Deloitte.

德勤

Fighting an unprepared battle

Rethinking auto semiconductor strategy in an uncertain era

MAKING AN IMPACT THAT MATTERS since 1845

Semiconductor Industry Series
November 2021

Contents


und view ON
160
200
120
140
180
220
240
0
100%
Autopilot
ON
3
2,5
3,5
2
4
1,5
4,5
1
5
P

Preface

The improvement of underlying technologies are driving transformations in the semiconductor industry, and the rapid development of intelligent vehicles is quietly changing the business and operation models of the automotive industry. The pandemic-induced chip shortage catalyzed the evolution of automotive industry, which also brought unprecedented attention from all players in the ecosystem including governments, industry stakeholders, manufacturers, and even end users. It is particularly critical for OEMs and semiconductor companies, especially local ones, to recognize the need for capability transformations. Going forward, the ability to secure semiconductor supplies to avoid disruptions is a strategic consideration every company should contemplate in the future.

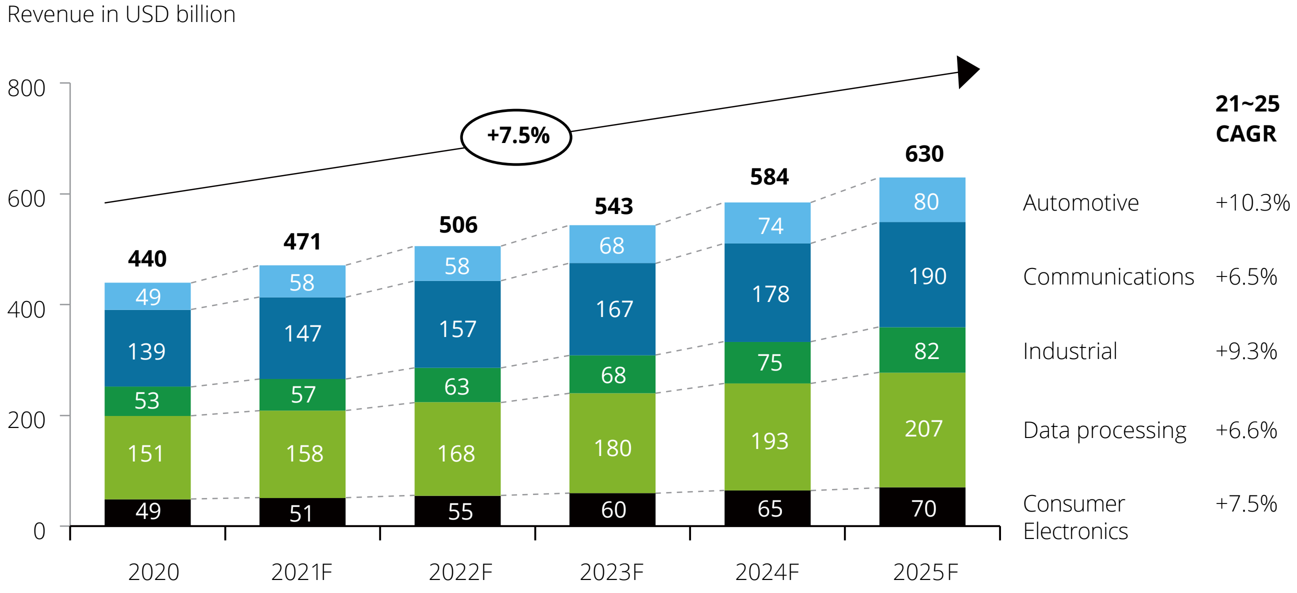
Part I. Overview

New Underlying Technologies Drive Global Semiconductor Transformation, with Strong Demand among Industry Verticals

1.1 Technology Development Drives High Growth in Semiconductor Industry

As underlying technologies such as 5G and IoT continues to mature, they will drive the electrification and intelligent empowerment among downstream verticals and facilitate the steady growth of demand in the global semiconductor industry. The market size of global semiconductor industry is expected to reach USD 630 billion by 2025. Along with technology advancement, several verticals including automotive, industrial, communications, and consumer electronics sectors will undergo industry-wide transformation, which will contribute to further demand for semiconductors. Forecast has shown that chip demand from automotive industry, which expected to grow at 10% CAGR in the next 5 years, will be the main driver of the industry demand.

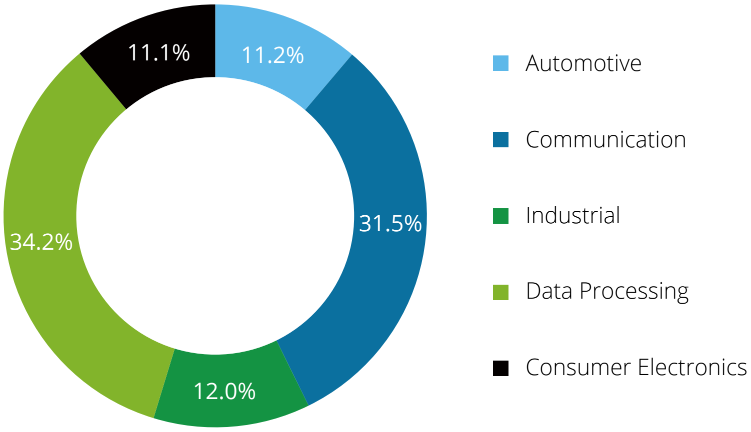
Figure 1: Global Semiconductor Industry Market Size, 2020-2025



Data source: Mordor Intelligence

Figure 2: Global Semiconductor Downstream Applications, 2020

100% = $440 billion



Data source: Mordor Intelligence

1.2 Black Swan Event Constrains Supply-Side Capacity

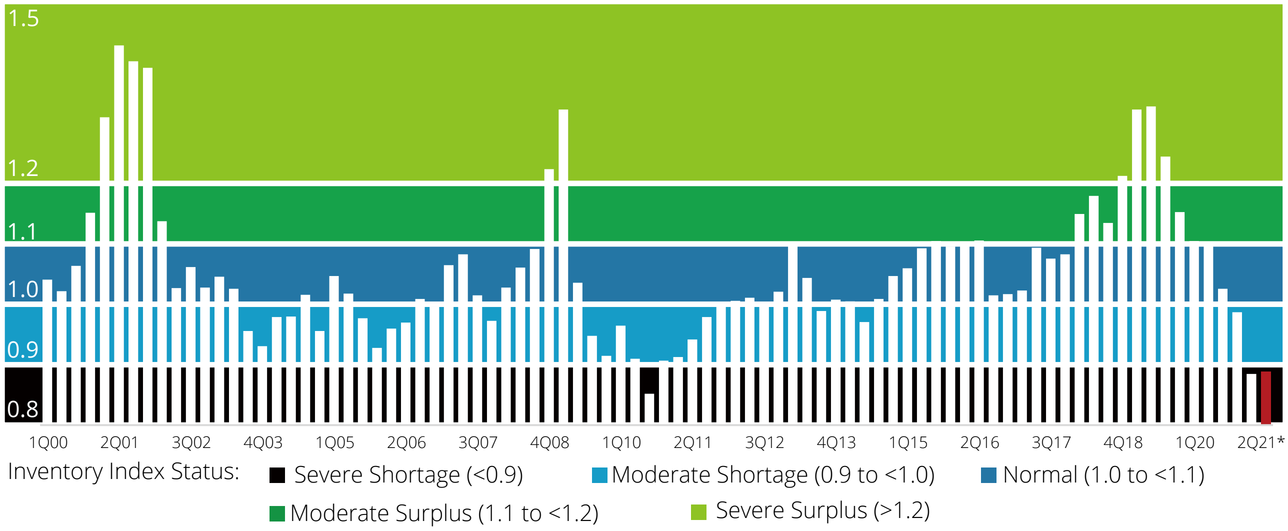
The semiconductor industry is highly cyclical. The Global Semiconductor Inventory Index is less than 0.9 as of Q2 2021, indicating the global market is in a period of severe shortage.

The semiconductor value chain consists of chip design, wafer fabrication, assembly and testing, which are performed in various regions across the globe. Companies in Europe and United States leads R&D intensive activities in chip design, Japan and Taiwan are mainly responsible for wafer fabrication, while Southeast Asia leads activities in assembly and testing.

The spread of COVID-19 since 2020 led to factory shutdowns worldwide. Despite the gradual recovery from the pandemic and subsequent factory reopening, supply-side capacity is still constrained since nations are at different stages of recovery from the pandemic, which restricts capacity.

In addition to the impact from the pandemic, natural disasters further limited production capacity. Fires and earthquakes significantly crippled the production capacity of Renesas Electronics, a Japan-based supplier of automotive-grade semiconductors. Massive power outages triggered by the Texas blizzard in the United States forced Samsung, Texas Instruments and NXP to shut down their production plants, which further undermined the capacity.

Figure 3: The Global Semiconductor Inventory Indicator, 2000-2Q2021



Data source：Gartner

Figure 4: The Global Semiconductor Industry Value Chain Specialization Map and COVID Recovery Status in Corresponding Regions

United States：Chip design、fabrication

- In February, the Texas was hit by a snowstorm led to a number of chip companies' factory shutdown, including Samsung, NXP, Infineon etc.,
- Major player: Texas Instruments

Southeast Asia: Chip assembly and testing

- Due to severe outbreak of epidemic in August, Malaysia government requested suspension of production
- Major chip company: assembly and testing facilities of semiconductor giants

Japan：Design and fabrication

- An accidental fire broke out in Renesas Electronics' Naka factory in March, which impeded production capacity until June to fully restore
- Major player: Renesas Electronics

Europe：Chip design

- The covid-19 is gradually under control, and the impact is gradually receding
- Major player: NXP, Infineon, STMicroelectronics

China(including Taiwan)：fabrication

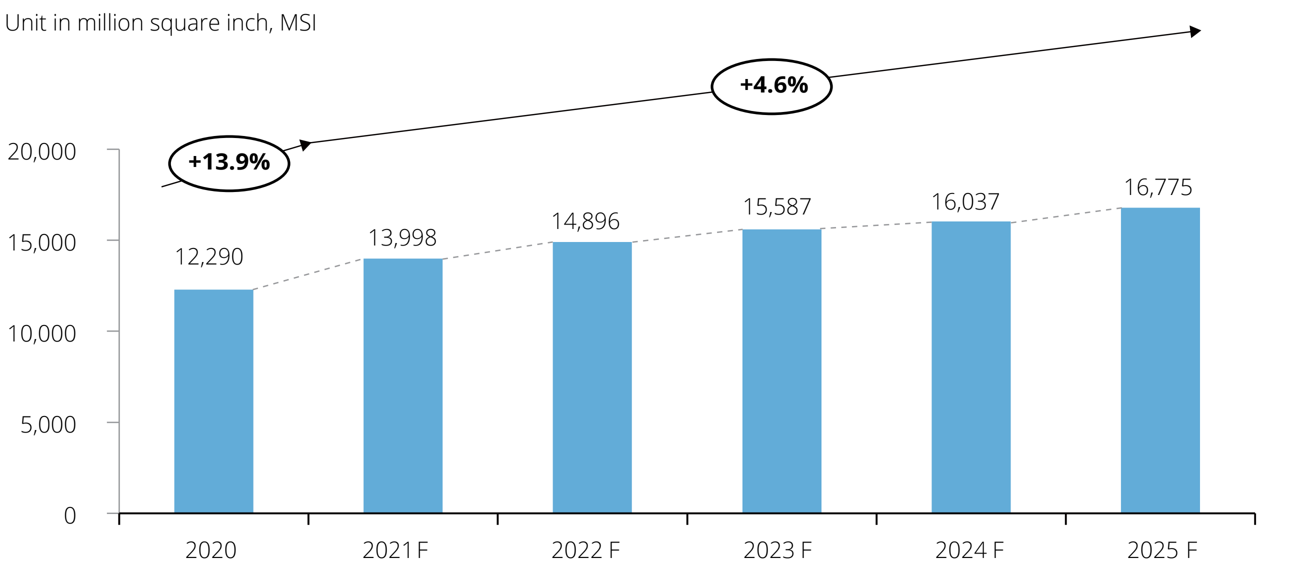
- As the epidemic is well controlled, production has begun to resume, and production capacity have gradually recovered
- Major player: TSMC

Data source: Publicly available information, Deloitte analysis

1.3 The Pandemic Stimulates Downstream Market Demand

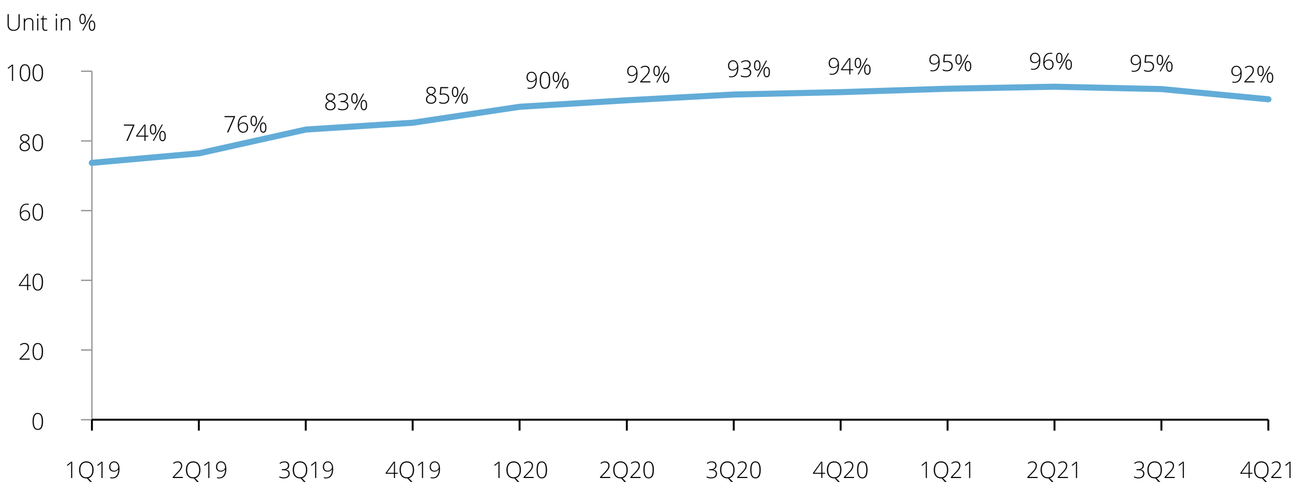
Working from home, as a result of pandemic, has driven the demand for electronic devices such as smart mobile, computers, tablets etc. During 2020, global silicon wafer shipment grew by 13.9% compared to 2019, reaching a record high. With the continued pull from downstream demand, average foundry utilization has reached 95% as of Q3 2021, implying limitation in near term capacity expansion.

