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Research on user characteristics and demand trend evolution of compact hybrid electric cars

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Abstract: Based on energy saving and emission reduction technology route 2.0: It is estimated that HEV new cars will occupy 50% of traditional fuel types in 2025, and HEV will occupy 100% of traditional fuel types in 2035. In order to better provide marketing ideas for the industry, provide clear product opportunities for enterprises, and follow the trend of electric and intelligent development, it is necessary to predict the market development, consumer characteristics and demands, and future demand trends of the HEV market. This paper combines desk research, big data research, quantitative analysis and qualitative analysis to analyze the HEV market, gain insight into the characteristics and needs of consumer in HEV market and predict the trend.

Keywords: Compact Hybrid Car; Consumer Characteristics; Consumer Demand; Trend.

1. Research Background

1.1. Concept Understanding

Hybrid Electric Vehicle refers to the vehicle whose driving system is composed of two or more single driving systems that can operate at the same time. It mainly includes hybrid electric vehicle (HEV) and plug-in hybrid electric vehicle.

HEV refers to a vehicle driven by a combination of internal combustion engine drive and electric drive [1]. After years of development, the HEV system assembly has been developed from the original discrete structure of engine and motor to the integrated structure of engine, motor and gearbox, namely the integrated HEV system. HEV assembly is classified by power transmission route, which can be divided into series, parallel and hybrid HEV [2,3].

The Plug-in Hybrid Electric Vehicle (PHEV) also has the engine, transmission, transmission system and fuel tank of the traditional car, as well as the battery, motor and control circuit of the pure electric vehicle. Unlike HEV, a PHEV can operate in either pure electric mode or hybrid mode, where the engine and drive motor work together, and has a relatively large battery capacity and a charging interface. The broad definition of PHEV also includes extended range hybrid electric vehicle, that is, an electric vehicle driven by battery power, generated by an internal combustion engine, and charged, which is a series hybrid vehicle.

1.2. Market Performance

From the perspective of end-market sales (Figure 1, monthly sales volume of the gas-electric hybrid market), the overall HEV entered the Chinese market in 2014 or 2015. In recent years, the sales volume continues to increase and the market performance is good. Among them, the annual sales volume of the HEV in 2021 is about 620,000 units.

From the perspective of brands, Japanese cars account for more than 90%, among which Toyota takes the lead, accounting for nearly 70%. In terms of classification, the HEV market is dominated by compact cars and medium-sized cars (Figure 2, Table 1).

In terms of specific models, the main best-selling car models in the gasoline-electric hybrid market are Levin dual-engine, Corolla dual-engine, accord hybrid, Camry Hybrid, Odyssey hybrid, etc., among which the Levin dual-engine and Corolla dual-engine compact cars perform best in the market and become the benchmark models of gasoline-electric hybrid power (Figure 3.).

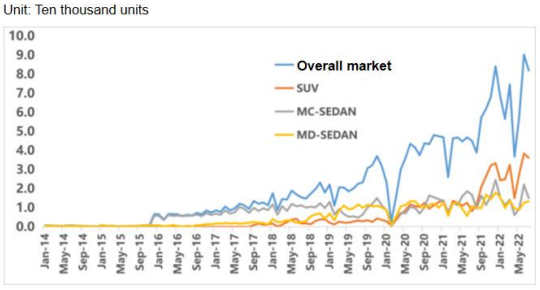


Figure 1. Monthly sales volume in the petrol-electric hybrid market

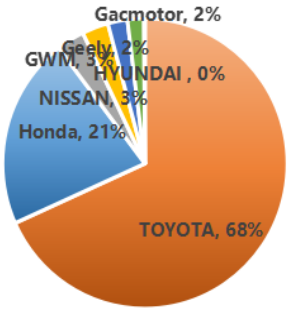


Figure 2. Sales proportion of each brand in the petrol-electric hybrid market

Table 1. The proportion of sales of main best-selling models in the gasoline-electric hybrid market

	HONDA	TOYOTA	Others
compact type	10%Crider-ENVIX	78% COROLLA-LEVIN	12%
Meso type	42%Accord-Inspire	58% Camry-Avalon	0%

