Industry Report on the Global and China's Human-Vehicle Vision Interaction Solutions and HUD Solutions Market

CIC Introduction, Methodologies, and Assumptions

- China Insights Consultancy is commissioned to conduct an analysis and report of the global and China's human-vehicle vision interaction solutions and HUD solutions market. The report commissioned has been prepared by China Insights Consultancy independent of the influence of the Company or any other interested party.
- China Insights Consultancy, originally established in Hong Kong, is a Shanghai-based investment consulting company whose services include industry consulting services, commercial due diligence, strategic consulting, and so on. CIC's consultant team has been tracking the latest market trends in sectors such as finance and service, agriculture, chemicals, consumer goods, marketing and advertising, culture and entertainment, energy and industry, healthcare, TMT, transportation, etc., and has the most relevant and insightful market intelligence in the mentioned industries.
- The information and data collected by CIC have been analyzed, assessed, and validated using CIC's in-house analysis models and techniques. Primary research was conducted via interviews with key industry experts and leading industry participants. Secondary research involved analyzing data from various publicly available data sources.
- The market forecasts in the CIC Report are based on the following key assumptions: (1) the overall social, economic and political environment in China is expected to remain stable during the forecast period; (2) related key industry-driving factors are likely to continue to drive the growth of the global and China's human-vehicle vision interaction solutions and HUD solutions industries, such as technological advancements, supporting policies and increasing downstream demands, during the forecast period and (3) there will be no extreme force majeure or unforeseen industry regulations during the forecast period, which may have a drastic or fundamental impact on the market.
- All statistics are reliable and based on information available as of the date of this report. Other sources of information, such as governments, industry associations, or marketplace participants, may have provided some of the information on which data or its analysis is based. Certain amounts and percentage figures included in this report have been subject to rounding adjustments.
- All the information about the Company is sourced from the Company's own audited report or management interviews. China Insights Consultancy is not responsible for verifying the information obtained from the Company.

Term abbreviations (1/4)

ADAS	advanced driver assistance system. ADAS is designed to assist drivers in the operation and safety of vehicles, by utilizing various sensors, cameras and software algorithms to provide additional functionalities and enhance the driving experience
automotive OEM or OEM	the original equipment manufacturer, which assembles and installs automotive parts during the construction of a new vehicle
AI	artificial intelligence
AR-HUD	augmented reality head-up display, an advanced version of a HUD Solution that uses augmented reality technology to project virtual images onto the windshield
automotive SPICE or ASPICE	automotive software process improvement and capability determination, an international standard framework used in the automotive industry to assess and improve the capabilities of software development and systems engineering processes, aiming to ensure products meet high-quality and safety requirements
binocular parallax	the difference in the position of an image on the retinas of both eyes, particularly in the horizontal direction, providing information about the depth of an object relative to the point of fixation
CAGR	compound annual growth rate
delivery cycle	the time span from the start of development after securing a design win to the final mass production and delivery to the customer
dynamic distortion	non-stationary distortion phenomena in optical systems caused by environmental disturbances, material deformation or dynamic loading during real-time operation, which typically requires adaptive optics, realtime feedback calibration or active thermal/mechanical compensation techniques for mitigation
DLP	digital lighting processing, a set of chipsets based on optical micro-electro-mechanical technology that uses a digital micromirror device. DLP technology is used in a variety of display applications from traditional static displays to interactive displays and also non-traditional embedded applications including medical, security and industrial uses
FoV	field of view, a display range parameter that refers to visible angular range of the virtual image in horizontal and vertical directions
HMI	Human-machine interface
HUD	head-up display,a term commonly used in both theautomotive as well as intelligent cockpit vision andinteraction solution industries, is a display that projectsimportant information onto the windscreen withoutrequiringthe drivers to look away from their usualviewpoint

Term abbreviations (2/4)

IATF16949	the international technical specification of automotive industry quality management system, prepared by the IATF (International Automotive Task Force) and the ISO
intelligent cockpit	a comprehensive application space for various new technologies of intelligent connected vehicles
intelligent vehicle	vehicles equipped with advanced sensors, controllers, actuators and other devices, utilizing new technologies such as AI and possessing autonomous driving functions, which conforms with the industry definition according to CIC
IP	Intellectual property
ISO	the International Organization for Standardization, a worldwide federation of national standards bodies
ISO14001	the Environmental Management System published by the ISO
ISO45001	the Occupational Health and Safety Management System published by the ISO
IT	information technology
LCoS	liquid crystal on silicon, a silicon-based liquid crystal microdisplay technology that modulates reflected light through a liquid crystal layer to generate images that is known for its high resolution, low power consumption and compact size
LDA	look-down angle, a human-machine interaction parameter that refers to vertical angle between the driver's line of sight when looking straight ahead and the line of sight to the center of the virtual image area displayed by the HUD solution
LiDAR	a remote sensing method that uses light to measure the distance or range of objects
local dimming	an LED backlight technology used in LCD display to improve picture quality. It works by dimming the backlight areas of the screen that need to be dark, while keeping the backlight bright parts of the screen bright, thereby increasing the contrast ratio and creating a better image
mass-produced or mass production	A mass-produced solution refers to a solution that has passed development and validation processes, met customer acceptance standards, and is ready for largescale delivery to OEMs for integration into vehicle models available for sale

Term abbreviations (3/4)

MCU	microcontroller unit, a programmable integrated circuit that integrates central processing unit (CPU) along with memory and input/out peripherals
OTA	over-the-air, a technology that updates vehicle software and firmware remotely through network
PCB	printed circuit board
PCBA	printed circuit board assembly, the process of mounting or placing electronic components which give the board its functionality on a PCB
"platformization" or "platformbased R&D"	platformization or platform-based R&D refers to our strategic shift from developing isolated, standalone solutions or technologies towards creating standardized, modular and reusable foundational systems—or platforms—that serve as the backbone for multiple derivative innovations. It emphasizes on scalability, interoperability and efficiency by consolidating our core technological infrastructure and processes into a unified framework that can be rapidly adapted for various automotive HUD solutions
R&D	research and development
real-image suspensory display or RISD	a display solution that utilizes dynamic optical field modulation and multidimensional optical compensation technology to generate naked-eye visible, medium free 3D real images in automotive scenarios, enabling real-time viewing angle adaptation to eliminate blind spots while meeting low-latency interaction and automotive-grade safety standards
SMT	surface mount technology, a method used in the assembly of PCBs where components are directly attached onto the designated position on the surface of the boards
SoC	system-on-chip, programmable integrated circuit(s) that integrates central processing unit (CPU), memory interfaces, on-chip input/output devices, input/output interfaces, and secondary storage interfaces
stray light or glare	any light in an optical system which is not intended in the design and interferes with the performance of an optical system's intended functions
sunlight backflow	an interference phenomenon in optical system where high-intensity ambient sunlight infiltrates internal components via unintended retrograde paths

Term abbreviations (4/4)

TFT	thin-film transistor, a technology that utilizes an array of microtransistors to precisely control the brightness and color of each pixel that is characterized by its high response speed, low power consumption and excellent display quality
ISO45001	the Occupational Health and Safety Management System published by the ISO
Tier-1 supplier	a company that supplies parts or systems directly to automotive OEMs. Other types of suppliers in the automotive industry include Tier-2 and Tier-3 suppliers. Tier-2 suppliers supply to Tier-1 suppliers. Tier-3 suppliers supply to Tier-2 suppliers
V2X	vehicle-to-everything, referring to the communication between a vehicle and any entity that may affect, or may be affected by, the vehicle
VAVE	value analysis and value engineering
VID	virtual image distance, an imaging distance parameter that refers to the distance between the human eye and the virtual image projected by our HUD solutions
W-HUD	windshield head-up display

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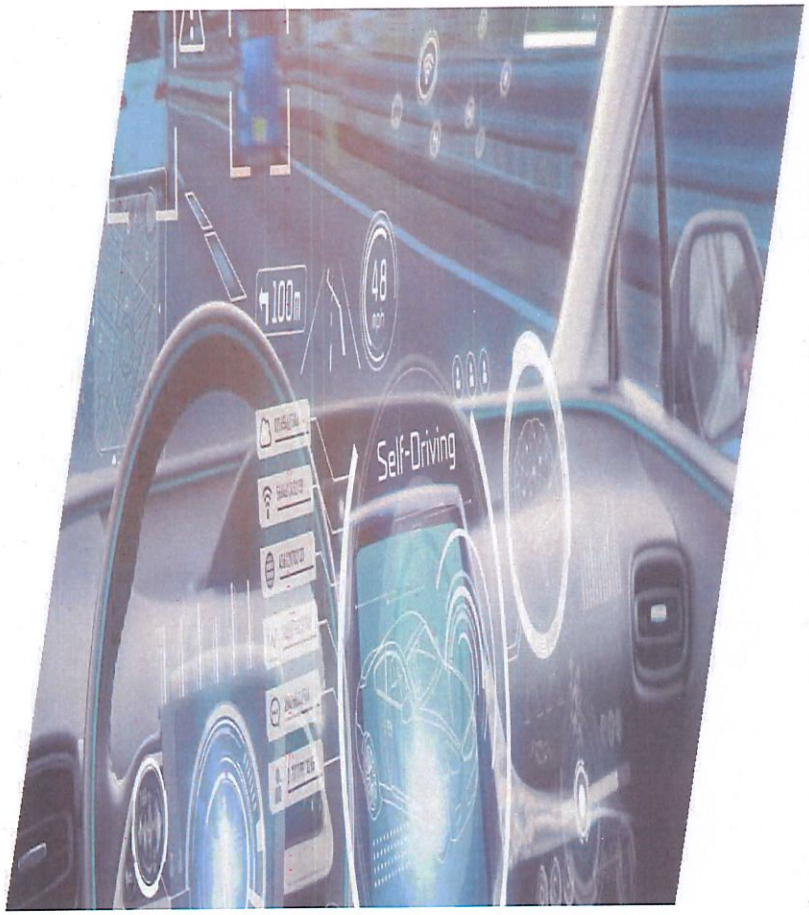


Definition, Classification, and Importance of Intelligent Vehicle

Definition

Intelligent vehicles refer to a new generation of automobiles equipped with advanced sensors and other devices, utilizing cutting-edge technologies, such as artificial intelligence. These vehicles possess autonomous driving capabilities and are progressively evolving into intelligent mobile spaces and application terminals.

Importance

Meeting Consumer Demands

The growing consumer demand for efficient, safe, and convenient intelligent mobility is accelerating the commercialization of autonomous driving.

Enhancing Road Safety

Smart vehicles equipped with autonomous driving assistance systems effectively mitigate traffic safety risks caused by human errors through coordinated environmental perception and control.

Intelligent Mobility Experiences

The growing adoption of multimodal human-machine interfaces - including visual, voice, touch and gesture controls - significantly improves information accessibility and operational convenience, ultimately enhancing the overall driving experience.

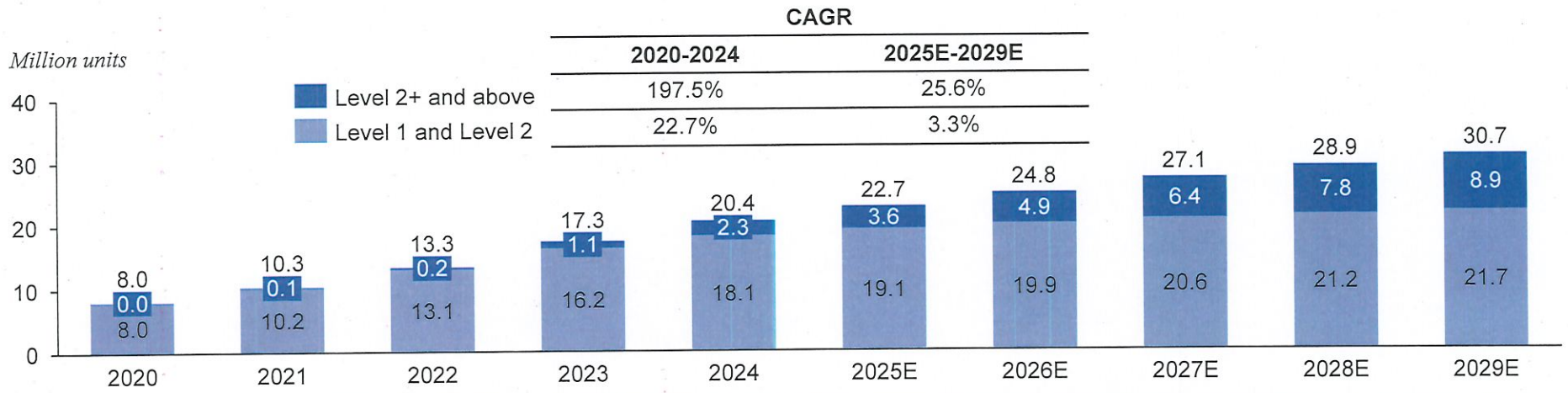
Classification

L1 and L2	Partial/Combined Driving Assistance	**Functional Integration**: Combines parking assistance (PA), lane change assist (LCA), and driver monitoring system (DMS) capabilities, supporting adaptive cruise control (ACC) and lane keeping assist (LKA) functions. **Driver Responsibility**: The system provides driving assistance only. The driver must maintain constant supervision, remain prepared to take immediate control, and assumes full safety responsibility. **Sensor Configuration**: Camera + Ultrasonic Radar + Millimeter-wave Radar (+V2X Communication Module).
L2+ and above	Conditional/Highly Automated Driving	**Full-domain Automated Control**: Traffic Jam Pilot (TJP), Highway Pilot (HWP), City Pilot (CP), Automated Valet Parking (AVP) **Control Transition**: The system assumes full vehicle control in designated scenarios (e.g., highways). The driver must only resume control upon system request. **Full-stack Sensing Hardware**: Cameras | Ultrasonic Radars | Millimeter-wave Radars | LiDAR | Complete V2X System

