

Research on the Carbon Reduction Pathway Mechanisms of New Energy Vehicles in the Yangtze River Delta Region Under the Dual Carbon Goals

Yunzheng Zhao

Anhui University of Finance and Economics, China
fyJ0000m@163.com

ABSTRACT

With China's rapid economic growth, automobile demand has surged, making cars essential in urban households. This paper focuses on new energy vehicle (NEV) development in the Yangtze River Delta, analyzing policies and energy-saving strategies. By comparing global and domestic NEV trends, we evaluate energy consumption and carbon reduction pathways, proposing targeted recommendations to enhance NEV mechanisms and predict future prospects.

KEYWORDS

Carbon Peaking and Carbon Neutrality Goals; Green Transformation; Data Analysis; New Energy Vehicle Industry

1. INTRODUCTION

With the rapid growth of China's economy, significant changes have occurred in people's income levels, lifestyles, and consumption patterns. When it comes to transportation, there is a growing preference for comfortable and convenient vehicles, leading to an explosive increase in automobile demand. Since 2009, when China's automobile production and sales surpassed those of the United States, the country has maintained its position as the global leader for ten consecutive years. By the end of 2010, the number of passenger cars per 100 urban households reached 13.1, an increase of 9.7 vehicles (287.8%) compared to 2005, with an annual growth rate of 31.1%. The widespread adoption of private cars has driven up expenditures on vehicle purchases, fuel, and taxes. In 2010, the per capita urban household expenditures on car purchases, fuel, and vehicle-related taxes were RMB 568, RMB 234, and RMB 70, respectively, representing increases of 239.1%, 421.8%, and 171.5% compared to 2005, with annual growth rates of 27.7%, 39.2%, and 22.1%.

Based on domestic and international literature reviews and economic-statistical methodologies, this paper focuses on the development of new energy vehicles (NEVs) in the Yangtze River Delta region. By analyzing domestic and international policies, energy-saving strategies, and structural optimization frameworks, we construct an analytical model. Guided by this model, we compare the development status of NEVs globally and domestically, evaluate energy consumption across different NEV types, and establish an assessment system for carbon reduction pathways in terms of efficiency, outcomes, and impacts. Based on these findings and emerging trends, we propose targeted recommendations to enhance NEV mechanisms and predict future prospects under feasible conditions.

2. STUDY ON PUBLIC AWARENESS OF CARBON REDUCTION PATHWAYS FOR NEVS UNDER THE DUAL CARBON GOALS

2.1. Descriptive Statistical Analysis of Sample Demographics and Awareness

2.1.1. Respondent Demographics

(1) Gender and Age

The survey targeted residents in selected areas of the Yangtze River Delta region, with a balanced gender ratio and a majority of respondents aged 15–35. Specific details are illustrated in Figure 1.

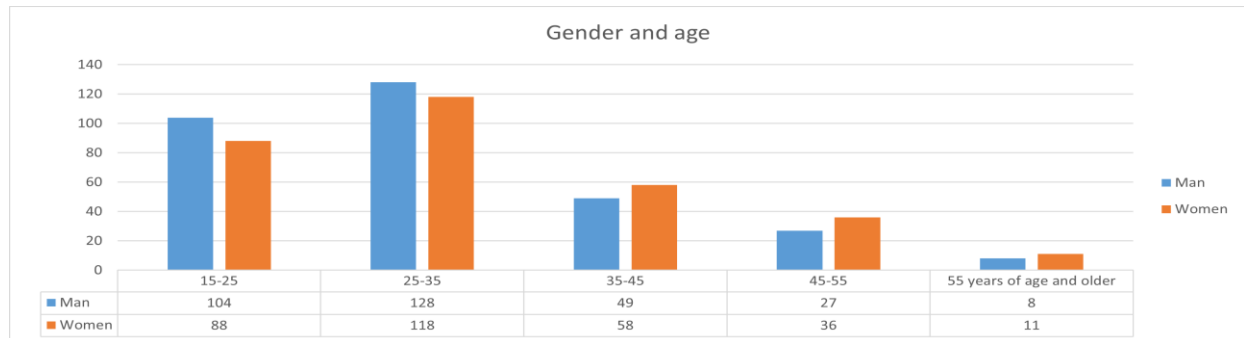


Figure 1. Age and Gender Distribution

A total of 627 valid questionnaires were collected, including 316 males, accounting for 50.39% of the total sample, and 311 females, accounting for 49.61% of the total sample. The number of males was slightly higher than that of females, but overall, the gender ratio was balanced, and the sample was representative to a certain extent. Among the respondents, 30.62% were aged 15–25, 17.07% were aged 35–45, 10.05% were aged 45–55, and 3.03% were aged 55 and above. Based on the collected data, it can be concluded that the majority of respondents were concentrated in the 15–25 age group, while the number of respondents aged 45 and above was relatively small.