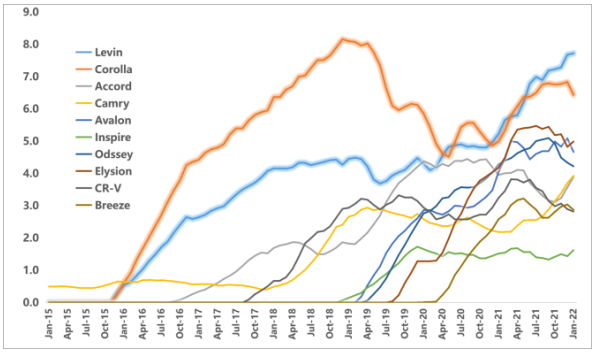


Figure 3. Annual mobile sales of main best-selling models in the gasoline-electric hybrid market

1.3. Layout of automobile enterprises

Under the background of national policy and market drive, automobile enterprises have successively arranged HEV market in terms of technology and products. With mature HEV technology and long accumulation time, Japanese automakers are in a leading position in the HEV market. Toyota's THS hybrid system uses two motors to cooperate with the engine as the output power, and adjusts the output power of the internal combustion engine and motor through a set of complex and ingenious planetary gear mechanism. The mechanical structure is complex, and the system has relatively balanced power and energy consumption performance under low, medium and high-speed conditions. Through continuous updating and iteration, it has been developed into the fifth generation in 2022. The main vehicle types include Corolla HEV, Levin HEV, etc. [4]. Honda i-MMD hybrid system can smoothly switch between electric, hybrid and engine driving modes, with the motor as the main driver at low speed and the engine as the main driver at high speed, which has outstanding energy-saving advantages and can achieve the balance of economic and power performance. The main models of Honda I-MMD HEV include C-RV HEV, Civic HEV and INSPIRE HEV. Dongfeng Nissan's second-generation e-POWER technology is equipped with ultra-high-performance lithium batteries, with a charge-discharge ratio more than 15 times that of ordinary pure trolley batteries. Its own power generation system focuses on efficient power generation, achieving 100% full-time pure electric drive. Its main vehicle is Yi e-POWER.

At the same time, autonomous vehicle enterprises actively layout HEV models. Great Wall Motor has released the Dedicated Hybrid Transmission (DHT) HEV technology platform, which uses a dual-motor hybrid topology to achieve EV driving, hybrid drive, series drive, energy recovery, idle shutdown and other modes of operation. Intelligent switch of control system to achieve the balance of power and fuel consumption in various driving scenarios, including the model of Harvard H6S; The Raytheon Engine Hi·X hybrid system of Geely Auto is a 3DHT hybrid gearbox +DHE engine hybrid technology, featuring a high degree of platform and universality. At present, it has been equipped with a model of "China Star". In addition, Changan's Blue Whale Idd, GAC's Jurang Power and Chery Kunpeng Hybrid are also included. In the future, the number of autonomous HEV models will gradually increase, and the competition will become increasingly fierce.

1.4. Project Proposal

Based on the "Energy-saving and New Energy Vehicle Technology Roadmap 2.0", energy-saving vehicles will remain the main force in the automobile market for a certain period of time, and it is estimated that HEV will account for 50% of traditional energy passenger vehicles in 2025. By 2035, 100% of new traditional energy passenger vehicles will be hybrid, and the automobile industry will realize electric transformation in the next 10 years. Hybrid sales are expected to continue to rise for some time to come.

In order to help the development of the industry, provide clear product opportunities for the enterprise, closely follow the development trend of electrification and intelligent direction, and more accurately provide planning and marketing ideas for the industry, this paper forecasts the development trend of the HEV market, characteristics of compact car hybrid users, requirements and future demand trends.

2. Research idea and method

This paper mainly adopts the method of desk research, online big data research, offline quantitative research and qualitative research.

2.1. Big data research

Big data research has been gradually applied to the study of the full life cycle of automobile products [5]. Online big data mainly come from HEV user word-of-mouth data of automotive vertical media such as Autohome and Pacific Auto. Through the analysis of the relationship between the various models of each other to form the segmentation market competition pattern.

