*Confidential*

# Global and China's Silicon Carbide Power Semiconductor Device Market

*Industry Report*



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# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
## Introduction and Definition

### Definition

•A power semiconductor device is a semiconductor device used as a switch or rectifier in power electronics. In electronic components, power semiconductor devices are electronic devices that need an external power source to operate actively. Materials used to make power semiconductor devices mainly manipulate, amplify, switch, or control the flow of electric current or voltage in a circuit. Power semiconductor devices, including diodes, transistors, thyristors, and sensors, are pivotal for managing electrical power in electronic systems. They require power to execute their roles, which include rectifying current, switching, amplifying signals, and sensing electrical parameters. These components are essential for a variety of applications, from consumer electronics to industrial machinery, where they ensure efficient power management and system performance.

•The global power semiconductor device industry has experienced substantial growth in recent years. As industries strive to achieve greater energy efficiency and reduce their carbon footprint, power semiconductors have become indispensable components in applications such as power supplies, motor drives and renewable energy systems. Technological advancements and the ongoing evolution of semiconductor manufacturing processes are key drivers behind the growth of the global power semiconductor device market. The development of wide-bandgap semiconductors, such as SiC and GaN, has enabled higher efficiency and power density in semiconductor devices.





*Source: Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry

## Major Components of Power Semiconductor Devices

Epitaxial wafer is the key raw material for the production of power semiconductor device. Basically, epitaxial wafer is made by forming various layers on the surface of substrate to enhance the performance characteristics of the substrate such as stronger current tolerance, higher voltage tolerance and operational stability.

**Epitaxial Wafer**

The development of epitaxial wafers has been under evolution and marked significant technological advancements. The epitaxial wafers were initially made of silicon (Si), and then developed into the new generation of materials, represented by silicon carbide (SiC) and gallium nitride (GaN), which reflects the industry's pursuit of higher efficiency and performance. As such, epitaxial wafers can be categorized according to various elements such as Si, SiC and GaN. Other epitaxial wafer materials also include germanium (Ge), gallium arsenide (GaAs) and indium phosphide (InP). Among these materials, SiC has become dominant and is anticipated to remain irreplaceable by alternative semiconductor materials in manufacturing epitaxial wafers in the near future considering its excellent physical properties such as superior efficiency and thermal conductivity

**Substrate**

A substrate is the foundation from which epitaxial wafers are produced by growing epitaxial layers on the substrate. These epitaxial layers are essential for enhancing the quality and performance characteristics of power semiconductor devices, as they address defects inherent to the substrate, aiming to achieve enhanced energy efficiency and improved performance in power semiconductor devices. Therefore, epitaxial wafers are not a type of substrates; instead, epitaxial wafers are produced from substrates and at an essential subsequent stage in the entire manufacturing process that enables the ultimate production of power semiconductor devices.





*Source: Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Classification of Semiconductor Materials and Comparisons among Major Power Semiconductor Materials (1/2)

## Semiconductor materials development process

| Semiconductor | First generation semiconductors | Second-generation semiconductors | Third-generation (broadband) semiconductors | Next Trend |
|---|---|---|---|---|
| **Materials** | Elemental semiconductors: silicon (Si), germanium (Ge) | Compound semiconductors: gallium arsenide (GaAs), indium phosphide (InP) | Compound semiconductors: gallium nitride (GaN), silicon carbide (SiC) | Compound semiconductor: Gallium Oxide($Ga_2O_3$) |
| **Date** | 1950s | 1970s | 1990s | Future |
| **Advantages** | • Abundant and low-cost, silicon is the most widely used semiconductor<br>• Enabled the shift from vacuum tubes to compact electronics | • Faster electron mobility for high-frequency transmission<br>• Direct bandgap for applications in light emission, including infrared lasers and high-brightness red LEDs | • Enhanced thermal and electronic properties<br>• Improved electrical strength and radiation resistance<br>• Energy-efficient and eco-friendly<br>• Compact device size | • Gallium oxide offers higher conduction and breakdown field strength than SiC<br>• It enables cost-effective production of large, high-quality crystals, outperforming SiC&GaN |
| **Disadvantages** | • Silicon outperforms germanium in heat resistance and radiation tolerance<br>• Its indirect bandgap and lower mobility limit applications in optoelectronics and high-frequency/high-power devices | • GaAs and InP are rare materials to obtain, leading to high costs<br>• Toxic and harmful to the environment, limiting their applications | • High Cost<br>• Cannot fully replace earlier semiconductor generations | • Higher crystal brittleness<br>• Stronger disintegration properties<br>• Lower fracture toughness |
| **Technology** | • Silicon manufacturing is mature and near-optimal, yet its physical limits are being reached, narrowing performance gains | • More complex fabrication processes, focusing on more intricate epitaxial growth, which requires two manufacturing stages: substrate production and epitaxy | • GaN semiconductors use heteroepitaxy, while SiC semiconductors use homoepitaxy. Both fabrication processes are complex | • Producing large, defect-free gallium oxide wafers for industrial use is challenging due to high-temperature decomposition and volatility |
| **Applications** | • Widely used in information processing and automation, including consumer electronics, telecommunications, photovoltaics | • In optoelectronics, including millimeter-wave devices, satellite communication, mobile communication, and GPS navigation | • In high-performance sensors<br>• Applications span 5G, IoT, electric vehicles, optoelectronics, and display technology | • Day-blind deep ultraviolet detector |

*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
## Classification of Semiconductor Materials and Comparisons among Major Power Semiconductor Materials (2/2)

**Si**

Si — First-Generation Semiconductor Material. Si is one of the major first-generation semiconductor materials with relatively mature development and applications. Si has abundant reserves with economic cost advantages and is primarily used in logic and memory chips. However, as the technology and performance of Si gradually reaches limits, its development faces bottlenecks. Constrained by factors of these limits and bottlenecks such as low frequency, high-voltage non-resistance, poor heat dissipation and insufficient power capacity, Si struggles to reconcile the contradiction between power density and conversion efficiency, making it unable to meet demands for high power density and high conversion efficiency, which are common in emerging applications such as electric vehicles (''EVs''), consumer electronics fast charging, power management and data centers.

**GaAs**

GaAs — Second-Generation Semiconductor Material. GaAs represents one of the major second-generation of semiconductor materials, which are characterized by superior electron mobility and saturation electron velocity. Relatively narrow bandgap of GaAs limits its capability under high-power and high-temperature conditions. Narrow bandgap implies a higher susceptibility to breakdown under extreme temperatures or voltages, thereby curtailing their performance in high-power scenarios. Therefore, the second-generation of semiconductor materials cannot meet the high-frequency and high-voltage demands brought about by the power revolution.

**GaN**

GaN — Third-Generation Semiconductor Material. GaN exhibits significantly improved performance compared to Si in certain aspects. It possesses overall advantages including wide bandgap, high electron mobility, high switching frequency, low on-resistance and enhanced resistance to high voltage and temperature. However, the lack of thermal conductivity limits the ability to shrink GaN devices when operating at high power densities.

**SiC**

SiC — Third-Generation Semiconductor Material. SiC has a wider bandgap compared to the first and second generations of semiconductor materials, which is suitable for high-voltage and high-temperature environments. Higher thermal conductivity combined with wide bandgap and high critical field give SiC power semiconductors an advantage when high power is a key desirable device feature. Fabricated from an SiC epitaxial wafer, an SiC power semiconductor device refers specifically to a homoepitaxial structure, where a high-quality SiC substrate is overlaid with an SiC epitaxial layer. This precise layering process ensures a high degree of crystalline alignment, which minimizes defects and enhances the material's overall quality. The homoepitaxial structure's superior thermal and electrical conductivity, along with its ability to withstand high temperatures and voltages, makes it highly suitable for efficient and reliable operation in power electronic applications.

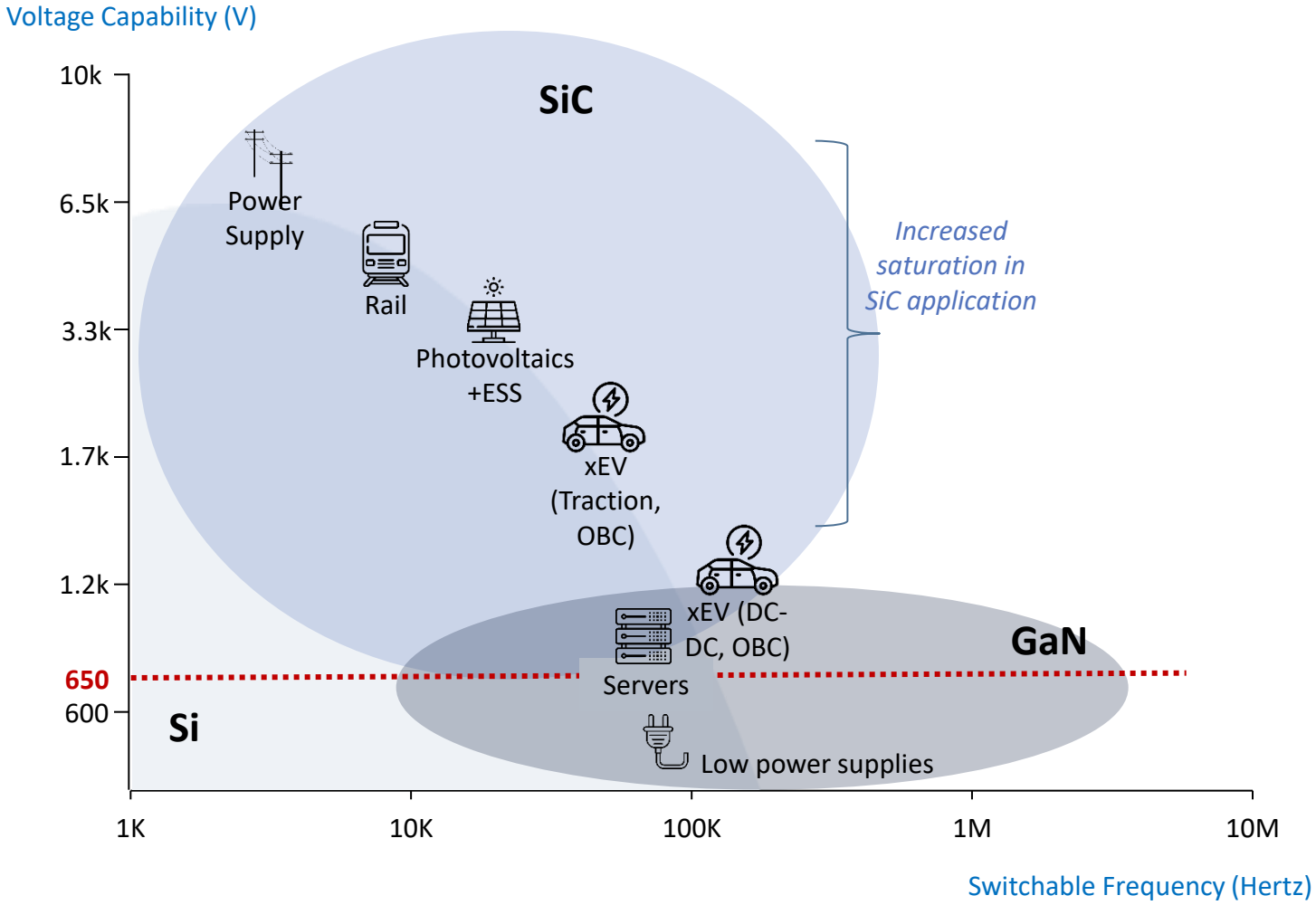
*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Comparisons among Types of Epitaxial Wafer Materials

| Epitaxial wafer material | Composition of power semiconductor device | Key features |
|---|---|---|
| Si | Si epitaxial wafer on Si substrate, resulting in Si power semiconductor device | Si-based power semiconductor device technology is mature and low-cost, but its performance is limited under extreme conditions such as high voltage, high temperature, and high frequency. |
| SiC | SiC epitaxial wafer on SiC substrate, resulting in SiC power semiconductor device | SiC has a wider bandgap, higher thermal conductivity, and higher breakdown electric field, allowing it to perform excellently in high-voltage, high-temperature, and moderate-frequency environments. This significantly reduces switching losses and allows for smaller device sizes. |
| GaN | GaN epitaxial wafer could grow on either Si or SiC substrate, resulting in GaN power semiconductor device | Compared to SiC, GaN is more suitable for high-frequency, and relatively lower voltage and temperature environments. GaN has extremely high electron mobility and saturation drift velocity, making it particularly suitable for high-frequency switching applications. This effectively reduces switching losses and enables higher power density and miniaturization |

