

Demographic Influences on Consumer Perceptions of Zero-Emission Vehicles

Personal Research Paper

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Abstract

This study assesses the survey dataset “California Residents’ ZEV Attitudes” published by the nonprofit organization Creative Commons to understand the correlation between consumers’ age, education level, income, commute, and home conditions versus their interest and consideration for electric vehicles. The variation in proportions of demographic groups holding a certain perception towards zero-emission vehicles is explained using the evidence of secondary sources. Using the Python library NumPy on Jupyter Notebook, a web-based interactive computing platform, the dataset is analyzed and visualized to showcase the percentage of each demographic group that finds electric vehicles interesting, the percentage that has never considered purchasing one, and the percentage that already owns one. According to the results of the analysis, the demographic group of high education and income had a greater proportion of consumers that already owned an electric vehicle and are interested in them than the group with less education and income. Additionally, groups of older age groups and generations had a lower proportion of consumers that are interested in electric vehicles than the groups with younger individuals. Furthermore, groups with access to a garage or a carport had a greater proportion of consumers that are interested than groups without access. Moreover, groups with commuters had a greater proportion of interested consumers than groups with non-commuters. The objective of this study is to highlight the idea that analyzing consumer consensus by demographics is crucial in a business setting. Consequently, this research will be helpful for individuals or organizations looking to sell electric vehicles as it gives a baseline of the groups of consumers to target.

Introduction

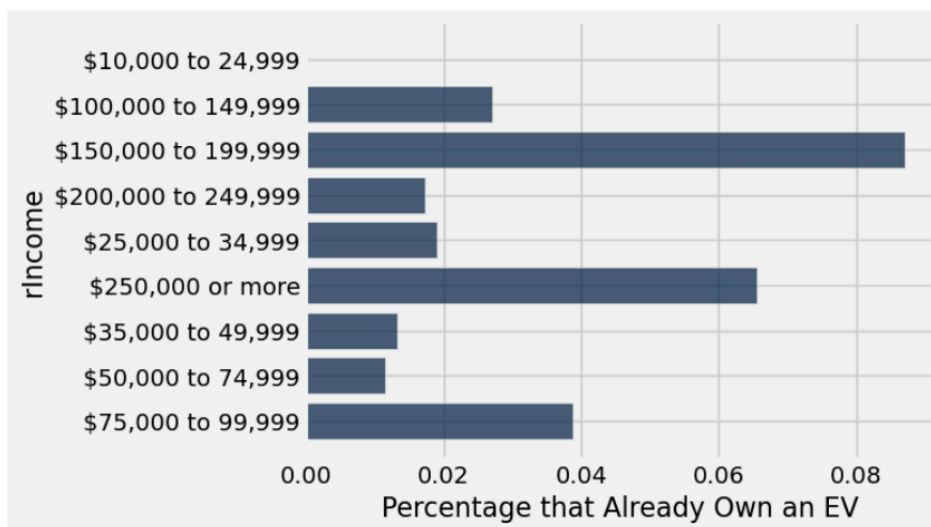
ZEV, which stands for zero-emission vehicle, has been gaining much attention and popularity throughout the past decade nationally and in California. With the release of popular car brands like Tesla, consumer demand for such vehicles is gradually increasing, and these products are becoming more common in the public. Although some people buy them for their aesthetics and functionality, others buy them because they are beneficial to the environment. Unlike standard gasoline vehicles, zero-emission vehicles do not emit harmful chemicals to the atmosphere because they are not powered by gas, but by sources like electricity and hydrogen. Due to their environmental benefit, the government offers incentives to individuals who transition to electric vehicles. For instance, “Those who buy new electric vehicles may be eligible for a tax credit of up to \$7,500, and used electric car buyers may qualify for up to \$4,000” (Parys 2). Despite their positive attributes, electric vehicles only account for “four out of 100 vehicles on the road in California” (McDonald 4). To understand why this is the case, analyzing consumer demographics and their perception of zero-emission vehicles is crucial. Despite the notion that non-gas vehicles are beneficial in many ways, many individuals show a lack of interest and consideration for them because of their upfront cost, limited designs, inconvenience, and lack of consumer awareness.