2.2. Quantitative and qualitative research

Quantitative research is a research method that designs questionnaires based on certain assumptions or hypotheses and visits a certain number of representative samples, so as to collect user information comprehensively and reach certain conclusions through comprehensive analysis of data. Based on the market understanding and research demand for the compact hybrid sedan (MC-Sedan HEV), the selection principles of the research model, city and user characteristics in this study are as follows. Firstly, based on the sales volume analysis and competitive pattern distribution of the compact HEV market, the research models were determined, mainly covering the compact PET and HEV models. The compact HEV covers: Levin dual engine, Sylphy E-POWER, Corolla dual engine; Compact PET covers: 11 generation Civic, Sagitar, TyG, Corolla, while increasing a small number of potential users who may want to buy compact HEV models. Secondly, considering the sales of the above models in major cities of China, the future market capacity and layout of the compact car segment, as well as the enforceability of the epidemic, Shenyang and Wuhan were selected as the cities to be investigated, and a total of 200 samples were completed in each city. Third, set the sample boundary conditions that meet the research requirements to improve the quality of the investigation: Male to female ratio: 7:3; aged 20-40 years old; resident in the local area for 3 years or above; college degree or above; purchase date: September 2021 to June 2022; purchase date: new car and personal car; the user is the main decision maker and user of the car; meet the general restrictions of the research industry. The quantitative questionnaire focuses on user related, product related, price related, advertising, sales service, level of business and other aspects.

Qualitative research refers to a research method based on

qualitative perspective to access research samples with the help of theoretical paradigms and logical questionnaires so as to obtain richer theoretical conclusions and user information. It usually includes focus group discussion, in-depth interview, expert interview, workshop and other forms. Focus group discussion means that a group of representative users are selected to have a discussion under the guidance of the moderator in a room equipped with single-sided mirror, audio recording and video recording equipment, so as to obtain the relevant information of user needs, consumer psychology, behavior and so on. In this study, two groups of symposia (designated HEV model acceptance group and hesitating group) were set in Shenyang and Wuhan respectively. The boundary conditions of the symposia samples were as follows: from quantitative samples, female users in each group were no more than 1, users should be able to tell the original intention of buying a car, have a deep memory of the purchase process, have clear thinking, strong expression ability and have their own unique opinions on the car. In-depth interview is the one-to-one visit of the interviewer to the user. Through logical inquiry, the interviewer can explore the user's needs, emotions, behaviors and values. In this study, one focus user with his/her own opinions was selected from each group of qualitative symposia, and the one-to-one in-home in-depth interview was adopted to dig the user information deeply and clarify the user portrait. In addition, 3 dealers were set up in each city to visit to obtain professional market insights, including Dongfeng Honda, FAW Toyota and Geely Lynk & Co. All of them were sales managers or above with 5 years of working experience and familiar with the compact sedan HEV market.

3. Research results and findings

After the quantitative data was uploaded and cleaned, the relevant data results were analyzed based on SPSS. Based on the analysis of the competitive landscape of online big data, 400 quantitative samples and qualitative research results, the main findings are as follows.

3.1. Competitive pattern of market segments

According to the results of big data analysis, in addition to the HEV models mentioned a lot, there is also a strong competitive relationship between HEV and PET models. On the one hand, some models such as Corolla, Levin, Envix, Crider and other models have both PET and HEV models; On the other hand, because there are not many models in the supply end of the HEV, users are wavering between PET and HEV.

There are not many terminal models, and users are wavering between PET and HEV. At the same time, the quantitative survey results show that nearly 40% of users have no clear intention to choose the fuel type when they purchase the vehicle initially, and there is a phenomenon that users with original intention of PET turn to HEV due to terminal sales tactics in the actual purchase of the vehicle [6].

3.2. Basic User Features

From the perspective of social groups, the current 80 generation, 90 generation and part of the 00 generation are the current and future mainstream consumer groups, mainly aged 20-45 years old. Compact car users (including PET and HEV users) are mainly married men with children, and the age group is distributed in the current mainstream consumer group, most of them are 25-40 years old, among which 30-35 years old accounts for the highest proportion (more than 30%). Mainly engaged in manufacturing, computer/software, wholesale/retail, transportation/logistics, etc. Education is mainly distributed in junior college or above, among which junior college accounts for more than 60%.

The interests of compact car users are mainly playing mobile phones at home, gathering with friends, exercising/running/watching drama, surfing the Internet/playing games, and most of their consumption views are rational and pragmatic.

Compared with PET car users, a higher proportion of HEV users were aged between 25 and 30 years (34%). At the same time, the income and budget are slightly higher than PET users. The proportion of HEV users willing to try new products is higher than that of PET users.

3.3. User vehicle requirements

The research on vehicle demand mainly focuses on two aspects: first, the core factors of car purchase at the time of purchase [7]; The second is the satisfaction feeling after the actual car experience.