*Source: Public Information Collection, Frost & Sullivan*

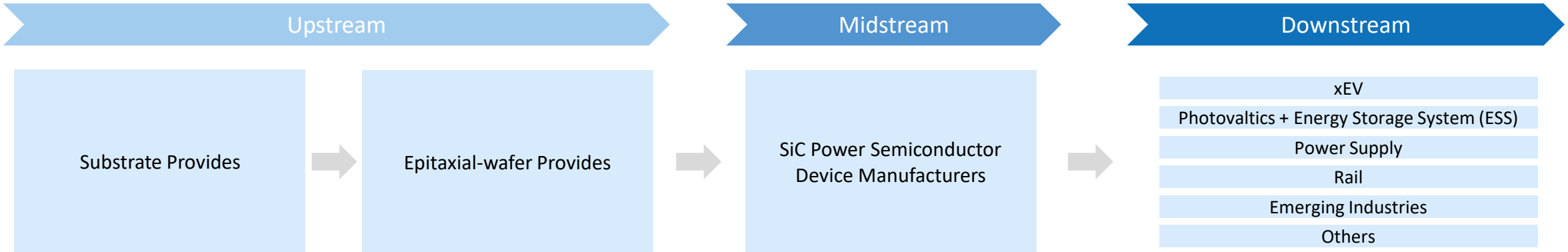
# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry Comparisons of the Currently Main Application Scenarios of SiC Power Semiconductor Device Materials (Among Si, GaN and SiC)




- As shown in the diagram below, Si is the retained traditional technology with lower tolerance in both frequency and voltage. SiC and GaN are materials with different features and application scenarios-SiC has been applied more in high-voltage scenarios while GaN has significant advantages in low-power supply scenarios.
- In commercial applications, considering the overall solution cost, SiC is expected to achieve a wider penetration than GaN in the following applications such as power supply, rail and EV power electronics.

*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry Value Chain of SiC Power Semiconductor Device Market




- The upstream segment of the value chain is composed of substrate providers and epitaxial-wafer providers. Epitaxial-wafer providers source substrates from substrate providers for the production of epitaxial wafers. This stage is crucial and has the most significant added value as the cost of SiC epitaxial wafers account for the largest share of the total cost of an SiC power semiconductor device, with a percentage of approximately 70%, including the cost of substrates and epitaxial wafers account for 47% and 23%, respectively
- The midstream segment involves SiC power semiconductor device manufacturers which use the epitaxial wafers as the base material to fabricate the SiC semiconductor devices through a series of complex manufacturing processes
- while the downstream segment encompasses the distribution of the final products and systems to various applications such as xEV and power supply. Normally, SiC power device manufacturers would not easily change their SiC epitaxial wafer suppliers due to the high switching costs

*Note: These semiconductor device manufacturers also possess the capability to manufacture wafers. A wafer is a substrate that has undergone a series of processing steps. It is a circular thin slice used in the semiconductor manufacturing process to fabricate ICs or other microelectronic devices. The wafer processing involves multiple complex steps such as photolithography, etching, and doping.*

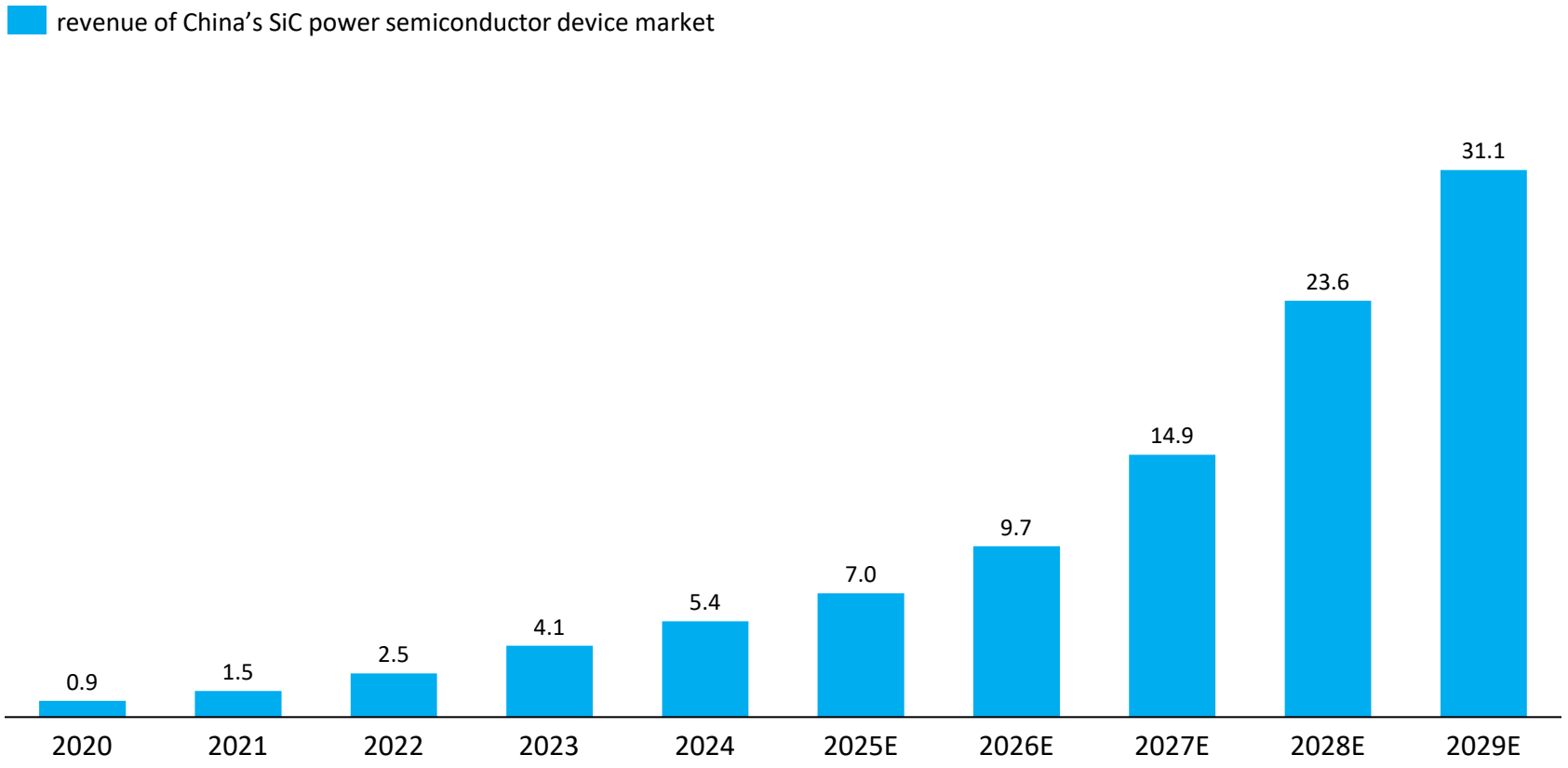
*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Market Size of China's SiC Power Semiconductor Device Industry

## Market Size of China SiC Power Semiconductor Device[1] Industry, in terms of revenue

RMB Billion, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| Total | 56.0% | 44.9% |




### *Key Takeaways*

- The market size of China's SiC power semiconductor device industry has been on a significant upward trajectory, with a CAGR of 56.0% from 2020 to 2024. Driven by the shift in automotive technology, such robust growth is set to continue, with a CAGR of 44.9% projected for the period from 2025 to 2029. The increasing adoption of SiC power semiconductor devices in various applications, particularly in the automotive sector, is a key driver behind this expansion. The penetration rate of the SiC power semiconductor device market in the overall power semiconductor device market in China was 4.1% in 2024. With the adoption of SiC in China, the penetration rate is expected to reach 13.8% by 2029

*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
## Market Size of Global Power Semiconductor Device Industry (1/2)

- Driven by technological developments in processing power, miniaturization and energy efficiency, as well as increasing demand from downstream industries such as consumer electronics, EVs and data centers, the market size of global power semiconductor device industry witnessed overall growth from 2020 to 2024. The market size of global power semiconductor device industry experienced a steady growth from US$45.2 billion in 2020 to 2024, reaching a total of US$49.6 billion, representing a CAGR of 2.3%. Such muted growth from 2020 to 2024 was primarily attributed to the COVID-19 pandemic which led to a significant drop in smartphone sales and a collapse in vehicle sales due to the closure of dealerships and the halt of production lines. The power semiconductor device sector was also affected by the overall semiconductor industry's downturn in 2024.

- In 2024, the overall semiconductor industry experienced a significant downturn, driven by a combination of factors: (i) weak demand in the consumer electronics market, particularly for smartphones and PCs, led to a sharp decline in memory chip prices, dragging down overall industry revenue; and (ii) the inventory overhang was severe, especially in the memory chip sector. Although manufacturers adjusted supply through production cuts, inventory digestion remained a prolonged process. Despite an increase in market size in the global power semiconductor device industry, market players had expanded production capacity at a rate which surpassed end customer consumption rate, leading to a transitional phase in the industry with oversupply

- The semiconductor industry is inherently cyclical, primarily driven by supply-demand imbalances, inventory adjustments, and technological advancements, typically following a pattern of demand growth, capacity expansion, oversupply, inventory correction, and eventual demand recovery. Cyclicality of the semiconductor industry is reflected across different product generations. The fact that different products are simultaneously located in the decline, maturity, and growth stages of the product life cycle is a representation of the semiconductor industry's fundamental, continuous cyclicality in action. That is, when the 4-inch SiC epitaxial wafers were no longer the mainstream product size, its price quickly declined and then became stabilized due to the matured technology and decrease in sales volume. Following a period of aggressive market competition and price drops, 6-inch SiC epitaxial wafers then entered maturity phase and market demand-supply relationship became balanced. Manufacturers expanded production lines when 8-inch SiC epitaxial wafers started to enter a rapid growth phase since 2024, a year when the overall industry faced a downturn driven by slow growing demand and inventory challenges, but signs of recovery began to emerge as inventory level normalized and new sectors like AI and automotive electronics gain traction. Thus, the forecast for the market size from 2024 to 2028 shows a more promising trajectory, benefiting from increasing vehicle demand and renewed consumer spending on electronics and other goods. It is expected that the market size of global power semiconductor device industry will resume its growth, and further increase from US$49.6 billion in 2024 to US$78.8 billion in 2029, representing a CAGR of 10.1% from 2025 to 2029.





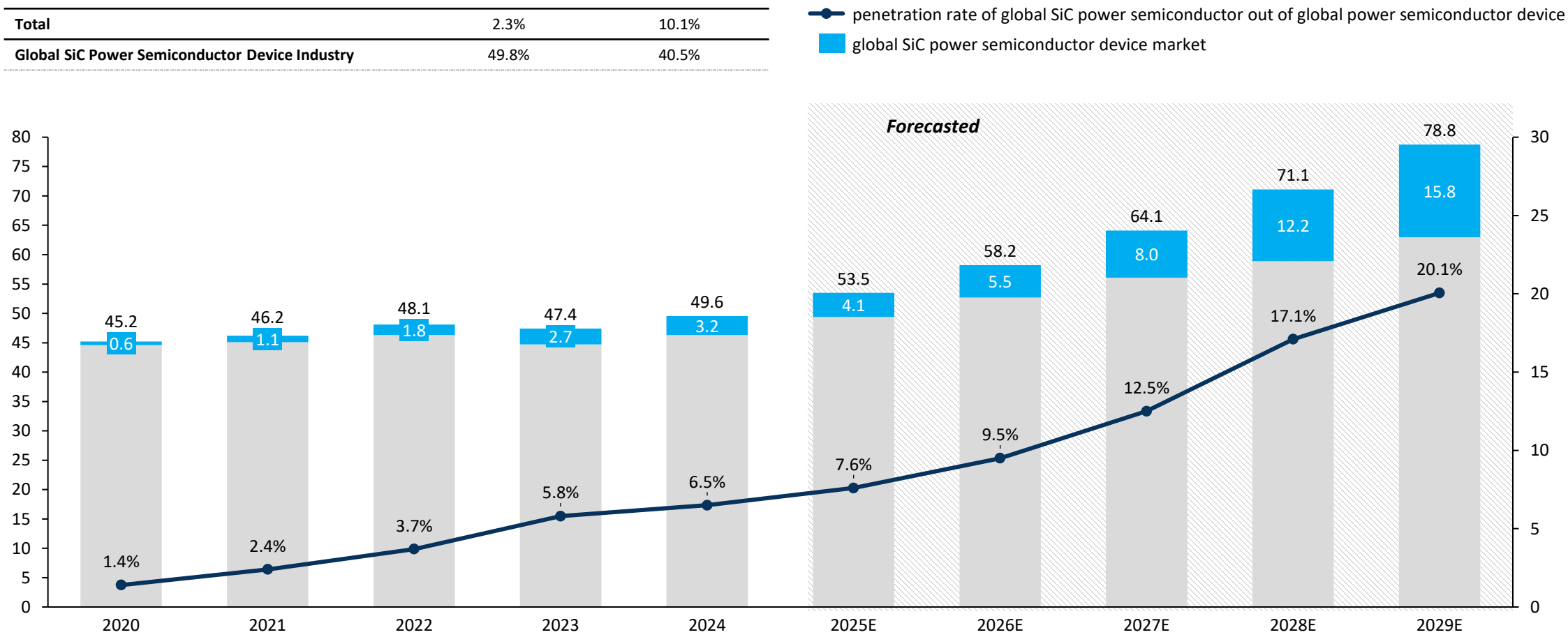
*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Market Size of Global Power Semiconductor Device Industry (2/2)

