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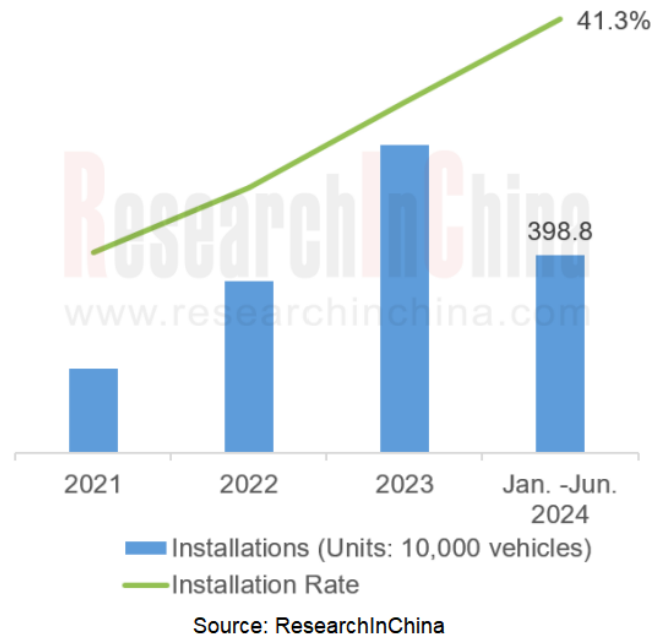
Passenger Car Brake-by-Wire and AEB Market Research Report, 2024

Sept. 2024

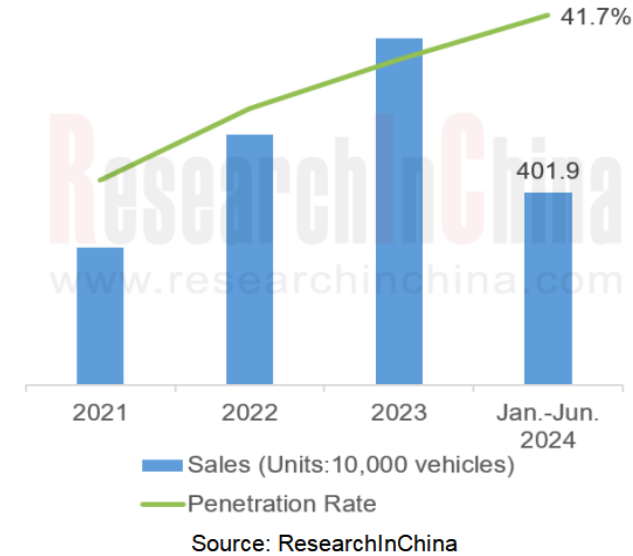
EHB penetration rate exceeded 40% in 2024H1 and is expected to overshoot 50% within the year

In 2024H1, the installations of electro-hydraulic brake (EHB) approached 4 million units, a year-on-year increase of 101%; the installation rate exceeded 40%, up 19.9 percentage points compared with the same period last year, the EHB market has kept prosper.

Installations and Installation Rate of EHB, 2021-Jun. 2024



Sales and Penetration Rate of New Energy Vehicle, 2021-Jun. 2024

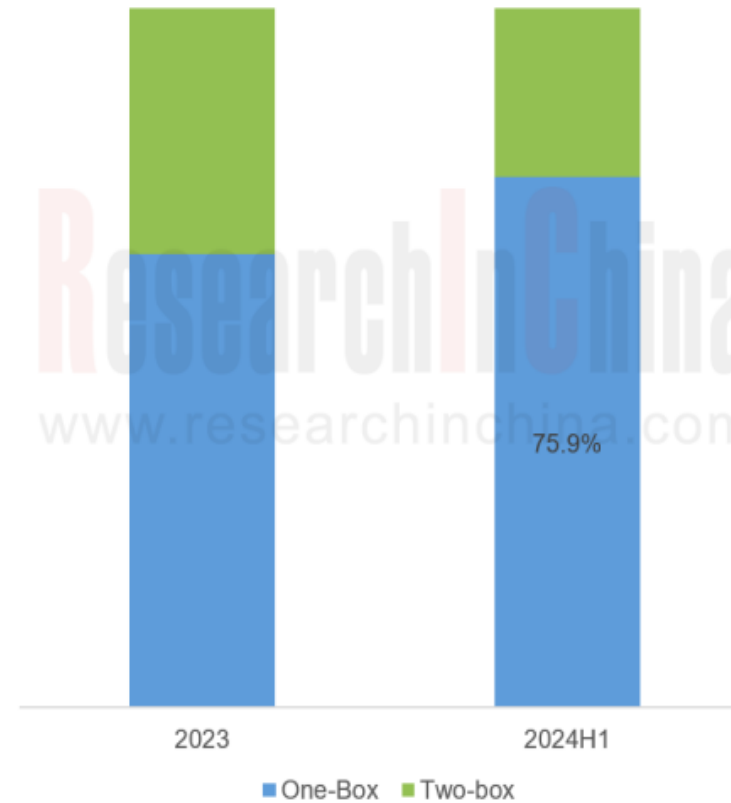


The hot brake-by-wire market is largely driven by the new energy market. Brake-by-wire meets a series of requirements of new energy vehicles, such as no vacuum power source, high requirements for system response speed, and brake energy recovery. The following figure shows the sales and penetration rate of new energy vehicles from 2021 to June 2024. From the data, the growth trend of brake-by-wire installations and installation rate is highly consistent with that of new energy vehicle sales and penetration rate.

