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Global and China Hybrid Vehicle Industry Research Report, 2021

Abstract

Research on hybrid vehicles: Five global major hybrid technologies compete fiercely in China

The hybrid technology is one of the important technology roadmaps to achieve emission peak, carbon neutrality and dual credit compliance.

In September 2020, President Xi Jinping pledged that China would reach its CO2 emissions peak before 2030 and achieve carbon neutrality before 2060. For this goal, China proposes to carry out transformation and innovation in ten fields, among which the construction of a green low-carbon transportation system and the promotion of green and low-carbon technological innovation involve automotive energy-saving technologies covering electric vehicles, hybrid, and hydrogen fuel cells.

Measures for the Parallel Management of Average Fuel Consumption of Passenger Car Companies and New Energy Vehicle Credits (hereinafter referred to as the dual credit policy) stipulates the average fuel consumption credits of passenger car companies and new energy vehicle credits. In 2020, the passenger car industry's fuel consumption credits were -7.33 million and new energy vehicle credits 3.3 million. In the face of the regulation on emission peak, carbon neutrality and double integration, hybrid technology will be one of the important technical routes for automakers to meet the standards for automakers.

Energy-Saving and New Energy Vehicle Technology Roadmap 2.0 released by China-SAE points out the development goal of China's automobile industry: "the total industrial carbon emissions should reach the peak around 2028 in advance of the national carbon emission reduction commitment, and the total emissions should drop by more than 20% from the peak by 2035. The sales volume of new hybrid passenger cars should account for 50%-60% of traditional energy passenger cars by 2025, 75%-85% by 2030, and 100% by 2035. This clarifies that energy-saving vehicles do not represent a transitional technology, but a high-efficiency technology that allows engines and motors to complement each other, replaces internal combustion engine vehicles on a large scale within a reasonable price range, and reduces fuel consumption.

Abstract

Five global major hybrid technologies compete fiercely in China

Currently, hybrid power is mainly being developed in Japan, the United States, Europe, and China which choose different hybrid technology roadmaps according to their technical reserves and development goals:

- Japanese cars are mainly powered by Toyota's Power-split (PS) and Honda's i-MMD series-parallel hybrid. Through strong hybrid, the best fuel-saving effect can be achieved. For example, Toyota THS available in Toyota Prius adopts a single planetary row structure design to maximize fuel economy in common vehicle speed ranges. Toyota is committed to licensing the hybrid technology to Chinese automakers. For example, the new-generation GAC Trumpchi GS8 hybrid system is planned to be equipped with the Julang Hybrid System composed of Trumpchi 2.0T engine and Toyota THS; Hunan Corun New Energy has purchased the core technology Toyota's THS for RMB1 and promoted the application in conjunction with Geely.
- American cars are mainly based on Power-split (PS) of GM and Ford; for example, the general hybrid power system of GM LaCrosse adopts a dual-row planetary structure design to achieve two “power split” modes (high and low speed modes) and one or multiple fixed gears so as to further improve the fuel economy and transmission efficiency of the car.
- German cars are mainly based on 48V low-voltage and high-voltage hybrid technology arranged in P0/P2. The system replaces traditional lead-acid batteries with power-type lithium-ion batteries with a voltage of 48V and an energy of less than 1kW·h, and replaces traditional starter motors and generators with B/ISG motors. A large number of Chinese plug-in models have exploited German technology roadmap and suppliers.
- Chinese automakers have transferred from the original technology diversification to the dual-motor-based series-parallel mode. For example, the GAC Trumpchi Electromechanical Coupling System (G-MC) adopts the series-parallel mode, which is mainly used for plug-in hybrid; BYD's DM-i super hybrid technology adopts the EHS to open up a new technology system in addition to Toyota's THS Power-split and Honda's i-MMD.
- The series extended-range hybrid power roadmap is represented by Nissan e-Power, Lixiang ONE, Dongfeng Voyah, etc.; In series mode, the engine and the electric motor are not mechanically connected, so the engine can obtain the best efficiency at different vehicle speeds and loads. In 2020, 32,600 Lixiang ONE cars were sold, ranking first in the extended-range field.

