

Electric Cars: Investigation into consumer attitudes in the UK car industry

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Abstract

Since the early 1900s global car ownership has continued to climb at accelerating rates. However, concerns about environmental and depleting fossil fuels are forcing manufacturers to look at alternatives to the combustion engine.

This thesis looks at the attitudes and perceptions of consumers in the United Kingdom of electric cars and aims to understand how the industry can manage and encourage this change.

As a new technology, this thesis believes that it is appropriate to return to a generalised view of consumers, rather than a focused view of consumers by the current auto industry.

Following a review of literature in the field and an in-depth survey aimed at those who are likely to take an active interest in the topic, extensive analyses is produced, identifying a number of significant findings that may hinder or encourage the growth of electric vehicles in the UK.

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Introduction

Following the launch of the Model T Ford in 1908 (Alizon et al, 2009) car ownership spiralled with over 1.5 billion cars in ownership globally today (GHO, 2015). Despite over 100 years now passing, cars are still driven by the same principle technology; the combustion engine (Bergthorson and Thomson, 2015). The combustion engine provides a huge array of benefits, from car performance in terms of speed and range to the ability to simultaneously charge the vehicle's battery in order to power an array of electronic driver and passenger comforts such as satellite navigation. As technology has moved forward, customers and consumers are expecting their cars to do more, as they would expect from any other product in their everyday life; and to keep pace with other technological advancements in other industries, such as the expectation to integrate mobile phones with their car's audio units. Ultimately, all these additional expectations are made possible by the combustion engine and its ability to continually provide power.

Valued globally at almost \$10 trillion (Euler Hermes Economic Research, 2018), excluding the retail operations and intangible products such as warranties that accompany a car sale, it is essential that this industry is able to manage consumer needs as the transition to electric cars unfolds. Without doing so there is a high risk the industry may enter years of stagnation as consumers hold on to their combustion powered cars until such a time that the industry has re-established equilibrium between consumers' needs and what the industry can offer. To place the situation into context; Autocar (2018) identifies the Ford Fiesta as the best-selling car in the UK in 2017. With an acceleration of 0-60 in 8.7 seconds, a range between refuelling at 813 miles and a price of £21,000 (Parkers, 2017), comparably, the Renault Zoe, identified by What Car (2017) as the best electric car for 2018 manages an

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acceleration of 13.5 seconds (0-60), a range of 130 miles (shrinking further if mainly urban driving) (Renault, 2017), but with a smaller price tag from £14,000 (Renault, 2018). Notably, Renault (2018) also lists the recharge time to take up to 13.5 hours, meanwhile when a combustion engine runs out of fuel, it takes only a few minutes to refill it at a refilling station.

However, an array of political, social, technological, ecological and legal factors is now driving the automobile industry into unknown territories. Although it is undeniable the industry was already innovating new propulsion technologies with Mercedes, Mitsubishi, Volvo and many other manufacturers (Huntingford, 2018) producing hybrid cars; vehicles which have both a battery and an engine to power them.

Politically, the transition away from combustion technologies is being led with France, Britain, Norway and India all setting dates when they intend any new car sold to be entirely electric (Petroff, 2017). With India in particular a fast growing market (Jha et al, 2014) the need for manufacturers to meet these new requirements is essential to ensure industry growth and stability.

Sociologically the car industry is coming under increased scrutiny regarding the emissions released from cars and attitudes of the public are becoming increasingly 'pro-green' with the global population becoming increasingly concerned about issues such as global warming (Kvaloy et al, 2012). The public made this view very clear following the 2015 VW emissions scandal, seeing VW's market share plummet (Campbell, 2016) before eventually recovering in 2017 (Bryant, 2017).

Technologically the forced change to electric cars may be seen as a hindrance. Whilst the transfer over to electric propulsion was always likely to

become widespread, the political factors are now making it a necessity. Prior to this, the next significant transformation within the car industry was likely to be that of self-autonomous cars (Yang, 2014).

Ecologically combustion engines were always of a limited life span, powered by the finite resource of oil, which is anticipated by some to reach peak production and resulting decline by 2030 (Alekklett et al, 2010). Although further reserves may be retrievable via fracking, this method of oil production is widely seen negatively in the UK (Williams et al, 2015) and the United States also having generally negative views on the process (Davis, 2014).

In general it should be noted that the car industry is not in itself a stranger to innovation; with law requiring 3 point seat belts to all seats in a car not coming into place until 1986 (The Road Vehicles (Construction and Use) Regulations 1986). Although this may be the most dramatic change the motor industry has faced, it is not unheard of for industries to be completely disrupted by new approaches to problems; UK company Dyson stormed the vacuum industry with its innovative new technology, building a 15% market share in the US (Cuneo, 2004), within 2 years (Seabrook, 2010). Dyson's case carries particular importance in reference to the car industry however in that Dyson's technology was able to perform the task better and more efficiently, something which the car industry does not currently seem capable of with electric cars.

Research Aims and Objectives

Aim: To Investigate the concerns of potential customers of electric cars.

Objectives:

- Research consumer attitudes towards electric cars.

- Identify key issues that consumers have regarding electric cars.
- Explore consumer variables that impact their choices when purchasing a new vehicle.
- Consider how the auto industry can approach/deal with these issues.

Strategy

The strategy to achieve these objectives will be to conduct a literature review, followed by a more detailed methodology for the production of a unique research.

What follows will be a review of existing literature on the topic, methodology of research, results and analyses.

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Literature Review

Motivation

Maslow (1943) presents a specific basis of needs that need to be met for an individual to achieve a certain level of motivation. Although later revised, the 1943 paper provides a solid basis to the psychological needs of any party, in this instance, a consumer. The 5 basic groups identified by Maslow; *physiological* (the most basic living needs such as sleep and food), *safety* (security in life), *love* (social inclusion), *esteem* (level of status) and *self-actualisation* (to achieve the best/most) provide a synonymous foundation that can be translated to the needs that must be met by any manufacturer. Maslow himself, considered a *major psychological thinker* (Hoffman, 2008), gives illustration to the factors affecting a person's desires and although strongly associated with business and management, his work can be interpreted for many different uses. The 1943 original paper does leave the question as to what motivates a person who has achieved *self-actualisation*; although this is later dealt with by Maslow (1969) himself with the addition of *self-transcendence*. Nevertheless this new aspect fails to recognise personality types that may be resistant to helping others for egotistical reasons. *Self-actualisation* could be argued to in fact conflict with *self-transcendence* as once others have reached the same level as yourself then you are no longer the person who is achieving the most. Maslow's work does fail to provide clear analyses of how external factors such as the achievement of others will also impact on your own motivations.

In this instance his work can be used analogously to consider the motivations for choices in the car retail industry and broken down by car manufacturers and marketers to ensure their vehicles meet consumer needs/desires. *Physiological* identifiable as the car body, propulsion system, 4 wheels and a fuel source. *Safety*

identifiable as seat belts and airbags along with newer technologies such as Audi's avoidance assistance system (Audi, 2017). *Love* identifiable as in car technologies allowing the driver to communicate with his larger social circle. *Esteem* plays directly into status and can be seen as the level of importance of car manufacturers such as a person wanting to achieve a higher level of *Esteem* may be driving a Vauxhall but would desire to drive a Mercedes. *Self-Actualisation* can be attributed to customised cars, whereby the car is to their exact specification beyond what the manufacturer may produce, such as the work carried out by Overfinch (Overfinch, 2018).

Global Consumer Segmentation

Elliot (1998) reports on the findings of a research study carried out by *Roper Starch*. Although a great deal of time has passed, no research of the same scale, and intensity has been produced, arguably keeping these findings highly significant. The article condenses an extensive study that looked at consumers across 35 different countries and a sample of 35,000 people. It breaks down global consumers into six different categories; *Strivers*: generally materialistic and ambitious, they represent 23% of global consumers. *Devouts*: a very traditionalist group where cultural beliefs are generally seen as an important part of life. *Altruists*: driven by social issues and highly educated this group is concentrated in Latin America and Russia. *Intimates*: Popular in the Western world, this group generally have close but large social networks. *Funseekers*: Seen as the *MTV generation*, this group represents many club and restaurant goers, many of whom are electric media orientated. *Creatives*: dedicated to personal improvement, this group is purposeful in gaining knowledge and applying technology.