Figure 5: Global Wafer Shipments Forecast, 2020-2025

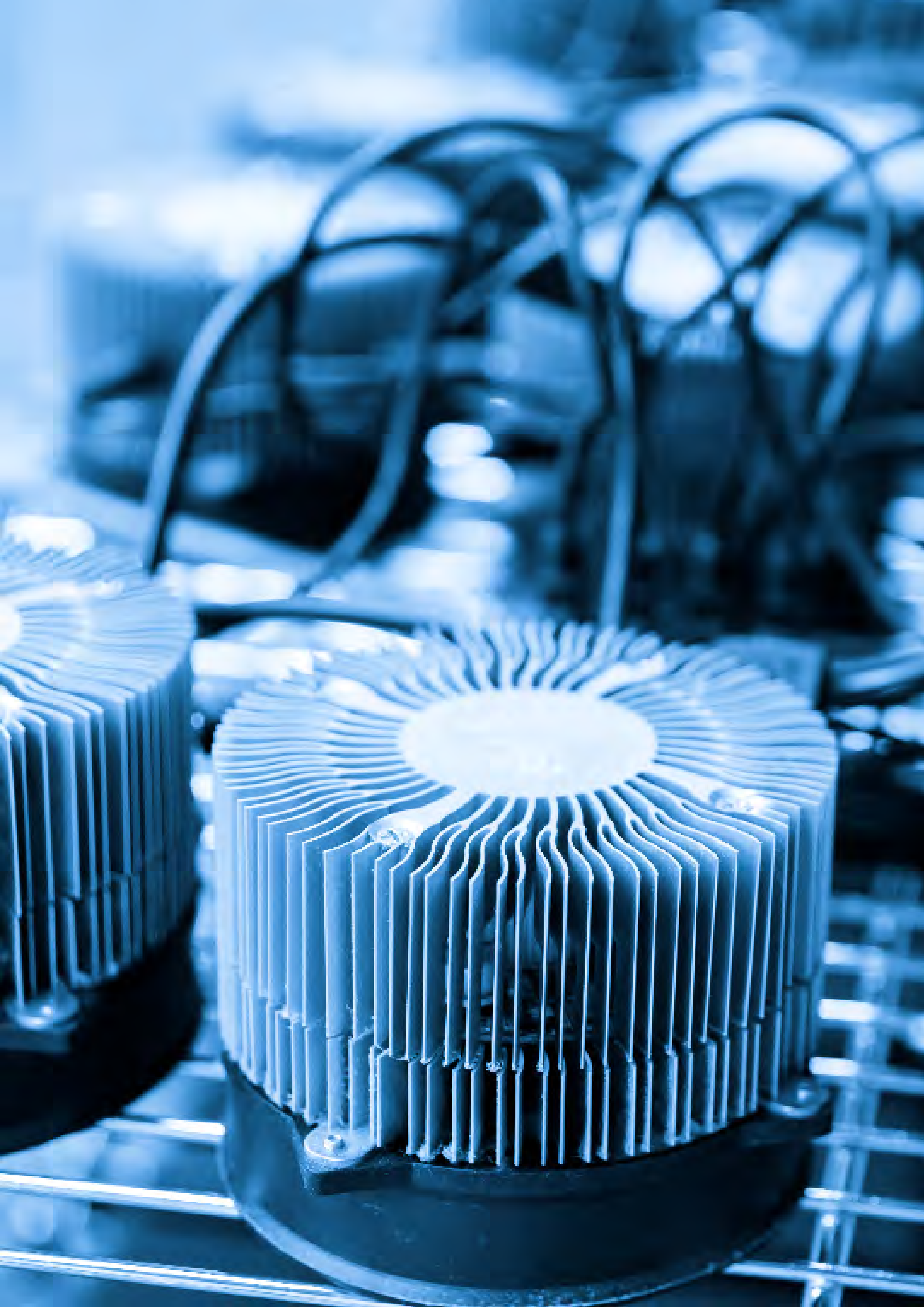


Data source: SEMI, Gartner

Figure 6: Global Wafer Capacity Utilization, by Quarter, 2019-2021



Data source: SEMI, Gartner



Part II. Insight

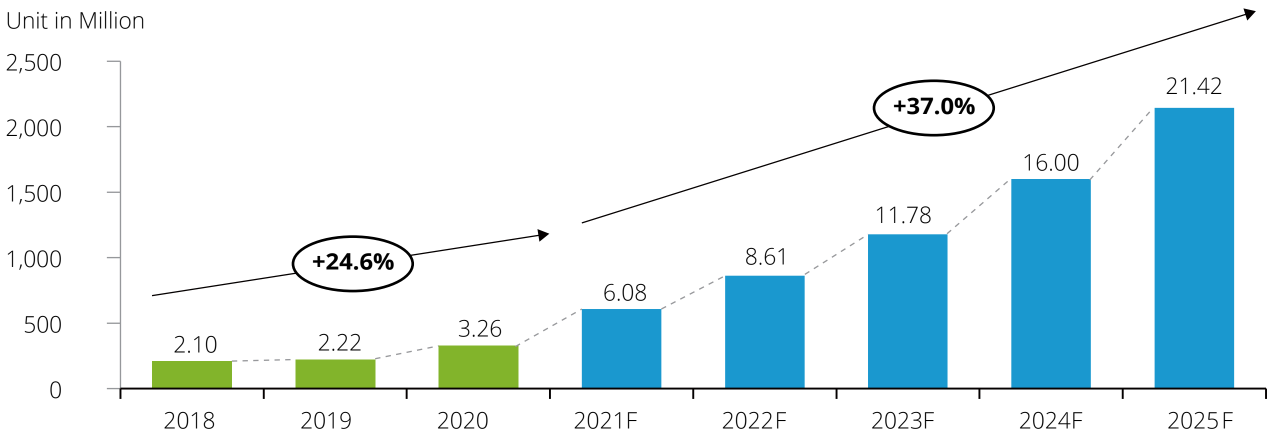
The Automotive Industry Is Ready to Embrace Future Opportunities, but Chip Shortage Will Persist in the Short Term

2.1 Demand for New Energy Vehicles Will Contributes to Growth of Auto Semiconductors

2.1.1 Adoption of electrification and intelligent technologies boost demand for automotive semiconductors

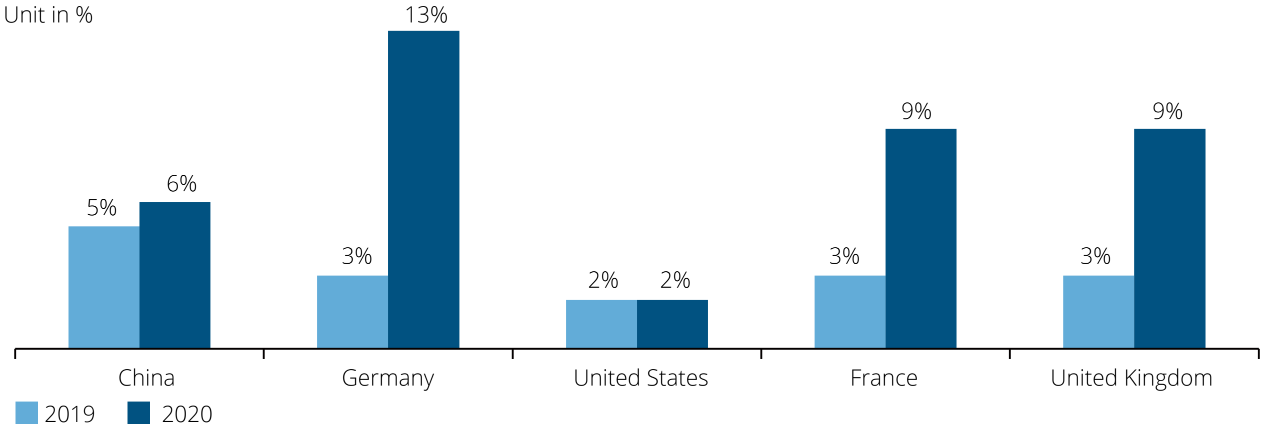
The number of global new energy vehicle sales are expected to exceed 21 million units by 2025, with a five-year compound growth rate of 37%. In addition, the pandemic did not stop future development characterized as CASE (Connected, Autonomous drive, shared service, electrification). The NEV penetration rate of FY2020 shows strong growth among different countries despite the impact of covid-19 pandemic. Based on development goals set force by different countries, new energy vehicles is expected to steadily penetrate markets worldwide.

Figure 7: Global New Energy Vehicle Sales and Forecast, 2018-2025



Data source: Deloitte analysis

Figure 8: Global New Energy Vehicle Market Penetration, 2019 to 2020



Data source: Deloitte analysis

China is the world's largest market for new energy vehicles with the highest level of car ownership and acceptance towards intelligent cockpit and autonomous driving. According to a study in 2020, which compared acceptance of autonomous driving among consumers in Germany, the United States and China, around 50% of Chinese consumers consider autonomous driving technology as important, a percentage much higher than that of the US (16%) and Germany (15%). In contrast, only 2% of Chinese consumers did not wish to have vehicles with autonomous driving technology, a phenomenon that signifies the emergence of China as the most important market for autonomous driving technologies.

Figure 9: New Energy Vehicle Sales Forecast in Major Markets, 2019 to 2020

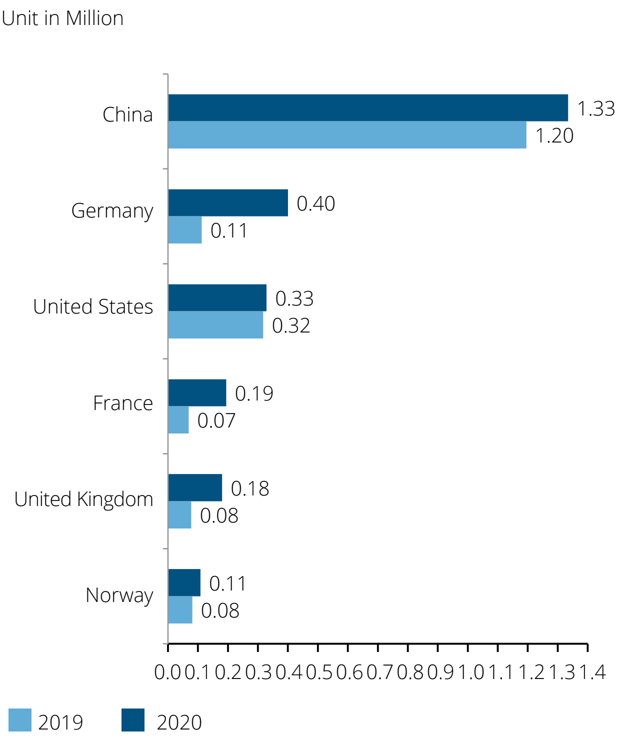
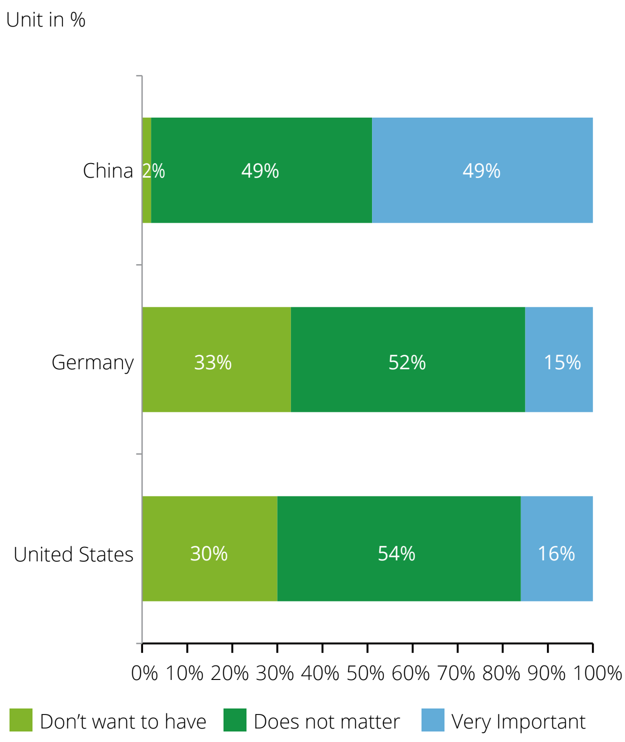


Figure 10: Consumer Survey Data on the Importance of Fully Automated Driving, 2020

