# Renewable Energy Access by NJ Households

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**Abstract**

Energy consumption is increasing rapidly as society makes technical advancements. This study gathers information about factors that could affect a person' decision in choosing renewable energy. Over 580 TCNJ students were surveyed for their behavior and opinion on various topics relating to the environment. The data results are interesting. The majority of students believe that climate change is an important issue needing to be addressed. However, only a small population of TCNJ students are aware of the solar tax credit program or have any solar installation in their family's home. The regression results consolidate this finding, as tax credit is one of the only two factors that affect renewable energy consumption.

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## Introduction

As the world continues to make technological advancements, energy requirements also grow. According to the U.S Energy Information Administration (2019), the projected world energy usage will increase by 50% by 2050, with Asia as the leading growth region. This rapid growth of energy demand will require many countries to create new energy projects to accommodate.

Such projects require massive amounts of capital and will have an impact on the environment. In 2020, the world's energy consumption totaled 153593 Terawatt-hours. Fossil fuel dominated energy production however, with 38228 Terawatt-hours from natural gas, 42062 Terawatt-hours from coal, and 48259 Terawatt-hours from oil (Ritchie and Roser). These three sources of energy production accounted for 83.6% of the world's total energy consumption. Meanwhile, renewable energy sources such as wind, solar, nuclear, hydropower, biofuels, and others only totaled 25044 Terawatt-hours, or 16.3% of the world's total energy consumption by source. Since fossil fuels are notorious for releasing large amounts of greenhouse gasses, it is expected that if consumption of fossil fuels continues to increase, climate change can become a pressing issue in the future (Our World In Data). Therefore, this paper aims to explore the attitude of the population towards renewable energy and the likelihood that they will convert to a more sustainable energy source.

## Literature Review

Renewable energy accessibility in developed countries is not a heavily researched topic. Most recent studies relevant to renewable energy focused on the correlation between income inequality and renewable energy consumption, the availability of renewable energy in developing countries, and the importance of renewable energy for economic growth. However,

there have been no studies involving the attitude of people towards renewable energy consumption as well as its accessibility. The literature in this section serves to provide relevant knowledge for readers to understand the goal of the paper.

## I. Energy Studies

Perry Sadorsky (2009) studied income and renewable energy consumption using data from 18 developing countries. The dataset parameters for developing countries specified that they must be listed in the Morgan Stanley Capital Income (MSCI) category and have 10 years of renewable energy consumption data. Perry Sadorsky (2009) constructed two empirical models, with the first model examining the relationship between per capita renewable energy consumption and per capita income, and the second model examining the relationship between per capita renewable energy consumption, per capita income, and electricity prices (2009). The empirical results were not very surprising, as past studies linking non-renewable energy consumption and income suggested that there is a positive correlation between these two variables. Given the growth of renewable energy, one can assume that there would also be a positive correlation between income and renewable energy.

An interesting finding in this paper is the difference between renewable energy income elasticities and electricity income elasticities. The results from the second model showed that renewable energy is more responsive to price changes compared to non-renewable energy. This means if electricity prices fell, consumption of renewable energy would be greater than consumption of non-renewable energy.

Building on these findings, Olalekan J. Akintande, Olusanya E. Olubusoye, Adeola F. Adenikinju, and Busao T. Olanrewaju (2020) studied the determinants of renewable energy consumption from five most populous nations in Africa. They obtained data from the World

Development Indicators of the World Bank between 1996 and 2016 for the five most populous countries in Africa. The data set was not complete however, as there were several missing variables during this time span. To account for these missing variables, they used a simple random imputation method to replace blanks in the data set. Their methodological framework uses the Bayesian Model Averaging method.

Their findings suggested that renewable energy adoption in those countries was affected by many variables such as GDP growth, land surface area, population increase, industry value-added, gross capital formation, urban population, etc. They found that renewable energy consumption increases when these determinants also increase. Perhaps an interesting finding in their result is each of the five selected countries have its unique variables that encourage the growth of renewable energy consumption. For example, South Africa's domestic credit provided by the financial bank sector is the only deciding factor, whereas Nigeria has GDP growth, school enrollment, foreign direct investment, regulatory quality, and rule of law as deciding factors (2020). This suggests that each of these countries can adjust accordingly to best promote renewable energy consumption.

Another study by Umut Uzar(2020) also expanded on the subject of income inequality and renewable energy. His motivation for the research is due to lack of studies regarding the impact of income distribution on renewable energy. He used income data from 43 countries between 2000 and 2015 and renewable energy consumption data acquired from the 2019 BP Statistical Review of World Energy. The Gini Index was acquired from the Standardized World Income Inequality Database in 2019. He analyzed the data by first applying a unit root procedure to determine whether the data should be regressed or differenced to render the data stationary. Afterwards, he used a cointegration procedure to determine whether there was

cointegration between the variables. Finally, he used a Pooled Mean Group estimation method to define short and long term relationships between variables in his model.

Perhaps the most important finding relevant to this paper's motivation is that the Gini index negatively affects renewable energy consumption. This implies that as income inequality increases, renewable energy consumption decreases. Another finding also suggests that CO2 emission increases renewable energy consumption, which is fairly obvious. Overall, the takeaway information we can get from this study is that apart from other determinants such as GDP, CO2 emission, trade openness, oil price, income inequality also contributes to the consumption of renewable energy.

## II. Behavioral Studies

Several behavioral studies have been conducted to gauge the consumer population's interest in renewable energy consumption.

Ariel Bergmann, Sergio Colombo, and Nick Hanley (2007) researched the preference differences for renewable energy developments between rural and urban areas. They designed a study where participants were asked to rate the impact of renewable energy projects on landscape, wildlife, air pollution, long-term jobs, and electricity price increase. They used data from 547 surveys collected from a random sample of participants in the districts of Aberdeenshire, Highlands and Islands, Western Isles, Edinburgh, Glasgow, Stirling, Galloway, Borders and Dumfires of Scotland during the first week of September 2003 (2007). 320 of the participants were from urban areas and the remaining from rural areas. 43% of the participants responded in the survey, which is a large enough sample to analyze statistical significance. Their findings showed that urban participants preferred renewable energy projects that do not impact

wildlife and natural landscape, whereas rural participants do not show any preference in this regard, but prefer projects that create new jobs.

Gwynne Rogers (2011) conducted a study using data collected from the Natural Marketing Institute's Lifestyles of Health and Sustainability Consumer Trends Database. The data contains responses from 2000 to 4000 nationally representative U.S adults. Respondents were questioned about their awareness of renewable energy, their interest level towards purchasing renewable energy, and their acknowledgement of the benefits of using renewable energy. The results showed that 71% of the respondents were aware of renewable energy and related terminologies, 80% were interested in the use of renewable energy sources, but only 14% of them are given the option to buy renewable energy and 7% currently have renewable energy in their home. The data suggests that there is opportunity for this sector to grow because there is a large amount of awareness in consumers.