## Market Size of Global Power Semiconductor Device Industry, in terms of sales revenue

USD Billion, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| **Total** | 2.3% | 10.1% |
| **Global SiC Power Semiconductor Device Industry** | 49.8% | 40.5% |



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*Source: Frost & Sullivan, Omdia, Yole*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
## Market Size of Global SiC Power Semiconductor Device Industry

- Driven by the increasing adoption of industrial automation and expansion of the renewable energy, the global SiC power semiconductor device industry has demonstrated remarkable growth from 2020 to 2024, with the market size escalating from US$0.6 billion in 2020 to US$3.2 billion in 2024 at a CAGR of 49.8%. The projected market size for the SiC power semiconductor device industry from 2024 to 2029 continues to show an impressive upward trend, with a CAGR of 40.5% from 2025 to 2029. The market is anticipated to reach an estimated US$15.8 billion by 2029.

- The penetration rate of global SiC in the overall power semiconductor device market has also seen a significant increase powered by the growing demand for cost-effective, high-efficiency and high-performance power electronics, particularly in electric vehicles, renewable energy systems, and industrial applications. SiC's superior properties, such as higher energy efficiency, thermal conductivity, and ability to operate at higher voltages and temperatures, which lead to reduced energy losses and translate into reduced battery sizes and consequently lower battery costs, have driven its adoption and integration into these sectors. Starting from 1.4% in 2020, the penetration rate increased to 6.5% in 2024, and is projected to soar to 20.1% by 2029, indicating a substantial shift in the market dynamics, with SiC materials becoming more prevalent and integral to the global power semiconductor device industry





*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Market Size of Global SiC Power Semiconductor Device Industry, by Application (1/2)

- Driven by the need for efficient power management in high-voltage environments, while emerging applications like home appliances and data centers seek to leverage SiC's advantages for improved performance and energy efficiency, SiC power semiconductor devices are widely used in several sectors.
- Breaking down the global power semiconductor device market by application, each sub-market exhibits its own growth trajectory:
  - **X Electric Vehicle (xEV):** xEV is the abbreviation for electric vehicle in general, where 'x' stands for some additional acronyms, such as hybrid electric vehicle (HEV), plug in hybrid electric vehicle (PHEV), and battery electric vehicle (BEV). The high efficiency and power density of SiC devices are vital for enhancing xEV performance, with applications in critical components such as power converters, main drive inverters, on board couriers, battery chargers, bidirectional DC/DC converters (high voltage), and motor drives. The xEV sector shows the strong CAGR of 65.1% from 2020 to 2024, followed by a still-impressive 41.6% from 2025 to 2029. Benefiting from the unique advantages that SiC power semiconductor devices could offer, such as lower conduction resistance, smaller chip size, higher operating frequencies, and the ability to withstand higher environmental temperatures, the penetration rate of SiC power semiconductor devices in the xEV sector has been on an upward trajectory, starting 19.2% in 2024 and projected to reach 47.7% by 2029.
  - **Photovoltaics+Energy Storage Systems (ESS):** SiC is used in photovoltaic system components like microinverters and DC/DC converters, improving inverter power density and efficiency, reducing energy loss, and minimizing system weight and volume, thus supporting the adoption of solar energy. The photovoltaics+ESS sector demonstrates robust growth, with CAGRs of 39.0% from 2020 to 2024 and 30.6% from 2025 to 2029. Driven by the need for more efficient and reliable energy storage solutions to complement the fluctuating nature of solar power generation, the penetration rate of SiC power semiconductor devices in the photovoltaics+ESS sector has been gradually increasing, starting from 9.7% in 2024 to 19.4% by 2029.
  - **Power Supply:** In the power supply sector, SiC is crucial in industrial supplies and smart grids. It boosts efficiency and compactness in motor drives and precision equipment due to its high thermal conductivity and fast switching, cutting energy loss. In smart grids, SiC is vital for advancing solid-state transformers and flexible AC/DC transmission, enhancing efficiency and grid stability with its superior thermal and electronic traits. The power supply sector increased with a CAGR of 8.0% from 2020 to 2024 and is expected to grow at a CAGR of 27.0% from 2025 to 2029. Driven by the significant demand from new infrastructure industries, the penetration rate is on the rise, from 4.2% in 2024, and is projected to reach 12.3% in 2029.
  - **Rail:** SiC's high critical field strength, high carrier saturation velocity, and high thermal conductivity enable the miniaturization and lightweight development of traction conversion systems, which is essential for meeting the green and energy-saving requirements of rail vehicle operations. Rail sectors, while starting from smaller bases, showed CAGRs of 12.9% from 2020 to 2024 and followed by 29.1% from 2025 to 2029. Starting from 16.7% in 2024, the penetration rate is projected to reach 31.8% by 2029, attributed to the advantages that SiC power semiconductor devices could offer in terms of high-temperature tolerance and high-frequency switching capabilities.
  - **Emerging Industries:** The emerging SiC market encompasses applications in energy-efficient home appliances, advanced aerospace systems such as drones, and high-performance data centers, such as AI data centers. SiC is revolutionizing these industries with its superior efficiency and performance. In home appliances, SiC enables compact, energy-saving designs for devices such as air conditioners and induction cooktops by enhancing power conversion efficiency. For low-altitude flights, such as drones and electric vertical takeoff and landing (eVTOL) vehicles, SiC's high thermal stability and power density support lightweight, reliable powertrains and extended flight durations. In data centers, SiC plays a critical role in high-efficiency power supplies, reducing energy consumption and heat generation, thus meeting the growing demand for sustainable and high-performance infrastructure.





*Source: Frost & Sullivan, Yole, Expert Interview*

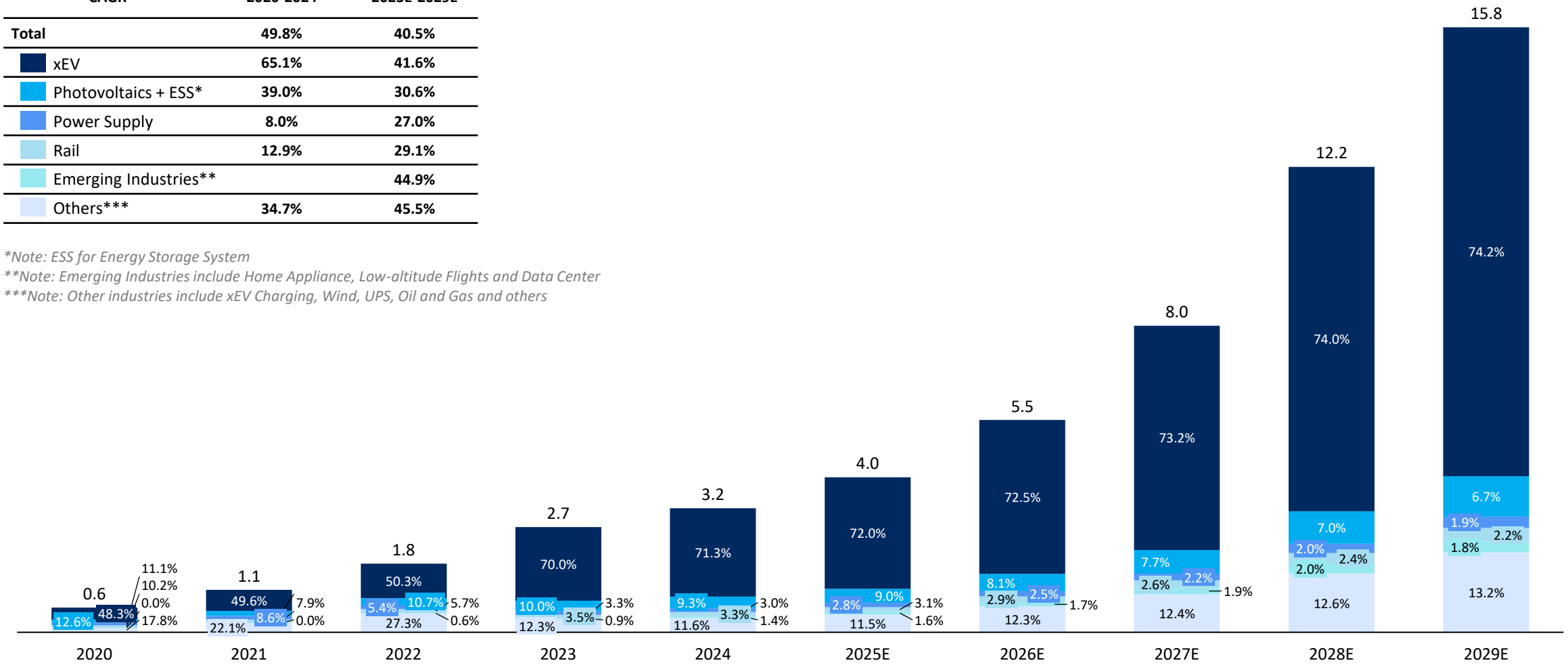
# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Market Size of Global SiC Power Semiconductor Device Industry, by Application (2/2)

## Market Size of Global SiC Power Semiconductor Device Industry, by application

USD Billion, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| **Total** | **49.8%** | **40.5%** |
| xEV | **65.1%** | **41.6%** |
| Photovoltaics + ESS* | **39.0%** | **30.6%** |
| Power Supply | **8.0%** | **27.0%** |
| Rail | **12.9%** | **29.1%** |
| Emerging Industries** | | **44.9%** |
| Others*** | **34.7%** | **45.5%** |

**Note: ESS for Energy Storage System*
***Note: Emerging Industries include Home Appliance, Low-altitude Flights and Data Center*
****Note: Other industries include xEV Charging, Wind, UPS, Oil and Gas and others*

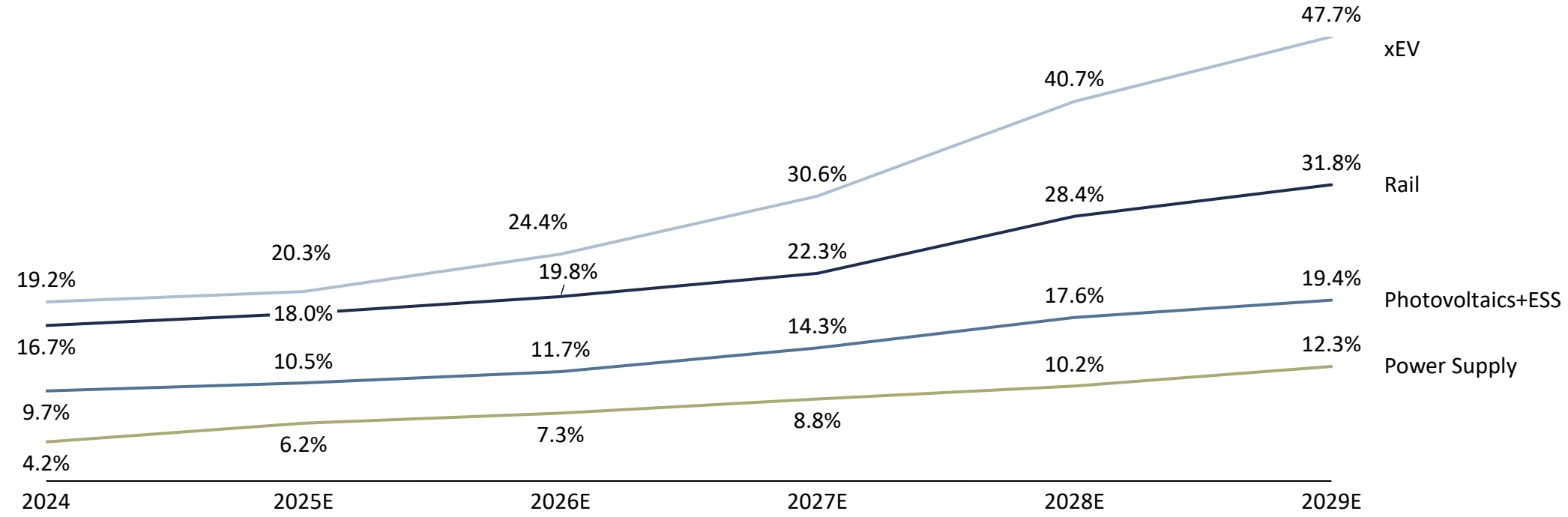



*Source: Frost & Sullivan, Yole, Expert Interview*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Penetration Rate of SiC Device, by Scenario