Source: CIC

Market Size of China's Intelligent Vehicle Industry

Market Size of China's Intelligent Vehicles[1] by Level of Intelligence, Measured by Sales Volume, 2020-2029E



CAGR	
2020-2024	2025E-2029E
197.5%	25.6%
22.7%	3.3%

Key Findings

- Driven by favorable policies in China for intelligent vehicles, ongoing iterations and updates in intelligent vehicle technologies and increasing consumer acceptance of intelligent driving, China's intelligent vehicle industry is thriving and expected to maintain growth.
- Sales of intelligent vehicles increased from 8.0 million units in 2020 to 20.4 million units in 2024.It is expected that the sales of intelligent vehicles in China will reach 30.7 million units by 2029.
- With the gradual advancement of intelligence, Level 2+ vehicle models can realize higher-level driving assistance features such as automatic lane changing, intelligent navigation and seamless switching between urban and highway scenarios, significantly reducing driving burden. Therefore, the CAGR of sales of intelligent vehicles at Level 2+ level and above from 2025 to 2029 is expected to reach 25.6%.

Notes:

1. Refers to vehicles equipped with advanced sensors, controllers, actuators and other devices, utilizing new technologies such as AI and possessing autonomous driving functions. Based on the level of autonomous driving solutions installed, intelligent vehicles can be categorized from Level 1 to Level 5. Solutions enabling Level 1 (Partial Driver Assistance) to Level 5 (Fully Automated Driving) automation are commonly known as autonomous driving solutions, which can execute varying degrees of sustained vehicle motion control in dynamic driving tasks.

2. Any discrepancies between the total shown in the table above and the sum of the listed amounts are due to rounding. The figures indicated for the total may not be the exact arithmetic sum of the preceding figures, the same below.

Source: CIC& CPCA

Main Drivers of China's Intelligent Vehicle Industry

1	**Consumer demand driving the iteration of intelligent and interactive functions in cockpit products**	Consumers' acceptance of intelligent driving features is continuously increasing, promoting the comprehensive intelligence and enhanced interactive functions of intelligent cockpits. The consumer base of intelligent vehicles is becoming younger, with changing preferences. Intelligent experience is gradually replacing traditional power parameters as key consideration factors in purchase decisions. Cockpit intelligence, performance and handling have become one of the main factors attracting consumers to buy vehicle products.
2	**Higher driving safety standards promoting the implementation of autonomous driving technology**	China is continuously improving the legal and regulatory framework and safety standards related to intelligent vehicles. While the compliant application of autonomous driving technology is promoted, the requirements for active safety feature configurations have become more stringent. The revised version of Technical Requirements for Automobile Active Safety Systems and other regulations have driven advanced driver assistance systems to become standard equipment in passenger vehicles, in order to reduce traffic accidents caused by human error. These regulatory requirements are accelerating the pre-installation deployment of autonomous driving systems for intelligent vehicles at L2+ level and above, and are driving technological upgrades in related perception and decision-making hardware and automotive vision interaction systems. For example, AR-HUD Solution is one of the most effective HMI forms in intelligent cockpits and driver assistance systems, helping drivers quickly capture critical information and significantly enhancing driving safety.
3	**Technological progress promoting the popularization of autonomous driving functions**	In recent years, China's intelligent vehicle industry has achieved breakthroughs in key technological fields such as AI algorithms, computing chips and V2X collaboration. Perception and decision-making technologies driven by large models have been continuously optimized, significantly enhancing the adaptability of autonomous driving systems in complex road environments. In addition, the promotion of V2X technology has greatly reduced data transmission delay, improving vehicle perception capabilities and overall intelligence levels. As the industrial ecosystem becomes more complete, technological progress is driving the popularization of autonomous driving from high-end models to middle- and low-end markets.
4	**Continuous investment and favorable policies promoting market growth:**	The PRC government has long regarded intelligent vehicles as a strategic emerging industry and supported the industry development through policies like special subsidies, tax incentives and infrastructure development. The implementation of policies such as the Innovative Development Strategy in Intelligent Vehicles and the Development Plan for the New Energy Vehicle Industry (2021-2035) has created a stable growth environment for the intelligent vehicle industry. Meanwhile, domestic capital markets are increasing their investments in intelligent vehicles and industrial ecosystem companies are accelerating research and development deployments, thereby promoting continuous enhancement of China's competitiveness in the intelligent vehicle sector.

Source: CIC

Threats and Challenges of China's Intelligent Vehicle Industry

Threats and Challenges of China's Intelligent Vehicle Industry

Uncertainty in Technology Roadmaps

- Key technology pathways such as autonomous driving, intelligent cockpit systems, and V2X communication remain in a stage of rapid evolution. Divergent integration strategies among OEMs may result in resource misalignment across the value chain, leading to prolonged R&D cycles or risks of technological obsolescence.

Cost Pressure and Profitability Challenges

- The rapid penetration of intelligent features into mid- and low-end vehicle segments has intensified price competition across the industry. OEMs have increasingly exerted downward pricing pressure on upstream suppliers, resulting in narrowing profit margins for core intelligent vehicle components and posing persistent profitability and cash flow challenges for suppliers.

Regulatory and Data Compliance Risks

- Intelligent vehicles rely heavily on data collection, algorithmic decision-making, and remote connectivity. Their development is constrained by varying regulatory requirements across jurisdictions regarding data security, autonomous driving legality, and OTA updates. Regulatory tightening or shifts could adversely affect vehicle delivery timelines and the rollout of intelligent features.

Source: CIC

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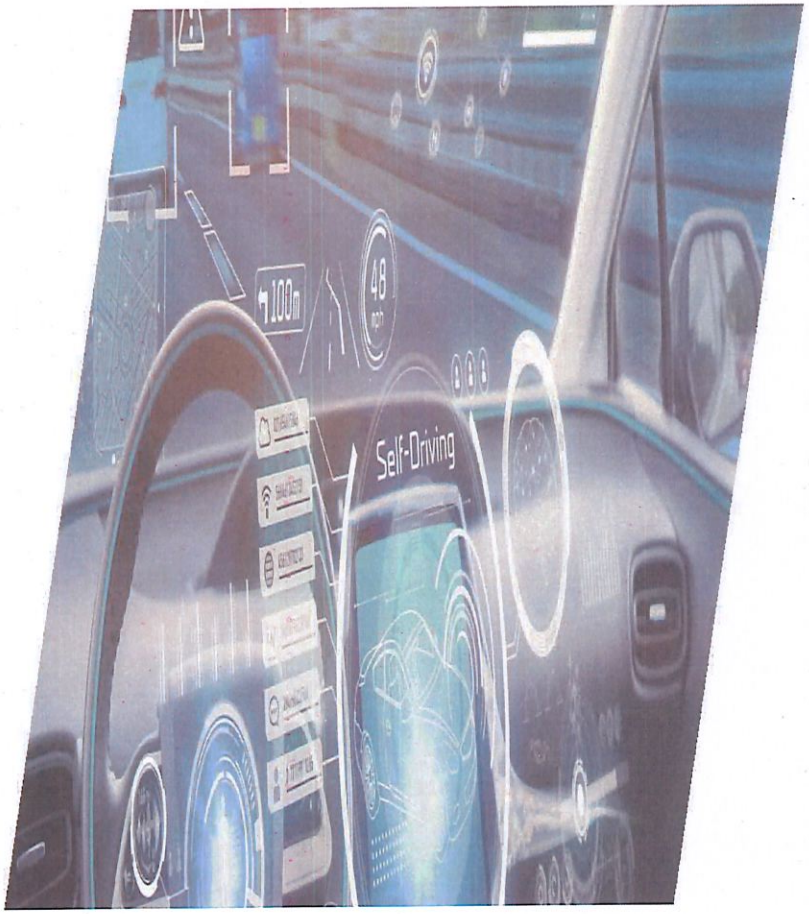


Definition and Classification of Automotive HUD Solution

Definition

- Automotive HUD Solution, which means automotive Head-up Display system, refers to a display device that uses optical projection technology to project key driving information (such as vehicle speed, navigation and ADAS warning) onto the driver's forward field of vision. By reducing the need for drivers to glance down at the dashboard, it improves driving safety and convenience. Moreover, automotive HUD solutions are powertrain-agnostic and can be applied to both ICE and EV. Nonetheless, the penetration rate of HUD in EV tends to be higher due to their stronger emphasis on digital interfaces and intelligent cockpit configurations. As an important interactive terminal that integrates intelligent cockpit and intelligent driving technologies, Automotive HUD Solution systems are gradually becoming one of the core configurations in intelligent vehicles.

Based on imaging methods, Automotive HUD Solutions are generally classified into three types: **C-HUD Solution, W-HUD Solution and AR-HUD Solution**. W-HUD Solution, the mainstream product, projects images onto the windshield through an optical projection unit, allowing drivers to see critical driving information within their forward field of view. AR-HUD Solution, the latest generation of HUD Solution products built upon W-HUD Solution, incorporates optical projection imaging technologies such as TFT, DLP and LCoS to support longer projection distances and wider fields of view. Moreover, AR-HUD Solution integrates vehicle environment perception data (such as data from cameras and radar) and uses software algorithms to achieve augmented reality displays of virtual-real fusion, which provides consumers with an enhanced experience. C-HUD Solution has been gradually phased out due to its technical limitations and inadequate intelligent capabilities.

Classification of Automotive HUD Solution

Illustration	Classification	Imaging Method	Display Content	Display Size	Cost	Description
	C-HUD Solution	Semi-transparent resin panel imaging	Integrated Digital Cockpit	6.6-12.3 inch	Low	Being gradually phased out
	W-HUD Solution	Windshield Projection Display	Integrated Digital Cockpit	5-28 inch	Medium	Accelerating market penetration
	AR-HUD Solution	Windshield Projection Display	Integrated Digital Cockpit with AR Fusion	29 inch and above	High	Promising applications powered by advanced algorithms, optical waveguides, and holographic technology

Source: CIC

Analysis of Challenges in Automotive HUD Solution Industry

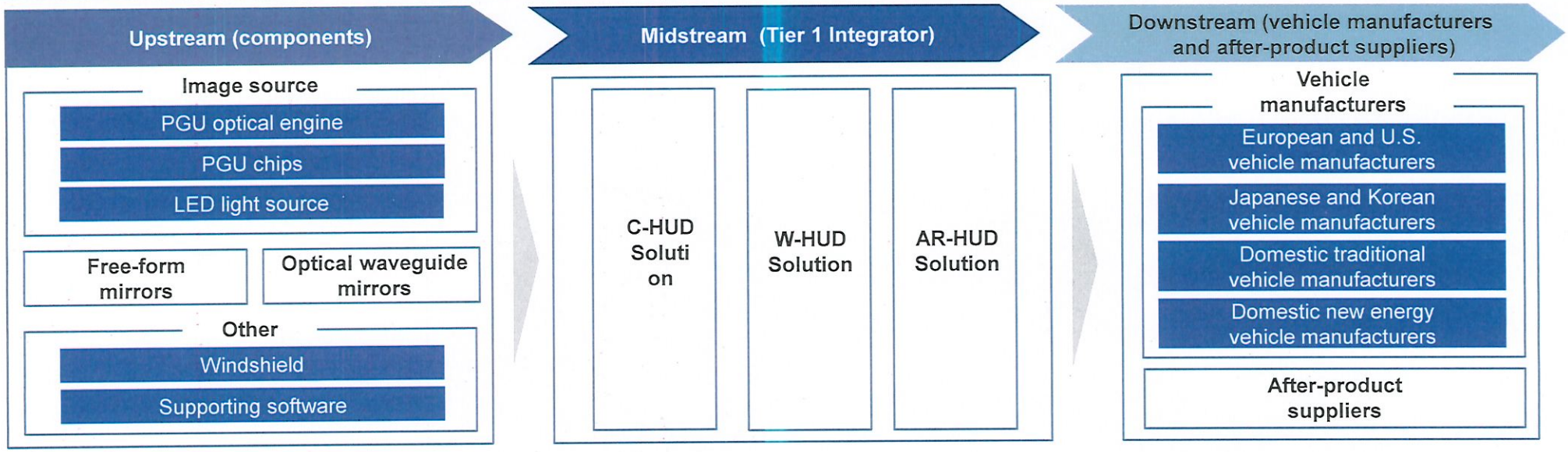
Analysis of Challenges in Automotive HUD Solution Industry