John DeCicco, Ting Yan, Florian Keusch, Diego Horna Munoz, and Lisa Neidert (2015) conducted a behavioral study to determine the attitude and expectations about energy of U.S consumers. They used a survey comprising six topics regarding energy: energy affordability, energy reliability, energy security, economic impacts of energy, environmental impact of energy, and energy efficiency and conservation. The survey was then tested by three focus groups consisting of 22 total participants in Southeastern Michigan to give feedback about the usefulness of the questions. Afterwards, the survey was given to SCA researchers to interview 500 adult men and women in the U.S every month. The data was collected from samples taken in October 2013 and January, April, and July 2014.

The results showed some interesting insights. Regarding reliability, 72% of respondents believe the energy they consume is very reliable. One notable finding is the increasing number of

respondents who consider energy to be very reliable as the income and home status bracket increases. This means that people who have a higher income and own a house are more likely to find energy consumption very reliable. For affordability, respondents were first asked how much their energy bills would have to increase for them to consider as unaffordable. Western homeowners believe a 173% increase in home energy bill is unaffordable compared to 108% for Northeasterners and 135% for Midwesterners and Southerners. They were also asked about the affordability of gasoline. Their responses, on average, pointed towards the price of $5.93 per gallon as being unaffordable. Regarding the environmental impact of energy, 70% of respondents from the South think energy fairly affects the environment, whereas the remaining regions, on average, had 79% of respondents believing energy impacts the environment. When asked about which aspect of the environment is most affected by energy consumption, 43% responded with air, 27% responded with global warming, 16% responded with water, and 15% responded with personal health.

Lauren Knapp, Eric O'Shaughnessy, Jenny Heeter, Sarah Mills, and John DeCicco (2020) studied consumers' willingness to pay for green electricity by comparing stated and revealed preferences for residential programs in the U.S. They utilized behavioral data collected by the U.S National Renewable Energy Laboratory (NREL), national energy data, and environmental surveys collected by the University of Michigan (UM). The NREL data consisted of 2017 estimates of enrollment in residential and commercial renewable energy programs in the U.S. Within the scope of their study, the residential estimates were taken from 46 utility programs, which accounted for 80% of green pricing program sales in the U.S (2020). The UM data consisted of U.S consumers' responses for attitudes, perceptions, and behavior regarding energy.

The results showed several interesting findings. First, home value has a positive correlation with green power sales. This means that people with more expensive homes are able to manage more green power sales than those with less expensive ones. Regarding attitudes on energy concerns and energy impacts, the study found that consumers with stronger feelings about the impact of energy use on the environment also have higher participation rates in green programs. Regarding the willingness to pay (WTP) for renewable energy, the study found that the mean WTP across all U.S programs is $6.06 per month. Moreover, the WTP is highly correlated with programs with high participation rates. This sounds obvious, but could be a key factor for states to incorporate programs that yield the highest participation. Most importantly, the survey discovered that consumers in 2018 were willing to pay $8.33 per month for more renewable energy, which is a 17% increase from previous years at $4.00 per month. This also suggests that the general population has a positive attitude towards renewable energy and is willing to pay for it.

There are also several studies assessing the public attitude towards renewable energy in other nations. Muhammad Irfan, Yu Hao, Muhammad Ikram, Haitao Wu, Rabia Akram, and Abdul Rauf conducted a study of the public acceptance and utilization of renewable energy in Pakistan (2020). They based their framework on the Theory of Planned Behavior (TPB), which states that an individual's behavior is regulated by his/her behavioral intention. Basically, an individual will weigh the outcome before executing a behavior, which will likely lead to a desired outcome (2020). With respect to renewable energy, the TPB is applied by weighing the benefits of using renewable energy before actually going forth with the decision. To test their framework, they used a survey collecting public responses in four large cities of Pakistan - Rawalpindi, Lahore, Gujranwala, and Faisalabad during May, June, and July of 2019. 400

questionnaires were given and 351 responses were received, which indicated a response rate of 87% (2020). They aimed to use the survey to test several hypotheses - perception of self-effectiveness (which influences consumer intention), environmental concern, beliefs about the cost of renewable energy, awareness about renewable energy, perception about neighbor participation, and beliefs about the benefits of renewable energy (2020).

Their hypothesis tests were done using Structural Equation Modeling (SEM). The results showed that the perception of self-effectiveness on consumers' intention to utilize renewable energy is significant and positively correlated. This means that the positive effects of using renewable energy can encourage consumers to switch to renewable energy. The relationship between environmental concerns and intention to utilize renewable energy is not significant, however. Basically, consumers are not as driven to use renewable energy based on their concerns of the environment. The paper reasoned that a cause for this finding is consumers often do not think about long-term environmental benefits while making energy purchases. The relationship between the beliefs about the cost of renewable energy and intention to utilize renewable energy is highly negative. This is reasonable within the scope of the study, as renewable energy is rather expensive in Pakistan and can deter consumers from purchasing it.

The relationship between awareness of renewable energy and intention to utilize renewable energy is very significant and positive. This is especially true for consumers who are knowledgeable about renewable energy, which is a good driver for them to consider purchasing it over regular energy. The relationship between perception about neighbor participation and intention to utilize renewable energy is also positive and significant. In essence, consumers who live in neighborhoods that have a lot of renewable energy usage are more likely to convert to renewable energy sources. Last but not least, the beliefs about the benefits of renewable energy

have no significant effect on consumers' intention to utilize renewable energy. The study believed this is likely due to the lack of information among consumers about renewable energy, as the Pakistani government had not promoted the comprehensive benefits of renewable energy to the public, and that the public still favored non-renewable energy sources (2020).

## Basic Model

This paper uses a survey to collect data from TCNJ students. The model used in the paper is a multiple regression with energy source as the dependent variable.

A person's attitude towards renewable energy is mainly influenced by three factors: income, environmental attitudes, and demographic controls. Since data is collected from TCNJ students who may or may not have a source of income, the survey uses parental education and condition of car purchase as proxies for income. Environmental attitudes can be measured with daily habits that are relevant to the environment such as transportation, heat consumption, etc. Demographic controls such as age and state of residence are also used to assess whether a person is likely to have a positive attitude towards the environment as they age, and whether their residence location may have an impact on their outlook of the environment.

The economic independent variables are whether a family owns or rent its home, highest level of education for each parent, condition of most recent purchased car, and size of most recent purchased car; the environmental-behavior variables are frequency of filtered water consumption, belief on climate change, condition of household item purchases, frequency of using a bicycle, frequency of A/C usage, frequency of public transportation usage, and electric heat consumption. Demographic controls include age, gender, and ethnicity; geographic

variables include state and county of residence. The latter is a proxy for more urban or more rural environments, with suburban areas as the excluded variable.

