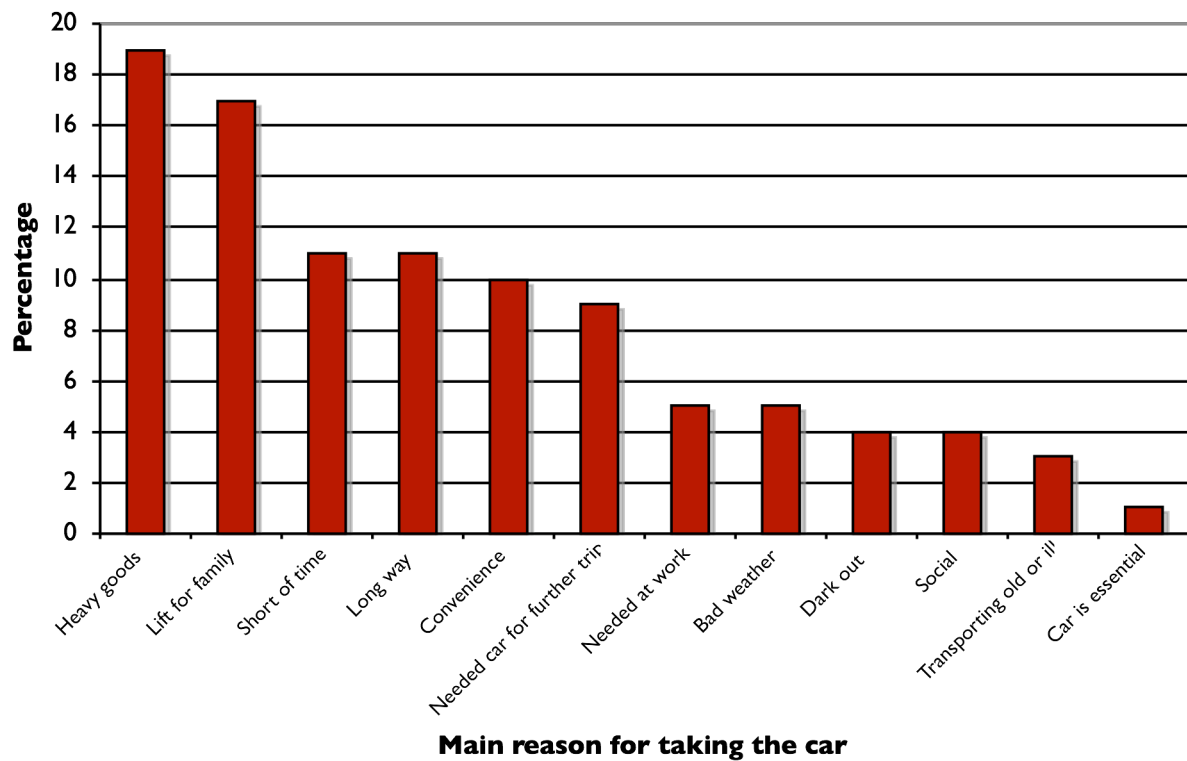
⁸⁵ (2004).

⁸⁶ Ewing and Sarigöllü (2000).

⁸⁷ (2001).

Roger Mackett⁸⁸, Professor of Transport Studies at University College, London observed that whereas there have been many studies based on hypothetical scenarios or stated preference surveys, there is a lack of post hoc investigation on why people use their cars for short trips. The results of his subsequent novel research are presented in *Figure 4*.

Figure 4: Main reasons for using the car for short trips in the UK



Whilst Mackett's research was conducted in the UK it is deemed as highly valuable in the Swedish context due to his original approach and also its focus on short distance trips (<100km), which is dominated by car transport in Sweden⁸⁹. How people choose to transport themselves, and in the case of car use which cars they choose to use, is also affected by their feelings towards the 'green' options available to them.

3.5 Green consumerism

Let us not forget that what differentiates conventional and alternative fuel cars, and makes them an 'innovation', is the technology that makes them 'green'. It may well be worth considering AFVs as 'green' products in seeking to understand how drivers view and experience vehicle ownership. Wong et al. noted, "many green products have not achieved the level of market success which might be expected in a society which claims to be sympathetic to the environment. In many consumer product categories, producers have achieved disappointingly low levels of market share for their green innovations"⁹⁰. This suggests somewhat of a paradox in that there appears to be "a

⁸⁸ (2003).

⁸⁹ 75% of short-distance trips are done by car (Åkerman and Höjer, 2006).

⁹⁰ (1996:264).

gap between consumers' environmental attitudes and purchasing behaviour[- an] 'attitude-behaviour gap' or 'words-deeds inconsistency'”⁹¹. The same researchers put forward the three main influences determining the extent and rate of consumer adoption of green technologies as being: individual preferences for ecologically friendly goods (i.e. *consumer demand*); the availability, promotion and pricing etc. of such products (i.e. *supply-side*); and germane government policy and action (i.e. *regulation*).

It is assumed that if offered the choice of two cars that are nearly identical in price and in most physical and functional ways, but where one offers the opportunity to be less environmentally harmful, that the average person would select the 'greener' alternative. However, there continue to be (an albeit decreasingly) higher percentage of new conventional vehicles than AFVs being registered in Sweden each month⁹². This suggests that, even disregarding their environmental impact, AFVs are not as indistinguishable from conventional cars as recently claimed by the City of Stockholm⁹³ or, they are not viewed or experienced as being so, therefore, the consumer discovers an inconsistency between their values and the product choice, leading to a behaviour gap⁹⁴. These differences, according to Wong et al.⁹⁵, can be termed as *demand*, *supply*, and *regulatory* factors. One such supply factor could be the premium pricing of green technologies⁹⁶ where consumers are often willing to pay more for environmentally friendlier goods, but due to the high purchase price of cars, this creates a problem⁹⁷. It is also possible that, as with the concerns over vehicle purchase criteria like alternative fuel availability, the inconsistency is reflective of the time when the research was conducted. There is now some evidence that inconsistencies are shrinking in some 'green' product markets. For instance, the demand for organic cotton in the US (the world's largest organic cotton producer) now far outstrips supply⁹⁸. Though there are also examples, such as Fair Trade coffee, where supply exceeds demand (with negative price consequences for the growers)⁹⁹. Empirical research should help to more conclusively evaluate the impact of *green consumerism* on car ownership views and experiences in Stockholm. How decisive all these factor in vehicle ownership, is also affected by how important the purchase is to the buyer. This phenomenon is known as *purchase decision involvement*.

3.6 Purchase decision involvement

Involvement can be understood as “*the level of perceived personal importance and interest evoked by a stimulus within a specific situation*. To the extent that a consumer is involved, the consumer acts to

⁹¹ Wong et al. (1996).

⁹² The mean average of AFVs sales as percentage of total new vehicle sales is 28.4% for January- August 2008, it was 15.6% in 2007 and 11.2% in 2006 (Swedish Road Administration, 2008)¹⁸².

⁹³ “Dagens miljöbilar är som vanliga bilar.” (Stockholm Stad, 2008)¹.

⁹⁴ Dembkowski and Hanmer-Lloyd (1994).

⁹⁵ (1996).

⁹⁶ Ibid.

⁹⁷ Byrne and Polonsky (2001).

⁹⁸ O'Neill (2007).

⁹⁹ Weber (2007).

minimize the risks and to maximize the benefits gained from purchase and use.”¹⁰⁰ Put simply, the greater the importance of a potential purchase to the buyer, the higher the level of involvement e.g. low for milk and paperclips, high for holidays and cars. Importance in turn, is determined by three factors.

When *personal factors* such as self-image are affected by the purchase, involvement tends to be higher¹⁰¹. “Because they can offer an array of symbolic benefits, automobiles become instruments for consumers to “define, maintain, and enhance their self-concepts[s]” and to communicate identity to others”¹⁰² e.g. the confident, successful young male who drives a bright yellow sports car. On the other hand, some owners may view their vehicle as a mere mode of transport and thus it is only representative of car ownership and little more. *Product factors* have also been identified as positively impacting purchase importance, especially the risk the product carries in purchase and use¹⁰³. The potential exposure with a car is to *physical, psychological, emotional, social, and financial* risks. When these perceived risks exceed an accepted level the buyer will attempt to minimise their exposure “through the search and pre-purchase alternative evaluation stages in extended problem solving”¹⁰⁴ or by avoiding purchase altogether. Finally, *situational factors* are identified as being significant. These factors include whether the item is being purchased for *personal use or not*; the *time constraints*; and *social pressures*¹⁰⁵. A driver’s level of involvement, as dictated by these factors (of which the Project is one), should influence how they view and experience vehicle ownership.

3.7 Incentive use

Incentives are a way for governments to match their macro level goals (such as those given in Section 1.2) with the needs and wants of consumers as identified in this section. Eriksson¹⁰⁶ identified measures for reducing the demand for conventional car use, and similarly measures for raising the demand for alternative transport modes, as one of the main techniques with which to reduce the negative environmental effects of households’ transportation. She goes on to explain that all measures, for example increased taxes on fossil fuels, car free zones, and workplace travel plans can be classified as either *push* or *pull* strategies. Push incentives are those that drive the individual away from the undesired behaviour, in this case unnecessary car driving e.g. congestion charging. Pull incentives on the other hand attract individuals to the desired behaviour- travelling with a mode of transport less environmentally damaging than the conventional car e.g. secure storage facilities for cycle commuters. Policy recommendations can be drawn by comparing the

¹⁰⁰ Blackwell, Miniard and Engel (2006:95, emphasis in original).

¹⁰¹ Blackwell et al. (2006).

¹⁰² General Motors’ Vice-Chairman Bob Lutz as cited by Heffner, Kurani and Turrentine (2005:1).

¹⁰³ Jacoby and Kaplan (1972); Kaplan et al. (1974) as cited by Dholakia (2001).

¹⁰⁴ Blackwell et al. (2006:96).

¹⁰⁵ Blackwell et al. (2006).

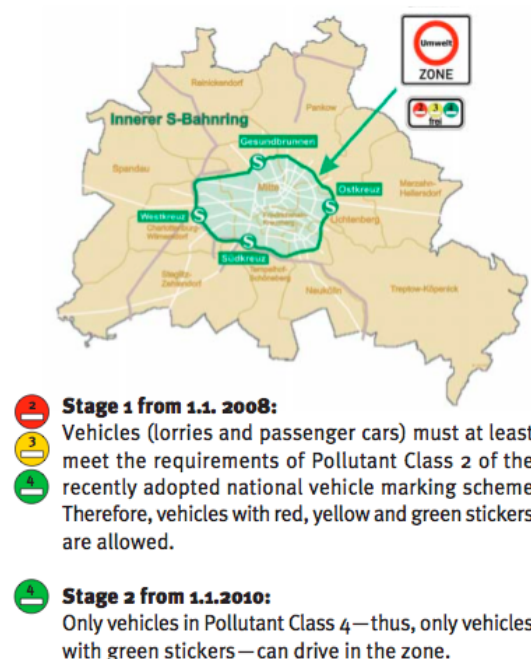
¹⁰⁶ (2008).

success of incentives trialled in other countries with the findings about consumer views and experiences of the incentives in Stockholm. As was stated in the introduction, few European cities have been especially concerned with increasing the private adoption of AFVs. A few examples that do exist are presented here, as well as some from outside Europe.

3.7.1 Europe

London took the lead in congestion charging in 2003 and saw considerable success cutting congestion by 18% and delays by 30% in the first year of operation¹⁰⁷. Other cities have taken this push approach one step further in banning certain vehicles from their central areas. The Berlin Environmental Zone is the area contained by the circular metro transport system. Only vehicles meeting specified emissions levels may enter the zone¹⁰⁸. Vehicles must display a windscreen sticker according to their corresponding (not uncontroversial¹⁰⁹) European emission classification¹¹⁰. The system is being implemented in two, increasingly strict, stages (see the accompanying information to Figure 5) and forms a part of the Clean Air and Action Plan in Berlin¹¹¹. Two other German cities, Cologne and Hamburg have also introduced similar systems, as have the Italian conurbations of Milan and Rome¹¹². Seeing as these schemes were started this year there are unfortunately few figures on which to assess their success as yet.

Figure 5: **Berlin's Environmental Zone**



Source: Berlin's Senate Department for Health, Environment and Consumer Protection (2007).

In Graz low emission vehicles benefit from reduced tariffs for citywide parking with the aim of raising awareness and heightening the desire for such vehicles. During the scheme's introduction (2004- 2005), a mere 41 vehicles were approved as eligible due to confusion over the required vehicle standards and a lack of support from producers and retailers¹¹³. It is unclear if the latter stages of the Project have been anymore successful. Bremen has achieved significant emissions reductions with a Stockholm-like purchase rebate of €1,000 for private buyers of new AFVs and an accompanying information campaign (the AFV fleet emits 23% lower CO₂ compared to petrol;

¹⁰⁷ BBC (2004).

¹⁰⁸ Berlin's Senate Department for Health, Environment and Consumer Protection (2007).

¹⁰⁹ EurActiv.com (2004:3).

¹¹⁰ The Euro 5 (2009) and Euro 6 (2014) emissions standards for cars are set by the European Commission. Further information can be found at: <http://ec.europa.eu/environment/air/transport/road.htm> [Last accessed on 5 November 2008].

¹¹¹ www.berlin.de/umweltzone [Last accessed on 5 November 2008].

¹¹² IEMA (2008).

¹¹³ EST (unknown).

and 77% lower NO_x and 99% lower PM10 compared to diesel)¹¹⁴. Suceava in Romania has also been using public marketing campaigns to catalyse adoption, including focus on the negative effects of fossil fuel dependence¹¹⁵. Their efforts resulted in 219 newly registered LPG vehicles and a threefold increase in the number of LPG refuelling stations during the two-year campaign¹¹⁶.