Challenges in imaging quality and environmental adaptability	The optical design of Automotive HUD solutions must ensure high brightness, low distortion, high contrast and effective thermal management. However, the existing solutions still face issues such as limited field of view and inadequate distortion control. In practical applications, key challenges include achieving high imaging accuracy, adapting to ambient light and controlling the thermal radiation of the optical system.
Space constraints and reliability to be improved	Automotive HUD solutions must integrate high-brightness display modules and optical systems within limited space, but the compactness and stability of HUD Solution components still need to be optimized. In addition, the HUD Solution optical-mechanical system must achieve a standardized design of low noise and a high sharing rate. However, the industry is currently challenged by issues such as low parts reuse rate, the susceptibility of transmission systems to wear and tear, and insufficient structural strength optimization, which affect product durability and cost control.
Multimodal fusion and computing efficiency needing urgent improvement	As HUD Solution integrates with ADAS, V2X, intelligent cockpit and domain control architectures, Automotive HUD solutions must achieve precise AR navigation, dynamic route guidance and environmental data fusion. At present, however, the industry lacks sufficient algorithm optimization capabilities, leaving significant room for improvement in the projection stability of AR-HUD Solution and real-time rendering of ADAS information. Meanwhile, with the advancement of cockpit driving synergistic integration, software architectures need to adapt to different MCU/SoC platforms and support efficient collaborative computing. However, some solutions still suffer from problems such as low code reuse rates and limited real-time computing capabilities, which hinders cross-model compatibility and upgradeability.
Bottlenecks in hardware compatibility and power consumption optimization	the hardware design of Automotive HUD solutions must be compatible with different automotive-grade controllers, optical engine PGUs and sensors. However, the industry currently faces bottlenecks in hardware module compatibility, PCB layout optimization and standardized component selection. Moreover, further optimization is needed for the heat dissipation and power consumption management of high-brightness display systems of Automotive HUD Solutions, in order to meet the low power consumption requirements of intelligent vehicles.
Lack of standardized and automated testing capabilities in the industry	Automotive HUD solutions need to maintain stable display effects under various environmental conditions (temperature, humidity, vibration, direct sunlight). However, the industry lacks a standardized verification and validation framework, and the coverage of automated stress testing, optical testing and Hardware-in-the-Loop (HIL) testing is insufficient, which undermines product reliability. Furthermore, due to the insufficient comparative validation of functional testing and real vehicle data, the adaptability of Automotive HUD solutions across different vehicle models still needs to be optimized.

Source: CIC

Industrial Ecosystem Analysis of Automotive HUD Solutions

The upstream of the Automotive HUD solution industry primarily consists of suppliers of optical components, raw materials and supporting software. The midstream of the Automotive HUD Solution ecosystem primarily consists of Automotive HUD solution providers. And the downstream of the Automotive HUD Solution ecosystem primarily consists of vehicle manufacturers and after-product suppliers.



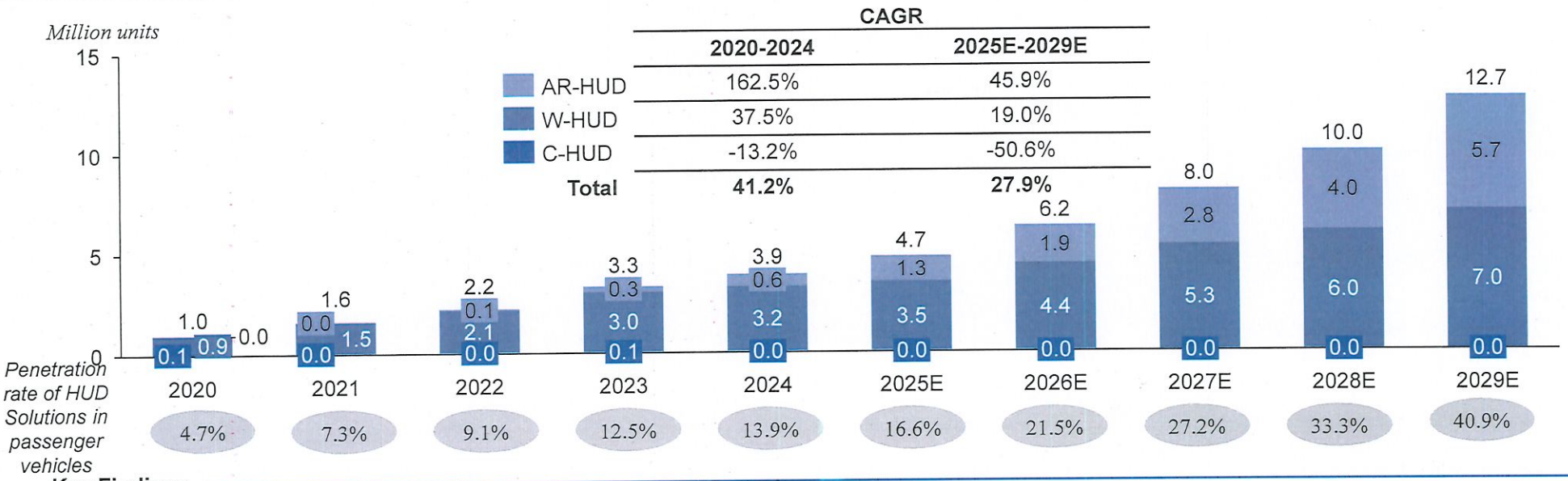
The relationship between the midstream suppliers and the downstream vehicle manufacturers in the Automotive HUD solution industry has shifted from the traditional one-way supply-demand model to a highly collaborative co-creation relationship.

Midstream manufacturers not only take on the responsibility of product delivery, but also actively engage in the early-stage definition, system design and function planning of visual and interactive solutions for vehicle projects. Through multi-dimensional joint development, a collaborative innovation mechanism focused on vehicle performance goals is established. This mechanism significantly enhances the product compatibility and mass-production efficiency, thereby becoming a crucial driving force in advancing the implementation of intelligent vehicle cockpits.

Source: CIC

Market Size of China's Automotive HUD Solution Industry, Measured by Sales Volume

Market Size and Penetration Rate[1] of Automotive HUD Solutions in China by Product Type, Measured by Sales Volume, 2020-2029E



	CAGR	
	2020-2024	2025E-2029E
AR-HUD	162.5%	45.9%
W-HUD	37.5%	19.0%
C-HUD	-13.2%	-50.6%
Total	**41.2%**	**27.9%**

Key Findings

- Driven by the rapid development and implementation of intelligent vehicles and the consumer demand for safer and more convenient driving experience, the installation rate of Automotive HUD Solutions in China continues to rise, with the market expanding rapidly.
- In terms of sales volume, the market size of China's Automotive HUD Solutions increased from 1.0 million units in 2020 to 3.9 million units in 2024, with a CAGR of 41.2% during the period. With the trends of full cockpit intelligence and the increasing installation rate of Automotive HUD Solutions, it is estimated that by 2029, the number of Automotive HUD Solutions in China will increase to 12.7 million units.
- W-HUD Solution will gradually penetrate mid- and low-end vehicle models and become a standard feature for intelligent vehicles, exhibit a CAGR of 19.0% from 2025 to 2029.
- AR-HUD Solution will gradually exhibit increasing penetration in new energy vehicles and premium vehicle segments, exhibiting a CAGR of 45.9% from 2025 to 2029.

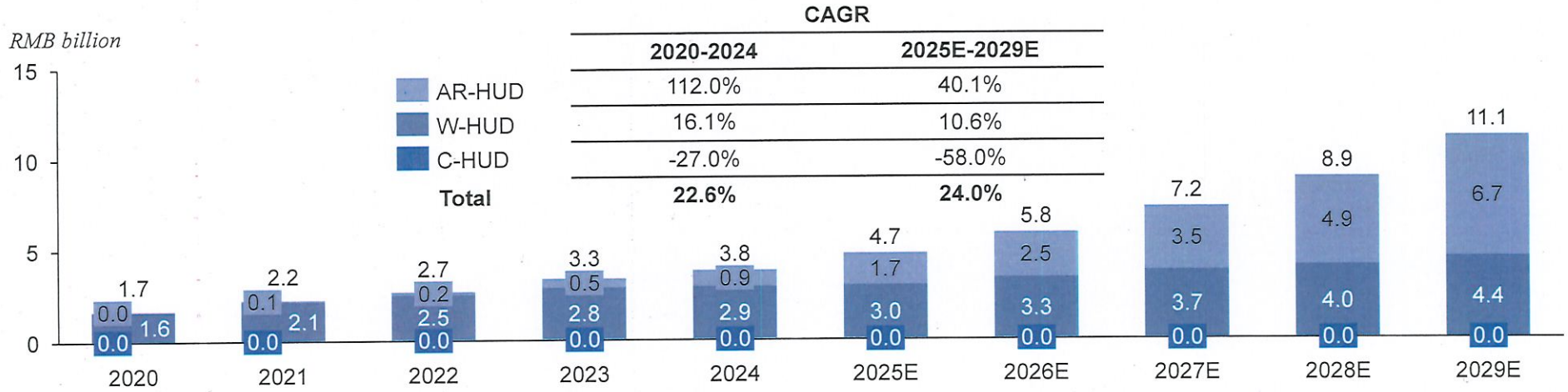
Notes:

1. The penetration rate refers to the proportion of HUD Solution installed in passenger vehicles in China.

Source: Gasgoo, CIC

Market Size of China's Automotive HUD Solution Industry, Measured by Revenue

Market Size of Automotive HUD Solutions in China by Solutions Type, Measured by Revenue, 2020-2029E



	CAGR	
	2020-2024	2025E-2029E
AR-HUD	112.0%	40.1%
W-HUD	16.1%	10.6%
C-HUD	-27.0%	-58.0%
Total	**22.6%**	**24.0%**

Key Findings

- In terms of revenue, the market size of Automotive HUD Solutions in China increased from RMB1.7 billion in 2020 to RMB3.8 billion in 2024, with a CAGR of 22.6% during the period.
- In terms of revenue, it is estimated that the market size will reach RMB11.1 billion by 2029, with a CAGR of 24.0% from 2025 to 2029.
- Currently, W-HUD Solution is the most mainstream product solution for Automotive HUD Solutions. However, in the future, with the full intelligentization of cockpit vision and interaction, the market share of AR-HUD Solution will continue to rise and exceed that of W-HUD Solution.
- In terms of revenue, the market sizes of W-HUD Solutions and AR-HUD Solutions in China reached RMB2.9 billion and RMB0.9 billion respectively in 2024, accounting for 76.4% and 23.3% of the overall Automotive HUD Solution market. It is expected that by 2029, the market share of AR-HUD Solutions in China will increase to 60.0%, exceeding W-HUD Solution's 40.0%.

Source: Gasgoo, CIC

Main Drivers of China's Intelligent Vehicle Industry (1/2)

1 **Accelerated penetration of EVs**

- In recent years, China's EVs market has experienced rapid expansion, supported by favorable policies and growing consumer acceptance. In2024, EVs accounted for 44.4%of total passenger vehicle sales in China, while ICEs comprised the remaining 55.6%. It is expected that by 2029, EVs are projected to reach 82.0% of China's passenger vehicle market, with a CAGR of 17.5%during the period. Given the higher propensity for intelligent cockpit features in EVs, their penetration directly stimulates demand for HUD solutions. As OEMs accelerate the adoption of intelligent cockpits, Automotive HUD solutions are increasingly integrated into EV models and experiencing robust growth.

2 **Increasing consumer demand for intelligent vehicle configurations and experience**

- As a core component of cockpit vision and interaction, HUD Solution can reduce driver eye movement and provide key information such as vehicle speed, navigation and ADAS warnings, which effectively meets consumer demand for a more intelligent, safe and convenient driving experience. With the growing consumer demand for immersive and digital interactive driving experience, HUD Solutions are increasingly becoming standard features in the flagship models of mid- and high-end intelligent driving brands.

3 **Rapid development of Automotive HUD Solutions driven by the intelligent vehicle ecosystem**

- As intelligent driving technologies continue to advance towards L2+ and above levels, the requirements for cockpit intelligence and cockpit-driving synergistic integration for the vehicle's overall HMI synergy are gradually increasing. HUD Solution, as a key information output interface in the intelligent driving system, is becoming increasingly important. The accelerated adoption of connected vehicles, high-definition maps and L2+ or higher-level intelligent vehicles has significantly elevated the importance of HUD Solutions as a vital information output interface within intelligent driving systems. In particular, by integrating environmental perception data from LiDAR, millimeter-wave radar, V2X and other sources, AR-HUD Solution can offer augmented reality display functions such as real-scene navigation, lane-level guidance and risk alerts. This significantly enhances driving safety and the efficiency of environmental perception. As vehicles advance towards intelligent driving, drivers are less involved in control actions. Meanwhile, the visual need for drivers and passengers to access vehicle status, environmental information and cockpit interaction experience have grown significantly stronger and more diverse. In this context, Automotive HUD Solution is set to become the primary display screen for intelligent driving.

