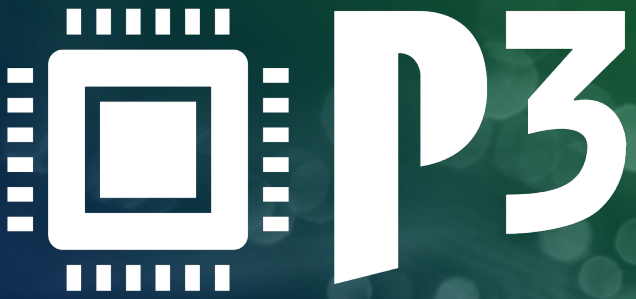


SiC (Silicon Carbide) teaser paper – Interested in more? Click here

Semiconductor Management @ P3

SiC in a glance

SiC, the next exciting material in the automotive semiconductor market

Opportunities

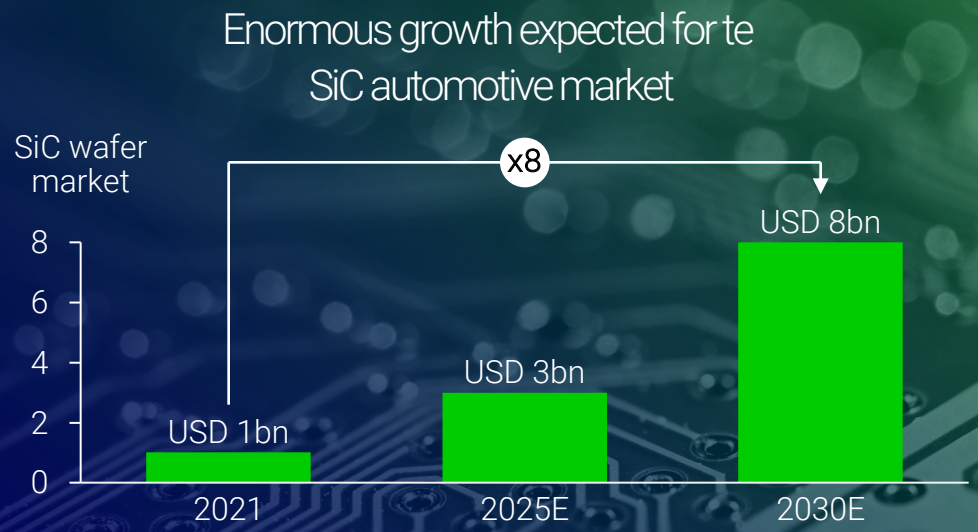
- SiC application within the inverter **improves** the driving range **by 3-7%**
- The **high voltage resistance** enables shorter charging times.
- **Enables 400V+ architecture** (e.g. commercial vehicles will have 800V)

Challenges

- SiC is **more expensive** than normal Si since it is harder than Si → **higher handling costs**
- SiC devices are capable of operating at high switching frequencies, but in order to extract the full potential from these features, **innovative packaging is required** (e.g., CoolSiC™)

Source: Infineon Product Portfolio

Automotive SiC market



Interpretation:

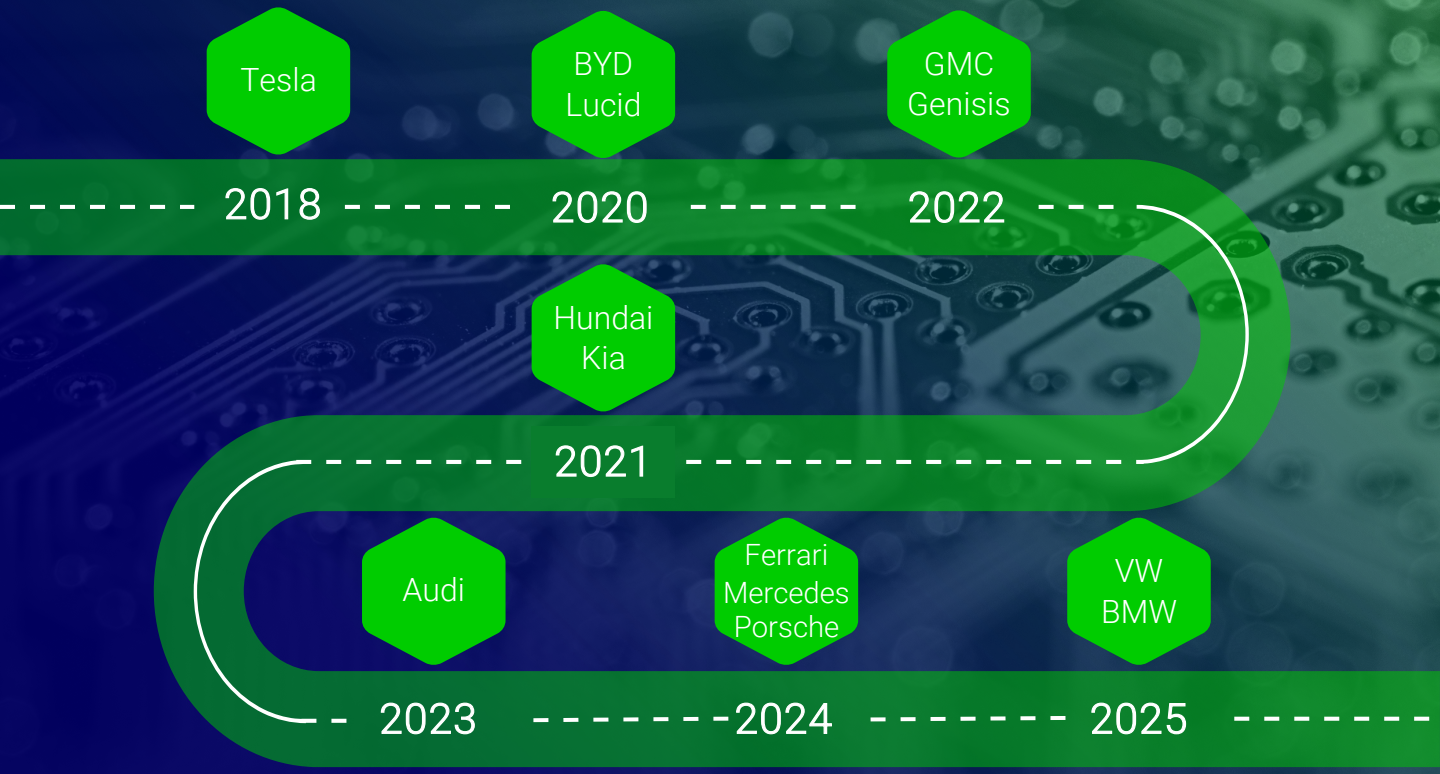
- The automotive SiC market has a **CAGR >25%.** Step by step it will replace the current Si-based power electronics (e.g. the SiC wafer market is **only 0.1%** of the Si wafer market)