This article has the benefit of producing a more in-depth understanding of segmented markets. It gives a closer understanding by marketers of their consumers,

but doesn't give a huge amount of detail in how open each consumer group is to 'change', with *Creatives*, the smallest group at 10%, seemingly the most open to new technologies. However, it does give an idea which groups and geographical segments would be most logical to target first in order for companies to gain a market share.

Consumer Intentions to Electric Cars: Germany

Peters and Dütschke (2014) begins with great promise; intending to identify and compare the consumer groups around Electric cars. It succeeds in identifying consumer groups; *current users, those with purchase intentions, interest in electric cars but no purchase intention and no interest or purchase intention*. However; its additional use in terms of understanding these groups is very limited. The study focused only on German consumers and had an overall sample of only 969 with 95% of those being men. It noted that those with *no interest or purchase intention* of electric vehicles may be more greatly swayed by the environmental benefits rather than any financial incentives. This does in itself question if these respondents truly have any enthusiastic interest in cars as car interests would reasonably dictate a preference towards financial benefits. Some results are unsurprising, only 16% of respondents were those with *no interest or purchase intention* and the sample in general was highly educated. Notably, the research does identify that even those with *no interest or purchase intention* may be prepared to pay up to an extra 16% on the price of an electric car. German consumers in particular may be taking a closer look at the automobile industry than other countries as 3 of the biggest European car manufacturers are located there; VW (and its subsidiaries), Daimler (owner of Mercedes-Benz) and BMW, in fact, the car manufacturing in Germany is responsible for 20% of German industrial revenue (Germany Trade & Invest, 2017). This would suggest that the German market is not likely to be as reflective of global views as

respondents from other countries may be as it is in their economic interest for the industry to succeed. Overall, this research is useful in ascertaining what consumer groups the industry should assume currently exist in the electric car industry, but its country of origin raises question over the validity of the research and whether it is truly free of bias.

Attention – Behaviour Group: Holland

Rijnsoever et al (2009) paper concerned research carried out in the Netherlands regarding attitudes to cars; both combustion powered and electric and also how people go about searching for information relating to their car purchase, sampling 1392 people. Participants of the study were offered €20 for the completion of the survey, potentially impacting on the trust worthiness of their results as some may simply flip through the survey with random answers so as to immediately gain the reward. Principally this piece identifies a *attitude-behaviour gap*, whereby respondents generally possessed a pro-environmental attitude but were reluctant to act on this in terms of purchasing cars with greener aspects, such as electric or low emissions vehicles. Specifically, its data identifies a strong concern about the environment in attitude, but when coming to purchase a car, the behaviour swings more towards concern about performance of the car. This information at the very least highlights a potential failure to translate positive attitudes into sales by marketers. Their survey also presents a potential problem in gaining the data. Despite being focused on consumers in the Netherlands, the survey is based on information regarding attributes placed on new cars by consumers from a UK Department for Transport document, which was itself produced for an entirely different purpose. This fails to recognise potential cultural differences between the two nations. The key question this paper raises is how to translate purchase intention

into actual purchases. Notably, the brand of the car also plays a big part in the car selection process, indicating that brand loyalty within the auto industry is strong, despite the amount of differentiation between manufacturers. Unfortunately, the decision to use cluster methods to display their findings makes gaining further information and using their data to its full potential, difficult.

Electric Car Purchase Intentions: Canada

Larson et al (2014) highlights the fact that electric cars are not an out rightly new innovation; the first vehicle appearing in 1834 but failing to meet competition from combustion engine vehicles. It notes that electric vehicle sales are well below what the industry had anticipated, partly due to the high price acting as a purchase barrier. This is reflected in current models with a Mitsubishi Outlander PHEV costing £35,000 whilst its combustion powered counterpart costing only £25,000 (Mitsubishi, 2018). The research focuses on a sample of 240 people from Manitoba, Canada. This may affect the sample's attitudes due to the cold winter climate in the area and the expected effect this may have on batteries in electric vehicles. It notes that consumers were not prepared to pay any premium on electric cars but also identifying operating costs and fuel efficiency as key factors in car purchase decisions. Vehicle power is seen as only moderate importance, which is arguably unusual for an area with generally rugged terrain. The paper then suggests, and apparently correctly so based on the data's conflicting results, that there is a lack of information available to consumers regarding electric cars. Notably, it also suggests that those with experience or exposure to electric vehicles are more likely to purchase them in the future. This would suggest that electric cars will naturally increase in overall market share simply from steadily increasing exposure. Notably,

findings around exposure increasing positive purchase intentions is reflected further by Mau et al (2008).

Electric Car Demonstrations: United Kingdom

Bunce et al (2014) set out on an ambitious mission with the UK's 'Technology Strategy Board's Ultra Low Carbon Vehicle Demonstration Programme'. 135 people took part in the programme whereby participants were given an electric car for 3 months and their opinions and attitudes recorded 1 week before the programme started and again after 3 months of use with the electric car. Notably, there was no standard electric vehicle used; rather a range of electric cars from six different manufacturers provided to the participants. Participants were recruited via advertising by the car manufacturers themselves, this should be considered an excellent way to take advantage of brand loyalty and gain the ability to recruit those who may be less interested in electric cars in the first instance. However, consumers loyal to a brand may choose to participate simply in the hopes of having access to their preferred brands latest models, yet those who are simply not open to new technology will still take no interest. The fairly long time period of the study also gave consumers the opportunity to naturally adapt to the differences of an electric car, such as remembering to plug it in at night to charge. Participants were 71% male and 69% educated at or above a degree level. This is therefore questionable if it was a true representation of the UK's population, which is in fact 49% male (World Bank, 2016) and 27%-40% of the UK population hold a degree or equivalent (Ball, 2013). A further issue is created in that the study does not strictly clarify if participants have access to another car which is combustion fuelled. As such, they could use this car instead for long journeys instead of the provided electric car, preventing any possible problems with range occurring. None the less, the study found some interesting

results, some very surprising; in the pre programme interview 92% of participants felt that large scale use of electric cars would reduce carbon emissions, this in fact drops to 64% after the 3 month programme. It also notes that the lack of an industry standard charging system dissuaded people from using public charging stations, such as those located at motorway rest stops. Interestingly though, the belief that public infrastructure of charging stations is an important part of running an electric car drops by 16% between the start and end of the study, with participants preferring to just charge at home. Finally, the study identified that 74% of respondents would be happy to pay an additional premium for an electric car after the study.

Literature Review Summary

Some key themes are arising from literature analysed. It is apparent that very precise consumer segments can be developed and that these consumer segments for the electric car industry are likely to be different to that of the combustion powered car industry.

There appears to be a lack of accessible information available to consumers, apparently at the 'Attention Stage' of the purchasing process, with consumers more likely to purchase an electric car if they have previously been exposed to one.

Motivational factors will be key in better understanding how consumers can be attracted to the market. Principally in understanding how the electric car can approach each factor in the way combustion powered cars can.

The question of brand loyalty has also arisen; if consumers may be more inclined to try electric cars if encouraged via marketing by their preferred brand. Understanding the significance of brand loyalty will be essential given the industry is

facing significant disruption from new market entrant Tesla (Cornell and Damodaran, 2014).

No definitive answer on this has been reached if consumers are prepared to pay a premium. Notably that at this early stage in the electric car industry does not have the economies of scale equal to that of the combustion powered industry (Beaume and Midler, 2009), meaning that electric cars with equal performance to those of combustion engines will cost more.

Issues around consumer perceptions as to the actual environmental benefits of electric cars has also been questioned, along with how environmentally friendly people act in comparison to how they would prefer to act.