Source: CIC

Main Drivers of China's Intelligent Vehicle Industry (1/2)

4 Continuous advancements in key technology routes such as TFT, DLP and LCoS

- TFT, DLP and LCoS are currently the leading projection technology solutions in the field of automotive AR-HUD Solution. In recent years, TFT technology has been evolving continuously, with large-sized TFT systems undergoing multiple rounds of upgrades in areas such as brightness enhancement, display uniformity, and cost control, making it able to meet the requirements of high-performance HUD Solution applications. DLP, reflecting light through a micromirror array, features high brightness and strong resistance to ambient light. LCoS, on the other hand, regulates light intensity through a reflective liquid-crystal chip, with the advantages of high resolution, low power consumption and a compact structure. In recent years, these three technologies have been steadily optimized for brightness output, projection distance, imaging clarity and optical engine volume control. Such advancements drive the HUD Solution system to perform better and adapt more effectively to vehicles. With the maturity of technology solutions and the promotion of large-scale applications, the installation rate of AR-HUD Solution is rising steadily. For future high-performance AR-HUD Solution market, large-size TFT, DLP and LCoS technologies are expected to become the core technological approaches.

5 Strong support from industry policies, laws and regulations

- At the national strategic level, China has been steadily promoting the integration and standardization of HUD Solution. The "Outline of the 14th Five-Year Plan and the Long-Range Objectives Through the Year 2035" clearly states the need to develop and expand strategic emerging industries and accelerate breakthroughs in key areas such as automotive electronics and intelligent connected vehicles. The "Guidelines for Building the Cybersecurity and Data Security Standard System of the Internet of Vehicles" proposes to standardize the data collection and interaction standards of automotive network terminals such as HUD Solution during their use. These policies not only provide institutional guarantees for the integrated application of HUD Solution in intelligent cockpits and autonomous driving systems but also strengthen its compliance and important position in intelligent connected vehicles, promoting the acceleration of the integration of relevant products into the overall vehicle intelligent development system.

Source: CIC

Analysis of the Development Trends in China's Automotive HUD Solution Industry

The Development Trends in China's Automotive HUD Solution Industry

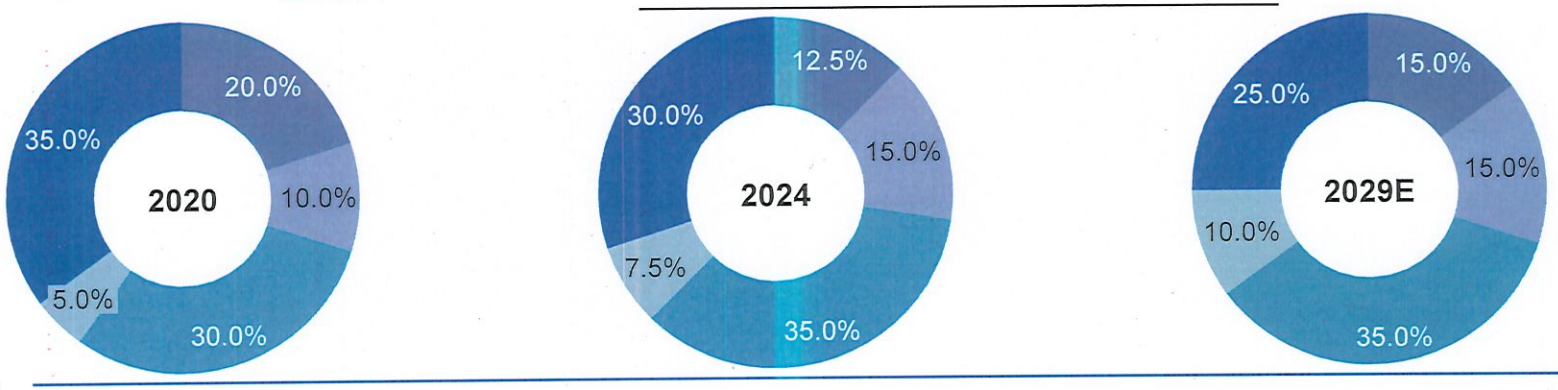
Development Trend	Key Analysis
Increased installation rates in mid and low-end vehicles	• As the visual interaction scenarios in vehicle cockpits become increasingly intelligent, HUD Solution, as the first screen for intelligent driving, are becoming standard in high-end vehicles while accelerating their penetration into mid-to-low-end vehicle markets. From 2020 to 2024, the penetration rate of HUD Solution in Chinese passenger vehicles increased from 4.7% to 13.9%. The growth was mainly driven by the accelerated penetration of HUD Solution in vehicles priced below RMB200,000 and the increased proportion of AR-HUD Solution as a standard feature in high-end vehicles. High-end intelligent vehicle brands have already made HUD Solution a standard feature in some of their flagship models to enhance driving safety and the technological feel of the cockpit.
Accelerating industry trend toward compact size and larger display	• As HUD Solution becomes increasingly integrated into intelligent cockpits, the industry is accelerating its evolution towards smaller overall sizes and wider display ranges. New-generation HUD Solution products achieve longer projection distances, larger fields of view and higher imaging quality through the optimization of optical paths, the flat design of optical engine systems and efficient image-processing algorithms, while maintaining the compactness of the system and its compatibility with the whole vehicle. The small-size design improves the compatibility with vehicle platforms, and the large-format display significantly enhances the information presentation ability and interaction experience, facilitating the large-scale application of HUD Solution in more vehicle models.
Innovative collaboration and localization of core components	• In the realm of innovation, leading automakers are collaborating closely with domestic HUD Solution suppliers. Together, they are developing HUD solutions and speeding up the launch of new products. This showcases the collaborative implementation capabilities between automakers and suppliers. Meanwhile, as China's Automotive HUD Solution industrial ecosystem matures, domestic enterprises have strengthened their capabilities for independent R&D and local supply of core components. HUD Solution optical components, which previously relied heavily on imports, are now locally produced. At the same time, the substitution of core components with domestic alternatives has accelerated, leading to a simultaneous drop in costs and prices. This has spurred the application of the new generation of cockpit vision and interactive products in vehicles. With the well-established supply of ecological resources and large-scale application, the cost-reduction cycle of new technology products has been notably shortened. As a result, the popularization of HUD Solution from high-end to mid-end vehicle models has been expedited.
Diversification of technical routes	• As the HUD Solution industrial ecosystem continues to mature, mainstream projection technologies such as TFT, DLP and LCoS have been widely applied in mass-produced vehicle models, promoting a development pattern where multiple technical paths co-exist for HUD Solution products. During product development, manufacturers leverage different technologies as optional tools, flexibly matching them to the positioning requirements of vehicle platforms. Automakers are more concerned with achieving a balance between the required functions and performance within a controllable cost range. The core evaluation indicators include imaging quality, field of view, brightness, power consumption and system integration efficiency. Application-oriented demand drives the need for platform-based, modular HUD solutions with greater market adaptability, accelerating adoption across various levels of vehicle models.
The trend of HUD Solution replacing traditional dashboards	• Against the backdrop of the intelligent development of vehicles and the upgrade of HMI, HUD Solutions are rapidly replacing traditional dashboards to become the primary information interface within the driver's visual field. Unlike traditional dashboards that require drivers to look down, HUD Solutions project critical data like speed, navigation routes and ADAS alerts directly into the forward field of view, presenting information intuitively to significantly enhance driving focus and road safety. At the same time, HUD Solution has stronger visual expressiveness and information integration capabilities, and can present more abundant real-time content, meeting the requirement of intelligent cockpits for the simultaneous presentation of multi-dimensional information. As HUD Solution display technology matures and its cost structure is optimized, the substitution of traditional dashboards by HUD Solution will accelerate.

Source: CIC

Cost Structure of China's Automotive HUD Solutions

Cost Structure of China's Automotive HUD Solutions, 2020, 2024, 2029E

	Average Percentage		
	2020	2024	2029E
PGU	35.0%	30.0%	25.0%
Optical Components	20.0%	12.5%	15.0%
Mechanical Components	10.0%	15.0%	15.0%
Electronic Components	30.0%	35.0%	35.0%
Others	5%	7.5%	10.0%



Key Findings

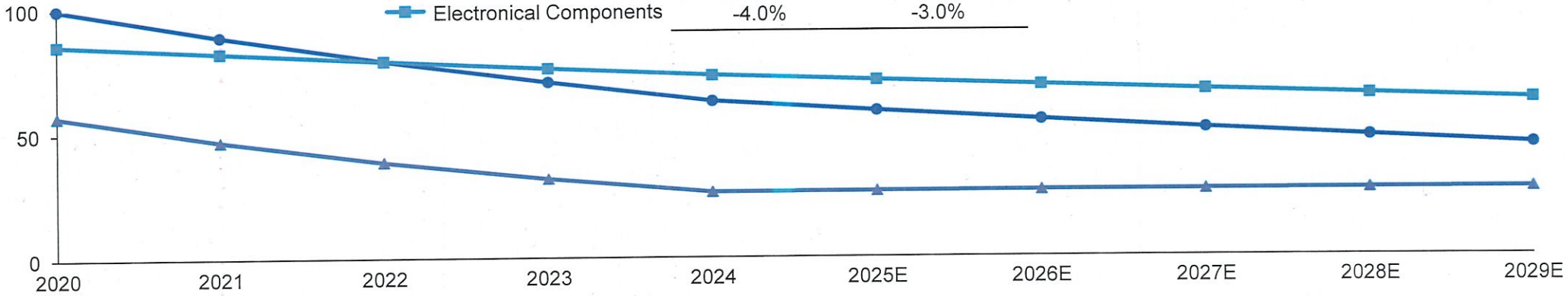
- The major cost of Automotive HUD Solutions is PGU and electronic components, accounting for 55% to 65% of total cost. In the future, as PGUs are increasingly localized, their proportion of total cost is expected to decline. Meanwhile, with the continuous miniaturization of HUD systems and their enhanced integration with other intelligent cockpit components, the cost contribution from electronic parts (including electronic components, mechanical components and optical components) and other elements (including software) is expected to rise progressively.

Source: CIC

Price Index of the Major Cost of China's Automotive HUD Solutions

Price Index of the Major Cost of China's Automotive HUD Solutions, 2020-2029E(1)

	CAGR	
	2020-2024	2025E-2029E
PGU	-11.1%	-6.5%
Optical Components	-17.9%	0.6%
Electronical Components	-4.0%	-3.0%



Key Findings

- From 2020 to 2024, maturing manufacturing processes and domestic substitution drove down costs for PGUs, optical and electronic components. Mechanical components and software saw modest cost increases due to larger FOV, longer VID and higher system intelligence.Between 2024 and 2029, PGUs still have limited room for further cost reductions supported by supply chain localization. Optical components may edge up in price as complexity and precision requirements rise. Mechanical and electronic components are expected to benefit from centralized electrical/electronic architectures and scale effects, while software and other elements will likely see slight price increases with continued intelligence upgrades.

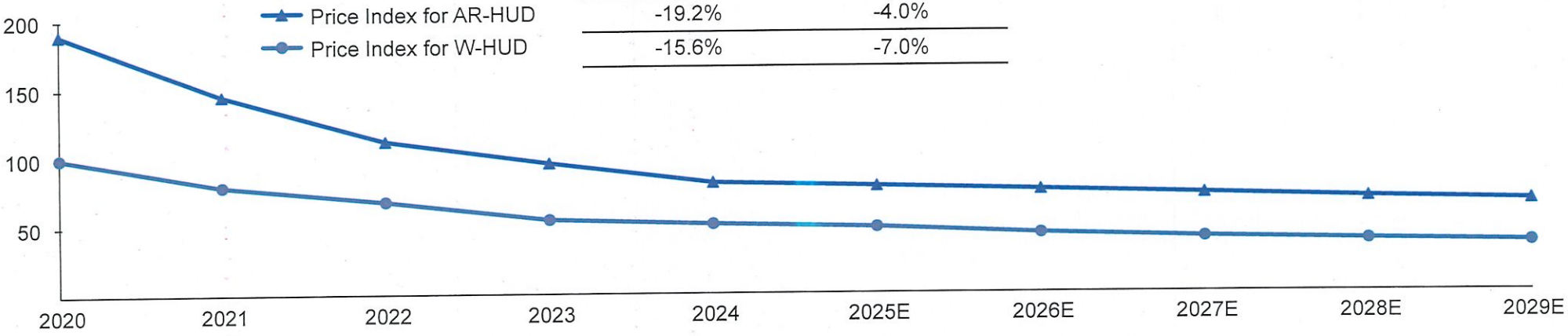
Note:
(1) The price index of the Cost Structure of China's Automotive HUD Solutions is based on the average price of PGU in 2020, which is set as 100.