(2) Highest Education Level

According to the sample data, the proportion of questionnaire feedback collected from university undergraduates and postgraduates is relatively high. The specific percentages are shown in Figure 2.

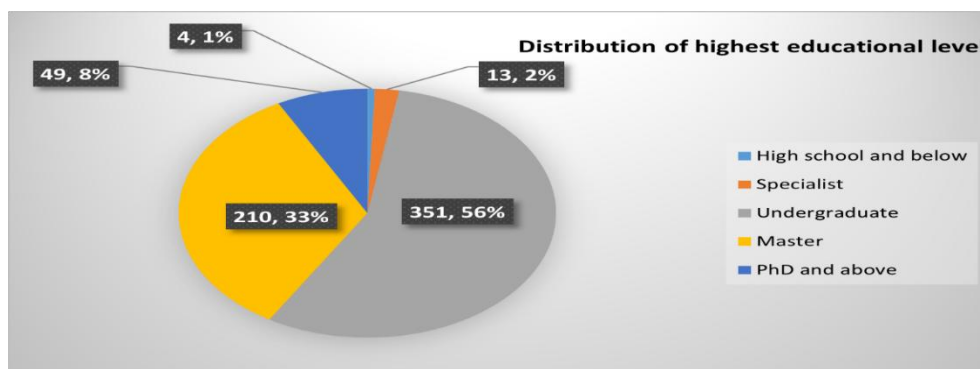


Figure 2. Distribution of Highest Education Levels

Based on the data, a pie chart was created, clearly showing that the largest group consists of university undergraduates, with 351 individuals, accounting for 56% of the total sample. Postgraduates follow with 210 individuals, representing 33% of the total sample. Doctoral degree holders and above account for 8%, while those with associate degrees and high school education or below make up 2% and 1%, respectively. The educational background of the sample exhibits diverse characteristics.

(3) Monthly Income

Monthly income levels vary slightly across different regions. Overall, the majority of residents have a monthly income of RMB 5,000 or below. The specific distribution is shown in Figure 3.

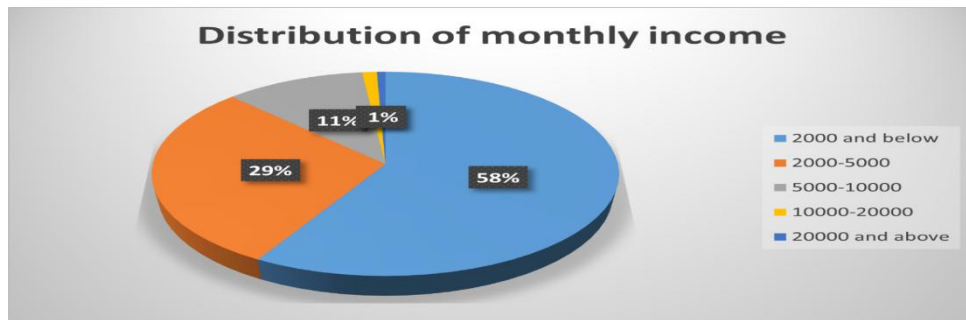


Figure 3. Monthly Income Distribution

According to the survey data, the largest group consists of individuals with a monthly income of RMB 2,000 or below, accounting for approximately 58% of the respondents. Those earning between RMB 2,000 and 5,000 make up about 29%, while those earning between RMB 5,000 and 10,000 account for approximately 11%. The proportions of respondents with monthly incomes of RMB 10,000–20,000 and RMB 20,000 or above are both close to 1%. In summary, the majority of respondents have a monthly income of RMB 5,000 or below, while the number of individuals with a monthly income of RMB 10,000 or above is significantly smaller.

2.2. Awareness of NEV Carbon Reduction Pathways

Based on the comprehensive data, it can be concluded that the majority of people have a moderate or limited understanding of the carbon reduction pathways of new energy vehicles, warranting further in-depth investigation.

Table 1. Statistical Table of Awareness Levels in the Survey Sample

	Mean Statistics	Standard Deviation Statistics	Skewness Statistics	Kurtosis Statistics
Male	63.200	66.923	0.668	-2.753
Femaie	62.200	62.902	0.680	-2.889

From the table, it can be seen that the statistical data contains no outliers, and the data is well-representative, allowing for direct descriptive analysis.