The model to be estimated is written as below:

$$Energy = \beta 0 + \beta 1\ OwnHome + \beta 2\ EduFath + \beta 3\ EduMoth + \beta 4\ UsedCar + \beta 5\ CarSize + \beta 6\ FilWater + \beta 7\ Climate + \beta 8\ UsedItem + \beta 9\ Bicycle + \beta 10\ PubTrans + \beta 11\ ElecHeat + \beta 12\ ACUse + \beta 13\ Female + \beta 14\ NonBin + \beta 15\ Asian + \beta 16\ Black + \beta 17\ Mixed + \beta 18\ Rural + \beta 19\ TaxCre + Epsilon$$

*where Epsilon is assumed to be random normally distributed.* I expect the coefficients of the variables to be as followed:

$\beta 1, \beta 2, \beta 3, \beta 4, \beta 5, \beta 6, \beta 7, \beta 8, \beta 9, \beta 10, \beta 11, \beta 12, \beta 18, \beta 19 > 0$

$\beta 13, \beta 14, \beta 15, \beta 16, \beta 17 < 0$

The variables are categorized into four types - dependent, economic explanatory, behavioral explanatory, demographic explanatory, and other explanatory. The dependent variable is *Energy*, which describes the type of energy consumption for each participant's family. The economic explanatory variables consist of *OwnHome, EduFath,* and *EduMoth*. These variables describe whether a participant's family owns or rents its home, and the highest education level of the parents. The behavioral explanatory variables consist of *UsedCar, CarSize*, *FilWater, Climate, UsedItem, Bicycle, PubTrans, ElecHeat,* and *ACUse*. These variables describe different behaviors of the participant's family that could potentially affect the type of energy consumption, such as condition and size of last purchased car, frequency of consuming filtered water, opinion on climate change, etc. The *TaxCre* variable describes the participant's awareness of the Solar Tax Credit, which reduces the tax a participant's family has to pay if they install a solar system in their home. See Table 1 for a full description of variables.

(table 1 goes about here)

## Methodology

One of the hardest steps for this thesis was data collection. Since data for our explanatory variables were not readily available on the Internet, we attempted to gather data by surveying TCNJ undergraduate and graduate students. This was divided into three steps - creating a questionnaire, submitting it to the Institutional Review Board (IRB) for approval, and gathering responses from students.

In the first step, we used several questionnaires done by Gwynne Rogers (2011), John DeCicco (2015), and Lauren Knapp (2020) as guidelines to formulate our own set of questions. The questionnaire consists of 20 questions, with 19 questions accounting for each explanatory variable and the dependent variable, and one question asking for the participant's age. This was a requirement as per IRB's guidelines because only students over the age of 18 can participate. Furthermore, all students are required to read the complete consent form and decide if they want to participate. The complete questionnaire is provided in Appendix I.

Each of these questions account for different variables that could affect a participant's decision in consuming renewable energy. Since income was found to be correlated with renewable energy consumption (Perry Sadorsky, 2009), we wanted to include income as an explanatory variable in the questionnaire. However, due to the sensitive nature of asking one's income, we decided to use home ownership and the highest level of education for the participant's father and mother as proxies for income. This can be seen in question 3, 4, and 5 on the questionnaire. We also assumed that a participant's behaviors and lifestyle may reflect environmental values that lead to renewable energy consumption, which is why there are

questions asking whether a participant drinks filtered water, or uses any electric heat in their home, etc.

In the second step, we submitted the full questionnaire to the IRB for inspection. As part of the approval process, both my thesis advisor and I had to watch a set of videos and pass all quizzes to obtain the Human Subjects Certification, which would prove that we are certified to conduct any data collection using human subjects. This approval process, including the Human Subjects Certification completion, took approximately two weeks to complete. However, it only took two days after our questionnaire submission for the IRB to approve because the questions posed minimal risk to the participants.

In the last step, my thesis advisor sent an email to all faculty members on campus requesting 10 minutes of their class time for me to survey their students. Over the course of two weeks, I scheduled and visited approximately 30 classrooms and gathered over 580 observations from both undergraduate and graduate students. The questionnaire was accessible via a QR code that could be displayed by the projector, or an anonymous Qualtrics link for those who wished to complete it at a later time. As per IRB guidelines, I was required to inform all students that they must read the consent form and ask any questions if necessary. Furthermore, any personal information and IP addresses of the participating students were not collected for privacy reasons. The data gathering process was smooth and quite interesting. Several professors and students also demonstrated clear interest in the thesis topic and asked me to revisit them after I have finished analyzing the data. The average number of students per classroom was approximately 25, which means the participation percentage lies in the 75-80% range. Due to time constraints, I was unable to visit several more classes, which could have increased my total observation to over 600.

## Results

### I. Data Results

First, we can examine the results for the dependent variable, the extent of solar-energy consumption. In Figure 1, we can see that an overwhelming majority of participants consume public-utility energy (90.97%). Only 3.50% of participants strictly consume solar-powered energy in their homes, and 5.05% consume energy generated by both solar and public utility. By adding up the results of participants who either strictly consume solar-powered energy or a combination of solar-powered energy, wind energy, and public utility energy, we get a total of almost 9%. This is somewhat similar to the findings in Gwynne Rogers (2011)'s paper, which states that only 7% of respondents currently have renewable energy in their home despite being overwhelmingly interested in consuming renewable energy (80%).

(figure 1 goes about here)

Although the results for all of the questions are interesting in their own right, we highlight 5 questions which we believe to be most important in explaining the likelihood that a participant would consume renewable energy: parental education, home ownership, attitude to climate change, tax-credit awareness. Figures 2 and 3 show the distribution of education level for the father and mother of the participants.

(figures 2 and 3 go about here)

While father's education level shows a higher concentration of high school completion and advanced degree at 24.08% and 8.16%, respectively, more mothers completed a 4-year college and associate degree at 40.78% and 10.10%. Since the education level of the parents are proxies for income, we can make an assumption regarding each family's income level based on these results. Generally, an Advanced and Master's degree is earned following the completion of

a 4-year college degree. Therefore, we can group all three of them together into a separate category for high level education. The results show that over 68% of participants' fathers and 67% of their mothers have a high education level. This means we can safely assume that the majority of families' income is high.

Figure 4 shows the homeownership results for the participants' families. Over 90.87% of the participants' families own their home, and only 9.13% rent theirs. Since John DeCicco (2015) has found that homeowners tend to find renewable energy to be more reliable, we assumed that the same results could be obtained from our pool of participants. Furthermore, we also assume that homeowners may be more willing to install solar panels on their roofs because of the fact that they own their house.