- From 2022/2023, high-volume SiC device manufacturers will begin to migrate from the current **150mm wafer** standard to **200mm.** This increasing the device yield and therefore **cost reductions**, making SiC increasingly competitive with Si.

Source: Goldman Sachs Equity Research 2022

Market entry SiC (selection)

Timeline of automotive OEMs with components (e.g. inverter) including SiC



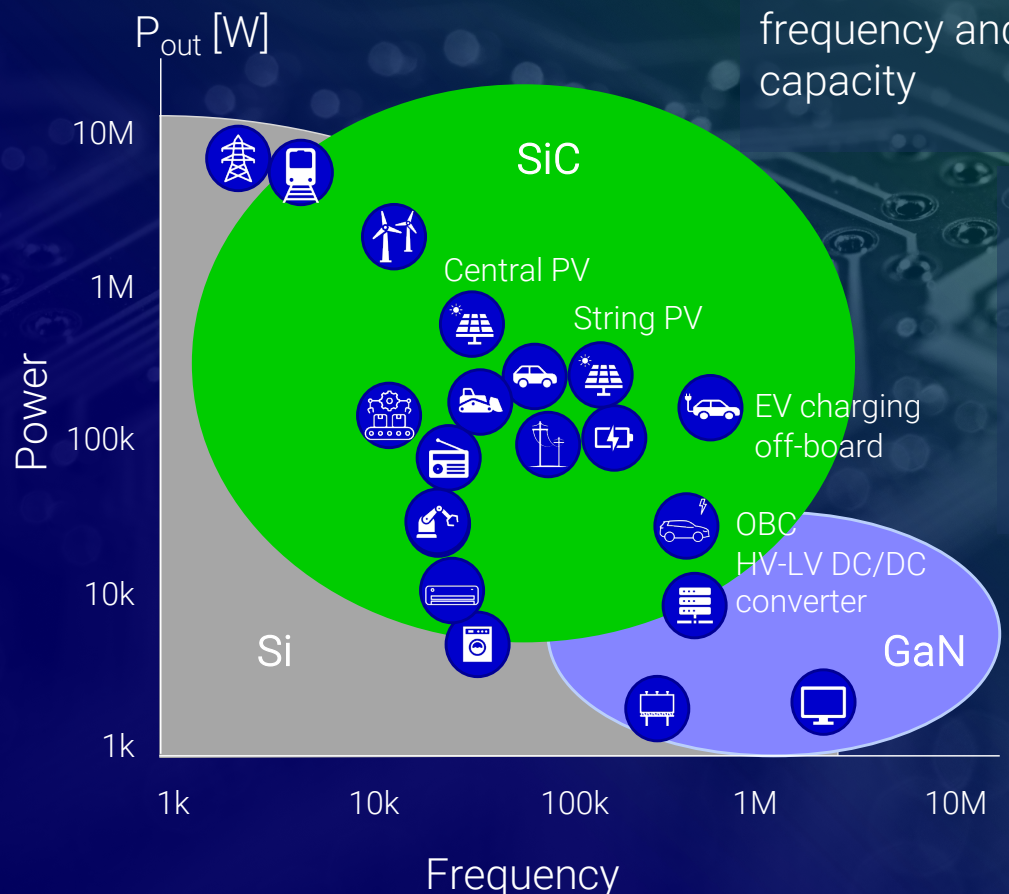
Source: P3 Analysis

Application of Si, SiC, GaN

Wide bandgap materials positioning

SiC is used in the automotive and PV industry - high switching frequency and power carrying capacity