3.7.2 Rest of the world

In China, a country where around half of total city air pollution is caused by vehicles, cleaner cars could be viewed as a priority. The Ministry of Finance is currently considering incentives to promote energy-efficient and less environmentally harmful vehicles. For consumers this could mean exemption from the 10% purchase tax on cars¹¹⁷ as well as “raising charges on high-emissions vehicles [and] lower parking charges for small vehicles”¹¹⁸.

The *ProAlcool* programme started in Brazil in 1975 with the aim of promoting ethanol fuel to increase energy security and to provide agricultural price support¹¹⁹. Consumers were drawn to ethanol and flexi-fuel vehicle purchases with tax reductions and the assurance that the price of ethanol would be fixed at 59% of petrol. By the late eighties 90% of new vehicles sales were E100 (pure ethanol) cars. However, due to a fall in the price of petrol; an increase in the price of sugar (sugar cane is the primary source of Brazilian ethanol); a lack of government resources to sustain the programme; and an increase in the demand for ethanol, a crisis resulted¹²⁰. Consequently people lost trust in the *ProAlcool* programme and producers returned to conventional vehicle production, which led to a significant fall in popularity of ethanol in the 1990s¹²¹.

The examples illustrate that different cities clearly have different opinions about the best incentives to use. As well as identifying practical cases to be compared with Stockholm’s approach, the literature shows there are theoretical comparisons to be made too. Using the revenues from *push factors* to finance *pull measures* has been found to gain higher acceptance than when those revenues simply enter the government kitty¹²². Such an arrangement is known as a *feebate* system where for instance, “vehicles with fuel consumption rates above a “pivot point” are charged fees while vehicles below receive rebates. By [the] choice of pivot points, feebate systems can be made revenue neutral.”¹²³ Pull measures in general have higher acceptability, especially those that focus on efficiency rather than curtailing behaviour and packages combining the two generally lead to low acceptability. However, a package containing a push measure and a pull measure has been

¹¹⁴ CIVITAS (2005)¹.

¹¹⁵ CIVITAS (2005)².

¹¹⁶ Blackledge and Dura (2007). Unfortunately the numbers of other newly registered vehicles during the period are inaccessible.

¹¹⁷ Wang (2008).

¹¹⁸ China Daily (2006:1).

¹¹⁹ Tavares (unknown).

¹²⁰ Tavares (unknown).

¹²¹ Ibid.

¹²² Eriksson (2008).

¹²³ Greene, Patterson, Singh and Li (2005:757).

shown to be more effective in changing behaviour than an individual measure on its own¹²⁴, as has a package that limits the total amount of behavioural change one has to make in order to comply¹²⁵. In their study of hybrid car adoption in the United States, Gallagher and Meuehlegger¹²⁶ discovered the timing of financial incentives also has an impact i.e. sales tax exemption has a greater effect on increasing sales than do income tax credits despite the latter being almost twice as much (\$1,077 versus \$2,011).

3.8 Summary and model of the literature

Table 2: Summarised findings from the literature review

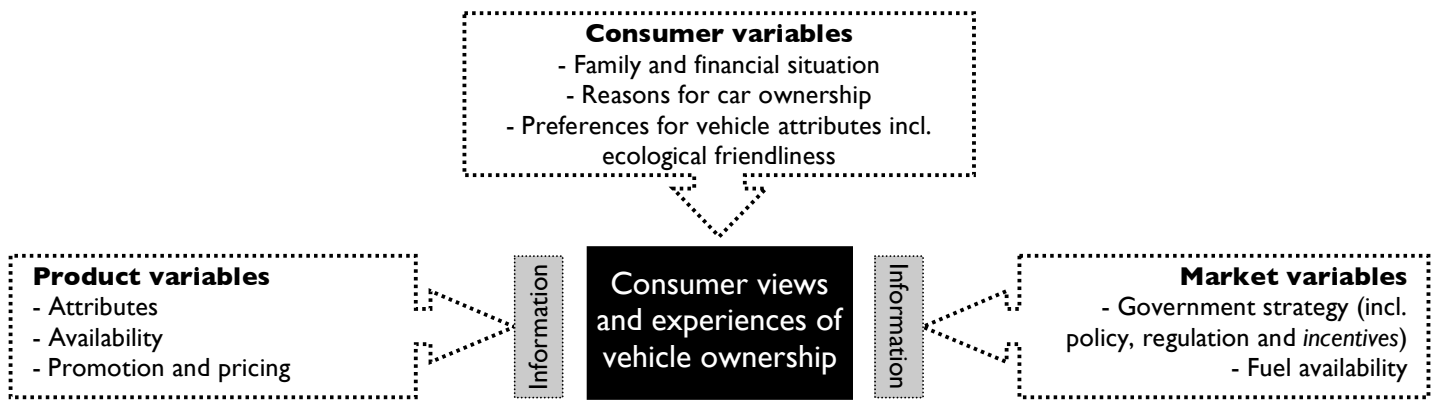
	Significant variable(s)	Type of variable(s)
Technological diffusion:		
Epidemic model	Necessity for accompanying information about the technology.	Product; market; information
Probit model	Personal preferences and characteristics for e.g. new technology.	Personal
Vehicle purchasing:		
Disaggregate models	Vehicle factors e.g. price and environmental impact; fuel availability.	Personal; product; market
Byrne and Polonsky (2001)	Vehicle characteristics; regulatory barriers; resources; infrastructure.	Product; market
Vehicle usage:		
Swedish National Travel Survey	In order of descending popularity: business, work or school related; leisure; service and shopping; other.	Personal
UK research on short trips	In order of descending popularity (top 5): heavy goods; lift for family; short of time; long way; convenience.	Personal
Green consumerism:		
Wong et al. (1996)	Consumer demand; supply; regulation.	Personal; product; market
Purchase decision involvement:		
Blackwell et al. (2006)	Personal factors; product factors; situational factors.	Personal; product; market
Incentives		
Eriksson (2008)	Pull factors are popular; push + pull factor packages are effective; push factors disliked.	Personal; market
Gallagher and Meuehlegger (2008)	Incentives are more effective if delivered immediately than delayed.	Personal; market

The table displays the types of variables that the literature review has shown to play a role in influencing views on vehicle ownership. The findings can be grouped into four categories: *personal variables*; *product variables*; *market variables*; and *information variables*. Figure 6 is a proposition for how the literature findings can be arranged to show how consumer views and experiences of vehicle ownership are influenced, and also that the influence of the *product* and *market* variables is dictated by how well the consumer is informed about them.

¹²⁴ Eriksson (2008).

¹²⁵ Byrne and Polonsky (2001).

¹²⁶ (2008).

Figure 6: **Variables impacting consumer views and experiences of vehicle ownership**

The model is not a rigid postulation. Different variables will be more influential for some consumers than others. For example, wealthy new parents may view the safety and reliability of a car as most important irrespective of the price or, a countryside resident may choose a fossil fuel car because of fuel availability irrespective of their preference for AFVs. Because many of the elements are inter-related, for example *product pricing*, (financial) *incentives* and *financial situation*, and given the exploratory nature of the case studies, it would be quite difficult to subject it to valid empirical testing. We can, however, use the empirical findings to see how the model can be further developed (see Section 5.4). For now, the model serves as a structural guide to steer the research questions and subsequent enquiry and analysis.

3.9 Research questions

The empirical section adds primary research concerning the predominant component of the research purpose- exploring consumer views and experiences of vehicle ownership during the Project. Summarised in the theory model are the variables that the literature suggests may cause any differing views and experiences. The research questions are therefore focused on exploring each of these categories of variables.

1. *Do private vehicle owners view AFV ownership as different from conventional vehicle ownership?* - Asking this question combines the interrelated categories of *Consumer* and *Product* variables and should hopefully lead to revelations about how drivers view and experience AFV ownership as different from conventional vehicle ownership.

2. *Do private vehicle owners view the Clean Vehicles in Stockholm project as catalysing the sale of AFVs?* - Question 2, in addressing the *Market* variables, focuses on how the current and potential AFV owners view the Administration's strategy for increasing AFV adoption.

3. Do private vehicle owners view themselves as having the necessary information to consider buying an AFV? - Finally, the model identifies *information* as playing a key role in facilitating the impact of the two former question areas and is therefore a necessity for investigation.

4. Interview findings

All of the interview subjects are presented in *Table 3*. In addition to the background information the interviewees have all been given pseudonyms based on their characteristics or opinions expressed during the interviews, which will become apparent in the following results section. Such names allow references to individuals whilst retaining their anonymity (as was preferred by several subjects).

Table 3: **Interviewees** (arranged by date of vehicle acquisition)

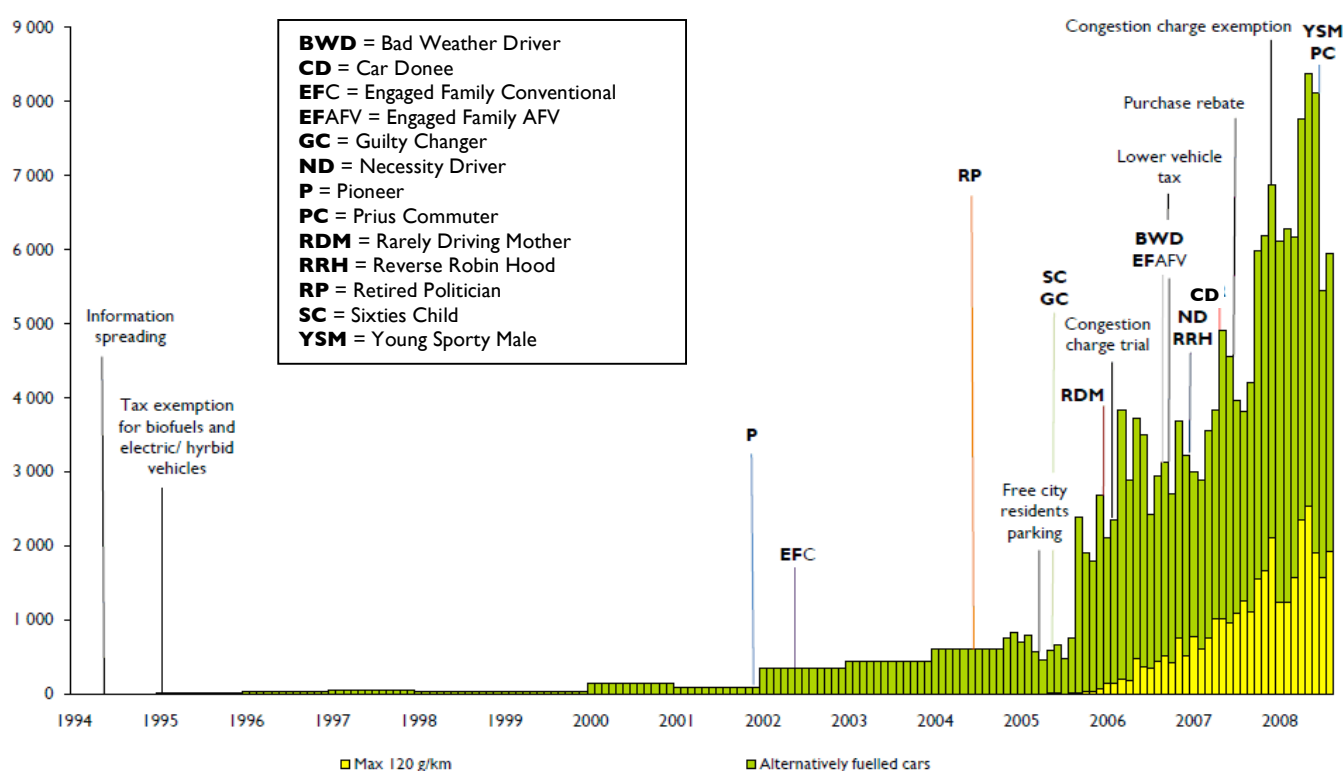
Pseudonym	Gender	Age*	Family status	Occupation	Vehicle	Date of acquisition* (year of first registration)
Conventional vehicle owners						
Guilty Changer	F	35	Husband, two young children	Company head of corporate sustainability	Audi A6 petrol	2005 (2003)
Rarely Driving Mother	F	39	Partner, one young child	Information and publications administrator	Renault Megane petrol	Dec 2005
Car Donee	F	33	Husband	Research assistant	Saab 900 petrol	May 2007 (1996)
Young Sporty Male	M	25	Girlfriend	Financial controller	Mazda MX-5 petrol	Jul 2008 (1998)
AFV owners						
Pioneer	F	50	Husband, three teenage daughters	Senior civil servant	Ford Focus Flexifuel	Dec 2001
Engaged Family	M	50s	Couple, one young child	IT consultant VP for communications	Saab 95 estate	2002
	F	40s			2.3turbo petrol Ford C-Max Flexifuel	2006
Retired Politician	M	76	Wife	Retired	Ford Focus Flexifuel	Jul 2004
Sixties Child	F	40s	Husband, two teenage children	Primary teacher	Toyota Prius	2005
Bad Weather Driver	F	37	Husband, two young children	Journalist	Saab Biopower 95	2006 (2005)
Necessity Driver	M	48	Wife, one young child	Business consultant and company owner	Ford Focus Flexifuel	Dec 2006
Reverse Robin Hood	M	43	Wife, two teenage children	Business consultant	Ford Focus Flexifuel	Dec 2006
Prius Commuter	F	30s	Divorced, two young children	Freelance photographer	Toyota Prius	Jun 2008 (2005)

* In some cases the interviewee preferred not to give their age and so estimations were made.