**Penetration rate[1] of SiC devices, by scenario**

%, 2024-2029E




*Note[1]: The penetration rate for a specific scenario in a specific year refers to the percentage of the number of SiC power modules out of the total number of power modules used in that scenario in the year.*





*Source: Frost & Sullivan, Yole, Expert Interview*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Main Drivers of China's SiC Power Semiconductor Device Industry

## *Downstream Applications are Driving the SiC Power Semiconductor Device Industry's Growth in China*

SiC power semiconductor devices offer higher efficiency, faster switching speeds, and better thermal management compared to traditional silicon-based devices, which is crucial for the performance and range of electric vehicles and the efficiency of solar power systems. Additionally, the expansion of smart grids and the need for more efficient and reliable power distribution systems further bolster the demand for SiC devices. As a result, the SiC power semiconductor device industry in China is experiencing significant growth, with market leaders investing in research and development to enhance the performance and reduce the production costs of SiC devices, enabling them more accessible for a broader range of applications

## *Epitaxial Technology is a Cornerstone in Advancing the Performance and Quality of SiC Power Semiconductor Devices, Addressing Critical Substrate Defects and Satisfying the Demand for the High-performance Devices in Various Industries*

The development of epitaxial technology plays a pivotal role in enhancing the quality and performance of SiC power semiconductor devices. The substrate itself may contain defects such as black polycrystalline defects, droplets, and triangular defects that can impede device performance. However, through the epitaxial process, a high-quality SiC layer can be grown over the substrate, which is essential for creating high-performance power devices capable of withstanding high voltages, high frequencies, and high temperatures. This advancement in epitaxy not only helps in reducing defect densities but also improves the electrical characteristics of the application devices, thereby ensuring better performance and reliability. The progress in epitaxial technology also enables the transition to larger sizes of epitaxial wafers, which can significantly reduce the cost per piece while maintaining or even enhancing device performance. This is crucial for meeting the growing demands of high-power applications across various industries, including electric vehicles, renewable energy systems, and industrial motor drives.

## *Rising Yields are Propelling SiC Power Semiconductor Device Industry's Penetration across Diverse Sectors, from Traditional to Emerging Applications*

The SiC power semiconductor device industry's growth is marked by increased penetration in both existing and emerging sectors, with xEV, photovoltaics+ESS, power supply, and rail sectors reaping the benefits of SiC's superior performance. The penetration rates for these key traditional downstream applications are on the rise. This expansion is fueled by continuous advancements in manufacturing processes, leading to higher yields and more reliable semiconductors, which in turn enhances the appeal of SiC devices for a wide array of high-performance applications.



*Source: Public Information Collection, Frost & Sullivan*

# Overview of Power Semiconductor Device Industry and SiC Power Semiconductor Device Industry
# Key Trends of China's SiC Power Semiconductor Device Industry

## *High Degree of Specialization and Division of Labor in Various Segments of the Industry Chain is Becoming More Pronounced*

Device manufacturers confront a strategic decision to integrate their supply chain by adopting an integrated device manufacturer model, for better controlling the entire production process. Conversely, the outsourcing of materials, particularly the procurement of epitaxial wafers from specialized suppliers, offers cost-effectiveness and quality assurance by capitalizing on suppliers' expertise. In the wake of technological advancements, the industry is experiencing a pronounced trend towards high degree of specialization and division of labor. This evolution suggests a future where industry participants will focus more intently on their respective areas of expertise, thereby enhancing overall production efficiency and driving innovation throughout the power semiconductor device sector.

## *Downstream Application Penetration is Accelerated by Cost Reduction and Technological Advancements*

Cost reductions and technological improvements are key trends driving the SiC power semiconductor device industry in China. As production efficiencies increase and manufacturing processes become more refined, the cost of SiC components has been decreasing, making them more accessible and economically viable for a broader range of applications. This affordability, coupled with the inherent performance advantages of SiC over traditional silicon, such as higher efficiency, better heat management, and superior electrical properties, is accelerating its adoption in various sectors. We are able to take advantage in the cost reduction in that we make purchases with decreased purchase costs in addition to digesting our existing inventory, after which our gross margin and financial performance are therefore increased. Such cost reduction will cease, and the cost will stabilize, along with growing demand, broader adoption across various application, and stable market supply-demand relationship. The industry is witnessing a surge in the use of SiC in electric vehicles, renewable energy systems, and high-voltage power electronics, where the capabilities of SiC to handle high temperatures and voltages are particularly beneficial. Moreover, ongoing research and development efforts are continuously enhancing the performance and reliability of SiC devices, further expanding their potential in emerging markets like 5G communications, advanced computing, and smart grid technologies. These trends indicate a promising future for SiC as a critical material in the power semiconductor device industry, poised to support the next generation of energy-efficient and high-performance electronic devices



*Source: Yole, Frost & Sullivan*

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# Overview of China's and Global SiC Epitaxial Wafer Markets
# Business Model

Epitaxial wafer production, being the upstream segment in the semiconductor value chain, is where the most significant value addition occurs through the meticulous growth of layers that forms the foundation for subsequent device performance and functionality. There are mainly two business models for SiC epitaxial wafer manufacturers:

### *Revenue from sales of epitaxial wafer*

For SiC epitaxial wafer production, manufacturers either source substrate materials based on customer requirements or independently. They complete the epitaxial growth process and sell the finished epitaxial wafers, with prices set to cover total costs including substrates. Revenue comes from epitaxial wafer sales. This model mandates full responsibility for the entire production process, offering a comprehensive service that enhances efficiency and provides an integrated solution for downstream manufacturers.

### *Revenue from consignment manufacturing*

Downstream device manufacturers supply substrate materials, and epitaxial wafer manufacturers handle other materials and production. They charge a fee for services plus profit, focusing on customization and utilizing their technology and production skills to meet specific customer needs. Revenue comes from service fees, not product sales.





*Source: Public Information Collection, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Market Size of China's SiC Epitaxial Wafer, by Revenue (1/2)

- The overall Chinese market is expected to grow faster than the global market, with a projected CAGR of 37.5% from 2025 to 2029, while the global market's CAGR is 28.4% over the same years. The faster growth rate of the SiC epitaxial wafer market in China is mainly because major Chinese manufacturers have already planned and scheduled their production capacity expansion for the future and the market demand in the future is expected to match the production capacity. In China, the 6-inch epitaxial wafer segment may continue to play critical role in the near future, while the 8-inch epitaxial wafer segment is poised for rapid growth, promising to be a key contributor to the future market's expansion.

- Between 2020 and 2024, the 6-inch epitaxial wafer segment saw a robust CAGR of 30.4%, yet this is expected to moderate to a CAGR of 15.6% from 2025 to 2029. The slower growth rate is due to the introduction of 8-inch epitaxial wafer in 2023. In terms of revenue, the 6-inch epitaxial wafer segment started at RMB0.5 billion in 2020 and experienced significant expansion, reaching RMB1.4 billion by 2024. Further growth is anticipated, with projections indicating a rise to RMB2.2 billion by 2029.

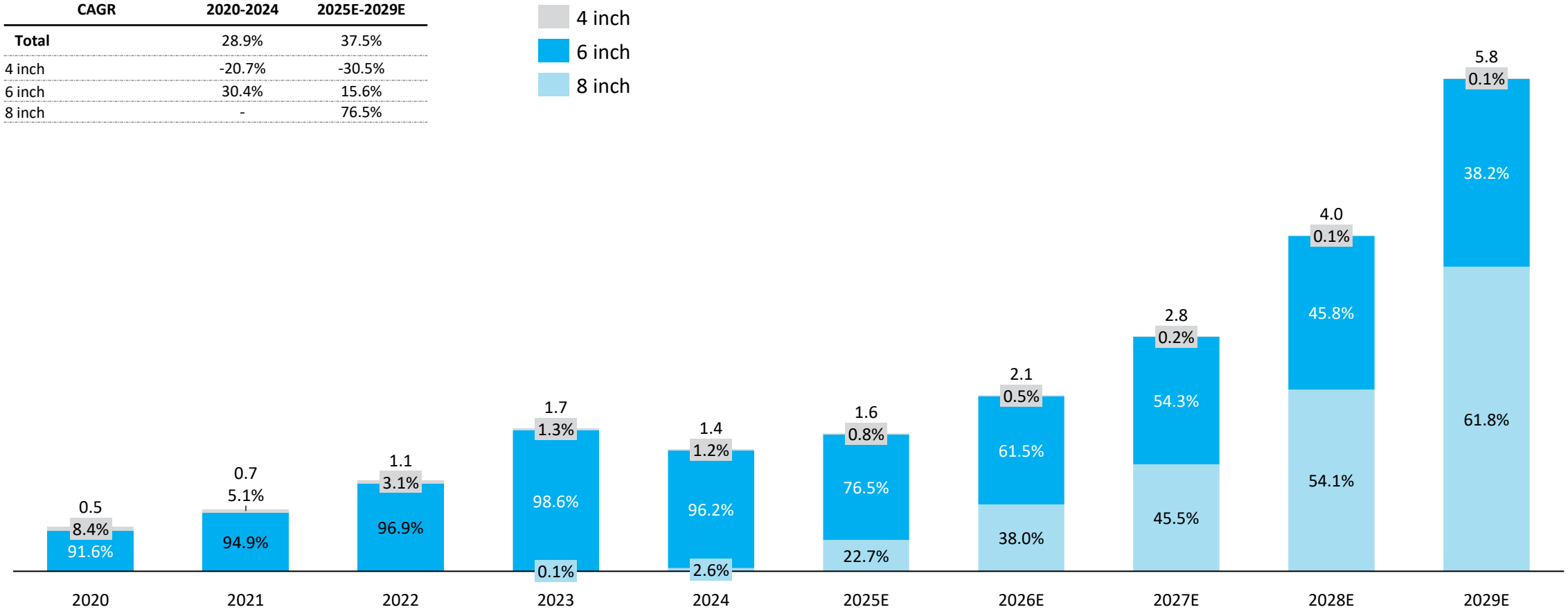
- Conversely, the 4-inch epitaxial wafer segment in China has shown a decline, with a CAGR of –20.7% from 2020 to 2024, and an anticipated CAGR of –30.5% from 2025 to 2029, indicating a significant contraction. As cyclicality of the semiconductor industry is reflected across different product generations, such contraction is principally due to the introduction of 6-inch epitaxial wafers. Before 2020, due to the technology advancements of manufacturing of 6-inch SiC substrates and epitaxial wafers, the 6-inch SiC epitaxial wafers had gradually began to replace the 4-inch SiC epitaxial wafers in mainstream applications, showing a market maturity cycle ending for the older generation. This substitution caused the sales volume of the 4-inch products growing at a slow pace and then began to decline rapidly while the 6-inch product took over the mainstream market position. Owing to technological improvements, China began the sample delivery phase of 8-inch epitaxial wafers in 2024 and is expected to grow at a CAGR of 76.5% from 2025 to 2029. Due to the aforementioned benefits of 8-inch SiC epitaxial wafers, there will be more demand in the market. It is expected that the market share of 8-inch SiC epitaxial wafers increased from 10.8% in 2024 to 52.0% in 2029 in terms of sales volume globally. Meanwhile, downstream SiC power semiconductor device manufacturers' new production capacity will mainly focus on 8-inch epitaxial wafers. China's SiC power semiconductor device manufacturers' production capacity for 8-inch SiC power semiconductor device is expected to exceed around 4 million pieces in total from 2025 to 2028, driving the growth of 8-inch SiC epitaxial wafer. The 8-inch epitaxial wafer segment is expected to reach RMB3.6 billion by 2029.