Throughout the research programmes an overriding feature is that of a majority male sample.

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Methodology

This investigation relates specifically to UK car consumers and therefore the only way to gain understanding of this is by asking them; in this case via an on-line survey with the Bristol Online Survey system.

The survey will consist of closed questions. There will be no financial incentive/reward in place for participants of the survey, in the aim that those completing it will do so out of genuine interest of the topic and therefore gain a more accurate response.

The survey will seek to gain a general understanding of the participant's lifestyle in terms of green credentials and some questions to attempt to identify how open they are to change in technologies, or perhaps more suitably in this instance; how prepared consumers are to make 'trade-offs'. It will then discuss the physical and psychological barriers to owning and running an electric car, along with assessing the person's current perceptions towards electric propulsion. The survey will identify the three different propulsion types; combustion, electric and hybrid, to understand prior exposure levels.

The survey will also seek to take a step back from previous research and look at car consumers from a more generalised point of view, fitting them into one of the global consumer types as identified in Elliot's (1998) article.

The framing of questions will aim to be as unbiased as possible although there will understandably be a numerical superiority in the amount of questions about electric cars than combustion powered cars.

The questionnaire will not offer a 'no opinion' or similar option. Krosnick et al (2002) proposes strongly that this option should be discouraged and their research

suggests that respondents are more likely to form an opinion or attitude without this option. All questions will also be made to require a response as suggested by Grendall and Davies (2003), although the 2 theories conflict, with the latter suggesting the importance of a 'no opinion' option. The only way for this approach to work is via an intensive sampling system.

Deployment of the survey will be done in a manner to target those who have a specific interest in cars and thus will complete the survey with more thought than the general population. The link and a short message inviting people to participate in it will be posted across car ownership club websites such as *Ford Focus owners group*. The ideology being that those with a sufficiently keen interest to be accessing these types of forums will also have a sufficient interest in the car industry to be able to respond to the questions.

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Findings

Demographics

Having achieved 119 responses, the survey was completed by a primarily male populace with 88% of respondents being so (Appendix B). It did however achieve a strong spread across age groups (Appendix C) with the most frequent age group being 40-44.

Academically the sample was primarily those with bachelor's degrees, A levels and GCSE qualifications, with 83% falling into one of those categories (Appendix D). 47% held a bachelor's degree or above.

Income wise there is a good spread, although over a third earn over £50,000 (Appendix E).

Environmental Thoughts

The results showed the sample to be leaning towards more *highly concerned* about the environment (Appendix F). *Air pollution* led by a considerable amount, over half the sample selecting this choice, in terms of which type of pollution they considered to be most concerning, followed by *water* and *radioactive* respectively (Appendix G). Concern about global warming was spread with 11% selecting the least concerned option and 13% selecting the highest option, although overall the sample did lean to the more concerned option (Appendix H).

43% of the sample felt that electric cars were not more environmentally friendly than petrol/diesel cars (Appendix I), with 100% of those with a post-doctorate education selecting this.

Environmental Behaviour

In terms of environmental behaviour the sample is very centre ground. The refuse recycle rates are higher than the national average with 65.5% of respondents stating they recycle 51% or more of their refuse (Appendix J) with the national average being 44.9% (Department for Environment Food & Rural Affairs, 2017). The most common environmentally friendly products employed by the sample are energy saving lightbulbs and double glazing (Appendix K). There was an even split between consumers who consider the energy rating of electrical appliances before purchase (Appendix L).

You and your car

105 (88%) of the respondents owns a petrol/diesel vehicle (Appendix M), 3 of these people also owned a hybrid vehicle, while 9 people also owned an electric car. 70% of the sample intend to replace their vehicle/s within the next 3 years (Appendix O) with petrol/diesel cars remaining the most common intended replacement (Appendix P).

Brand loyalty was even with 55% stating that they buy specifically from a particular brand (Appendix Q). Car Review articles and general exposure to cars were leading (Appendix R) in terms of what best first gains a consumer's attention to a new car with 75% choosing these options. TV ads drew in only 4% of consumer's attention.

Electric Cars

Attitudes and perceptions of electric cars were varied. 50% of respondents considered electric cars to be a viable replacement to combustion powered cars (Appendix S). 50% stated they would be more concerned about the presence of a lithium battery in the event of a collision than the presence of petrol (Appendix T). Comfort, Look of the Car and Acceleration were the highest ranking specifications that consumers looked for when purchasing a car (Appendix U). 79% of respondents stated that a premium would put them off purchasing an electric car (Appendix V) while 46% stated they would be concerned about remembering to charge their vehicle (Appendix W). Performance being equal to a petrol/diesel car was identified as the main incentive to purchase an electric car with Environmental benefits being the smallest incentive (Appendix X)

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Analyses & Discussion

Demographics

The sample is not wholly reflective of the UK population. There is a disproportionate amount of males in relation to the populace as a whole however this may be due to the subject criteria, it is noted strongly that men have a vaster more keen interest in cars than woman (Kennedy, 2014 and Greer, 2002) and reinforced by car manufacturers preferring to segment and target males via advertising (Duerringer, 2015). This was also a prevailing theme of the literature review.

The average weekly income identified by the UK Office of National Statistics (2018) is £512, making the average earnings of a UK household per year around £27,000. This sample has a considerably higher average income. The generally high income range is particularly useful for this research as a high income will naturally increase a buyer's choice in vehicle, giving them access to better performing electric cars in the market.

The sample does present a promising spread of academic which should allow for a fair judgement between academic groups. Although based on Dos Santos's (2012) findings, use of education segmentation can be of very limited use when looking at consumers and environment.

Environmental Thoughts

In terms of thoughts, those with a Bachelor's degree or above were considerably more concerned about the environment than those with lower level completed qualifications, this follows a trend also seen by Hamilton et al (2010) and may be due to education providing increased states of awareness of their

surroundings. There is a similar trend with the *millennial* generation showing more concern, this may simply be due to the pressure on this generation to repair damage caused by previous generations.

Air was identified by the sample overall as the biggest concern, possibly due to its prominent media coverage in terms of health concerns such as asthma (Laurent et al, 2008), the greenhouse gas effects on global warming and the much visible issues of smog (Mérel et al, 2014) affecting larger cities such as London. Cars are a key cause of air pollution (Department for Environment Food & Rural Affairs, 2011), notably in 2016 *transportation* became the biggest cause of greenhouse emissions in the UK (Department for Business, Energy & Industrial Strategy, 2016). In theory, electric cars should be a less polluting method of transport than combustion engine powered cars. *Water* pollution and *radioactive* pollution rated second and third most concerning to the sample, in terms of the car industry this presents a dilemma; if combustion engines are to be continually used within the UK long term then additional stores of oil will need to be accessed to make this possible, most likely through fracking. Fracking has already been strongly associated with pollution of ground water (Pfunt et al, 2016) but conversely the UK power grid, of which electric cars would charge from, is coming to rely increasingly on nuclear power stations (Williams, 2017). Nuclear waste in the UK is processed at Sellafield, which has become the subject of frequent leakage incidents, including into ground water (Webb et al, 2006). It may be for this reason that only 57% of the sample felt that electric cars were more environmentally friendly than petrol/diesel cars. Indeed, 33% of the sample that felt that electric cars were not environmentally friendly also rated water pollution as an equally big concern as air. The entire post doctorate level of education group may therefore have been looking at the bigger picture, as they have been trained to do so in further academic study. A clear issue developing in this area

is the production of energy for the UK national grid and if this requires a move to renewables before electric cars can be truly seen as green.