(figure 4 goes about here)

Figure 5 shows the results for opinion on climate change. Most participants demonstrate a level of concern towards climate change with 20.58% believing that it is a very important issue, and 55.15% believing that it is somewhat important. 20.58% of participants do not think climate change is an issue, and less than 1% believe that it is not real. Since over 75% of participants believe that climate change is either important or very important, we assumed that there is a correlation between positive opinion on climate change and renewable energy consumption.

(figure 5 goes about here)

Tax credit awareness results were also very interesting, as seen in Figure 6. Our results show that the majority of participants (87.38%) did not know about the federal tax credit program. It is possible that the overwhelming majority of participants do not know about the tax credit program because our sample pool only includes students who have yet to own a home. People who do not own a home may not be inclined to do research on existing solar projects.

(figure 6 goes about here)

## II. Regression Results

A Probit regression was conducted, because the dependent variable is a dummy variable representing those whose families use solar power. Table 2 displays the probit regression results for all explanatory variables, where the coefficients measure the likelihood that a participant's family would consume solar or wind powered energy.

(table 2 goes about here)

As mentioned before, we expected that the variables for income proxy, behaviors of the participants, their awareness of the solar tax credit program, and their location of residence are positively correlated with renewable energy consumption. Surprisingly, the only variables with a P-value of less than 0.05% were Asian and Taxcre (0.008 and 0.033). This means that while the awareness of the solar tax credit program is indeed significant, the remaining variables do not influence a participant's decision to use renewable energy.

In an attempt to further analyze the data, we used factor analysis to find out if the behavioral explanatory variables can be influenced by an unknown variable and thus be combined into a single variable. See Figure 7 for the complete factor analysis.

The results show that the loading patterns for *UsedItem, Bicycle, PubTrans,* and *ACUse* are larger for factor 1, whereas *FilWater* and *Climate* have larger loadings on factor 2. Based on the factor analysis results, we decided to generate three new variables called *Environment, Manyenv, and Edu*. The *Environment* variable is a combination of the behavioral explanatory variables and their factor loading coefficient. The *Manyenv* variable is a combination of the behavioral explanatory variables without their factor loading coefficient. The *Edu* variable is a

combination of the variables describing the father and mother's level of education. These new variables were then used in three stepwise regression analyses with a 0.05 significance level criteria to find out if the results could be better.

Table 3 shows the results of the stepwise analyses using these variables. We can see that the results are identical. *TaxCre* and *Asian* continue to be the only significant variables. All remaining variables were removed from the regression analysis because they do not meet the 0.05% significance level criteria. Therefore, the factor analysis and stepwise regression models did not improve the original model in Table 2.

(table 3 goes about here)

## Conclusion

From these results, we concluded that income proxies, behavioral characteristics, and most demographic factors do not affect the student's family's choice in energy consumption. On the other hand, the student's awareness of tax credit for solar programs does have an effect on their family's energy choice. It can also be concluded that their knowledge of the solar tax credit system may come from their parents, considering the data shows several responses answering YES for tax credit awareness and Solar for their family's current energy consumption. However, the data also shows that the families of the vast majority of those who answered YES for tax credit awareness do not consume renewable energy. This means the students may be aware of the program, but their family may not or does not want to participate in it. Perhaps the government can focus on spreading awareness to more homeowners or give more incentives to promote installation of solar panels or other renewable energy programs.

Additionally, Asian race positively correlates with renewable energy consumption. We believe that this correlation can be explained by the assumption that Asian American families

tend to focus on reducing costs or earning a rate of return more due to their cultural background. It could also be due to a small sample size. If more data was collected, we could potentially see this correlation disappear. Overall, future researchers can improve on this study by sampling a larger population consisting of not only students but also homeowners as well.

## Appendix I

*Complete Questionnaire with Consent Form*

2) What kind of energy source does your family use for electricity? Choose all that apply.

- ☐ Solar
- ☐ Wind
- ☐ Public Utility

3) Does your family own or rent its home?

- ○ Owned
- ○ Rented

4) What is the highest level of education for your father/step-father?

- ○ Some high school
- ○ High school
- ○ Associate degree
- ○ 4-year college degree
- ○ Master's degree
- ○ Advanced degree

5) What is the highest level of education for your mother/step-mother?

- ○ Some high school
- ○ High school
- ○ Associate degree
- ○ 4-year college degree
- ○ Master's degree
- ○ Advanced degree

6) For the last car your family bought, was it new or used?

- ○ New
- ○ Used

7) What was the size of the last car?

- ○ Compact
- ○ Mid-sized
- ○ Full-sized
- ○ SUV
- ○ Other

8) Does your family drink any type of filtered water?

- ○ Never drink filtered water
- ○ Sometimes drink filtered water
- ○ Often drink filtered water
- ○ Almost always drink filtered water
- ○ Other

9) What is your family's opinion on climate change?

- ○ Very important concern
- ○ Somewhat important concern
- ○ Not a concern
- ○ Not real
- ○ Real but not a result of human actions

10) Does your family buy used or new household items?

- ○ Often used
- ○ Sometimes used
- ○ Almost always new

11) Do your family members ever walk or bike locally instead of driving a car?

- ○ Never walk or bike
- ○ Sometimes walk or bike
- ○ Often walk or bike
- ○ Almost always walk or bike

12) Do your family members ever take public transportation instead of driving?

- ○ Never take public transportation
- ○ Sometimes take public transportation
- ○ Often take public transportation
- ○ Almost always take public transportation

13) Is there any electric heat in your family's home?

- ○ Yes
- ○ No

14) How often does your family use air conditioning (A/C)?

- ○ Never use A/C
- ○ Sometimes use A/C
- ○ Almost always use A/C

15) What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

16) What is your race/ethnicity? Choose all that apply.

- ☐ Asian
- ☐ Black
- ☐ Hispanic
- ☐ White
- ☐ Other

17) What state are you from?

18) What county in New Jersey do you reside in?

**19) If you're not from New Jersey, please write the county where your family resides in.**

20) Did you know that there is a 26% federal solar tax credit for purchased home solar systems installed by December 31st, 2022, and that homes are compensated per kilowatt-hour produced by their solar systems?