* In some cases the interviewee could not recall the month of purchase.

As was explained in *Section 2.2.2*, the vehicle owners made their purchases at a variety of times during the Clean Vehicles project. The incentives in place at the time of purchase, as well as the then current state of adoption will have affected the interviewees' ownership decisions. The distribution of these acquisitions, and the growth in sales of AFVs can be seen in *Figure 7*.

Figure 7: **Distribution of vehicle acquisitions, incentive start dates and number of new AFVs registered each month**



Source: VSP (2008).

N.B. In the definition of AFVs used here there is no explicit distinction regarding vehicles emitting less than 120g/km of CO₂. A different coloured line marks each interviewee's acquisition.

The results of the interviews are now presented as the highlights uncovered in each topic area and interview group¹²⁷. In accordance with the semi-structured format interviewee comments transcended multiple topics and thus in several instances, components that are separate in the model, are combined in the presentation of the findings. Accordingly, the results start with *Personal and Product variables* which constitutes two of the sections in the model and investigates *Question 1*; the *Market variables* are then given their own section (*Question 2*); followed by the *Information aspects* (*Question 3*); and a section on *Additional topics*. The opinions expressed in the findings are that of the interviewees and not the author.

4.1 Personal and product variables

4.1.1 Family and financial situation

On the basis of the proxy indicators (see *Section 2.2.1*) and that the interviewees all owned relatively new vehicles (mean age of 5.2 years) it is estimated that all subjects are middle- to high-income earners. The interviewees' family situations are presented in *Table 3* and show that nearly all interviewees have a partner and three quarters of them have children.

¹²⁷ Many of the quotes are paraphrased.

4.1.2 Reasons for car ownership

AFV owners

All AFV drivers described their ownership by their use of the vehicles. Roughly half of usage is work related, both commuting and trips during the day. The other half of the use is personal, including weekly food shopping, transporting big purchases (e.g. furniture), and social visits. A number of participants mentioned the specific necessity of their cars for travelling to a summerhouse and also as a “functional thing” when the weather is bad. In addition, nearly all AFV owners indicated that they tried to minimise the use of their vehicles.

Conventional vehicle owners

A fairly similar pattern to the AFV owners was observed. Again, one subject, Car Donee, commented that if you have something that is really practical then you use it more. Specifically with a car this means that “when it is cold and dark, the temptation is there to jump in the car, turn the heating on and start your journey right from your front door.” Pioneer said she would be unable to get herself and her daughter to the riding stables without the car and Guilty Changer summarised her thoughts as the flexibility having a car provides to, “just go and pick up my child when they are sick”. Young Sporty Male also stated that he drives his car occasionally simply for the joy of motoring, which is something no one else in either group hinted at. It also contrasted with Guilty Changer who aims to minimise her car usage, never using it for trips to town or to see friends etc.

4.1.3 Views and experiences of vehicle attributes and availability

Rather than asking owners to state their preferences¹²⁸ they were asked about the product variables that helped determine the purchase of their current vehicle(s). Knowing they had already detailed their current vehicles, owners should have been discouraged from providing any inconsistent criteria e.g. ‘prestige’ when owning a Ford Focus.

AFV owners

Rather unsurprisingly nearly all owners gave the environmental performance of the car as their primary buying criterion. Sixties Child talked of her “immediate attraction” to AFVs, growing up with the 1970s oil crisis meant that minimising energy consumption has always been important and Pioneer jumped at the chance to be one of the first 5,000 flexi-fuel customers required by Ford to start production in 2001. The one exception from this was Retired Politician who had actually been approached by Ford in 2004 with a price promotion making the alternatively fuelled Focus

¹²⁸ The drawbacks of this approach have already been illustrated in the sections on *Vehicle usage* and *Green consumerism*.

cheaper than the conventional engine. Seeing as he and his wife were satisfied with their previous (then aging) Ford Escort, they decided to buy a Focus Flexifuel¹²⁹.

Financial impact was often stated though with varied importance. For those buyers such as Prius Commuter who are more price sensitive (due to self-reported lower incomes) and those who did not predict using the vehicle much (Necessity Driver and Reverse Robin Hood), the purchase price was very significant. For others it was more about how much it would cost to run i.e. monthly fuel costs, as this is viewed as a relatively easy estimated comparison to make with their current car at the time of buying. A telling example is that Reverse Robin Hood disregarded a Toyota Prius because of its relatively high purchase price and given how little he predicted using it, he predicted the greater fuel economy it provides would not make it cheaper over the ownership period. Nobody said they made any complex calculations incorporating projected fuel price changes, insurance costs, depreciation, and the financial impact of the incentives etc.

Whilst size was also named as important in several cases, namely by those families with children who needed transporting and contributed to larger food purchases, vehicle brand played a small role. Prius Commuter named Toyota as reliable and Engaged Family stated that they would have never previously considered a Ford but a Focus fitted their (general and environmental) needs.

At various points throughout the interviews the subject of public transport arose. The general consensus was that the standard and availability of public transport in central Stockholm is very good and thus for those living centrally their vehicles are seldom used. It is Prius Commuter who lives in Norrtälje, and others working in less well-served areas, that are more reliant on their cars on a daily basis. For those who own one, accessing a summerhouse necessarily involves driving.

Several other considerations were also mentioned very briefly: purchasing an AFV as symbolic support for the AFV industry; concerns over the refuelling structure for some alternative fuels outside of Stockholm; and the safety and handling of the car.

Conventional vehicle owners

Financial cost was given as the over-riding factor in conventional vehicle purchase decisions, though for Car Donee it was irrelevant as she was given the car by a relative. A couple of owners had a more holistic picture of cost with their thoughts focused on ownership costs such as insurance, maintenance outgoings, and fuel economy. Young Sporty Male even selected the smaller

¹²⁹ So-called 'flexi-fuel' vehicles can be run on both petrol and ethanol.

engine option on the grounds of this final criterion as well as stating that he would have preferred an AFV though no ‘sporty’ models in his price range were available.

As with AFV owners, size also played a significant role for the family owners, Guilty Changer naming the necessity to transport a double pram. Other fleeting considerations for this group were the comfort to drive; the design; the brand; the quality; and again the safety aspect.

4.1.4 Views on AFVs

AFV owners

Although no longer seen as alternative by several owners, most expressed pride to varying degrees in owning their vehicles- “doesn’t feel good, just less bad”, “more proud than before, but will be more proud in the future” and that they are “making a vote”, “stepping in the right direction” and “doing the best I can do”. Bad Weather Driver also commented on the social acceptance you gain when you live in certain areas of the city (middleclass Bromma). She also felt that the initial pride she experienced has now diminished and Retired Politician even expressed displeasure due to the jerky performance of his specific vehicle. Pioneer, in being one of the first AFV owners in Stockholm, faced a lot of negative questions in the beginning but these have faded out as the popularity of AFVs has grown.

Conventional vehicle owners

Aside from the difficulty in actually identifying AFVs, conventional vehicle owners feel everything from neutrality (“not nerds, not geeks”) to positivity about the owner’s consideration of the environment. In one case even “you’re fooled, it’s too expensive” in reaction to the Toyota Prius. As well as reminding some motorists to consider buying an AFV themselves, a sighting triggers related questions of e.g. the real difference between AFVs and conventional cars.

4.2 Market variables

As the Clean Vehicles project falls directly under the heading of ‘government strategy and incentives’, this area was given more focus in the interviews with opinions sought on several angles of the Project.

4.2.1 Views on the government’s AFV strategy

AFV owners

Retired Politician commented that it “is always scary and dangerous when you promote a single policy above all others for example, during the first oil crisis all focus went on lower fuel usage which led to compact and closely-packed housing, which led to build ups of mould and I suspect many allergies.” He added, “back-tracking on policy is very dangerous as is using feebate style tolls to subsidise, for example with the 10,000SEK, because the government becomes reliant on the

existence of conventional vehicle drivers. This also damages the credibility of politics.” Reverse Robin Hood also expressed confusion that there are “no incentives to buy less. Now you get tax benefits for driving to work but not for using public transport, it should be the reverse.”

There was also quite a lot of praise from people like Pioneer who see the government strategy as very successful, although not viewed as being enough for the future. Significant comments from other parties included that the government must be clear in their strategy, and that they are “responsible for changing consumer behaviour”; AFVs cannot be just “a fling”. There is an opportunity to be less dependent on other countries (for oil) and this should be made apparent. Engaged family also commented on how a sudden or predicted change in policy could effect when they buy a new vehicle.

Conventional vehicle owners

Rarely Driving Mother suspects that the “back-peddalling” [draw back of the purchase rebate] is indicative that the government no longer views the incentives as important, which would be unconstructive. Changing strategy in this manner is “stupid” and new money should be found from elsewhere. Guilty Changer who is on the brink of buying an AFV told of how she feels it is too big a risk to use her personal money (versus a company car) to buy an AFV as the government could change focus and destroy the second-hand market for her choice, adding “[this subject] contains lots of emotions and feelings”. On a more positive note, the strategy is viewed as concerted thought and action, with special focus on the consumer side. This therefore leaves room for more regulation on the supply-side (car industry) as well as greater effort on the research and development side.

4.2.2 Views on the Clean Vehicles incentives

AFV owners

All of the interviewees displayed their awareness of the purchase rebate and the exemption from the congestion charge. There was less understanding about the free city residents’ parking (Prius Commuter enquired whether she gets free city parking although living elsewhere), and no mention of the lower vehicle tax or the 1995 incentives.

Opinions on the incentives appear to be mixed amongst AFV owners. Most agree that it in general the incentives are highly positive and should continue. It is seen as good that the government is supporting the adoption of AFVs through the “period of slow realisation” and that the incentives are “user-friendly” e.g. the 10,000SEK requires no calculation and not having to think about the congestion charge is a convenience as well as a financial saving (and is also relatively cheap for the government). Pioneer wondered if the same impact might be achieved by offering only 5,000SEK

(based on the popularity of an industrial measure where companies get a tiny tax rebate of 0.5öre/kWh for energy efficiency measures). Other positive comments include that the incentives help improve awareness of AFVs and by offering a rebate, should speed up the renewal of the vehicle fleet on the road today- a “catalyst for the market” as Pioneer put it.

Those who expressed doubt over the incentives did so by pointing to the impact they will have on increasing ethanol production (which several subjects now view as a highly controversial alternative) and frustration that the government has shorted the purchase rebate period. Furthermore with regards to the 10,000SEK, some felt that it probably was not enough to make a difference given the cost of buying a new car and also that it constitutes “a sort of reverse Robin Hood”¹³⁰. This remark was made by the AFV owner, Reverse Robin Hood, who sees the rebate as unfair in how it uses public finances to subsidise the rich (i.e. those who can afford to buy a new car) and also that it is “stupid to give people money to buy cars. People that don’t buy cars should receive double”. Prius Commuter also raised the point that if the congestion charge is truly intended to decrease city centre traffic then it should be applied to all cars not just conventionally fuelled choices.

Conventional vehicle owners

General awareness of the incentives was lower with this group. All subjects gave quite vague support for the incentives they were familiar with. Some more specific comments were that “it’s important that they sound good even if they don’t make such a major difference” and that it “must feel good to get something on top of the inherent pleasure of buying an AFV”. Whilst Young Sporty Driver estimated the collective package to be of significant financial value, especially as a city resident, Car Donee and Rarely Driving Mother reflected on the purchase rebate as probably too small to have a significant impact. In the middle of this continuum of opinions was a comment that as the 10,000SEK is not actually that much money (as a percentage of the cost of a new car) it is “a cheap way to trick people”. The same commenter, Guilty Changer, also mentioned knowing several people who have bought an AFV simply because they were angered by paying the congestion fee and for parking (which she sees as “too cheap anyway”).

4.2.3 Views on the effects of the incentives on future ownership

AFV owners

The almost unanimous opinion amongst AFV owners was that the incentives have not affected their future car ownership, namely because it was their values that led them to their current vehicles, not the incentives. Retired Politician commented on how in his first period of ownership (2004/5) he would refuel his flexi-fuel car with petrol in the winter and E85 [85% ethanol, 15%

¹³⁰ Robin Hood is a figure in English folklore that notoriously steals from the rich to give to the poor.

petrol] in the summer because it was cheapest to do so. When ethanol became cheaper he switched to using it all year round and will continue to do so even if the price rises, as he does not want to cheat the congestion charge¹³¹. Engaged Family have also stomached any E85 price rises to provide continued sales for their local garage (who will therefore continue to stock it).

Conventional vehicle owners

Of the conventional vehicle owners half claimed the incentives have had no effect and in the words of Guilty Changer, a forthcoming convert- "it is not modern to not buy an AFV. If you can go on holiday for two weeks to Thailand, you can buy an AFV". The other respondents said the incentives will impact them if they decide to move into the city centre.

4.2.4 Views on those most affected by the incentives

AFV owners

When asked about whether they thought there are certain groups of people more likely to be affected by the incentives, the AFV owners provided a variety of answers. Sixties Child highlighted those "occupied with their own situation", people who are only looking at personal gain thus, the incentives might turn them into an AFV supporter. She gave ex-smokers as an example in that education failed to reach them, the change had to come from within and with conventional vehicle buyers, the incentives might be the way to achieve such a gain. Necessity Driver reiterated this in saying that the economic incentives can change people's perspectives and start "non-greens buying green". A further take on this persuasion angle was when one half of a couple is motivated by the environmental benefits of an AFV they can use the economic appeal to sway their partner.