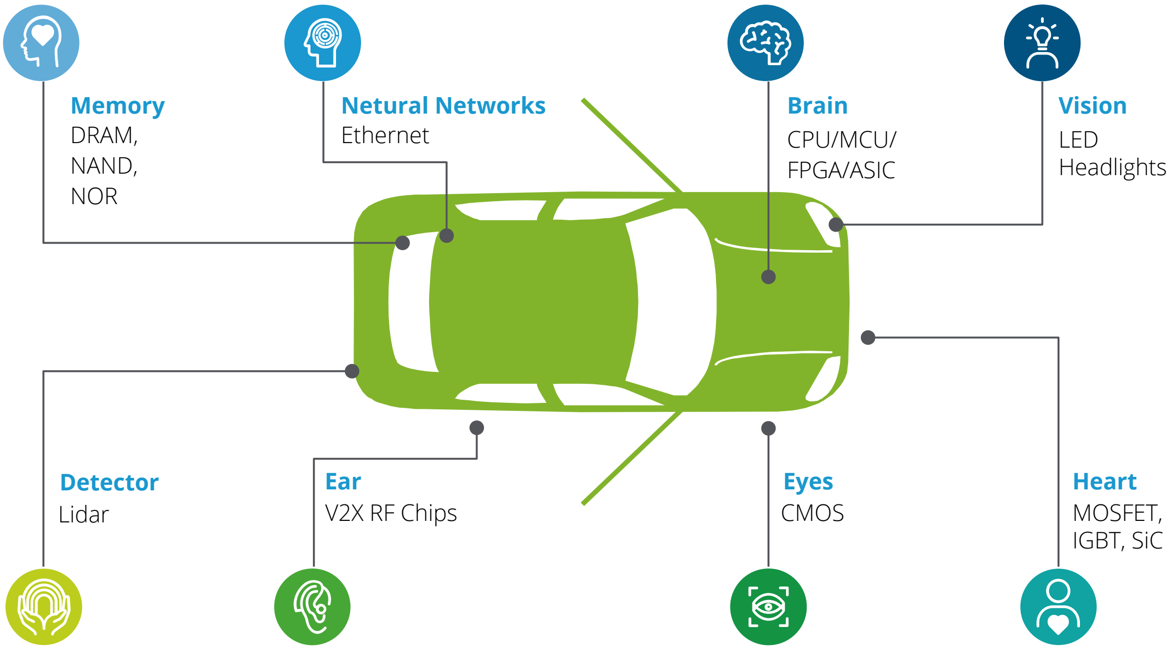


Data source: CPSC, NIC, Deloitte analysis

Features such as intelligent cockpit and autonomous driving have become the key indicator among customers to determine the attractiveness of new energy vehicles in China. With further development of vehicle electrification and autonomous driving technologies, auto-semiconductor is becoming increasingly important.

Vehicle perception systems incorporate multiple sensors, and collect data of the surrounding environment, including radar systems (light detection ranging, millimeter wave radar, ultrasonic radar) and visual systems (cameras). Decision making systems are responsible to process data through on-board computing platform and relevant algorithms to come up with optimal decisions. Lastly, the execution module converts signals into vehicle behaviors. Vehicle control and human-computer interaction on the execution level will determine the control signal of actuators such as motor, throttle, brake, etc.

Figure 11: Major Applications of Semiconductors in Automobiles



Data source: Deloitte analysis

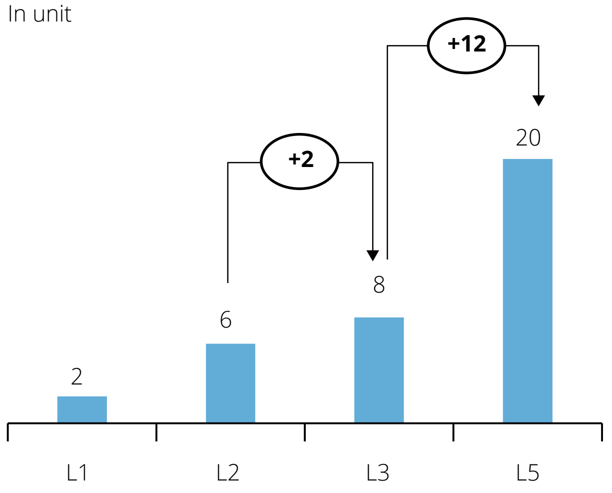
- Semiconductors are the "brain" of smart cars. GPUs, FPGAs and ASICs each have their own strengths in the field of AI computing for autonomous driving. Traditionally speaking, the CPU is typically the control center of semiconductors, which has the advantages of scheduling management and strong coordination, but the CPU computing power is relatively limited. Therefore, GPU/FPGA/ASIC are used to enhance high performance AI computing.
- Power semiconductors are the "heart" of smart cars. They are essential for many aspects of smart cars such as the engine, transmission control and braking in the drive system, or steering control.
- CMOS cameras are the "eyes" of smart cars. CMOS image sensors share a common history with CCD (charge-coupled components), but CMOS is 15-25% less expensive than CCDs, and CMOS semiconductors can be integrated with other silicon-based components to help reduce system costs. In terms of quantity, about 18 cameras are required for L3+ assisted driving such as reverse rear view, surrounding view, forward view, and blind turns.
- RF receivers are the "ears" of smart cars. RF devices are important for wireless communication. RF refers to electromagnetic frequency that can be radiated into space, ranges from 300 KHz to 300 GHz. RF semiconductors can convert RF signals to digital signals, including power amplifiers PA, filters, low noise amplifiers LNA, antenna switches, duplexers, tuners, etc. In the future, RF semiconductors will work as the ears of the car and support the development of C-V2X technology, connecting "human - vehicle - road - cloud" and other elements of traffic participation organically to make up for the lack of single vehicle intelligence and promote the development of collaborative application services.

- Ultrasonic/millimeter wave radar is the "walking stick" of smart cars. Smart cars receive large amounts of data through sensors, and L5 level cars will carry more than 20 sensors. Car radar mainly includes ultrasonic radar, millimeter wave radar and LIDAR. Development in ultrasonic radar is relatively mature in China given low technical barriers; ultrasonic radar currently enjoys rapid growth momentum despite high technical barrier thanks to its importance for intelligent vehicles; LIDAR is an important sensor for high level autonomous driving with high technical barrier, but faces high cost, regulation hurdles, and implementation difficulties.
- Memory semiconductors are the "memory" of smart cars. As the demand for memory storage on intelligent vehicles grow in the post-mobile computing era, car storage emerges as an important growth driver in the memory semiconductor market and has the ability to shape the market landscape in the future. DRAM, Flash and NAND will be widely used in various fields of smart cars in the future. In addition, with cloud and edge computing set to shine in smart cars, and L4/ L5 level self-driving cars developing complex network data and applying advanced data compression technologies, local storage volumes will stabilize and may even decline in the future.
- Multi-screen panels is likely to become the future trend. Vehicle display devices mainly include the central display and instrument display as of now. Intelligent cockpit display, integrated windshield head-up display, virtual electronic rearview mirror display, rear seat entertainment display are becoming the key focus in future intelligent vehicle development.
- LED lighting has reached mass adoption among intelligent vehicles. LED has achieved a level of brightness and irradiation distance that halogen lights could not reach in the past. LED lighting possesses functions such as curve assist (follow steering), adjust with speed, and distance warning. As the technology matures, future evolution of LED will concentrate on higher brightness, more intelligence, and entertaining functions.

2.1.2 Demand for intelligent vehicles drives the value of semiconductors

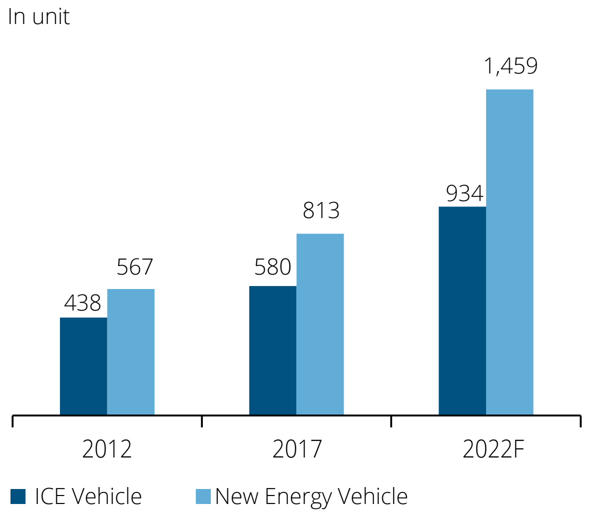
Compared with traditional ICE vehicles, new energy vehicles increasingly utilize more chips. Take autonomous driving as an example, the higher the level of autonomous driving, the more sensors are required. L3 level autonomous driving carries an average of 8 sensor chips, while the number of sensors required from L5 level autonomous driving reaches 20. By the same token, the degree of information processing and data storage done by vehicles is positively correlated with the level of maturity of autonomous driving technologies, which builds up demand for more control and storage chips onboard. Statistics have shown that the average number of chips in new energy vehicles will reach around 1,459 by 2022, further outnumbering chips installed on traditional ICE vehicles.

Figure 12: Number of Sensor Chips Required for Different Levels of Autonomous Driving



Data source: Deloitte analysis

Figure 13: Average number of Chips per Vehicle in China, 2012-2022

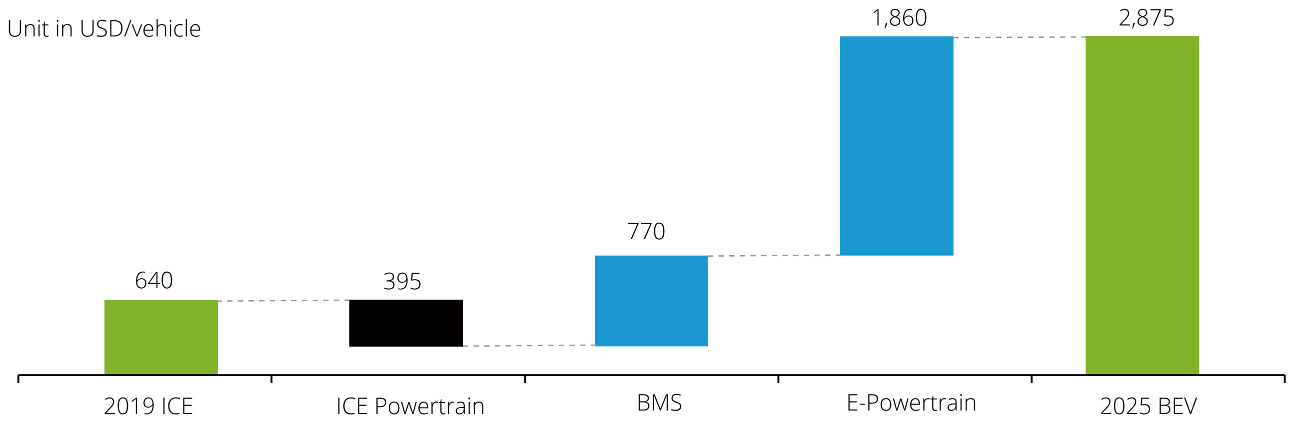


Data source: Deloitte analysis

In addition, electrically-powered new energy vehicles have higher requirements for electronic components power management and power conversion requirements, which boosts the value of automotive semiconductors. As autonomous driving technology matures, the price of semiconductors in a single vehicle will also rise.

According to statistics, the value of automotive electronic components BOM (bill of materials) will increase significantly by 2025, fueled by electronic components used in battery management system and electric powertrain (e.g. inverters, powertrain domain controller DCU, various sensors, etc.).

Figure 14: Electronic Component BOM Boost from Vehicle Electrification

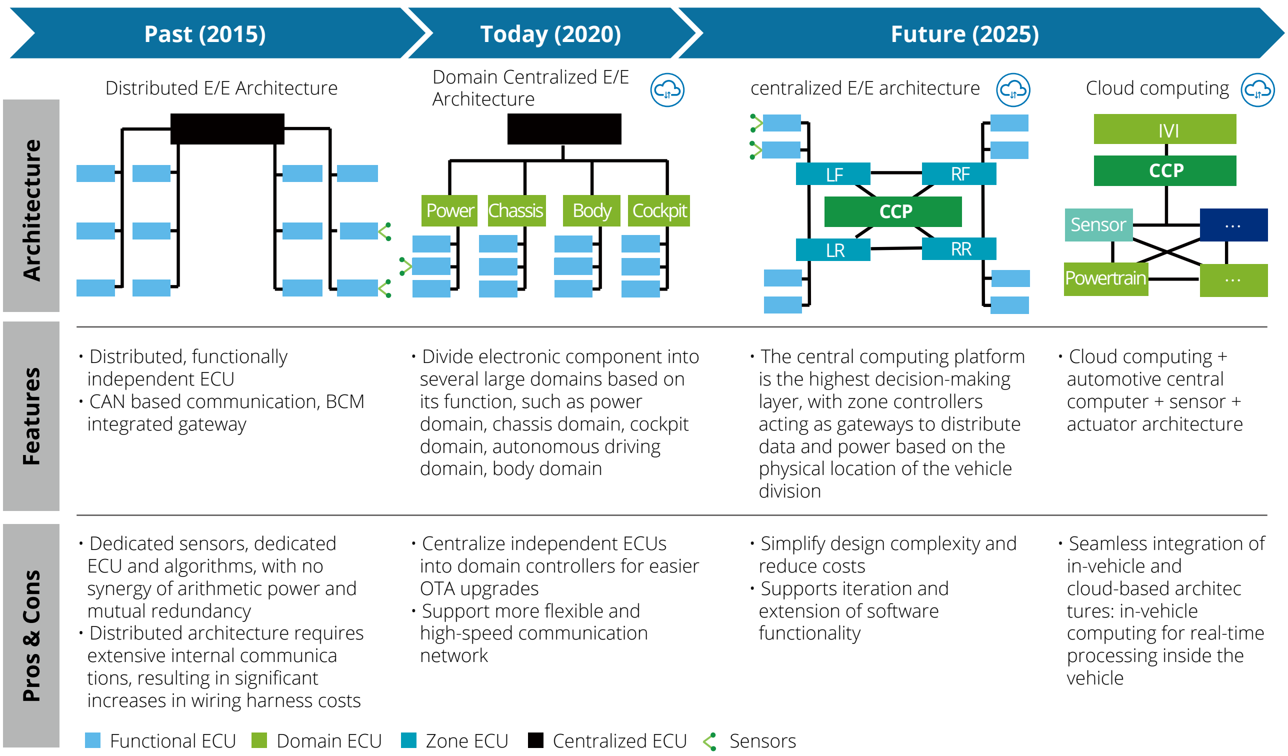


Data source: Deloitte analysis

2.1.3 Domain-centralized Powertrain Electrical and Electronic Architecture drives structural shift in auto-semiconductor

With the increase in consumer demand for economical, safe, comfortable, and entertaining vehicle experience, distributed electronic/electrical architectures can no longer meet the future demand for higher in-vehicle computing power. Rise of intelligent vehicles also contributes to more demand in electronic controllers. Since the number of ECUs and sensors in the vehicle rises, the cost of the vehicle wiring harness and the difficulty of wiring increase dramatically. Therefore, it is necessary to reshape automotive electrical/electronic hardware architecture from traditionally distributed model towards more "centralized, lightweight, streamlined and scalable" approaches. In addition, the transformation will help to meet the demand for more powerful computing power deployment, higher signal transmission efficiency, while taking into account body weight reduction and cost control considerations.