From the TOP3 concerns, compact PET car users are most concerned about safety (41%), appearance (36%), comfort (35%); This is closely related to their purpose and usage scenarios (commuting, daily transportation, leisure and entertainment, business use, etc.). These users mainly purchase cars for household use, while very few users have personal use needs. Users of compact HEV have slightly different concerns. Based on the performance of the supply side of the existing market, they pay the most attention to the brand (42%) and economy (39%), and rank the third in the cost performance ratio, which is consistent with their cognition of the HEV product and technology and the purchase reason of energy-saving and environmental protection attributes of the HEV. The above research results are similar to those of Li Hui et al., who studied the consumption concerns and demands of hybrid vehicle users in 2021 [8].

After the use of the new vehicle, from the perspective of satisfaction, the HEV user is satisfied with the economy (fuel consumption), brand and appearance, which is almost consistent with the main concerns of the vehicle purchase.

3.4. User Trend Prediction

In 2015, HEV entered the market in our country. At that time, it was in the embryonic stage of PET as absolute mainstream and HEV. At present, PET still accounts for the mainstream sales volume, but HEV sales volume continues to increase. In the process of market cultivation and maturity, users' cognition and consumption concept have changed to some extent.

In the embryonic stage, the majority of HEV users are 30-35 years old, with an annual income of more than 300,000 yuan, highly educated and most of them have overseas study background, who are engaged in middle management posts in foreign capital or joint ventures. "Focus on environmental protection" and "show yourself" are their labels. During the rapid production period, HEV users are 25-35 years old, with annual income of 180,000 to 300,000-yuan, college degree, and mainly working in private enterprises. Their labels are "emphasis on experience", "emphasis on quality", "energy saving and environmental protection".

The increase of user base is the trend of HEV population. Compared with the initial HEV users, the current HEV users

are younger, their income and educational background are slightly lower, and the purchase of the HEV is more rational, with clear HEV vehicle cognition and driving force.

3.5. User Demand Trend Prediction

According to the analysis of the purchase concerns of compact car HEV users from 2019 to 2021 (see Figure 4, changes in the demand of compact car users), the top two are brand and economy, which is related to the deep market recognition of Toyota, Honda and other brands' technology, and the low fuel consumption, low cost and other economic benefits brought by the HEV technology.

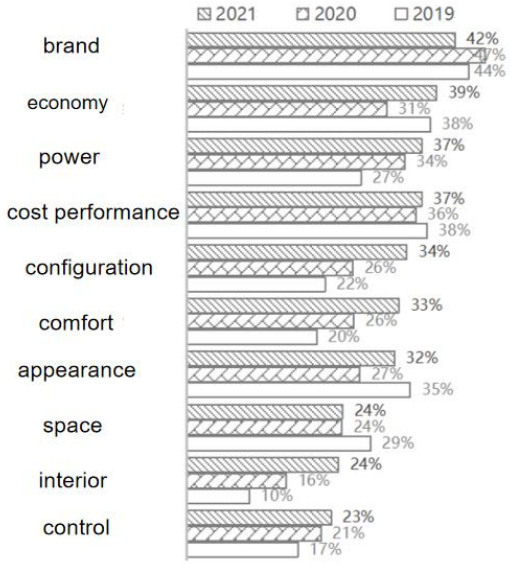


Figure 4. Change of user demand for compact HEV sedan

The user's attention to power, configuration, comfort and interior is increasing year by year. Through in-depth investigation, it is found that users' attention to power is mainly reflected in the starting acceleration, overtaking acceleration and other aspects; In terms of configuration, it mainly focuses on ADAS driving assistance configuration, the number of airbags and the performance of the center control screen size/vehicle-machine interconnection/voice interaction reflecting the level of scientific and technological intelligence. In terms of comfort, users mainly pay attention to the seat function (such as ventilation, heating) and encapsulation, inside the car smell and inside the car silence performance; In terms of interior decoration, users focus on the sense of quality.

Users' demand for power, configuration, comfort and interior decoration increases year by year. On the one hand, it benefits from the cultivation and guidance of the consumer social environment. From the perspective of consumer society, our country is currently in the transition stage from the second consumer society to the third consumer society. Users' needs are transforming from mainly satisfying household needs to focusing on individual needs, and at the same time, consumption is inclined from the pursuit of "quantity" to the pursuit of "quality". In the segment market of compact HEV sedan, the high demand for power, configuration, comfort and interior is one of the characteristics of consumer society.

On the other hand, due to the continuous enrichment of supply side products, joint venture brands and national brands gradually pay more attention to the HEV market, providing consumers with more choice possibilities. Within the affordable range of the budget, users are more inclined to choose more quality, more sense of science and technology, higher level of intelligent models.

