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New Energy Vehicle VCU Industry Report, 2021

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VCU research: rapid evolution to integration and domain control

OEMs gradually realize independent supply amid the competitive landscape of VCUs for new energy passenger cars

The VCU is the "brain" of new energy vehicles. In the early development stage of China's new energy vehicle industry, VCUs were mainly supplied by foreign vendors. Afterwards, domestic automakers and automotive electronics suppliers have gradually mastered core technologies, so that their industrialization capabilities were greatly improved.

For example, BYD has fully realized independent supply of VCUs, Geely has continuously increased the proportion of self-produced VCUs to about 60%, almost 80% of Changan Automobile's VCUs are produced by itself, and Chery can produce more than 90% of its own VCUs.

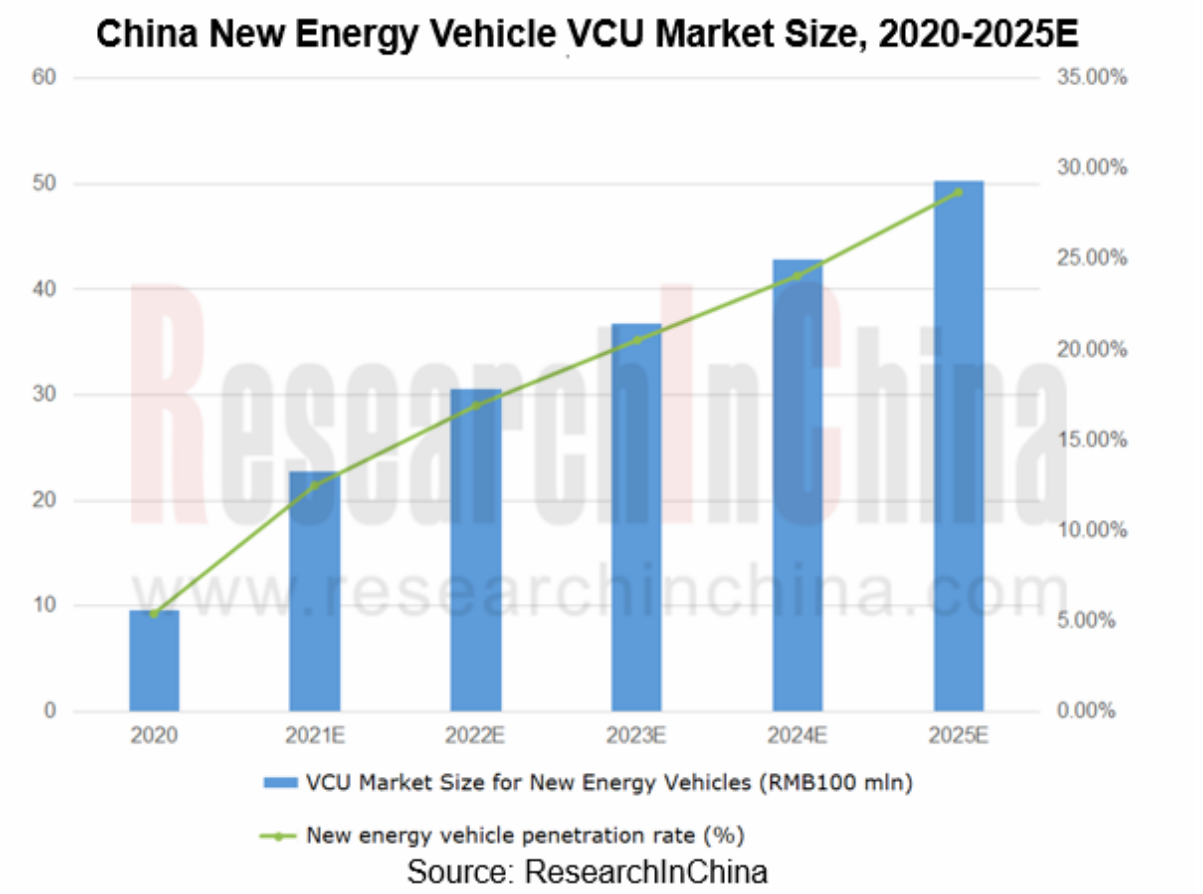
VCU of Changan Automobile

Source: Changan Automobile

China New Energy Vehicle VCU Market Size

The VCUs of some OEMs or some models are purchased from third-party suppliers like UAES, Bosch, Continental, Denso, G-Pulse Electronics Technology, Atech, Hefei Softec Auto Electronic, Hangsheng Electronics, etc. Suppliers can provide their own software and hardware directly to OEMs, or they can be the foundries of OEMs.