Income and Cost

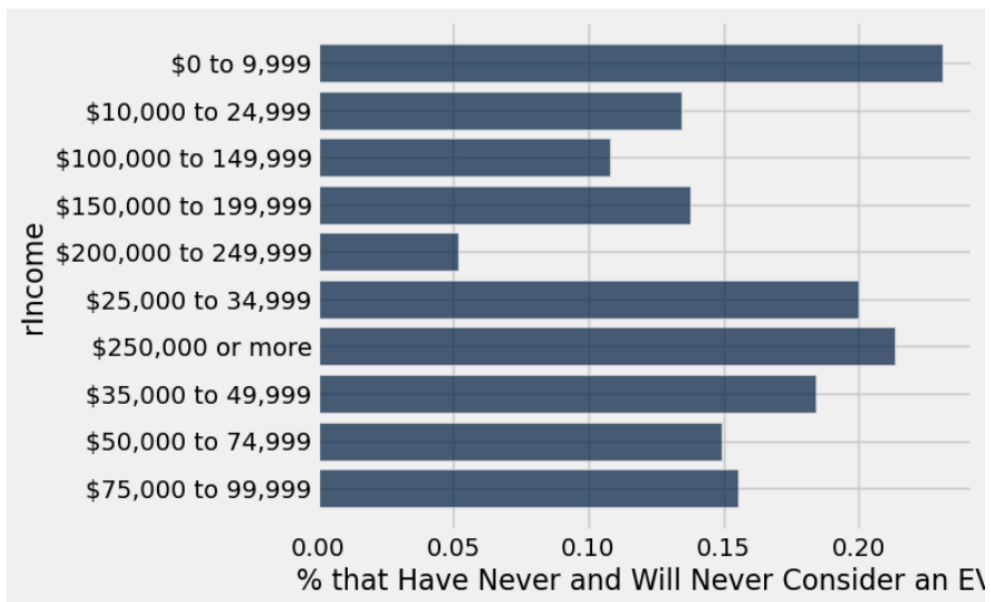
Consumers who make less than average income are reluctant to purchase zero-emission vehicles because they are expensive to purchase. According to a customer demographic analysis of electric vehicles, “owners of EV’s were predominantly middle-aged white men earning more than \$100,000 per year” (Inspire 4). According to my analysis of the survey data titled “California Residents’ ZEV Attitudes” collected by the non-profit organization “Creative Commons,” affluent consumers earning from \$150,000 to \$190,000 had the highest proportion of electric vehicle owners at 0.087 or 8.7%. On the other hand, impoverished consumers earning from \$10,000 to \$24,999 had the lowest proportion of electric vehicle owners at 0%. This evidence supports a positive correlation between income and the proportion of zero-emission vehicle owners. In other words, demographic groups with a higher salary tend to have a greater proportion of non-gas vehicle owners. Additionally, according to my analysis, individuals earning from \$0 to \$9,999 had the greatest proportion of consumers who have never considered and will never consider buying an electric vehicle at 0.23 or 23%. On the other hand, wealthy individuals earning from \$200,000 to \$249,000 had the lowest proportion of consumers who have never considered and will never consider buying an electric vehicle at 0.052 or 5.2%. Therefore, although zero-emission vehicles are becoming more common, such observation can only be made inside the sphere of consumers earning higher than average salaries. Despite many individuals wanting to benefit the ecosystem with electric vehicles, such products are outside of the budget for customers with less than average income. According to CBS News, “Only 18% of individual Americans make more than \$100,000 a

year...about 34% of U.S. households earn more than \$100,000 a year” (Brooks 7). Individuals and households earning six figures can be seen as a minority of the general population. Even within that minority, not every customer is willing to purchase an electric vehicle. Thus, the sum of individuals who own zero-emission vehicles is substantially lower than the amount who own emission vehicles.