Source: CIC

Price Index of China's Automotive HUD Solution Industry

Price Index of China's Automotive HUD Solution Industry, 2020-2029E(1)

	CAGR	
	2020-2024	2025E-2029E
Price Index for AR-HUD	-19.2%	-4.0%
Price Index for W-HUD	-15.6%	-7.0%



Key Findings

- The HUD industry's average selling price was constantly declining, primarily driven by break throughs in the localization of core components such as the PGU and freeform mirrors, significantly reducing the overall BOM cost.

Note:
(1) The price index of China's Automotive HUD Solution Industry is based on the average price of W-HUD in 2020, which is set as 100.

Source: CIC

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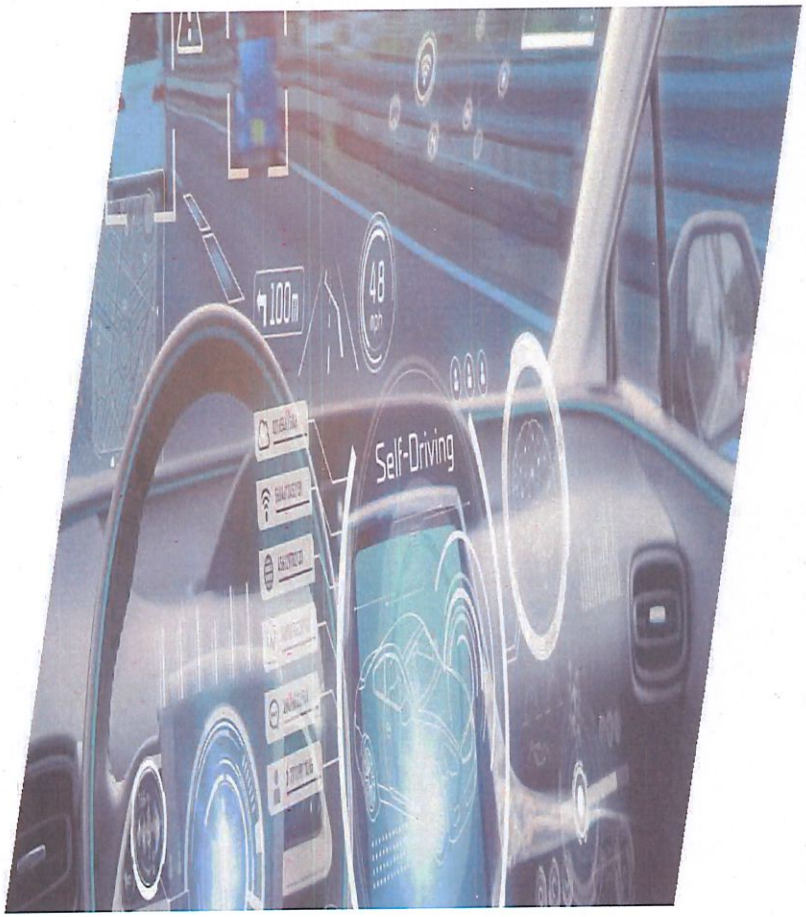

Ranking of the Top Five Automotive HUD Solution Suppliers in China by Sales Volume, 2024

Ranking of the Top Five Automotive HUD Solution Suppliers in China by Sales Volume, 2024

Ranking	Company Name	Home Country	Automotive HUD Solution Sales Volume（Million Units）	Market Share (%)
1	Company A	China	0.9	23.3%
2	**Our Company**	**China**	**0.6**	**16.2%**
3	Company B	Japan	0.4	9.8%
4	Company C	China	0.4	9.3%
5	Company D	China	0.3	7.9%
	Total of the top five companies		**2.6**	**66.5%**
	Total of other companies		**1.3**	**33.5%**
	Market total		**3.9**	**100.0%**

Key findings

- The players in China's Automotive HUD Solution market primarily include international manufacturers from Japan and Europe and domestic companies.
- In recent years, domestic firms have increasingly displaced traditional leading international manufacturers through technological innovation, rapid response capabilities and customized services, thereby significantly enhancing their market dominance. By 2024, the market share of domestic manufacturers had grown from approximately 16.7% in 2020 to 79.2%, with further growth anticipated by 2029.
- In 2024, based on sales volume, the top five Automotive HUD suppliers in China collectively accounted for 66.5% of the market. the Company ranked second among all Automotive HUD Solution suppliers in China, capturing approximately 16.2% of the market.

Notes：

1. *Company A, established in China in 1993, was listed on the Shenzhen Stock Exchange in 2017 and is now a leading Chinese system supplier of automotive electronic products and components.*
2. *Company B, founded in Japan in 1949, was listed on the Nagoya Stock Exchange in 1951 and subsequently on the Tokyo and Osaka Stock Exchanges in 1953. It is a globally leading supplier of automotive components.*
3. *Company C, established in China in 2016, is a privately held company specializing in the research, development and application of augmented reality display technologies for the automotive industry.*
4. *Company D, founded in China in 1983, was listed on the Taiwan Stock Exchange in 2002. It is a globally recognized manufacturer and supplier of automotive electronics, primarily focusing on head-up displays, driver safety and protection systems, multimedia rear-seat entertainment systems, charging solutions and other automotive accessories.*

Source：Annual Reports, CIC

Ranking of the Top Five Automotive HUD Solution Suppliers in China by Revenue, 2024

Ranking of the Top Five Automotive HUD Solution Suppliers in China by Revenue, 2024

Ranking	Company Name	Home Country	Automotive HUD Solution Revenue (RMB Billion)	Market Share (%)
1	Company A	China	0.7	18.5%
2	**Our Company**	**China**	**0.5**	**14.3%**
3	Company B	Japan	0.5	12.0%
4	Company D	China	0.4	10.3%
5	Company F	China	0.4	9.3%
	Total of the top five companies		**2.4**	**64.4%**
	Total of other companies		**1.4**	**35.6%**
	Market total		**3.8**	**100.0%**

Key Findings

- In 2024, based on revenue, the top five automotive HUD solution suppliers in China collectively accounted for 64.4% of the market. The company ranked second among all automotive HUD solution suppliers in China in terms of revenue, capturing approximately 14.3% of the market.

Note:

1. *Company F was founded in China in 1987. It is privately held and is a leading global provider of ICT (Information and Communications Technology) infrastructure and intelligent terminal products..*

Source: Annual Reports, CIC

Ranking of the Top Five Automotive W-HUD Solution Suppliers in China by Sales Volume, 2024

Ranking of the Top Five Automotive W-HUD Solution Suppliers in China by Sales Volume, 2024

Ranking	Company Name	Home Country	Automotive W-HUD Solution Sales Volume (Million Units)	Market Share (%)
1	Company A	China	0.7	22.4%
2	**Our Company**	**China**	**0.6**	**17.8%**
3	Company B	Japan	0.4	11.8%
4	Company C	China	0.3	11.1%
5	Company E	Japan	0.2	6.9%
	Total of the top five companies		**2.2**	**70.0%**
	Total of other companies		**1.0**	**30.0%**
	Market total		**3.2**	**100.0%**

Key findings

- the Company's W-HUD products hold a leading position in the market. In 2024, the Company's W-HUD Solution sales volume ranked second in China with an approximate market share of 17.8%

Note:

1. *Company E, founded in Japan in 1946 and listed on the Tokyo Stock Exchange in 1989, is a leading global supplier of automotive instruments, automotive components and resin materials.*

Source: Annual Reports, CIC

Ranking of the Top Five Automotive W-HUD Solution Suppliers in China by Revenue, 2024

Ranking of the Top Five Automotive W-HUD Solution Suppliers in China by Revenue, 2024

Ranking	Company Name	Home Country	Automotive W-HUD Solution Revenue (RMB Billion)	Market Share (%)
1	Company A	China	0.5	17.4%
2	**Our Company**	**China**	**0.5**	**16.5%**
3	Company B	Japan	0.5	15.7%
4	Company C	China	0.3	9.7%
5	Company E	Japan	0.3	9.2%
	Total of the top five companies		**2.0**	**68.5%**
	Total of other companies		**0.9**	**31.5%**
	Market total		**2.9**	**100.0%**

Key findings

- the Company's W-HUD products hold a leading position in the market. In 2024, the Company's W-HUD Solution revenue ranked second in China with an approximate market share of 16.5%

Source: Annual Reports, CIC

Ranking of the Top Five High-performance Automotive AR-HUD Solution Suppliers in China by Sales Volume, 2024

Ranking of the Top Five High-Performance Automotive AR-HUD Solution Suppliers in China by Sales Volume, 2024[1]

Ranking	Company Name	Home Country	Sales Volume of High-performance Automotive AR-HUD Solutions (1,000 Units)	Market Share (%)
1	Company F	China	156.4	39.9%
2	Company G	China	66.8	17.1%
3	**Our Company**	**China**	**53.7**	**13.7%**
4	Company H	South Korea	50.1	12.8%
5	Company I	China	48.6	12.5%
	Total of the top five companies		**375.6**	**96.0%**
	Total of other companies		**15.4**	**4.0%**
	Market total		**391.0**	**100.0%**

Key findings

- Based on sales volume in the Chinese market in 2024, the Company ranked third among all high-performance automotive AR-HUD Solution manufacturers, with a market share of approximately 13.7%.

Notes:

1. *The standards defining high-performance AR-HUD Solutions are as follows: The hardware must have a horizontal field of view (HFoV) of at least 10°, a vertical field of view (VFoV) of at least 3.5° and a visual image distance (VID) of at least 7.5 meters. Additionally, it should possess software capabilities for AR-based virtual-real fusion.*
2. *Company G, established in China in 2003, was listed on the Shanghai Stock Exchange in 2022. It focuses on providing electronic products, research and development services and advanced intelligent driving solutions for the automotive and unmanned transportation sectors.*
3. *Company H was founded in South Korea in 1958 and was listed on the Korea Stock Exchange in 1970. It is a leading global manufacturer specializing in consumer electronics, mobile communication products and home appliances.*
4. *Company I, established in China in 2002, was listed on the Shenzhen Stock Exchange in 2008. It is a one-stop optical component manufacturer, offering a complete range from core components to modules and solutions*

Source: Annual Reports, CIC

Ranking of the Top Five High-performance Automotive AR-HUD Solution Suppliers in China by Revenue, 2024

Ranking of the Top Five High-Performance Automotive AR-HUD Solution Suppliers in China by Revenue, 2024[1]

Ranking	Company Name	Home Country	Sales Volume of High-performance Automotive AR-HUD Solutions (RMB Billion)	Market Share (%)
1	Company F	China	0.35	50.9%
2	Company G	China	0.10	15.0%
3	Company H	South Korea	0.10	14.5%
4	**Our Company**	**China**	**0.06**	**8.9%**
5	Company I	China	0.04	6.3%
	Total of the top five companies		**0.66**	**95.6%**
	Total of other companies		**0.03**	**4.4%**
	Market total		**0.69**	**100.0%**

Key findings

- Based on revenue in the Chinese market in 2024, the Company ranked fourth among all high-performance automotive AR-HUD Solution manufacturers, with a market share of approximately 8.9%.

Notes:

1. *The standards defining high-performance AR-HUD Solutions are as follows: The hardware must have a horizontal field of view (HFoV) of at least 10°, a vertical field of view (VFoV) of at least 3.5° and a visual image distance (VID) of at least 7.5 meters. Additionally, it should possess software capabilities for AR-based virtual-real fusion.*
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Source: Annual Reports, CIC

Ranking of the Top Five HUD Solution suppliers in terms of number of registered invention patent owned

Ranking of the Top Five HUD Solution suppliers in terms of number of registered invention patent owned

Ranking	Company Name	Home Country	Number of registered invention patent owned
1	**Our Company**	**China**	**105**
2	Company F	China	59
3	Company C	China	46
4	Company A	South Korea	27
5	Company D	China	24

Key findings

- as of December 31, 2024, the Company ranked first in terms of the number of registered invention patents related to HUD Solution among domestic suppliers.