The low rate of the sample that believes electric cars to be more environmentally friendly is surprising. Based on Fishman's (2016) identification of the age generation boundaries, only 55% of Millennials in the sample believed electric cars to be more environmentally friendly than combustion powered cars, this is concerning as the sample showed millennials to be very concerned about the environment, a trend that is also found by other researchers (Smith and Brower, 2012). The rate falls even further, with 100% of those sampled aged between 18-22 finding electric cars to be less environmentally friendly than petrol/diesel cars. This raises questions around the marketing tactics employed by car manufacturers with Smith (2014) highlighting that manufacturing companies may be failing to understand how millennials are interpreting the message given by companies when advertising from a 'green' aspect. Indeed, Leslie et al (2013) goes so far as to suggest that millennials are unable to differentiate between environmentally friendly and non-environmentally friendly products. Alternatively, this may in fact be further evidence of Rijnsoever et al's (2009) *attitude-behaviour* gap.

Significant Finding

Those aged over 45 (*Baby Boomers*) did however believe that electric cars were more environmentally friendly, with a lead of 17%. Despite this, 75% of this group intend to replace their current car with another petrol/diesel car. This is further conflicted by the group generally leaning toward the *More Concerned* scale with the environmental concern question. This group is also a very high income group, with 37% falling into the £50,001+ category; this places them in income ranges of vehicles such as Tesla which considers itself a maker of premium electric

vehicles and states some of their vehicles can achieve an acceleration of 0-60mph in as little as 2.5 seconds and a range of up to 250 miles (Tesla, 2018). 65% of this group also identified 'If the performance was equivalent to a petrol/diesel car' or 'Lower running costs' as reasons to buy an electric car, making the Tesla range an ideal solution. The apparent issue for this segment of the sample is that they have also largely stated they would rather buy from a *Traditional Car Manufacturer*; this is something Tesla is not and will only become one when electric vehicles are considered the 'norm'. Sovacool and Hirsh (2008) specifically identifies the socio-technical barrier as a leading barrier to electric vehicle adoption and this is a clear issue within the UK market based on the research of this thesis. Whilst *Traditional Car Manufacturers* are investing in electric vehicle production, their main focus appears to still be on combustion propelled cars (Hildermeier, 2017).

Environmental Behaviour

Rain water harvesting systems seemed to be surprisingly popular with 15% owning them. This would fit in with the earlier consensus regarding concerns about water pollution; alternatively it may have been a fault with the questionnaire. Whilst the researcher had intended for rain water harvesting systems to signify storage of rain water to be pumped into homes for domestic use, respondents may have interpreted it as anything from this to considerably simpler systems such as garden water butt storage connected to guttering.

Significant Finding

Notably, the key drivers of investment in environmentally friendly products appeared to be that of financial return or regulation. This is on a par with Larson et al (2014) indicating that running costs were a key incentive. 85% of respondents had

double or triple glazing, which provides significant utility cost savings (Levy et al, 2016), whilst the next highest performer were low energy light bulbs, larger energy consuming light bulbs have been banned under EU law (European Commission, 2009). Regulation may increase pressure on the car industry to have suitable alternatives in place to prevent stagnation. In 2014, consumers panic bought vacuums before they were outlawed by the EU (Straus, 2014), these consumers would now have no need to return to the market for a significant amount of time due to now owning a new model. The car industry may face a similar situation as countries introduce bans on petrol/diesel powered vehicles.

You and your car

The vast majority (65%) intending to replace their current vehicle with another combustion powered vehicle is a continual reminder that electric cars are either not meeting or not perceived to be meeting consumer needs. Notably, brand loyalty seemed surprisingly low within the car industry, with only 56% stating that they had a preferred brand. This may be explained with the application of Maslow's (1943) work; brand loyalty of the consumer can perhaps only be achieved with the reaching of *self-actualisation* with a product. This can be further explored with acknowledgement that some people may have a preferred brand which would achieve *self-actualisation* but it may not be accessible to them due to financial restraints etc and as a result they are purchasing vehicles which meet only their basic or physiological needs of transport. This question may have produced a different response had it used a two tier scale similar to that used by Jørgensen et al (2016), General exposure as a leading attention seeker to new cars on a par with the findings of Larson et al (2014). None of the sample that currently have electric cars intend to

return to a combustion vehicle, suggesting that electric cars are meeting the requirements of at least some market segments.

Significant Finding

Curiously 47% of those who stated they intended to replace their car with a combustion powered car also rated their concern for the environment as 7 or above, this would again suggest a *behaviour-attitude* gap. However, 58% of this sub group also stated they do not believe electric cars to be more environmentally friendly than petrol/diesel cars. This recurrent theme between subgroups led the researcher to investigate further and identified a significant article by Hawkins et al (2012) who highlights that after factors around the supply chain are included in production of electric cars, they could have a *global warming potential* reduction rate as low as only 9% compared to petrol vehicles and an unnoticeable impact for diesel cars. This raises a question for the industry; are electric cars green enough?

Electric Cars

Notably, 63% of the overall sample did not know where the nearest public charging point is to their house. This suggests a low visibility rate of the electric car infrastructure. If such points were advertised in the same way as petrol stations then it is likely this figure would be significantly reduced. It would also dramatically improve exposure by users to electric cars by users of combustion cars if charging points were located at petrol/diesel refilling stations. Reflected by Bunce et al (2014), this sample was also not prepared to pay a premium for an electric vehicle, this would link into the earlier finding that economic drivers are a key to adopting greener practises.

Significant Finding

Question 20 (Appendix Y) specifically aims to identify if consumers would be prepared to make 'trade-offs'. It is a 'blind test' of 2 vehicles; a Mitsubishi Outlander, its hybrid variant and its hybrid variant in pure electric mode. The stats given are for acceleration, range and Co2 emissions. By using such close variants, the consumer cannot be affected by barriers of entry as the company will have identical finance plans etc. 39% of those who earlier stated they intended to replace their next car with a petrol/diesel car chose the hybrid car. This indicates that even car enthusiasts are prepared to sacrifice acceleration and range for a greener vehicle. Notably, the Outlander and its variants are all 4x4 SUVs. This may suggest hybrid cars could be a key method to introduce consumers to electric vehicles.

Significant Finding

The response regarding which would cause the most concern in a crash; *a lithium battery or the presence of petrol/diesel* is curious, with 50% stating they would be more concerned about the lithium battery. Drivers are conditioned to consider petrol/diesel a highly hazardous substance, mainly via warning signs at petrol stations. A lithium battery however is therefore a curious item when generally the consumer is generally exposed to little information about the product and it is present in numerous consumer items such as phones (Scrosati and Garche, 2010). The most likely cause for this may be the highly publicised fires resulting from the *Samsung Galaxy Note 7* (BBC, 2017). With the majority of electric cars now likely to use lithium battery technology (Väyrynen and Salminen, 2012) it is clear that consumer reservations about this technology needs to be reviewed.

Considerations for the Industry

If electric cars are to succeed then it is clear the industry must deliver clear and concise solutions to the issues facing it. Increasing general exposure to the public of electric cars is a key theme across both literature and this thesis's own research that perceptions are driven and changed in this manner. Raising general awareness of electric cars may likely be achieved by larger scale media advertising of public recharging points, so as to introduce the technology to the everyday driver and develop the technology into a 'social norm'.

Hybrid vehicles may potentially represent a 'bridge' for the public to transition between the technologies. Generally hybrid vehicles are designed to run in a way that is most economical to the user, with the engine only designed to start when certain parameters are met. However, selling products from an entirely economical point of view will only appeal to a limited amount of the market, as is prevalent with his sample identifying *Performance equal to a combustion car* as a leading incentive to buy an electric car. Hybrid vehicles designed to offer the benefits in terms of acceleration as a combustion powered vehicle and the reduced running costs of an electric vehicle would appeal to different market segments. For instance; a hybrid vehicle that uses its engine in rapid acceleration to produce a shorter 0-60mph time and then returning to battery operation once the speed is achieved. It would also allow a 'softer' introduction between consumers and lithium battery technology, reservations around of which may cause a significant obstacle to the electric car industry.

Based on the research carried out for this thesis, it is unlikely that Tesla and other new market entrants will be able to significantly disrupt the industry in the short term with traditional car manufacturers remaining the preference of the

market. This however may change and it is in the interests of traditional car manufacturers to begin larger scale investment into electric models in order to protect their market positions. Equally, it may be possible for the industry to leave Tesla to take the risks and then replicate the technology when it is perceived more positively by a broader range of market segments.