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Market Size of China's SiC Epitaxial Wafer, by Revenue (2/2)

## Market Size of China's Silicon Carbide Epitaxial Wafer, in terms of Sales Revenue

RMB Billion, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| **Total** | 28.9% | 37.5% |
| 4 inch | -20.7% | -30.5% |
| 6 inch | 30.4% | 15.6% |
| 8 inch | - | 76.5% |



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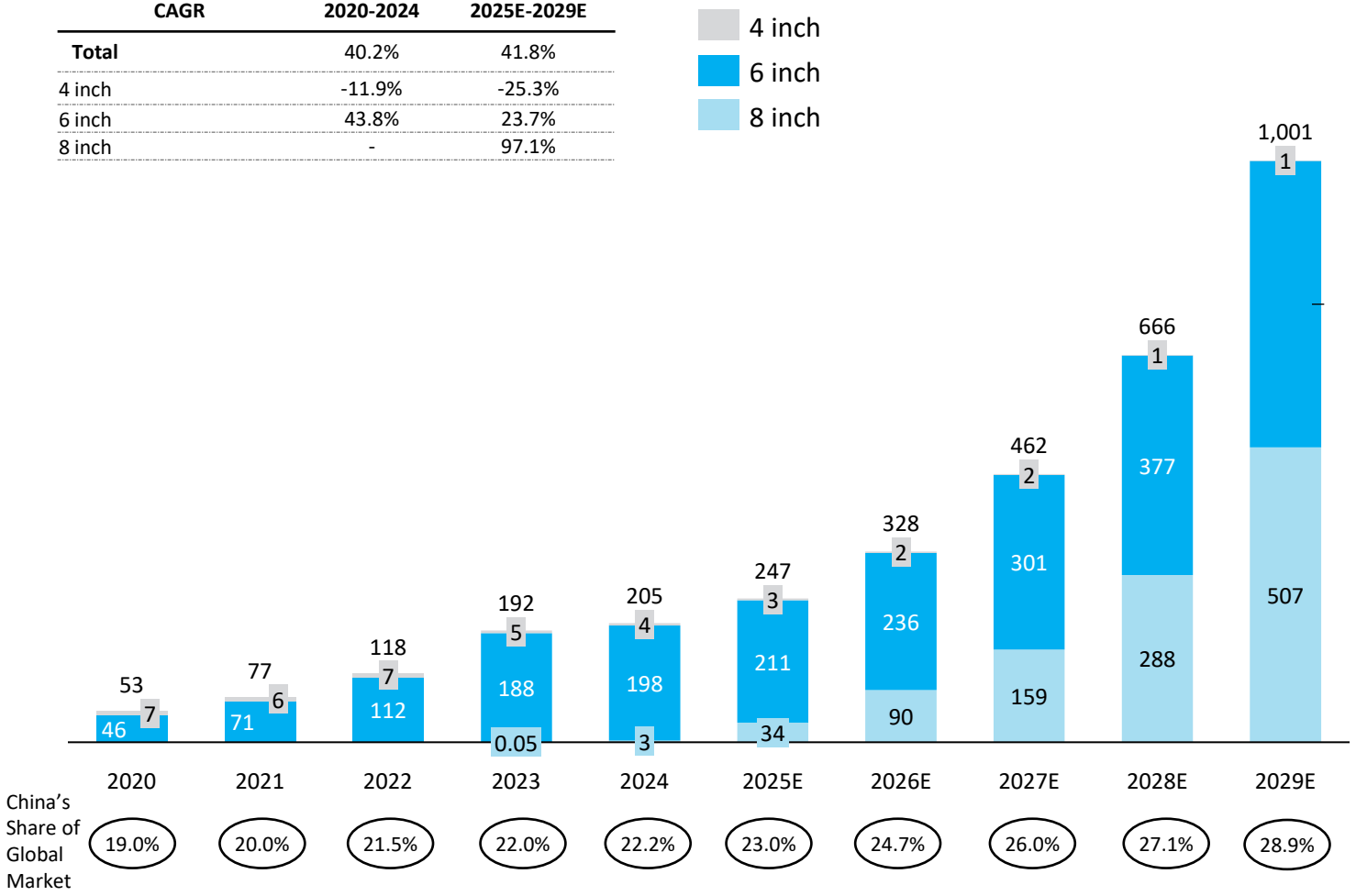
*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Market Size of China's SiC Epitaxial Wafer, by Sales Volume

## Market Size of China's Silicon Carbide Epitaxial Wafer, in terms of Sales Volume

1,000 units, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| **Total** | 40.2% | 41.8% |
| 4 inch | -11.9% | -25.3% |
| 6 inch | 43.8% | 23.7% |
| 8 inch | - | 97.1% |




### *Key Takeaways*

- China's SiC epitaxial wafer market has shown superior growth compared to the global average. Looking forward to the period from 2025 to 2029, China's CAGR is projected to maintain a strong momentum at 41.8%, which is higher than the anticipated growth rate of 34.1% in the global SiC epitaxial wafer market.
- China's 6-inch epitaxial wafer segment experienced rapid growth, especially from 2020 to 2024. The sales volume increased from 46 thousand pieces in 2020 to 198 thousand pieces in 2024, growing at a CAGR of 43.8%. The sales volume is expected to further increase from 198 thousand pieces in 2024 to 492 thousand pieces in 2029, with a CAGR of 23.7% from 2025 to 2029. Such slower growth reflects the shift of focus to 8-inch epitaxial wafer segment. The 4-inch epitaxial wafer segment is on a declining trend, with a CAGR of –11.9% from 2020 to 2024, and a projected CAGR of –25.3% from 2025 to 2029. The sales volume of the 8-inch epitaxial wafer segment is expected to increase from 3,000 pieces in 2024 to 507,000 pieces in 2029, representing an impressive CAGR of 97.1% from 2025 to 2029.



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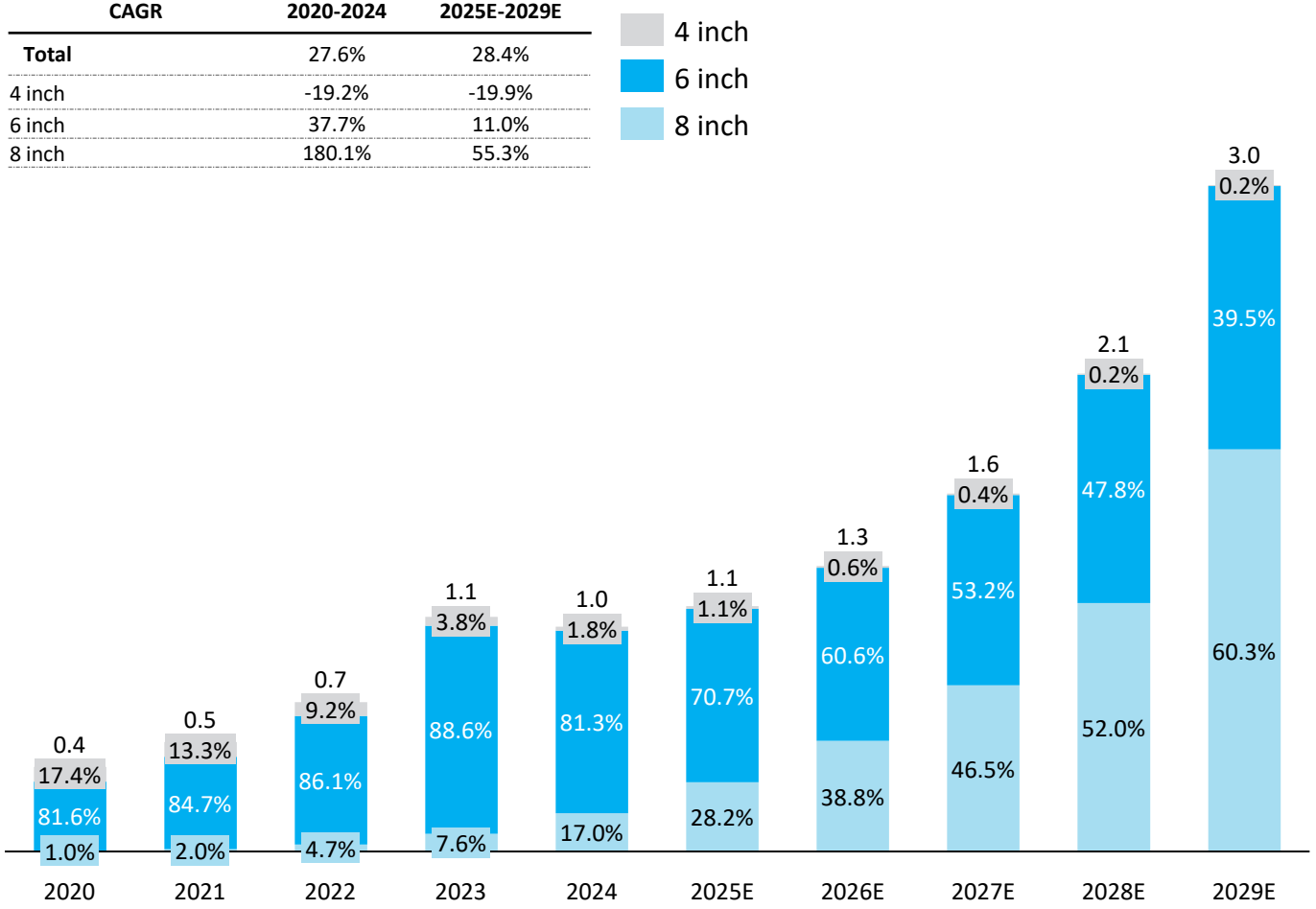
*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Market Size of Global SiC Epitaxial Wafer, by Revenue

## Market Size of Global Silicon Carbide Epitaxial Wafer, in terms of Sales Revenue

Billion USD, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| **Total** | 27.6% | 28.4% |
| 4 inch | -19.2% | -19.9% |
| 6 inch | 37.7% | 11.0% |
| 8 inch | 180.1% | 55.3% |




### *Key Takeaways*

- Currently, SiC epitaxial wafer offered in the market can be classified as 4-inch, 6-inch and 8-inch in terms of its size. 8-inch epitaxial wafers are a key trend for the future SiC epitaxial wafer industry. With larger size of epitaxial wafers, the total number of integrable chips increases. 8-inch SiC epitaxial wafers will increase the chip count by per epitaxial wafer 89% compared to 6-inch ones. Additionally, 8-inch substrates could lower the cost of SiC power semiconductor devices.
- The global market for SiC epitaxial wafers has undergone a notable transformation, particularly in the revenue of 6-inch epitaxial wafers. The 6-inch epitaxial wafer segment has demonstrated substantial growth with the revenue increasing from US$0.3 billion in 2020 to US$0.8 billion in 2024, with a CAGR of 37.7%. It is expected to further increase to US$1.2 billion by 2029, with a CAGR of 11.0% from 2025 to 2029. The reason for such growth is principally due to relatively mature technology and better cost efficiency. Conversely, the 4-inch epitaxial wafer segment has experienced a decline in revenue with the popularity of 6-inch epitaxial wafers, decreasing from US$66.0 million in 2020 to US$17.8 million in 2024 and further to an expected US$4.9 million by 2029. Owing to technological advancements, the 8-inch epitaxial wafer segment, although starting from a low base, has shown promising growth, with the revenue rising from US$0.1 billion in 2024 to an anticipated US$1.8 billion by 2029.