The VCU market size is related to the output of new energy vehicles. By 2025, China new energy vehicle VCU market size will hit RMB5.03 billion (including self-supply of automakers).

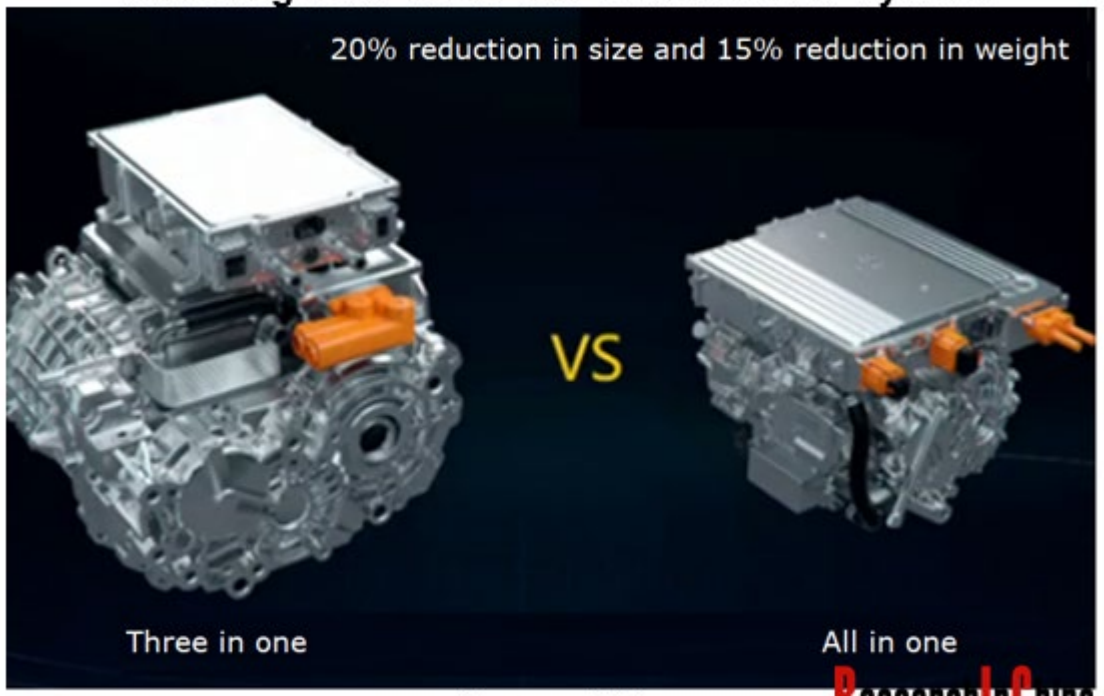


Lightweight promotes the development of "electric drive + electric control + VCU" integrated system

In order to cater to the development trend of electrified, intelligent and lightweight vehicles, VCUs will tend to be highly integrated in the future. OEMs and Tier 1 suppliers have launched "all-in-one" electric drive systems, containing VCUs.

To further reduce the weight of new energy vehicles, improve product performance and ride comfort, BAIC started to try highly integrated products, followed by GM, Huawei, BYD, etc.. "Electric drive + electronic control + VCU" integrated systems have become the focus of OEMs and Tier 1 suppliers.