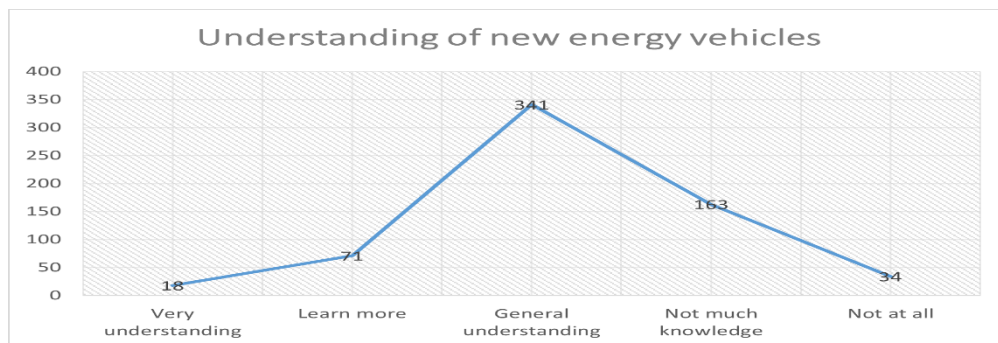


Figure 4. Distribution of Awareness Levels of New Energy Vehicles

As shown in the figure, 341 respondents have a moderate understanding of new energy vehicles, accounting for 54.39% of the total sample. The second-largest group consists of respondents with limited understanding, making up approximately 26.00% of the total sample. The number of

respondents with extreme levels of understanding—either very familiar or completely unfamiliar—is relatively small, accounting for 2.87% and 5.42%, respectively. A further cognitive survey was conducted among residents with some level of understanding, and the results are presented in Figure 5.

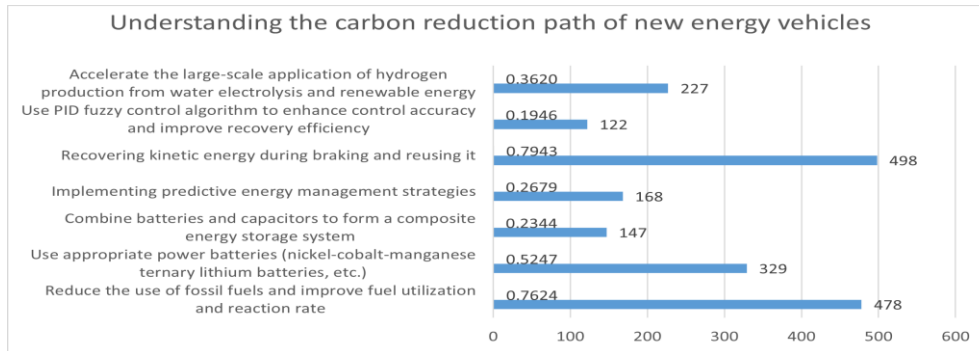


Figure 5. Awareness of Carbon Reduction Pathways for New Energy Vehicles

The survey focused on seven major carbon reduction methods for new energy vehicles. According to the statistical data, respondents showed a higher level of familiarity with "reusing kinetic energy during braking," "reducing fossil fuel usage and improving fuel efficiency," and "using appropriate power batteries." In contrast, they were less familiar with "enhancing control precision using PID fuzzy control algorithms," "constructing hybrid battery-capacitor energy storage systems," and "implementing predictive energy management strategies."

2.3. Exploration of Awareness of Carbon Reduction Pathways for New Energy Vehicles Based on Contingency Analysis

2.3.1. Gender & Awareness Contingency Analysis

Table 2. Correlation Between Gender and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Correlation	
Pearson Correlation	0.996
Sig Values	0.000
Degrees of Freedom	3
Significant at the 0.01 level (two-tailed)	

Table 3. Cross-Tabulation of Gender and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Gender and Awareness of Carbon Reduction Pathways for New Energy Vehicles (%)						
	Very Familiar (1)	Moderately Familiar (2)	Generally Familiar (3)	Somewhat Unfamiliar (4)	Completely Unfamiliar (5)	Total
Male	18(56.26)	122(50.62)	149(51.20)	21(52.50)	6(26.09)	316
Female	14(43.75)	119(49.38)	142(48.80)	19(47.50)	17(73.91)	311
Total	32	241	291	40	23	627

There is a significant difference in the awareness of carbon reduction pathways for new energy vehicles among respondents of different genders. Based on the chi-square test of gender and awareness of new energy vehicles, the results of the chi-square test were obtained. The Pearson chi-square test for independence yielded a p-value of 0.000, which is less than 0.01, leading to the

rejection of the null hypothesis. This suggests that there is no significant correlation between gender and awareness of new energy vehicles.

Cross-analysis further validates this conclusion.