Figure 15: Roadmap for the Evolution of Automotive E/E Architecture



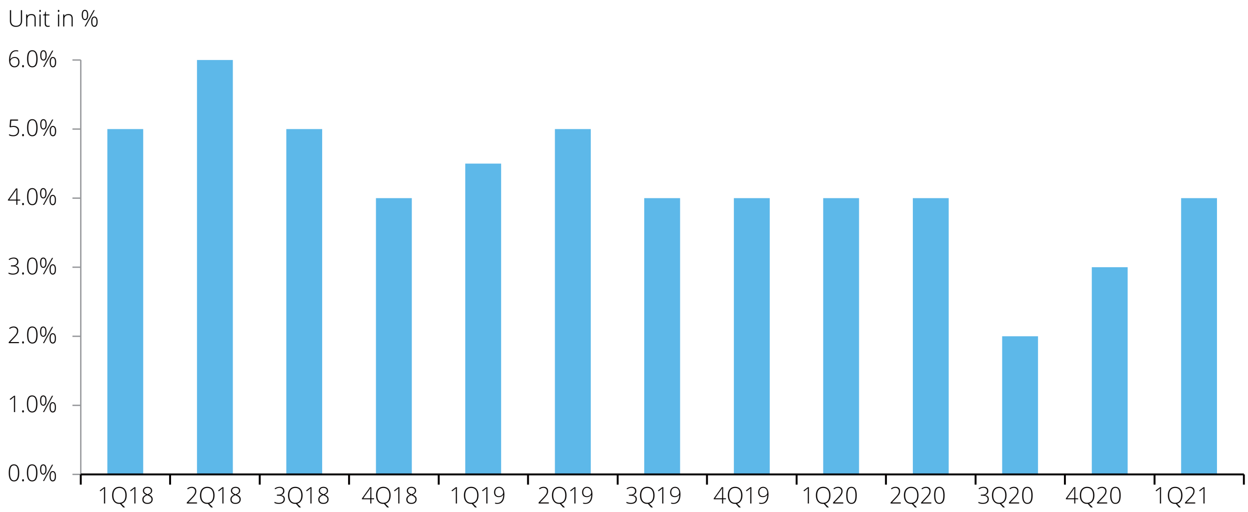
Data source: Deloitte analysis

2.2 Chip Shortage Continues to Spread Its Impact with No Relief in Sight

Compared to the overall semiconductor industry, shortage of automotive semiconductors is particularly prominent. According to the forecasts from AFS, global vehicle production will be reduced by 8.1 million units in 2021, bringing a total economic loss of $210 billion dollar, with the Chinese market expected to lose about $26 billion dollar.

Mismatch between constrained supply and soaring demand was the biggest trigger for automotive semiconductor shortage in the short term. Auto makers lowered demand forecast in early 2020 as a result of the coronavirus outbreak, hence reduced orders for relevant car parts and components.

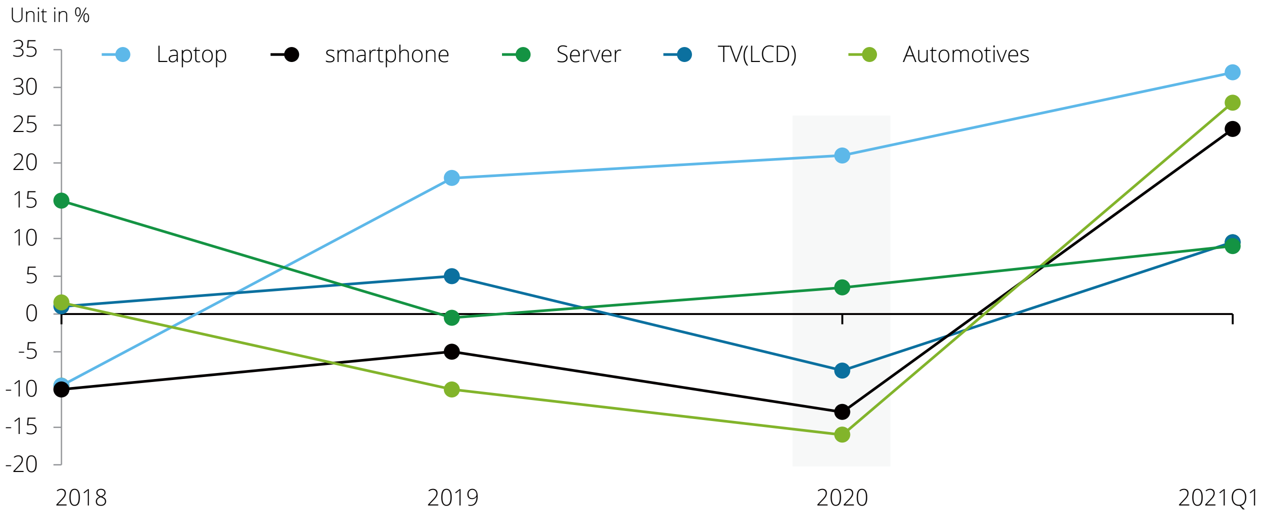
Figure 16: 1Q18 - 4Q20 TSMC's Share of Revenue from automotive sector



Data source: Factiva

During the same period, the pandemic stimulated demand for consumer electronics, which took over chips from OEM order cancellations. In the first quarter of 2020, for example, global shipments of laptops, TVs, mobile phones, automobiles and servers have increased significantly, with shipments of laptops rose more than 35%. In order to cope with surging demand, OEMs shifted their manufacturing capacity almost entirely to the production of consumer electronics, resulting in the plummet of automotive shipments.

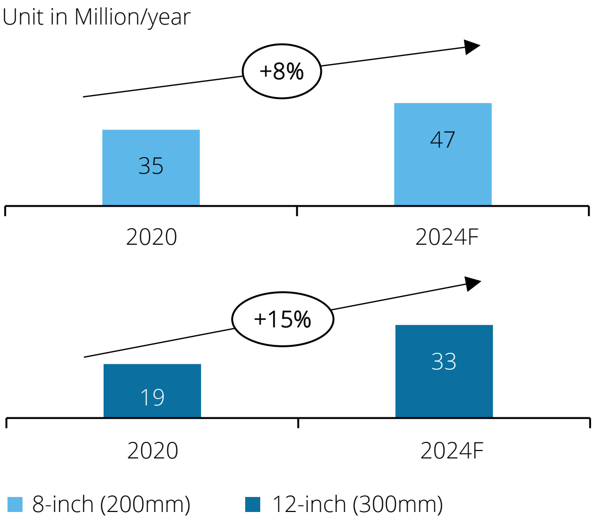
Figure 17: Worldwide Laptop/TV/Mobile/Auto/Server Shipments, Q1 2021



Data source: Factiva

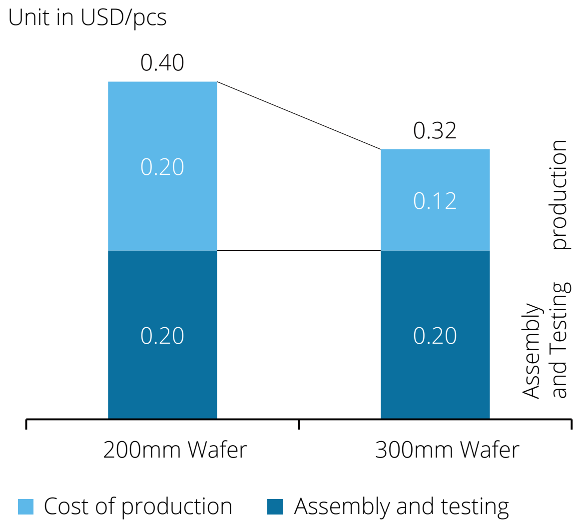
Another key factor behind the current shortage stems from foundries' low willingness to expanded capacity for the mature node 200mm capacity, which are primarily used to produce automotive-graded semiconductor. Automotive chips mainly leverages 200mm wafer since its matured production process provides desired safety and stability. Compares to 200mm wafers, 300mm wafers are mainly used for the production of consumer electronics products including computers, tablets, smart phones; however, since the 300mm wafer production line enjoys higher efficiency, covering a wider range of downstream use cases, foundries invest heavily in 300mm capacity. For instance, the production of analog chips is 40% cheaper using the 300mm capacity and in turn bolster gross margin by 8%. In addition, 200mm fabs are older facilities, which means that equipment required in 200mm capacity is even more difficult to acquire today. The problem is there is not enough used equipment available, and not all of the new or expanding 200mm fabs can afford to pay the premium for refurbished or new equipment. Therefore, 300mm capacity is expected to grow twice as faster compared to that of the 200mm capacity worldwide.

Figure 18: Global 200mm and 300mm Wafer Capacity and Growth Rate, 2020-2024



Data source: Gartner

Figure 19: 200mm and 300mm Wafer Cost Comparison (Analog Chips)

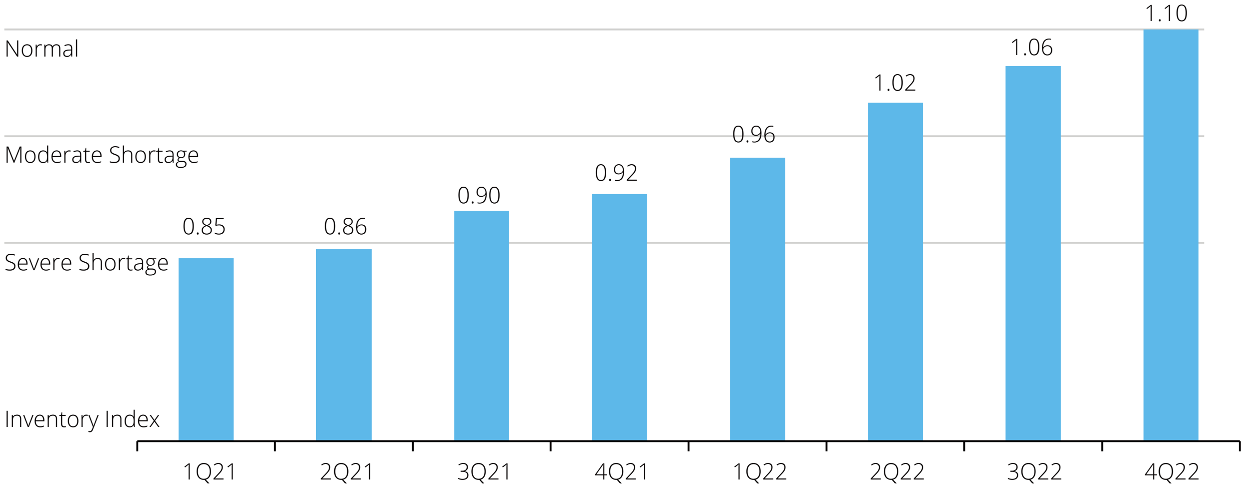


Data source: Texas Instruments

2.3 Domestic Substitution will be An Unstoppable Trend Given Long Term Demand

The primary reason for the current semiconductor shortage is the mismatch between automotive semiconductor market demand and supply in the pandemic environment; therefore, the most effective solution is to expand capacity. However, given the 1-2 years lead time to expand capacity in the semiconductor industry, the shortage is expected to persist until the second quarter of 2022.

Figure 20: Global Semiconductor Inventory Index Forecast



Data source: Gartner

In the short term, we have observed a series of responses from traditional OEMs, new entrants and domestic OEMs to alleviate production pressure from semiconductor shortages, with key measure including temporary chip substitution and feature reduction.

Temporary chip substitution. A luxury overseas brand OEM plans to use alternative chips for non-essential car functionalities, and provide replacement and upgrade at a later stage when chip supply is restored. It plans to keep necessary chips for more profitable models or the ones with lower emission to fulfill its emission reduction target. Such move reduces the impact of the automotive chip shortage by adjusting chip usage while guarantees the performance of key safety functionalities.

Likewise, leading EV OEMs with semiconductor development capabilities are proactively addressing challenges posed by the chip shortage. They are re-writing software to reconfigure available chips for replacement. Similarly, traditional leading OEMs are also attempting to reduce the reliance on chips in short supply and redesign vehicle components to leverage available semiconductors.

Temporary Feature Deduction. In addition to exploring the possibility of chip replacement, a number of car companies have reduced car functionalities to ensure the continuing operation of production lines. A leading NEV OEM, for instance, reduced the number of millimeter-wave radars from 5 to 3 among its recent productions to ensure delivery, but offered customers free installation of required chips when the supply is restored. Many traditional OEMs from overseas also adopted a similar approach by reducing the amount of chips used in non-essential parts and features as a response to the chip shortage crisis.