Advantages of "All-in-one" Electric Drive System



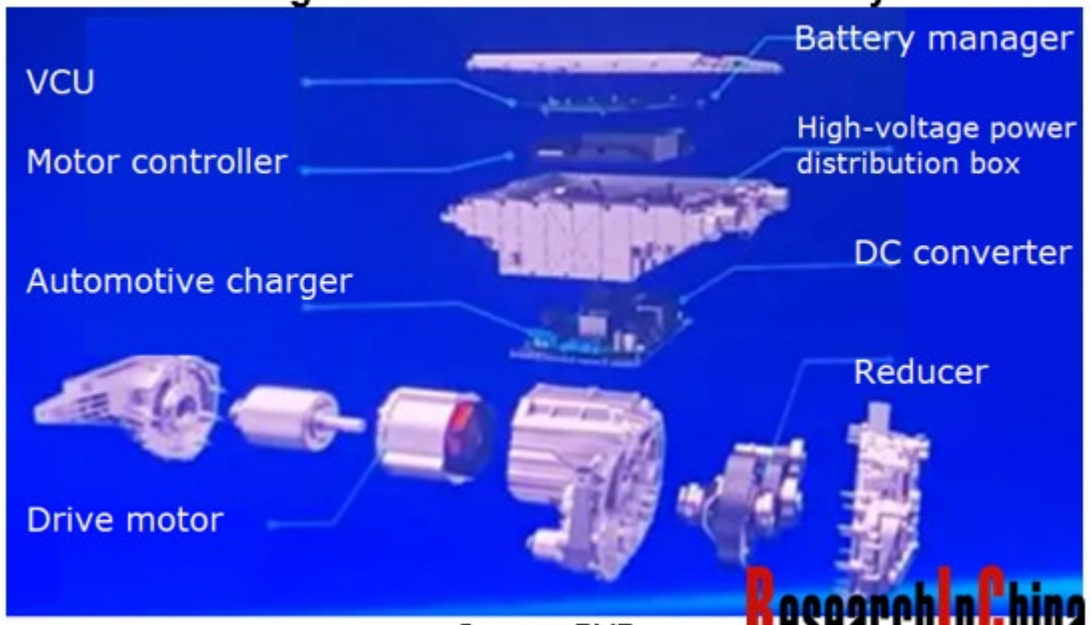
Source: BYD

BYD's "eight-in-one" Electric Powertrain System

In September 2021, FinDreams Powertrain under BYD launched the "eight-in-one" electric powertrain, which deeply integrates drive motor, motor controller, reducer, automotive charger, DC converter, power distribution box, VCU, and battery manager.

One of the main purposes of BYD's "eight-in-one" integrated system is to reduce the weight of electric vehicles. It can realize the sharing of external high-voltage filters, external interface filter circuits and high-voltage sampling, as well as the in-depth integration of system DC, OBC, power distribution, transformers, inductors and VCU/BMC/MCU chips, so that an H-Bridge, transformers and a lot of high-voltage wiring harness are unnecessary, the magnetic module size is reduced by 40%, the overall volume is cut down by 16% (which can expand the riding space or increase the battery capacity), and the weight is slashed by 10% (which can further reduce power consumption).