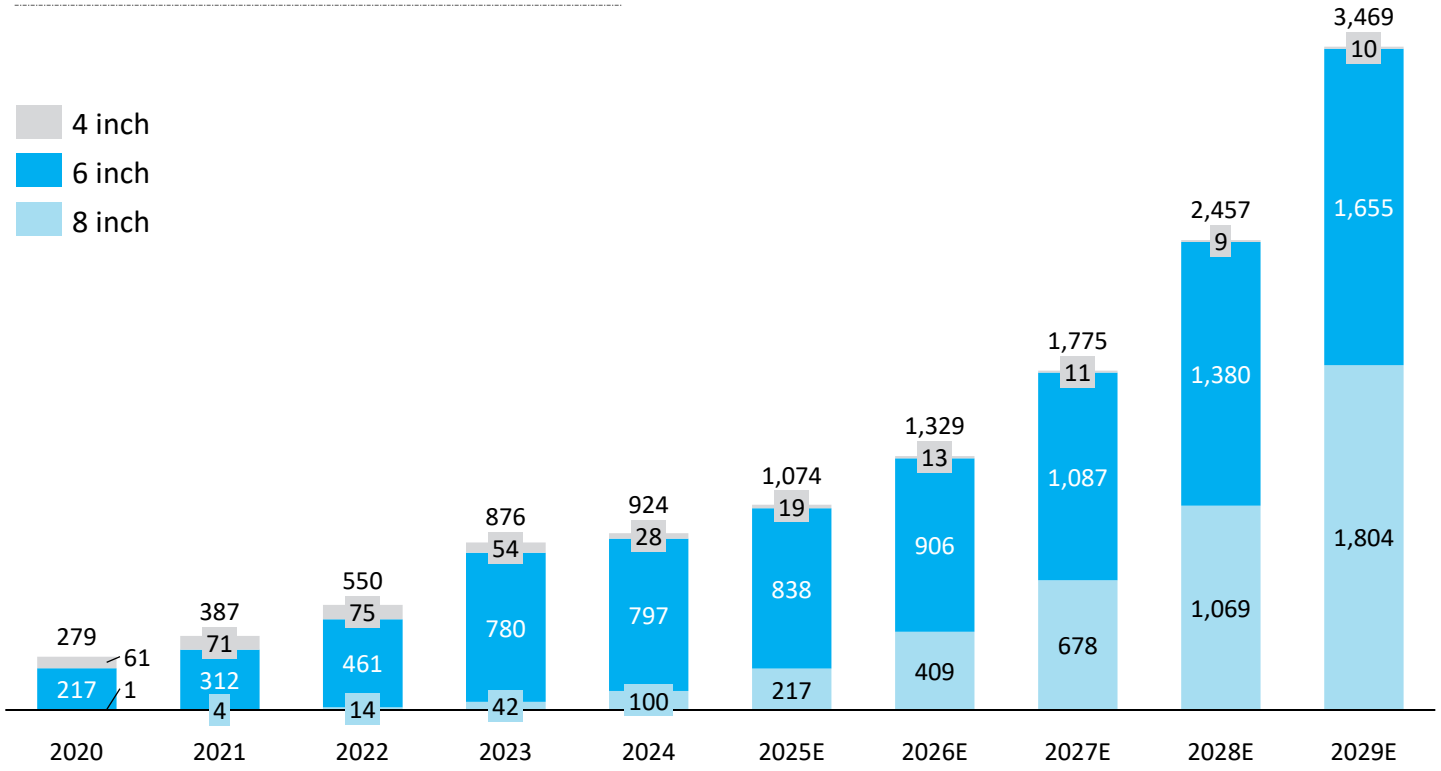
*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Market Size of Global SiC Epitaxial Wafer, by Sales Volume

## Market Size of Global Silicon Carbide Epitaxial Wafer, in terms of Sales Volume

1,000 units, 2020-2029E

| CAGR | 2020-2024 | 2025E-2029E |
|---|---|---|
| **Total** | 34.9% | 34.1% |
| 4 inch | -17.8% | -14.3% |
| 6 inch | 38.4% | 18.5% |
| 8 inch | 194.1% | 69.8% |




### *Key Takeaways*

- The global market for SiC epitaxial wafers has witnessed a significant shift towards 6-inch epitaxial wafers, driven by technological advancements and the efficiency benefits. The sales volume of 6-inch epitaxial wafers has shown a substantial increase, growing from 217 thousand pieces in 2020 to 797 thousand pieces in 2024, with a CAGR of 38.4%. It's projected that by 2029, the 6-inch epitaxial wafers will increase from 797 thousand pieces in 2024 to 1,655 thousand pieces, with a CAGR of 18.5% from 2025 to 2029.

- On the other hand, the market for 4-inch epitaxial wafers has been on a downward trend, with sales volume dropping from 61 thousand pieces in 2020 to 28 thousand pieces in 2024, reflecting a CAGR of –17.8%. Looking ahead, driven by technological advancements and the efficiency benefits, the 4-inch epitaxial wafer segment is forecasted to further contract from 28 thousand pieces in 2024 to 10 thousand pieces by 2029, with a CAGR of –14.3% from 2025 to 2029. With the further advancements of the technologies, the 8-inch epitaxial wafer segment, despite its nascent stage, has exhibited most remarkable growth, increasing from a mere 1.3 thousand pieces in 2020 to 100 thousand pieces in 2024, with a CAGR of 194.1%. By 2029, it is expected to increase from 100 thousand pieces in 2024 to 1,804 thousand pieces, with a CAGR of 69.8% over the same years.



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*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# SiC Substrate Average Selling Price Globally and in China

**Average Price of Global SiC Substrates by Product Types**

Thousand RMB, 2020-2030E

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025E | 2026E | 2027E | 2028E | 2029E | 2030E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-inch | 2.5-4.5 | 2.3-4.3 | 2.2-4.2 | 2.1-4.1 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 1.3-3.3 | 1.0-3.0 | 0.9-2.9 | 0.8-2.8 |
| 6-inch | 5.6-7.6 | 5.5-7.5 | 5.2-7.2 | 4.7-6.7 | 3.3-5.3 | 2.8-4.8 | 2.5-4.5 | 1.6-3.6 | 1.3-3.3 | 1.2-3.2 | 1.1-3.1 |
| 8-inch | 10.4-20.5 | 9.0-15.6 | 8.8-12.4 | 6.9-9.0 | 5.9-8.3 | 5.3-7.3 | 4.8-6.8 | 4.3-6.3 | 3.9-5.9 | 3.7-5.7 | 3.7-5.7 |

**Average Price of China's SiC Substrates by Product Types**

Thousand RMB, 2020-2030E

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025E | 2026E | 2027E | 2028E | 2029E | 2030E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-inch | 1.6-3.6 | 1.5-3.5 | 1.4-3.4 | 1.2-3.2 | 1.1-3.1 | 1.0-3.0 | 0.9-2.9 | 0.8-2.8 | 0.8-2.8 | 0.7-2.7 | 0.7-2.7 |
| 6-inch | 2.6-4.6 | 2.4-4.4 | 2.2-4.2 | 2.1-4.1 | 1.5-3.5 | 1.3-3.3 | 1.1-3.1 | 1.0-3.0 | 0.9-2.9 | 0.9-2.9 | 0.8-2.8 |
| 8-inch | N/A | N/A | 9.0-15.0 | 8.4-12.3 | 5.3-10.0 | 4.5-6.5 | 3.9-5.9 | 3.4-5.4 | 3.0-5.0 | 2.6-4.6 | 2.3-4.3 |

*Note: Price is given in range as it is affected by multiple market factors, including unexpected market demand and supply, among others.*





*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
## Price Analysis

The average selling price of SiC substrates and SiC epitaxial wafers in various inches is expected to gradually decrease from 2025 to 2030. However, the average selling price of SiC epitaxial wafers in various inches is expected to decrease in smaller magnitude than the average selling price of the relevant SiC substrates with the following principal factors :

1. The price of SiC epitaxial wafers is influenced not only by cost considerations but also by a variety of other market dynamics, including but not limited to market competition within the industry, and downstream environment, which affect the market demand and supply of the SiC epitaxial wafers and in turn affecting relevant selling prices. Therefore, the fluctuation in selling price of SiC substrates does not always proportionally affect the selling price of SiC epitaxial wafers;

2. It is noted that the CAGR of the average selling price of 6-inch SiC epitaxial wafers, which constituted more than 90% and 80% of the PRC and global market size of SiC epitaxial wafers in each year from 2020 to 2024 in terms of revenue, respectively, was approximately –5.0% and –5.8% in the aforesaid PRC and global market, while the CAGR of the average selling price of 6-inch SiC substrates was approximately –8.6% and –10.1% in the aforesaid PRC and global market, respectively for the same period. As such, it shows that the fluctuation of average selling price of SiC epitaxial wafers may not always proportionate to the fluctuation of average selling price of SiC substrates based on the aforesaid historical data; and

3. The SiC epitaxial wafers with 4-inch, 6-inch and 8-inch sizes are becoming increasingly mature, which has contributed to the stabilization of their prices. After the market has undergone a process of industry consolidation, the demand and supply is expected to be restored in a relatively balanced situation. Given that the 4-inch SiC epitaxial wafer is no longer the mainstream product size, manufacturers are only producing 4-inch SiC epitaxial wafers to satisfy niche or specific demands. Hence, its price stabilized due to the matured technology and contracted sales volume. Following a period of aggressive market competition and price drops, 6-inch SiC epitaxial wafer is entering maturity phase, with gradually restored market demand-supply balance. Its price is getting to a more stabled range as the market phasing towards 8-inch SiC epitaxial wafer. 8-inch SiC epitaxial wafer is in early developing stage with manufacturers proactively schedule and expand production lines. Given this expanded capacity, the 8-inch product is entering a rapid growth phase since 2024; its volume will increase, and prices will show a downward trend affected by technology advancements in manufacturing and economies of scale. The fact that these different products are simultaneously located in the decline, maturity, and growth stages of the product life cycle is a representation of the semiconductor industry's fundamental, continuous cyclicality in action.

In view of the above factors, it is expected that the average selling price of SiC epitaxial wafers will not have a significant fluctuation from 2025 to 2030 resulting in relatively stable price range of SiC epitaxial wafers with various inches, notwithstanding that the SiC substrate is expected to keep decreasing in the aforesaid forecast period.



*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Price Range of SiC Epitaxial Wafers in China and Globally (1/3)

The price decline of SiC epitaxial wafers was driven by expanded production capacity and technological advancements that reduced manufacturing costs. Other than industry oversupply caused by expanded production capacity, production iteration may also affect the market prices of SiC epitaxial wafers and substrates. For example, when 6-inch SiC epitaxial wafers are widely accepted by the downstream customers, the market demand for 4-inch SiC substrates as well as 4-inch SiC epitaxial wafers would consequently decrease given that 6-inch SiC epitaxial wafers have a larger total usable area. Similarly, as technology evolves and with the introduction of 8-inch SiC epitaxial wafers, the ASPs of 6-inch SiC substrates and 6-inch SiC epitaxial wafers steadily decline. However, at the same time, sales volume of 8-inch SiC substrates increase as the demand of 8-inch SiC epitaxial wafers rise, which will offset the decline in the ASPs of 4-inch and 6-inch SiC substrates as the ASP of 8-inch SiC substrates is higher than that of 4-inch and 6-inch SiC substrates, leading to a stabilized overall price of SiC substrates of all three types. In other words, the increased adoption of 8-inch SiC substrates, spurred by the rising market demand for 8-inch SiC epitaxial wafers, is anticipated to contribute to the stability of SiC substrate prices in China and globally. Despite the potential decrease in ASPs of 4-inch and 6-inch SiC substrates, the growing sales volume and relatively high ASP of 8-inch SiC substrates will help maintain an overall stable ASP of SiC substrates.

**Average Price Trends of SiC Epitaxial Wafers in China and Globally**

Thousand RMB, 2020-2030E

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025E | 2026E | 2027E | 2028E | 2029E | 2030E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| China Price Range | 8.8-10.8 | 8.4-10.4 | 8.0-10.0 | 7.8-9.8 | 6.5-7.5 | 6.1-7.1 | 5.8-6.8 | 5.5-6.5 | 5.4-6.4 | 5.3-6.3 | 5.2-6.2 |
| Global Price Range | 8.5-10.5 | 7.8-9.8 | 7.5-9.5 | 7.4-9.4 | 7.2-9.2 | 6.8-7.8 | 6.2-7.2 | 6.0-7.0 | 5.8-6.8 | 5.6-6.6 | 5.4-6.4 |





*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Price Range of SiC Epitaxial Wafers in China and Globally (2/3)

### Average Price of Global SiC Epitaxial Wafers by Product Types

Thousand RMB, 2020-2030E

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025E | 2026E | 2027E | 2028E | 2029E | 2030E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-inch | 6.8-8.2 | 6.0-7.6 | 4.7-6.7 | 4.1-6.1 | 3.7-5.7 | 2.2-4.2 | 2.2-4.2 | 2.2-4.2 | 2.2-4.2 | 2.2-4.2 | 2.2-4.2 |
| 6-inch | 9.5-10.5 | 8.2-10.3 | 7.8-9.8 | 7.4-9.4 | 6.9-8.9 | 4.5-6.5 | 3.5-5.5 | 3.5-5.5 | 3.5-5.5 | 3.5-5.5 | 3.5-5.5 |
| 8-inch | 18.7-20.3 | 16.8-18.5 | 14.4-16.4 | 13.3-15.3 | 11.1-13.1 | 9.0-11.0 | 7.0-9.0 | 7.0-9.0 | 7.0-9.0 | 7.0-9.0 | 7.0-9.0 |