Although OEMs have come up with various solutions, none is sustainable in the long run. Both temporary chip replacement and feature reduction will further increase R&D cost and reduce consumer confidence to make a purchase.

In the medium to long term, the degree of shortage and response strategy will be different for various types of auto-semiconductors, depending on the level of technology barriers.

Figure 21: Shortage status of of Various Semiconductors and the Corresponding Coping Measures

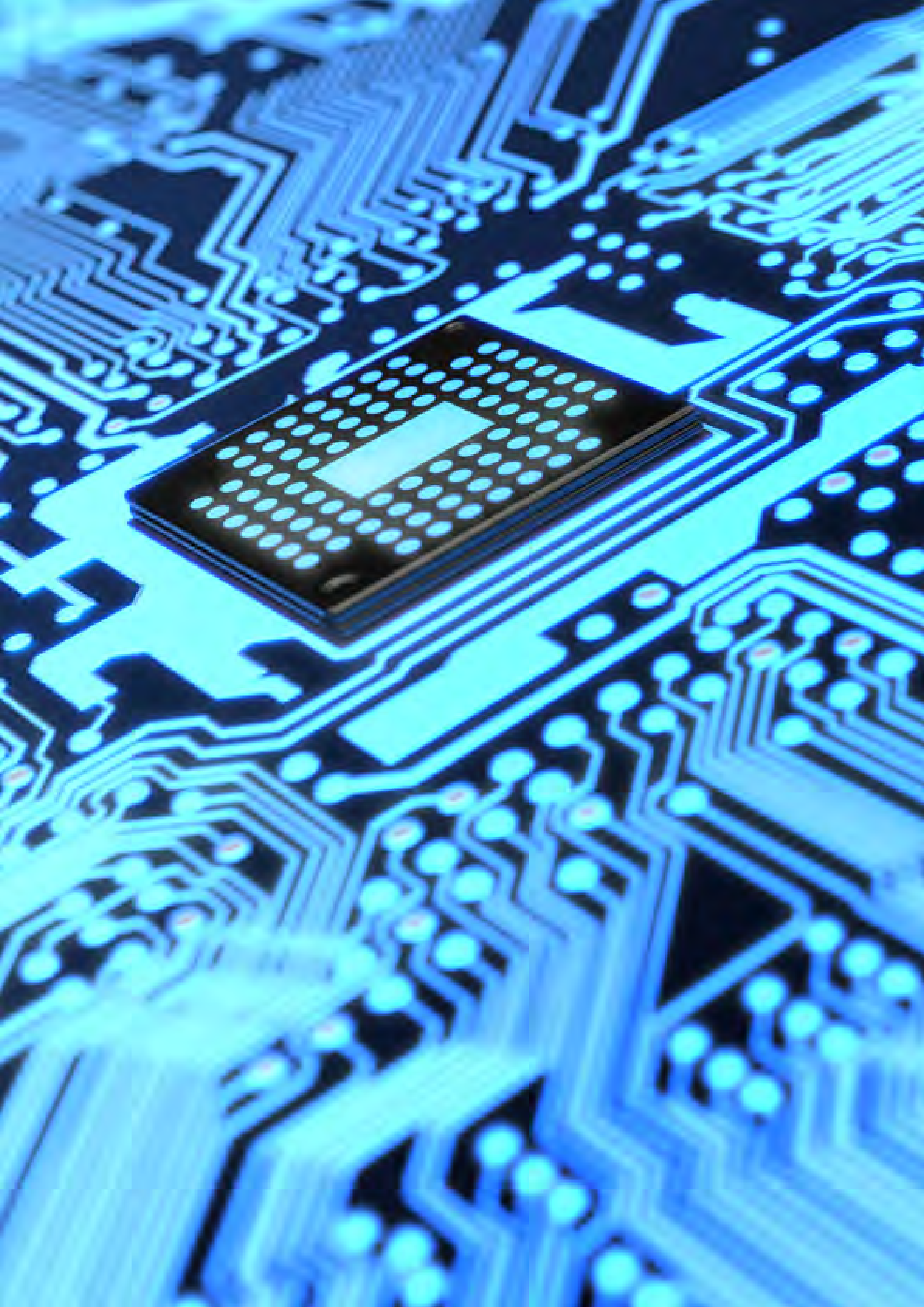
	Current shortage degree	Responding strategy
MCU Chip	Delayed delivery from mainstream factories. According to market statistics of Q3, the average delivery period is more than 20 weeks, which is twice as usual	• **Highest process complexity and concentrated production capacity.** Production is highly dependent on economies of scale. IDM manufacturers are considering outsourcing,. 70% of the production capacity comes from TSMC • **Slow domestic substitution process.** Only a few Chinese manufacturers can mass produce MCUs for less-premium car model and can only be used in non–vehicle control scenarios (such as seats, air conditioning, etc.)
IGBT Chip	According to market statistics of Q3, the delivery period of manufacturers fluctuated significantly, ranging from 30 to 50 weeks	• **Moderate process barriers and relatively fragmented production capacity, especially for <650V IGBT field for passenger vehicle.** There are leading players and capacity layout in Europe, America, Japan, Korea and China • **Successful breakthrough of domestic substitution.** IGBT products from manufacturers such as CRRC, BYD and STARPOWER successfully entered the leading OEM supply chain
Analog Chip power management chip, etc.	The delivery cycle in Q2 can be as long as 20 weeks.	• **Mature technology and extensive downstream applications.** The market share of the top 5 manufacturers exceeds 65%, but there are still many small and medium-sized manufacturers in each region with mass production capacity • **The proportion of domestic substitution is gradually increasing.** The technology gap between local players and overseas leading players is narrowing.

Data source: Desk research, Deloitte analysis

Microcontrollers (MCUs) are in the highest shortage and there are challenges to recovery.
The long R&D cycle, high standard of supporting facilities and potential collateral liability of automotive-grade MCU semiconductors make it difficult for OEMs or domestic semiconductor companies to make a breakthrough in the short term. Speaking with automotive-graded MCUs, the global top five companies are NXP, Infineon, Renesas Electronics, STMicroelectronics and Texas Instruments, totaling to more than 95% of the market share. In addition, about 70% of the world's automotive-grade MCU are made by TSMC, that is to say, the feasibility of domestic replacement is limited in the short run. Therefore, automotive-grade MCU semiconductors will remain in short supply before TSMC adjust its capacity.

The shortage of power semiconductors (IGBT) is expected to ease in the medium term.
Due to the relatively mature production process of IGBT semiconductors, automotive-grade IGBT semiconductors have broken through the technical barriers and partially achieved domestic substitution that has the ability to fulfill the short-term demand gap.

The shortage of analog chips for power management and other categories is gradually easing. Although leading companies have taken significant market shares, small and medium-sized manufacturers in all regions, including China, have caught up from technical perspective and incorporated into local supply chain because the process of such chips is relatively mature, signaling strong domestic substitution.



Part III. Strategy Formulation

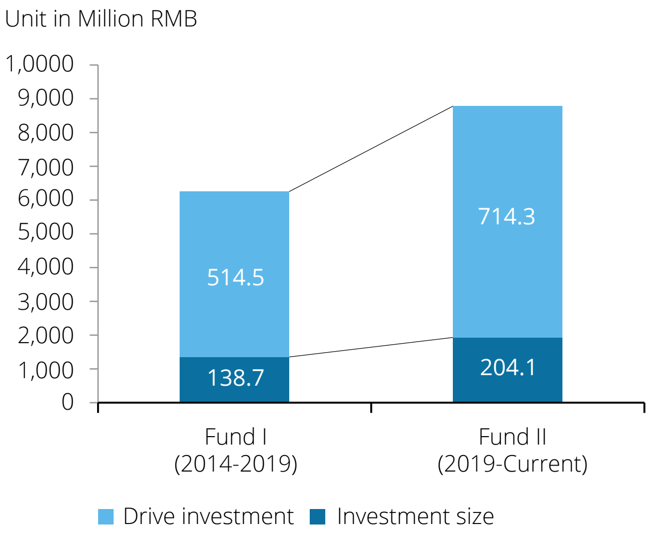
Reshape the Value Chain of the Automotive Industry and Create a Thriving Ecosystem

3.1 Policies to Bolster Chip Industry and Make Up for Shortcomings

The Chinese government has devoted its efforts in supporting the semiconductor industry. Throughout the evolution of the industry, government and relevant authorities are increasingly involved and play the following key roles:

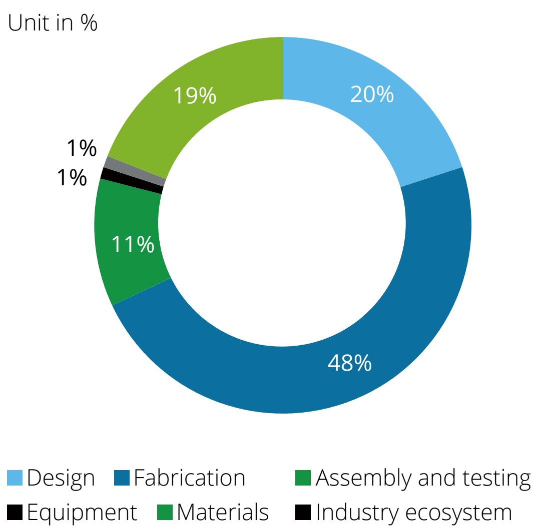
1. Policy Enabler. Provide companies within semiconductor industry value chain with economic support such as tax exemptions. For example: tariff-free policy for imported equipment, materials and spare parts; "two exemptions and three halves" policy for income tax for equipment, materials and packaging companies, etc.; as well as support and training of future talents in education, research, development, financing and application.

Figure 22: National IC Industry Investment Fund Size and Related Investment from Multiplier Effect



Data source: Publicly available information, Deloitte analysis

Figure 23: National IC Industry Investment Fund (Phase I) Investment Categories (2019)



Data source: Publicly available information

2. Cultivator of Local Champions. Since 2014, the Ministry of Finance, the Ministry of Industry and Information Technology and the China Development Bank have jointly launched a national industry fund, the National Integrated Circuit Industry Investment Fund, which focuses on investing in leading enterprises in the domestic semiconductor industry value chain to support the construction of an independent integrated circuit supply chain in China.

3. Industry Development Strategy Architect. During the Two Sessions in 2021, the central government formulated a strategy to promote the localization of automotive-grade semiconductors. Two Sessions put forward the strategic guidelines of "improving the localization of automotive-grade semiconductors" and "formulating a two-step strategy for automotive-grade semiconductors": the first step is to be jointly promoted by OEMs and system suppliers, by supporting key semiconductor companies, the government aims to help semiconductor enterprises to address localization of automotive-grade semiconductors with low technical threshold. The second step is to be promoted by semiconductor suppliers to form an incentive mechanism for semiconductor suppliers to solve the problem of localization of automotive-grade semiconductors with high technical threshold.

4. Resource Consolidator and Industry Standard Setter. Automotive industry semiconductor certification standards are strict, and the demand for safety is extremely high. However, there is no existing standard system or certification platform, and automotive semiconductor process quality lacks systematic experience accumulation. Such phenomenon has hindered the long-term investment willingness of automotive semiconductor enterprises. In 2020, the China Automotive Semiconductor Industry Innovation Alliance was established, the alliance integrates cross-border automotive and semiconductor industries, consolidates industry chain upstream and downstream together to form a transparent, consistent, and open industry certification standards. The alliance also opens up the industry value chain upstream and downstream resources to jointly promote the industry development. In the same year, the Automotive Semiconductor Supply and Demand Matching Manual promulgated by the Electronic Information Bureau of the Ministry of Industry and Information Technology proposed to establish a supply and demand platform for automotive semiconductors, integrate supply and demand resources from upstream and downstream of the industry, and solve the supply and demand imbalance brought about by asymmetric access to information.

Figure 24: National Policies to Support IC Development in China

Year	Policy & Initiative	Issuing Agency	Interpretation
2016	The 13th Five-Year Plan for the Development of National Strategic Emerging Industries	State Council of the People' s Republic of China	Support to improve the service level of OEMs and third-party IP core enterprises, support collaborative innovation between enterprises, and promote key segments to improve industrial concentration. Promote collaborative innovation in the semiconductor industry chain.
2016	Outline of the National Strategy for the Development of Information Technology	General Office of the CPC Central Committee, State Council of the People's Republic of China	Use systematic thinking to make up for the weaknesses, and create an internationally advanced, secure and controllable core technology system, **driving integrated circuits, basic software, core components and other weak links to achieve a fundamental breakthrough.**
2017	Outline of the National Strategy for the Development of Information Technology	NDRC	**Include integrated circuits, new components in the strategic emerging industries key product catalog** for the core electronics industry.
2017	Medium and Long-term Development Plan for the Automotive Industry	NDRC, MIIT, Ministry of Science and Technology	For the shortcomings of the industry, support the advantageous enterprises to carry out joint research in government, industry, academia, research and use, focusing on breakthroughs in power batteries, automotive sensors, automotive chips, electronic control systems, lightweight materials and other engineering, industrialization bottlenecks, and encourage the development of modular supply and other advanced models, as well as high value-added, knowledge-intensive and other high-end components.
2017	One-stop Application Plan for Industrial Strength IGBT Devices	MIIT	Within the three major fields of new energy vehicles, smart grids and rail transportation, **focus on supporting IGBT design, chip manufacturing, module production and IDM, upstream materials, production equipment manufacturing, etc. to promote the development of IGBT and related industries**.
2018	Three-Year Action Plan for Expanding and Upgrading Information Consumption (2018-2020)	MIIT	**Increase financial support to support the research and development of cutting-edge technologies for information consumption, the expansion of various new products and applications.** Local industry and information technology, development and reform authorities to further implement a number of policies to encourage the development of software and integrated circuit industry, and increase the implementation of existing tax policies to support small and medium-sized enterprises.