Income	count	Percentage that Already Own an EV
\$10,000 to 24,999	52	0
\$100,000 to 149,999	370	0.027027
\$150,000 to 199,999	138	0.0869565
\$200,000 to 249,999	58	0.0172414
\$25,000 to 34,999	105	0.0190476
\$250,000 or more	61	0.0655738
\$35,000 to 49,999	152	0.0131579
\$50,000 to 74,999	348	0.0114943
\$75,000 to 99,999	361	0.0387812



income	count	% that Have Never and Will Never Consider an EV
\$0 to 9,999	26	0.230769
\$10,000 to 24,999	52	0.134615
\$100,000 to 149,999	370	0.108108
\$150,000 to 199,999	138	0.137681
\$200,000 to 249,999	58	0.0517241
\$25,000 to 34,999	105	0.2
\$250,000 or more	61	0.213115
\$35,000 to 49,999	152	0.184211
\$50,000 to 74,999	348	0.149425
\$75,000 to 99,999	361	0.155125



Age and Preference for Designs

Many customers of older age are also opposed to buying electric vehicles because of their limited designs and contemporary aesthetics. According to a consumer demographic analysis of electric vehicles, “young people aged between 18 to 29 were the most likely to consider purchasing an electric vehicle...with 55% expressing a likelihood to consider buying an electric car.” In contrast, out of those “aged over 65...only 31% showed an interest” (Pierce 5). This difference in proportional interest for zero-emission vehicles between generations is due to their varying preferences for designs and brands. The electric vehicle market is mainly composed of a select choice of designs depending on their popularity in the consumer world. Thus, traditional designs that are more appealing to older generations may be less popular due to the market’s inclination towards more modern designs. The variance in generational preference can be seen with “Generations Y and Z [exhibiting] a much stronger inclination towards...innovative brands like BMW and Audi.” On the other hand, “Baby Boomers show a preference for more established brands like Toyota, Honda, and Ford” (Pierce 8). With such demand for varying brands and designs in the electric vehicle market, one type is bound to be more popular. In this case, the more popular and thus, more commonly manufactured choice of designs would revolve around innovative brands because younger generations are more likely to purchase vehicles than older generations. Aside from car brands, vehicle year also determines its appearance and aesthetic. According to the California Air Resources Board, “(CARB) first adopted the Zero-Emission Vehicle requirement in 1990 as part of the Low-Emission Vehicle regulation” (CARB 3). Although electric vehicles began launching in

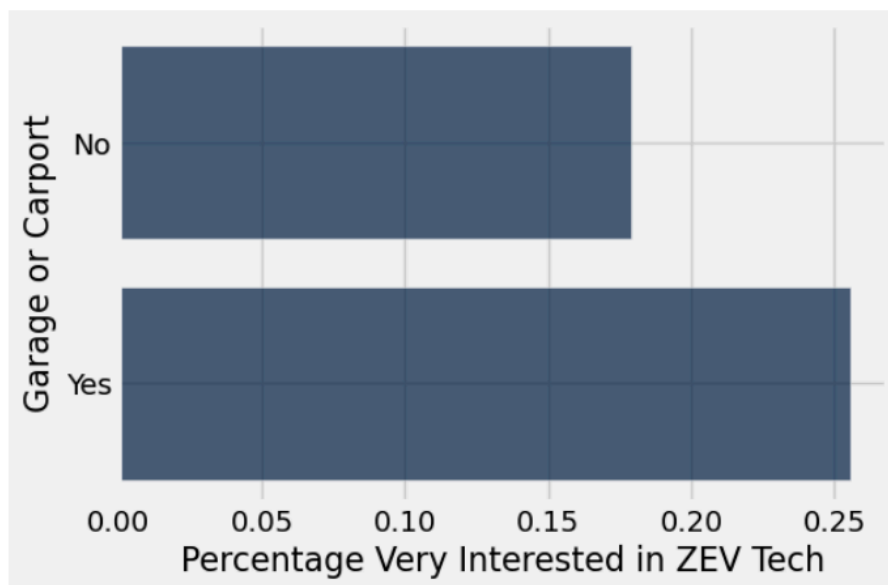
the 20th century, it wasn't until the 21st century that they began getting widely recognized and purchased. Thus, electric vehicles of older models and designs, preferred by older age groups, are less common and hard to buy. With the lack of appealing models and designs, older consumers are less likely to be interested in zero-emission vehicles than younger individuals.