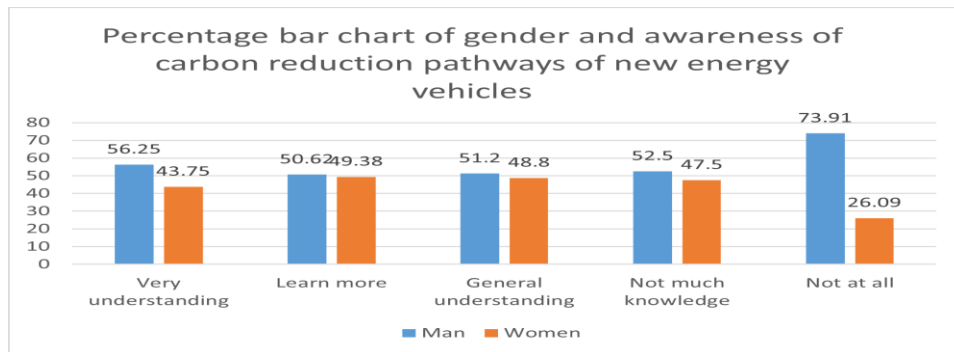


Figure 6. Percentage Stacked Chart of Gender and Awareness of Carbon Reduction Pathways for New Energy Vehicles

From the percentage stacked bar chart, it can be observed that the awareness of carbon reduction in new energy vehicles among both males and females approximates a normal distribution. In both groups, the majority of respondents fall into the "moderately aware" and "generally aware" categories, with males showing a slightly higher level of awareness regarding the carbon reduction pathways of new energy vehicles compared to females. In the "completely unaware" category, females account for as much as 73.91%, nearly three times the proportion of males. This suggests a partial explanation: females tend to show less interest in science and engineering research and development, while males are generally more interested in these fields.

2.3.2. Age & Awareness Contingency Analysis

The level of understanding of carbon reduction pathways for new energy vehicles varies across different age groups. A correlation test between age and understanding level reveals that, at the 0.05 confidence level, there is a significant correlation between all age groups and awareness of new energy vehicle carbon reduction pathways. At the 0.01 confidence level, significant correlations are observed for certain age groups.

Table 4. Sig Values and Pearson Correlation Test for Age and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Sig value	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar
15-25					
25-35	0.003				
35-45	0.005	0.025			
45-55	0.003	0.021	0.004		
Over 55	0.006	0.009	0.033	0.008	
Pearson Correlation					
	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar
15-25					
25-35	0.983				
35-45	0.972	0.925*			
45-55	0.980	0.933*	0.979		
Over 55	0.971	0.961	0.908*	0.964	
Significant at the 0.01 level (two-tailed)					
* Significant at the 0.05 level (two-tailed)					

Table 5. Cross-Tabulation of Age and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Age and Awareness of Carbon Reduction Pathways for New Energy Vehicles (%)						
	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar	Total
15-25	28(41.18)	101(45.50)	61(34.86)	49(39.20)	17(45.95)	256(40.83)
25-35	16(23.53)	59(26.58)	42(24.00)	28(22.40)	8(21.62)	153(24.40)
35-45	13(19.12)	37(16.67)	38(21.71)	23(18.40)	5(13.51)	116(18.50)
45-55	8(11.76)	14(6.31)	27(15.43)	21(16.80)	5(13.51)	75(11.96)
Over 55	3(4.41)	11(4.95)	7(4.00)	4(3.20)	2(5.41)	27(4.31)
Total	68	222	175	125	37	627

From the chart data, it can be observed that the impact of age on awareness of carbon reduction in new energy vehicles approximates a normal distribution. Across all age groups, the majority of respondents fall into the "moderately aware" and "generally aware" categories. The 15–25 age group shows a slightly higher level of awareness regarding the carbon reduction pathways of new energy vehicles compared to other age groups. In contrast, individuals aged 55 and above have significantly lower awareness, accounting for only 4.31% of the total respondents. This indicates that new energy vehicles are innovative products aligned with contemporary trends.

To better visualize this trend, a line chart was created for clearer observation.

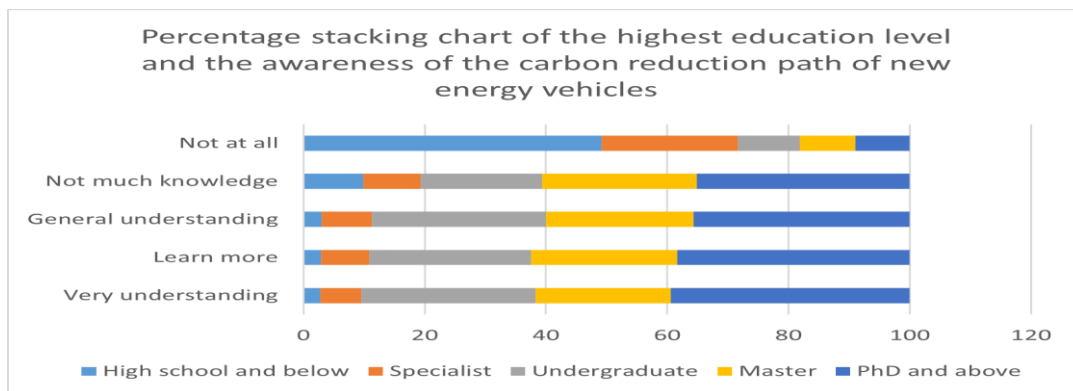


Figure 7. Line Chart of Age and Awareness of Carbon Reduction Pathways for New Energy Vehicles

2.3.3. Education & Awareness Contingency Analysis

The level of understanding of carbon reduction pathways for new energy vehicles varies among individuals with different highest education levels. A correlation test between age and understanding level variables yielded a Pearson correlation coefficient matrix and significance (sig) values. From the table data, it can be seen that, at the 0.05 confidence level, there is a significant correlation between individuals with postgraduate education or below and their understanding of new energy vehicle carbon reduction pathways. However, no significant correlation was found between individuals with doctoral degrees or higher and their understanding level.