BYD's "Eight-in-one" Electric Powertrain System



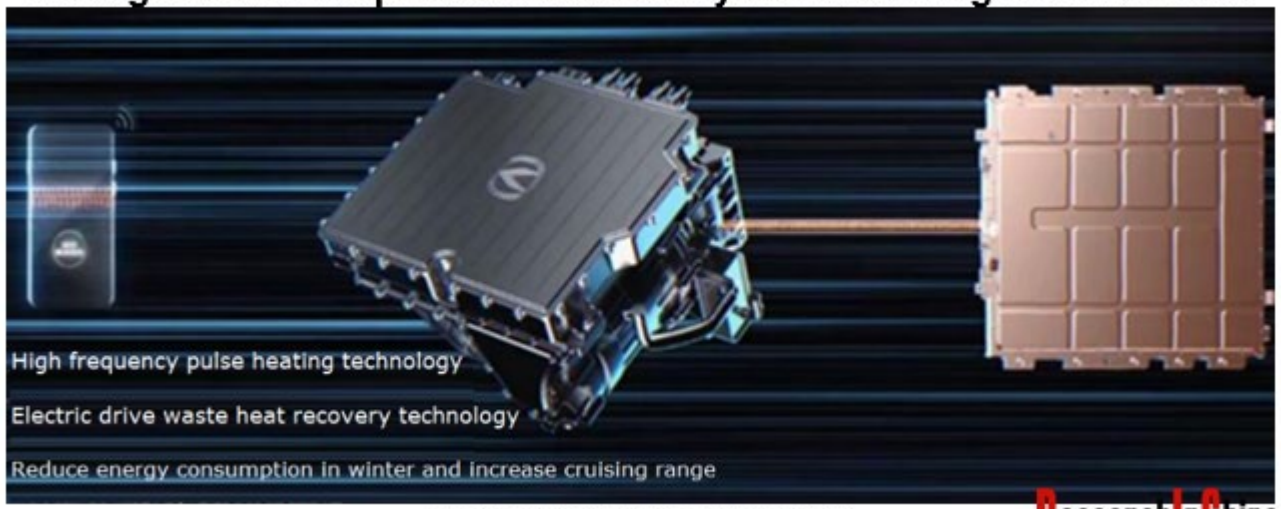
Source: BYD

Super Electric Drive System of Changan Automobile

In July 2021, Changan Automobile released the second-generation electric drive integrated system, which combines seven components: VCU, high-voltage junction box, motor controller, DC converter, charger, motor, and reducer. Compared with the first-generation "three-in-one" (integrated motor, electronic control, and reducer) system, the second generation has been significantly improved in comprehensive performance, with the size reduced by 5%, the weight reduced by 10%, the power density increased by 37%, and the efficiency improved by 5%.

Changan Automobile expects to mass-produce next-generation super integrated electric drive in the second quarter of 2022, and which will be first deployed on C385, the first strategic model of the dedicated electric platform (EAP1).

Next-generation Super Electric Drive System of Changan Automobile



Source: Changan Automobile

VCU develops towards Domain Control Integration

Under the new EEA, VCU develops towards domain control integration

From the perspective of evolution process, automotive E/E architecture (EEA) will inevitably develop towards centralized EEA. From the perspective of mass-produced models, domain-centralized EEA prevail now. The quasi-central architecture consisting of the central computing platform + zonal controllers will be the next step for automakers who finally evolve towards the central computing architecture concentrating the functional logic to a central controller.

With the evolution of the vehicle's EEA, the "all-in-one" electric drive system will eventually be integrated into the domain control system. For example, Huawei's "seven-in-one" DriveONE electric drive system has the most eye-catching domain control solution. The integration of modules, systems, scenarios and solutions effectively improves the system security.

(1) VCUs are integrated into domain controllers

(2)

For the development of vehicle EEA, the VCUs of the domain control architecture can be integrated into domain controllers. For example, ENOVATE integrates VCU and BMS to form the first-generation power domain controller VBU with completely independent research and development.

Hardware: The VBU uses Infineon's tri-core processor, has rich I/O resources, and supports Fast Ethernet;

Software: AUTOSAR architecture. The software architecture and interface protocol comply with AUTOSAR 4.2.2;