GaN is currently used in low voltage applications like consumer electronics

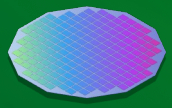


Source: Wide Bandgap Semiconductors (SiC/GaN) - Infineon Technologies

SiC Value Chain

Different steps in the SiC value chain

Sic Wafer

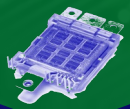


SiC wafers are produced with *Physical Vapor Transport* and must be sliced **with diamond cutting tools**. Hence, the handling costs are **~10x of Si**.

SiC Die

Technical parameters to differentiate the products from each other will be packaging technology and packaging design.

SiC Module



Multiple SiC MOSFETs are integrated into a **SiC Module.**

Components

Integration of the SiC module into a component (e.g. inverter, on-board-charger, or DC/DC-converter).

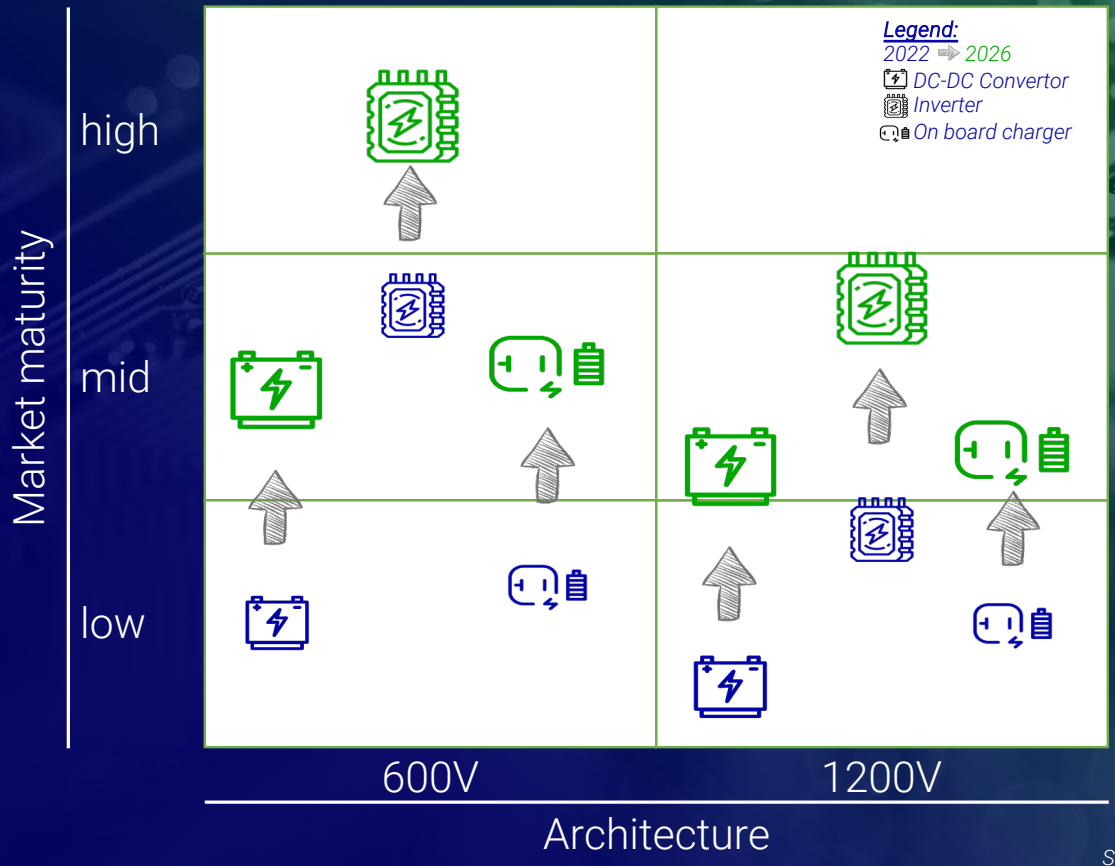
Vehicle

With the **increasing demand** for SiC in the next few years, OEMs are forming **strategic partnerships** in the value chain.

Source: Wide Bandgap Semiconductors (SiC/GaN) - Infineon Technologies

Auto. market development

When different components will shift to SiC and at what Voltage architecture



Source: P3 Analysis

Interested in what we do?

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List of abbreviations

Auto:	automotive
CAGR:	Compound Annual Growth Rate
DC:	Direct Current
EV:	Electric Vehicle
GaN:	Gallium Nitride
HV:	High Voltage
LV:	Low Voltage
MOSFET:	Metal–Oxide Semiconductor Field-Effect Transistor
OBC:	On Board-Charger
OEM:	Original Equipment Manufacturer
PV:	Photovoltaic
Si:	Silicon
SiC:	Silicon Carbide