The other major group suggested as being heavily influenced by the incentives are those middle-aged families thinking about their children's future and similarly older people considering their grandchildren. Additionally, commuters and city residents (who faced recently raised parking prices) were put forward as susceptible candidates. Pioneer commented that it is only ever first time AFV buyers who are likely to need the incentives, by the second round you are definitely convinced of the benefits.

Conventional vehicle owners

As well as mentioning the same family structures of young families and grandparents, and also those couples with split priorities, young people were highlighted as especially *uninfluenced*. Young consumers are targeted for being perceived as unengaged in environmental issues but also as having less disposable income and thus, restricted by the lack of cheap AFVs (little second hand choice). The same assertion was also applied to people with low incomes in general. One

¹³¹ Flexi-fuel AFVs are exempt from the congestion charge even if they are being fuelled with petrol.

additional group also cropped up- those who take pride in “cheating the system”. By receiving financial incentives to buy and drive a flexi-fuel vehicle and then drive it on petrol, “a group of 50+ year old men have found a perfect way to cheat”.

4.2.5 Views on continued conventional vehicle purchases

AFV owners

When asked about why they thought people have continued to buy conventionally fuelled vehicles during the Clean Vehicles project, the most common conjecture were about product fit and engagement. Engaged Family mother mentioned her brother’s interest in the history and development of a model whilst several others cited families looking for a medium-sized medium-priced vehicle, those seeking something sporty and those searching for certain brands, as being left un-catered for. As well as the vehicle priorities not being met, more general priority variance was often given as a contributing factor. People’s lack of interest and engagement in better environmental behaviour was explained by suggesting they simply do not care and thus do not investigate the impact of their behaviour; a difficulty in comprehending the nuances of environmental vehicle impacts; the media’s role in creating uncertainty (with biofuels); and a resistance to change (habits). In support of the role habits play, Pioneer quoted a study by the Swedish Road Administration which found “that habits are the first, second, third and fourth most important factors in resistance to change”!

Several people also focused on location as weighing prominently. Firstly, this came as a practical comment about the availability of fuels outside the big cities but also a suggestion about mindset. “Stockholmers” are seen as more engaged in such big debates and supplement this by reading national newspapers etc. Prius Commuter, a village resident, commented on how she sees city-dwellers, visiting their summer houses in the area, buying locally farmed organic eggs whereas “people in the country live in their own small world, reading local papers, not caring”.

Conventional vehicle owners

A lack of environmental engagement cropped up in this group also, as did the lack of alternatives for e.g. sports cars. One additional point was mentioned several times and that was price. Because there is a relatively small second hand market for AFVs (with a more narrow range of alternatives than on the new market), those without the means to buy a new AFV must look elsewhere. As a follow on to this point, Rarely Driving Mother said how she therefore could not understand why “monster truck, SUV drivers don’t buy an AFV.” In Guilty Changer’s opinion exceptions could only be granted in circumstances that required a specialised vehicle (e.g. with wheelchair access) and thus, when her friends who do not have such requirements continue to buy conventional vehicles, she wonders if she should still be friends with them. She added, “I think my boss is a

hypocrite to be CEO of a company that pretends to care and then to drive an XC90 [Volvo SUV].”

4.2.6 Views on alternative incentives

Given their own experience of owning a vehicle during the Clean Vehicles project the interviewees were asked about any alternatives that they felt might assist the Administration’s goal of increasing the number of AFVs in Stockholm.

AFV owners

Most suggestions were given an economic focus. Most owners agreed that there needs to be a clear economic incentive at the pump to buy an AFV or to refuel their flexi-fuel vehicle with the non-petroleum option. Bad Weather Driver suggested ensuring sufficient ethanol subsidies to guarantee its cheapness but Reverse Robin Hood declared such a strategy dangerous as it “gives manufacturers a free ride to price hike knowing they will get subsidised”.

Information is seen as another area not being fully utilised. By providing a clear target e.g. Stockholm/ Sweden being conventional car free by 2020 would give clarity to buyers and force car dealers to educate buyers. Additionally, it was suggested that motorists need to be made aware of the “true cost” of the [conventional] fuel they are using- “what you pay at the pump is not the true cost as it excludes externalities. There is systemic failure and some people are visibly paying- with their lives in wars. The environment is currently the small concern with gasoline. Politics is so involved. It is others who are paying the externalities.” These comments were made by Necessity Driver who proposed gaining public support for reducing Sweden’s dependence on oil producing nations and in the short-term, as someone else suggested, differentiating peaceful oil and starting a ‘buy local’ campaign i.e. Norwegian.

To reassure AFV buyers of their choice, it was proposed that the government could produce full life-cycle analysis of the AFV choices and help consumers to understand the long-term effects of their decisions. In going one step further, Necessity Driver suggested the government pick a single AFV e.g. biogas and champion it as the sole choice. In contrast to this idea Retired Politician felt strongly about panning out from a single strategy (AFVs as a whole) and engaging the public in a wider debate about the environment. Other actions which this group felt are necessary are a system for ensuring flexi-fuel drivers are not refuelling with petrol and then evading the congestion charge; extending free AFV city centre parking to non-residents; and the necessity to make it easier for refuelling stations to sell alternatives i.e. “make AFV fuel easier to use and sell and conventional harder and more expensive”. This was felt to be especially important outside of the city centre. To this point, Reverse Robin Hood quoted a television documentary on refuelling

stations closing down under the cost pressure of alternative fuel pump installations. Finally, that the congestion charge continues to adapt with the technology only giving exception to those with the most advanced vehicles.

Conventional vehicles owners

Again, the necessity to distinguish alternative fuels on a financial cost basis was raised. Young Sporty Male mentioned subsidies as an objection to higher taxes on conventional fuels as they “only punish those who can’t afford to change”. As AFVs are still relatively new, Car Donee suggested offering 10,000SEK worth of additional services instead of the rebate, such as servicing (which will also prolong the car’s life) or insurance to reassure buyers. The best (most convenient etc.) city parking places could also be prioritised for AFV drivers. Whilst subsidising second-hand AFV purchases was thought to be too difficult to administer, Car Donee thought that a financial package of favourable loan conditions and insurance should be made available, especially to youth drivers learning to drive who could also be taught economical driving skills.

Young Sporty Male believes in the power of market forces in that the growth opportunities offered by AFVs should be sufficient to stimulate private and public R&D to bring down the cost of AFVs and to improve their efficiencies further. However, “the government could increase what they are doing or at least communicate it better to the public.” Additional communication about AFVs was suggested via ambassadors to improve word of mouth, as well as add-ins and articles in target-group magazines etc. These could focus around e.g. the school run in women’s magazines, drawing links between child health and emissions- a way to satisfy the general necessity for better education. Extra information should also come from a designated AFV specialist at large sales showrooms, as currently “the cars are on the market but the staff aren’t educated”. Finally, these drivers also pointed out the necessity to improve the outer-city refuelling infrastructure and to declare “no petroleum in Stockholm by 2018”. Filling the gaps in the market for e.g. mid-sized biogas cars and getting the exclusively Swiss multi-fuel editions of the Volvo V50 and V70 available in Sweden¹³².

4.3 Views on information about product and market variables

Whilst there may have been a small amount of value in asking the interviewees where they find information about conventional vehicles, given that it is the métier of the multi-billion dollar vehicle manufacturers to ensure that consumers have rich information about their products via as many channels as possible, the focus was placed solely on the primary product, AFVs instead, as well as the Clean Vehicles project.

¹³² These cars can run on ethanol, gasoline, compressed natural gas (CNG) or biogas.

AFV owners

Most buyers mentioned that there exists a mass of information on AFVs and the Project available to anyone who cares to look for it. Several buyers turned to specialist sources like the ‘*Green motorist*’¹³³ website, dedicated books and for Pioneer, information available at work. Given barriers to the required knowledge are: conflicting time pressures (such as children); a lack of clarity (Sixties Child named an expert friend who even struggled); and difficulties in converting the information into the right decision, especially given “scare stories in the media” (about ethanol). Bad weather driver said how she does not blame the government for the challenge of digesting information- “you can’t go from zero to ten immediately” and that a breadth of information is required because people have different requirements, it is important to keep the information flowing especially when the formal incentives decrease.

Conventional vehicles owners

Conventional vehicle owners generally had less knowledge about AFVs and the Project but what they had gathered was typically from the general media. The struggles they faced are in assessing the reliability of the source as well as converting the mass of data into meaningful conclusions on which to act. Word-of-mouth also played a strong role for this group. The one outlier was Guilty Changer who has both worked in the environmental and transport sectors and also in corporate sustainability roles.

4.4 Additional topics

These additional questions extend previous research by asking interviewees about their views on the future of alternative vehicles per se, as well as that of their car ownership.

4.4.1 Views on the near future of AFVs

AFV owners

The AFV owners raised a variety of opinions in conjecturing the near future of AFVs in the county. Consensus was presented by the majority of interviewees on the importance of the national economy. Retired Politician commented that, “people need to feel safe and satisfy basic needs first before the environment. Private concerns come before the public ones.” If people feel the financial pinch they will make short-term decisions based on the immediate costs they face i.e. vehicle purchase prices. In contrast those who feel that if petrol and diesel prices continue to rise then people will react with their buying decisions. “The debate must be kept alive” and the financial sense to buy AFVs will support this.

Whilst “green is a fashion right now” many viewed the ball as already rolling and AFVs as “no longer strange”. Engaged Family gave the example of their neighbour who lost significant money in

¹³³ Grönabilister (<http://www.gronabilister.se/>).

switching his nearly new petrol Volvo XC90 (SUV) for an imported flexi-fuel Mitsubishi Pajero (SUV). In addition to the economy, one additional hurdle is the manufactures that lack the incentives to move faster as well as needing to plug the gaps in the AFV market. Pioneer saw electric hybrids (and soon, fully electric vehicles) accelerating in popularity in the market, as ethanol is really only a stepping stone, though an important one at that.

Conventional vehicles owners

Conventional vehicles owners saw the continued growth of AFVs based on the growing engagement of the average citizen (though retailers will also need to be more actively involved), especially as a second hand market develops. Additionally, as part of the economic downturn individuals and companies will curb car purchases and thus as AFV sales continue or grow, they will increase their proportional market share. However, as AFVs age unique functional problems may arise which will require special maintenance and also as the average conventional car becomes more fuel efficient, the difference in AFV performance will shrink.

4.4.2 Views on the causes of vehicle replacement

AFV owners

When asked about what is likely to prompt the replacement of their AFV, several respondents supposed traditional problems such as when it gets too old and begins to break down mechanically, but many also talked about motives like technological improvements. “If a plug-in hybrid was available”, and when “I can replace the motor with one which runs on a better fuel” were comments supporting this view. There was also some disagreement over ethanol with Necessity Driver calling it a “stop gap” with the process ongoing to seek an “alternative for the alternative” and Engaged Family calling their ethanol vehicle “far too thirsty” (they also relayed agreement from the taxi drivers they have asked who also use ethanol). In contrast, Prius Commuter sees ethanol as the future rather than the present and thus they may buy one in the future. Bad Weather Driver and Pioneer also mentioned that when their children grow up they are likely to change their vehicles.

Conventional vehicles owners

Again, if a vehicle begins to break down regularly, becomes unsafe and costs a lot in maintenance, it is likely to be replaced. Owners would also be attracted to a purchase if there were stronger economic incentives to do so. These owners also cited changes in lifestyle in that the arrival of children or acquisition of a summerhouse, or a move to the city centre would also incite change. Guilty Changer feels pushed from her current petrol Audi as it “uses too much fuel and is too big and I don’t want to be the one driving that kind of car”.

4.4.3 Views on the causes of vehicle abandonment

AFV owners

Developing from the conversations about vehicle replacement, subjects were asked if there was anything that would likely cause them to forfeit their right to vehicle ownership. Most owners have experienced or can imagine life without a car as a city resident (relying on public transport and taxis), but outside the centre it is difficult to manage and thus improvements in frequency and destinations (including summerhouses) were named as necessary. Indeed Sixties Child knew she would sell her car when she moves to an apartment in the city next spring.

Car clubs and car-pooling were also seen as alternatives though those who had investigated them alluded to the marginally high cost and inconvenient amount of planning required. Engaged Family mother also told of how she would be quite happy using a Class II moped¹³⁴ with which to commute on the cycle paths, if one was available in an environmentally-friendly electric version, but there is not as the rules governing the use of mopeds on the cycle paths are incompatible. Finally, the position of simply having less money would force Bad Weather Driver to give up her car.

Conventional vehicles owners

Rarely Driving Mother stated how despite living adjacent to a metro stop, she feels she could not give up her car until there are more places for prams on the buses she would need to use to satisfy her travel requirements. For another mother, her young children will have to grown some years before she can envisage being car free. Others cited the need to make waiting for transport less of a hardship in bad weather.

5. Analysis

The interviews revealed some outcomes in line with the findings from the literature review, and also some unexpected insights such as the deceitful flexi-fuel drivers, which would be unlikely to emerge from closed-question research. This section analyses the most interesting results of the two interview groups, which are combined and considered in relation to the research questions. Application of the empirical findings to the literature model from *Section 3.8* completes the analysis.

¹³⁴ Class II mopeds are those limited to 30km/hr with an engine capacity of max. 1kw. Due to these restrictions and others, it is impossible to have a functioning electric moped that abides by these rules.

5.1 Question 1

- Do private vehicle owners view AFV ownership as different from conventional vehicle ownership?