Consumers are not accepting electric cars to be as green as manufacturers would hope them to be. It would benefit manufacturers to consider the workings of their supply chains and other aspects to make them more environmentally friendly. In an age when the majority of consumers have access to the internet and this thesis has identified internet activities as a key method of research prior to purchasing a car, it is likely consumers will delve more deeply into just how environmentally friendly some products actually are. Conversely, a problem the industry cannot deal with is that of how the National Grid is powered and thus how their electric models will receive their power. Manufacturers must educate consumers on why electric cars are truly a greener alternative.

Opportunities for future research

The most obvious area requiring additional research is around the public's perceptions of lithium batteries and how to more directly deal with the apparent negative connotations surrounding them that has been evidenced in this research. Other areas requiring additional research is that of the functionality of hybrid vehicles; how would consumers prefer the mix of engine and battery technology be used to produce the best results for themselves? The apparent social resistance to electric vehicle adoption also requires study.

Creating a greener manufacturing and supply chain system is also an element that requires extensive study. Whilst supply systems in place may benefit from low level changes to make slight improvements to their carbon footprint; an entirely new system may need to be developed in order to convince consumers of company's green credentials. The automobile industry is without doubt a champion of *JIT* (Dinsdale and Bennett, 2015), a key issue with this system is that it allows little flexibility for large scale changes to the supply chain as a whole. *JIT* could almost be seen to be very un-environmentally friendly with trucks and other large scale transport methods travelling with only what is needed for production instead of being filled to capacity. Research should principally focus on how improvements would change perceptions of consumers and potential financial reward, before starting research into the methodology of changes. It is clear however that the modern consumer is taking a closer look at just how environmentally friendly products are.

A recurrent theme that this thesis and related literature have suffered from is the distinct lack of females who have participated in the research. Although this may be due to a number of reasons from internal family hierarchies to simply a lack of interest, this remains a considerable consumer segment and requires urgent attention.

Restrictions and failures to this Thesis

Due to the length of the original questionnaire during piloting, respondents lost interest half way through. As a result a number of demographic questions were removed meaning it was no longer possible to identify different consumer types in Elliot's (1998) article. Although this did not significantly impact on the general success of understanding UK consumer attitudes.

One area which this thesis in particular struggled to assess further due to content volume restrictions was the impact of charging. This was a huge disappointment. The requirement of charging changes the way in which the product is used which Herbig and Day (1992) argue would deter consumers. However the research for this thesis found that from a theoretical point of view, consumers did not feel overly deterred by this issue. Davis et al (1989) identifies perceived ease of use as one of three critical factors in the adoption of new technologies, although his research relates more specifically to computer technology, the research was carried out at a time when mainstream computer technology was in its early days, similar to the electric car industry is now and therefore highly relevant. This may pave the way for an entirely new complementary industry around wireless charging methods as proposed by Panchal et al (2017) and Fuller (2016).

On review it was also noted a fairly critical factor was excluded from the investigation which would have filled a hole in existing academic literature; the importance of resale value in purchasing a new car. Although it may still be too early for the industry to fully understand how resale values will be affected by newer technologies of this type at this early stage of adoption.

Excluding 'no opinion' options in the questionnaire proved a success. However, the interface showed a number of people gave up on completing it as they went through the sections, potentially due to this decision. It may have been more appropriate to use more scaling options in place of 'no opinion' options, although Hinkin (1998) argues this can create significant difficulties in interpreting the results, cluster methods may be useful in analysing scaled results.

Conclusion

This thesis set out with the overall aim of investigating concerns of potential customers of electric cars. It has identified the following significant themes, with other smaller findings some of which confirming existing literature.

- Consumers are prepared to make trade-offs of performance in exchange for reduced Co2 emissions.
- Electric cars are not seen by UK consumers to be environmentally friendly.
- UK consumers are no prepared to pay a premium on electric vehicles.
- UK consumers have a largely negative view on lithium battery technology.
- Those with the buying power to buy from premium electric car brands such as Tesla are unwilling to do so, preferring to remain with traditional car manufactures.

The electric car industry is a fast changing environment and there is a clear need for more extensive research into the smaller details within it, as opposed to much of the current literature which gives primarily broader research perspectives.

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Examples Provided by JK Essay

Appendices

Appendix A

About you

1. Are you

Male Female

2. How old are you?

18-22 23-29 30-34 35-39 40-44
 45-49
 50-54 55-59 60+

3. What is your highest level of completed education?

Secondary- no qualifications GCSE (Or equivalent) A Level (Or equivalent)
 Bachelor's degree Master's Degree Doctorate
 Post Doctorate

4. What is your income?

£0-£15,000 £15,001-£20,000 £20,001-£25,000
 £25,001-£30,000 £30,001-£35,000 £35,001-£40,000
 £40,001-£45,000 £45,001-£50,000 £50,001+

Environmental Thoughts

5. On a scale of 1-10, how concerned are you about the environment? (1 being the least concerned and 10 being the most concerned)

1 2 3 4 5 6 7 8 9 10

6. Which of the following types of pollution do you consider to be the biggest issue?

- Air Light Noise Soil Water
Radioactive

7. On a scale of 1-10, how serious a threat do you consider global warming/climate to be? (1 being the least concerned and 10 being the most concerned)

- 1 2 3 4 5 6 7 8 9 10

8. Do you consider electric cars to be more environmentally friendly than petrol/diesel cars?

- Yes No
-

Environmental Behaviour

9. How much of your rubbish do you/your household recycle?

- 0% 1%-25% 26%-50% 51%-75% 76%-99%
100%

10. Do you have any of the following?

- Electric Car Hybrid Car Compost Heap Solar Panels
 Wind turbine
- Rain water harvesting system Low Flow shower head Energy saving light bulbs
- Double/Triple glazing

11. When purchasing electrical products, does the electrical efficiency rating play a part in your purchase?

- Yes No
-

Your car and your car

12. Which of the following do you currently own?

- Petrol/Diesel Car Hybrid Car (Battery and combustion engine powered)

Electric Car

13. When are you next likely to replace your current car?

0-1 years 2-3 years 4-5 years 6+ years

14. What are you likely to replace it with?

Electric Car Petrol/Diesel car Hybrid Car

15. Is there a particular car manufacturer that you prefer and do buy from?

Yes No

16. When considering what car to buy, which advert type best gains your attention to a car?

TV Ads Magazine Ads Internet Ads YouTube ads
 Billboards ads

Car review articles Displays in car showrooms

General exposure to a car, eg: seeing one drive down a street/in a TV programme

17. Which avenues do you use most to research a potential car purchase?

Magazine Reviews Online Reviews YouTube Reviews

Manufacturer Website Parkers Website Reviews from friends

Industry Literature Manufacturer publications Other

Electric Cars

18. Do you consider Electric cars to be a viable replacement to combustion engine cars?

Yes No

19. Do you know where the nearest public electric car charging point is to your home address?

Yes No

20. Based only on the following information; which car do you feel would be most suited to your preferences and needs?

Car 1:

Acceleration (0-60mph): 11 seconds,

Range (On one full tank): 542 miles

Co2 Emissions: 41g/km

Car 2:

Acceleration (0-60mph): 10.2 seconds

Range (On one full tank): 704 miles

Co2 Emissions: 139g/km

Car 3:

Acceleration (0-60mph): 11 seconds

Range (On one full tank): 33 miles

Co2 Emissions: 0g/km

21. Do you have off road parking at your home?

Yes No

22. Which would you be more concerned about in a crash?

Presence of petrol/diesel Presence of a Lithium battery

23. How often do you make a single trip (without stopping for longer than half an hour) of over 100 miles?

Daily Weekly Monthly Quarterly Once a year
Never

24. What are the top 5 most important specifications/characteristics you look for in a car?

- | | | |
|---|---|---|
| <input type="checkbox"/> MPG
60mph) | <input type="checkbox"/> Co2 Emissions | <input type="checkbox"/> Acceleration (0- |
| <input type="checkbox"/> Comfort | <input type="checkbox"/> Look of the car | <input type="checkbox"/> Boot/cargo space |
| <input type="checkbox"/> Manufacturer of the car | <input type="checkbox"/> Purchase Cost | <input type="checkbox"/> Feel of the car |
| <input type="checkbox"/> Running Cost
of filling up | <input type="checkbox"/> NCAP Rating | <input type="checkbox"/> Convenience eg: |
| <input type="checkbox"/> Horsepower | <input type="checkbox"/> Range | <input type="checkbox"/> Reliability |
| <input type="checkbox"/> Safety Features
Entertainment | <input type="checkbox"/> Latest Technology | <input type="checkbox"/> In Car |
| <input type="checkbox"/> 4 Wheel Drive | <input type="checkbox"/> Driver Assist technologies | <input type="checkbox"/> Seating Capacity |

25. Would a premium on top of the price of an electric car put you off purchasing it? (eg: If an electric car cost more than its petrol/diesel equivalent)

- Yes No

26. Would you be concerned about remembering to charge an electric car if you owned one?

- Yes No

27. Given the lack of an industry standard, allowing manufacturers to use different connection types, would you find the task of charging an electric car daunting?

- Yes No

28. Which of the following would most encourage you to buy an electric car?

Lower running costs Tax incentives Environmental Benefits

If the performance was equivalent to a petrol/diesel car

29. Please select the option which best suits your primary driving environment

Urban Rural Motorway

30. From your current knowledge, what do you believe to be the maximum range of any electric car on the market?

<50 miles 50-100 miles 101-150 miles 150+

31. Which of the following words would you associate with electric cars?

Fast Slow Ugly Stylish Cheap
 Expensive

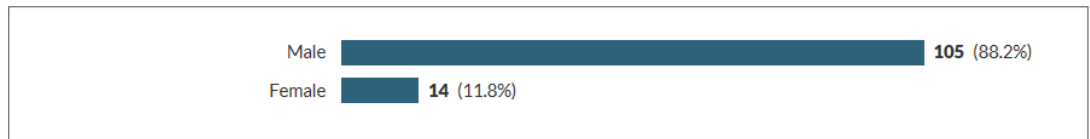
Eco-friendly Polluting Trend Setting Old technology

32. If you were to buy an electric car, would you prefer to buy it from a traditional car manufacturer such as Vauxhall, Ford and VW, or would you prefer to buy it from a new market entrant dedicated to electric cars such as Tesla or in the future, Dyson?