Year	Policy & Initiative	Issuing Agency	Interpretation
2018	Notice on Income Tax Policy Issues of Integrated Circuit Manufacturing Enterprises	Ministry of Finance, State Taxation Administration, NDRC, MIIT	Establish tax policies such as "two exemptions and three reductions" and "five exemptions and five reductions" for IC production enterprises.
2018	Strategic Emerging Industries Classification 2018	National Bureau of Statistics	Recognize integrated circuit manufacturing and semiconductor discrete device manufacturing as a strategic new emerging industries.
2019	Letter of Response to Proposal No. 2282 (No. 256 in the category of public transport and postal services) of the Second Session of the 13th National Committee of the Chinese People's Political Consultative Conference	MIIT	Continuously **promote the development of industrial semiconductor materials, chips, apparatus and IGBT module industry**, according to the industrial development situation, adjust and improve the policy implementation details to better support industrial development.
2020	Notice on the Issuance of Several Policies to Promote the High-Quality Development of Integrated Circuit Industry and Software Industry in the New Period	State Council of the People' s Republic of China	**Encourage the development of IC industry from various aspects** such as finance and taxation, investment and financing, research and development, import and export, talents, intellectual property rights, market application, international cooperation, etc.
2020	Strategy for the Innovative Development of Intelligent VehiclesNotice on the Issuance of Several Policies to Promote the High-Quality Development of Integrated Circuit Industry and Software Industry in the New Period	NDRC and 10 other agencies	**Clearly proposed the construction of intelligent vehicle key components industry clusters, including automotive-grade chips, intelligent operating systems and intelligent computing platforms**

Year	Policy & Initiative	Issuing Agency	Interpretation
2020	The New Energy Vehicle Industry Development Plan (2021-2035)	State Council of the People's Republic of China	Clearly focus on **promoting breakthroughs in key technologies and products such as automotive-grade chips, automotive operating systems, new electrical and electronic architectures, and high-efficiency, high-density drive motor systems**, as important parts of the implementation of the new energy vehicle basic technology enhancement project.
2020	Automotive Semiconductor Supply and Demand Matching Manual	MIIT	**The Ministry of Industry and Information Technology will actively guide and support the development of the semiconductor industry.** At the same time, through the automotive semiconductor supply and demand matching platform and other ways to strengthen the construction of the supply chain, increase capacity deployment to provide strong support for the stable and healthy development of the industry.
2020	China Automotive Chip Innovation Alliance was established in Beijing	Ministry of Science and technology, MIIT, NEVC	The alliance aims to establish China's automotive chip industry innovation ecology, break industry barriers, make up for the industry's shortcomings, and **achieve independent security control and comprehensive rapid development of China's automotive chip industry**.
2020	Several Policies for Promoting High-Quality Development of IC Industry and Software in the New Era	State Council of the People's Republic of China	Promote **IC localization through targeted financial and tax subsidies with design and manufacturing as the core.**

Data source: Desk research

3.2 OEMs Leverage Different Business Models to Secure Their Supply Chains

Domestic OEMs and semiconductor companies are focusing on developing automotive-grade IGBT semiconductors at the moment before tackling MCU semiconductors, which needs higher technical requirement and industry standard. Companies have adopted two different approaches: self-sufficient strategy and equity investment strategy

Self-sufficient Strategy
Representative: BYD Company Limited.
Supply Chain Security: BYD started with its battery business, and since IGBT is the core component of the battery management system, the company has already established the key strategy of building its own IGBT supply chain. To date, BYD has a market share of about 20% in the Chinese IGBT market, second only to Infineon, the global IGBT leader. In addition to guarantee a stable supply of its own IGBT semiconductors, BYD also has the ability to provide automotive-grade IGBT semiconductors to other OEMs

Develop a Cost Leadership Strategy: The IGBT semiconductor is a high cost component for new energy vehicle, and thanks to its independent supply capability, BYD enjoys significant cost advantage. For same IGBT, cost of BYD's is only 1/3 than that of its competitors. In addition, self-control of the production process makes the standardization of component specifications possible, which further helped BYD to reduce the overall manufacturing cost of its products. Hence, the independent and controllable semiconductor supply chain has helped BYD to gain cost advantages and enhance product competitiveness.

Support Future Business Development: Going forward, BYD also plans to expand into OEM business in the future, and the core competitiveness of the OEM model also lies in the cost advantage. Thanks to its capability that covers full IGBT industry value chain, coupled with its manufacturing expertise in the battery field and vehicle production, BYD will externalize its industry experience, and further enhance its influence in the automotive industry.

Equity Investment Strategy
(1) Cross Shareholding Representative: Toyota Group
Toyota Group invests in automotive-grade semiconductor giant Renesas Electronics to ensure secure and stable semiconductor supply. Cross-shareholding is Toyota's typical way of building in-depth partnership with core component suppliers. The shift in demand to electric vehicles and autonomous driving translates to increasingly important roles of semiconductors and software in automobiles. With such trend in mind, Toyota Group takes an indirect 4.5% stake in Renesas Electronics through its core component supplier DENSO (2019) to deepen the partnership, which notably mitigates the impact of the current ship shortage on Toyota compared to other companies. Compared to typical procurement relationship, the cross-shareholding model helps OEMs ensure priority procurement in unprecedented times.

(2) Joint Venture Representative: SIAPM (SAIC Infineon Automotive Power Modules (Shanghai) Co, Ltd.)
Extensive Ties with Core Suppliers to Ensure Stable IGBT Supply: For SAIC, the establishment of the joint venture not only reduces the procurement cost of IGBT, but also ensures the stable supply of IGBT semiconductors. On the other hand, SAIC also leverages resources at the joint venture company to train local teams and build automotive-grade semiconductor talent pipeline.

Seize Market Opportunities and Local Demand to Expand Industry Reach: China is by far the world's largest market for electric vehicles. The establishment of a joint venture will help Infineon solidify its relationship with Chinese OEMs and leverage its partners' resources to capture local customer needs, market opportunities, and quickly develop desired application scenarios. We also observe more future localization initiatives in manufacturing, sales, and services among leading multinational corporations to respond to China market demand in a timely manner.

3.3 Collaboration among Ecosystem Players to Facilitate High-Quality Growth

In the ICE era, the demand for semiconductors was relatively clear. Therefore, OEMs, component suppliers (Tier-1) and semiconductor suppliers (Tier-2) had a clear division of labor and operated in a single chain model. The accelerated transformation towards intelligent and electrified automobiles lead to increasingly complex demand for car semiconductors. OEMs and suppliers at all levels should collaborate more closely in R&D, supply chain and sales. The relationship needs to change from single chain model to "co-creation, co-management and co-marketing". Therefore, OEMs, component suppliers and semiconductor companies should establish new mechanism of partnership within the ecosystem.

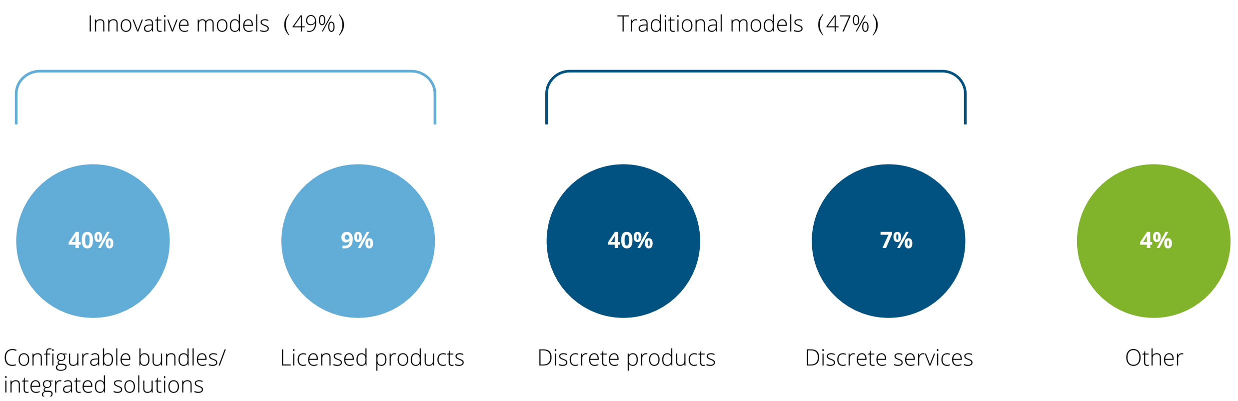
The construction of the ecosystem depends on the transformation of the core capabilities of enterprises. In summary, companies should focus on the business model transformation, new capabilities acquisition, digital transformation, and talent development.

3.3.1 Business Model Transformation: Product Innovation through Co-Creation to Improve Product-Market Fit

OEMs, semiconductor companies and hardware manufacturing companies have to co-create solutions in the future and transform their business models from a "transaction-based" model to "continuous service based" model.

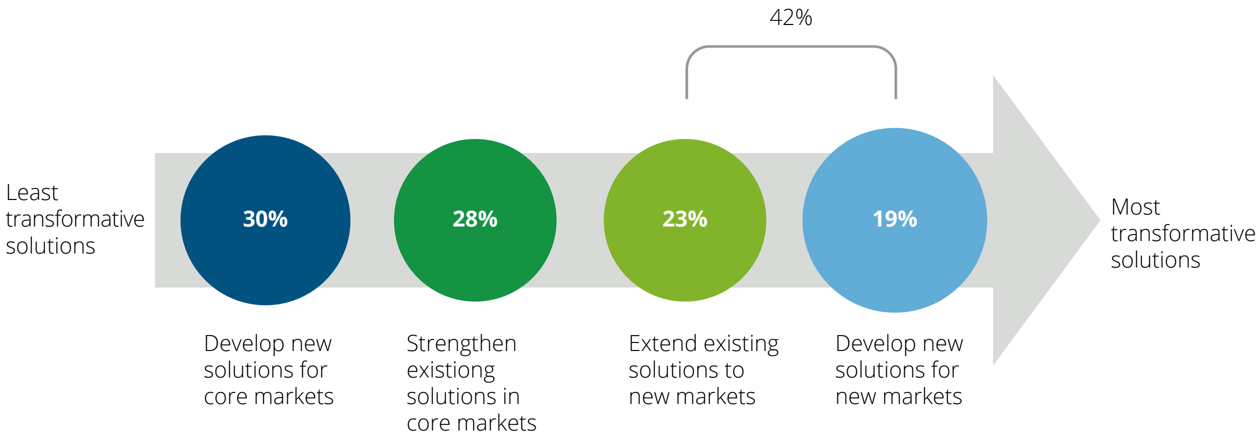
Based on the results of Deloitte's global survey on leading semiconductor companies, 42% of the executives surveyed want to access new markets and shape new business models by co-creating scenario-based solutions with vertical industry leaders or software companies. The shift in business model implies a transformation in the model of product development, sales, and go-to-market for all companies along the value chain. Many semiconductor companies will broaden their product portfolio to meet the customized needs of OEMs and end consumers, in addition to offering their core products.

Figure 25: Research Question: Which Method Best Describes Your Approach to Relevant Markets in Your Transformation Strategy?



Data source: Deloitte analysis

Figure 26: Research Question: Which Method Best Describes Your Approach to Relevant Markets in Your Transformation Strategy?

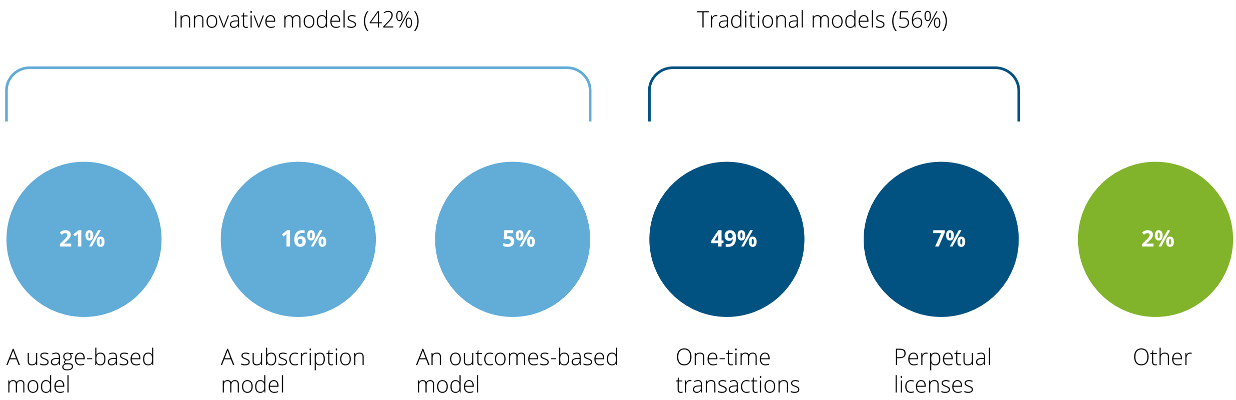


Data source: Deloitte analysis

19% of global semiconductor leaders believe that additional solutions should be developed to cater new markets. 50% of semiconductor companies believe that business models such as customized product portfolios, scenario-based integrated solutions, and selective licensing fees will be as important as established, traditional, stand-alone product models.