### Average Price of China's SiC Epitaxial Wafers by Product Types

Thousand RMB, 2020-2030E

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025E | 2026E | 2027E | 2028E | 2029E | 2030E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-inch | 5.5-7.4 | 4.8-6.8 | 4.1-6.1 | 3.7-5.7 | 3.5-5.2 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 |
| 6-inch | 9.3-11.0 | 8.0-10.5 | 8.3-10.3 | 7.9-9.9 | 6.6-8.6 | 4.2-6.2 | 3.0-5.0 | 3.0-5.0 | 3.0-5.0 | 3.0-5.0 | 3.0-5.0 |
| 8-inch | N/A | N/A | N/A | 33.0-35.0 | 12.0-14.0 | 10.1-12.1 | 6.8-8.8 | 6.8-8.8 | 6.8-8.8 | 6.8-8.8 | 6.8-8.8 |

*Note: Price is given in range as it is affected by multiple market factors, including unexpected market demand and supply, among others.*





*Source: Yole, Expert Interview, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Price Range of SiC Epitaxial Wafers in China and Globally (3/3)

The following events show the development of the SiC epitaxial wafer industry and illustrate its impact on the ASP, which is primarily caused by product iteration and market supply-demand relationship:

- In previous years, SiC epitaxial wafer manufacturers expanded their production capacity, focusing on 4-inch and 6-inch products in view of downstream demand. .
- The expanded production capacity led to an oversupply of 4-inch and 6-inch SiC epitaxial wafers, resulting in a steady decrease in the ASPs. This also caused the exit of small market players who were unable to maintain profitable performance, resulting in a reshuffling of market players and hence a decrease in the number of participants.
- Technological advancement has driven the iteration of products, and the prevalence of 6-inch SiC epitaxial wafers has led to the obsolescence of 4-inch products. As 6-inch products are generally more advanced than 4-inch products, the ASP of 6-inch products is generally higher than that of 4-inch products.
- The ASPs of 4-inch and 6-inch products will become stable when the market supply-demand balance is restored. 8-inch products will become mainstream, replacing 4-inch and 6-inch products' markets. Therefore, the market players will not compete in 4-inch and 6-inch products' markets, and the ASPs of 4-inch and 6-inch products are expected to be relatively stable. Hence, the ASP of 4-inch products has reached its bottom line and is expected to remain relatively stable since 2025, and the ASP of 6-inch products will reach its bottom line and will remain relatively stable since 2026.
- Although 8-inch SiC epitaxial wafers have been developed in the overseas market for years, 8-inch products, in particular domestically made products, were initially launched in the PRC market in 2023. The ASP of 8-inch products were relatively high principally due to its scarcity at the commencement in the PRC. As such, the SiC epitaxial wafer manufacturers started to further expand the production capacity to get prepared for the increased demand on 8-inch products with advanced technology. Downstream customers choose 8-inch SiC epitaxial wafers from domestic suppliers despite the higher prices than products provided by overseas suppliers, primarily due to a more secure supply chain which ensures a more reliable source of raw materials in face of global uncertainties. In addition, procurement from domestic suppliers facilitate better collaboration and customized solutions, and ensures more responsive services. It also reduces transportation costs and logistics complexities, avoids potential tariff and import cost burdens which can significantly affect the price of internationally sourced wafers. Therefore, such procurement is more cost-effective and strategically sound for PRC companies.
- The transition from the sampling phase to full-scale production of 8-inch SiC epitaxial wafers will lead to an expected decrease in the ASP of 8-inch products in the PRC. Coupled with growing demand, broader adoption across various applications and decrease in the number of participants as discussed above, this lowered ASP will lead to a gradual stabilization of price since 2026.
- Alongside controlled supply growth and technology barriers possessed by limited market players, the reshuffling will again lead to a balanced market supply-demand relationship, leading to a stable ASP and thus halting the price wars that previously caused persistent price reductions in the industry.
- With the expected decrease in the ASP of SiC substrates, the cost of epitaxial wafers is also projected to decline, as SiC substrates are the main raw material of SiC epitaxial wafers. The ASP of SiC epitaxial wafers globally and in China is expected to drop steadily by 2028, mainly because (i) the decline in the ASP of SiC substrates caused by the combination of market competition and scale production has led to a reduction in unit production costs; (ii) technological advancements which are expected to improve epitaxy growth efficiency and lead to lower per-epitaxial wafer costs; and (iii) increasing domestic equipment substitution that is expected to cut depreciation costs for manufacturing SiC epitaxial wafers. SiC epitaxial wafer manufacturers can enhance their gross margins by focusing on high-value products for advanced applications, improving production efficiency, scaling capacity to achieve economies of scale, and leveraging innovations such as larger epitaxial wafers and advanced epitaxial technologies.





*Source: Public Information Collection, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Drivers of China's SiC Epitaxial Wafer Industry

## *Growth of SiC Power Semiconductor Device Market*

SiC epitaxial wafers are key materials for manufacturing SiC power semiconductor devices. As the demand for high-performance SiC power semiconductor devices continues to grow, it drives the demand for SiC epitaxial wafers. Over the years, the growth of industries such as renewable energy, power electronics, automotive and telecommunication, have combined to drive the expansion of the SiC power semiconductor device market. These high-performance semiconductors have become indispensable due to their ability to operate efficiently at high temperatures and voltages, low energy consumption during switching, and the ability to improve the overall efficiency of electronic systems. The SiC power semiconductor device market in China grew rapidly from 2020 to 2024, with a CAGR of 56.0%. It is expected to continue to grow, with a CAGR of 44.9% from 2025 to 2029. These factors will drive the growth of the upstream SiC epitaxial wafer market.

## *The Quality of SiC Epitaxial Wafer is Getting More Reliable Due to the Advancements in Production Technology*

The quality of SiC epitaxial wafer is getting more reliable due to the advancements in epitaxial layer thickness, deposition technologies, and equipment innovations. The industry is moving towards thicker epitaxial layers, with some manufacturers achieving up to 300 µm, to meet the need for higher voltage tolerance. Such development enhances device performance, reliability, and energy efficiency while reducing production costs. Chemical vapor deposition (CVD) technology is currently the most popular 4H-SiC epitaxial method, with the advantages of moderate cost, good epitaxial quality and fast growth rate. CVD technology prepares high-quality SiC epitaxial layers by degrading and decomposing the gaseous precursors at high temperatures, so as to make their atoms recombine and form a solid film on the surface of the substrate. Innovations in epitaxial equipment, such as multi-chamber designs and multi-chip processing, are crucial for boosting production efficiency and reducing costs. Compared to horizontal SiC epitaxial furnaces, the gas intake of vertical machines helps to achieve lower defect rates because the gas enters vertically from the top, which facilitates uniform distribution of the gas and uniform growth of the epitaxial layer. All these technological advances help to improve the production efficiency and reduce production costs, thereby promoting the overall development of the SiC epitaxial wafer industry

## *Government Policy Support*

In recent years, the PRC government has been enacting favorable policies related to SiC epitaxial wafers. In July and August 2023, MIIT issued the Implementation Opinions on Reliability Improvement of Manufacturing Industry and Action Program for Stable Growth in the Electronic Information Manufacturing Industry 2023–2024, which emphasized the need to set industry standards and improve the reliability of wide-band power semiconductor devices like SiC power semiconductor devices. In March 2021, the National People's Congress published the Outline of the Fourteenth Five-Year Plan for the National Economic and Social Development of the People's Republic of China and the Vision 2035 to promote the development of wide-band gap semiconductors materials such as SiC. These policies reflect a strategic focus on advancing SiC epitaxial wafer technology and fostering the semiconductor industry in China.





*Source: Public Information Collection, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Trends of China's SiC Epitaxial Wafer Industry (1/2)

## *China's Domestic SiC Substrates Will Replace Foreign SiC Substrates*

In recent years, as the China's domestic SiC substrate industry continues to mature, China's SiC epitaxial wafer manufacturers are increasingly adopting domestic substrates, gradually reducing their dependence on foreign sources. Specifically, the price of domestic 6-inch SiC substrates has been on a downward trend. Please see ''— Overview of China's and Global SiC Epitaxial Wafer Markets — SiC substrate average selling price globally and in China'' in this section for further information on average selling price globally and in China. This trend suggests that the domestic SiC substrates will experience a more rapid price reduction compared to their foreign counterparts, which indicates that the substitution of domestic SiC substrates will become a market trend.

## *Scale Effect Appears; Professional Epitaxial Wafer Manufacturers Will Form Cost Barriers*

In the future, with the development of technology-intensive industry, manufacturers focusing on the upstream segment of the industry chain, particularly those specializing in epitaxial wafer production, are poised to create substantial industrial value. The economy of scale resulting from their operations will enhance efficiency and confer a competitive advantage. This trend is expected to lower per-unit production costs, enabling these manufacturers to establish significant cost barriers. As these epitaxial wafer manufacturers ramp up production and refine their manufacturing processes, they will be able to use their scale to negotiate more favorable terms with suppliers, invest in cutting-edge technologies, and achieve higher levels of automation. These factors will contribute to a reduced cost base, essential for sustaining profitability in a competitive landscape. The cost barriers arising from these advantages will increasingly challenge new entrants, who would need to match the cost structures of established players to remain viable.

## *Shifting From 6-Inch to 8-Inch Production Lines*

At present, the SiC epitaxial wafer industry is in a critical period of transition from 6-inch to 8-inch. 6-inch SiC epitaxial wafers are widely used in power electronic devices due to its mature technology, stable quality and relatively low cost. However, with the advancement of technology and the growth of market demand, 8-inch SiC epitaxial wafers have gradually become the new focus of the industry due to its higher output rates, reduced edge loss, and improved device performance. Currently, the PRC 8-inch SiC epitaxial wafer market has moved beyond the testing phase in 2023, with a few leading manufacturers commencing mass production since 2024. As demand for 8-inch SiC epitaxial wafers of China's downstream SiC power semiconductor device manufacturers is expected to increase due to its cost-efficiency and die-yield characteristics, several existing manufacturers are actively upgrading their production lines and planning new capacity additions. It is anticipated that as technology matures and production capacity is unleashed, the price of 8-inch SiC epitaxial wafers will gradually decrease, significantly boosting market sales and adoption rates. It is expected that China's SiC epitaxial wafers manufacturers possessing advanced technology and production capacity for mass production of 8-inch SiC epitaxial wafers would have competitive advantages to seize the potential market demand on 8-inch SiC epitaxial wafers. In summary, the transition from 6-inches to 8 inches is the inevitable trend of the future development of the SiC epitaxial wafer industry. Such process will be subject to technological advances, cost reductions and the growth of market demand for the joint promotion.





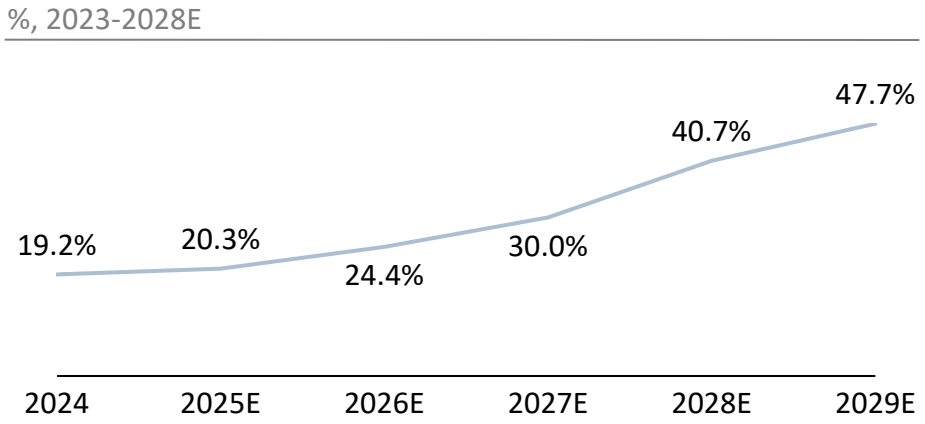
*Source: Public Information Collection, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Trends of China's SiC Epitaxial Wafer Industry (2/2)