- ○ Yes
- ○ No

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*https://www.mdpi.com/1996-1073/14/17/5420/htm*

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**Figure 1**

*Results for Energy Consumption Type*

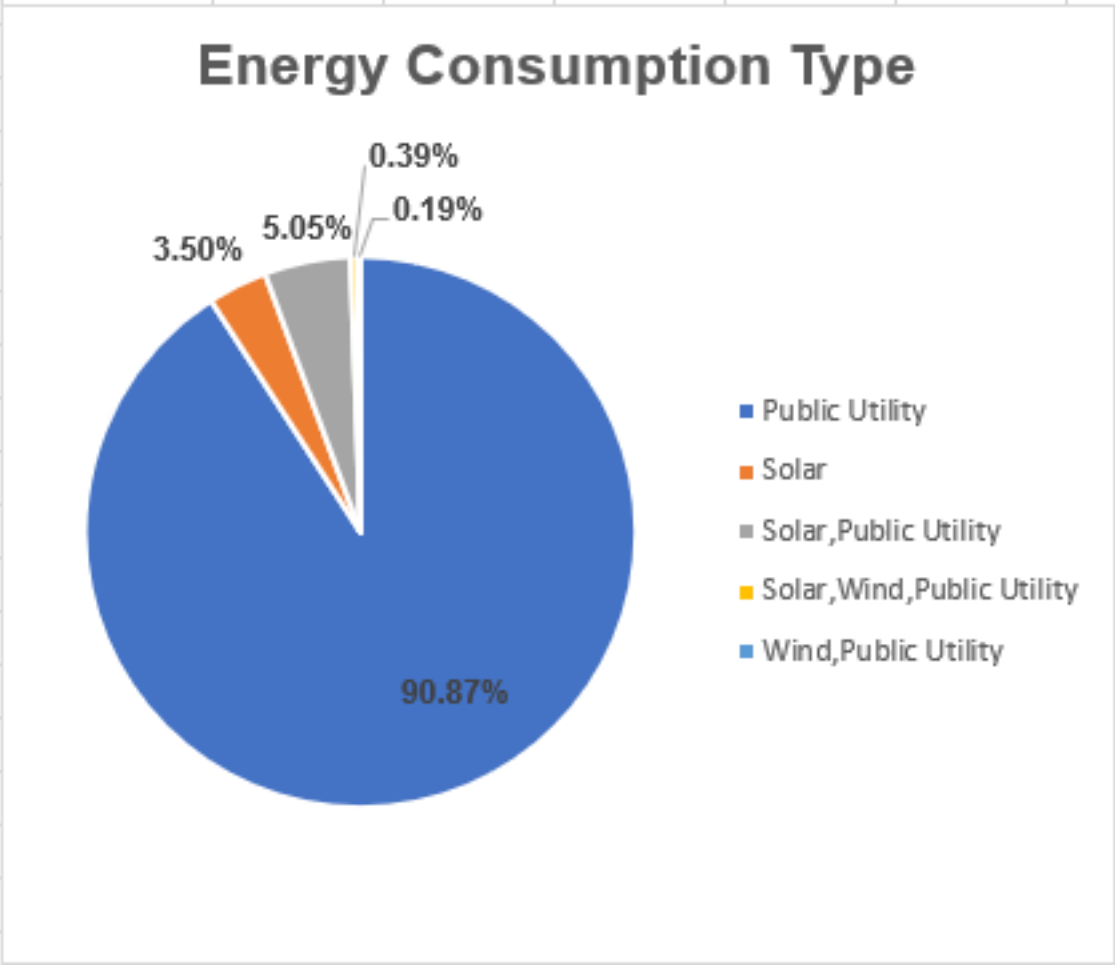

**Figure 2**

*Results for Father's Education Level*

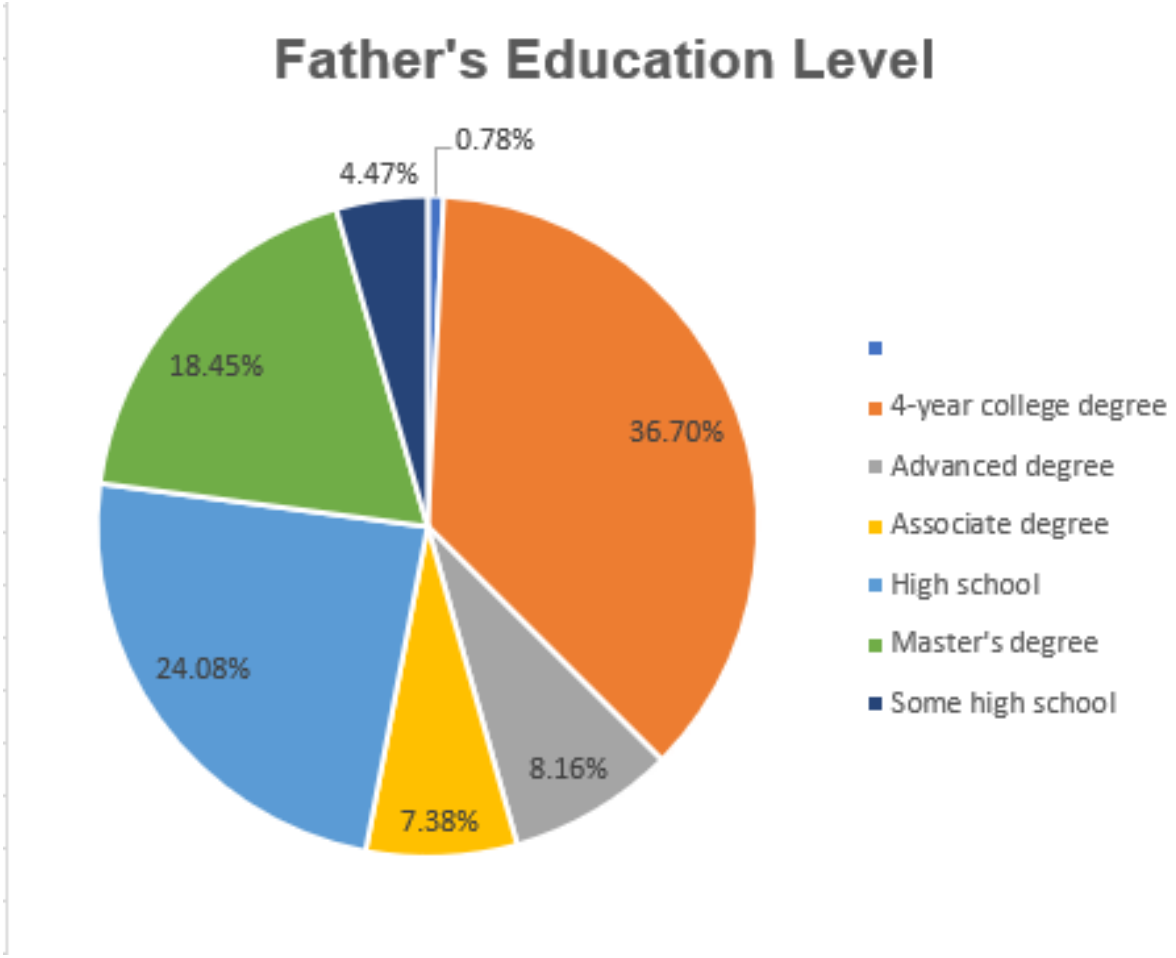

**Figure 3**

*Results for Mother's Education Level*

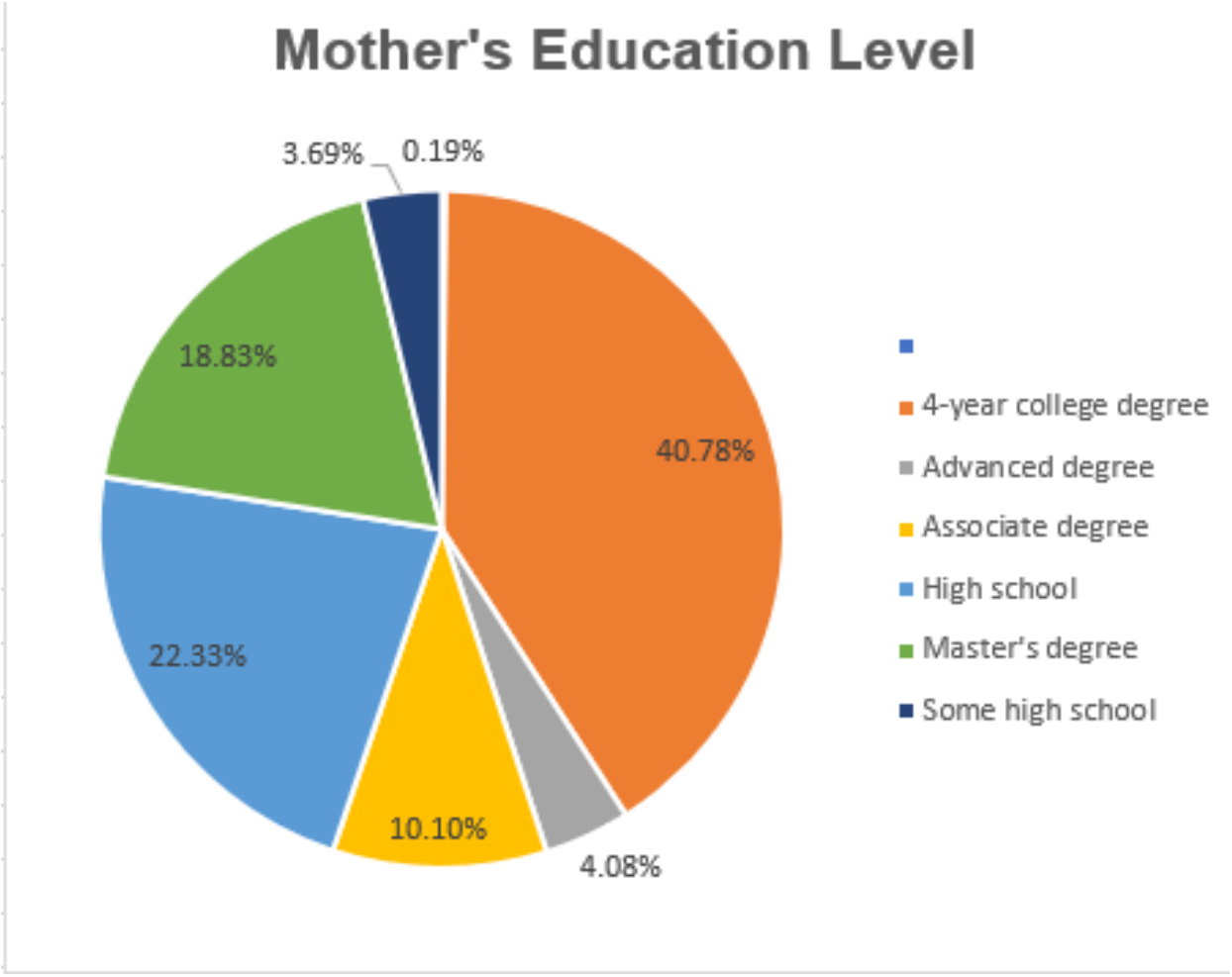

**Figure 4**

*Results for Homeownership*

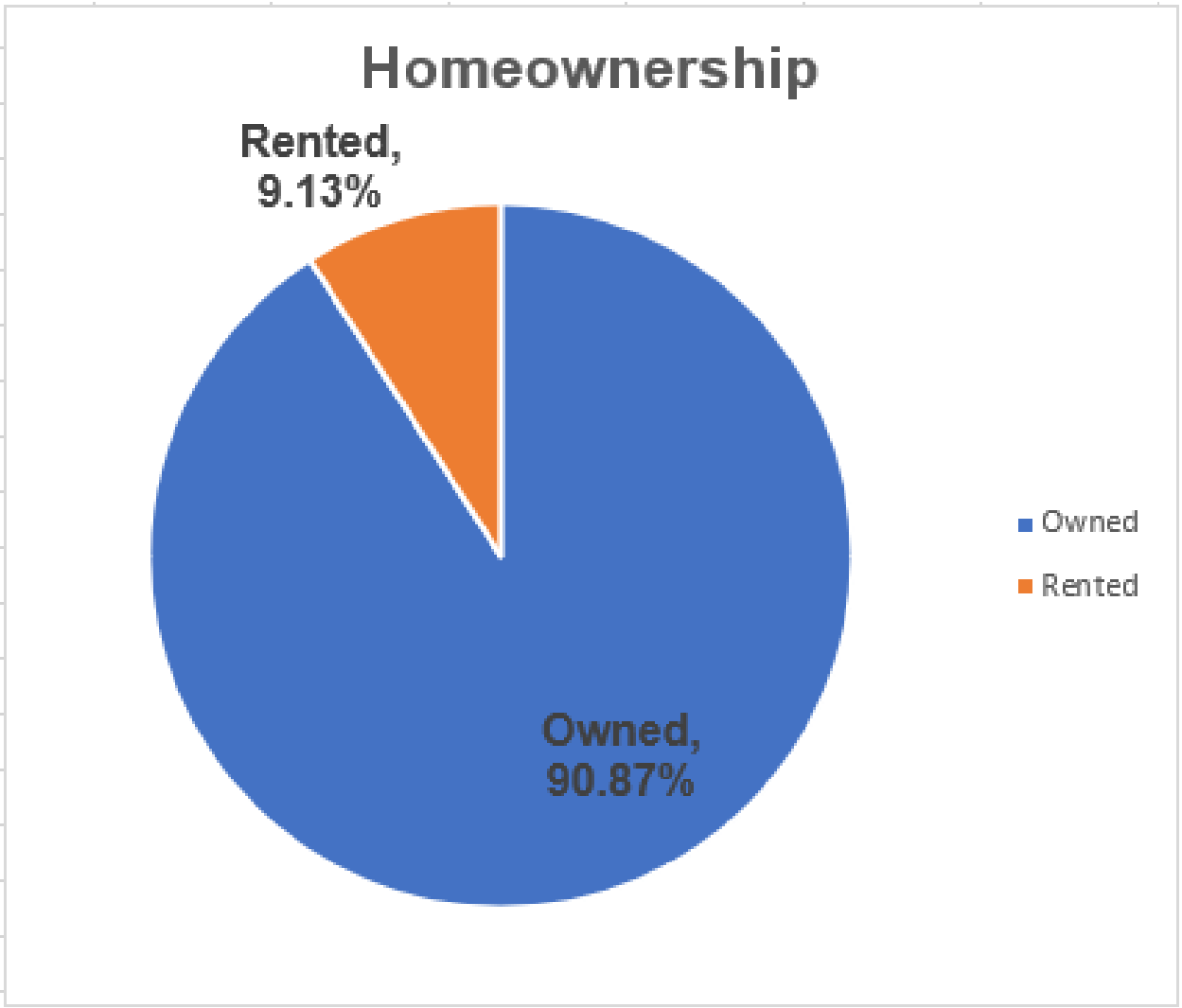


**Figure 5**

*Results for Opinion on Climate Change*

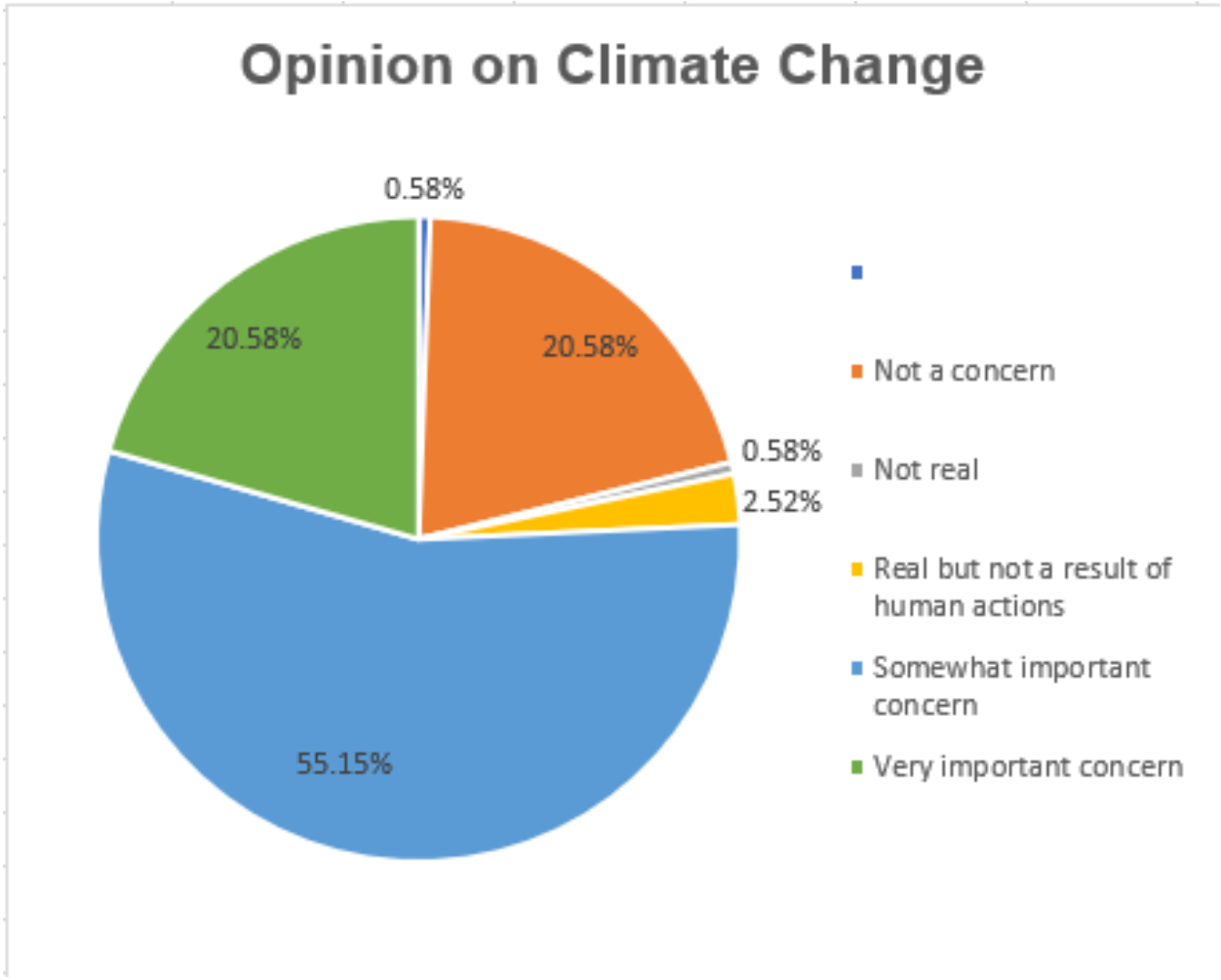

**Figure 6**

*Results for Tax Credit Awareness*

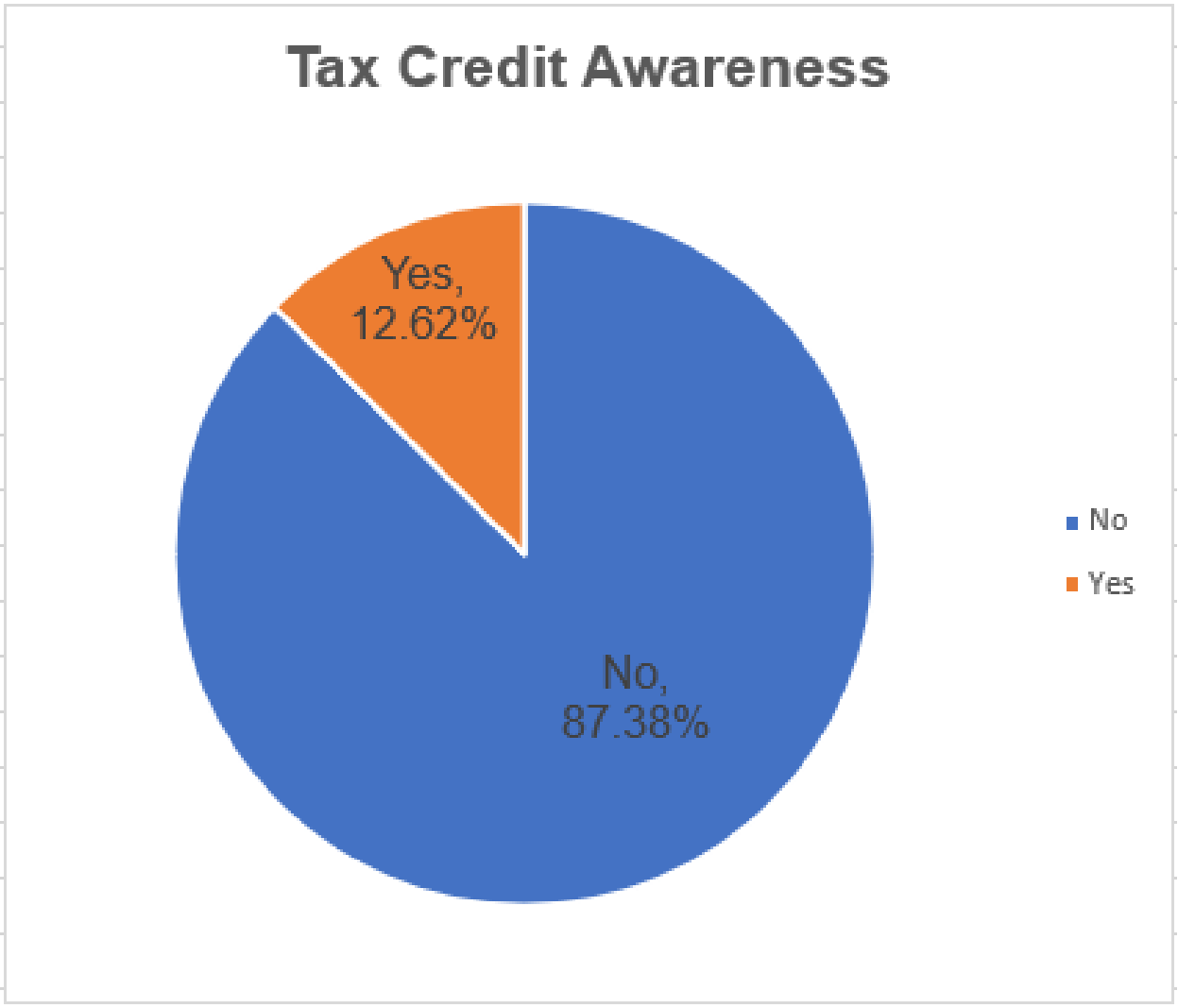

**Figure 7**

*Results for Factor Analysis*

| Variable | Factor1 | Factor2 | Factor3 | Factor4 | Factor5 | Uniqueness | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|---|---|---|---|---|---|
| usedcar | 0.1389 | -0.2638 | -0.108 | 0.0038 | 0.0077 | 0.8993 | 0.63565 | 0.41452 | 1.4705 | 1.4705 |
| carsize | 0.2223 | -0.218 | 0.1324 | 0.011 | -0.0177 | 0.8851 | 0.22113 | 0.14429 | 0.5115 | 1.982 |