Source: Annual Reports, CIC

Entry Barriers in China's Automotive HUD Solution Industry

1	**Strong expertise in optical product development and extensive industry service experience**	• Optical systems are vital components of HUD Solutions, covering aspects such as freeform optical design, distortion correction, ambient light adaptation and luminance uniformity. Strong expertise in optical product development combined with extensive industry service experience is essential for advancing product iterations and meeting the diverse requirements of different vehicle models. This is particularly true for high-end HUD Solutions, which impose particularly higher optical system standards, making it challenging for companies lacking adequate relevant experience to enter the market. As a result, traditional optical firms or well-established Tier-1 suppliers enjoy a distinct competitive advantage in the HUD Solution sector.
2	**Automotive-grade mass production and delivery capabilities**	• HUD Solutions are highly integrated systems consisting of multiple modules, including optical components, display modules, projection systems and electronic controls, which demands greater automotive-grade manufacturing capabilities. OEMs enforce strict criteria regarding defect rates, parameter consistency and delivery stability. Therefore, HUD Solution suppliers must have a well-established quality management system, strong supply chain coordination and proven experience in consistent high-volume deliveries to satisfy OEMs' long-term project requirements.
3	**Pioneering capabilities in visual system R&D and intelligent interaction integration**	• As AR-HUD Solutions gradually become the industry norm, HUD Solution products must possess the ability to integrate the data with ADAS, enabling augmented reality navigation and real-time driving information display through environmental sensing and AI rendering. As a core interaction interface within the intelligent cockpit, HUD Solutions need to integrate closely with vehicle infotainment systems, HMI, DMS and V2X. In the future, companies with cross-system integration and software algorithm expertise are expected to gain a competitive edge, whereas new entrants lacking system integration expertise will face significant technical barriers.
4	**Extensive customer resources and brand recognition**	• Brand reputation and customers constitute critical entry barriers to the HUD Solution market. As automotive OEMs impose the stringent vendor qualification requirements and lengthy auditing processes, their preferences are typically given to suppliers with proven track records and longstanding partnerships. Consequently, incumbent suppliers benefit from first-mover advantages through extensive customer resources and brand recognition, making it difficult for new entrants to disrupt the existing supply chain system.

Source: CIC

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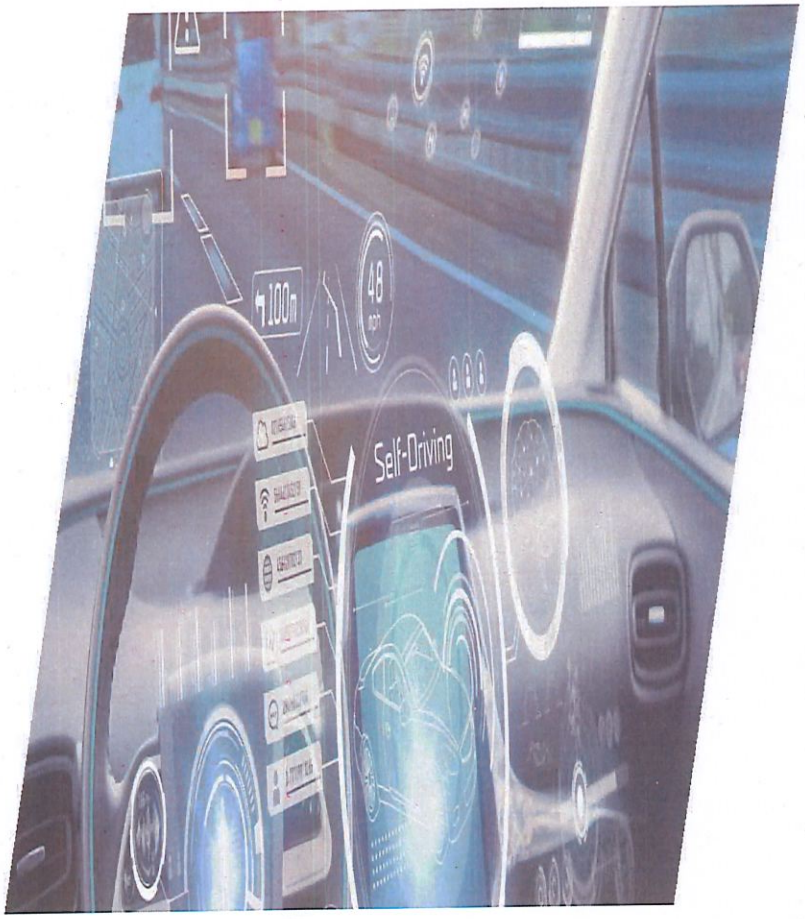
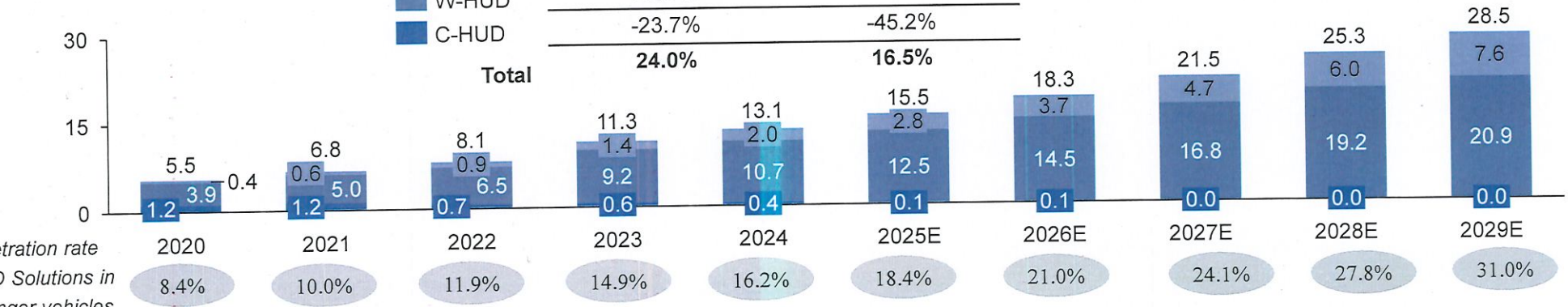


Market Size and CAGR of the Global Automotive HUD Solutions Industry

Global Market Size and Penetration Rate[1] of Automotive HUD Solutions by Product Type, Measured by Sales Volume, 2020-2029E



CAGR	
2020-2024	2025E-2029E
46.6%	27.8%
28.6%	13.7%
-23.7%	-45.2%
24.0%	**16.5%**

Penetration rate of HUD Solutions in passenger vehicles	2020	2021	2022	2023	2024	2025E	2026E	2027E	2028E	2029E
	8.4%	10.0%	11.9%	14.9%	16.2%	18.4%	21.0%	24.1%	27.8%	31.0%

Key findings

- Driven by the rapid advancements in intelligent cockpits and autonomous driving technologies, the global HUD Solution industry is entering an accelerated development phase. In recent years, Chinese HUD Solution manufacturers have gained notable technological advantages in areas such as optical design, imaging quality and system integration, with their product performance and engineering capabilities steadily aligning with international standards.
- Looking ahead, it is anticipated that more Chinese HUD Solution firms will expand their global footprint through collaborations with domestic automotive OEMs for overseas growth or by establishing partnerships with international automotive OEMs.
- The global Automotive HUD Solution industry is primarily characterized by the dominance of W-HUD Solutions, with AR-HUD Solutions representing the promising growth segment for the future. In terms of sales volume, the W-HUD Solution market is forecasted to grow from 10.7 million units in 2024 to 20.9 million units by 2029, with a CAGR of 13.7% from 2025 to 2029. On the other hand, the AR-HUD Solution segment is relatively nascent overseas compared to the domestic market, with Tier-1 suppliers lagging behind R&D and commercialization efforts. This creates opportunities for Chinese manufacturers to enter and expand within the global market. Based on sales volume, the AR-HUD Solution market is expected to increase from 2.0 million units in 2024 to 7.6 million units in 2029, with a CAGR of 27.8% between 2025 and 2029.

Notes:

1. Refers to the proportion of HUD solutions installed in passenger vehicles worldwide

Source: CIC & ICV

Drivers of the Global Automotive HUD Solutions Industry

1	The wave of automotive intelligence and networking	• With the popularity of Level 2+ autonomous driving, drivers need real-time access to key information such as navigation, vehicle speed, and ADAS alerts, and HUD Solutions can significantly reduce gaze drift and improve driving safety. At the same time, the rapid development of vehicle-to-everything (V2X) has further driven the need for information interaction, making HUD Solutions an ideal carrier for displaying dynamic data such as real-time road conditions and charging pile locations, thereby optimizing the driving experience and enhancing road safety.
2	Consumption upgrades drive the evolution of intelligent cockpit technology	• As the recognition of intelligent driving technology continues to increase, the market demand for interactive experience in intelligent cockpits has increased significantly. At present, the automobile consumer group is showing a younger trend, and their car purchase decision-making criteria are shifting from traditional power performance to intelligent experience. Intelligent cockpit systems and interactive functions have become one of the core elements influencing consumers' car purchase choices.
3	Technology iteration accelerates superimposed cost optimization	• The new generation of projection system combined with intelligent algorithms not only expands the viewing range, but also intelligently adapts to different lighting environments, presenting a stable picture without distortion. These innovations allow navigation guidance and safety tips to be integrated into the driver's field of vision as if they were real, resulting in an immersive experience like never before. At the same time, the maturity of the supply chain has effectively controlled production costs, gradually lowered the technical threshold, and accelerated the popularization of HUD Solution systems to mainstream models, so that more consumers can enjoy the driving innovation brought by technology.
4	Global safety regulations upgraded	• The continuous upgrading of global safety regulations is driving the development of HUD Solution technology in the direction of standardization. In 2023, Euro NCAP will incorporate the display of key HUD Solution information (such as vehicle speed and navigation prompts) into the safety scoring system, prompting car companies to optimize brightness, viewing angles, and content prioritization. At the same time, China's *Intelligent Connected Vehicle Technology Roadmap 2.0* clearly lists HUD Solutions as 'the core interactive interface for human-machine co-driving' and strongly encourages its development.

Source: CIC

The Development Trend of the Global Automotive HUD Solutions industry

The development trend of the global automotive HUD Solution industry

Development Trend	Key Analysis
Diversified application scenarios	• The on-board HUD Solution is extending from a single driving information display to multiple interactive scenarios. In the field of in-vehicle entertainment, the new generation of HUD Solutions has begun to integrate with VR/XR technology to provide immersive audio-visual entertainment experience for co-pilots, such as supporting innovative functions such as AR games and virtual cinemas. At the same time, with the development of V2X vehicle-road collaboration technology, HUD Solution gradually integrates real-time traffic data, which can dynamically display traffic light status, congestion warning, electronic road signs and other Internet of Vehicles information, greatly improving driving safety and convenience.
The market landscape is reshaped	• The international HUD Solution market may undergo structural changes, and Chinese manufacturers will accelerate their global layout by virtue of technological innovation and cost advantages, and promote the evolution of the industrial pattern from Europe, America and Japan dominating to multi-polarization. • With the maturity of China's smart electric vehicle industry chain, local HUD Solution suppliers have broken through the bottleneck of key technologies and formed differentiated competitiveness in cutting-edge fields such as AR-HUD Solution and holographic display. On the one hand, Chinese manufacturers are entering emerging markets such as Southeast Asia and the Middle East through the *technology licensing + localization service* model; On the other hand, with its cost-effective advantages and rapid response capabilities, it has gradually won the favor of European second-tier brands and global emerging electric vehicle companies.
Collaborative innovation of the industrial chain	• The industry ecosystem presents the characteristics of cross-border integration: optical manufacturers, technology companies and traditional Tier1 suppliers break through technical bottlenecks through strategic cooperation, and jointly promote the mass production of innovative solutions such as AR-HUD Solution. At the software level, *software-defined HUD Solution* has become a new trend, and OEMs continue to optimize the display effect and add custom interfaces and other functions through OTA remote upgrades, significantly extending the life cycle and value chain of the HUD Solution system.
The market is sinking and penetrating at an accelerated pace	• HUD Solution technology is breaking through the boundaries of the traditional high-end market and rapidly popularizing into the mainstream consumer field. With the maturity of technology and cost optimization, this configuration, which was once exclusive to luxury models, is gradually becoming the standard choice for smart cars.

Source: CIC

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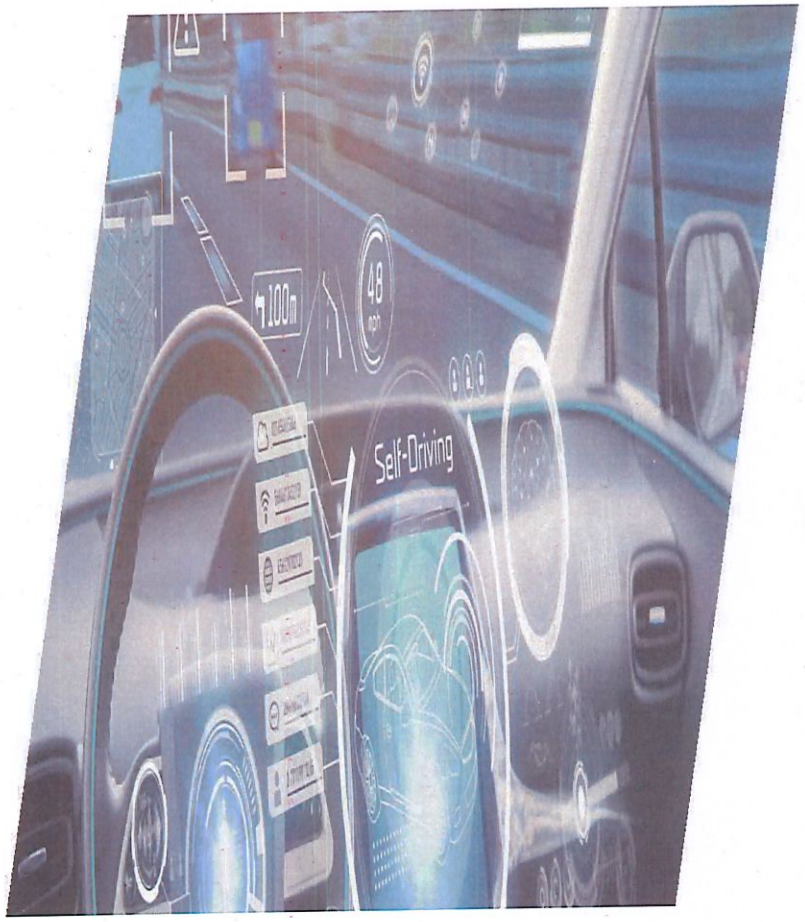


Definition and Classification of Visual and Interactive Solutions for Intelligent Cockpits

Definition

- Visual and interactive solutions for intelligent cockpits are innovative solutions that support critical functions such as information display, autonomous driving assistance and dynamic interaction. Leveraging technologies like optical displays and software algorithms, these solutions enable information transmission and exchange between the vehicle and the driver, further enhancing safety, comfort and the intelligent driving experience.