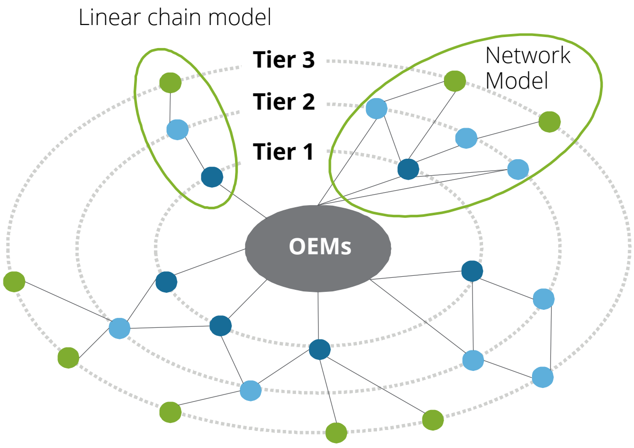
Nearly 42% of the semiconductor companies surveyed believe that a subscription, pay-per-use model is needed, a shared perception among semiconductor design, production, and manufacturing companies. Such philosophy mirrors the changes that have taken place in the software industry over the past 10-15 years. The guiding principle has driven the transformation of the software industry, producing numerous high-growth, high-value business models that generate sustainable revenue. We expect the similar trend will prevail in both semiconductor and automotive industry.

Figure 27: Research Question: How Will You Generate Revenue from Your Main Products?



Data source: Deloitte analysis

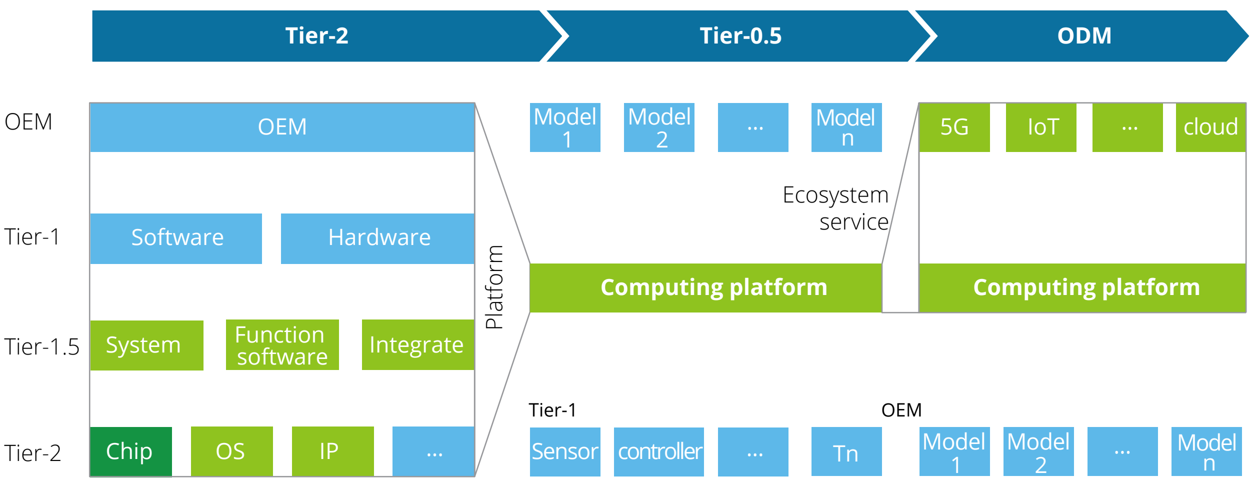
Figure 28: Supply Chain Structure Shifting from Single Chain to Integrated Network



In this context, the collaboration between OEMs and semiconductor companies has evolved from a "linear" to a "network" model.

For instance, a recent development trend in AI semiconductor suppliers has shown that some of tier-2 companies, which focus on the development of software and algorithm, have advanced from tier-2 to tier-1 or even tier-0.5 suppliers for OEMs. Such transformation enhanced their market position by strengthening hardware and software collaborative development capabilities, achieving full integration of hardware resources, system software and functional software, and improve compatibility with various demands from upstream and downstream of the industry value chain.

Figure 29: The Evolving Role of AI Semiconductor Companies in the Smart Car Value Chain



Given changes described above, the R&D, supply chain and production models of OEMs and semiconductor companies all undergo transformations. OEMs and their partners jointly develop scenario-based solutions and design next generation products in the early R&D phase; in addition, mass production based on customized solutions put pressure on the overall supply chain process, and quality management.

3.3.2 Capabilities acquisition through M&A

Based on the results of Deloitte's Global Semiconductor Leaders Survey, in addition to self-built capabilities, more company management team begin to recognize that building ecosystem and acquire new capabilities through M&A will be key approaches for business transformation.

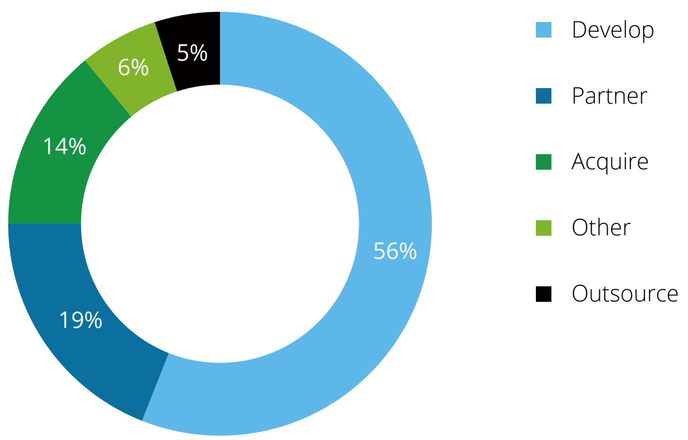
More than half of respondents say that their organizations plan to develop needed capabilities internally. A third plan to fortify their capabilities through partnerships or acquisitions. As the chip market becomes increasingly complex, with a diverse set of capabilities needed, some semiconductor companies believe they will need outside help to fill capability and talent gaps to achieve their ambitions for growth.

It is worth noting that building a collaborative ecosystem requires systematic coordination and planning. Companies need to have a clear understanding on their own capabilities, the cooperation approach, and the business boundary from both sides; we have observed that leading enterprises from various industries have established organization that responsible for managing partner for their entire lifecycle.

At the same time, companies also need to quickly acquire capabilities in the short term through M&A. Establishing joint ventures would also allow OEMs and semiconductor companies to foster long-term interests. It is worth noting that M&A and JV activities are not easy tasks, as many failed due to a lack of alignment of strategic objectives, imbalance in governance and equity, lack of integration experience, and cultural and communication differences.

According to Deloitte's M&A and integration methodology and experience, companies should focus on 12 critical success factors for M&A success, and follow up with the corresponding capability building.

Figure 30: Deloitte Global Semiconductor Leaders' Access to Core Competencies for Strategic Transformation
Research Question: What is Your Plan (Preference) to Acquire Transformation Capabilities?



Data source: Deloitte analysis

Figure 31: Deloitte M&A/Joint Venture Key Success Factors

Success factors

Articulated vision for the JV	Defined perimeter for the JV's activities	Continued support from parents	Clear business / synergy delivery plan	Robust multi-channel communication plan	Detailed roadmap to human capital management
Well established governance structure and process	Clear operating model	Strong sponsorship from executive teams	Comprehensive plan for stakeholder engagement	Experienced and dedicated management team	Clear exit strategy / dissolution criterion

Pre-Day 1 leading up to JV launch

Building blocks for Joint-Venture success

Purpose & Objectives

- Align parents' interests around the JV's objectives up front
- Communicate clearly to ensure "buy-in" across the organization
- Agree how value will be derived and shared with JV partners
- Focus on a small number of critical initiatives
- Build the "blueprint" for the JV as early as possible
- Tackle risks and issues quickly and make tough decisions early
- Define timeframe for JV and if require agree on exit/dissolution mechanism

Governance & Oversight

- Identify the sources of benefit and establish clear ownership and accountability
- Create clear protocols for decision making
- Track benefits and ensure alignment of numbers
- Parents should play an active role in capital allocation, risk and performance management
- Give careful consideration to the appointment of the JV leaders
- Allocate your best resources to managing the implementation of the JV
- For high-tech companies, the parent company's licensing model for key technologies and IP is critical

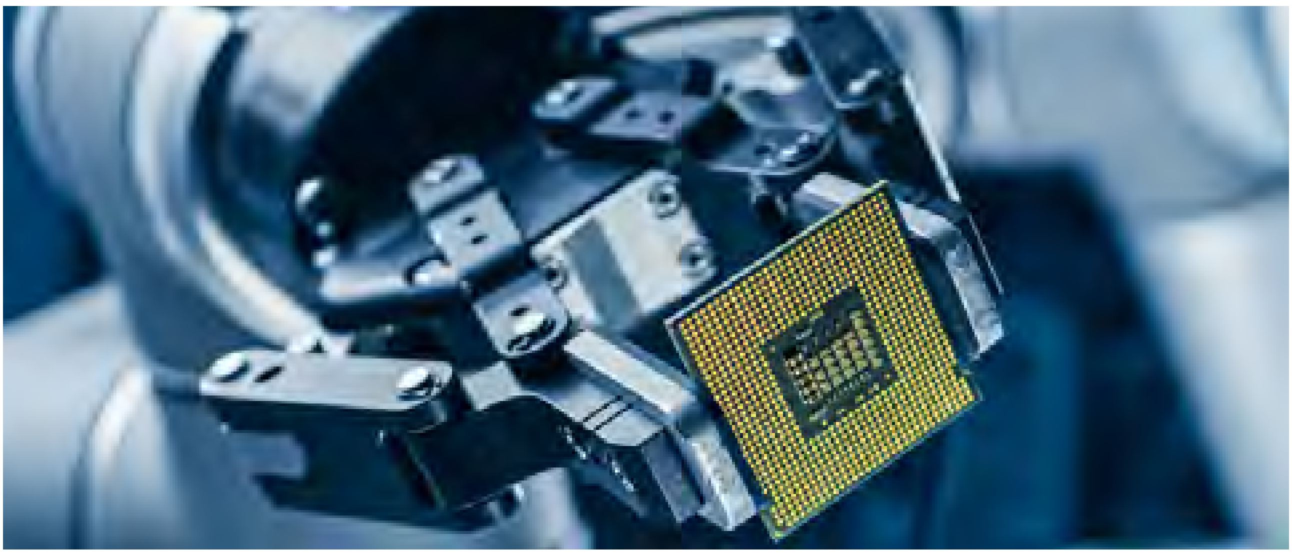
Metrics & Financials

- Specify the services parents will provide, and establish fair transfer-pricing schemes
- Establish risk and performance management systems
- Challenge and limit interdependencies
- Link the JV to the corporate review and planning of at least one of the parents
- Implement robust planning and programme management to underpin JV objectives
- Make planning and reporting frameworks as practical as possible

Human Capital & Talent

- Create a compelling value proposition for JV employees
- Recognize that change increases uncertainty
- Remove uncertainty quickly through open, honest and timely communications
- Involve and prepare the HR team early on, ensuring it is skilled and fully resourced
- Plan for change at all levels across the organization and ensure effective support and training is available
- Realign objectives and rewards with the objectives of the JV

Data source: Deloitte analysis

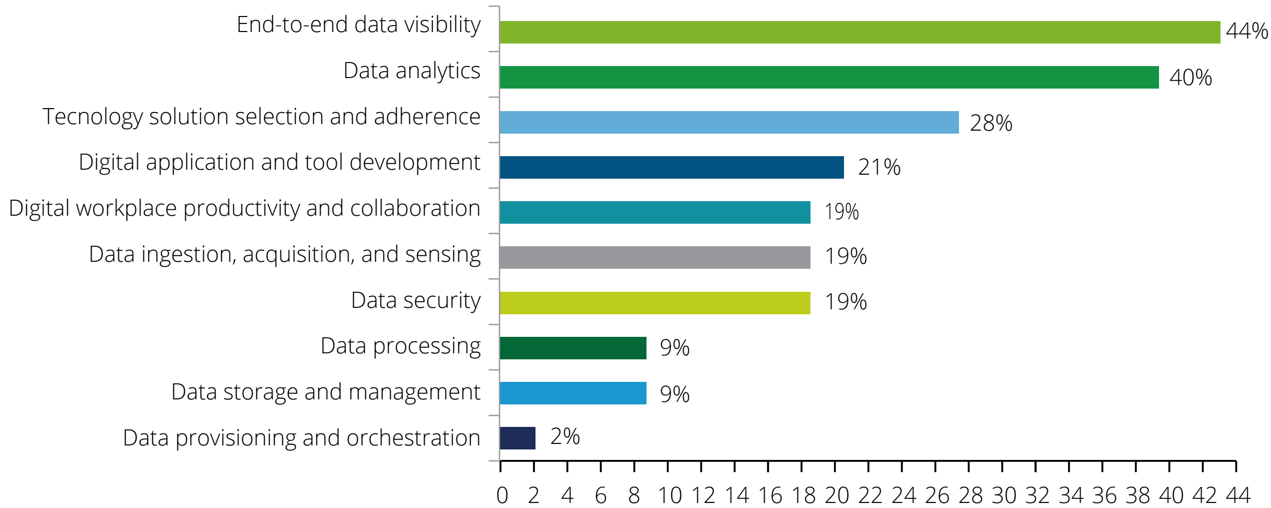


3.3.3 Digital Transformation：Building a Digitalized Engine with Digital DNA

In the future, as the "CASE" transformation continues to deepen, "Consumer Experience" and "Vehicle intelligence" will become the core competitiveness of industry. Consequently, it is crucial for companies to build digital capabilities. Advancing digital adoption in the industry is vital for deriving actionable insights from the increasingly vast amounts of product and customer data curated from expanding markets.

While companies are focused on winning and providing solutions to enable advanced digital technologies like artificial intelligence and edge computing, they should deploy related technologies internally to provide capabilities (data visibility, advanced analytics, and process automation) essential to executing their transformation. End-to-end data visibility and analytics can facilitate responsive sensing of new demand and market shifts, collaborative engineering of new products, and efficient manufacturing and delivery of those products. A data-driven digital architecture or "DN" also advances automation to support expansion and scalability. These tech-enabled capabilities will be the foundation of a digital end-to end value chain across expanding markets and portfolios.