Traditional Car Manufacturer New market entrant

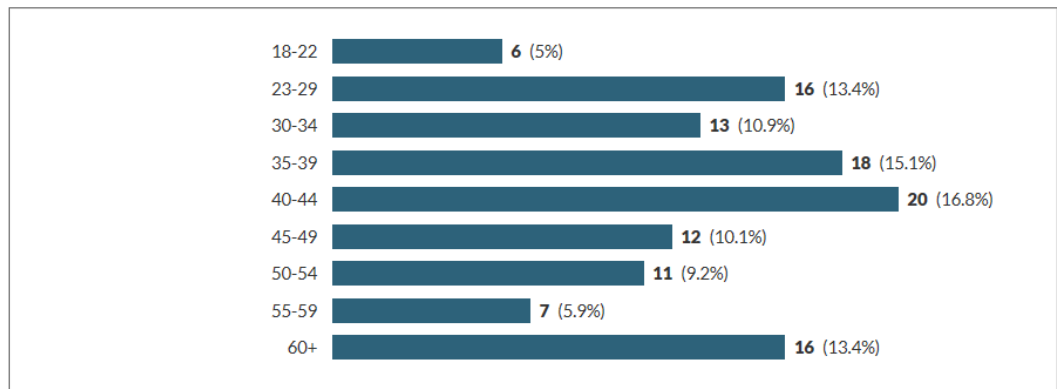
Appendix B

1 Are you...



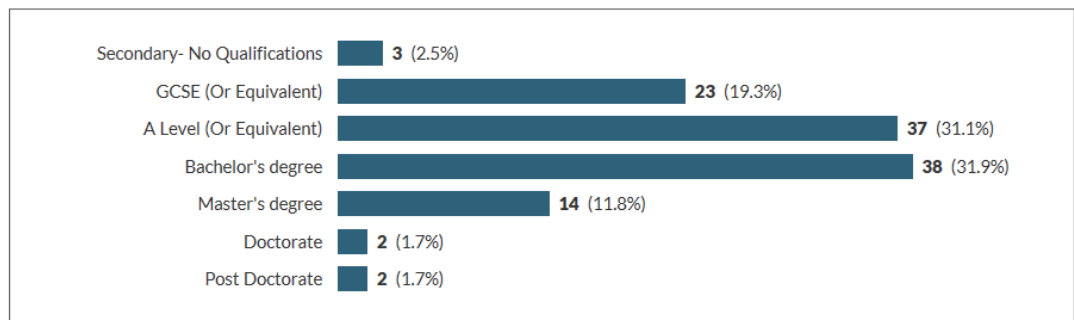
Appendix C

2 How old are you?



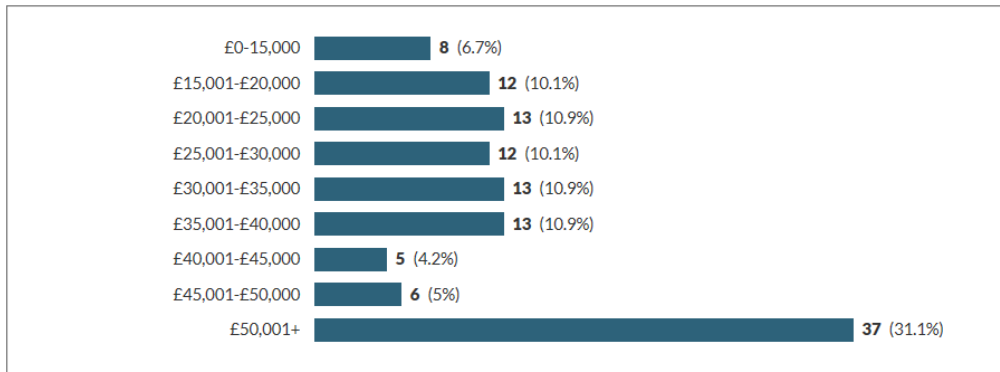
Appendix D

3 What is your highest level of Completed Education?



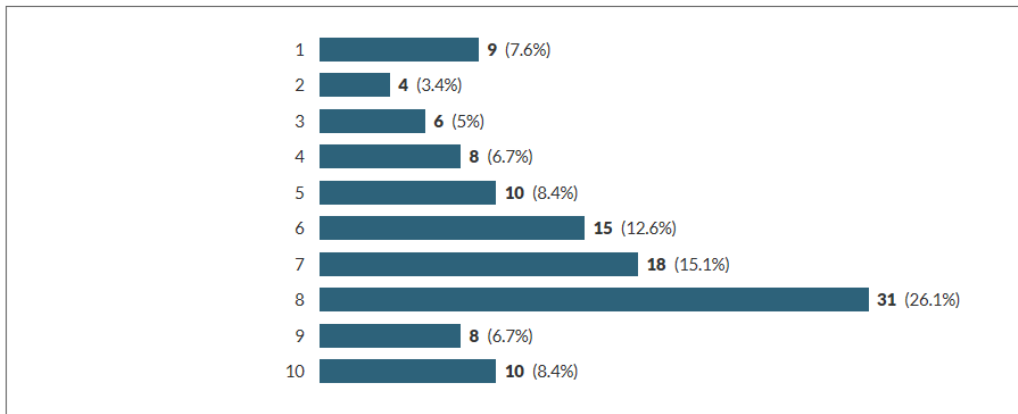
Appendix E

4 What is your annual income?



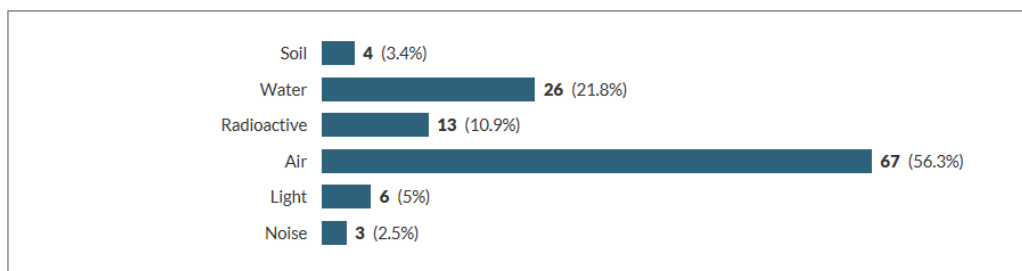
Appendix F

5.1 Least Concerned vs Most Concerned



Appendix G

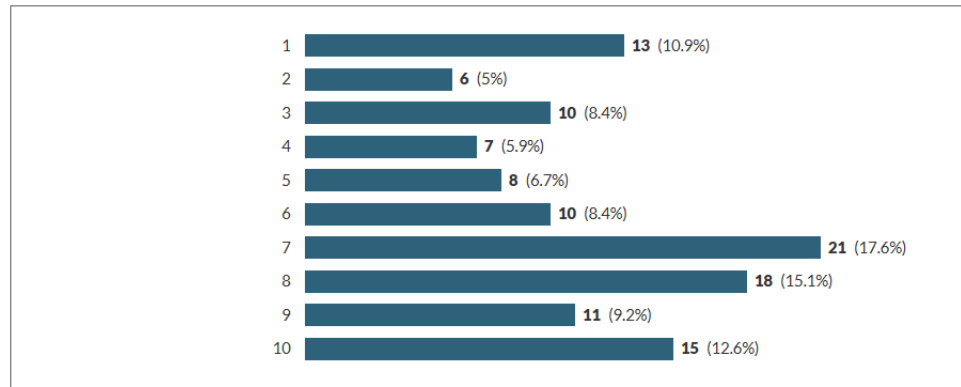
6 Which of the following types of pollution do you consider to be the biggest concern?



Appendix H

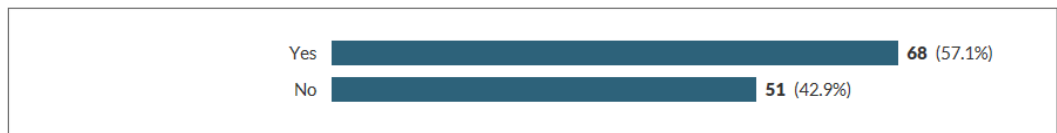
7 On a scale of 1-10, how serious a threat do you consider global warming/climate to be? (1 being the least serious and 10 being the most serious)