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Table 6. Sig Values and Pearson Correlation Test for Highest Education Level and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Pearson Correlation						
	Very Familiar	Generally Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar	
High School or Below						
Associate Degree	0.936*					
Undergraduate Degree	0.999	0.933*				
Postgraduate Degree	0.977	0.944*	0.968			
Doctoral Degree or Above	-0.851	-0.821	-0.876	-0.789		
* Significant at the 0.05 level (two-tailed)						
Significant at the 0.01 level (two-tailed)						
Sig value						
	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar	
High School or Below						
Associate Degree	0.019					
Undergraduate Degree	0.034	0.021				
Postgraduate Degree	0.004	0.016	0.007			
Doctoral Degree or Above	0.068	0.088	0.052	0.113		

Table 7. Cross-Tabulation of Highest Education Level and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Highest Education level and Awareness of Carbon Reduction Pathways for New Energy Vehicles (%)						
	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar	Total
High School or Below	2(2.90)	9(3.03)	4(2.65)	6(8.22)	17(45.95)	38
Associate Degree	4(5.8)	21(7.07)	11(7.28)	7(9.59)	8(21.62)	51
Undergraduate Degree	17(24.64)	52(17.51)	38(25.17)	14(19.18)	5(3.51)	126
Postgraduate Degree	17(24.64)	98(33.00)	37(24.50)	17(23.29)	5(13.51)	174
Doctoral Degree or Above	29(42.03)	117(39.39)	61(40.40)	29(39.73)	2(5.41)	238
Total	69	297	151	73	37	627

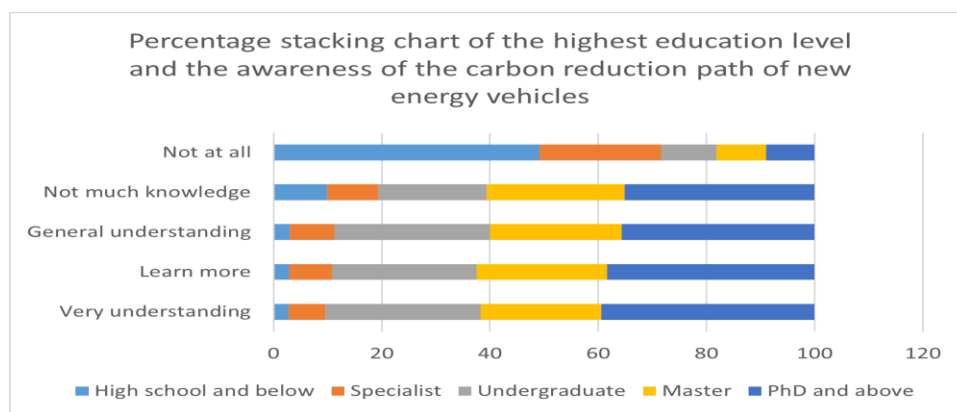


Figure 8. Percentage Stacked Chart of Highest Education Level and Awareness of Carbon Reduction Pathways for New Energy Vehicles

From the percentage stacked chart and the cross-tabulation data of awareness levels, it can be concluded that individuals with a highest education level of undergraduate degree or above have a relatively higher awareness of new energy vehicles, while those with associate degrees or high school education and below show comparatively lower awareness. Additionally, the majority of respondents fall into the "moderately aware" and "generally aware" categories. The reason for this may be that new energy vehicles have not yet achieved widespread adoption, leading to limited exposure and in-depth understanding among certain regional populations.

2.3.4. Income & Awareness Contingency Analysis (Unit: yuan)

Table 8. Sig Values and Pearson Correlation Test for Monthly Income and Awareness of Carbon Reduction Pathways for New Energy Vehicles

	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat unfamiliar	Completely Unfamiliar
2000 below					
2000-5000	-0.463				
5000-10000	0.564	0.191			
10000-20000	0.970**	-0.357	0.742		
Over 20000	0.67	0.18	0.905*	0.782	
** Significant at the 0.01 level (two-tailed)					
* Significant at the 0.05 level (two-tailed)					
Sig value					
	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat unfamiliar	Completely Unfamiliar
2000 below					
2000-5000	0.432				
5000-10000	0.322	0.758			
10000-20000	0.006	0.555	0.151		
Over 20000	0.216	0.772	0.035	0.118	