## *Continuous Expansion of Manufacturers' Production Capacity to Meet Growing Market Demand*

With the growing demand for SiC power semiconductor devices in China, especially the rapid development of new energy vehicles, 5G communications, photovoltaic power generation and other industries, SiC epitaxial wafer, as a key upstream material, has attracted a lot of attention for its market prospects. The sales volume of automobiles in China is projected to grow from 33.5 million units in 2025 to 50.8 million units in 2029 at a CAGR of 11.0%, and the global sales volume of automobiles is projected to grow from 98.7 million units in 2025 to 119.9 million units in 2029 at a CAGR of 5.0%. The sales volume of xEVs accounted for an increasing percentage of the entire automobile market in China and globally, increasing from 19.5% and 40.9% in 2024 and are expected to reach about 80.3% and 44.4%, respectively, in 2029. On average, around 0.4 pieces of 6-inch SiC epitaxial wafers are used on one single electric vehicle in 2025. On contrast, internal combustion engine (ICE) vehicles typically do not use SiC epitaxial wafers, as ICE vehicles' power system does not require a high temperature- and high pressure-resistant semiconductor material like SiC. The increasing sales volume of xEVs and cost-effectiveness of SiC epitaxial wafers have resulted in the rising application and penetration rate of SiC epitaxial wafers in the xEV sector. As an important component of xEVs, the rapid growth in the xEV sector is expected to provide a robust foundation for the development of the SiC epitaxial wafer industry. Moreover, the decreasing prices in recent years will lead to an increasing penetration rate of SiC power semiconductor devices andhence, SiC epitaxial wafers, in the xEV sector, being 19.2% in 2024 and expected to reach 47.7% by 2029. The following graph illustrates the penetration rate of SiC epitaxial wafers in the xEV sector from 2024 to 2029

**Penetration rate of SiC epitaxial wafers in the xEV sector***




In this context, numerous enterprises in China are ramping up their production capacities to cater to the burgeoning market needs. The CAGR of the SiC epitaxial wafer market in China in terms of revenue is anticipated to see an even more robust CAGR of 37.5% from 2025 to 2029, underscoring the significant potential for future demand. In addition, as production capacities expand, economies of scale will drive down the cost of sales, enabling manufacturers to lower their production costs. This reduction in cost will enhance the competitiveness of manufacturers, allowing them to offer more attractive pricing and increase market share. Mainstream SiC epitaxial wafer manufacturers will focus on expanding their 8-inch SiC epitaxial wafer production lines.

**Note: The penetration is calculated by the installation volume of SiC modules in global xEV over the potential installation volume of SiC modules in global xEV*



*Source: Public Information Collection, Frost & Sullivan*

# Overview of China's and Global SiC Epitaxial Wafer Markets
# Key Threats and Challenges of China's SiC Epitaxial Wafer Market

## *Price Drop Challenge*

The competition is increasing in the SiC epitaxial wafer industry. The market's average price range of 6-inch SiC epitaxial wafer in China is expected to drop steadily from around RMB8.3 thousand to RMB10.3 thousand per piece in 2021 to around RMB3.1 thousand to RMB5.5 thousand per piece in 2029, while the average price range of 6-inch SiC substrates globally is also expected to drop from around RMB4.6 thousand to RMB6.6 thousand per piece in 2021 to around RMB2.3 thousand to RMB4.3 thousand per piece in 2029. Such trend is applicable to the overall SiC market. The price drop is gradually eroding the profit margin of the manufacturers. Despite the current industry-wide price pressures, prices are expected to show a steady decline in the future, and will not continue to experience sharp fluctuations or precipitous drops, eventually stabilizing

## *Risk of Policy Change*

As the technology development and equipment investment in the SiC industry requires huge capital and has a long payback period, policy support is strongly related to the healthy development of the industry. Policy changes globally and in China may lead to fluctuations in the market demand, cost structures and supply chain stability in the SiC industry, resulting in a range of policy-related risks. For example, the tariff sanction policy imposed by the U.S. on China's semiconductor industry in 2023 has already had an impact on the export of China's SiC products, leading to a decline in exports. The global sales downturn for China's SiC epitaxial wafer manufacturers has been counterbalanced by a surge in domestic sales, bolstered by the Chinese government's robust policy supports, such as a series of favorable policies, including the Implementing Opinions on Promoting the Innovative Development of Future Industries and the Action Program for Stable Growth in the Electronic Information Manufacturing Industry 2023–2024



*Source: Public Information Collection, Frost & Sullivan*

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# Competitive Landscape of China's SiC Epitaxial Wafer Market

## Ranking of SiC Epitaxial Wafer Providers in China, in Terms of Revenue

Overall, there are over 20 SiC epitaxial wafer providers in the PRC market in 2024. The competition of China SiC epitaxial wafer market is highly concentrated, with the top five players accounting for 87.6% of the total market in terms of revenue generated in China in 2024. Notably, the Group emerged as the market leader, securing a significant market share of 30.6% with revenue reaching about RMB0.4 billion. This dominant position underscores the Group's substantial influence on the industry and its ability to shape market dynamics within the SiC epitaxial wafer sector.

**Ranking of SiC Epitaxial Wafer Providers in China, in Terms of Revenue (2024)**

| Ranking | Company | Revenue of SiC Epitaxial Wafer (RMB Billion) | Market Share (%) |
|---|---|---|---|
| 1 | Guangdong Tianyu Semiconductor (广东天域半导体) | 0.4 | 30.6% |
| 2 | Company A | 0.4 | 29.2% |
| 3 | Company B | 0.2 | 12.0% |
| 4 | Company C | 0.1 | 9.7% |
| 5 | Company D | 0.1 | 6.1% |
| CR5 | | 1.3 | 87.6% |





*Source: Public Information Collection, Expert Interview, Frost & Sullivan*

# Competitive Landscape of China's SiC Epitaxial Wafer Market

## Ranking of SiC Epitaxial Wafer Providers in China, in Terms of Sales Volume

In 2024, the top five companies in China's SiC epitaxial wafer market held a significant share of the market, accounting for 87.6% of the total sales volume. The Group stood out as the market leader, capturing an impressive 32.5% share with sales volume reaching about 67 thousand pieces. This dominant position highlights the Group's strong market presence and its significant influence on the industry

**Ranking of SiC Epitaxial Wafer Providers in China, in Terms of Sales Volume (2024)**

| | Company | Sales Volume of SiC Epitaxial Wafer (1,000 units) | Market Share (%) |
|---|---|---|---|
| 1 | Guangdong Tianyu Semiconductor（广东天域半导体） | 67* | 32.5% |
| 2 | Company A | 56 | 27.3% |
| 3 | Company B | 25 | 12.2% |
| 4 | Company C | 20 | 9.8% |
| 5 | Company D | 12 | 5.9% |
| CR5 | | 179.6 | 87.6% |

*Note: 67,000 pieces as the basis of such ranking represents the Group's sales volume of self-manufactured SiC epitaxial wafers in Chinese Mainland, while 73,675 pieces represents the sales volume of total SiC epitaxial wafers in Chinese Mainland in 2024, including both self-manufactured epitaxial wafers and those under foundry service*





*Source: Public Information Collection, Expert Interview, Frost & Sullivan*

# Competitive Landscape of China's SiC Epitaxial Wafer Market
## Ranking of China-based SiC Epitaxial Wafer Providers in Global Market, in Terms of Revenue (1/2)

The group derived a majority of revenue from domestic market during the Track Record Period, and a relatively smaller portion of revenue from overseas market. Top China-based players typically involve in domestic and overseas sales. The group ranked the third among all China-based SiC epitaxial wafer manufacturers both in terms of revenue and sales volume generated from the global market (including both domestic and overseas markets) in 2024, with a market share of 6.7% in terms of revenue and 7.8% in terms of sales volume, respectively.

**Ranking of China-based SiC Epitaxial Wafer Providers in Global Market, in Terms of Revenue (2024)**

| Ranking | Company | Revenue of SiC Epitaxial Wafer (RMB Billion) | Market Share (%) |
|---|---|---|---|
| 1 | Company B | 840 | 11.7% |
| 2 | Company A | 754 | 10.5% |
| 3 | Guangdong Tianyu Semiconductor (广东天域半导体) | 484 | 6.7% |
| 4 | Company D | 440 | 6.1% |
| 5 | Company C | 187 | 2.6% |
| CR5 | | 2,705 | 37.6% |





*Source: Public Information Collection, Expert Interview, Frost & Sullivan*

# Competitive Landscape of China's SiC Epitaxial Wafer Market
## Ranking of China-based SiC Epitaxial Wafer Providers in Global Market, in Terms of Revenue (2/2)

| Ranking of China-based SiC Epitaxial Wafer Providers, in terms of sales volume of SiC epiwafer in global market (2024) | | | |
|---|---|---|---|
| **Ranking** | **Company** | **Sales Volume of SiC Epitaxial Wafer (1,000 units)** | **Market Share (%)** |
| 1 | Company B | 122 | 13.2% |
| 2 | Company A | 101 | 10.9% |
| 3 | Guangdong Tianyu Semiconductor (广东天域半导体) | 72 | 7.8% |
| 4 | Company D | 60 | 6.5% |
| 5 | Company C | 27 | 2.9% |
| CR5 | | 381 | 41.2% |

# Competitive Landscape of China's SiC Epitaxial Wafer Market

## Ranking of China SiC Epitaxial Wafer Market, including Foundry and Self-Manufacture (1/2)

| Ranking of China SiC Epitaxial Wafer Market, in terms of Sales Revenue from Both Foundry and Self-Manufacture (2024) | | | |
|---|---|---|---|
| **Ranking** | **Company** | **Revenue of SiC Epitaxial Wafer (RMB Billion)** | **Market Share (%)** |
| 1 | Guangdong Tianyu Semiconductor （广东天域半导体） | 0.5 | 26.2% |
| 2 | Company A | 0.4 | 25.6% |
| 3 | Company B | 0.2 | 11.9% |
| 4 | Company C | 0.2 | 9.1% |
| 5 | Company D | 0.1 | 5.6% |
| CR5 | | 1.4 | 78.4% |

# Competitive Landscape of China's SiC Epitaxial Wafer Market

## Ranking of China SiC Epitaxial Wafer Market, including Foundry and Self-Manufacture (1/2)

| Ranking of China SiC Epitaxial Wafer Market, in terms of Sales Volume from Both Foundry and Self-Manufacture (2024) | | | |
|---|---|---|---|
| **Ranking** | **Company** | **Sales Volume of SiC Epitaxial Wafer (1,000 units)** | **Market Share (%)** |
| 1 | Guangdong Tianyu Semiconductor（广东天域半导体） | 73 | 28.2% |
| 2 | Company A | 66 | 25.4% |
| 3 | Company B | 37 | 14.2% |
| 4 | Company C | 27 | 10.4% |
| 5 | Company D | 15 | 6.0% |
| CR5 | | 218 | 84.2% |

# Competitive Landscape of China's SiC Epitaxial Wafer Market
# Entry Barriers of China's SiC Epitaxial Wafer Market

### *Sufficient Industry Know-how*

SiC epitaxial wafer is a highly technology-intensive industry, and the epitaxial growth technology involved requires long-term R&D and production. Accumulated experience and know-how make the epitaxial wafers meet high requirements in many parameters. For new entrants in the industry, it is impossible to break through the core R&D technology in a short period of time and make the products reach the same quality standard, facing high technical barriers.

### *Adequate Resource*

The SiC epitaxial wafer industry demands significant equipment investment, particularly for crystal growth furnaces and processing machinery such as cutting, grinding, and polishing equipment, which necessitate substantial capital outlay. To sustain technological leadership and ensure product quality, companies must continuously allocate considerable R&D funding. This includes the development of new materials and the optimization of production processes. With ongoing capital investment, economies of scale will gradually emerge, thereby establishing cost advantages. The industry requires a robust and specialized management and R&D team to maintain a competitive edge. Currently, the industry has established a high barrier to entry for professionals and technical experts, and the cost of recruiting high-end talent is substantial, making it challenging for new market entrants to rapidly assemble a professional team

### *Advancement in Technology*

The production of SiC epitaxial wafers involves high-precision technologies, including material growth and the optimization of epitaxial processes, which necessitate long-term technological accumulation and extensive research and development. For instance, producing high-quality SiC epitaxial wafers requires mastering advanced growth technologies and optimization processes, which are essential for reducing or eliminating substrate defects and enhancing device yields. Such requirements demand that companies possess robust R&D capabilities and a commitment to technological innovation

### *Solid Channels*

Supply chain management in the SiC epitaxial wafer industry faces channel barriers, requiring companies to establish long-term relationships with upstream and downstream. Upstream substrate quality is critical to product performance, and limited resources for high-quality epitaxial furnaces and substrates increase the difficulty of entry for new companies. Downstream device manufacturers have long product validation cycles and strict certification procedures, and once a partnership is established, customer stickiness is high, making it difficult for new competitors to gain access to customers



*Source: Public Information Collection, Frost & Sullivan*

# Thanks !

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