7.1 Least serious vs Most serious



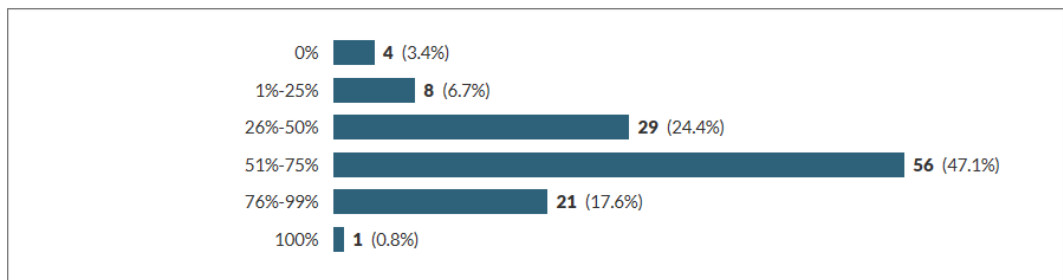
Appendix I

8 Do you consider electric cars to be more environmentally friendly than petrol/diesel cars?



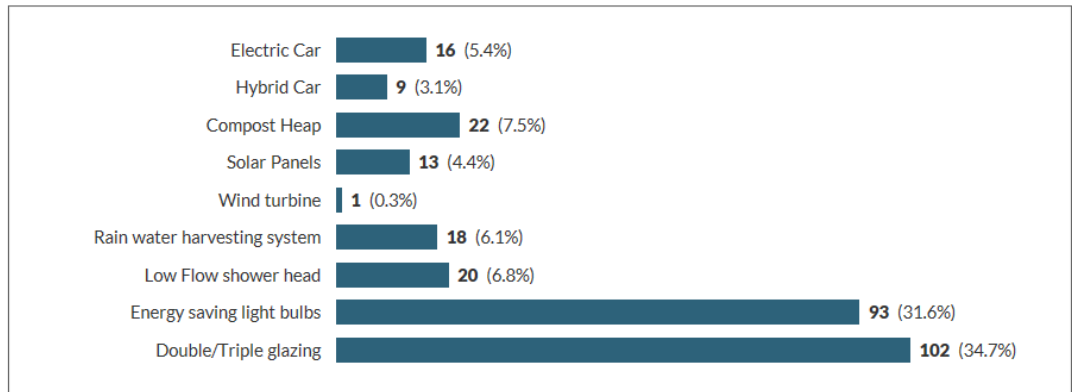
Appendix J

9 How much of your rubbish do you/your household recycle?



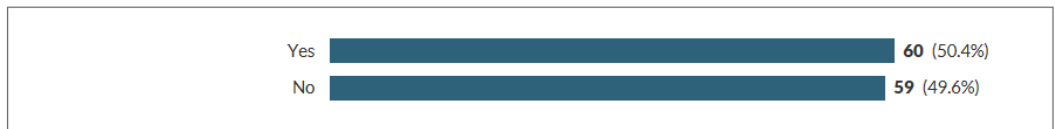
Appendix K

10 Do you have any of the following?



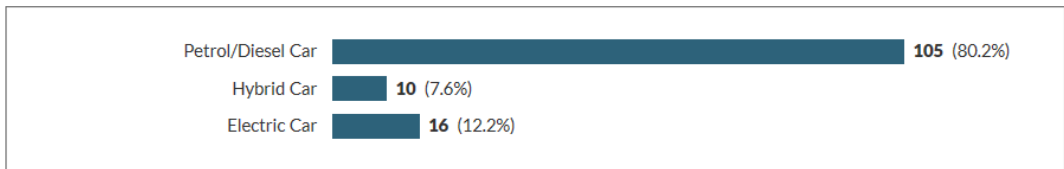
Appendix L

11 When purchasing electrical products, does the electrical efficiency rating play a part in your purchase?



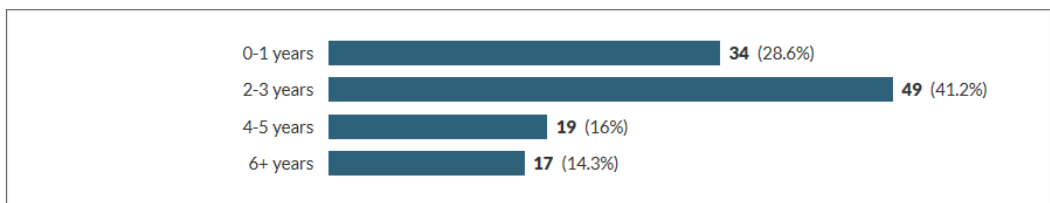
Appendix M

12 Which of the following do you currently own?



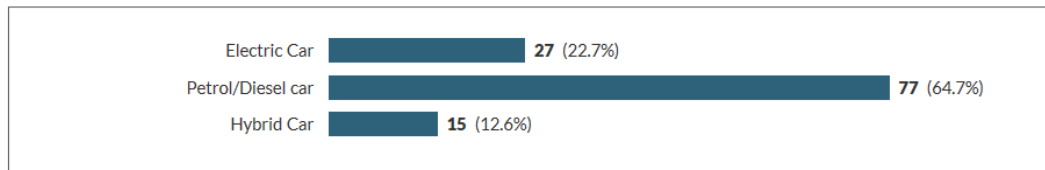
Appendix O

13 When are you next likely to replace your current car?



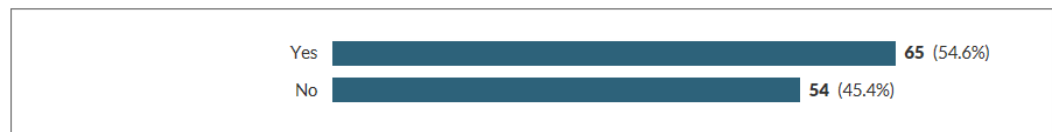
Appendix P

14 What are you likely to replace it with?



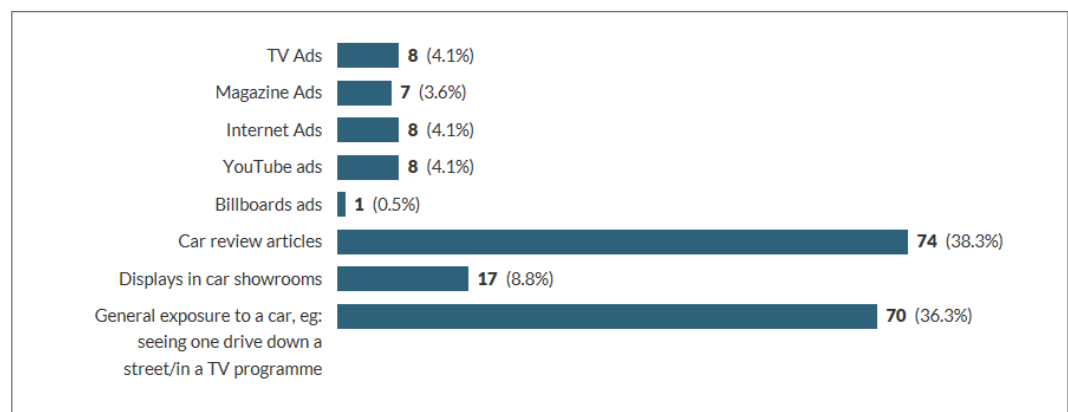
Appendix Q

15 Is there a particular car manufacturer that you prefer and do buy from?



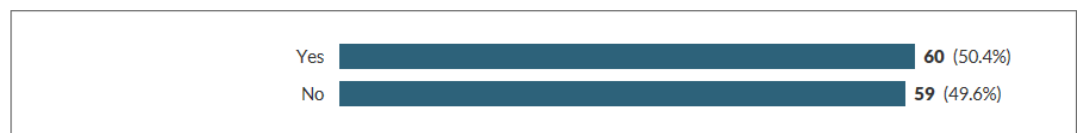
Appendix R

16 When considering what car to buy, which advert type best gains your attention to a car?



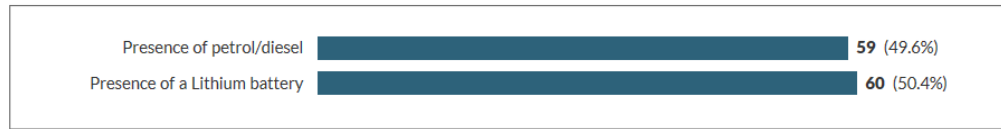
Appendix S

18 Do you consider Electric cars to be a viable replacement to combustion engine cars?



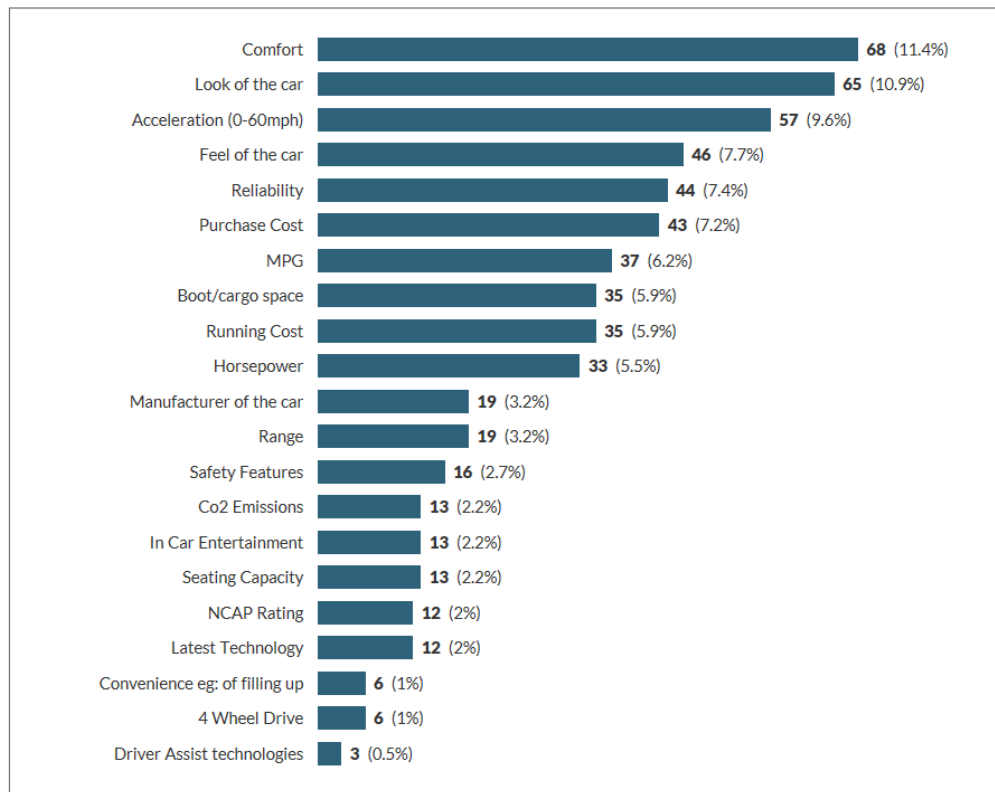
Appendix T

22 Which would you be more concerned about in a crash?



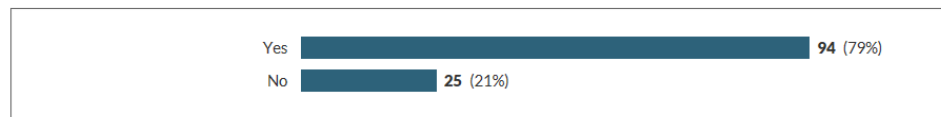
Appendix U

24 What are the top 5 most important specifications/characteristics you look for in a car?



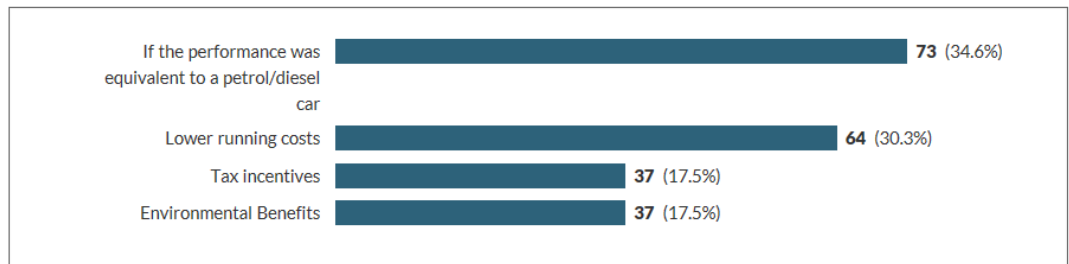
Appendix V

25 Would a premium on top of the price of an electric car put you off purchasing it? (eg: If an electric car cost more than its petrol/diesel equivalent)



Appendix X

28 Which of the following would most encourage you to buy an electric car?



Appendix Y

20 Based only on the following information; which car do you feel would be most suited to your preferences?