Figure 32: The Most Important Digital DNA for Organizational Transformation



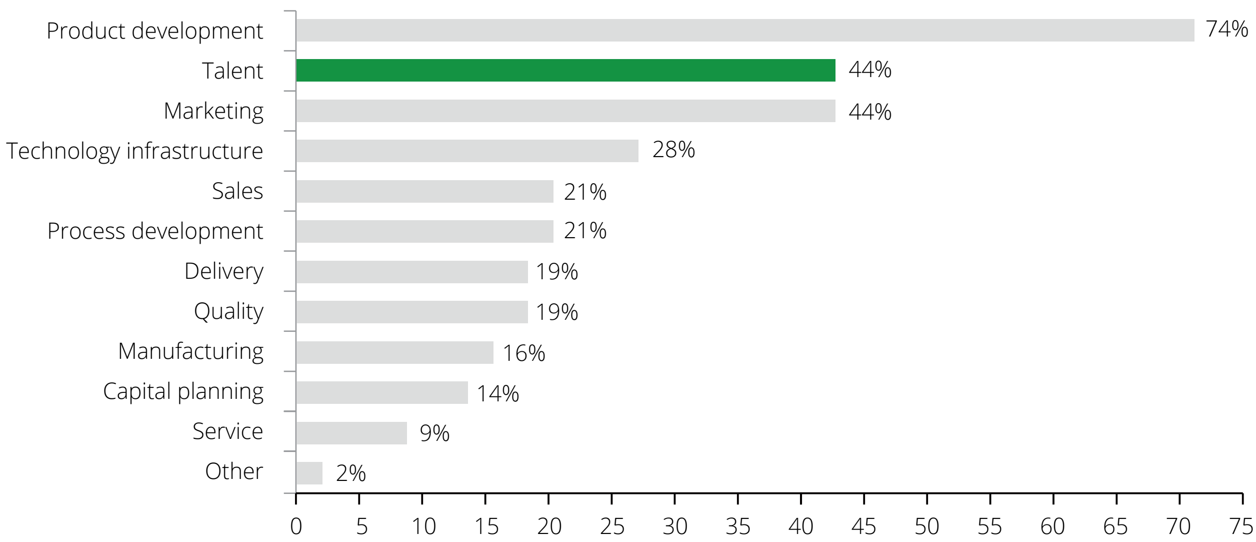
Data source: Deloitte analysis

3.3.4 Building a Comprehensive Talent Echelon in the New Ecosystem

Based on the results of Deloitte's global survey of leading semiconductor companies, executives believe that the most important element, besides product development, is the transformation of talent capabilities. As automobiles become intelligent and electrified, the boundary between the automotive industry and the semiconductor industry is gradually blurred, and the demand for cross-industry talent will increase significantly. Automotive manufacturers, semiconductor companies and other companies from both the upstream and downstream will need such talent who have in-depth understanding of the semiconductor industry and the ability to propose scenario-based solutions in the automotive industry.

This puts forward the following requirements for future corporate human resource management strategy: first, provide a diversified capability development platform for existing talents; second, set force a clear cross-industry talent recruitment target for the human resource team; third, establish an independent organization for special talents and provide them with certain degree of autonomy to prevent bureaucratic formalities from undermining employee motivations; fourth, pay attention to the talent strategy under the new business model. In the future, software capability will gradually become the core competitiveness of OEMs, who will establish direct and closer ties with tier-2 semiconductor companies.

Figure 33: Core Elements of Strategy Transformation in the Deloitte Global Semiconductor Leaders Survey Research Question: What are the key Agendas for Your Transformation Strategy?



Data source: Deloitte analysis

Concluding Remarks

The current shortage of automotive semiconductors reflects the vulnerability of its global supply chain. The stable and secure supply of auto-semiconductor is becoming increasingly important. As the "CASE" transformation of the automotive industry continues to advance, semiconductors will enjoy significant improvement both in terms of quantity and performance. Domestic semiconductor companies are expected to embrace a period of rapid growth thanks to support from the government, who deems the localization of automotive-grade semiconductors as a strategic mandate. For all players in the automotive ecosystem, it is important to deepen collaboration and form an open, diversified partnerships to jointly address industry challenges and changes onward.

The journey to realize self-sufficient auto semiconductor epitomizes China's transition from "high growth" development to "high quality" development. The future industry landscape will be volatile, uncertain, complex, and ambiguous. As the boundaries of various industries blur, an open ecosystem and collaboration will be the key winning strategy in the future. All players should work together to build an new ecosystem and stay proactive in the wave of transformations.

Contacts

Victor Chen
Deloitte Consulting China
Merger & Acquisition Practice Leader
Tel: +86 21 2316 6413; +86 135 6413 1745
Email: vicchen@deloitte.com.cn

Andrew Chen
Deloitte Consulting China
Clients Industries & Markets Partner
Tel: +86 755 3353 8168
Email: andrewclchen@deloitte.com.cn

Yin Sun
Deloitte Consulting China
Merger & Acquisition Director
Tel: +86 10 8512 4950; +86 139 1116 9615
Email: yinbjsun@deloitte.com.cn

Johnny Chen
Deloitte Consulting China
Merger & Acquisition Senior Consultant
Tel: +86 185 0050 5899
Email: johnnchen@deloitte.com.cn

Andy Zhou
Deloitte China Automotive Industry Leader
Tel: +86 21 6141 1028; +86 139 1612 3115
Email: andyzhou@deloitte.com.cn

Nickie Wang
Deloitte China Automotive Industry Senior Manager
Tel: +86 21 2316 6664
Email: nickiwang@deloitte.com.cn

Acknowledgements
The authors would like to thank Deloitte consultants Carlson Qiao, Rabby Yang, Harry Liu, Bessy Ma, Qingguo Zhang, Yang Hu for their contributions to this report.

Footnote

1. Mordor Intelligence, "Global Semiconductor Industry Landscape - Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026)", 2020
2. Mordor Intelligence, "Global Semiconductor Foundry Market - Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026)" 2020
3. Gartner, "Semiconductor Inventory Analysis Worldwide", 2021
4. Gartner, "Worldwide Foundry Capacity, Shipments and Utilization Rate", 2021
5. Gartner, "Forecast analysis: Semiconductor Foundry Service, Worldwide", 2021
6. SEMI, "2021 Silicon Shipment Forecast （MSI）", 2021
7. Deloitte, "Semiconductor Transformation Study", 2021
8. Deloitte, "Software-defined vehicle - industry change" 2020
9. Automotive Industry Association, 2021
10. Real-time big data report on coronavirus outbreak
11. China Passenger Car Association, "Global New Energy Vehicle Sales and Forecast, 2018-2025"
12. TSMC's Share of Revenue from Automotive sector", Factiva
13. "Chip shortage will cause the global automotive industry to lose more than two hundred billion dollars", China Business Network
14. China Consumer News, "Lack of core has given rise to "half-finished" cars, will you buy?"
15. The Economic Observer, "How OEMs solve chip shortage in China?"

Office locations

Beijing
12/F China Life Financial Center
No. 23 Zhenzhi Road
Chaoyang District
Beijing 100026, PRC
Tel: +86 10 8520 7788
Fax: +86 10 6508 8781

Changsha
20/F Tower 3, HC International Plaza
No. 109 Furong Road North
Kaifu District
Changsha 410008, PRC
Tel: +86 731 8522 8790
Fax: +86 731 8522 8230

Chengdu
17/F China Overseas
International Center Block F
No.365 Jiaozi Avenue
Chengdu 610041, PRC
Tel: +86 28 6789 8188
Fax: +86 28 6317 3500

Chongqing
43/F World Financial Center
188 Minzu Road
Yuzhong District
Chongqing 400010, PRC
Tel: +86 23 8823 1888
Fax: +86 23 8857 0978

Dalian
15/F Shenmao Building
147 Zhongshan Road
Dalian 116011, PRC
Tel: +86 411 8371 2888
Fax: +86 411 8360 3297

Guangzhou
26/F Yuexiu Financial Tower
28 Pearl River East Road
Guangzhou 510623, PRC
Tel: +86 20 8396 9228
Fax: +86 20 3888 0121

Hangzhou
Room 1206
East Building, Central Plaza
No.9 Feiyunjiang Road
Shangcheng District
Hangzhou 310008, PRC
Tel: +86 571 8972 7688
Fax: +86 571 8779 7915

Harbin
Room 1618
Development Zone Mansion
368 Changjiang Road
Nangang District
Harbin 150090, PRC
Tel: +86 451 8586 0060
Fax: +86 451 8586 0056

Hefei
Room 1506, Tower A China Resource Building
No.111 Qian Shan Road
Shu Shan District
Hefei 230022, PRC
Tel: +86 551 6585 5927
Fax: +86 551 6585 5687

Hong Kong
35/F One Pacific Place
88 Queensway
Hong Kong
Tel: +852 2852 1600
Fax: +852 2541 1911

Jinan
Units 2802-2804, 28/F
China Overseas Plaza Office
No. 6636, 2nd Ring South Road
Shizhong District
Jinan 250000, PRC
Tel: +86 531 8973 5800
Fax: +86 531 8973 5811

Macau
19/F The Macau Square Apartment H-L
43-53A Av. do Infante D. Henrique
Macau
Tel: +853 2871 2998
Fax: +853 2871 3033

Mongolia
15/F, ICC Tower, Jamiyan-Gun Street
1st Khoroo, Sukhbaatar District
14240-0025 Ulaanbaatar, Mongolia
Tel: +976 7010 0450
Fax: +976 7013 0450

Nanjing
40/F Nanjing One IFC
347 Jiangdong Middle Road
Jianye District
Nanjing 210019, PRC
Tel: +86 25 5790 8880
Fax: +86 25 8691 8776

Ningbo
Room 1702 Marriott Center
No.168 Heyi Road
Haishu District
Ningbo 315000, PRC
Tel: +86 574 8768 3928
Fax: +86 574 8707 4131

Sanya
Floor 16, Lanhaihuating Plaza
(Sanya Huaxia Insurance Center)
No. 279, Xinfeng street
Jiyang District
Sanya 572099, PRC
Tel: +86 898 8861 5558
Fax: +86 898 8861 0723

Shanghai
30/F Bund Center
222 Yan An Road East
Shanghai 200002, PRC
Tel: +86 21 6141 8888
Fax: +86 21 6335 0003

Shenyang
Unit 3605-3606,
Forum 66 Office Tower 1
No. 1-1 Qingnian Avenue
Shenhe District
Shenyang 110063, PRC
Tel: +86 24 6785 4068
Fax: +86 24 6785 4067

Shenzhen
9/F China Resources Building
5001 Shennan Road East
Shenzhen 518010, PRC
Tel: +86 755 8246 3255
Fax: +86 755 8246 3186

Suzhou
24/F Office Tower A, Building 58
Suzhou Center
58 Su Xiu Road, Industrial Park
Suzhou 215021, PRC
Tel: +86 512 6289 1238
Fax: +86 512 6762 3338 / 3318

Tianjin
45/F Metropolitan Tower
183 Nanjing Road
Heping District
Tianjin 300051, PRC
Tel: +86 22 2320 6688
Fax: +86 22 8312 6099

Wuhan
Unit 1, 49/F
New World International Trade Tower
568 Jianshe Avenue
Wuhan 430000, PRC
Tel: +86 27 8538 2222
Fax: +86 27 8526 7032

Xiamen
Unit E, 26/F International Plaza
8 Lujiang Road, Siming District
Xiamen 361001, PRC
Tel: +86 592 2107 298
Fax: +86 592 2107 259

Xi'an
Room 5104A, 51F Block A
Greenland Center
9 Jinye Road, High-tech Zone
Xi'an 710065, PRC
Tel: +86 29 8114 0201
Fax: +86 29 8114 0205

Zhengzhou
Unit 5A10, Block 8, Kineer Center
No.51 Jinshui East Road
Zhengdong New District
Zhengzhou 450018, PRC
Tel: +86 371 8897 3700
Fax: +86 371 8897 3710

MAKING AN IMPACT THAT MATTERS *since 1845*

About Deloitte
Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited ("DTTL"), its global network of member firms, and their related entities (collectively, the "Deloitte organization"). DTTL (also referred to as "Deloitte Global") and each of its member firms and related entities are legally separate and independent entities, which cannot obligate or bind each other in respect of third parties. DTTL and each DTTL member firm and related entity is liable only for its own acts and omissions, and not those of each other. DTTL does not provide services to clients. Please see www.deloitte.com/about to learn more.

Deloitte is a leading global provider of audit and assurance, consulting, financial advisory, risk advisory, tax and related services. Our global network of member firms and related entities in more than 150 countries and territories (collectively, the "Deloitte organization") serves four out of five Fortune Global 500® companies. Learn how Deloitte's approximately 330,000 people make an impact that matters at www.deloitte.com.

Deloitte Asia Pacific Limited is a company limited by guarantee and a member firm of DTTL. Members of Deloitte Asia Pacific Limited and their related entities, each of which are separate and independent legal entities, provide services from more than 100 cities across the region, including Auckland, Bangkok, Beijing, Hanoi, Hong Kong, Jakarta, Kuala Lumpur, Manila, Melbourne, Osaka, Seoul, Shanghai, Singapore, Sydney, Taipei and Tokyo.

The Deloitte brand entered the China market in 1917 with the opening of an office in Shanghai. Today, Deloitte China delivers a comprehensive range of audit & assurance, consulting, financial advisory, risk advisory and tax services to local, multinational and growth enterprise clients in China. Deloitte China has also made—and continues to make—substantial contributions to the development of China's accounting standards, taxation system and professional expertise. Deloitte China is a locally incorporated professional services organization, owned by its partners in China. To learn more about how Deloitte makes an Impact that Matters in China, please connect with our social media platforms at www2.deloitte.com/cn/en/social-media.

Designed by CoRe Creative Services. RITM0884263

This is printed on environmentally friendly paper