IPA model (Importance Performance Analysis) is a method to analyze the degree of importance. The horizontal axis represents the degree of satisfaction and the vertical axis represents the degree of importance. IPA divides key factors into four phenomena through two-dimensional analysis of satisfaction and importance. In this paper, a two-dimensional cross-analysis is made on the attention and dissatisfaction of compact HEV car users (Figure 5). The results show that brand, economy and cost performance of region B, which have high attention and low dissatisfaction, are the indicators that future HEV enterprises should continue to maintain.

The power performance, configuration and comfort of region A are the regions with high user attention and high degree of dissatisfaction, which are the indicators to be urgently improved in future HEV enterprises.

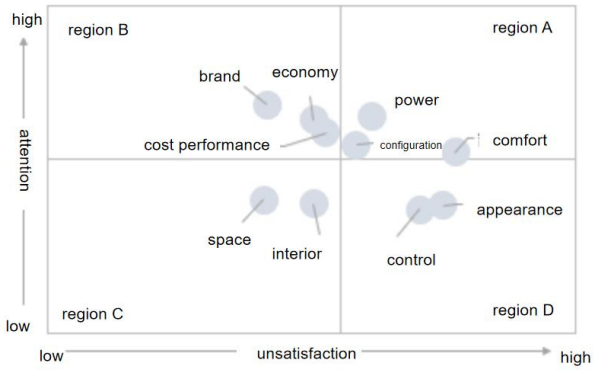


Figure 5. IPA model of a compact HEV passenger car user

The basic functional requirements of the current compact HEV in terms of brand, economy and cost performance have been fully met. Based on the satisfaction of energy-saving attributes, users' demands for power, configuration, comfort, quality and convenience have been improved [9,10].

4. Conclusion and Prospect

The HEV market gradually develops from the cultivation stage to the mature stage, and the consumer cognition also changes from the initial emotional impulse purchase to the rational and thoughtful purchase, and the vehicle demand becomes more and more clear. Economy and brand are the most basic factors of current compact HEV sedan with high satisfaction. In the future, users will pursue more quality requirements, including the improvement of scientific and technological intelligent configuration, comfort, better power experience and classier interior. The automobile enterprise should take the user as the core, have an insight into the HEV user demand, grasp the HEV user development trend, and follow the trend. This paper focuses on the field of compact cars, and the market analysis of midsize cars and SUVs is insufficient, which will be continuously tracked in the future.

References

[1] Liu Yongning. Petrol-electric Hybrid Electric Vehicle and its Key Technologies [J]. Internal Combustion Engine and Accessories,2022(16):103-105.

[2] M.A. Hannan, F.A. Azidin, A. Mohamed, Hybrid electric vehicles and their challenges: A review, Renewable and Sustainable Energy Reviews, Volume 29,2014, Pages 135-150.

[3] Chen Fuyun. Technology Status and Development Prospect of petrol-electric Hybrid Electric Vehicle [J]. Hunan Agricultural Machinery, 2019, 046(006):99-100,108.

[4] Wang Bo. Comparison of BYD DM3 and Toyota THS Hybrid System [J]. Internal Combustion Engine & Accessories,2019(20):51-52.

[5] Wan Tiantian, Zhang Lei, Yang Jing. Application of Big Data Research in Automobile Market Research [J]. Automotive Practical Technology,2021,46(09):228-230.

[6] Jonn Axsen, Kenneth S. Kurani, Hybrid, plug-in hybrid, or electric -- What do car buyers want? , Energy Policy, Volume 61, 2013, Pages 532-543.

[7] Xiaogu Li, Christopher D. Clark, Kimberly L. Jensen, Steven T. Yen, Burton C. Consumer purchase intentions for flexible-fuel and hybrid-electric vehicles, Transportation Research Part D: Transport and Environment, Volume 18,2013, Pages 9-15.

[8] Li Hui, Liu Chunhui, Yu Xinlei. Research on Market Characteristics and Consumer Demand of Hybrid Vehicle Buyers (Part 2) [J]. Automobile & Parts,2021(22):68-70.

[9] Lin He, Wei Chen, Guenter Conzelmann, Impact of vehicle usage on consumer choice of hybrid electric vehicles, Transportation Research Part D: Transport and Environment, Volume 17, Issue 3, 2012, Pages 208-214.

[10] Zeinab Rezvani, Johan Jansson, Jan Bodin, Advances in consumer electric vehicle adoption research: A review and research agenda, Transportation Research Part D: Transport and Environment, Volume 34,2015, Pages 122-136. A review and research agenda, Transportation Research Part D: Transport and Environment, volume 34,2015, Pages 122-136.