Table 9. Cross-Tabulation of Monthly Income and Awareness of Carbon Reduction Pathways for New Energy Vehicles

Monthly Income and Awareness of Carbon Reduction Pathways for New Energy Vehicles (%)						
	Very Familiar	Moderately Familiar	Generally Familiar	Somewhat Unfamiliar	Completely Unfamiliar	Total
2000 below	32(29.91)	48(22.22)	55(41.04)	46(34.59)	19(51.35)	200(31.90)
2000-5000	28(26.17)	32(14.81)	24(17.91)	34(25.56)	4(10.81)	122(19.46)
5000-10000	26(24.30)	38(17.59)	16(11.94)	28(21.05)	8(21.62)	116(18.50)
10000-20000	14(13.08)	29(13.43)	18(13.43)	17(12.78)	2(5.41)	80(12.76)
Over 20000	7(13.08)	69(31.94)	21(15.67)	8(6.02)	4(10.81)	109(17.38)
Total	107	216	134	133	37	627

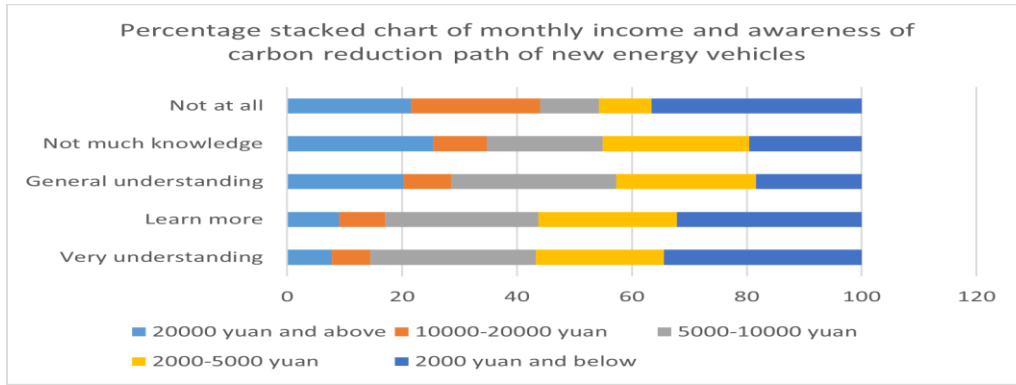


Figure 9. Percentage Stacked Chart of Monthly Income and Awareness of Carbon Reduction Pathways for New Energy Vehicles

From the percentage stacked chart and cross-tabulation data analysis, it can be observed that, overall, higher monthly income correlates with greater awareness of the carbon reduction pathways of new energy vehicles. Specifically, individuals with a monthly income above RMB 20,000 show a relatively high level of understanding, accounting for approximately 31.94% of the total sample. Meanwhile, those earning between RMB 2,000 and 5,000 have the highest percentage in the "moderately aware" category, making up about 26.17% of the sample. This suggests that better economic conditions are associated with greater familiarity with innovative products.

2.4. Cluster Analysis of NEV Awareness Characteristics

2.4.1. Methodology: K-Means Algorithm

Cluster analysis is a multivariate statistical method used for classification. Unlike traditional classification, where the target categories are known, the goal of clustering is unknown. Due to varying degrees of similarity among indicators, statistical measures are derived from the sample data based on the defined observation metrics to quantify the similarity between indicators. Indicators with high similarity are grouped into the same category until all indicators are aggregated. In simple terms, clustering involves grouping data points with high similarity into clusters, and the more similar the data within a cluster, the better the clustering results.

To further understand and analyze residents' awareness of the carbon reduction pathways of new energy vehicles, this study conducted cluster analysis on the feedback from 627 respondents. Based on differences in cognitive characteristics, all respondents were divided into four groups: A, B, C, and D.

2.4.2. Method Selection: K-Means Algorithm

The K-Means algorithm randomly selects k initial points as the centers of clusters (collections of all data points). For each point, it identifies the nearest cluster center and assigns the point to that cluster. This process is repeated until all points in the dataset are closest to their corresponding cluster centers, i.e., the function converges. Typically, the squared error criterion is used, defined as follows:

$$E = \sum_{i=1}^k \sum_{p \in C_i} |p - m_i|^2$$

E: The sum of squared errors for all initial points in the database.

P: Points in the space.

m_i : The mean value of cluster C_i .

2.4.3. Variable Selection

Referencing domestic and international scholarly literature and considering the actual conditions of the Yangtze River Delta region, the following points were selected as clustering variables to analyze respondents' cognitive characteristics regarding new energy vehicles.