The conventional vehicle market is very mature whereas the AFV market is relatively new¹³⁵. As such, the range of AFVs (brands and models according to respondents) available on the market in Sweden is far more restricted than that for conventional vehicles, despite the gap narrowing in recent years. Whilst on a personal level price was not highlighted as being so important by any of the drivers, interviewees still made comments about the lack of cheap AFVs, in keeping with the *higher price barrier* identified by Cao¹³⁶. Taking, for example, the cheapest conventional fuel cars by Hyundai¹³⁷, Citroen¹³⁸ and Peugeot¹³⁹, due to their relatively low emissions and high fuel economy they are classed as AFVs, representing little difference at this end of the market. However, that is not to say that AFV purchase prices remain comparable to their conventionally fuelled counterparts as you move up the range. Indeed, higher purchase price is a criticism that has often been levied at AFVs in modern times¹⁴⁰, though there is promise of the gap narrowing¹⁴¹. Engaged Family and Guilty Charger highlighted the particular lack of a medium priced, medium sized family car for instance. In addition, these *product factor* gaps will remain inhibitive especially for those who habitually stick to a certain manufacturer or model of car, which is something Pioneer commented on too.

Those who are looking for the relatively cheapest AFV alternative in any product class may of course look to the second hand market. The limitations of the second hand market arose numerous times, most clearly in Sporty Young Male's case. It is due to these gaps in the (cheap) *vehicle availability* market that leads to AFV ownership being potentially more expensive. AFV owners therefore are suggested as having greater financial freedom, which permits greater choice and the ability to act on personal convictions. For instance, in the case of the Engaged Family, where both parents have (presumably) well-paid jobs, they stated how they have continued to buy E85 even when it has been more expensive in order to support the industry. Additionally, they said that if a new manufacturer solely producing AFVs came on the scene they would "take a financial hit" in order to give them their custom. Bad Weather Driver hinted that there is *social pressure* in the middleclass area where she lives to drive an AFV, which adds another angle to the view of financial difference between the groups.

¹³⁵ Bitard (unknown).

¹³⁶ (2004).

¹³⁷ The i10 1.1 e-Base at RRP 89,900SEK incl. VAT (<http://www.miljofordon.se/fordon/detail.aspx?fordonid=442> Last accessed on 22 October 2008).

¹³⁸ The C1 1.0 ix at RRP 92,300SEK incl. VAT (<http://www.miljofordon.se/fordon/detail.aspx?fordonid=716> Last accessed on 22 October 2008).

¹³⁹ The 107 1.0 X-Line at RRP 105,900SEK incl. VAT (<http://www.miljofordon.se/fordon/detail.aspx?fordonid=733> Last accessed on 22 October 2008).

¹⁴⁰ Cao (2004); Byrne and Polonsky (2001); Belz (1998) etc.

¹⁴¹ Autocar (2008).

Views on drivers' families and their strong impact became apparent in the *reasons for vehicle ownership* and also in the answers identifying the necessary changes required to change or abandon vehicles. Vehicle ownership allows all drivers to do food shopping for the whole family and collect items to build and furnish the family home. Several comments were also made about the positive impact bad weather has on using the car and also e.g. in Pioneer's case, giving a lift to a child. These results seem to fit well with Mackett's findings in *Section 3.4* that some of the dominating reasons for using the personal automobile are the transportation of "heavy goods", providing a "lift for a family member", and "bad weather". It would seem reasonable to presume that those respondents to Mackett's survey alluding to family holidays would give the answers of "lift for family", "long way" and probably "convenience". Again this is well aligned with the commonly quoted Swedish activity of going to a domestic summerhouse. The only significant difference between the ownership groups is that "convenience" appears to be responsible for more conventional vehicle use. If, as the data suggests, AFV drivers are interested in reducing their environmental impact and thus, reduce their total vehicle use whenever possible, the trips based on convenience would logically be the first ones to erase.

The attributes viewed as deciding most owners' vehicle choice were quite restricted. The entire interviewee pool expressed concern for the environment to various degrees. Even Young Sporty Male, a petrol car driver and arguably the least likely of the group to do so, would prefer to have an AFV if a suitable one was available i.e. the requisite *consumer demand*, as suggested by Wong et al.¹⁴², exists, but the *supply* is missing. Whilst lower vehicle *emissions* is the typical standard for measuring ecological concern in vehicle buying, the results here show that people's concerns may be much wider reaching. Conventionally- and alternatively fuelled vehicle drivers alike talked of a desire to reduce cross-national dependence on oil for security and peace reasons, as well as expressing serious concerns over the production of alternative fuels, namely ethanol. There was little mention of *cruising range*, *fuel flexibility* or *fuel availability* during the buying criteria discussions. This is likely due to the interrelatedness of these factors and the vehicles owned. To clarify, all of the interviewed AFV drivers have vehicles which can run on electricity or ethanol and petrol and therefore their flexibility means that *cruising range* and *fuel availability* do not have to be critical concerns, just ideological ones. Additionally, as was mentioned in *Section 3.3*, concerns about such factors may be lessening with time as firstly, improvements in technology are made. Secondly, a study this year also found the availability of Sweden's most popular alternative fuel, E85 has been improving at a steady rate with a little less than a third of all refuelling stations nationwide stocking it¹⁴³.

¹⁴² (1996).

¹⁴³ Bederoff and Zang (2008).

Vehicle size was the other prevalent vehicle attribute, though it failed to distinguish the ownership groups. Those owners who had already provided transportation and family-based reasons for owning a vehicle unsurprisingly owned vehicles large enough to accommodate these requirements, which fits with Cao's¹⁴⁴ finding of household preference for *spacious cars*, though not especially *powerful* ones. As a result, it appears that *probit model personal preferences* cannot provide significant differences between AFV and conventional vehicle ownership in the cases observed here.

5.2 Question 2

- Do private drivers view the Clean Vehicles in Stockholm Project as catalysing the sale of AFVs?

For most of the interviewees the Clean Vehicles in Stockholm project begins and ends with the incentives. The incentives are the typical depth of engagement with the programme and are generally viewed as being a positive step by the government- perhaps a reflection of the combination of *push* and *pull factors* and that they require almost no *behavioural change*. Vehicles owners interviewed here said they were not personally important, though subjects may feel socially compelled to say they are motivated to purchase AFVs due to their superior environmental performance rather than the Clean Vehicles incentives, mitigating the *social risk* associated with a *high involvement purchase*. The greater anonymity granted by an electronic or postal survey may help to overcome this potential barrier.

The purchase rebate is generally believed to be too small to have a significant impact and could possibly be put to greater use as specialist insurance or a maintenance package, to lessen some of the *emotional* and *financial product risks* associated with adopting a new technology¹⁴⁵. Such a tactic may also go some way to satisfying anyone dissatisfied with the direct subsidisation of those wealthy enough to buy a new car. However, although not mentioned by any of the interviewees, it may be the *immediacy of delivery* noticed by Gallagher and Muehlegger¹⁴⁶ that gives this incentive its potential advantage over some of the other measures. The rebate is also a *pull factor* that should help to boost its popularity. The sole *push factor* for conventional drivers, the congestion charge was also the only one to be criticised, in fitting with the Eriksson¹⁴⁷.

The interviewees viewing those as generally inherently motivated are the parents and grandparents concerned for the habitat of their children and grandchildren. The logical suggestion therefore is to focus incentives at those without children, especially those, this research would

¹⁴⁴ (2004).

¹⁴⁵ Blackwell et al. (2006).

¹⁴⁶ (2008).

¹⁴⁷ (2008).

suggest, who are not engaged in environmental issues for whatever reason, live outside the city, and are youthful in age.

There were also some subjects quite willing to criticise the Project primarily on the grounds of a wider political debate about, what Retired Politician views as, a strong single issue pursuit and also, the perceived absurdity of “paying people” to buy *any* sort of car. The purchase rebate is not based on a feebate system. Instead, the government simply set aside 50MSEK for 2007 and 100MSEK per year for 2008 and 2009 from general funds¹⁴⁸. This means that the government can be viewed as “paying people” to buy vehicles with public resources. If, as has been cautiously suggested here, it turns out that AFV buyers are higher-income earners, then they are the ones receiving a higher percentage of purchase rebates. In observing a similar phenomenon with hybrid vehicles in the United States, Diamond¹⁴⁹ suggests that preventing rebates going to consumers with incomes over a certain level may help prevent a regressive distribution of the tax money required to fund those incentive programmes. Partially due to the viewed unsustainability of the current approach, some people see the present strategy as successful but insufficient for the future. As the rebate funds ran out sooner than had been predicted¹⁵⁰, this caused a revision to the policy (ending of the rebate) and also removes the option of using the funds in any of the other manners suggested in the findings. Changes in policy, such as this may not be harmful to ownership decisions in that it is fairly clear to consumers whether an incentive is applicable or not. However, the idea that the government is prone to changes in policy may not only damage the credibility of politics as suggested by Retired Politician, but also heighten *purchase decision risk*. Without offering sufficient clarity about the future of AFV ownership, buyers, such as Guilty Changer and Engaged Family, will not be *persuaded* as Geroski¹⁵¹ suggests they must, to invest their own money in a purchase. Interviews conducted with Swedish car suppliers reveal that they too are fearful of a sudden change in Government strategy and require the reassurance of “fixed-term rules and a clear strategy” in order to invest in an AFV launch¹⁵². Unstable strategy in Brazil caused a “lack of credibility in [the] program”¹⁵³ and proved detrimental for AFV sales. For drivers who are reliant on their car on a day-to-day basis the *product variables* weigh deeply in their purchase decision involvement. If, for instance, a buyer is fearful that the hybrid car they buy is unlikely to be reliable or, that it will become worthless in a few years when the government ceases to champion the technology, the government must provide information, not just financial incentives, to *persuade* the buyer of the purchase.

¹⁴⁸ VVSP (2008).

¹⁴⁹ (2008).

¹⁵⁰ Sveriges Radio (2008).

¹⁵¹ (2000).

¹⁵² Miljöbyrån Ecoplan (2005:5).

¹⁵³ Tavares (unknown:15).

For some drivers the incentives are catalysing adoption for reasons other than the environmental and financial ones. There is a suggestion that the congestion charge (the sole *push factor*) and the free residents' parking are having a greater impact due to their convenience, a time saving, rather than in the pocket. For the AFV driver these incentives *improve efficiency* (less time paying etc.) and therefore match Eriksson's¹⁵⁴ postulations about incentive effectiveness. Seeing as the intention of the incentives is to increase AFV uptake irrespective of how they do so, and also given that some interviewees judge that these incentives are "quite cheap" to provide, this could be considered a success. In fact there was much conjecture about the cost to the government, and financial benefit to the consumer, of the incentives. The government is presumably clear about their part but, as has already been suggested, consumers appear to find it troublesome to make accurate financial calculations about vehicle ownership choices. The 'tax dodgers' also see benefit in the incentives by continuously fuelling the flexi-fuel vehicles on petrol. This ought to be a concern for the Administration as they are subsidising these non-complying drivers via the incentives. Whilst *fuel flexibility* is itself an attractive factor for certain buyers, those not matching the requirement of refuelling with E85 (or higher percentage ethanol fuel) should not evade the congestion charge nor get free residents parking.

When it comes to the suggestions of how the Project might more effectively catalyse adoption several noteworthy comments were made, many of which have been included elsewhere in the analysis. The matter of taxes and subsidies will not be discussed further. This is a highly contentious area and thus has attracted a wealth of academic and popular focus of much greater richness than could be dealt with here¹⁵⁵. A relevant point from the literature review which should be reiterated here is Eriksson's¹⁵⁶ finding that revenues from *push factors* such as taxes when used to finance *pull measures* e.g. subsidies, have been found to gain higher acceptance than when those revenues simply enter the exchequer. Some drivers (especially non-city residents) thought the AFV free parking should be extended to those living in other areas of the County. Whilst this would serve as another *pull factor* for AFV drivers, it would also encourage people to take their cars into the city centre instead of using public transport, which is not something the Administration is aiming for. Drivers also considered that prioritising AFVs for the most convenient residents' parking spaces could be a useful tactic as well. Two problems with this idea present themselves (i) there is unlikely to be consensus over what the most convenient parking is, (ii) conventional drivers who bought their properties in consideration of the available parking may become malcontent if the situation changes (possibly devaluing their property too).

¹⁵⁴ (2008).

¹⁵⁵ The reader is directed to the World Bank publication *Trends in Fuel Taxes (and Subsidies) and the Implications* (2001) as a starting point for this field.

¹⁵⁶ (2008).

5.3 Question 3

- Do private vehicle owners view themselves as having the necessary information to consider buying an AFV?

It is worth continuing the discussion on vehicle market gaps initiated in Section 5.1 from an information perspective. Some of the gaps identified may well just be the perceptions of the interviewees rather than reflections of the true situation. The reason the interviewees viewed



these gaps could be because the information about the *hardware* is not making its way to the consumer (the hatched information barriers). To ascertain if this is the case or not, one would need to take each alleged gap and compare it with the models available

on the Swedish market. However, in at least the situations faced by the Engaged Family and Young Sporty Driver, these gaps are very likely the reality as both parties had conducted extensive searches into finding vehicles to fit their needs. Thus it is *supply-side* actions that are maintaining the *words-deeds inconsistency* for these consumers. Guilty Changer also provided one specific example, the multi-fuel Volvo, of where national *product availability* was an issue. Whilst the desire for a multi-fuel, mid-priced, mid-sized car is satisfied at the European level i.e. available in Europe, this car is not actually available in Sweden¹⁵⁷.