Living Conditions and Inconvenience

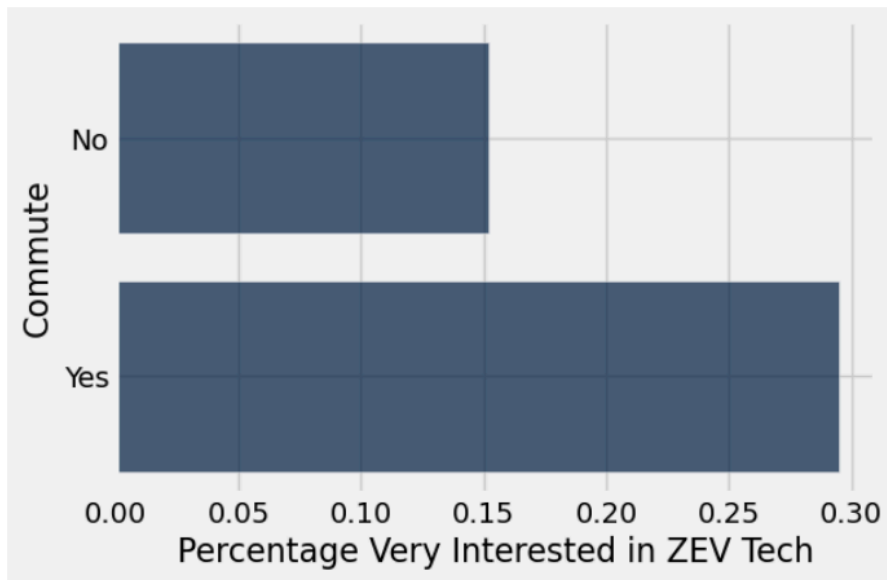
Consumers who commute to work and have access to a garage or carport are more likely to be interested in electric vehicles because of the suitable qualities that make them convenient. These vehicles are entirely dependent on their percentage of battery similar to how gas vehicles are dependent on the amount of gas it has. Non-gas vehicles have the option of charging their batteries from local charging stations or “EV owners may install Level 2(240 V) charging equipment in their homes for a faster charge, or opt for the Level 1 cordset provided with the vehicle” according to the U.S. Department of Energy. According to my analysis of the survey data, there is a significant difference in the proportions of garage owners and non-owners who are interested in electric vehicles. Individuals with access to their garage or carport have a higher proportion of consumers interested in electric vehicles at 0.255 or 25.5%. Individuals without access have a lower proportion of interested consumers at 0.179 or 17.9%. According to the excerpt titled “EV Charging: Everything you need to know”, “A tidy garage allows easy access to your EV charging station and lets you enjoy the numerous other benefits of parking your cars and trucks indoors.” Thus, non-emission vehicles are ideal for individuals with access to personal indoor vehicle space because they offer the option of quickly charging them without worrying about driving to a public charging station. Individuals without access to a garage-like space typically park their vehicles in public parking lots or on the street, where it is difficult or impossible to set up a personal charging station, making it less ideal. According to my analysis of the survey data, commuting individuals have a higher proportion of consumers who are interested in electric vehicles at 0.295 or 29.5%.

Non-commuting individuals have a lower proportion of interested consumers at 0.152 or 15.2%, making it a significant difference. Non-emission vehicles are favored by commuters because “modern electric cars can cover considerable distances on a single charge, making them suitable for daily commutes and longer journeys” according to Dick’s Canby Ford. Access to a garage and the need for commuting are examples of living condition demographics that heavily determine a consumer’s interest in non-gas vehicles.

Garage or Carport	count	Percentage Very Interested in ZEV Tech
No	481	0.178794
Yes	1190	0.255462