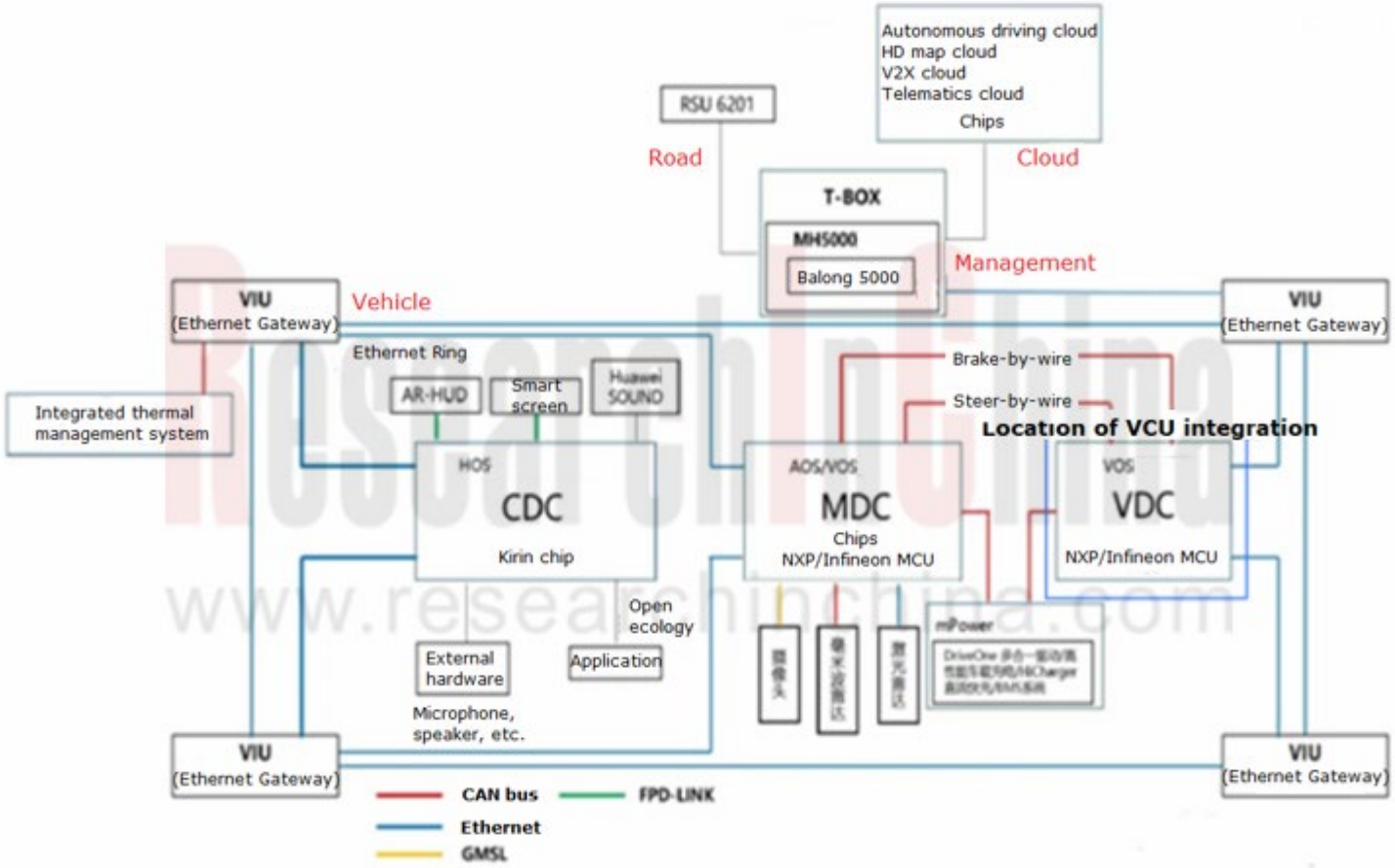
Application: At present, the VBU has integrated vehicle control, battery management, charging control, and extended range control.

Huawei CC Architecture

Huawei's CC architecture includes 3 central controllers (smart cockpit, vehicle control, and smart driving) and 4 zonal controllers. Among them, the vehicle domain control (VDC) integrates the original VCU, adopts VOS system, and is compatible with AutoSar.

On the VDC platform, Huawei will develop an MCU and a vehicle control operating system which will be open to automakers, allowing automakers to perform differentiated vehicle control based on the VDC platform.

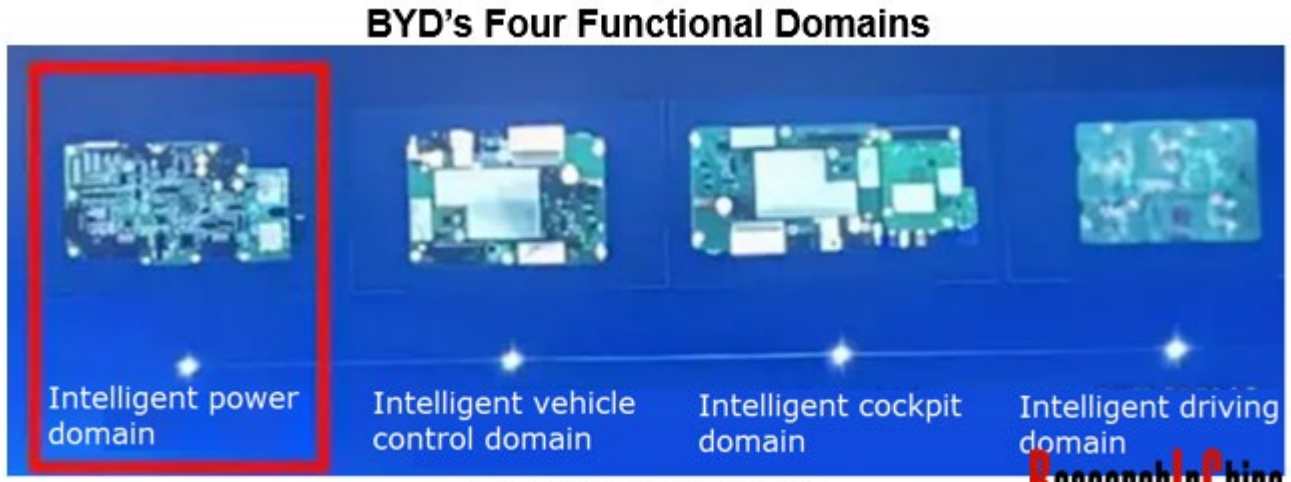
Huawei integrates VCU functions into VDC under CC architecture