The world's mainstream OEMs have conducted diversified explorations in hybrid systems, and finally chose the hybrid strategy that is most suitable for their own models. We have summarized the hybrid strategies of the global mainstream automakers.

Abstract

Hybrid System Application Strategies of Global Mainstream Automakers

	Automakers	Current strategy
Japan	Toyota	Power-split DHT
	Honda	P13 configuration DHT
	Nissan	P2/REEV
	Mazda	Power-split DHT
	Mitsubishi	P13+P4
South Korea	Hyundai Kia	P2
U.S.	Ford	Power-split DHT
	General Motors	Power-split DHT
	Chrysler	Power-split DHT
Europe	Volkswagen	P2
	Audi	P2
	Porsche	P2
	BMW	P2
	Benz	P2
	PSA	P2+P4
	FCA	Power-split DHT
	Volvo	P1+P4/P2.5
China	Changan	P2
	Great Wall	Dual-motor DHT/P2
	Geely	Dual-motor DHT/P2
	SAIC	P13 configuration DHT/P2.5
	GAC	P13 configuration DHT/P2
	BYD	P0+P3+P4/Dual-motor DHT
	FAW	P2
	Chery	P13 configuration Dual-motor DHT
	BAIC	P13 configuration DHT
	Dongfeng	P13 configuration DHT

Source: ResearchInChina

Abstract

Chinese automakers have developed hybrid systems independently to seize the hybrid market

In the context of energy saving and emission reduction, Chinese automakers have made efforts to develop the hybrid technology in recent years. They have launched self-developed hybrid systems, such as Great Wall Lemon DHT Hybrid System, BYD DM-i Super Hybrid, GAC Julang Hybrid System, Chery Kunpeng DHT System, etc.

Hybrid Systems of Major Automakers in China

Automakers	Hybrid system	Introduction
Geely	GHS 2.0	Geely is developing a next-generation hybrid powertrain platform, with the indicated thermal efficiency as high as 49.5%. In the development process, it pays more attention to users' real operating conditions, especially on urban congested roads, and covers MHEV/HEV/PHEV/REEV hybrid technology roadmaps to achieve better energy-saving effects and stronger power performance
Great Wall	Lemon DHT	The logic of the dual-motor high-efficiency hybrid system is basically similar to i-MMD. It has a high-power TM drive motor with the maximum power of 130kW and the maximum torque of 300N·m.
BYD	DM-i	The core is composed of a 1.5L high-efficiency Xiaoyun engine, an E-CVT gearbox and a high-capacity battery. The 1.5L high-efficiency Xiaoyun plug-in and hybrid engine has made a major breakthrough in engine thermal efficiency, which hits 43%
GAC	Julang Power	The hybrid system is a combination of a 2.0TM engine developed by GAC independently (thermal efficiency: 40.23%) + Toyota THS. The G-MC 2.0 dual-motor hybrid system, with the fuel consumption of 5.5L/100km under NEDC operating conditions, will be mounted on hybrid models produced by the B and C platforms. The first model, new GS8, will be unveiled at the end of 2021.
Chery	Kunpeng DHT	Thermal efficiency: up to 45%. Fuel saving rate: more than 95%. Dual-motor drive. 9 working modes. 11 combined gears. Super smooth driving experience via TSD dual-axis drive.
SAIC	EDU 1.0	EDU 1.0 is equipped with a 2-speed gearbox, which is driven by hydroelectric integration. It is also equipped with two motors at both sides of the gearbox. An ISG motor at the P1 position is mainly used for power generation; a TM motor at the P2 position (the other end of the gearbox input shaft) is more powerful and is mainly used to drive the vehicle. The ISG motor and the gearbox are connected by the C1 clutch, and the TM motor and the gearbox input shaft are linked by the C2 clutch.
	EDU 2.0	The core components of EDU 2.0 are the 6-speed transmission on the engine and the 4-speed transmission on the motor. The 6-speed transmission is coaxially connected with the engine, and the 4-speed transmission is coaxially connected with the TM drive motor. The two power systems are arranged in parallel, and the power is transmitted to the wheels through the middle output shaft. EDU 2 has a layout structure with three parallel axes.