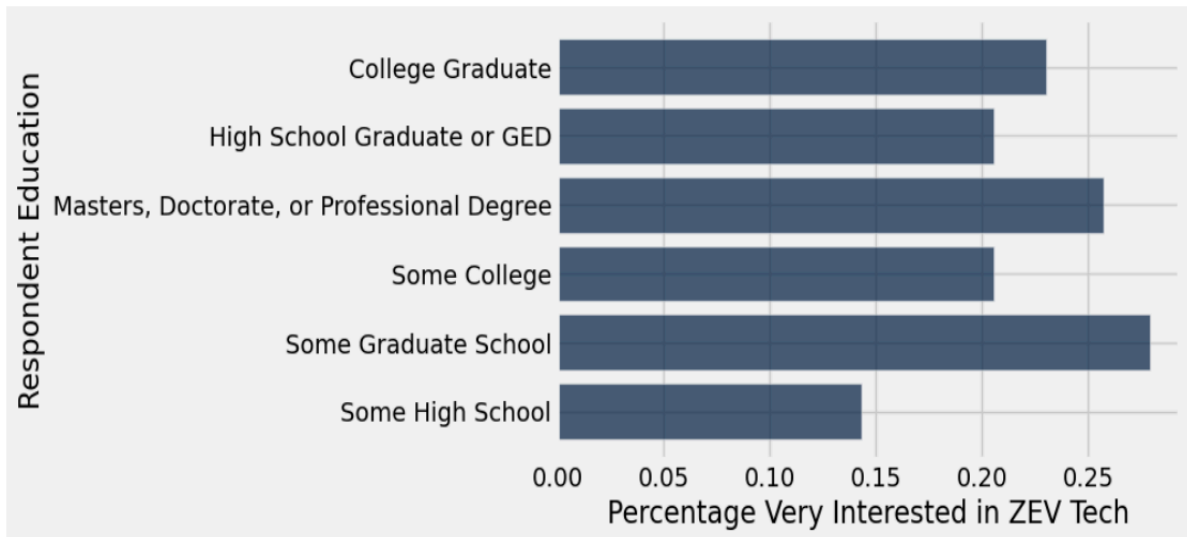
Commute	count	Percentage Very Interested in ZEV Tech
No	718	0.151811
Yes	953	0.294858



Education and Consumer Awareness

Many consumers, typically those coming from less educated backgrounds, are less interested in purchasing electric vehicles because they are unaware of their benefits to the environment and simply do not care. According to my analysis of the survey data, individuals coming from higher education like Master's, Doctorate's, or Professional degrees as well as individuals with some Graduate School experience had the highest proportion of consumers who were interested in electric vehicles. 0.257 or 25.7% of those with professional degrees considered themselves to be interested and 0.279 or 27.9% of those with some graduate school experience considered themselves to be interested. In contrast, only 0.143 or 14.3% of those coming from some high school experience considered themselves to be interested. This evidence shows that there is a positive correlation between education experience and the proportion of demographics that are interested in non-emission vehicles. This is backed by the excerpt "The U.S. Electric Vehicle Market: Exploring Ownership" which states that "Primarily those with higher education (a college degree+)" are likely to own battery electric vehicles. Although education level is positively correlated with income which is then positively correlated with electric vehicle interest as earlier stated, those coming from less educational background also lack the awareness of the electric vehicles' cruciality for the environment and benefits for its owners, consequently driving down their interest.

Respondent Education	count	Percentage Very Interested in ZEV Tech
College Graduate	638	0.230408
High School Graduate or GED	112	0.205357
Masters, Doctorate, or Professional Degree	381	0.257218
Some College	389	0.205656
Some Graduate School	129	0.27907
Some High School	7	0.142857



Conclusion

Despite the basis that zero-emission vehicles are beneficial in many ways, many customers still choose to not purchase them because of their expensiveness, limited choice of designs, unsuitability, and the lack of consumer knowledge about them. Despite the numerous features and benefits that electric vehicles offer, they account for a minority of all the vehicles in the United States and the state of California. When analyzing the “California Residents’ ZEV Attitudes” survey data which contains responses “from households who had acquired at least one household vehicle as new (rather than used) since January 2008,” (Kenneth 6) associations between various demographic factors versus consumers’ interest and ownership of electric vehicles was apparent. Individuals of affluent and highly educated backgrounds were more likely to own and be interested in electric vehicles. This was because non-emission vehicles are expensive and out of the budget for individuals making less than average income, causing them to have never considered purchasing one. Higher education also meant a greater interest not only because of the individuals’ likely sufficient income but also because of their knowledge about these vehicles. Additionally, owners of a garage or carport and individuals who commute showed greater interest because of convenience and suitability, suggesting that living conditions and daily lifestyle are determining factors. Finally, interest in zero-emission vehicles was highest among young adult and middle-aged generations and lower amongst older age groups because of their varying preference for design and aesthetics. Age, education level, living conditions, lifestyle, and income are some key demographic factors to consider

when trying to sell electric vehicles. Whether it comes to vehicles or any other products, using statistical data analysis of demographics can maximize a business' sales outcome.

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