Source: ResearchInChina

BYD’s Four Functional Domains

In April 2021, BYD released the e-platform 3.0, which gradually integrates dozens of ECUs in the vehicle into domain controllers of intelligent power domain, intelligent vehicle control domain, intelligent cockpit domain and intelligent driving domain; wherein, intelligent power domain integrates the control part of VCU, BMS, Inverter, PDU, DC/DC and AC/DC.



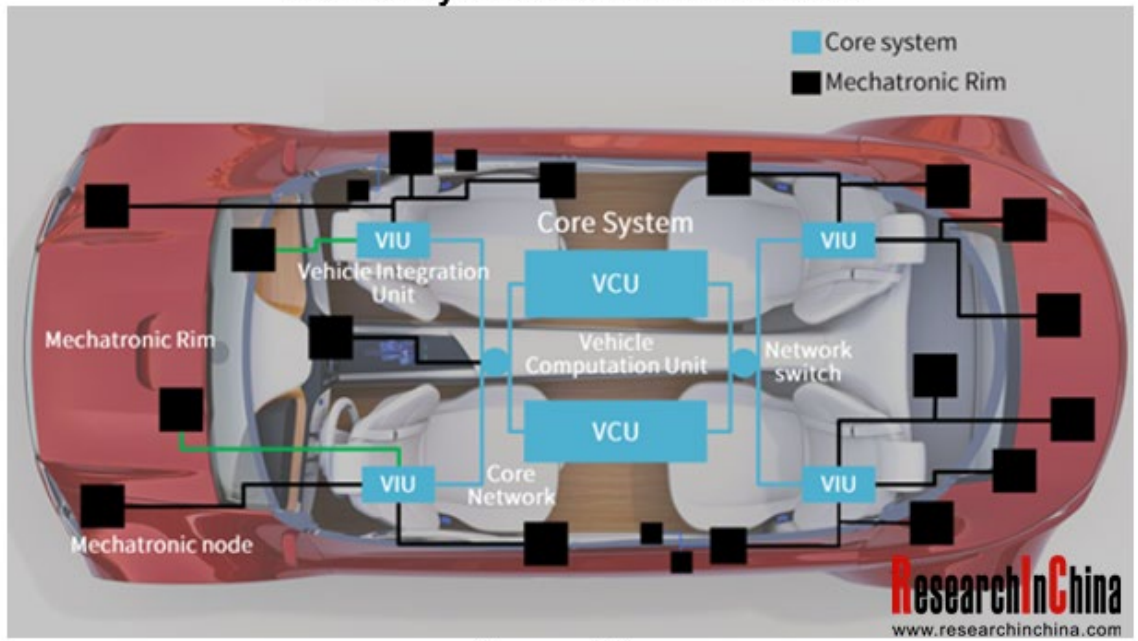
Source: ResearchInChina

Volvo’s Hybrid Central Architecture

(2) VCUs are integrated into central computing unit
Under the central computing architecture, the central gateway degenerates into multiple zonal gateways, and VCU functions will be integrated into the vehicle control unit of the central computing unit.

For example, Volvo's hybrid central architecture includes a central computing platform, an intelligent interconnection module (IHU), and an autonomous driving module (ADPM) to integrate the original domain controllers into a central computing platform.

Volvo's Hybrid Central Architecture



Source: Volvo

ResearchInChina’s New Energy Vehicle VCU Industry Report, 2021 mainly studies the following contents:

- Industry overview, market size, competitive landscape, etc. of VCUs for new energy vehicles;
- Industry chain, status quo of upstream and downstream of VCUs for new energy vehicles;
- The impact of the EEA reform on VCUs for new energy vehicles, the development trend of VCU technology, etc.;
- VCU solutions of some OEMs (such as BYD, ENOVATE, Changan, etc.);
- VCU solutions of major domestic and foreign suppliers.

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