Classification

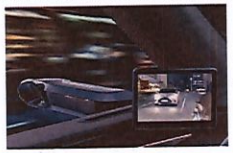
- Major types of visual and interactive solutions in this domain include Head-Up Displays (HUD Solution), Camera Monitor Systems (CMS), digital windshields and window projection systems

Head-Up Displays (HUD Solution)

☐ A head-up display system that projects driving information into the driver's line of sight through optical reflection

Camera Monitor Systems (CMS)

☐ A device that realizes the rearview function through electronic image presentation, completely or partially replaces the traditional optical rearview mirror



Digital Windshields

☐ The windshield system with integrated display function presents information to the driver while maintaining transparency

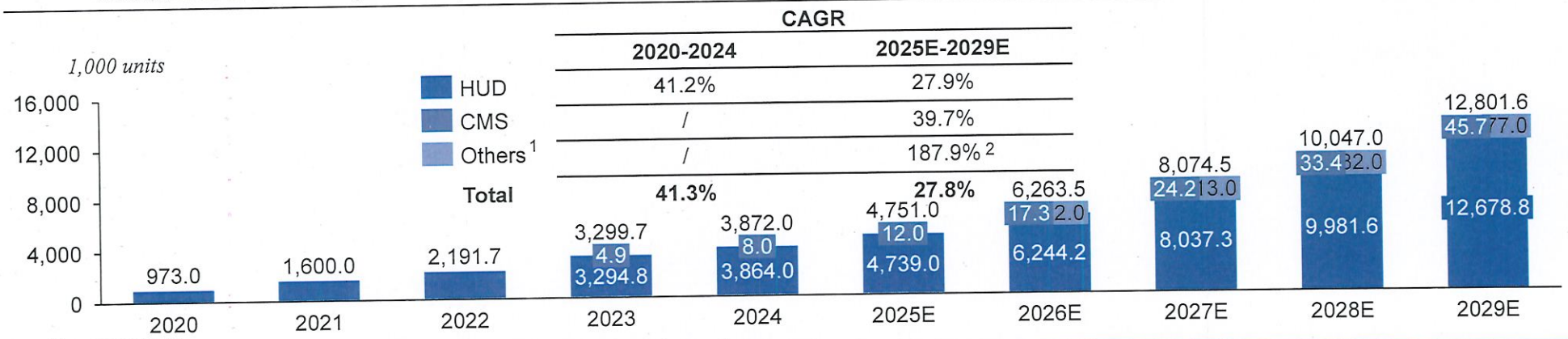
Window Projection Systems

☐ A system that uses holographic or laser projection technology to realize interactive window display functions

Source: SAE International, VDA, NHTSA, CMS, CIC

Market Size of the Visual and Interactive Solutions for Intelligent Cockpits in Chinese Market

Market Size of the Intelligent Cockpit Visual and Interaction Solutions in China by Product Type, Measured by Sales Volume, 2020-2029E



	CAGR	
	2020-2024	2025E-2029E
HUD	41.2%	27.9%
CMS	/	39.7%
Others [1]	/	187.9% [2]
Total	41.3%	27.8%

Key Findings

- As intelligent vehicles evolve from transportation tools to integrated travel spaces, user demand for enhanced cockpit experience in safety, visualization and interaction continues to rise. Automotive HUD Solutions serve as core interfaces between driving systems and users, improving information collection efficiency and safety while elevating the human-vehicle interaction experience. The Chinese government also supports this sector with comprehensive policies providing clear direction for industry development.
- Automotive HUD Solutions have achieved significant breakthroughs in optical design, image processing, AR rendering and human-vehicle interaction, driving advancements towards intelligence and miniaturization while improving solution performance, environmental adaptability and vehicle integration efficiency. As vehicle manufacturers increasingly appreciate intelligent and differentiated layouts, these solutions have become key factors in attracting end users.
- China's automotive HUD Solution market in terms of sales volume grew from 1.0 million units in 2020 to 3.9 million units in 2024, with a CAGR of 41.3%, and is expected to reach 12.7 million units by 2029, with a CAGR of 27.9% from 2025 to 2029.
- In the global market, W-HUD Solution remains the mainstream HUD solution, with projected growth from 10.7 million units in 2024 to 20.9 million units in 2029. AR-HUD Solution emerges as the future growth driver, expected to increase from 2.0 million units to 7.6 million units in the same period. Chinese HUD Solution manufacturers have accumulated significant technological advantages in optical design, imaging quality and system integration, with performance and capabilities approaching international standards. As China's leading automotive HUD solution provider, we are well positioned to capture overseas opportunities through collaborations with domestic vehicle manufacturers expanding globally or directly with overseas OEMs.

Notes:

1. *Including digital windshields and window projection systems.*
2. *Refers to the CAGR from 2026 to 2029.*

Source: CIC & CPCA

Drivers Analysis of the Visual and Interactive Solutions for Intelligent Cockpits in China

Drivers Analysis of the Visual and Interactive Solutions for Intelligent Cockpits in China

Rising demand for cockpit visual interaction

- As intelligent vehicles evolve from traditional transportation tools into integrated, intelligent mobility spaces, consumer expectations regarding the visualization of driving-related information and the comfort of HMI continue to grow. Visual and interactive solutions for intelligent cockpits serve as the core interface between intelligent driving systems and users. They not only enhance the efficiency of information acquisition and the sense of safety during driving, but also significantly improve the overall HMI capabilities and user experience of the vehicle, fueling sustained market demand. In 2024, the penetration rate of L2+ and above intelligent vehicles in China reached 7.3%, and it is expected to continue rising in the coming years, further driving the adoption of visual and interactive solutions for intelligent cockpits as supporting configurations.

Technological breakthroughs accelerating product iteration and adoption

- Visual and interactive solutions for intelligent cockpits have continued to achieve breakthroughs in key technological areas such as optical design, image processing, AR rendering and HMI, exemplified by improvements in imaging resolution of HUD Solution products, expansion of field of view and imaging distance, and stronger integration of AR navigation with ADAS perception. These developments have substantially improved system performance, environmental adaptability and vehicle integration efficiency, driving the evolution of products toward greater intelligence and miniaturization, and further strengthening their role as an interactive bridge within intelligent driving systems. As automotive OEMs accelerate efforts in intelligent and differentiated vehicle design, these solutions have become a key factor in attracting consumers, and the market is expected to expand further.

Innovation in solutions and trends toward globalization and standardization

- Visual and interactive solutions for intelligent cockpits are evolving from traditional functional display systems into integrated and scenario-based intelligent interaction terminals. These solutions are no longer limited to displaying driving information, but are increasingly being applied in various scenarios such as driver assistance prompts, passenger information services and personalized cockpit experience — becoming a vital component of the vehicle's overall HMI system. Meanwhile, Chinese suppliers are playing an increasingly prominent role in the global market for visual and interactive solutions for intelligent cockpits, contributing to overall cost reduction and efficiency improvement, and accelerating the global adoption of such solutions. Technological breakthroughs have driven down the costs of core products such as HUD Solutions, paving the way for these solutions to become standard configurations in intelligent vehicles.

Support for industry policies, laws and regulations

- The Chinese government attaches great importance to the development of intelligent vehicles and intelligent cockpit related industries, and has launched a comprehensive range of policies to provide clear directions and institutional guarantees for the promotion and application of intelligent cockpit vision and interactive solutions. The "Intelligent Connected Vehicle Technology Roadmap 2.0" lists the improvement of human-computer interaction capabilities as one of the key development tasks. At the same time, the standardization work related to HUD Solution and other products is also accelerating, such as the group standard of "Automotive Cockpit Electronic Information Head-up Display" has been completed for comments. The continuous improvement of these policies and regulations has created stable development expectations and institutional support for the in-vehicle vision and interaction industry, and accelerated the large-scale implementation of product technology after maturity.

Source: CIC

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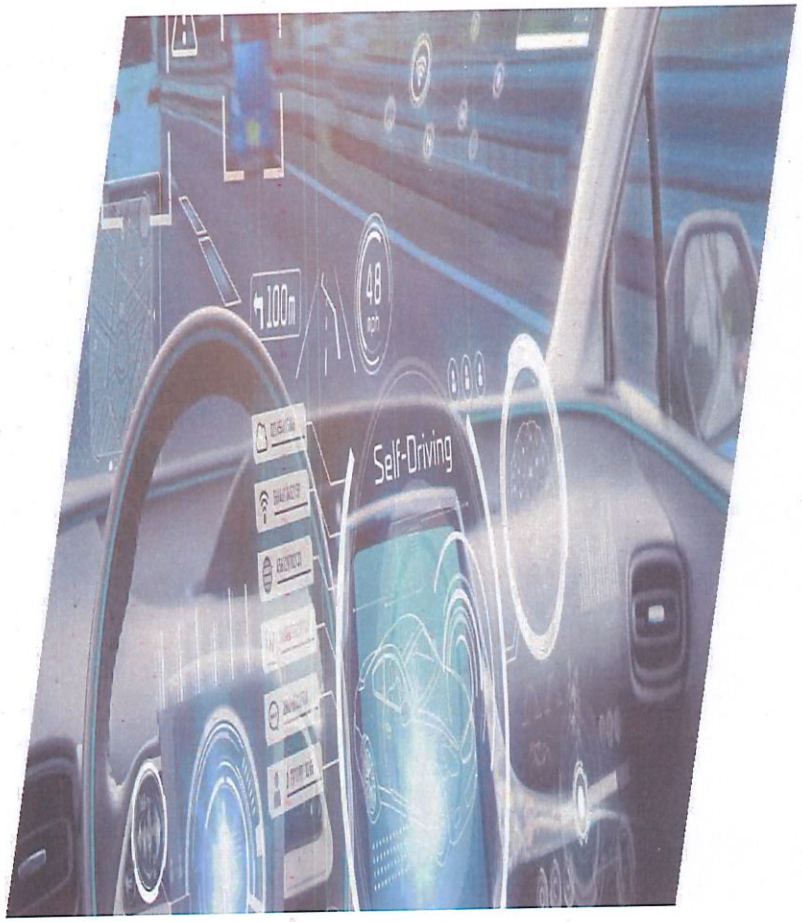
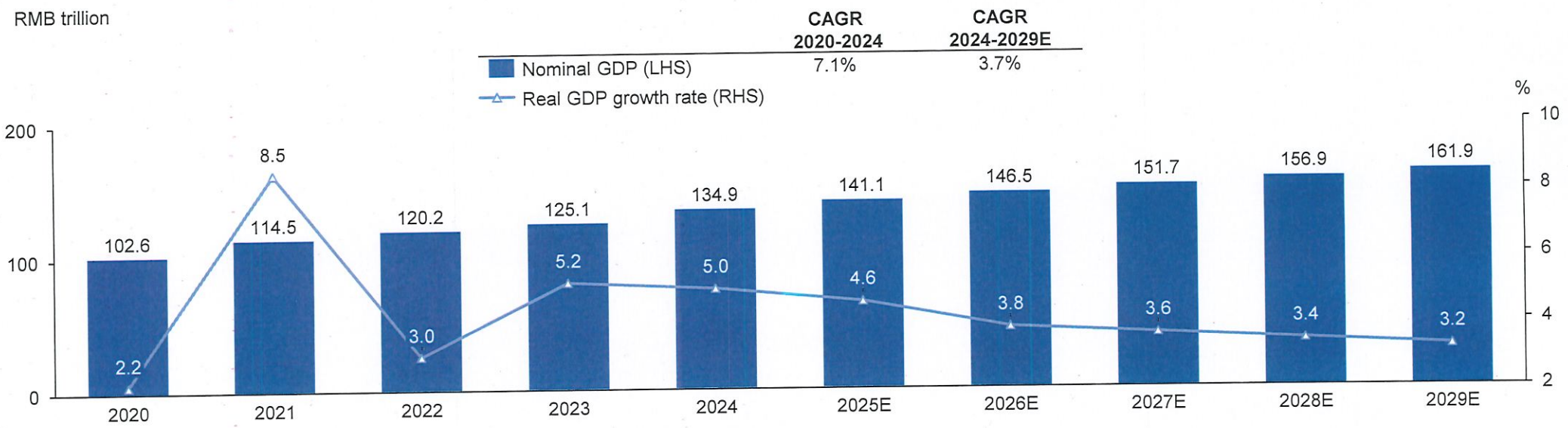


China's real GDP growth rate witnessed a sharp decline in 2020 and 2022, however, it is expected to stabilize in the future, fueled by increasing consumer demand and an opening-up policy.