| filwater | 0.0278 | 0.2189 | -0.1185 | 0.023 | 0.006 | 0.9367 | 0.07684 | 0.03631 | 0.1778 | 2.1598 |
| climate | 0.1831 | 0.1387 | 0.0214 | 0.1256 | -0.0258 | 0.9303 | 0.04053 | 0.03407 | 0.0938 | 2.2535 |
| useditem | 0.3536 | -0.0548 | -0.0551 | 0.0138 | 0.0432 | 0.8669 | 0.00646 | 0.04847 | 0.015 | 2.2685 |
| bicycle | 0.3967 | 0.1173 | -0.0004 | -0.0867 | 0.0132 | 0.8212 | -0.042 | 0.07619 | 0.0972 | 2.1713 |
| pubtrans | 0.3662 | 0.0902 | 0.0184 | -0.0826 | -0.0378 | 0.8491 | -0.11819 | 0.03924 | 0.2734 | 1.8979 |
| elecheat | 0.0559 | 0.1031 | 0.1691 | 0.0266 | 0.0435 | 0.9551 | -0.15743 | 0.07328 | 0.3642 | 1.5337 |
| acuse | 0.3361 | -0.0366 | -0.0345 | 0.0941 | -0.0049 | 0.8756 | -0.23071 |  | 0.5337 | 1 |

**Table 1**

*Description of Variables*

| Type | Variable | Variable Description |
|---|---|---|
| Dependent Variable | Energy | Type of energy consumption |
| Economic Explanatory Variables | OwnHome | Whether participant's family owns or rents their home |
| | EduFath | Highest level of education for participant's father |
| | EduMoth | Highest level of education for participant's mother |