Table 10. Variables and Corresponding Survey Questions

Dependent Variable	Corresponding Survey Questions
Awareness Level	How familiar are you with the carbon reduction pathways of new energy vehicles?
Acceptance Level	Are you willing to reduce the use of fossil fuel vehicles and prefer purchasing and using new energy vehicles?
Importance Level	How do you evaluate your awareness of energy conservation and carbon reduction?
Development Significance	Do you think the development of new energy vehicles is significant?
Promotion Willingness	As new energy vehicles are in their early development stage, are you willing to recommend them to your friends and family?

(1) Awareness Level: This variable is linked to the question in the questionnaire, "How familiar are you with the carbon reduction pathways of new energy vehicles?" Responses are scored as follows: "Very familiar" = 10 points, "Moderately familiar" = 7.5 points, "Generally familiar" = 5 points, "Somewhat unfamiliar" = 2.5 points, and "Completely unfamiliar" = 1 point. This effectively reflects the awareness level of residents in the Yangtze River Delta region regarding the carbon reduction pathways of new energy vehicles.

(2) Acceptance Level: This variable is related to the question, "Are you willing to reduce the use of fossil fuel vehicles and prefer purchasing and using new energy vehicles?" Responses are scored as follows: "Willing and strongly supportive" = 10 points, "Somewhat willing and considering taking action" = 7.5 points, "Willing but not ready to take action" = 5 points, and "Unwilling and unsupportive" = 2.5 points. This question clearly reflects the acceptance level of new energy vehicles among residents in the Yangtze River Delta region and their attitudes toward these vehicles.

(3) Importance Level: This variable is tied to the question, "How do you evaluate your awareness of energy conservation and carbon reduction?" Responses are scored as follows: "Very important, no reminders needed" = 10 points, "Somewhat important, occasionally wasteful" = 6 points, and "Almost unimportant, difficult to achieve" = 2 points. This question helps residents gain a basic understanding of their awareness of energy conservation and carbon reduction, laying a solid foundation for supporting the development of new energy vehicles.

(4) Perceived Significance: This variable is associated with the question, "Do you think the development of new energy vehicles is significant?" Responses are scored as follows: "Very significant" = 10 points, "Somewhat significant" = 7.5 points, "Neutral" = 5 points, "Not very significant" = 2.5 points, and "Not significant at all" = 1 point. This question encourages residents to think about the importance of new energy vehicles, increasing their interest in the topic and motivating them to follow related news, thereby creating a positive starting point.

(5) Promotion Willingness: This variable is connected to the question, "As new energy vehicles are in their early development stage, are you willing to recommend them to your friends and family?" Responses are scored as follows: "Very willing" = 10 points, "Somewhat willing" = 7.5 points, "Neutral, no strong opinion" = 5 points, "Somewhat unwilling" = 2.5 points, and "Completely unwilling" = 1 point. This question can deepen residents' interest in new energy vehicles, encouraging them not only to follow related information but also to promote participation among those around them.

2.4.4. Result Analysis

The obtained results were consolidated, and the average scores were calculated, as detailed in the table below.

Table 11. Cluster Distribution Characteristics of Cognitive Features

category	Group A	Group B	Group C	Group D
Awareness Level	9	6	5	9
Acceptance Level	7	5	4	5
Importance Level	7	6	8	1
Development Significance	8	9	5	8
Promotion Willingness	9	9	2	4

(1) Group A Respondents

These individuals have a general understanding of carbon reduction in new energy vehicles. They show high acceptance of such vehicles and place significant importance on energy conservation, often practicing energy-saving habits without reminders. They firmly embrace energy-saving awareness, highly accept new energy vehicles, recognize their developmental significance, and are willing to recommend them to others. They actively contribute to the advancement of new energy vehicles and support national policies.

(2) Group B Respondents

These individuals have a moderate understanding of carbon reduction in new energy vehicles. Their acceptance of such vehicles and emphasis on energy conservation are average, and they hold a neutral attitude. However, they show strong interest and high expectations for the significance of new energy vehicles and are willing to promote and introduce them to others.

(3) Group C Respondents

These individuals have a moderate understanding of carbon reduction in new energy vehicles and show average acceptance of such vehicles. While they subconsciously view this initiative positively, they are reluctant to recommend new energy vehicles to others. This is likely due to limited knowledge about new energy vehicles in their region and a lack of understanding of national and local policies. Although they see the development of new energy vehicles as a promising direction, they hesitate to make decisions due to uncertainty about the current situation.

(4) Group D Respondents

These individuals have a thorough understanding of carbon reduction in new energy vehicles and believe in their significant developmental importance. However, their acceptance of such vehicles is moderate, and they show limited initiative in promoting them to others. This may be related to their relatively low emphasis on energy conservation and carbon reduction in daily life.

3. EXPLORATION OF FACTORS INFLUENCING RESIDENTS' ACCEPTANCE OF NEW ENERGY VEHICLES

3.1. Evaluation of Residents' Willingness to Accept New Energy Vehicles Based on Principal Component Analysis

3.1.1. Quantification of Questionnaire Items on Acceptance Willingness

To gain a deeper understanding of the carbon reduction pathways of new energy vehicles and the awareness of residents in the Yangtze River Delta region, combined with the current development

status of new energy vehicles, this study uses random variables X_i ($i = 1, 2, \dots, 12$), corresponding to the relevant questions in the questionnaire. The response options are quantified as follows.