Nominal GDP and Real GDP growth rates, China, 2020-2029E



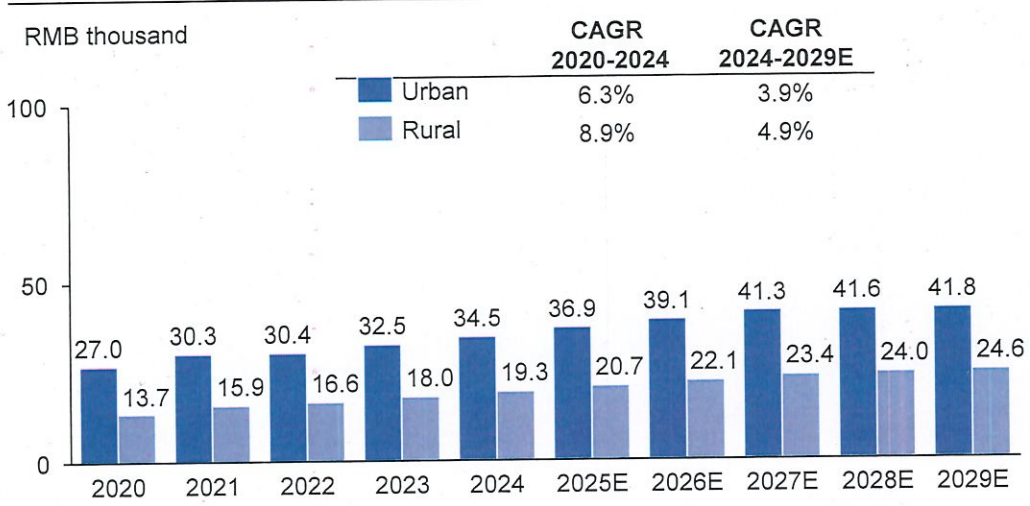
Key analysis

- China's economy has shown significant growth in recent years, with its nominal GDP rising from RMB 99.1 trillion in 2019 to RMB 134.9 trillion in 2024 and is projected to reach RMB 161.9 trillion by 2029. However, the value of real GDP growth took a plunge in 2020 due to the covid-19. Although there was a one-time increase in real GDP during the economic recovery in 2021, the future GDP growth is expected to remain stable after 2023.
- China's economic outlook is currently facing several challenges. The ongoing trade tensions with the United States have led to uncertainty and a potential slowdown in economic growth. In addition, China's aging population is putting pressure on its labor force and social security system. Despite these challenges, China continues to invest heavily in infrastructure and technology, which could drive future economic growth. The government's commitment to economic reform and opening up to foreign investment also presents opportunities for sustained growth.

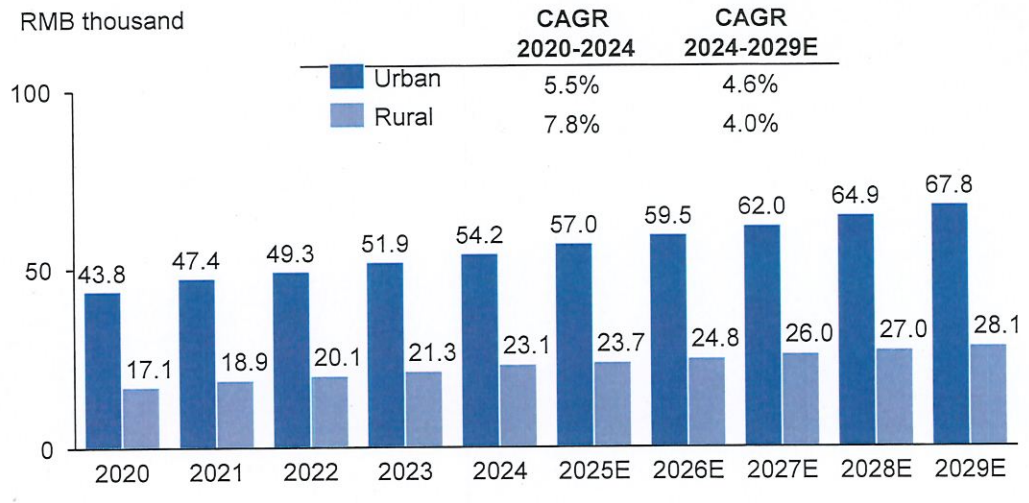
Source: NBS, CIC

Urban and rural per capita consumption rose; despite urbanization shifts, higher incomes drive increased consumer spending.

Per capita consumption expenditures in China, urban and rural, 2020-2029E



Per capita disposable income in China, urban and rural, 2020-2029E

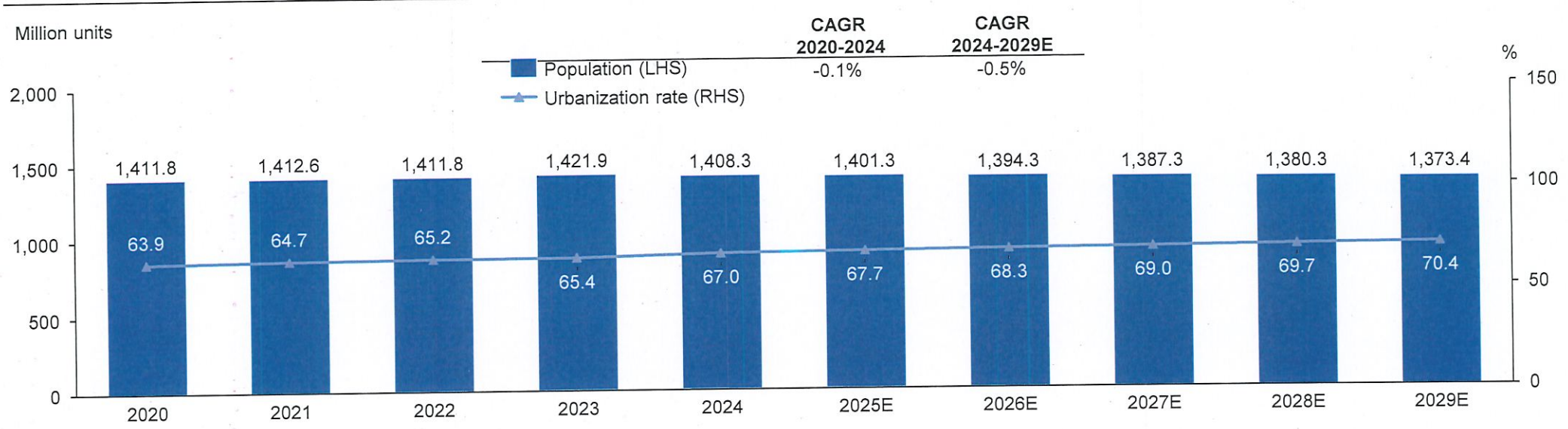


Key analysis

- In 2024, the country's per capita consumption for urban and rural areas showed growth, with urban resident's spending increasing nominally by 4.7%, reaching around RMB 34.5 thousand, while rural resident's consumption grew by 6.1%, surpassing RMB 19 thousand over the same period. The national per capita disposable income of urban residents increased by 4.6% to RMB 54.2 thousand in 2024, while rural residents saw a 6.6% increase to reach RMB 23.1 thousand.
- The ongoing increase in consumption expenditure is the direct result of rising per capita disposable income. This growth in income has mainly been driven by the rapid development of the Chinese economy and the continuous upgrading of China's manufacturing sector, along with a structural shift in the mainstay of development, from the primary and secondary sectors to the tertiary sector. Growing purchasing power and consumption upgrades in both urban and rural areas suggest a stronger level of consumer confidence and sustainable internal circulation, thus giving rise to the new retail and logistics industry. It provides tremendous development potential for China's consumer and FMCG industries.
- The compound annual growth rates of per capita disposable income and consumption expenditure in the urban area is expected to decline in the future due to lower birth rates and an ageing population. Despite this, disposable income and expenditure levels will still grow steadily, driven by the globalization of trade, productivity gains and the internationalization of the Renminbi.

Despite the low population growth due to the one-child policy, China's population size remains globally significant.

Population and Urbanization, China, 2020-2029E



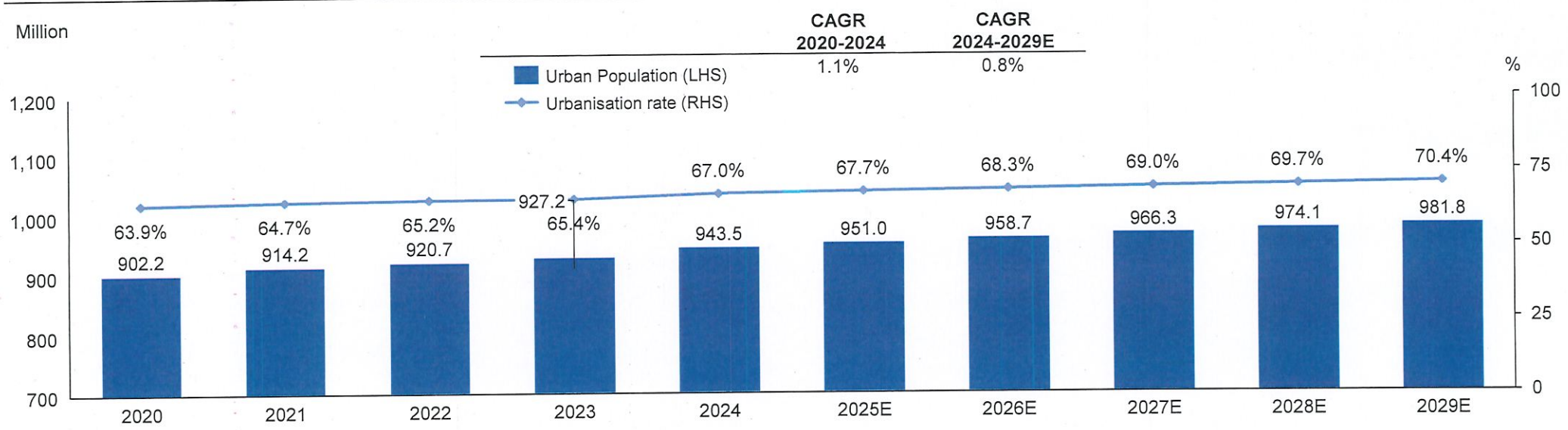
Key analysis

- China's population and urbanization data highlight the intricate nature and diverse aspects of its economic and social progress. Being the second most populous country, accounting for 20% of the global population, China is confronted with both challenges and prospects due to its enormous size. Despite having a sizable population, the impact of the one-child policy has led to consistently low population growth in recent years. It is projected China's population will reach 1.37 billion with a minus compound annual growth rate from 2020 to 2024 continuing to the 2029. By 2029, the growth rate of the urbanization rate will remain at around 70.4%.
- This suggests that more people will migrate from rural to urban areas in the coming years, fueling urban economic development but also posing challenges in areas such as urban planning, infrastructure development and social security. China's population and urbanization figures have far-reaching implications for economic and social development. As population growth continues and urbanization accelerates, the demand for resources will increase, as will the pressure on the environment.

Source: NBS, CIC

The urbanization rate has steadily increased, creating a substantial market for industries including digital retail.

Urban population and urbanization rate, China, 2020-2029E



Key analysis

- China presently holds the title for the world's second largest population, and this figure is expected to maintain an upward trajectory. China's population currently constitutes roughly 20% of the global population. With the advent of reform and opening up policies, urban built-up areas have experienced rapid expansion, aligning with the nation's swift urbanization. As of the end of 2024, urban residents reached 943.5 million, marking an increase from 902.2 million in 2020. At the same time, urbanization rates are expanding rapidly, regarding the narrowing gap relative to developed nations. China has already stepped into the post-industrialization period, with its urbanization rate of permanent population standing at 67.0% in 2024, up 3.1 from 2020.
- This increasing urbanization is driven by various factors, including economic opportunities in urban areas, improved infrastructure, and government policies aimed at promoting urban development. As more people migrate to cities, it presents both opportunities and challenges for China, including the need for sustainable urban planning, infrastructure development, and social welfare systems to support the growing urban population.

Source: NBS, CIC