Market Share of EHB Technology (By Type)

From the perspective of EHB technology classification, the share of One-Box has further expanded. In 2024H1, the share of One-Box increased to 75.9%, an increase of 17.4 percentage points from the same period last year.

Market Share of EHB Technology (by Type), 2021-2024H1



Source: ResearchInChina

Mass Production of Brake-by-wire Products for Some OEMs

Mass Production of Brake-by-Wire Products for Some OEMs

OEM	Brake-by-wire Layout
BYD	<ul style="list-style-type: none"> In 2022, BYD successfully developed its brake-by-wire system BSC (Braking Safety Control) through its subsidiary FinDreams Powertrain This system is a one-box product and has been first launched on the Dolphin (E3.0) platform
GWM	<ul style="list-style-type: none"> Independent R&D of brake-by-wire through Figure Intelligent Technology Brake-by-wire layout includes EAD (Two Box), EAI (One Box), and EMB products. One Box has been in SOP in 2022
SAIC	<ul style="list-style-type: none"> DIAS Automotive Electronic was established as a wholly-owned subsidiary to complete brake-related products such as EBS, ABS, ESC, and IEB (One Box) SOP for IEB and IEB+RDU products has been completed by 2023
Changan Automobile	<ul style="list-style-type: none"> In 2023, Chenzhi Technology, a new brand in the field of intelligent chassis-by-wire, was launched. In December 2023, Chenzhi Technology's brake-by-wire product IBCU (Integrated Braking Control Unit) completed the first round of high-attachment calibration at Dianjiang test site and successfully passed customer evaluation and approval, reaching another milestone in the development of IBCU. It is planned to achieve One Box SOP in June 2025
Geely Automobile	<ul style="list-style-type: none"> Established a joint venture with HL Mando Co., Ltd., HL Mando (Ningbo) Automotive Chassis System Technology Co., Ltd. to develop vehicle braking systems, steering systems, and shock absorption system products Subsidiary Jirun Automobile and Bethel Electronic, a subsidiary of Bethel, jointly established a joint venture to co-invest in the manufacturing and sales of intelligent brake-by-wire chassis products, as well as technology upgrades and innovations Holding company VCS Technology mass produced ONE-BOX product HDBS in December 2023

Some OEMs, mainly Chinese independent brands, have entered the brake-by-wire market by setting up subsidiaries or joint ventures with other manufacturers. By 2024, many OEMs have completed mass production of brake-by-wire products.

Source: ResearchInChina

Geely - VCS Technology

Founded in May 2022, VCS Technology focuses on the R&D and production of 3 core chassis systems, namely brake-by-wire, steer-by-wire and suspension-by-wire, as well as chassis domain controllers.

Zhejiang Yaoning Technology Group
Co., Ltd.

53.93%, RMB 19.50 million

Jiangsu VCS Automotive Technology
Co., Ltd.