Most of the interviewees viewed there to be a lot of *information* available about AFVs and the Clean Vehicles project yet it takes significant time and effort to find and evaluate everything, which slows or hinders the “process of persuasion”¹⁵⁸ to make a purchase. The *learning and search costs* are played-off with other conflicting demands on individual time. Reverse Robin Hood acknowledged that most people simply struggle from a lack of available time and thus parents are more concerned about looking after their children on a daily basis than ensuring climate change does not jeopardise their future. Retired Politician sees the current economic pressures on the individual as displacing wider issues, like the environment, of concern to the public at large. He illustrated his thoughts with reference to Maslow’s Hierarchy of Needs whereby the economic downturn is making it increasingly difficult to satisfy the basic needs of food and shelter [i.e. *consumer variables*] and thus, the strive for higher goals are put on hold. Because of the various pressures on personal time and the differing preferences for information (in format, complexity, nature etc.) there is a necessity for information that is personalised rather than general¹⁵⁹. The non-profit website *Clean Vehicles*¹⁶⁰ (www.miljofordon.se) run by the Stockholm, Malmö and Gothenburg city administrations *spreads news* on available vehicles, fuels, fuel availability, the

¹⁵⁷ NGV Global (2008).

¹⁵⁸ Geroski (2000:609).

¹⁵⁹ Eriksson (2008).

¹⁶⁰ Author’s translation of “miljöfordon” given the Administration’s translation of “Miljöbilar i Stockholm” as “Clean Vehicles in Stockholm”.

incentives etc. a selection of which factors can be compared easily. Many of these considerations are those Byrne and Polonsky¹⁶¹ suppose as requisite to AFV adoption. If the site is viewed as being *easy to use*, having *high compatibility*, being *trustworthy*¹⁶² and providing necessarily personalised information, this portal along with the newsletters and other information channels used in the Clean Vehicles project could, if distributed correctly, be providing some of the needed *accompanying information* to *persuade* those considering AFV ownership and to reassure those that currently do.

There is, however, some information desired by the interviewees viewed as missing from this primary Clean Vehicles information channel. From the descriptions about buying criteria and the comments about second hand cars and fuel prices etc. *cost*, the importance of which was identified by Cao¹⁶³, clearly factors in buying decisions. Some people estimated parts of the *operating costs*, such as Reverse Robin Hood who considered purchase price versus usage, but generally it was thought to be “too hard work”. Also “[f]or resource-saving technology, there is the additional uncertainty that the economic value of such savings depends on future resource prices, which are themselves uncertain. This uncertainty about future returns means that there is [a financial] “option value” associated with postponing the adoption of new technology”¹⁶⁴. Similar forecasting difficulty has been encountered when trying to work out the environmental impact of various vehicle choices (see Section 4.1.4 Views on AFVs). Such hindrance can leave environmentally-engaged buyers involved in *high involvement purchases* unsatisfied and so they are likely to *extend their search* until a satisfactory alternative turns up or, to *abandon their AFV purchase* altogether when necessity takes over. This should perhaps not come as a surprise given the average citizen cannot be expected to comprehend the significant difference between 140 grams/km of CO₂ and particle emissions of 8 mg/km, and even for those who can, the debate on biofuels and sustainability has been so intensive in recent years¹⁶⁵ that there is still a minefield to navigate. Elsewhere it has been found that consumers struggle to calculate whether it is better for the environment to retain an old car until it naturally expires or purchase a ‘cleaner’ car, and thus put a new vehicle on the road¹⁶⁶. Furthermore, in addition to how well the car performs today, buyers are rightfully concerned (given the fluctuating popularity of some alternative fuels) with how it will perform in the future. Incomplete information may be sufficient for *innovators* and *early adopters* but not so for the *majority*. A number of personal examples were given in the interviews where suppliers and other sources were failing to provide *technological expectations* and *information* to reduce *learning and search costs* as the epidemic models of diffusion suggests they must. Geroski identified the

¹⁶¹ (2001).

¹⁶² The three factors most significant in determining the use of e-government services (Carter and Bélanger, 2005).

¹⁶³ (2004).

¹⁶⁴ Jaffe, Newell, and Stavins (2002:49).

¹⁶⁵ “Debatten om biodrivmedel och hållbarhet har varit intensiv i år” (Miljöfordon.se, 2008)².

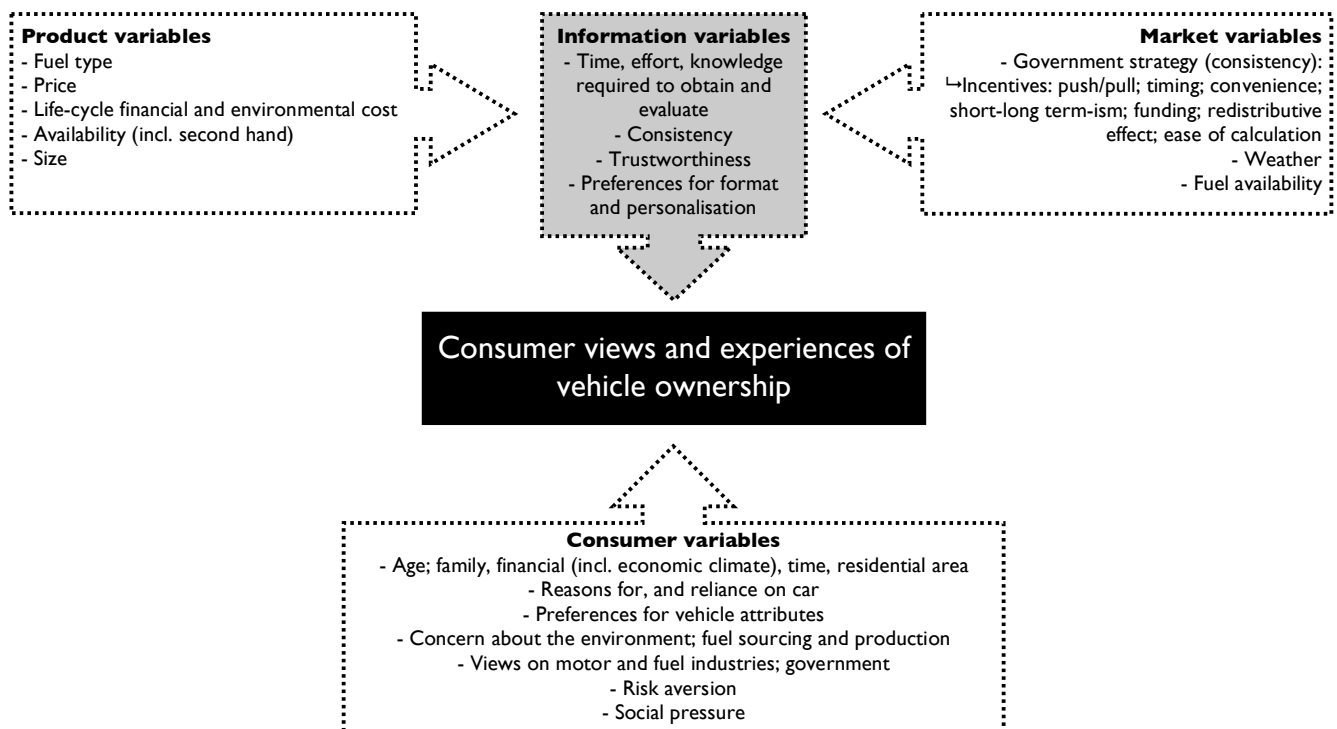
¹⁶⁶ Marell, Davidsson and Gärling (1995).

importance of suppliers as being “frequently responsible for facilitating the flow of information about the new technology, and, more generally, for marketing it.”¹⁶⁷ Given that AFVs have accounted for more than a quarter of new vehicle sales so far this year¹⁶⁸, it is perhaps unexpected that they are not viewed as keener to provide more information. As regards the Clean Vehicles website, other than links to articles in the press etc. there is little prediction about future government strategy or fuel/ technology development nor help with calculating the financial impact and environmental impact of various vehicles/ fuels and thus, the government is not providing all of this essential *software* either.

5.4 Post investigation model

The model proposed in Section 3.8 encapsulates the variables suggested by the literature review, which affect consumer views and experiences of vehicle ownership (within the set parameters). Figure 8 reformulates and develops the literature-based model in light of the analysis of the most significant empirical findings. Now that *Information variables* has been expanded to show their impact more explicitly, all of the variables identified during the investigation should fall into one of the categories. The post-investigation model therefore, summarises the findings of the literature and empirical exploration into subjective consumer views and experiences of conventional and ‘clean vehicle’ ownership during the Clean Vehicles in Stockholm project.

Figure 8: **Variables determining consumer views and experiences of vehicle ownership post-investigation**



¹⁶⁷ (2000:612).

¹⁶⁸ Örtengren (2008).

6. Conclusion

Figure 8 represents the most significant findings of the literature and this empirical investigation. More specifically, the investigation has also indicated, somewhat surprisingly, that AFV ownership is not viewed as being radically different from conventional vehicle ownership. Being a grandparent or parent (therefore age) may lead to greater engagement with environmental and political issues (plus related subjects like the fuel and motor industries) as may do living in more urban areas and having time to devote to such concerns. Different neighbourhoods may also pressure their residents to act in certain ways. This may substantiate a return to linking certain demographics and particular environmentally conscious consumer behaviour¹⁶⁹. Due to the deemed limitations of second hand sales and other price and functional gaps existing throughout the market, AFV ownership may be more restricted in the choice of vehicles though the owners appear to have the financial means to act on their convictions more readily. Owners' concerns about fossil fuels seem to go beyond their ecological impact though how easy the life-cycle environmental (and financial) impacts vehicles and fuels have also influences ownership decisions. This uncertainty around vehicle impacts may mean AFV owners are less risk averse.

Estimating the impacts of the Clean Vehicles project likely places the greatest want on the aforementioned wide-scale surveying. Initial examination shows there to be little alignment with views on the strategy and the vehicles people own. In general, the incentives are viewed as providing a catalytic role, though there are mixed feelings about the principles upon which they are based as well as their consistency and how easy their impacts are to calculate. Drivers also view several other measures as potentially successful in an incentive role.

Respondents viewed there to be a plethora of information on AFVs and the Clean Vehicles in Stockholm project, though many of the AFV and conventional vehicle drivers investigated here do not view it as satisfactory due to the time, effort, and knowledge required to obtain and evaluate the data. The consistency, trustworthiness, format and degree of personalisation may also impact on how information about the other variables is communicated to consumers.

7. Discussion and recommendations

The empirical investigation and analysis have explored subjective consumer views and experiences of conventional and AFV ownership during the Clean Vehicles in Stockholm project. This section discusses that material and draws out some policy recommendations.

¹⁶⁹ See Section 2.2.4.

The introduction provided the various EU initiatives; the government's total green house gas targets; the aim to rid Stockholm of fossil fuels by 2050; and the targets to increase sales of AFVs as a percentage of all new vehicles sold. The Clean Vehicles in Stockholm project has also been described as charged with the simple mission to “increase the number of AFVs in Stockholm.”¹⁷³ Stockholm's public transport body, SL, say they “work actively to increase the number of public transport travellers at the sacrifice of car use”.¹⁷⁴ There are also measures to increase the number of cyclists and pedestrians in the city¹⁷⁵. At the same time as one department is trying to develop sales of AFVs, another is promoting public transport and so forth. The incentives to buy an AFV therefore may have left some individuals, such as Reverse Robin Hood, confused that the AFV incentives encourage more consumption not less. If, as their targets suggest, the government's focus is more sustainable travel, then the ways to do so should be clear to individuals.

```
graph LR; S1[Step 1: Conventional vehicle] --> S2[Step 2: AFV]; S2 --> S3[Step 3: Public transport]; S3 --> S4[Step 4: Walk or cycle];
```

Step 1: Conventional vehicle

Step 2: AFV

Step 3: Public transport

Step 4: Walk or cycle

Full vehicle occupancy is best

¹⁷⁵ CIVITAS (2005)³.

The research conducted and reviewed here suggests the majority of drivers see their vehicles as travel solutions. This suggests that the government should consider readjusting their separate strategies and unite to move people along this chain of transport solutions from travelling in a conventional vehicle to walking or cycling- ‘Clean Movement in Stockholm’ perhaps. Janic¹⁷⁶ proposes the sine qua non of *specified* and *scheduled quantitative targets* in the effectuation of sustainable transport solutions. Something more affecting at the consumer level than the 2050 fossil-free target would serve as an overall focus for vehicle use and ownership decisions e.g. the interviewee suggestion of no conventional cars by 2020. Swedish car suppliers also view this as a necessary condition¹⁷⁷.

Whilst developing such a strategy would fill another thesis, a few initial recommendations can be made. Swedes have been shown to view individualised sustainable transport marketing positively¹⁷⁸. Nearly half of all day-to-day journeys in Stockholm are made for work- or school-related purposes with a further third accounted for by leisure activities¹⁷⁹. It could therefore be considered wise to focus travel solutions and their marketing on these tasks. A combination of measures should lead to the largest behavioural change¹⁸⁰ and thus it would be logical to use a range of measures pushing people from left to right and pulling them towards the next step whenever possible. Browsing through the measures taken by the 36 member cities of the CIVITAS project (see *Section 1.2*) you can see that the focus lies at the more general level of helping to achieve more sustainable, clean, and energy efficient urban mobility systems¹⁸¹. In Stockholm, this just needs to be communicated in a more perspicuous fashion.

In many ways the dominant focus of this paper has been on the transition from *Step 1* to *Step 2*, conventional vehicles to AFVs. Inceptive analysis of the current strategy has been provided here as well as some alternative incentives. A large-scale survey is required before any solid conclusions can be drawn about the most effective way to incentivise this transition. Several possible avenues for moving from *Step 2* to *Step 3* have also arisen during this research. Indeed Mackett¹⁸² found in the UK that “‘Improving public transport’ is the specific action which drivers say is most likely to attract them out of their cars’”. The government will have to identify if this is the same in Sweden. The most common reason for parents taking their children to school in the UK has been shown to be bad weather¹⁸³ and whilst the government cannot change the (even colder Swedish) weather, they can minimise the discomfort it causes by providing better bus shelters and

¹⁷⁶ (2006) as cited by Eriksson (2008).