| Behavioral Explanatory Variables | UsedCar | Condition of last purchased car |
| | CarSize | Size of last purchased car |
| | FilWater | Frequency of consuming filtered water |
| | Climate | Opinion on climate change |
| | UsedItem | Frequency of purchasing used items |
| | Bicycle | Frequency of using bicycle for transportation |
| | PubTrans | Frequency of using public transportation |
| | ElecHeat | Whether participant's family uses electric heat or not |
| | ACUse | Frequency of using A/C |

| | | |
|---|---|---|
| Demographic Explanatory Variables | Female | Gender |
| | NonBin | |
| | Asian | Race |
| | Black | |
| | Mixed | |
| | Rural | Whether participant lives in urban/rural areas |
| Other Explanatory Variable | TaxCre | Participant's awareness of the Solar Tax Credit |

**Table 2**

*Results for Probit Regression with All Explanatory Variables*

| **Variables** | **Coefficients** | **Standard Error** | | **Regression Statistics** | |
|---|---|---|---|---|---|
| *OwnHome* | 0 (omitted) | N/A | | Wald chi2(18) | 22.980 |
| *EduFath* | -0.104 | (-0.19) | | Prob > chi2 | 0.191 |
| *EduMoth* | 0.215 | (0.194) | | Pseudo R2 | 0.058 |
| *UsedCar* | 0.016 | (0.168) | | Log pseudo-likelihood | -145.493 |
| *CarSized* | -0.090 | (0.168) | | | |
| *FilWater* | -0.039 | (0.187) | | | |
| *Climate* | -0.188 | (0.181) | | | |
| *UsedItem* | -0.061 | (0.185) | | | |
| *Bicycle* | 0.100 | (0.17) | | | |
| *PubTrans* | -0.124 | (0.176) | | | |
| *ElecHeat* | 0.112 | (0.179) | | | |
| *ACUse* | -0.072 | (0.168) | | | |
| *Female* | -0.441 | (0.67) | | | |
| *NonBin* | 0 (omitted) | N/A | | | |
| *Asian* | 0.595** | (0.224) | | | |
| *Black* | 0 (omitted) | N/A | | | |
| *Mixed* | 0.367 | (0.262) | | | |
| *Rural* | -0.274 | (0.304) | | | |
| *TaxCre* | 0.434** | (0.204) | | | |
| *_Cons* | -0.889 | (0.692) | | | |

**Table 3**

*Result for Stepwise Analysis with Environment, Manyenv, and Edu Variables*

| Variables | Coefficients | Standard Error |
|---|---|---|
| *Asian* | 0.531** | (0.218) |
| *TaxCre* | 0.449** | (0.206) |
| *_Cons* | -1.417 | (0.096) |

| Regression Statistics | |
|---|---|
| Wald chi2(2) | 11.4 |
| Prob > chi2 | 0.003 |
| Pseudo R2 | 0.037 |
| Log pseudolikelihood | -145.49 |