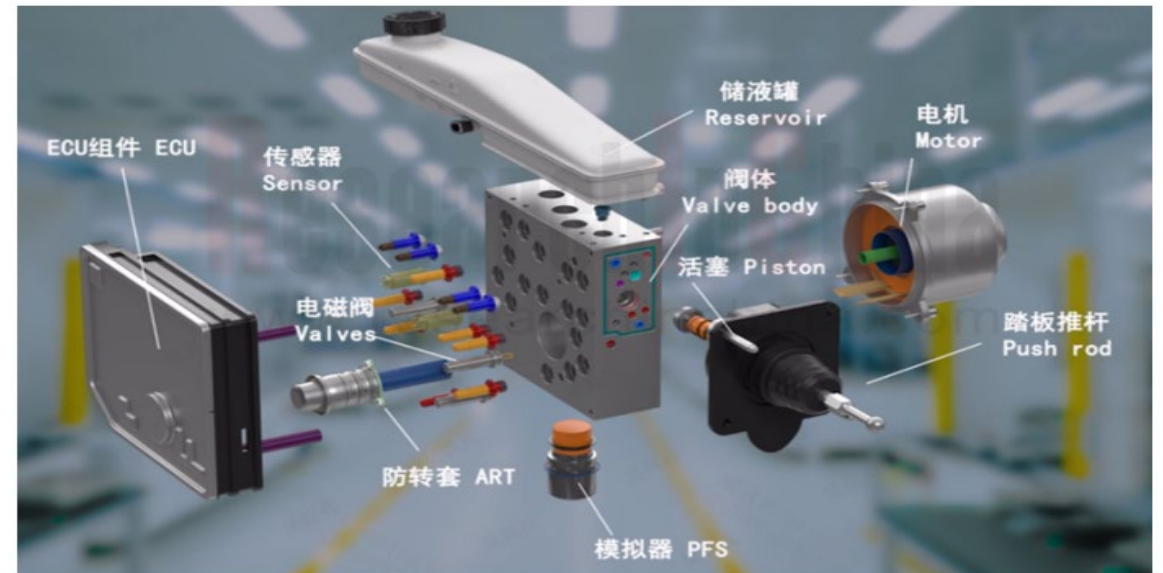


- Established: December 2020
- Chairman of the company: Li Xingxing, the controlling shareholder of Geely Group, and the son of Geely's Li Shufu
- Yaoning Technology Group was born out of Geely Auto, formerly known as Geely Auto Parts Business Center

Source: ResearchInChina

In December 2023, VCS Technology's One-Box product HDBS was mass-produced and rolled off the production line, with an expected annual output of 600,000 sets. The system can realize brake assist, conventional ESC functions and intelligent driver assist functions, and the response time can reach within 150ms. Its application range can cover fuel, all-electric and hybrid models, and can also be applied to some light commercial vehicles. It is reported that VCS Technology HDBS will be the first to be equipped on Geely brands after mass production.

Exploded Diagram of VCS Technology HDBS



Source: VCS Technology

EMB expects to achieve small-scale mass production by 2026 at the latest

It is an industry consensus that EMB is truly brake-by-wire. Although the research history of EMB system has been more than 20 years, it is difficult to overcome a series of technical problems such as "high requirements for motors, no fail-safe backup braking function, and high cost", and EMB system has not been applied in large quantities so far. However, in recent years, Chinese and foreign manufacturers have made great progress in EMB research and development. According to the plans of various manufacturers, it is expected that EMB will be able to achieve small-scale mass production by 2026 at the latest.

EMB Product Planning of Some Manufacturers

Manufacturer	EMB Planning	Estimated Time for Mass Production/Installation
Brembo	Front-EHB rear-EMB solution, SENSIFY intelligent braking system released in 2021	Planned to be put into mass production and released in 2025
Continental	Front-wet rear-dry	Expected to supply the front-wet rear-dry EMB system to North American automakers in 2025
Hella	Under development	Will start production in HELLA's European production network in 2025
Hitachi Astemo	In 2020, the Smart Brake System (EMB) prototype was successfully assembled and entered the platform verification stage.	Mass production is planned in 2027
Bethel	In 2023, the development of A-round prototype has been completed. In 2024H1, main indicators of the EMB project, whose functional samples have been installed and tested, have met expectations.	Mass production is expected to be achieved in 2026H1; EMB production line with an annual output of 600,000 sets is under construction
Tongyu Automotive	Currently developed are front EMB calipers and rear EMB calipers	Mass production is expected to be achieved in 2026
Beijing West Industries	Jointly developed dual-motor all-dry EMB products with ThyssenKrupp and completed winter dynamic testing in early 2024	Advanced automated production line will be built in 2025, and mass production and delivery of EMB will begin in 2026
Trugo Technology	EMB is under development, providing front-wet rear-dry EMB POC project for the upcoming models of Chinese leading emerging OEMs	Achieve small-scale mass production of EMB in 2026-2027

Source: ResearchInChina

Beijing West Industries (BWI)'S EMB will be mass-produced in 2026, with the first batch to be launched in Kaiyi Auto and U POWER

In July 2024, BWI released the "2035 Full X-by-wire" global technology strategy, which mentioned that BWI's electronic mechanical braking system (EMB) has obtained strategic cooperation with Kaiyi Automobile and U POWER, and will be mass-produced for customers in 2026. Its product features include:

BWI's EMB system integrates ABS, ESC, TCS, ACC, etc. The self-developed dual-motor EMB system dramatically accelerates the response speed, and the wheel locking time is as short as 75ms. Four-wheel independent control maximizes braking stability.

Without servo mechanism or ESC module, BWI EMB realizes truly x-by-wire. The system is completely free of braking pipe, while left and right rudder structures are unified, reducing space requirements and enhancing the possibility of lightweight and compactness.

Utilizes plug-in electronic structural interfaces, eliminating the need for filling or discharge brake fluid and simplifying the assembly process.

Once finished braking, the BWI EMB system releases calipers instantly, achieving true zero drag, effectively lowering energy consumption and reducing CO2 & particulate matter emissions.

EMB of Beijing West Industries



Source: Beijing West Industries

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