¹⁷⁷ Miljöbyrån Ecoplan (2005).

¹⁷⁸ Loukopoulos et al. (2005).

¹⁷⁹ See *Section 3.4*.

¹⁸⁰ Eriksson (2008).

¹⁸¹ CIVITAS (2005).

¹⁸² (2003:348).

¹⁸³ Black (1997) as cited by Mackett (2003).

continuing to improve the network etc. The congestion charge could also be extended to charge all motorists though at descending rates, for example by starting with conventional vehicles, then high occupancy conventional vehicles, AFVs, and finally high occupancy AFVs¹⁸⁴. If there was a change in the law about the use of Class II mopeds using electric engines, it could be possible to add these to *Figure 9* directly before or after public transport (depending on the impact calculations). After all, “regulatory and consumer forces have been [shown to be] the most influential factors in triggering suppliers’ investment in green technologies”¹⁸⁵. Offering free public transport to anyone who gives up their right to car ownership for that period could be an incentive to move people further on, with safer and more convenient bike and pedestrian systems completing the transition.

As part of a ‘Clean Movement’ project, the Administration must continue their work promoting AFVs. Belz stated that “[m]arketing plays a vital part in introducing new ecological products/services and promoting new ways of living, which aim at the reduction of energy and material flows”¹⁸⁶. There appears to be an opportunity to enrich the AFV marketing by focusing not only on the environmental ‘savings’ people can make with AFV ownership but also the associated impacts of using oil. Necessity Driver commented on this aspect as has Diamond: “harmful emissions and resource security – create subsequent externalities and social costs, such as expenses for healthcare, environmental remediation and national defense, which are borne by [sic] not by the individual consumer but by society”¹⁸⁷. The city of Suceava has promoted alternative choices in such a manner, which requires effective communication of more information than the Administration is currently providing.

The study has shone light on several other alternative communication/ information options as well. After a search of the Internet, it appears there are no established websites dedicated solely to selling second-hand AFVs in Sweden. By building up a used-car section of the Clean Vehicles website, the Administration would take one step further to building a one-stop shop for AFVs on the web. The website could also be the primary tool for providing the other demanded information about relevant policy and technology projections; a tool(s) to help drivers calculate the life-cycle environmental and financial impacts of choosing particular vehicles (more than just their fuel efficiency and CO₂ emissions) and fuels; and layman’s explanations of those environmental impacts and fuel taxes and subsidies.

¹⁸⁴ Cameras would be needed to measure occupancy.

¹⁸⁵ Wong et al. (1996:266).

¹⁸⁶ (1998:2).

¹⁸⁷ (2008:18).

Some of the interviewees' comments (which need to be confirmed with hard data) also suggest it might be necessary to run print advertisements (including promoting the website) and editorials in rural area newspapers and publications as the residents in these areas may not be as engaged in the climate change/ fuel debate(s) as those living in metropolitan areas. Supplementary short-term actions include identifying a technical solution to ensure that drivers of flexi-fuel vehicles are fulfilling their refuelling requirements and the continued expansion of the alternative fuel *infrastructure*, especially the refuelling network in more rural locations. Not only would such expansion attract those who live in the vicinity of such a refuelling station to buy an AFV but also satisfy city residents who are travelling further afield and allow flexi-fuel drivers to refuel with E85 more often. The Administration would also be wise to keep an eye on the, as yet unreported, success of the projects recently launched in Germany, Italy and China.

Finally and perhaps most earnestly, the Administration is recommended to consider performing some of the further research suggested in the following section.

8. Further research

This section builds on the discussion and recommendations in the previous section in completing the thesis purpose by adding research suggestions that could strengthen theoretical and practical understanding in this field.

The Administration can only obtain valid pictures of consumer vehicle owners in Stockholm on the basis of reliable quantitative research. This research can be used to generate some of the falsifiable testable hypotheses for quantitative surveying. The post-investigation model *Figure 8*, in summarising this research, provides the *consumer*, *product*, *market*, and *information variables* categories, which can be used as the bases for research hypotheses. Examples of such hypotheses are:

Consumer variables:

- *Consumer risk aversion is negatively correlated to AFV purchases;*
- *Decision involvement is higher for purchases of AFVs than for conventional vehicles;*

Product variables:

- *Differences in available AFV and conventional vehicle attributes continue to inhibit purchases of AFVs;*
- *The state of the second hand AFV market inhibits the adoption of AFVs in Stockholm;*

Market variables:

- *Consumer fears about changes in AFV policy inhibit AFV purchases;*
- *Consumers would view the purchase rebate more positively if it was based on a feebate system;*

Information variables:

- *The consistency of information provided to consumers about the Project is positively correlated to its popularity;*
- *The Internet is the most popular way for consumers to receive information about AFVs and related policy.*

In addition to researching the above hypotheses or any others that can be drawn from the findings, it could be useful to have some statistical analysis performed comparing AFV sales with various key activities related to the Clean Vehicles project. Beyond that, it would be interesting to approach the topic from a marketing communications perspective and investigate the best way(s) to engage the different consumer groups in that manner. In line with the greater goal of lowering the city's environmental impact, it would be rational to look at the related impacts of bike/ vehicle/ bus/ train manufacturing, operation, and disposal etc. in making decisions about transport. One could also take any number of positions in further researching the roles the manufacturers and distributors of these transport methods have in promoting 'cleaner' movement, such as improving the availability of AFVs. The role habits play has also partially surfaced as an interesting topic in the field. Observing the impact of other market variables such as fuel prices, especially shock events like the outbreak of war in the Middle East or Al Gore's win of the Nobel Peace Prize, could also make for insightful research.

9. Reflections on the study

It can be helpful for both author and reader to acknowledge those aspects of the research which, given the chance to turn back the clock, the researcher would have done differently. Put concisely, it could have been beneficial to: expand the number of interviews by ensuring that those additional car owners acknowledged in *Section 1.6* were included in the subject pool; seek and employ a more accurate measure of financial status; analyse more project information channels; place more focus on the household decision making process including the different roles different people take; and to levy a specific question at the availability of alternative fuel rather than relying on volunteered information.

10. Acknowledgements

Specific acknowledgment is necessary for the support and advice provided by Susanne Sweet, the thesis supervisor. Thanks also go to Eva Sunnerstedt and Björn Hugosson, Project Managers for 'Clean Vehicles in Stockholm' and to Ida Örtengren at WSP Analysis & Strategy, Stockholm for answering questions and providing useful documents. Finally, gratitude is given to all of the interviewees who generously donated their time.

11. References

Autocar (2008). Hybrids getting cheaper. Available at: <http://www.autocar.co.uk/News/NewsArticle/AllCars/235457/> [Last accessed on 5 November 2008].

- BBC (2004). Congestion charging 'a success'. Available at: http://news.bbc.co.uk/2/hi/uk_news/england/london/3494015.stm [Last accessed on 5 November 2008].
- Bederoff, J. and Zang, Y. (2008). A market in transformation – a study on the diffusion of E85 on the Swedish market. Master Thesis at the Stockholm School of Economics.
- Belz, F. (1998). Eco-Marketing 2005- Beyond Environmental Management Systems. *7th International Conference of the Greening of Industry Network November 15-18*.
- Berlin's Senate Department for Heath, Environment and Consumer Protection (2007). Better Air for Berlin. Available at: http://www.berlin.de/sen/umwelt/luftqualitaet/de/luftreinhalteplan/download/Umweltzone_Broschuere_en.pdf [Last accessed on 24 July 2008].
- BEST (2008)¹. Fuel the Future. Available at: http://www.best-europe.org/upload/BEST_documents/info_documents/BEST_leaflet_v2.pdf [Last accessed on 15 September 2008].
- BEST (2008)². Participants / Stockholm. Available at: <http://www.best-europe.org/Pages/ContentPage.aspx?id=144> [Last accessed on 15 September 2008].
- Biogasmax (2008)¹. Issues and choices. Available at: <http://www.biogasmax.eu/biogas-biofuel-stockholm/biogas-biofuel.html> [Last accessed on 16 September 2008].
- Biogasmax (2008)². The project. Available at: <http://www.biogasmax.eu/biogasmax-project-biogas-and-biofuel/biogas-and-biofuel-for-sustainable-developpement.html> [Last accessed on 16 September 2008].
- Bitard, P. (unknown). Innovation in the Swedish Automotive industry [1995 – 2000], A sectoral comparative perspective. Division of Innovation, Lund University, Sweden.
- Blackledge, D. and Dura, D. (2007). Reducing the environmental and health impacts of transport – Transferring good practice from Western Europe to Romania. Polis Annual Conference, Toulouse, 15-16 March. Available at: http://polis.euregio.net/fileadmin/POLIS_EVENTS/March_2007_PolisAnnualConference/INTEGRATION_Suceava.pdf [Last accessed on 17 November 2008].
- Blackwell, R.D., Miniard, R.W. and Engel, J.F. (2006). *Consumer Behaviour*. 10th Edition. Ohio: Thomson South-Western.
- Brownstone, D., Bunch, D.S. and Golob, T.F. (1994). A Demand Forecasting System for Clean-Fuel Vehicles. Working Paper- The University of California Transportation Center. UCTC No. 221.
- Byrne, M.R. and Polonsky, M.J. (2001). Impediments to consumer adoption of sustainable transportation. *International Journal of Operations & Production Management*. Vol.21, No.12.
- Cao, X. (2004). The Future Demand for Alternative Fuel Passenger Vehicles: A Diffusion of Innovation Approach. Report prepared for the UC Davis – Caltrans Air Quality Project. Task Order No. 31.
- Carter, L. and Bélanger, F. (2005). The utilization of e-government services: citizen trust, innovation and acceptance factors. *Information Systems Journal*. Vol.15, No.1.

- China Daily (2006). Green Light Given to Eco-friendly Vehicles. Available at: http://www.chinadaily.com.cn/english/doc/2006-01/05/content_509482.htm [Last accessed on 24 July 2008].
- CIVITAS (2005). About CIVITAS. Available at: http://www.civitas-initiative.net/cms_pages.phtml?id=348&lan=en [Last accessed on 16 September 2008].
- CIVITAS (2005)¹. Clean vehicles in Bremen. Available at: http://www.civitas-initiative.net/measure_sheet.phtml?lan=en&id=71 [Last accessed on 16 September 2008].
- CIVITAS (2005)². Promotion of alternative fuels in the public and private sector. Available at: http://www.civitas-initiative.net/measure_sheet.phtml?lan=en&id=223 [Last accessed on 16 September 2008].
- CIVITAS (2005)³. Stockholm. Available at: http://www.civitas-initiative.net/city_sheet.phtml?id=30&lan=en [Last accessed on 16 September 2008].
- Dembkowski, S. and Hanmer-Lloyd. (1994). The Environmental Value-Attitude-System Model: a Framework to Guide the Understanding of Environmentally-Conscious Consumer Behaviour. *Journal of Marketing Management*. Vol.10.
- Dholakia, U.M. (2001). A motivational process model of product involvement and consumer risk perception. *European Journal of Marketing*. Vol.35, No.11/12.
- Diamantopolous, A., Schlegelmilch, B.D., Sinkovics, R.R. and Bohlen, G.M. (2003). Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business Research*. No.56.
- Diamond, D.B. (2008). Public Policies for Hybrid-Electric Vehicles: The Impact of Government Incentives on Consumer Adoption. Dissertation at George Mason University.
- Dimas, S. (2008). Commissioner responsible for the environment speaking at the Climate Change Conference in Prague, 31 October. Available at: <http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/08/570&format=HTML&aged=0&language=EN&guiLanguage=en> [Last accessed on 17 November 2008].
- DirectGov UK (2005). The effects of climate change. Available at: http://www.direct.gov.uk/en/Environmentandgreenerliving/TheWiderEnvironment/Climatechange/DG_072929 [Last accessed on 13 July 2008].
- DirectGov UK (2005)¹. Transcript of a short film on the causes and effects of climate change. Available at: http://www.direct.gov.uk/en/Environmentandgreenerliving/TheWiderEnvironment/Climatechange/DG_072984 [Last accessed on 13 July 2008].
- Ek, M. and Klingspor, N. (2001). Potential Demand for Alternative Cars – A Study of the Swedish Market. Master Thesis at the Stockholm School of Economics.
- Eriksson, L. (2008). Pro-environmental travel behavior: The importance of attitudinal factors, habits, and transport policy measures. PhD Thesis at the Department of Psychology, Umeå University.
- EST (unknown). Graz reduced parking fee for low emission vehicles. Available at: http://est.east.unep.ch/default.asp?community=est-east&page_id=551725E9-DB26-4004-92ED-42FDF5214053 [Last accessed on 17 November 2008].