Source: ResearchInChina

Sales Volume of China's Hybrid Vehicle Market Segments

(1) PHEV passenger cars

According to CPCA (China Passenger Car Association)'s data, the sales volume of PHEV passenger cars in China increased by 2.7% year-on-year to approximately 211,900 units in 2020. From January to June 2021, the sales volume reached 183,200 units.

At present, China's PHEV passenger cars companies are mainly represented by BYD, SAIC, and Lixiang. In 2020, SAIC ranked first with the sales volume of 59,900 PHEV passenger cars, followed by BYD and Lixiang with the sales volume of 51,700 and 32,600 respectively.

(2) HEV passenger cars

According to the data from CAAM (China Association of Automobile Manufacturers), the sales volume of HEV passenger cars in China jumped by 21.9% year-on-year to about 290,400 units in 2020, approximately 272,400 units in H1 2021. It is expected to hit 500,000 units in 2021;

In 2021, the sales volume of HEV passenger cars in China soars. On the one hand, Toyota has added dual-engine to a variety of models to meet demand for energy-efficient and fuel-efficient vehicles. On the other hand, China has raised higher requirements on carbon emission, which forces automakers to reduce emissions. Automakers mainly promote lower-displacement dual-engine vehicle models.

At present, the sales volume of HEV passenger cars in China is mainly contributed by GAC Toyota, FAW Toyota, GAC Honda, and Dongfeng Honda. The sales volume of GAC Toyota's HEV passenger cars accounted for 32% of the total in 2020, and 41% in H1 2021 with a spike of 9 percentage points. Under the pressure of carbon emissions, Toyota actively boosts dual-engine models and has installed the dual engine technology on multiple models.

(3) 48V mild hybrid system

The 48V mild hybrid system is evolved from the 12V electrical system which is not completely abolished but continues to exist. The biggest advantage of the 48V mild hybrid system is that it can save much more energy and reduce emissions to comply with stringent emission policies at low costs:

1. The application of start-stop technology makes the carrying capacity of the traditional 12V system approach the limit. Electrical systems with higher carrying power are needed to achieve better energy-saving effects;
2. More and more electronic functions are integrated in a single vehicle, while the 12V system cannot match high-power electrical equipment.

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In 2020, the sales volume of passenger cars equipped with the 48V mild hybrid system in China was swelled 39% year-on-year to 331,000 units. According to China Association of Automobile Manufacturers, 20.178 million passenger cars were sold in China in 2020, of which only 1.64% was 48V mild hybrid cars. By 2025, the sales volume of passenger cars with the 48V mild hybrid system in China will reach 3.12 million units.

The 48V mild hybrid system can reduce fuel consumption to a certain extent at a low cost. Considering carbon emissions and costs, automakers are keen to install the 48V mild hybrid system on traditional fuel vehicles. However, from a consumer's point of view, the fuel saved by the 48V system is not obvious, so the subsequent promotion still requires continuous technological progress and cost reduction.

Fuel Saving Rate and Cost of 48V Mild Hybrid System

		Automatic start/stop	48V mild hybrid
Fuel saving rate	General roads	5%	10%-15%
	Congested roads	15%	
Installation cost (RMB)		2,500-3,500	6,000-15,000
Increased usage cost	Battery replacement frequency (years)	2	5
	Battery replacement cost (RMB)	400-1,500	8,000-16,000
	Maintenance cost compared with ordinary fuel vehicles (RMB)		4,000-5,000

Source: ResearchInChina

Of course, 48V mild hybrid is only a transitional technology, not a solution that can be done once and for all. The 48V system can meet the average fuel consumption limit of passenger cars in the fourth and fifth stage (the fourth stage: 5.0L/100km (2020); the fifth stage: 4.0L/100km (2025) with a reduction of 42%), but it is difficult to realize the goal in the sixth stage (3.2L/100km (2030)). Therefore, Chinese automakers need to step up research and development of strong HEV, PHEV, high-efficiency engines and other advanced technologies while introducing the 48V mild hybrid technology so as to prompt the long-term development.

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