Table 12. Explanation of Residents' Evaluation of Acceptance Levels for New Energy Vehicles

Random Variable X_i	Questionnaire Content	Scoring Method
X1	I believe new energy vehicles offer good value for money	Scores range from 0 ("Strongly Disagree") to 10 ("Strongly Agree"), ordered from low to high acceptance (unit: points).
X2	I believe new energy vehicles can effectively save energy, reduce carbon emissions, and protect the environment.	
X3	I believe the state and government will strongly support the development of new energy vehicles.	
X4	believe new energy vehicles will attract more public interest.	
X5	I believe the development of new energy vehicles depends on everyone's efforts and contributions.	
X6	I believe accepting the popularity of new energy vehicles is everyone's duty.	
X7	When media and other channels promote the advantages of new energy vehicles, I will actively accept them.	
X8	If the government releases policies related to new energy vehicles, I will strongly support them.	
X9	I will voluntarily recommend and promote new energy vehicles to people around me.	
X10	The government is fully committed to the development of new energy vehicles.	
X11	Policies are very attractive for people to pay attention to new energy vehicles.	
X12	I am willing to thoroughly study and learn about new energy vehicles.	

This study uses a 10-point scale for all questions, with five response options ranging from high to low: "Strongly Agree," "Somewhat Agree," "Neutral," "Somewhat Disagree," and "Strongly Disagree." These options are scored from 10 to 0, respectively.

3.1.2. KMO and Bartlett's Test

Table 13. KMO and Bartlett's Test

KMO and Bartlett's Test		
KMO Measure of Sampling Adequacy		0.772
Bartlett's Test of Sphericity	Approximate Chi-Square	67.629
	Degrees of Freedom	66
	Significance	0.042

Before applying principal component analysis (PCA), we conducted the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity on the relevant indicator data. When the KMO test coefficient is ≥ 0.5 (with the significance probability of Bartlett's test χ^2 statistic) and the p-value is < 0.05 , the questionnaire has structural validity. In SPSS factor analysis, if the sig value for Bartlett's test is < 0.05 , the data is considered spherically distributed.

In the sample data statistics table, the KMO result was calculated as 0.772, which is ≥ 0.05 , and the significance value for Bartlett's test was 0.042, which is < 0.05 , indicating that the data is spherically distributed. This confirms that the sample data is suitable for principal component analysis.

3.1.3. Principal Component Factor Analysis

The 12 questions collectively reflect people's acceptance levels of new energy vehicles. However, due to the high dimensionality and slow computation, after passing the KMO and Bartlett's tests, principal component factor analysis was used to reduce dimensionality. The eigenvalues from the principal component factor analysis are presented in the form of a scree plot.

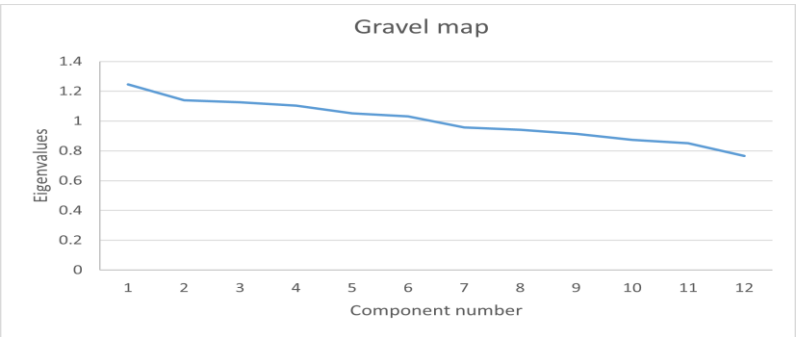


Figure 10. Scree Plot of Principal Component Factor Analysis Eigenvalues

Using principal component factor analysis for extraction and applying the Kaiser normalization with the optimal oblique rotation method, the scree plot of eigenvalues was obtained. As shown in the figure, the first six eigenvalues are all greater than 1, and according to the total variance explained table, these six common factors account for a cumulative contribution rate of 85.795%, effectively capturing the information contained in the sample. Therefore, selecting six common factors is appropriate.

4. CONCLUSION

In the analysis of awareness and acceptance levels regarding the carbon reduction pathways of new energy vehicles, we found that differences in age, gender, highest education level, and monthly income lead to varying levels of understanding. Higher education levels and incomes correlate with greater awareness and acceptance of these pathways. In future development, it is hoped that new energy vehicles can be widely adopted in daily life, contributing to energy conservation and carbon reduction, aligning with national goals, and actively implementing national policies.

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