- EurActiv (2004). Euro 5 emissions standards for cars. Available at: <http://www.euractiv.com/en/transport/euro-5-emissions-standards-cars/article-133325> [Last accessed on 13 July 2008].
- European Environment Agency (EEA) (2008). Curbing CO₂ Emissions from Road Transport. Available at: <http://www.eea.europa.eu/themes/transport/multimedia/curbing-co2-emissions-from-road-transport/view> [Last accessed on 15 September 2008].
- Ewing, G. and Sarigöllü, E. (2000). Assessing Consumer Preferences for Clean-Fuel Vehicles: A Discrete Choice Experiment. *Journal of Public Policy & Marketing*. Vol.19, No.1.
- Gallagher, K.S. and Muehlegger, E. (2008). Giving Green to Get Green: Incentives and Consumer Adoption of Hybrid Vehicle Technology. Faculty Research Working Paper Series at the John F. Kennedy School of Government, Harvard University. RWP08-009.
- Germanwatch (2008). Climate Change Performance index 2008. Available at: <http://www.germanwatch.org/klima/ccpi2008.pdf> [Last accessed on 15 September 2008].
- Geroski, P.A. (2000). Models of technology diffusion. *Research Policy*. No.29.
- Giddings, B., Hopwood, B. and O'Brien, G. (2002). Environment, Economy and Society: Fitting them Together into Sustainable Development. *Sustainable Development*. Vol.10, No.4.
- Grahn, M. (2004). Why is ethanol given emphasis over methanol in Sweden? Available at: http://fy.chalmers.se/~np97magr/other/Coursepaper_MeOH_EtOH_2004.pdf [Last accessed on 09 October 2008].
- Greene, D.L., Patterson, P.D., Singh, M. and Li, J. (2005). Feebates, rebates and gas-guzzler taxes: a study of incentives for increased fuel economy. *Energy Policy*. No.33.
- Heffner, R.R., Kurani, K.S. and Turrentine, T.S. (2005). Effects of Vehicle Image in Gasoline-Hybrid Electric Vehicles. Presented at the 21st Worldwide Battery, Hybrid, and Fuel Cell Electric Vehicle Symposium and Exhibition (EVS-21), Monaco, April 2-6, 2005.
- IEMA (2008). Low Emission Zones for Italy & Germany. Available at: <http://www.iema.net/news?aid=17943> [Last accessed on 24 July 2008].
- Inregia (1999). Incitament för miljöbilar- En rapport från Miljöförvaltningen i Stockholm.
- Jaffe, A.B., Newell, R.G. and Stavins, R.N. (2002). Environmental Policy and Technological Change. *Environmental and Resource Economics*. Vol.22, No.1.
- Kvale, S. (1996). *InterViews- An Introduction to Qualitative Research Interviewing*. Sage Publications.
- Litman, T. (2003). The Online TDM Encyclopedia: mobility management information gateway. *Transport Policy*. No.10.
- Loukopoulos, P., Jakobsson, C., Gärling, T., Schneider, C.M. and Fujii, S. (2005). Public attitudes towards policy measures for reducing private car use: evidence from a study in Sweden. *Environmental Science & Policy*. No.8.
- Mackett, R.L. (2003). Why do people use their cars for short trips? *Transportation*. No.30.

- Mainieri, T., Barnett, E.G., Valdero, T.R., Unipan, J.B. and Oskamp, S. (1997). Green buying: The Influence of Environmental Concern on Consumer Behaviour. *Journal of Social Psychology*. Vol.137, No.2.
- Marell, A., Davidsson, P. and Gärling, T. Environmentally friendly replacement of automobiles. *Journal of Economic Psychology*. No.16.
- Mathison, S. (1988). Why Triangulate? *Educational Researcher*. Vol.17, No.13.
- Miljöbyrån Ecoplan (2005). Car suppliers' view of the Swedish clean vehicle market- Interviews with importers/general agents. Available at: http://www.miljofordon.se/files/1729Car_suppliers_view_Swedish_CV_market.pdf [Last accessed on 8 September 2008].
- Miljöfordon.se (2008)¹. Miljöfakta översikt. Available at: <http://www.miljofordon.se/miljoaspekter/miljofakta.aspx> [Last accessed on 19 September 2008].
- Miljöfordon.se (2008)². Biodrivmedel – frågor och svar. Available at: <http://www.miljofordon.se/nyheter/artikel.aspx?iArticleID=229> [Last accessed on 23 October 2008].
- Ministry of the Environment, Sweden (2004). Climate policy. Available at: <http://www.regeringen.se/sb/d/5745/a/21787> [Last accessed on 17 September 2008].
- Mittal, B. (1989). Measuring Purchase-Decision Involvement. *Psychology & Marketing*. Vol.6, No.2.
- Newholm, T. and Shaw, D. (2007). Studying the ethical consumer: A review of research (Editorial). *Journal of Consumer Behaviour*. No.6.
- NGV Global (2008). Volvo Swiss Edition Multifuel Unveiled. Available at: <http://www.ngvglobal.com/en/market-developments/volvo-swiss-edition-multifuel-unveiled-01887.html> [Last accessed on 17 November 2008].
- O'Neill, M. (2007). Closet Case. Available at: <http://www.slate.com/id/2164128/> [Last accessed on 14 November 2008].
- Pachauri, R.K. (2007). IPCC Fourth Assessment Report. Press Presentation 17 November. Available at: <http://www.ipcc.ch/pdf/presentations/valencia-2007-11/pachauri-17-november-2007.pdf> [Last accessed on 10 November 2008].
- Princeton University WordNet (2008). Search term: "incentive". Available at: <http://wordnet.princeton.edu/>. [Last accessed on 10 November 2008].
- Rogers, E.M. (1962). *Diffusion of Innovations*. Free Press of Glencoe, Macmillan Company.
- Rogers, E.M. (1995). *Diffusion of Innovations*. 4th edition. New York: Free Press.
- Stockholms Stad (2008). Environment. Available at: <http://www.stockholm.se/-/English/Stockholm-by-theme-/Environment/> [Last accessed on 10 November 2008].
- Stockholms Stad (2008)¹. Lika bra som en vanlig bil. Available at: <http://www.beta.stockholm.se/Fristaende-webbplatser/Fackforvaltningssajter/Miljoforvaltningen/Miljobilar/10-skal-for-miljobil/Lika-bra-som-en-vanlig-bil/> [Last accessed on 16 September 2008].

Stockholms Stad (2008)². Om miljöbilar- Uppdrag och mål. Available at: <http://www.stockholm.se/Fristaende-webbplatser/Fackforvaltningssajter/Miljoforvaltningen/Miljobilar/Om-Miljobilar-i-Stockholm/Uppdrag-och-mal/> [Last accessed on 16 September 2008].

Storstockholms Lokaltrafik (2008). On our way towards the world's cleanest public transport- SL's environmental work. Available at: http://www.sl.se/Upload/eng_text/uploads/SL_environmental_work.pdf [Last accessed on 23 October 2009].

Straughan, R.D. and Roberts, J.A. (1999). Environmental segmentation alternatives: a look at green consumer behaviour in the new millennium. *Journal of Consumer Marketing*. Vol.16, No.6.

Sunnerstedt, E. (2008). Email. 13 June.

Sveriges Radio (2008). Miljöbilspremien dras in ett halvår i förtid. Available at: <http://www.sr.se/cgi-bin/ekot/artikel.asp?artikel=2297972> [Last accessed on 23 October 2009].

Swedish Road Administration (Vägverket) (2007). Eco cars (miljöbilar). Available at: http://www.vv.se/templates/page3_____21943.aspx [Last accessed on 16 September 2008].

Swedish Road Administration (Vägverket) (2008)¹. Antal registerförda fordon i Sverige uppdelat på fordonsslag. Available at: http://www.vv.se/templates/page3wide_____21310.aspx [Last accessed on 10 October 2008].

Swedish Road Administration (Vägverket) (2008)². Antal nyregistrerade miljöbilar. Available at: http://www.vv.se/templates/page3_____22128.aspx [Last accessed on 10 October 2008].

Tadajewski, M. and Wagner-Tsukamoto, S. (2006). Anthropology and consumer research: qualitative insights into green consumer behavior. *Qualitative Market Research*. Vol.9, No.1.

Tavares, M.M. (unknown). Brazilian Ethanol. Guest lecture at the University of Minneapolis. Available at: mmtecon.googlepages.com/Ethanol7.ppt [Last accessed on 10 October 2008].

Tellis, W. (1997). Application of a case study methodology. *The Qualitative Report*. Available at: <http://www.nova.edu/ssss/QR/QR3-3/tellis2.html> [Last accessed on 10 November 2008].

Toyota (2008). Worldwide Prius Sales Top 1 Million Mark. Available at: <http://www.toyota.co.jp/en/news/08/0515.html> [Last accessed on 6 November 2008].

Wang, L. (2008). Green Vehicles Drive into the Greenest Olympics. Available at: <http://www.chinastakes.com/story.aspx?id=536> [Last accessed on 5 November 2008].

Wahlund, R. (2008). Email. 24 September.

Weber, J. (2007). Fair Trade coffee enthusiasts should confront reality. *Cato Journal*. January 1.

Wong, V., Turner, W. and Stoneman, P. (1996). Marketing Strategies and Market Prospects for Environmentally-Friendly Consumer Products. *British Journal of Management*. Vol.7.

WSP (2008). Incitament för miljöbilar 1994-2008. Internal report.

Yin, R.K. (2003). *Case Study Research- Design and Methods*, 3rd Edition. Sage Publications.

Yin, R.K. (1994). *Case Study Research- Design and Methods*, 2nd Edition. Sage Publications.

Åkerman, J. and Höjer, M. (2006). How much transport can the climate stand?- Sweden on a sustainable path in 2050. *Energy Policy*. No.34.

Örtegren, I. (2008). Hur få fler miljöbilar? Incitament för miljöbilar 1994-2008. WSP Analys & Strategi.

I2. Appendices

Appendix I: Impacts of different fuels

Type of vehicle/ fuel	Environmental impact	
	Locally	Globally
Electric car	No exhaust emissions	Negligible
Biogas*	Lower particle and nitrogen oxide emissions and reactive hydrocarbons	Reduced by 50-90% depending on the gas production method and vehicle type
Natural gas*	See biogas	Reduced by 20-25% vs. petrol; no reduction vs. diesel
Ethanol E85*	Lower nitrogen oxide emissions	Reduced by approx. 60% vs. petrol Reduced by approx. 40% vs. diesel
Electric hybrid*	Lower hydrocarbon and nitrogen oxide emissions	Reduced by 30-50% vs. petrol; no reduction vs. diesel
Petrol vs. diesel without particle filter	2-4 times less nitrogen oxide emissions 3-10 less particle emissions 5-10 times more hydrocarbon emissions	20-35% greater impact
Petrol vs. diesel with particle filter	Particle emissions same as petrol Other: see above	See above
* Compared with conventional petrol/ diesel vehicles.		

Source: Miljöfordon.se: Miljöfakta översikt (2008¹).

Appendix 2: Interview framework

Interview date, time and place:

Background

1. Name:
2. Gender:
3. Occupation:
4. Age:
5. Family:
6. Residential region:

Consumer and product variables

7. What car do you have (make, model, purchase date):
8. Why do you own a car:
9. What were your considerations when buying your car:

Market variables

10. How do you view the government's strategy for AFVs (Clean Vehicles in Stockholm):
11. What do you know about the purchase incentives for alternative fuel vehicles:
12. What is your view on the purchase incentives for AFVs:
13. How have the incentives affected your future car ownership:
14. Which consumers, if any, do you view as being more influenced by the incentives than others:
15. Why do you think some people choose to buy conventional cars instead of AFVs:
16. What else could the government do to entice people to buy an AFV:

Information variables

17. Where does your knowledge about the government strategy for AFVs come from:
18. Where does your knowledge about AFVs come from:

Additional topics

19. The number of people buying AFVs has grown in recent years, what do you think will happen in the near future:
20. What will cause you to replace your car:
21. What could entice you to give up your car:
22. How do you view owning an AFV/ What are your views when you see an AFV:

Would you like a copy of the final thesis:

Appendix 3: Detailed interviewee data

	Time and date of interview	Given name	Gender	Age*	Family status	Residential region	Occupation	Vehicle	Date of acquisition* (year of first registration)
Conventional vehicle owners									
1	13.30 1 October	Occasional Driving Mum	Female	39	Partner, one young child	Hägersten	Information and publications administrator	Renault Megane petrol	Dec 2005
2	19.00 9 October	Young, Sporty Male	Male	25	Girlfriend	Nacka	Financial controller	Mazda MX-5 petrol	Jul 2008 (1998)
3	13.15 8 October	Car Donee	Female	33	Husband	Spånga	Research assistant	Saab 900 petrol	May 2007 (1996)
4	15.00 15 October	Guilty Changer	Female	35	Husband, two young children	Bromma	Head of corporate sustainability	Audi A6 petrol	2005 (2003)
AFV owners									
5	19.30 25 September	Necessity Driver	Male	48	Wife, one young child	Nacka	Business consultant and company	Ford Focus Flexifuel	Dec 2006
6	18.30 29 September	Engaged Family	Male Female	50s 40s	Couple, one young child	Bromma	IT consultant VP for communications	Saab 95 estate 2.3turbo petrol Ford C-Max Flexifuel	2002 2006
7	21.00 29 September	Bad Weather Driver	Female	37	Husband, two young children	Bromma	Journalist	Saab Biopower 95	2006 (2005)
8	10.00 30 September	Reverse Robin Hood	Male	43	Wife, two teenage children	Sigtuna	Business consultant	Ford Focus Flexifuel	Dec 2006
9	12.00 30 September	Retired Politician	Male	76	Wife	Farsta	Retired	Ford Focus Flexifuel	Jul 2004
10	09.00 8 October	Prius Commuter	Female	30s	Divorced, two young children	Norrtälje	Photographer	Toyota Prius	Jun 2008 (2005)
11	12.15 8 October	Sixties Child	Female	40s	Husband, two teenage children	Spånga	Teacher	Toyota Prius	2005
12	17.00 23 October	Pioneer	Female	50	Husband, three teenage daughters	Södermalm	Civil servant	Ford Focus Flexifuel	Dec 2001

* In some cases the interviewee preferred not to give their age and so an estimation was made

* In some cases the interviewee could not recall the month of purchase.